PHASE 2 Technical Memorandum for
Red and Assiniboine Ammonia Criteria Study

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To: City of Winnipeg Project Management Committee
Study Team Members

Subject: **Fish Populations Technical Memorandum # FP 02**

Title: **SPECIES COMPOSITION, ABUNDANCE, AND DISTRIBUTION OF FISH IN THE RED AND ASSINIBOINE RIVERS WITHIN THE CITY OF WINNIPEG AMMONIA CRITERIA STUDY AREA, 1999.**

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EXECUTIVE SUMMARY

This memorandum is one of a series that has been produced to characterize fish habitat and fish populations in the Red and Assiniboine rivers within the City of Winnipeg Ammonia Criteria Study Area.

The initial intent of this study was to examine the fish community within specific zones of the study area and relate the species composition, distribution, and abundance of the fish community to concentrations of aqueous ammonia within these zones. Whether or not the distribution of fish in the study area was related more closely to exposure to ammonia or to physical and/or biological attributes of habitat (e.g., water velocity, substrate, or food resources) was also to be addressed. However, high flows in the Red and Assiniboine rivers during much of the mid- to late-1990s, including 1999, resulted in lower instream concentrations of ammonia. As a result, relating biological parameters of the fish community to aqueous ammonia concentrations within the study area was not possible.

Consequently, the overall objective of the study shifted to providing a biological description of the fish community in the study area in order to answer the question “what needs to be protected?”. The study area was divided into several zones which were delineated based on the location of City of Winnipeg Water Pollution Control Centre outfalls. The collection of these data allowed comparison of the fish community between specific zones and between the two rivers.

Relatively few studies documenting the fish community of the Red and Assiniboine rivers within the City of Winnipeg have been conducted recently. Fish have been collected at one site in the Red River annually since the late 1960s by the University of Manitoba and Manitoba Conservation recently initiated the Urban Stock Monitoring Program in the Red and Assiniboine rivers. The fish community of the Red River within the City of Winnipeg was, however, studied extensively from 1972 to 1974. Additionally, fish inventories and evaluations of biological conditions have recently been conducted in American waters of the Red River basin. The collection of data on the fish community of the Red and Assiniboine rivers within the City of Winnipeg in 1999 allows comparison between fish communities of the two rivers, comparison with historic data, and comparison with upper reaches of the Red River and other river systems.

Specific objectives of the study included the following:

- to describe the seasonal species composition, distribution, and abundance of the fish community within specific zones of the Red and Assiniboine rivers within the City of Winnipeg, and to compare the fish community within and between zones;

- to compare, where possible, the species composition, distribution, and abundance of the fish community within the study area in 1999 to results of similar studies conducted in 1972-1974; and,

- to compare, using the Index of Biotic Integrity (IBI), the relative health of the fish community within the study area to that of other rivers.

Three surveys were conducted to characterize the fish community of the Red and Assiniboine rivers within the City of Winnipeg. The first survey was conducted in winter (February/March), 1999, the second in summer (July), 1999, and the third in fall (September), 1999. Additional data from hoop nets set in the Red and Assiniboine rivers in August 1999 to obtain fish for acoustic tagging (Barth and Lawrence 2000), were used. The study area was divided into five major zones which were divided further into segments previously designated by the physical habitat surveys; two additional zones were used as reference areas. A description of the extent of each zone is as follows:

Zone 1a extended between Ste. Agathe and St. Adolphe on the Red River; used as a reference area upstream of all wastewater discharges within the study area;

Zone 1 extended from St. Adolphe downstream to the South End Water Pollution Control Centre (SEWPCC) on the Red River; used as a reference area upstream of the SEWPCC;

Zone 2 extended from the SEWPCC downstream to the North End WPCC (NEWPCC) on the Red River;

Zone 3 extended from the NEWPCC downstream to the St. Andrews Dam near the Town of Lockport on the Red River;

Zone 3a extended from the St. Andrews Locks near Lockport downstream to the City of Selkirk on the Red River; used as a reference area downstream of all wastewater discharges within the study area;

Zone 4 extended from the West End WPCC (WEWPCC) on the Assiniboine River downstream to the confluence of the Assiniboine and Red rivers; and,

Zone 5 extended from Headingley downstream to the WEWPCC on the Assiniboine River; used as a reference area upstream of the WEWPCC.

Habitat was described by channel position and segment on the basis of depth, velocity, and substrate type and level of compaction (Davies and MacDonell 2000). Preliminary analysis of the data collected in the Red River revealed no substantial differences in depth and velocity, regardless of where in the channel the data were collected. Substrate type and level of compaction (hard, medium, or soft) did appear to differ between zones and channel position. Based upon this description, habitat types in the Red and Assiniboine rivers were classified for the purposes of fisheries investigations as hard, medium, or soft.

During winter, fish sampling in the Red and Assiniboine rivers was conducted using gill nets, while during summer and fall boat electrofishing, hoop nets, gill nets, backpack electrofishing, and beach seines were used. Sampling locations were selected based on zone and habitat type. Summer and fall sampling also were conducted in the lower reaches of Bunns Creek, Seine River, La Salle River, and Sturgeon Creek using backpack electrofishing and beach seines.

All fish captured were enumerated by location, gear type, and species. Virtually all larger fish (>100 mm) captured during July, August, and September sampling programs were captured in live condition and were released following field sampling. During winter, fish captured in live condition were released following field sampling; all others were sampled in the laboratory. In the field, fish were measured for length (± 1 mm) and weight (± 25 g), and examined externally for sex and state of maturity and the presence of external deformities, erosion, lesions, and tumours (DELTs). In the laboratory, fish were measured for length (± 1 mm) and weight (± 1 g), and examined for the presence of DELTs, sex and state of maturity, and stomach contents. Additionally, ageing structures were taken from a variety of species. A sub-sample of all fish captured that were smaller than 100 mm in length were preserved in the field to confirm identification in the laboratory.

No consistent trends between catch-per-unit-effort (CPUE) and habitat type were discernable. Habitat types in much of the study area were not spatially well defined from one another and, as a result, it is likely that fish in a given area move freely over a variety of substrates and, therefore, habitat types. In rivers with more heterogeneous habitats that are separated from one another by greater distances, differences in habitat would likely play a greater role in determining the composition, abundance, and distribution of the fish community. Consequently, the relationship between habitat types and fish species composition, distribution, and abundance of fish was not examined further.

During 1999, discharge in the Red and Assiniboine rivers was much higher than long-term average conditions (1962-1999). In the Assiniboine River at Headingley, mean monthly flows ranged from 106 to 123% of average during February and March and were from 300 to 330% of average from July to September. In the Red River at Ste. Agathe and Lockport, mean monthly flows were approximately 150% higher than average during February and March, 200% of average during July and August, and 400% of average in September. High flows resulted in high debris levels in the rivers, particularly in the Red River during September. The debris, in combination with the greater volume of water, reduced the effectiveness of sampling gear.

A total of 5,445 fish were captured during this study. Of these, 2,215 fish, representing 31 species, were captured in the Red River using gill nets, boat electrofishing, hoop nets, backpack electrofishing, and beach seines; 737 fish, representing 26 species, were captured in the Assiniboine River using the same gear types; and, 2,493 fish, representing 26 species, were captured from Bunns Creek, Sturgeon Creek, La Salle River, and the Seine River using backpack electrofishing and seines.

While catches varied considerably between and among gear types, the five most abundant species in the Red River were channel catfish (*Ictalurus punctatus*), sauger (*Stizostedion canadense*), goldeye (*Hiodon alosoides*), white sucker (*Catostomus commersoni*), and quillback (*Carpiodes cyprinus*). The five most abundant species in the Assiniboine River were shorthead redhorse (*Moxostoma macrolepidotum*), channel catfish, sauger, carp (*Cyprinus carpio*), and freshwater drum (*Aplodinotus grunniens*). Fathead minnow (*Pimephales promelas*), black bullhead (*Ameiurus melas*), black crappie (*Pomoxis nigromaculatus*), white bass (*Morone chrysops*), and river shiner (*Notropis blennius*) were the five most abundant species captured in the four tributaries.

Gillnet catches were very low in most zones during winter, with no fish captured in zones 3 and 4. Catch-per-unit-effort of fish in Zone 3a was approximately six times higher than in any other zones. Although gillnet sets in July, and especially in September, were affected by high water velocities and debris, catches in zones 1 to 3 of the Red River were still approximately five times higher than in winter. Catches in the Assiniboine River in July and September were also several times higher than in winter. Hoopnet catches were variable, with the highest average catches of fish from zones 3, 2, and 4. Boat electrofishing catches in July were highest in zones 4 and 5, a result that may have been due to the shallower water in the Assiniboine River, which made fish capture more effective. In September the boat electrofishing catch in Zone 3a was approximately three times higher than the second largest catch (Zone 4).

Carp, channel catfish, freshwater drum, silver redhorse (*Moxostoma anisurum*), and walleye (*Stizostedion vitreum*) captured in the Assiniboine River were larger on average than those captured from the Red River. Higher water velocities in the Assiniboine River and/or more suitable habitat for juvenile fish in the Red River may explain this difference.

Comparison of catch data for the Red River from the present study with that of 1974 (Clarke et al. 1980) suggests that the relative abundance of four of the five most commonly captured species in 1974 (sauger, freshwater drum, white sucker, and channel catfish) have remained approximately the same. Black bullhead and emerald shiner (*Notropis atherinoides*) were captured less frequently in the present study while goldeye were captured more frequently. Differences in CPUE data for hoop nets set in the Red River during July, August, and September in 1974 and 1999 suggest that almost every species was less abundant in 1999 than it was in 1974. However, differences in the way in which sampling locations were selected, and higher flows and increased levels of debris during

1999 are all likely to have contributed to the reduced CPUE in 1999. While comparison between 1974 and 1999 data showed differences in growth rates and weight-length relationships among species, no consistent pattern was observed for all species. Walleye, sauger, and northern pike (*Esox lucius*) were heavier at a given length in 1999 as compared to 1974, while carp and goldeye were lighter for a given length.

The Index of Biotic Integrity (IBI) is a tool widely used to assess the integrity of rivers and streams. The IBI is a composite index based on an array of the following ecological attributes of fish communities: species richness and composition; trophic status; and fish abundance and condition. Indices of biotic integrity were calculated for both rivers and all zones within the study area. This allowed comparison of the relative health of the Red and Assiniboine rivers within the study area with waters of the upper Red River basin and other systems.

The IBI scores obtained for the Red and Assiniboine rivers within the City of Winnipeg were 40 and 34, respectively, of a possible 60, and received a ranking of fair. Red River mainstem sites in the United States ranged from 32 to 48 with a mean score of 39.5 (Niemela et al. 1999). This suggests that the health and condition of the fish community between Canadian and American portions of the Red River are similar. Comparison of the IBI scores for the Red and Assiniboine rivers with those from Ohio (where the IBI is used extensively), indicated that zones of the Red and Assiniboine rivers within the study area appear to meet the minimum recommended IBI score for warm-water habitat use. However, examination of the IBI data suggested potential signs of stress in the fish communities of both rivers, including the following: a low proportion of large river individuals in the Assiniboine River; low evenness values in the Assiniboine River and, to a lesser extent, the Red River; a high proportion of tolerant individuals in both the Red and Assiniboine rivers; skewed trophic structure in the Red River; and, a high proportion of DELTs in the Assiniboine River and, to a lesser extent, the Red River.

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1.0 INTRODUCTION

This memorandum is one of a series that has been produced to characterize fish habitat and fish populations in the Red and Assiniboine rivers within the City of Winnipeg Ammonia Criteria Study Area (study area). Physical, chemical, and biological components of fish habitat in the study area were documented by Davies and MacDonell (2000), Davies and Toews (2000), and Davies and Zrum (2000), respectively. The benthic invertebrate community within the study area was described by Zrum and Davies (2000), while the relative health of the fish community was assessed by Cooley and Davies (2000). This memorandum provides an assessment of the species composition, distribution, and abundance of fish in the study area, incorporating data obtained from the other studies in this series.

The original intent of this study was to examine the fish community within specific zones of the study area (delineated according to locations of City of Winnipeg Water Pollution Control Centres [WPCCs]) and relate the species composition, distribution, and abundance of the fish community to concentrations of aqueous ammonia within each zone. Whether or not the distribution of fish in the study area was more closely related to exposure to ammonia or to physical and/or biological attributes of habitat (e.g., water velocity, substrate or food resources) was also to be addressed. However, due to high flows in the Red and Assiniboine rivers during much of the mid- to late-1990s, including 1999 (the year in which the study was conducted), which diluted instream ammonia concentrations, relating biological parameters of the fish community to concentrations of aqueous ammonia within the study area became difficult.

Consequently, the overall objective of the study shifted to providing a biological description of the fish community in the study area in order to answer the question “what needs to be protected?”. A biological description of the fish community within specific zones of the study area would allow comparison of the fish community between specific zones of each river, and between the two rivers.

Relatively few studies documenting the fish community of the Red and Assiniboine rivers within the City of Winnipeg have been conducted of late. The University of Manitoba has collected fish near the Red River floodway gates annually from the late 1960s to the late 1990s (Dr. K. Stewart, Senior Scholar, University of Manitoba, pers. comm.). Recently, Manitoba Conservation has initiated the Urban Stock Monitoring Program, which is designed to monitor the species composition over time in the Red and Assiniboine rivers within the City of Winnipeg (R. Cann, Manitoba Conservation, pers. comm.).

The fish community of the Red River within the City of Winnipeg was, however, studied extensively from 1972 to 1974 (Clarke et al. 1980). Additionally, several inventories of the fish community of the American portion of the Red River drainage basin, including mainstem sites, have been conducted (e.g., Renard et al. 1986, Peterka and Koel 1996, Koel and Peterka 1998). Biological conditions in American waters of the Red River of the North drainage basin have also been evaluated using the Index of Biotic Integrity (e.g., Goldstein et al. 1994, Niemela et al. 1999).

An assessment of the fish communities of the Red and Assiniboine rivers within the City of Winnipeg during 1999 allowed for the following comparisons: between the fish communities of each river; with historic data (i.e., 1972-1974 data; Clarke et al. 1980); with waters of the Red River in the United States; and, with other similar river systems. Specific objectives of this study included the following:

1. to describe the seasonal species composition, distribution, and abundance of the fish community within specific zones of the Red and Assiniboine rivers within the City of Winnipeg, and to compare the fish community within and between zones;

2. to compare, where possible, the species composition, distribution, and abundance of the fish community within the study area in 1999 to results of similar studies conducted in 1972-1974; and,

3. to compare, using the Index of Biotic Integrity (IBI), the relative health of the fish community within the study area to that of other rivers.

This technical memorandum is separated into two components. In Part I, objectives 1 and 2 are addressed by providing a description of the fish community of the Red and Assiniboine rivers in 1999 and comparing it to that provided by Clarke et al. (1980). In Part II, the Index of Biotic Integrity (IBI) is used to further analyse the data collected in 1999, which addresses objective 3 and provides additional information to further address objective 1.

PART I

SPECIES COMPOSITION, ABUNDANCE, AND DISTRIBUTION OF FISH IN THE RED AND ASSINIBOINE RIVERS WITHIN THE CITY OF WINNIPEG

2.0 METHODS

2.1 STUDY AREA

The City of Winnipeg Ammonia Criteria Study Area includes the Red River from St. Adolphe downstream to Selkirk, the Assiniboine River from Headingley downstream to the confluence of the Assiniboine and Red rivers at the Forks, and the most downstream reaches of all tributaries entering into those portions of the Red or Assiniboine rivers within the study area (Figure 1).

2.1.1 Zones

For the purposes of this study, the Red and Assiniboine rivers were originally divided into the following five zones:

Zone 1 the Red River between the upstream extent of the study area boundary (St. Adolphe) and the South End Water Pollution Control Centre (SEWPCC);

Zone 2 the Red River between the SEWPCC and the North End Water Pollution Control Centre (NEWPCC);

Zone 3 the Red River between the NEWPCC and the downstream extent of the study area (Selkirk);

Zone 4 the Assiniboine River between the West End Water Pollution Control Centre (WEWPCC) and the confluence of the Red and Assiniboine rivers at the Forks; and,

Zone 5 the Assiniboine River between Headingley and the WEWPCC.

The study area was later modified to include the following:

Zone 1a the Red River between Ste. Agathe and St. Adolphe was established as an additional reference area upstream of any backwater effect from the St. Andrews Dam; and, Zone 3a due to the presence of the St. Andrews Dam, and differences in physical characteristics of the channel upstream and downstream of the dam, the lower portion of Zone 3 (St. Andrews Dam to Selkirk) was reclassified as Zone 3a, a reference area downstream of the dam.

2.1.2 Segments

For ease of classification, and identification of sampling sites, the Red River was further divided into 86 segments or reaches, including 35 straight segments and 51 river bend segments (Davies and MacDonell 2000). The Assiniboine River was divided into 30 segments, including 12 straight segments and 18 river bend segments (Figures 2 and 3).

2.1.3 Habitat Types

Habitat in the Red and Assiniboine rivers was described in October, 1998, by channel position and segment, on the basis of depth, velocity, substrate type, and level of substrate compaction (Davies and MacDonell 2000). Preliminary analysis of the data collected in the Red River revealed there were no substantial differences in depth and velocity across the river channel (i.e., centre, left quartile, or right quartile). Substrate type and level of compaction (hard, medium, or soft) did appear to differ between zones and position across the river channel. Accordingly, a more detailed description of substrate type and level of compaction was conducted in June and July, 1999 (Davies and MacDonell 2000). Based on both sets of data, habitat types in the Red and Assiniboine rivers were defined according to substrate type using the following classification:

<u>Soft</u>
- any combination of substrates with soft compaction; and,
- mud/silt/clay with medium compaction.

<u>Medium</u>
- sand/mud/silt/clay with hard compaction; and,
- sand/mud/silt or clay as dominant substrate with gravel as secondary or tertiary substrate and medium compaction.

<u>Hard</u>

- any presence of cobble/boulder/rip-rap in the substrate mix;
- gravel as dominant substrate with medium or hard compaction; and,
- sand as dominant substrate with gravel as secondary substrate and hard compaction.

2.2 FIELD PROGRAM

2.2.1 Physical Data

2.2.1.1 Water Velocities

Water velocity was measured using a Price Model 622AA current meter suspended from a manual winch and stabilized by a 13.6 kg weight. Velocity was measured at 0.5 of the effective depth (from the bottom of the ice to the stream bottom) in winter and at 0.2 and 0.8 of the water depth (where depth was greater than 1.0 m) or 0.6 of the water depth (where depth was less than 1.0 m) under open water conditions. Water velocity was measured in conjunction with all fish sampling activities. During winter, velocity was measured at both ends of gill nets. During open water conditions, velocity was measured at three locations within the specific site being fished.

2.2.1.2 Water Temperature

Water temperature was measured just below the surface in conjunction with all fish sampling activities. During winter, temperature was measured using a Horiba® U-10 Water Quality Checker (Horiba® Ltd., Kyoto, Japan). During the open water period, temperature was measured using a YSI Model 30 handheld meter.

2.2.2 Biological Data

2.2.2.1 Winter Sampling

The initial habitat description (October, 1998) was used to define fish sampling sites during winter. Because substrate was described based on the collection of samples taken from only three points per segment (Davies and MacDonell 2000), the initial habitat description was fairly general. Although not all zones contained equal proportions of the three habitat types, where possible, the same number of replicates of each habitat type (i.e., substrate) were sampled within a given zone during winter. In zones 1 and 2, four replicates of each of hard, medium, and soft substrate were sampled. Due to the poor ice conditions and a lack of habitat diversity, a total of three segments were sampled in Zone 3. In Zone 3a, which was a reference zone, two replicates of each habitat type were sampled. Poor ice cover and the presence of slush ice in the water limited sampling in Zone 4 to three segments. Due to the small geographical area covered by Zone 5 (eight segments long), one replicate of each habitat type was sampled.

Sampling of the fish community in the Red and Assiniboine rivers during winter was conducted with standardized experimental gill nets. Gillnet gangs, each consisting of six 10 m long, 1.8 m deep panels of 38, 51, and 76 mm stretched twisted nylon mesh and 95, 108, and 127 mm stretched twisted monofilament mesh were set through the ice using a motorized jigger (Figure 4) for approximately 24 hour periods.

2.2.2.2 July and September Sampling

Fish sampling sites were selected based on an examination of the initial (October 1998) and more detailed (June and July 1999) habitat descriptions. Habitat was described more accurately in the detailed examination due to the collection of substrate data at twelve sites per segment (Davies and MacDonell 2000). The collection of these more detailed data resulted in a modification to the initial habitat description for some of the sites sampled during winter.

A variety of gear types were employed to sample the fish community of the Red and Assiniboine rivers during summer and fall. Although not all zones contained equal proportions of the three habitat types, sampling was conducted during July using an equal number of replicates of each habitat type within zones 1 to 5 with all gear types. Two replicates of each of hard, medium, and soft substrate were sampled in zones 2 and 3 and one replicate of each habitat type was sampled in zones 1 and 4. Two sites were sampled in Zone 5 due to its small size. All sites that were sampled in July were sampled again during September.

Additional sampling of the fish community during July and September was conducted with specific gear types. Zones 1a and 3a were sampled with a boat electrofisher. Tributary confluence habitat in zones in which major tributaries entered either the Red or Assiniboine rivers was sampled with a boat electrofisher, a backpack electrofisher, and seine nets. Sampling methodology for these gear types is described below. Additionally, habitat in four tributaries to the Red or Assiniboine rivers (La Salle River, Seine River, Bunns Creek, and Sturgeon Creek [Figures 2 and 3]) was sampled at a variety of locations in each tributary with a backpack electrofisher and/or beach seine during July, August, and September.

Gill Nets

The same gillnet gangs used to sample the fish community of the Red and Assiniboine rivers during winter (Section 2.2.2.1) were used in July and September. To reduce fish mortality, gill nets were set in the morning and pulled in the afternoon, resulting in a typical set duration of approximately six hours per sampling site.

Hoop Nets

Hoop nets (5 cm stretched nylon mesh, 1.2 m diameter mouth, and 10 m long wings [Figure 5]) were generally oriented to capture fish moving upstream and were set approximately 5 m offshore at the edge of the river channel for a twenty-four hour period.

Boat Electrofishing

Boat electrofishing was conducted using a 5.5 m long flat-bottom aluminum boat powered by a 175 horsepower inboard motor. A 5000 W portable Honda generator was used to power a Smith-Root Type VIA electrofishing system. The anode assembly consisted of a Smith-Root Model UAA-4 Umbrella Anode Array (0.91 m diameter with 4 stainless steel drop electrodes) mounted on a 2.4 m long retractable boom. The boat hull functioned as the cathode. Pulse width and voltage were adjusted to allow the electrofishing unit to produce 3-6 amperes (A), generally believed to be the most effective output to sample fish (Reynolds 1983).

Prior to sampling, habitat types were marked out on maps so that electrofishing could be restricted to the specific habitat type being sampled. The electrofishing crew consisted of a boat driver and two dip-netters, one located on each side of the boat. Electrofishing was conducted in a downstream direction along either side of the riverbank (Figure 6).

Backpack Electrofishing

Backpack electrofishing was conducted using a Smith-Root, Model 15-C backpack electrofisher powered by a Honda EX 350 generator. The majority of shoreline habitat along the Red and Assiniboine rivers was too deep to be sampled from shore, particularly at the high water levels experienced in 1999. During the summer sampling period, backpack electrofishing was conducted along the shoreline in pre-determined segments by operating the electrofishing unit from the front of a 4.9 m boat. Using this method the electrofishing crew consisted of a boat driver and one individual operating the electrofisher and dip-netting.

During the fall sampling period, it was felt that the shoreline fish community would be sampled more effectively by selecting the most favourable locations within a segment (generally boat launches) at the time of sampling. Using this method, electrofishing was conducted from shore with a two person crew consisting of one individual operating the electrofisher and one person dip-netting. Electrofishing runs were generally conducted for approximately 400 seconds at a setting of 300-400 volts.

Beach Seining

Beach seining was conducted using an 8 m long seine with 3.2 mm stretched mesh. The majority of shoreline habitat along the Red and Assiniboine rivers was too deep to seine effectively, particularly at the high water levels experienced in 1999. During July, seining was conducted along the shoreline in pre-determined segments. Using a 4.9 m boat, one end of the seine was anchored to shore and the other end was circled out into the river using the boat.

During September, it was felt that the shoreline fish community would be sampled more effectively by selecting the most favourable locations within a zone (usually boat launches) at the time of sampling. Using this method, beach seining was conducted with one individual holding one end of the seine onshore and the other individual walking out from shore in a semi-circle.

Minnow Traps

Wire mesh minnow traps were used during the initial portion of the summer sampling period as a component of sampling of the shoreline fish community. Minnow traps were suspended in the water column near shore and were set with a variety of types of bait. As no fish were captured in minnow traps set for 2-3 days, the use of this gear type was not continued.

2.2.2.3 August Sampling

Additional hoop nets were set in the Red and Assiniboine rivers during August to capture fish for acoustic tagging (Barth and Lawrence 2000). Hoop net construction, orientation, and sampling technique are described in Section 2.2.2.2. All data obtained from these hoop nets are discussed in this report.

2.2.2.4 Fish Sampling

All fish captured were enumerated by gear type and species. Mesh size (gill nets) or direction of travel (hoop nets) was recorded. Virtually all larger fish (> 100 mm) captured during the July, August, and September sampling programs were captured in live condition and released following field sampling. During winter sampling, live fish were released following collection of data in the field; mortalities were sampled in the laboratory.

In the field, fish were measured for fork length (± 1 mm) and round weight (± 25 g), and were examined externally to determine sex and state of maturity. The presence of external deformities, erosion, lesions, and tumours (DELTs; Cooley and Davies 2000) was also recorded. In the laboratory, fish were measured for length (± 1 mm) and weight (± 1 g), and examined for sex and state of maturity, stomach contents, and the presence of DELTs. Ageing structures were taken from a variety of species according to the following protocol: pectoral fin rays from goldeye (*Hiodon alosoides*), northern pike (*Esox lucius*), carp (*Cyprinus carpio*), white sucker (*Catostomus commersoni*), and shorthead redhorse (*Moxostoma macrolepidotum*); pectoral spines from channel catfish (*Ictalurus punctatus*); and, dorsal spines from walleye (*Stizostedion vitreum*), sauger (*Stizostedion canadense*), and freshwater drum (*Aplodinotus grunniens*). A subsample of all fish captured that were smaller than 100 mm in length were preserved in 10% formalin for subsequent identification in the laboratory.

Fish sampling during winter and the open-water period are pictured in Figures 7 and 8, respectively.

2.3 DATA ANALYSES

2.3.1 Physical Data

Fish habitat within the Red and Assiniboine rivers was quantified in the present study by calculating the percentage of soft, medium, and hard substrate within each segment, zone, and river using substrate data provided by Davies and MacDonell (2000). Velocities taken at 0.2 and 0.8 of the depth of the water column were averaged to determine mean velocity for a particular location. Mean velocity and the range of velocities were tabulated by habitat type, zone, and season. Water temperatures measured in the Red and Assiniboine rivers were plotted.

2.3.2 Biological Data

2.3.2.1 Fish Tabulation

All fish captured during February/March, July, August, and September were tabulated by gear type, river, zone, set or run number, and species.

2.3.2.2 Catch-Per-Unit-Effort

Catch-per-unit-effort (CPUE) for gill nets, hoop nets, and boat electrofishing was calculated as the number of fish caught per hour of fishing (# fish/hr). Mean CPUEs were calculated and presented by season, zone, and habitat type for each of these three gear types. Mean CPUE also was calculated and presented for selected fish species by gear type, season, and zone.

2.3.2.3 Fish Size

Mean length, weight, and relative condition factor for all species was calculated by river, zone, and season. Relative condition factor (K), after Fulton in Ricker (1975), was calculated for each fish for which both fork length (mm) and round weight (g) were measured using the following formula:

$$K = \text{Weight} \times 10^5 / \text{Length}^3$$

2.3.2.4 Length-Frequency Distributions

Where data sets were of sufficient size, species-specific length-frequency distributions were plotted by zone and river. Length intervals of 25 mm were chosen (e.g., 225-249 mm) and designated by the starting point (e.g., 225 mm).

2.3.2.5 Weight-Length Relationships

Weight-length relationships were calculated for selected species captured in the Red and Assiniboine rivers, by river, zone, and season, using least squares regression analysis on logarithmic transformations of individual fork lengths (mm) and round weights (g) using the following equation:

$$\text{Log}_{10}\,(\text{Weight}) = a + b\,(\text{Log}_{10}\,[\text{Length}])$$

2.3.2.6 Ageing Data

Age-specific mean length, weight, and relative condition factor were calculated for all species for which ages were determined.

For channel catfish that were older than 12 years of age, lengths at age were back-calculated using the Fraser-Lee or proportional method (Busacker et al. 1990). The annual growth in length (mm) observed for each of the 25 fish during 1988 and 1989 were compared to the amount of annual growth expected for a fish of that age (e.g., four year-old) by calculating the average growth for that age for all 25 fish.

2.3.3 Comparison to Previous Studies

Data from the present study were compared to data collected from the Red River in 1972 to 1974 (Clarke et al. 1980). The species composition of the total catch (all gear types) and total hoopnet catch in the present study were compared with 1974 data. To minimize differences due to seasonal effects, and to allow for more direct comparisons, only data from hoop nets set during similar time periods in 1974 (2-10 July, 16-30 July, 1-14 and 25 August, 3-6 September) and 1999 (8-28 July, 10-21 August, 8-20 September), and in similar reaches of the Red River, were used for a comparison of mean CPUE (number of fish per hour).

Where sufficient data were available, age-specific mean lengths were calculated for selected fish species collected during 1973 and 1974 and compared to those calculated for 1999. Weight-length relationships were calculated for fish captured in 1973 and compared to values calculated for fish captured in 1999. Weights were not measured for fish captured in 1974 and, therefore, comparison of weight-length relationships for fish captured in 1974 was not possible. Linear regression analysis was used to compare size-adjusted (standardized) weight-length relationships for black bullhead (*Ameiurus melas*), carp, channel catfish, freshwater drum, goldeye, northern pike, sauger, and walleye captured in the Red River in 1973 and 1999.

3.0 RESULTS

3.1 PHYSICAL DATA

3.1.1 Quantification of Habitat Types

The proportion of each segment and zone of the study area that was classified as being either soft, medium, or hard is presented in Appendix 1. These data are summarized by zone in Table 1. Zones 1 and 2 were composed primarily of soft and medium substrates and zones 3, 3a, 4, and 5 were composed primarily of hard substrates. In general, the Red River contained nearly equal amounts of soft, medium, and hard substrates, while the Assiniboine River contained about 20% soft substrate, 10% medium substrate, and 70% hard substrate.

3.1.2 Discharge

Mean monthly discharge in the Red and Assiniboine rivers was higher during every month of 1999 than historic (1962 - 1999) mean monthly discharges (Figures 9 to 11). Additionally, with the exception of about the first two weeks of March, a few days in May, and a short period at the end of November and the beginning of December, daily discharge was higher than monthly discharge (1962-1999) for every day of 1999. These discharges were often more than 100% greater than long term averages.

During 1999, discharge in the Red River near Ste. Agathe peaked on April 16-17 at 1660 m^3/s, with secondary peaks occurring on May 25 (883 m^3/s) and September 15 (558 m^3/s). Peak discharge in the Red River near Lockport occurred on April 18-21 at 1650 m^3/s, with secondary peaks on May 25 (1160 m^3/s), and Sept 16 (655 m^3/s). Discharge in the Assiniboine River at Headingley peaked on June 21 at 242 m^3/s.

3.1.3 Water Velocity

Water velocities measured in conjunction with fish sampling in the Red and Assiniboine rivers are summarized in Table 2 and presented in detail in Appendix 2. Water velocities were generally higher in the Assiniboine River than in the Red River. High flow conditions in 1999 (Section 3.1.2) suggest that velocities in 1999 were higher than during years with average flow conditions.

Mean velocities in winter ranged from 0.18 to 0.40 m/s for the Red River, and 0.18 to 0.46 m/s for the Assiniboine River. Zone 4 was found to have the highest water velocities, followed by zones 3, 1, 2, 5, and 3a (velocities in 1a were not measured at this time).

Mean velocities in summer ranged from 0.39 to 0.57 m/s in the Red River, and 0.75 to 0.94 m/s for the Assiniboine River. Zone 5 was found to have the highest water velocities, followed by Zone 4 (both of which were in the Assiniboine River). Of the remaining zones, 1a had the highest velocity, followed in descending order by zones 3, 1, 2, and 3a.

Mean velocities in the fall ranged between 0.52 and 0.65 m/s in the Red River, and from 0.60 to 0.71 m/s in the Assiniboine River. Zone 5 had the highest velocities at this time, followed in descending order by zones 1a, 3a, 4, 1, 3, and 2, although during fall there was little variation in velocity between zones.

3.1.4 Water Temperature

While water temperatures in the Red and Assiniboine rivers differed between seasons, they were similar within seasons (Table 3). Temperatures ranged from 0.1 to 0.4^{o}C in February and March, 21.1 to 26.1^{o}C in July, and 14.6 to 16.8^{o}C in September.

3.2 BIOLOGICAL DATA

The number of sample replicates, by gear type, zone, and season is presented in Table 4. The location of sampling sites, by river and zone, for all gear types used, and seasons fished, is presented in Appendix 3.

3.2.1 Species Composition and Relative Abundance

A total of 35 species of fish were captured in the Red and Assiniboine rivers and selected tributaries during February/March, July, August, and September, 1999. The common names of these species, along with their scientific names and abbreviations are presented in Table 5.

There were 2,215 fish, representing 31 species, captured in the Red River using gill nets, boat electrofishing, hoop nets, backpack electrofishing, and seines in 1999 (Table 6). The majority of fish were captured by boat electrofishing and hoop nets. Overall, the most abundant species captured in the Red River were channel catfish, sauger, goldeye, white sucker, and quillback (*Carpiodes cyprinus*) (Figure 12).

A total of 737 fish, representing 26 species, were captured from the Assiniboine River in 1999 using the same gear types (Table 7). Overall, the most abundant species captured in the Assiniboine River were shorthead redhorse, channel catfish, sauger, carp, and freshwater drum (Figure 13).

An additional 2,493 fish, representing 26 species, were captured from Bunns Creek, Sturgeon Creek, La Salle River, and the Seine River using backpack electrofishing and seines in July, August, and September, 1999 (Table 8). Overall, the most abundant species captured in the four tributaries were fathead minnow (*Pimephales promelas*), black bullhead, black crappie (*Pomoxis nigromaculatus*), white bass (*Morone chrysops*), and river shiner (*Notropis blennius*) (Figure 14). The largest number of fish captured was from Sturgeon Creek in July, where the catch was composed primarily of fathead minnow (1514 of 1525 fish). The largest number of species captured were from Bunns Creek (15) and the La Salle River (11) in July. In general, species diversity was greater in these four tributaries in July than in September.

The results of gillnetting, boat electrofishing, hoopnetting, backpack electrofishing, and seining conducted in the Red and Assiniboine rivers and the four tributaries in 1999 are presented in Appendix 4.

3.2.2 Catch-Per-Unit-Effort

Catch-per-unit-effort (CPUE) was calculated by gear type (gill nets, hoop nets, and boat electrofishing only), habitat type, zone, season, and species of fish. No consistent trends between CPUE and habitat type were discernable for any of the gear types used, or in any of the zones.

Catch-per-unit-effort data for gill nets set in February/March, July, and September are presented in Table 9. Mean CPUE for gillnet sets in the Red and Assiniboine rivers in

February/March, July, and September are illustrated in Figure 15. During winter, CPUE was low in most zones, with no fish captured in zones 3 and 4. Winter CPUE in Zone 3a was approximately six times higher than in any other zone. High water velocities and associated debris during the summer and fall sampling periods reduced the effectiveness of gill nets and CPUE was generally low. During September, gill nets were not set in zones 1 or 3 due to high debris.

Catch-per-unit-effort data for hoop nets set in July, August, and September are presented in Table 10. Mean CPUE for hoopnet catches in the Red and Assiniboine rivers in July, August, and September, 1999, is illustrated in Figure 16. Channel catfish were the most abundant species captured in hoop nets in all months and the proportion of the total catch that was comprised of channel catfish increased from July to September. The highest catches of sauger occurred in zones 2 and 3 in August, and the majority of white sucker were captured in zones 2 and 3 in September.

Catch-per-unit-effort data for boat electrofishing in July and September, 1999, are presented in Table 11. Mean CPUE for boat electrofishing in the seven zones of the study area in July and September, 1999, is illustrated in Figure 17. Goldeye made up the majority of the catch in the upstream areas of the Red River (zones 1 and 1a), while the majority of carp captured were from Zone 4 in the Assiniboine River. The highest CPUE of any species was for sauger, which made up the majority of the catch in Zone 3a in September. The highest CPUE for boat electrofishing in all sampling periods was in Zone 4. The lowest boat electrofishing CPUE was obtained in Zone 1 (from St. Adolphe downstream to the SEWPCC) during both July and September.

3.2.3 Fish Size

Mean lengths, weights, and relative condition factors were calculated by river, zone, and season for 20 species of fish captured in the study area. This information is presented in Appendix 5 and is summarized by river in Table 12. Condition factor for most species did not differ greatly between the Red and Assiniboine rivers, although, in general, carp, channel catfish, freshwater drum, silver redhorse (*Moxostoma anisurum*), and walleye captured from the Assiniboine River were found to be larger than fish captured from the Red River.

Length-frequency distributions were generated by zone and river for 14 species that were captured in the Red and/or Assiniboine rivers (Figures 18 to 31). Length-frequency distributions for channel catfish suggested that smaller fish favoured the Red River (particularly Zone 2), while the Assiniboine River appeared to support primarily larger fish. However, the majority of species for which length-frequency distributions were calculated showed little difference between rivers or zones.

Weight-length relationships were calculated by river, zone, and season for 19 species captured in the Red and Assiniboine rivers (Appendix 6). These data are summarized in Table 13.

Age-length relationships were established for seven species (carp, channel catfish, freshwater drum, goldeye, northern pike, shorthead redhorse, and walleye). These data were used to calculate age-frequencies for each species, which are illustrated in Figures 32 to 38. One or more weak or absent year-classes (cohorts) were apparent for some species, including carp (age 4), northern pike (age 7), and walleye (which showed considerable variation in year-class strength). However, there did not appear to be a specific year (or years) in which a number of species displayed weak or absent year-classes. This suggests that the observed absence of specific cohorts was probably due to a variety of factors, and represented natural variation in the year-class strength of individual species, rather than any single cause. Calculated age-specific mean lengths, weights, and condition factors for fish captured in the Red and Assiniboine rivers are presented in Appendix 7.

Individual growth curves plotted for twenty-five 13 to 18 year-old channel catfish (Figures 39 to 44, respectively) illustrated fairly linear rates of growth. Mean length at age plotted for the 109 channel catfish for which ages were determined reveals a series of four or five successive cycles of two or three years of fairly rapid growth followed by one or two years of slower growth (Figure 45). Observed growth was greater than expected growth for 13 of 19 channel catfish in 1988 and for 12 of 24 fish in 1989 (Table 14). These years had the highest number and greatest proportion of exceedences of the un-ionized ammonia objective for aquatic life and wildlife in the Red River at the north perimeter bridge (Gurney 1991).

4.0 DISCUSSION

No consistent trends between CPUE and habitat type were discernable, which was probably due to a combination of factors. Habitat types in much of the study area are not spatially well defined from one another. As a result, it is likely that fish in a given area move freely over a variety of substrates, and therefore, habitat types. In rivers with more heterogeneous habitats that are separated from one another by greater distances, differences in habitat would likely play a greater role in determining the composition, abundance, and distribution of the fish community. Consequently, the relationship between habitat types and fish species composition, distribution, and abundance of fish was not examined further.

4.1 COMPARISON BETWEEN ZONES AND RIVERS

4.1.1 Species Composition and Relative Abundance

Gillnet catches suggested that the most abundant species in the Red River during winter were white sucker, followed by goldeye, sauger, and lake cisco (*Coregonus artedi*). However, most fish, including all lake cisco, were captured in Zone 3a (downstream of St. Andrews Dam). No fish were captured in zones 3 (Red River between NEWPCC and Lockport) or 4 (Assiniboine River downstream of the WEWPCC). Only one fish (a walleye) was captured in six overnight gillnet sets in the Assiniboine River.

In the Red River, white sucker, goldeye, sauger, freshwater drum, and channel catfish were the most abundant species captured during July. Fish were captured in all zones of the Red River, but appeared to be most abundant in Zone 3. In August, large numbers of channel catfish and sauger were captured in the Red River, especially in Zone 3. In September, the hoopnet catch in zones 1 to 3 of the Red River were dominated by channel catfish, with smaller numbers of white sucker and other species. Sauger and goldeye dominated the large boat electrofishing catch in Zone 3a. These species were also the most abundant in boat electrofishing catches in the other zones of the Red River.

In the Assiniboine River, catches during the open water period were gear-dependent but in general were dominated by shorthead redhorse, channel catfish, sauger, carp, freshwater drum, and white sucker. There appeared to be little difference in species composition and relative abundance of the fish community between zones of the Assiniboine River (i.e., upstream and downstream of the WEWPCC).

Four tributaries to the Red and Assiniboine rivers (Bunns Creek, Sturgeon Creek, La Salle River, and Seine River) were fished during July and September and two tributaries (Sturgeon Creek and La Salle River) were fished during August to examine the use of these tributaries by small fish. During July, when catches in these tributaries were largest, certain species were caught in only one or two of the tributaries, while others were caught in all four. For example, black crappie were captured in the La Salle River in July, August, and September, and in Bunns Creek in July, but were not captured in Sturgeon Creek or the Seine River. White bass were also captured in the La Salle River and in Bunns Creek but not in Sturgeon Creek or the Seine River. However, fathead minnow and white sucker were captured in all four tributaries.

4.1.2 Catch-Per-Unit-Effort

Gill nets were employed so that comparisons between open water conditions and winter conditions could be made. In general, fish were less abundant in winter, although catches downstream of Lockport in winter (0.59 fish per hour) were comparable to those from other zones of the Red River during the open-water period. Catch-per-unit-effort for zones 1 to 3 of the Red River increased from 0.09 fish per hour in winter to 0.50 fish per hour in July (Table 9). Zone 2 yielded a CPUE of 0.49 fish per hour during September. In the Assiniboine River, fish were also more abundant during the open water period than in winter. Gillnet CPUE was higher in the Red River than in the Assiniboine River in all sampling periods.

The low gillnet CPUE during winter suggests that most locations in the study area probably support lower numbers of fish during the winter than during the open water season. This is supported by the findings of Barth and Lawrence (2000) who reported that most fish tagged with acoustic transmitters moved downstream out of the study area during winter. The higher winter gillnet CPUE in Zone 3a suggests that more fish overwinter in this area as compared to further upstream. However, seasonal reductions in fish activity levels probably also contributed to low winter CPUE. When fish are less active they are less likely to be captured by gill nets.

Zone 3 had the highest hoopnet CPUE in July and August, and Zone 2 had the highest hoopnet CPUE in September (Figure 16). Catch-per-unit-effort in Zone 3 was influenced by large catches of channel catfish and sauger. The higher CPUE for hoop nets in the Red River compared to the Assiniboine River (Table 10) was partially due to the difficulty in setting hoop nets in areas with high velocity. Catch-per-unit-effort in the Assiniboine River increased in August and September when discharge was lower. The highest CPUE for hoop nets was from the Red River in August, when the lowest flows of the study period occurred. The majority of fish captured in hoop nets in September were channel catfish, with white sucker also making up a large portion of the catch in zones 2 and 3.

During July, boat electrofishing CPUE was higher in the Assiniboine River than in zones 1 to 3, 1a, and 3a of the Red River (Table 11). Catches in Zone 4 of the Assiniboine River (downstream of the WEWPCC) were also high in September. It is likely that the high CPUE in the Assiniboine River was influenced by the shallower water, which increases the efficiency of electrofishing. High CPUE in Zone 3a in September was likely due to the influence of the St. Andrews Dam, which concentrates fish downstream. The majority of the catch in Zone 3a at this time was sauger and goldeye. Sauger and goldeye may have been concentrated in this area due to restricted upstream movement by the dam, or they may have been feeding on forage fish that were concentrated at the base of the dam.

4.1.3 Fish Size

Comparisons of fish lengths, weights, and condition factors between zones were made for species which were captured in sufficient numbers from more than one zone, such as carp, channel catfish, freshwater drum, goldeye, quillback, sauger, shorthead redhorse, and white sucker (Appendix 5). Fish captured in Zone 4 were generally found to be the largest, followed by fish from zones 3 and 2.

There were few notable differences in length-frequency distributions between zones for most species. This suggests that different size classes of most species utilize the same zones of the two rivers. The mean length, weight, and condition factor for most species did not vary greatly between fish from the Red River and fish from the Assiniboine River (Table 12). However, some species were consistently larger in the Assiniboine River, including carp, channel catfish, freshwater drum, silver redhorse, and walleye.

Since the same gear types were used in each river, the trend for larger fish in the Assiniboine River, despite the fact that the Red River is much larger and deeper, suggests that there is some factor that limits the use of the Assiniboine by smaller fish, or encourages use by larger fish. One factor that may explain this difference is water velocity. It is possible that the higher velocities in the Assiniboine River act as a deterrent to smaller fish, resulting in proportionately more larger individuals. Due to the larger volume of the river, and the greater amount of debris, the Red River may also provide more habitat for smaller fish by providing cover and protection from predators. Finally, greater angling pressure in the Red River may also contribute to differences in fish size. If a sufficient proportion of the larger fish are being removed from the Red River by angling then it is possible that this activity is influencing the mean size of fish in the population.

4.2 COMPARISON WITH PREVIOUS STUDIES

One of the objectives of the study was to compare contemporary data with data from previous studies of the Red River fish community (e.g., Clarke et al. 1980). Data was compared where possible, but differences in aspects such as study design and time of collection precluded comparison of some components of the studies. Differences between the present study and that of Clarke et al. (1980) included the following:

- *the duration of open-water gillnet sets*. In 1974, most nets were set for 24 hours, while in 1999, nets were set for approximately 6 hours, from morning to mid-afternoon, in order to reduce fish mortality. This would have influenced the size and composition of catches, by excluding fish that were active only at night. Although high turbidity levels in the Red River probably allow most species to remain active to a certain degree throughout the day, it is likely that the absence of nocturnal gillnet sets resulted in lower catches.

- *selection of sampling sites*. In 1999, specific habitat types were sampled with each of the gear types used. As a result, some sites that were sampled were not ideal locations in which to catch fish. In 1974, the selection of sampling locations was not dictated by habitat type. This would have allowed gear to be set in the best fishing sites, rather than by the need to sample certain habitat types.

- *differences in streamflow*. Although discharge in both sampling years was higher than average, during the months that hoop nets were used discharges were greater in 1999 than they were in 1974. High discharge can reduce fish catches in several ways. One of the primary ways that this occurs is by decreasing the density of fish in a given area. When water levels rise, more habitat is made available to fish and they are able to spread out over a larger area. As a result of this lower concentration of fish in a given area, CPUE will generally decline. High discharges, and the high velocities and increased levels of debris that accompany high flows, also combine to make hoopnet and gillnet sets less productive.

- *hoopnet mesh size*. Hoop nets set in 1974 were constructed of 2.54 cm stretched mesh, while hoop nets used in 1999 were constructed of 5.0 cm stretched mesh. The use of smaller mesh nets in 1974 would have acted to increase CPUE by allowing the capture of smaller fish.

4.2.1 Comparison of the Abundance of Fishes

Comparison of catch data for the Red River from the present study with that of 1974 (Clarke et al. 1980) (Table 15) suggests that the relative abundance of four of the five most commonly captured species in 1974 (sauger, freshwater drum, white sucker, and channel catfish) have remained approximately the same (Figure 46). The data suggest that the relative abundance of black bullhead and emerald shiner (*Notropis atherinoides*) have decreased, while the relative abundance of goldeye has increased. However, populations of many cyprinid species, such as emerald shiner, are often characterized by large seasonal and/or yearly fluctuations in abundance (Lyons 1987).

Shorthead redhorse made up a large percentage of the Assiniboine River catch in 1999, but only a small portion of the 1974 and 1999 Red River catches. Catch composition data for hoop nets suggest that the relative abundance of some species, such as sauger and white sucker, do not appear to have changed substantially between 1974 and 1999 (Table 16, Figure 47). The relative abundance of freshwater drum in hoopnet catches declined while channel catfish and quillback catches increased. These differences suggest that conditions in the Red River may have changed over the past 25 years, which has had an effect on at least some species in the Red River fish community.

Differences in CPUE data for hoop nets set in the Red River during July, August, and September in 1974 and 1999 suggest that the abundance of almost every species in zones 1, 2, and 3 may be lower in 1999 than it was in 1974 (Table 16). However, as discussed, there are a number of reasons why it is likely that the differences in CPUE between 1974 and 1999 are less extreme than they appear in Figure 48.

4.2.2 Comparison of Fish Size

A comparison of age-specific mean lengths for selected species captured in the Red and Assiniboine rivers in 1973, 1974, and 1999 is presented in Table 17. Age-length relationships for selected species captured in the Red and Assiniboine rivers in 1974 and 1999 are presented in Figures 49 to 57. For channel catfish, carp, northern pike, and sauger there were no noticeable differences between the age-specific mean lengths for fish captured in 1974 and in 1999. However, other species did display differences in age-specific mean lengths between the two years. Freshwater drum were longer at a given age in 1999 than in 1974, although in older fish this difference became less pronounced. Walleye also displayed a greater age-specific mean length in 1999 than in 1974. This difference increased with age, which suggests that walleye presently reach larger sizes at a younger age than in 1974.

Goldeye appear to have been longer at a given age in 1974 than in 1999. A similar pattern also appears to exist for shorthead redhorse, although data for this species were based on a limited number of samples. White sucker were found to be longer at a given age in 1999 up until about age 9, after which time fish captured in 1974 were longer at a given age. This suggests that conditions for the growth of young white sucker are more favourable now than they were in the past, but conditions for older white sucker may be less favourable now than they were 25 to 30 years ago. An increase in food availability for small white sucker may explain their greater age-specific mean lengths in 1999, while a decrease in food availability, which can be caused by such factors as greater interspecific or intraspecific competition, may explain the smaller length at age for older white sucker in 1999.

Weight-length relationships for selected species captured in the Red River in 1973 and 1999 are presented in Figures 58 to 65. Several species (carp, goldeye, and to a lesser extent, freshwater drum and channel catfish) were found to have lower weights for a given length in fish captured in 1999 than in 1974. This suggests that for these species, conditions for growth were less favourable in recent years than they were in the past. Northern pike, walleye, and sauger were found to have greater weights for a given length in 1999 than in 1974. This suggests that for these species conditions for growth were more favourable in recent years than they were in the past. All of the species which were found to be heavier at a given length in 1999 are piscivorous, suggesting that forage fish may be more abundant presently than in 1974. However, comparisons between 1974 and 1999 weight-length data should be made with caution. Weight-length relationships are subject to a number of factors that can effect the accuracy of results. Differences in the time of year, sex of the fish, and state of maturity all may effect the weight-length relationship.

4.2.3 Back-Calculated Lengths for Channel Catfish

One of the questions to be addressed by the initial study design was whether fish populations within the study area were affected by exposure to ammonia. While this question was not specifically addressed as a component of the revised study plan (Section 1.0), it was felt that an examination of growth rates for channel catfish, a long-lived fish species, could provide some indication of whether the effects of exposure to elevated ammonia levels in the late 1980s were detectable in fish captured in 1999.

As presented previously, individual catfish generally showed linear rates of growth (Figures 39 to 44). While some of the fish displayed apparent stagnation of growth (e.g., fish #s 4281 and 4536), none of the periods of stagnation appeared to coincide with the late 1980s. Fish that were 2 to 5 years of age in 1999 appear to be longer at a given age than fish that were 2 to 5 years of age in 1983 to 1991 (Figure 45). However, one of the concerns with back-calculated lengths is Lee's phenomenon, in which back-calculated lengths of a given age-group are smaller when calculated from older fish than they are when derived from younger fish (Busacker et al. 1990). While Lee's phenomenon does not always occur; if present, it would also effect a comparison of lengths at age derived from back-calculations versus measured lengths.

4.3 SPECIES-SPECIFIC INFORMATION

4.3.1 Channel Catfish

Catches of channel catfish in hoop nets were highest in Zone 3 in August and Zone 2 in September, when catches in all zones except for Zone 3 were the largest (Figure 16). The high catches in hoop nets in fall suggests that movements of channel catfish were at a peak during this time period. Clarke et al. (1980) also found that catches of channel catfish in hoop nets were highest in September. This peak period in fish movement is consistent with the results of Tyson (1996), who reported that radio-tagged channel catfish began to move out of tributaries and into the Red River and Lake Winnipeg in the fall. This general downstream movement was likely due to fish seeking areas with deeper water and low velocities in which to overwinter, and coincided with the seasonal drop in water temperatures. Barth and Lawrence (2000) reported that 75% of the channel catfish tagged with acoustic transmitters in the Red and Assiniboine rivers moved downstream out of the study area into deeper, overwintering habitat.

The lowest CPUE for channel catfish occurred in July. Low catches of channel catfish in July may have been due to fish moving out of the larger rivers and into tributaries, or simply moving less due to recovery from spawning. Although Clarke et al. (1980) reported high catches in July, differences in conditions such as discharge and water temperatures during their study period may have resulted in channel catfish spawning activities occurring earlier or later than in 1999. Overall higher CPUE in the Red River than in the Assiniboine River suggests that the Red River contains more suitable channel catfish habitat.

Condition factors for channel catfish were similar for fish from the Red and Assiniboine rivers, suggesting that fish in each river may be part of the same population. This is supported by acoustic tagging work by Barth and Lawrence (2000), who found that channel catfish moved freely between the two rivers. Channel catfish Floy-tagged by Clarke et al. (1980) in the Red River at Winnipeg were subsequently recaptured as far upstream as Halstad, Minnesota (412 km), downstream to West Dogwood Point in Lake Winnipeg (246 km) and upstream in the Assiniboine River to Portage la Prairie (160 km).

Clarke et al. (1980), proposed that the changes in fish abundance, size of fish captured, and pattern of tag returns suggested that there were two elementary populations of channel catfish in the Red River. One of these populations is thought to consist of smaller fish that move upstream from Lake Winnipeg in the spring to spawn, and return to the lake in the summer and fall to overwinter. The second population is thought to consist of larger fish that move upstream in the fall into northern Minnesota to overwinter, and later spawn, before moving back downstream to summer in the lower Red River and Lake Winnipeg. Smaller fish in this population are believed to remain in tributary areas in Minnesota, migrating downstream when they get older (Clarke et al. 1980). This theory is supported by the findings of Renard et al. (1986), who reported that the majority of channel catfish captured in the Red River in Minnesota and North Dakota were immature fish.

Barth and Lawrence (2000) reported that about 45% of channel catfish which were large enough to tag with acoustic transmitters moved downstream to overwinter, 20% moved upstream to overwinter, 25% overwintered within Winnipeg city limits, and 10% appeared to have left the study area, but were not detected doing so. These data support Clarke et al.'s (1980) hypothesis that some channel catfish migrate upstream to overwinter while others migrate downstream. However, the presence of fish overwintering within city limits would suggest that there may not be two completely separate populations and that fish will overwinter in areas throughout the river where conditions are suitable. Additionally, Lawrence and Barth (2000) captured large numbers of small catfish in early October, 1999, that appeared to be part of an upstream movement of fish. These data provide information contradictory to Clarke et al.'s (1980) suggestion that smaller channel catfish migrate downstream to Lake Winnipeg to overwinter.

Channel catfish from the Red River were smaller than fish from the Assiniboine River (Table 12). A large portion of the smaller channel catfish were from Zone 2 (from the SEWPCC to the NEWPCC). Lawrence and Barth (2000) also captured large numbers of small channel catfish immediately upstream of the NEWPCC (Zone 2) in early October, 1999. Greater water velocities in the Assiniboine River may partially explain the tendency for catfish in zones 4 and 5 to be larger, on average, than those from the Red River.

The greater proportion of smaller catfish in Zone 2 than in other zones is more difficult to explain. It is possible that Zone 2 offers more suitable habitat for smaller channel catfish in the form of cover, foraging locations, or some other factor or combination of factors. The hypothesis that Zone 2 may offer more suitable foraging locations is supported by the fact that this zone has also been found to have the greatest total invertebrate abundance of all zones, excluding the area immediately downstream of the NEWPCC outfall (Zrum and Davies 2000).

Age data indicate that the channel catfish population is evenly distributed across a wide range of ages (Figure 33). Slightly stronger age classes are present at approximately five year intervals, but there are no missing or exceptionally weak age classes. Lower frequency of younger fish is most likely due to gear selectivity, as most of the fish in these age classes would be too small to be captured by most of the gear types used, while the lower frequency of fish older than 17 is most likely due to natural mortality. Age-specific mean lengths for channel catfish captured in 1974 and 1999 (Figure 50) indicate little difference between the two time periods. This suggests that channel catfish growth rates have not changed significantly in the past 25 years.

4.3.2 Walleye

Length-frequency distributions for walleye indicate that the majority of fish in the study area were between 300 and 550 mm in length (Figure 30). In general, walleye from the Assiniboine River were larger than those from the Red River (Table 12), although the largest walleye were captured in Zone 1 (n=4). Walleye catches were too small to make meaningful comparisons between zones.

It has been suggested that the majority of walleye move into the Red River from Lake Winnipeg during spring and fall. Following spring spawning, these fish are thought to disperse both upstream and downstream and are expected to return gradually to Lake Winnipeg (Clarke et al. 1980). However, no walleye tagged by Clarke et al. (1980) were recaptured north of the St. Andrews Locks. Walleye tagged by Barth and Lawrence (2000) generally moved only short distances throughout the period of study (August 1999 to February 2000). Tag returns from fish that were Floy-tagged in the lower Red River by Kristofferson (1994) suggested that lower Red River walleye are present in this area from at least October to March. Additional walleye tag returns in Kristofferson's study ranged from north of the Lake Winnipeg Narrows to as far south as the Roseau River, near the Manitoba/Minnesota border.

Age-frequency data for walleye indicate that the population within the study area varies considerably in year class strength (Figure 38). While no missing year classes were observed there appeared to be a weak age class for three year old fish and a very strong age class for four year old fish. Variations in year class strength for walleye are likely the result of natural variations in discharge, temperatures, or other factors, during the reproductive period.

Age-specific mean lengths indicate that walleye were longer at a specific age in 1999 than they were in 1974, and that this difference increased with age (Figure 56). Walleye that were sampled in 1999 reached larger sizes at a younger age than walleye that were sampled in 1974. This could indicate that food for larger walleye is more readily available at present than it was in 1974, possibly due to an increased abundance of forage fish or lower levels of interspecific or intraspecific competition. It is likely that a combination of factors has contributed to the observed difference in age-specific mean lengths.

4.3.3 Freshwater Drum

Condition factors for freshwater drum were similar for fish captured from the Red and Assiniboine rivers. The mean size of freshwater drum that were captured in the Assiniboine River was slightly larger than the mean size of fish from the Red River and the majority of the largest drum came from zones 5, 4, and 2. Length-frequency distributions for freshwater drum indicate that there was little difference between the population structure of fish in the Red and Assiniboine rivers, with the exception of fish under 250 mm, which were absent from the Assiniboine River catch. The majority of freshwater drum were between 300 and 400 mm in length. The similarity of length-frequency distributions between rivers suggests that the freshwater drum in both rivers are part of the same population.

Freshwater drum were found to move extensively throughout the Red River by Clarke et al. (1980). Drum that were Floy-tagged in Winnipeg were later recaptured as far north as Rabbit Point in Lake Winnipeg and as far south as Drayton, North Dakota. From these individual fish movements, Clarke et al. (1980) hypothesized that freshwater drum moved upstream from Lake Winnipeg during the spring and early summer to spawn, and began moving back downstream to the lake in late summer to overwinter. This is supported by acoustic tagging work by Barth and Lawrence (2000), who reported that the majority of tagged freshwater drum moved downstream out of the study area towards Lake Winnipeg in late summer. Only one tagged drum overwintered in the study area. Barth and Lawrence (2000) also found that freshwater drum moved extensively throughout the study area, with one fish travelling more than 55 km in two days.

Mean length at age and length-frequency data indicate that freshwater drum have a typical unimodal age-frequency distribution (Figure 34). The majority of drum sampled were six year old fish. Low numbers of younger freshwater drum in catches was most likely due to gear selectivity, with the gradual decline in the frequency of fish older than six being attributed to natural mortality. Age-specific mean lengths indicate that freshwater drum were longer at a given age in 1999 than in 1974, which became less pronounced in older fish (Figure 51). This suggests that conditions for young drum had improved over the time period between the two sampling years.

4.3.4 Goldeye

Catch-per-unit-effort for goldeye was much higher in the Red River than in the Assiniboine River. This may have been due to lower velocities in the Red River, which provide more suitable habitat for this species. The higher number of tributary streams flowing into the Red River that may provide spawning and nursery habitat for goldeye, such as the La Salle River, may also contribute to the higher abundance of this species in the Red River. Clarke et al. (1980) suggested that the presence of young-of-the-year goldeye in their catch indicated that goldeye probably spawn in the Red River or its tributaries.

Condition factors for goldeye were similar for fish captured in the Red and Assiniboine rivers (Table 12). Goldeye from the Assiniboine River were larger on average, but only small numbers were captured. Goldeye that were 100 to 125 mm long made up approximately 20% of the catch from the Red and Assiniboine rivers, and more than 40% of the catch from Zone 3a (the Red River from Lockport to Selkirk). However, none of these small fish were captured from the Assiniboine River (Figure 23). These results suggest that the Assiniboine River does not contain nursery habitat for goldeye while Zone 3a may be a valuable nursery area.

Clarke et al. (1980) captured goldeye in the Red River in June and from August to October. They suggested that the goldeye captured in June were probably migrating upstream towards spawning grounds and foraging areas, while goldeye captured in late summer and early fall were moving downstream towards overwintering areas. However, results of the present study, and gillnetting surveys in the vicinity of the NEWPCC in March, 1991 (Tetr*ES* Consultants Inc. 1992), indicate that at least some goldeye overwinter in the study area.

The age-frequency distribution for goldeye indicates that all fish were five years of age or younger (Figure 35). Variations in year class strength for goldeye were noticed but there were no conspicuously weak or absent year classes. The absence of fish older than five years of age is probably due to natural mortality. Age-specific mean length data indicate that goldeye were longer at a given age in 1974 than they were in 1999 (Figure 52). This suggests that conditions for goldeye growth were better in the years immediately preceding 1974 than they were in the years preceding 1999.

4.3.5 Shorthead Redhorse

Shorthead redhorse CPUE was much higher in the Assiniboine River than in the Red River. Clarke et al. (1980) also captured only small numbers of shorthead redhorse from the Red River during their study. Higher velocities and a greater proportion of hard substrate provide more suitable habitat for this species in the Assiniboine River. The preference that shorthead redhorse display for harder substrates has also been reported by Nelson and Franzin (1999), who found that this species tended to be found in the shallower areas of the Assiniboine River over substrates that are composed of larger particle sizes.

Condition factors and mean lengths and weights for shorthead redhorse captured in the Red and Assiniboine rivers were similar (Table 12). This suggests that, although there is a preference for the Assiniboine River, shorthead redhorse captured from both rivers likely belong to the same population. The majority of fish in the study area were between 325 and 400 mm in length (Figure 28). Only a small number of shorthead redhorse longer than 400 mm were captured, which is probably due to natural mortality.

Mean length at age and length-frequency data indicate that shorthead redhorse in the study area have a typical unimodal age-frequency distribution (Figure 37). The majority of shorthead redhorse sampled were seven year-old fish. Lower numbers of younger fish were most likely due to gear selectivity. The decline in the frequency of fish older than seven years of age is probably due to natural mortality. Age-specific mean lengths for shorthead redhorse indicate that this species was longer at a given age in 1974 than in 1999 (Figure 55). While these data are based on a small sample size, it suggests that conditions for shorthead redhorse growth were better in the years preceding 1974 than they were in the years preceding 1999.

4.3.6 White Sucker

Catches of white sucker in hoop nets were highest in September (Figure 16). During September, zones 2 and 3 had the highest CPUE, while in July and August Zone 3 had the largest catches. Boat electrofishing CPUE for white sucker was highest in zones 4 and 3 in July and September, with the greatest catches occurring in July. The higher CPUE for boat electrofishing in Zone 4 may have been due to the fact that this zone had shallower water, which increases the effectiveness of this gear type.

Mean lengths, weights, and condition factors for white sucker were similar for fish captured in the Red and Assiniboine rivers (Table 12), suggesting that they may be part of the same population. Movements of white sucker from the Red to the Assiniboine River were documented by Clarke et al. (1980). White sucker tagged in the Red River were also recaptured as distant as Black Island in Lake Winnipeg (Clarke et al. 1980).

Length-frequency distributions suggest that the majority of white sucker in the population are between 325 and 425 mm in length, with few fish outside this size range. Clarke et al. (1980) also captured only small numbers of white sucker that were outside of the 325 to 425 mm length range. White sucker are thought to grow slowly once sexual maturity is reached (Scott and Crossman 1998), which could explain the low numbers of fish longer than 425 mm. The near absence of smaller white sucker in the catch was probably due to selectivity by both gear type and sampling location. Smaller white sucker are most frequently found in tributaries and backwater areas (Scott and Crossman 1998). Young white sucker were captured in the four tributaries although these fish were not included with the biological data from the two rivers. Age-specific mean lengths for white sucker were greater in 1999 than in 1974 until approximately age 9, after which fish from the 1974 catch were longer for a given age (Figure 57).

4.3.7 Carp

Boat electrofishing CPUE for carp was highest in Zone 4 in both July and September, with the greatest CPUE in September. As previously mentioned, the shallower water in Zone 4 may have increased CPUE by increasing the effectiveness of electrofishing.

Condition factors for carp were similar for fish that were captured from the Red and Assiniboine rivers but the mean lengths and weights of carp were greater in the Assiniboine River (Table 12). Zone 4 was found to have the largest carp, with the exception of Zone 3a, from which only three carp were captured. Carp from Zone 3a were much larger on average than carp captured in any other zone, possibly due to the proximity of this zone to Netley Marsh, which supports an abundance of excellent foraging habitat for this species. The majority of carp captured from both rivers were between 475 and 600 mm in length, with few fish less than 425 mm being captured in the Assiniboine River (Figure 19). Smaller carp may be less abundant in the Assiniboine River due to higher water velocities. Young carp were captured in Sturgeon Creek in July and August (Table 8).

Mean length at age data for carp indicated several weak or missing age classes, most notably fish of four and five years of age (Figure 32). These weak and missing age classes are most likely due to variations in conditions such as water temperatures and water levels. The majority of carp captured in the study area were eight to eleven years of age. Age-specific mean lengths for carp in 1974 and 1999 were similar (Figure 49). This suggests that conditions for growth of this species within the study area have not changed noticeably in the past 25 years.

Clarke et al. (1980) Floy-tagged 54 carp in the Red River, but none were recaptured. Barth and Lawrence (2000) reported that some carp tagged with acoustic transmitters travelled over distances of up to 48.5 km in five days. They also suggested that carp may show attraction to the effluent plumes of Winnipeg's sewage treatment plants, specifically the WEWPCC plume. Carp were captured in large numbers from the WEWPCC plume with boat electrofishing equipment during July and September (Appendix 4 [Table A4.2]). Barth and Lawrence (2000) also found that at least some carp overwinter in the Assiniboine River.

4.3.8 Sauger

Boat electrofishing CPUE for sauger was greatest in Zone 3a in September, when high numbers of this species were captured (Figure 17). The high concentration of sauger in this area may have been due to increased foraging opportunities, or restricted fish passage upstream over the St. Andrews Locks. The largest hoopnet catches of sauger, which occurred in zones 3 and 2 in August, may have been due to lower flows in the Red River during this time period. Lower water levels would have restricted sauger to a smaller area in the river, which would have made them more susceptible to being captured in hoop nets.

Clarke et al. (1980) stated that aggregations of sauger at the mouth of the Red River during fall suggest that some sauger may overwinter in the river, but that upstream spawning migrations in the spring also indicate that many fish overwinter in Lake Winnipeg. Large numbers of ripe sauger captured in the spring, and young-of-the-year fish captured by Clarke et al. (1980) in the fall, also suggest that sauger spawn in the Red River. After spawning, sauger are thought to disperse both upstream and downstream. Sauger Floy-tagged by Clarke et al. (1980) in the Red River at Winnipeg were recaptured as distant as Hecla Island to the north, Grafton, North Dakota to the south, and Portage la Prairie to the west.

Mean size, condition factor, and length-frequency distributions for sauger were similar between the Red and Assiniboine rivers, and between zones within each river (Table 12, Figure 27). This suggests that different size classes of sauger are not restricted to specific zones or rivers. Age-specific mean length data do not indicate a noticeable difference in growth rate for sauger between 1974 and 1999 (Figure 54). This suggests that the conditions affecting the growth of this species have not changed considerably in the past 25 years.

4.3.9 Northern Pike

Catches of northern pike were low from both the Red and Assiniboine rivers. Although pike from the Red River were larger than those from the Assiniboine River, condition factors were similar (Table 12). Length-frequency distributions for northern pike are based on small sample sizes; 25 from the Red River and three from the Assiniboine River. The most frequently captured size class was 350 to 400 mm in length, but in general the size of pike captured was evenly distributed between lengths of 150 to 700 mm. The age-frequency distribution for northern pike indicates that three-year old fish were the most frequently captured (Figure 36). Age-specific mean lengths for northern pike indicate that the growth rate calculated for this species from the 1974 catch was similar to the growth rate for the 1999 catch (Figure 53). This suggests that there has been little change in the conditions that affect the growth of northern pike in the last 25 years.

Clarke et al. (1980) recaptured four of 65 northern pike that they had Floy-tagged. All were recaptured within 32 km of the tagging sites, suggesting that pike in the study area do not travel extensively. The recapture of a northern pike at the NEWPCC outfall in March of 1999 (Lawrence 1999), that had been Floy-tagged at the mouth of Sturgeon Creek in the spring of 1998 (D. Wain, Manitoba Wildlife Federation, pers. comm.), indicates that at least some pike move between the Red and Assiniboine rivers. Data from 10 northern pike tagged with acoustic transmitters in the vicinity of the NEWPCC in February, 2000, suggest that northern pike in the Red River may have small home ranges in winter (Eddy et al. 2000).

5.0 CONCLUSIONS

1. A total of 5,445 fish were captured in this study. Of these, 2,215 fish, representing 31 species, were captured in the Red River; 737 fish, representing 26 species, were captured in the Assiniboine River; and 2,493 fish, representing 26 species were captured from Bunns Creek, Sturgeon Creek, La Salle River, and the Seine River.

2. In decreasing order of relative abundance, the five most commonly captured species in the Red River were channel catfish, sauger, goldeye, white sucker, and quillback. The five most abundant species in the Assiniboine River were shorthead redhorse, channel catfish, sauger, carp, and freshwater drum. Fathead minnow, black bullhead, black crappie, white bass, and river shiner were the most commonly captured species in the four tributaries sampled.

3. Comparison of catch data for the Red River from the present study with that of 1974 (Clarke et al. 1980) suggests that the relative abundance of four of the five most commonly captured species in 1974 (sauger, freshwater drum, white sucker, and channel catfish) have remained approximately the same. Black bullhead and emerald shiner were captured less frequently in the present study while goldeye were captured more frequently.

4. Differences in catch-per-unit-effort for hoop nets set in the Red River during July, August, and September in 1974 and 1999 suggest that most species were less abundant in 1999 than they were in 1974. However, differences in the way in which sampling locations were chosen, hoop net mesh sizes, and streamflow would have contributed to the lower CPUE observed in 1999.

5. While comparison between 1974 and 1999 data showed differences in growth rates and weight-length relationships among species, no consistent pattern was observed. Walleye, sauger, and northern pike were heavier at a given length in 1999 as compared to 1974, while carp and goldeye were lighter for a given length.

6. Habitat types in the Red and Assiniboine rivers that were classified on the basis of substrate type and level of compaction revealed little difference in depth and velocity. No relationship between substrate and fish catch was found and,

consequently, the relationship between habitat types and species composition, distribution, and abundance of the fish community was not examined further.

7. During winter, gillnet catches were low in most zones. Catch-per-unit-effort in Zone 3a (Lockport to Selkirk) was approximately six times higher than that of any other zone in the study area.

8. Although gillnet catches in July and, especially in September, were affected by high water velocities and debris, open-water catches in the Red and Assiniboine rivers were much higher than those in winter. Catches suggested that fish were more abundant in zones downstream of the WPCCs in both the Red and Assiniboine rivers.

9. On average, carp, channel catfish, freshwater drum, silver redhorse, and walleye from the Assiniboine River were larger than those from the Red River. This suggests that higher water velocities in the Assiniboine River, and/or more suitable habitat for juvenile fish in the Red River, may limit use by smaller fish of that portion of the Assiniboine River within the study area.

10. While one or more weak or absent year-classes were apparent for some species, there did not appear to be a specific year (or years) in which a number of species displayed weak or absent year-classes. This suggests that the observed absence of specific cohorts was probably due to a variety of factors, and represented natural variation in the year-class strength of individual species.

PART II

AN ASSESSMENT OF THE RELATIVE HEALTH OF THE FISH COMMUNITY OF THE RED AND ASSINIBOINE RIVERS WITHIN THE CITY OF WINNIPEG USING THE INDEX OF BIOTIC INTEGRITY (IBI)

6.0 METHODS

The following analysis was conducted using the biological data presented and discussed in Part I.

6.1 BACKGROUND

One of the most widely used tools to assess the integrity of lotic systems is the Index of Biotic Integrity (IBI). The IBI is a composite index based on an array of ecological attributes of fish communities, including species richness, indicator taxa (both tolerant and intolerant), trophic status, fish abundance, and the incidence of disease and anomalies (Fausch et al. 1990). Consequently, the IBI uses community, population, and individual organism indicators to assess biological integrity (Karr et al. 1986; Fausch et al. 1990).

The IBI measures a suite of fish community attributes, or metrics, to provide an evaluation of water resources. Often the IBI is used to compare a specific site to a reference condition, which is typically a site or series of sites that have been exposed to minimal human interference (Angermeier and Karr 1986, Simon and Sanders 1999). Generally, the reference condition is defined by sites that are upstream of point sources, urban areas, or other anthropogenic factors. However, some workers argue that few reference sites exist in large rivers and, therefore, the reference condition should be determined by an examination of all sites within the water body (Simon and Emery 1995, Simon and Sanders 1999). Individual metrics are scored with either a 5, 3, or 1, depending on whether the value for the site in question is comparable to, deviates somewhat from, or deviates strongly from, respectively, the value for the reference condition (Fausch et al. 1990).

The IBI was originally developed to assess the environmental health of warm-water streams within the upper midwestern United States by Karr (1981) and Karr et al. (1986). Since its inception, the IBI has been modified and adapted for use in several other environments, including waters of the upper Red River basin (Goldstein et al. 1994, Niemela et al. 1999).

A variety of gear types and levels of effort were used to sample the fish community of different zones of the Red and Assiniboine rivers (Part I, Section 2.2.2). To compare all seven zones and both rivers equally, the data were analysed with the same effort applied to each. Boat electrofishing catches from July and September were used to compare Zone 1a with other zones (first level comparison). To permit comparison of Zone 3a with other zones, using the maximum amount of data, a comparison was conducted between all zones using February/March gillnetting data and July and September boat electrofishing data (second level comparison). A comparison of zones 1 to 5 was conducted using all data collected during February/March, July, and September (third level comparison). Hoop netting during August was conducted in zones 2 and 3 (Red River) and 4 (Assiniboine River) and, consequently, these data were included for comparisons between the two rivers (fourth level comparison). No data from any of the tributaries were used for IBI comparisons.

To facilitate comparison with the upper Red River basin, the current study was developed using the IBI formulated by Niemela et al. (1999). For all species captured in this study, that were also present in waters of the upper Red River basin, biological classifications were determined as per Niemela et al. (1999). Classifications for the few species captured in this study, that were not present in the upper Red River basin, were determined through a review of available literature. A list of all species present, and metric classifications for each, are presented in Table 18. The IBI scoring system, which was developed based on that used by Niemela et al. (1999), is presented in Table 19. A discussion of the development of each metric is presented below.

6.2 METRICS

Species Richness and Composition Metrics

6.2.1 Total Number of Fish Species (Metric 1)

Based on a review of available literature (e.g., Clarke et al. 1980, Renard et al. 1986, McCulloch and Franzin 1996, Peterka and Koel 1996, Koel and Peterka 1998, Nelson and Franzin 1999, Stewart 2000), and discussions with Dr. K. Stewart, Senior Scholar, University of Manitoba, the total number of species present in the Red and Assiniboine rivers, in or near the City of Winnipeg, was determined to be 53. Niemela et al. (1999) documented 85 species in the upper Red River watershed.

All fish captured were identified to species and the number of species for each comparison was tabulated. Under the scoring system used by Niemela et al. (1999), a score of 5 was given where the number of species was >16, a score of 3 was given where the number of species was >8 and #16, and a score of 1 was given where the number of species was # 8 (Table 19). Although the potential total number of species was much lower in the present study, the same scoring system was used as Niemela et al. (1999) found in their study that the number of species reached a maximum at a drainage area of approximately 1,750 mi^2 (4,532 km^2).

6.2.2 Proportion of Round-Bodied Suckers (Metric 2)

Round-bodied suckers are unable to tolerate a wide variety of environmental perturbations. Based on an examination of the literature, results of this study, and key person interviews, it was determined that there are six sucker species present in the study area, three of which are classified as round-bodied (Table 18). Therefore, the highest potential proportion of round-bodied sucker species would be 50%. For each comparison, the proportion of round-bodied sucker species (e.g., 1/6 or 16.6%) was calculated. A score of 5 was awarded when the proportion of round-bodied sucker species was >40%, a score of 3 was given for >20 and #40%, and a score of 1 was awarded for #20% (Table 19).

6.2.3 Proportion of Large River Individuals (Metric 3)

Niemela et al. (1999) suggested that minnows were a better indicator of the quality of pools in the Lake Agassiz Plain than sunfish, which were the indicator used by Karr (1981) in his original IBI metrics. However, since minnows are often difficult to collect in large rivers, and sunfish are not abundant in the Red River basin, Niemela et al. (1999) replaced sunfish and minnows with “proportion of large river individuals” in sites with a drainage area greater than 2,000 mi^2 (5,180 km^2). Fourteen species that occur in the study area were designated as large river individuals (Table 18). The proportion of large river individuals was calculated as the total number of fish of these species over the total number of all fish enumerated. The scoring system for this metric is presented in Table 19.

6.2.4 Evenness (Metric 4)

Evenness is a term used to describe the distribution and abundance of individuals among species by comparing the observed diversity to a theoretical maximum diversity (Pielou 1975). As the difference in abundance among species decreases, the evenness value approaches a maximum value of 1 (i.e., all species are equally abundant). As the difference in abundance among species increases, evenness decreases and the value approaches 0.

Krebs (1989) stated that one of the most commonly used indices of evenness in the literature is based on the Shannon-Weiner function:

$$J' = \frac{H'}{H'_{MAX}}$$

where

J' = evenness measure (range 0-1)

H' = Shannon-Wiener function

H'_{MAX} = maximum value of $H'=\log_2 S$.

Calculation of the Shannon-Weiner function is as follows:

$$H' = \sum_{i=1}^{s} (p_i)(\log_2 p_i)$$

where H' = index of species diversity

s = number of species

p_i = proportion of total sample belonging to i^{th} species

For the Shannon-Wiener function, maximum possible diversity occurs when p =1/S (a standard which applies to all H'_{MAX} values for this study), and thus:

$$H'_{MAX} = -S\left(\frac{1}{S} \log_2 \frac{1}{S}\right) = \log_2 S$$

where

H'_{MAX} = maximum possible value of the Shannon function

S = number of species represented in the community

For each comparison, the Shannon-Wiener function (H') was calculated as the sum of the proportional abundance of each species multiplied by the log to the base 2 of that number. The number of species present in the study area (S) was determined to be 53 for all comparisons.

The resulting maximum possible value of the Shannon function (H'_{MAX}) was 5.73 for all comparisons. For each comparison, evenness (J') was calculated as $H'/H'_{MAX.}$ The scoring system for this metric is presented in Table 19.

6.2.5 Number of Sensitive Species (Metric 5)

Niemela et al. (1999) and others have refined Karr's (1981) original intolerant species metric into the sensitive species metric to include some species that are classified as moderately intolerant. All species that were designated as sensitive by Niemela et al. (1999), plus lake cisco and lake whitefish (*Coregonus clupeaformis*), were classified as sensitive species for this study. Although fewer species were classified as sensitive in this study (13), the same scoring system as used by Niemela et al. (1999) was retained to keep this a discriminating metric (Table 19).

6.2.6 Proportion of Tolerant Individuals (Metric 6)

Niemela et al. (1999) replaced green sunfish (*Lepomis cyanellus*) as an indicator of tolerance with several tolerant species due to the scarcity of this species in the Lake Agassiz Plain ecoregion and because increasing the number of tolerant species improves the sensitivity of this metric for various sized streams and rivers. All 13 species identified as tolerant by Niemela et al. (1999), that were potentially present in the study area, were considered tolerant species in this study. These included quillback, white sucker, bigmouth buffalo (*Ictiobus cyprinellus*), carp, fathead minnow, brook stickleback (*Culaea inconstans*), black bullhead, channel catfish, and freshwater drum. For each comparison, the proportion of tolerant individuals was calculated as the total number of fish representing species classified as tolerant over the total number of all fish enumerated. The scoring system used by Niemela et al. (1999) also was used in this study (Table 19).

Trophic Composition Metrics

Three metrics are designed to measure the energy base and trophic dynamics of a stream community and assess how energy flow through the system may have changed due to disturbance (Karr et al. 1986). The use of proportional group biomass (total weight of each of omnivores, insectivores, and piscivores) is recommended rather than the proportion of individuals to avoid misleading information due to conditions of a good year-class or temporary abundance (Goldstein et al. 1994). Additionally, biomass is considered a better indicator of how energy has been transformed and where it is stored.

6.2.7 Proportion of Omnivore Biomass (Metric 7)

Omnivores are species that consume a significant quantity of both plant and animal material (including detritus) and have the ability (usually indicated by the presence of a long coiled gut and dark peritoneum) to utilize both food groups (Karr et al. 1986). Eight species that occur in the study area were classified as omnivores, including quillback, white sucker, bigmouth buffalo, carp, fathead minnow, black bullhead, and brown bullhead (*Ameiurus nebulosus*) (Table 18). For each comparison, the proportion of omnivore biomass was calculated as the total weight of all omnivores over the total weight of all fish captured. A score of 5 points was given when omnivore biomass was <33 % of the entire fish community, 3 points when it was $ 33 % and < 66%, and 1 point when it was $ 66% (Table 19).

6.2.8 Proportion of Insectivore Biomass (Metric 8)

This metric assesses the benthic macroinvertebrate community, which comprise the primary food base for most insectivorous fishes, which in turn transfer energy to piscivorous species. Species in this metric included lake sturgeon (*Acipenser fulvescens*), silver redhorse, golden redhorse (*Moxostoma erythrurum*), shorthead redhorse, silver chub (*Macrhybopsis storeriana*), emerald shiner, spottail shiner (*Notropis hudsonius*), river shiner, spotfin shiner (*Cyprinella spiloptera*), flathead chub (*Platygobio gracilus*), brook stickleback, goldeye, mooneye (*Hiodon tergisus*), stonecat (*Noturus flavus*), tadpole madtom (*N. gyrinus*), johnny darter (*Etheostoma nigrum*), yellow perch (*Perca flavescens*), river darter (*Percina shumardi*), troutperch (*Percopsis omiscomaycus*), freshwater drum, and lake cisco. For each comparison, the proportion of insectivore biomass was calculated as the total weight of individuals within this trophic level over total weight of all fish enumerated. A score of 5 points was awarded when insectivore biomass was > 60% of the entire fish community, 3 points when it was > 30 and # 60%, and 1 point when it was # 30% (Table 19).

6.2.9 Proportion of Piscivore Biomass (Metric 9)

Karr (1981) proposed the carnivore metric to measure community integrity at higher trophic levels of the fish community. This metric includes species in which the adults are predominantly piscivores, although some species may also feed on other vertebrates or invertebrates such as crayfish (Karr et al. 1986). The following nine species found in the study area were classified as piscivores: rock bass (*Ambloplites rupestris*); black crappie; northern pike; burbot (*Lota lota*); channel catfish; white bass; sauger; and walleye (Table 18). For each comparison, the proportion of piscivore biomass was calculated as the total weight of individuals within this trophic level over the total weight of all fish enumerated. A score of five points was given when piscivore biomass was >20% and <30 % of the entire fish community, three points when it was >10% and #20% or $30 and <40%, and one point when it was #10% and $40% (Table 19).

Fish Abundance and Condition Metrics

Karr et al. (1986) used three metrics to evaluate population attributes such as abundance, age structure, growth and recruitment rates, and fish condition. Other workers have modified these metrics and the metrics used here are based on those used by Niemela et al. (1999).

6.2.10 Catch-Per-Unit-Effort (Metric 10)

This metric assesses population density and is expressed as catch-per-unit-effort (CPUE). Niemela et al. (1999) expressed CPUE as the total number of individuals collected per metre of stream reach sampled. In the present study, CPUE was expressed as the number of individuals captured per hour of boat electrofishing because this gear type was used in more of the zones than the other gear types. The classification of CPUE values into scores was based on the range of observed values. A score of 5 was given to CPUE values >100 fish per hour of boat electrofishing, a score of 3 was assigned to values >40 and #100 fish per hour, and a score of 1 was given for values #40 fish per hour (Table 19).

6.2.11 Proportion of Individuals as Simple Lithophilic Spawners (Metric 11)

Many workers have replaced Karr et al.'s (1986) original proportion of hybrids metric with the proportion of individuals that are simple lithophilic spawners due to a perceived lack of sensitivity by the former (Niemela et al. 1999). Simple lithophilic spawners broadcast eggs that drift into, and develop in, the interstitial spaces between sand, gravel, and cobble. These species are sensitive to siltation because they require clean gravel or cobble substrates for reproductive success. Range reductions have been documented for some simple lithophilic spawners due to increased silt loads (Niemela et al. 1999).

Species captured in this study which were considered simple lithophilic spawners by Niemela et al. (1999) included white sucker, silver redhorse, golden redhorse, shorthead redhorse, river shiner, burbot, river darter, sauger, and walleye (Table 18). For each comparison, the proportion of simple lithophilic spawners was calculated as the total number of lithophilic individuals divided by the total number of all fish enumerated. Niemela et al. (1999) found no relation with drainage area for this metric and, therefore, the same scoring system was used for this study (Table 19).

6.2.12 Proportion of Individuals with Deformities, Eroded Fins, Lesions, and Tumours (DELTs; Metric 12)

The proportion of individuals with deformities, eroded fins, lesions, and tumours may be used to rate the health and condition of individuals within the fish community. This metric is generally used in place of Karr's (1981) percentage of diseased fish metric. Studies of fish populations indicate that these anomalies usually occur at very low rates naturally and generally reach higher frequencies at impacted sites (Niemela et al. 1999).

Niemela et al. (1999) examined the entire fish community (including forage fish) for incidence of DELT anomalies and found the frequency of DELTs in the Lake Agassiz Plain ecoregion to be very low. Niemela et al. (1999) gave the fish community a score of 5 where the DELT frequency was <1%, a score of 3 for a DELT frequency of $1 and <4%, and a score of 1 where the DELT frequency was $4%. Generally, frequencies of DELTs are only observed on fish >200 mm, since smaller fish are unlikely to exhibit DELTs (Simon and Sanders 1999). Consequently, the use of all fish may produce an artificially low frequency of DELTs. Cooley and Davies (2000) examined only those fish that were greater than 200 mm in length and found frequencies that were much higher than those found by Niemela et al. (1999).

Data for this metric were calculated using boat electrofishing, hoop net, and gill net data, but not backpack electrofishing or seine data as the majority of the fish captured with these gear types were less than 200 mm in length. For each comparison, the proportion of individuals with anomalies was calculated as the total number of fish with DELTs over the total number of all fish enumerated. A score of 5 was given when the frequency of DELTs was <5%, a score of 3 was given when DELT frequencies ranged from $5% to <10%, and a score of 1 was given when the frequency of DELTs was $10% (Table 19). This scoring system differs from that of Niemela et al. (1999) and was developed through a review of available literature.

7.0 RESULTS

The IBI scores for the fish community of the Red and Assiniboine rivers within the City of Winnipeg are presented in Table 20.

7.1 TOTAL NUMBER OF FISH SPECIES

The total number of fish species ranged from six in Zone 1 for the first level comparison (comparison between all zones using data from boat electrofishing in July and September) to 30 in the Red River for the fourth level comparison (comparison between rivers using all data except that collected from the tributaries). A score of 1 was awarded only twice; in both cases the low number of species was likely an artifact of limited sampling. With greater sampling effort (third and fourth level comparisons), a score of five was awarded in most cases.

7.2 PROPORTION OF ROUND-BODIED SUCKERS

All three round-bodied sucker species that were present in the study area were found in the majority of the comparisons. As a result, the maximum score of 5 was awarded for most of the comparisons.

7.3 PROPORTION OF LARGE RIVER INDIVIDUALS

There was a marked difference in this metric between the Red and Assiniboine rivers. The proportion of large river individuals was 73% in the Red River and 40% in the Assiniboine River. Proportions for individual zones were as high as 94% in the Red River, but reached a maximum of only 46% in the Assiniboine River.

7.4 EVENNESS

A score of 3 was awarded to Zone 1 in the third level comparison (a comparison between zones 1 to 5 using all data except that collected in August) and to the Red River in the fourth level comparison. The minimum score of 1 was awarded in all other cases.

7.5 NUMBER OF SENSITIVE SPECIES

The number of sensitive species collected reached a maximum of eight in the Red River, which tended to support a larger number of these species than the Assiniboine River and the zones within.

7.6 PROPORTION OF TOLERANT INDIVIDUALS

Individuals belonging to tolerant taxa represented up to 46% of the catch (Red River). However, some zones (e.g., 1a and 3a) displayed a very low proportion of tolerant individuals. Only 5% of the catch in Zone 1 in the first level comparison was composed of tolerant individuals, compared to 25% and 24% of second level (a comparison between all zones except 1a using data from July and September boat electrofishing and winter gill netting) and third level comparisons, respectively. This suggests that gear selectivity or small sample sizes affected the sensitivity of this metric.

7.7 PROPORTION OF OMNIVORE BIOMASS

The proportion of omnivore biomass in the study area ranged between 5% (Zone 5 in the third level comparison) to 65% (Zone 3 in both the first and second level comparisons). The Red and Assiniboine rivers were composed of 27% (a score of 5) and 33% (a score of 3) omnivore biomass, respectively.

7.8 PROPORTION OF INSECTIVORE BIOMASS

Insectivore biomass was generally low in the study area, with scores of more than one being awarded on only a few occasions. The proportion of insectivore biomass in the Red and Assiniboine rivers was 10% and 30%, respectively.

7.9 PROPORTION OF PISCIVORE BIOMASS

In the present study piscivore biomass was variable, ranging from 9 to 69% of the fish community. This metric was influenced by effort and by gear type. For example, in each zone the proportion of piscivore biomass increased substantially from the second level comparison to the third level comparison as gear types other than boat electrofishing (particularly hoop nets) were included. Scores for the Red and Assiniboine rivers were 63% and 37%, respectively.

7.10 CATCH-PER-UNIT-EFFORT

This metric was derived from the boat electrofishing catch, which resulted in the first, second, and third level comparisons all producing the same scores. Catch-per-unit-effort ranged from 16 fish per hour in Zone 1 to 155 fish per hour in Zone 3a and 108 fish per hour in Zone 4.

7.11 PROPORTION OF INDIVIDUALS AS SIMPLE LITHOPHILIC SPAWNERS

For the majority of comparisons, between 30 and 60% of the fish community was composed of simple lithophilic spawners, which resulted in a rating of 3. Forty-three percent of the fish community in the Red River were classified as simple lithophilic spawners (score of 3) while the Assiniboine River was composed of 62% simple lithophilic spawners (score of 5).

7.12 PROPORTION OF INDIVIDUALS WITH DEFORMITIES, ERODED FINS, LESIONS, AND TUMOURS (DELTs)

The proportion of individuals with deformities, eroded fins, lesions, and tumours (DELTs) ranged from a low of 0.6 % for Zone 3a in the first level comparison to a high of 24.3% for Zone 5 in the third level comparison. When each river was considered separately (fourth level comparison), the frequency of DELTs in the Red and Assiniboine rivers was 8.3% and 15.6%, respectively. In the first level comparison, zones 1, 1a, and 3a received scores of 5, while in the second level comparison only Zone 3a was awarded a score of 5.

7.13 TOTAL SCORE

In the first level comparison (boat electrofishing), the total IBI score ranged from 20 in both zones 1 and 5 to 44 in Zone 3a (Table 20). In the second level comparison (boat electrofishing and winter gillnetting), scores ranged from 20 in Zone 5 to 44 in Zone 3a. In the third level comparison (winter gillnetting and all gear types from July and

September), scores ranged from 30 in both zones 1 and 5 to 40 in Zone 4. In the fourth level comparison (all gear types fished in February/March, July, August, and September), the total score was 40 for the Red River and 34 for the Assiniboine River.

When ranked using the IBI scoring system proposed by Niemela et al. (1999), most of the zone scores in the present study fit into either the poor or fair categories, with Zone 3a being classified as good (Tables 20 and 21). In the first and second level comparisons, both zones 1 and 5 fell into the very poor or poor categories, but interpretation is limited by the small sample sizes (n #64). Total score for most zones tended to increase progressing from the first level comparison through to the second and third level comparisons as sampling effort and number of fish captured increased (Figure 66). Scores for none of the zones reached an asymptote, suggesting that increased sampling effort and catch would have altered the scores. Additionally, zones where the smallest amount of sampling was conducted (zones 1 and 5) also received the lowest IBI scores. It cannot be determined whether the low IBI score was entirely a function of sampling effort, or due to some other factor.

8.0 DISCUSSION

8.1 COMPARISONS BETWEEN ZONES AND RIVERS

First level comparisons (boat electrofishing data) were conducted so that the upstream reference zone could be compared with other zones at a consistent level of fishing effort. The number of fish sampled ranged from 30 fish for Zone 5 to 454 fish for Zone 4. Zones 1a, 1, 3a, and 5 all functioned as reference areas in this comparison. Zones 1 and 5, which are located upstream of all City of Winnipeg Water Pollution Control Centre (WPCC) outfalls in the Red and Assiniboine rivers, respectively, had the smallest number of fish sampled and the lowest scores. Zone 1a, which is located immediately upstream of Zone 1, obtained a score six points higher than Zone 1, suggesting that the low score in Zone 1 may have been due to site-specific conditions. Zone 3a received the highest score (44), followed by Zone 2 (38), Zone 4 (32), and Zone 3 (30).

Second level comparisons (boat electrofishing and winter gillnetting data) were conducted so that Zone 3a could be compared with the other zones at a consistent level of effort. The number of fish sampled ranged from 31 fish in Zone 5 to 454 fish in Zone 4. Zones 1 and 5 had lower scores than the remainder of the zones, both being classified as poor. Zone 3a had the same score as in the first level comparison and again was classified as good. Scores for the zones downstream of the WPCCs ranged from 30 to 40.

For the third level comparisons (all data collected from the Red and Assiniboine rivers during February/March, July, and September), the number of fish sampled ranged from 77 in Zone 5 to 550 in Zone 4. The scores obtained were less variable than first and second level comparisons, ranging from 30 in zones 1 and 5 to 40 in Zone 4. Two reference areas (zones 1 and 5) had the lowest IBI scores while the scores for the zones downstream of the WPCCs ranged from 36 to 40.

For the fourth level comparison (all data collected from the Red and Assiniboine rivers, including August), 2,158 fish were sampled from the Red River and 701 fish were sampled from the Assiniboine River. The score for the Red River was 40 and the score for the Assiniboine River was 34, both of which fall into the classification of fair. Potential signs of stress suggested by examination of the IBI data (Table 20) included the following: a low proportion of large river individuals in the Assiniboine River; low evenness values in the

Assiniboine River and, to a lesser extent, the Red River; a high proportion of tolerant individuals in both the Red and Assiniboine rivers; skewed trophic structure in the Red River; and, a high proportion of DELTs in the Assiniboine River and, to a lesser extent, the Red River.

8.2 COMPARISON TO OTHER RIVERS

Niemela et al. (1999) sampled eight sites in the Red River mainstem within Minnesota and North Dakota waters of the United States and found total IBI scores ranging from 32 to 48, with a mean score of 39.5. The IBI scores did not decrease with increasing distance downstream, despite the input from potential pollution sources. Conversely, they found that the most downstream sites (near the U.S./Canada border) had the highest IBI scores. These downstream sites showed an abundant, well-balanced fish community that was not dominated by opportunistic or tolerant species. The IBI score obtained for the Red River within the City of Winnipeg (40), suggests that health and condition of the fish community between American and Canadian sections of the Red River are similar. The IBI score obtained for the Assiniboine River (34) falls into the low end of the range of scores obtained for the Red River basin by Niemela et al. (1999).

To place the IBI scores obtained for the reaches of the Red and Assiniboine rivers within the City of Winnipeg in context, information from the State of Ohio, a jurisdiction where much of the work using biological criteria, including IBIs, has been conducted, was examined.

Whereas water quality monitoring activities have historically focused on monitoring of chemical and physical variables, a number of state governments in the United States have started to develop and implement biological monitoring, criteria, and assessments as components of water quality monitoring programs (Yoder and Smith 1999). The use of fish communities is a recent development which has been driven primarily by two events: 1) the availability of cost-effective sampling methods such as pulsed DC electrofishing; and, 2) the development of evaluation tools like the Index of Biotic Integrity and the Index of Well-Being (Yoder and Smith 1999). The Ohio Environmental Protection Agency (EPA) has been a leader in this field, with work conducted on the Ohio River mainstem and many smaller watersheds within the state of Ohio (Yoder and Rankin 1995, Simon and Sanders 1999, Yoder and Smith 1999).

The Ohio EPA employs aquatic life use objectives and regional reference conditions to define water quality goals for watersheds, and specific reaches within them (Ohio EPA 2000). The following are the three most common aquatic life use objectives:

1) the warm-water habitat designation (WWH), which defines the typical warm-water community of aquatic organisms for Ohio rivers and streams and represents the principal restoration target for the majority of water resource management efforts in Ohio;

2) the exceptional warm-water habitat designation (EWH), which is given to waters which support unusual and exceptional aquatic organism communities that are characterized by a high diversity of species; and,

3) the modified warm-water habitat designation (MWH), which applies to streams and rivers that have been subjected to sanctioned and permitted extensive, maintained, and essentially permanent hydraulic modifications such that the biocriteria for WWH use are not attainable.

Ohio biological criteria were defined based on contemporary reference conditions that were determined through extensive sampling of reference sites during the 1980s (Yoder and Smith 1999). Due to differences in landscape disturbance between ecoregions, the IBI score that equals the baseline reference condition for WWH use ranges from 32 (53% of the maximum possible IBI score) to 44 (73% of the maximum possible IBI score) (Yoder and Rankin 1995). Scores for EWH use range between 48 and 50 (Yoder and Rankin 1995).

Median IBI scores for 99 rivers and streams in Ohio sampled during the 1980s and early 1990s ranged from 13 to 54 (Yoder and Smith 1999). Median IBI scores for Ohio River mainstem stations sampled between 1989 and 1995 ranged from 39 to 50 (Simon and Sanders 1999). The ranking of the 99 rivers and streams can also be used to assess why certain rivers and streams harbour exceptional, good, and various degrees (fair, poor, and very poor) of degraded fish communities (Yoder and Smith 1999). Rivers and streams that ranked in the lowest 25% generally flowed through heavily urbanized and industrial areas and were frequently impacted by severe point source loading. Those ranking in the middle were impacted by a variety of stressors including agricultural non-point source runoff, habitat modifications, and municipal WWTP inputs (Yoder and Smith 1999). Those ranking in the top 10% included most of the exceptional resources, harboured the best populations of rare, threatened, endangered, and declining fish species, and generally supported the highest biological integrity and offered the best recreational opportunities (Yoder and Smith 1999). Whereas scores for many sites have improved over time due to the construction and operation of advanced wastewater treatment facilities, others (usually those being impacted by other industrial developments) have not (Yoder and Rankin 1995, Yoder and Smith 1999).

While differences in field and analytical techniques used, and physical and biological characteristics of the study area exist, IBI scores for the fish community of the Red and Assiniboine rivers within the City of Winnipeg were compared to those from the Ohio database to place the former in context. Depending on the ecoregion used, scores for the Assiniboine River and particularly the Red River meet the IBI score recommended for warm-water habitat use in Ohio. However, scores for both rivers are lower than most sites in the Ohio River mainstem.

9.0 CONCLUSIONS

1. The IBI score obtained for the Red River in this study (40) is comparable to those of Red River mainstem sites in the United States (mean score of 39.5; Niemela et al. 1999), suggesting comparable health and condition of the fish community of the Red River between jurisdictions. Using the IBI ranking system proposed by Niemela et al. (1999) for the upper Red River watershed, the fish communities of the Red (40) and Assiniboine (34) rivers within the City of Winnipeg are both classified as fair.

2. Examination of the IBI data suggested potential signs of stress in the fish communities of both rivers, including the following: a low proportion of large river individuals in the Assiniboine River; low evenness values in the Assiniboine River and, to a lesser extent, the Red River; a high proportion of tolerant individuals in both the Red and Assiniboine rivers; skewed trophic structure in the Red River; and, a high proportion of DELTs in the Assiniboine River and, to a lesser extent, the Red River.

PART III

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TABLES

Table 1. Summary of habitat classification and quantification (%) by habitat type and zone in the Red and Assiniboine rivers within the City of Winnipeg Ammonia Criteria Study Area, 1999.

		Habitat Type (%)		
Zone	Segments	1[A]	2[B]	3[C]
Red River				
1	***1-26***	***39.4***	***47.1***	***13.5***
2	***27-57***	***29.0***	***58.9***	***12.1***
3	***58-74***	***15.7***	***11.8***	***72.5***
3A	***75-86***	***21.5***	***14.6***	***63.9***
Total	***1-86***	***28.4***	***40.2***	***31.6***
Assiniboine River				
4	***109-130***	***23.9***	***6.4***	***70.0***
5	***101-108***	***5.1***	***24.2***	***70.7***
Total	***101-130***	***19.1***	***10.0***	***70.9***
Red and Assiniboine Rivers	***All***	***26.1***	***32.5***	***41.4***

Category:

[A]1 (Soft)

- any combination of substrates with soft compaction
- mud/silt/clay with medium compaction
- any presence of sand elevates substrate to category 2 or 3

[B]2 (Medium)

- sand/mud/silt/clay with hard compaction
- sand/mud/silt or clay as dominant substrate with gravel as secondary with medium compaction
- sand with medium compaction

[C]3 (Hard)

- any presence of cobble/boulder/rip-rap in substrate mix
- gravel as dominant substrate with medium or hard compaction
- sand as dominant substrate with gravel as secondary substrate and hard compaction

Table 2. Water velocities measured in the Red and Assiniboine rivers during winter, summer, and fall, 1999.

			Winter			Summer			Fall		
Zone	Waterbody	Habitat Type	n	Mean Velocity (m/s)	Range	n	Mean Velocity (m/s)	Range	n	Mean Velocity (m/s)	Range
1A	RR	H	-	-	-	3	0.53	0.32-0.71	3	0.59	0.52-0.64
	RR	M	-	-	-	3	0.52	0.37-0.61	3	0.55	0.39-0.70
	RR	S	-	-	-	3	0.65	0.56-0.75	3	0.81	0.75-0.87
		Total	***-***	***-***	***-***	***9***	***0.57***	***0.32-0.75***	***9***	***0.65***	***0.39-0.87***
1	RR	H	2	0.08	0.03-0.13	3	0.41	0.36-0.47	3	0.59	0.44-0.68
	RR	M	8	0.26	0.13-0.52	3	0.39	0.21-0.53	3	0.69	0.61-0.78
	RR	S	14	0.27	0.16-0.38	6	0.53	0.18-0.79	7	0.59	0.09-0.73
		Total	***24***	***0.24***	***0.03-0.52***	***12***	***0.47***	***0.18-0.79***	***13***	***0.57***	***0.09-0.78***
2	RR	H	5	0.20	0.14-0.24	8	0.54	0.30-0.63	6	0.57	0.27-0.77
	RR	M	17	0.19	0.03-0.30	7	0.41	0.05-0.61	10	0.47	0.12-0.69
	RR	S	4	0.20	0.16-0.24	6	0.40	0.20-0.49	6	0.55	0.26-0.81
		Total	***26***	***0.19***	***0.03-0.30***	***21***	***0.46***	***0.20-0.63***	***22***	***0.52***	***0.12-0.81***
3	RR	H	5	0.46	0.17-0.71	6	0.68	0.25-0.91	7	0.71	0.03-1.05
	RR	M	-	-	-	10	0.42	0.18-0.62	8	0.49	0.23-0.71
	RR	S	2	0.27	0.21-0.31	8	0.41	0.06-0.65	10	0.45	0.03-1.02
		Total	***7***	***0.40***	***0.17-0.71***	***24***	***0.49***	***0.06-0.91***	***25***	***0.54***	***0.03-1.05***

Table 2. (Continued)

Zone	Waterbody	Habitat Type	Winter n	Winter Mean Velocity (m/s)	Winter Range	Summer n	Summer Mean Velocity (m/s)	Summer Range	Fall n	Fall Mean Velocity (m/s)	Fall Range
3A	RR	H	6	0.23	0.12-0.53	1	0.66	0.50-0.83	3	0.89	0.72-1.12
	RR	M	4	0.10	0.03-0.16	3	0.33	0.25-0.45	3	0.50	0.36-0.62
	RR	S	2	0.15	0.09-0.21	3	0.36	0.19-0.46	3	0.45	0.36-0.53
		Total	***12***	***0.18***	***0.03-0.53***	***7***	***0.39***	***0.19-0.83***	***9***	***0.61***	***0.36-1.12***
4	AR	H	1	0.30	-	7	0.81	0.07-1.20	8	0.71	0.08-1.06
	AR	M	4	0.48	0.12-0.82	1	0.05	0.03-0.06	1	0.33	0.28-0.38
	AR	S	2	0.51	0.50-0.52	3	0.76	0.55-0.95	3	0.41	0.29-0.50
		Total	***7***	***0.46***	***0.12-0.82***	***11***	***0.75***	***0.03-1.20***	***12***	***0.60***	***0.08-1.06***
5	AR	H	4	0.21	0.12-0.30	6	0.86	0.76-1.04	7	0.78	0.54-1.08
	AR	M	2	0.14	0.10-0.17	3	1.01	0.83-1.31	3	0.55	0.50-0.58
	AR	S	-	-	-	-	-	-	-	-	-
		Total	***6***	***0.18***	***0.10-0.30***	***9***	***0.94***	***0.76-1.31***	***10***	***0.71***	***0.50-1.08***

Codes:

RR = Red River
AR = Assiniboine River

H = Hard
M = Medium
S = Soft

Table 3. Summary of water temperature data collected from the Red and Assiniboine rivers in conjunction with other related activities, during winter, summer, and fall,1999.

Location	Date	Number Of Observations	Range of Temperature (^oC)	Mean Temperature (^oC)
Red River	23-Feb	6	0.1 - 0.2	0.1
	24-Feb	-	-	-
	25-Feb	8	0.1 - 0.5	0.3
	26-Feb	8	0.2 - 0.6	0.4
	27-Feb	4	0.2 - 0.6	0.3
	28-Feb	-	-	-
	1-Mar	6	0.2 - 0.6	0.4
	2-Mar	6	0.0 - 0.3	0.1
	3-Mar	6	0.1 - 0.4	0.3
	4-Mar	6	0.1 - 0.4	0.3
	5-Mar	-	-	-
	6-Mar	-	-	-
	7-Mar	4	0.1 - 0.3	0.3
	8-Mar	4	0.1 - 0.2	0.2
	9-Mar	6	0.1 - 0.2	0.1
	8-Jul	6	20.7 - 21.5	21.1
	9-Jul	4	21.7 - 21.9	21.8
	10-Jul	-	-	-
	11-Jul	-	-	-
	12-Jul	3	22.6 - 22.7	22.6
	13-Jul	3	22.9 - 23.0	22.9
	26-Jul	3	26.1 - 26.2	26.1
	27-Jul	3	25.3 - 25.5	25.4
	12-Sep	3	15.2 - 15.4	15.3
	13-Sep	3	14.4 - 15.2	14.9
	14-Sep	3	-	14.7
	15-Sep	3	-	14.7
	16-Sep	3	14.6 - 14.9	14.7
	17-Sep	-	-	-
	18-Sep	3	15.1 - 15.2	15.1
	19-Sep	3	14.7 - 14.8	14.7
Assiniboine River	28-Feb	2	0.2 - 0.3	0.2
	1-Mar	-	-	-
	2-Mar	-	-	-
	3-Mar	-	-	-
	4-Mar	-	-	-
	5-Mar	6	0.2 - 1.1	0.4
	6-Mar	6	0.1 - 0.7	0.3

Table 3. (Continued)

Location	Date	Number Of Observations	Range of Temperature (^oC)	Mean Temperature (^oC)
Assiniboine River (Continued)	14-Jul	3	22.5 - 22.9	22.7
	15-Jul	-	-	-
	16-Jul	2	-	22.2
	8-Sep	3	16.8 - 16.9	16.8
	9-Sep	-	-	-
	10-Sep	2	14.6 - 14.7	14.6

Table 4. Number of sample replicates, by zone, gear type, and season, in the Red and Assiniboine rivers within the City of Winnipeg Ammonia Criteria Study Area, 1999.

		Zones						
Gear Type	**Season**	**1**	**1a**	**2**	**3**	**3a**	**4**	**5**
Gillnet	***Feb-Mar***	12	-	12	3	6	3	3
	July	3	-	6	6	-	3	2
	September	-	-	6	-	-	3	2
Hoopnet	***July***	3	-	6	6	-	3	2
	August	-	-	13	13	-	11	-
	September	3	-	6	6	-	3	2
Boat electrofishing	***July***	3	3	6	6	3	3	2
	September	3	3	6	6	3	3	2
Backpack electrofishing	***July***	3	-	6	6	-	3	2
	September	4	-	6	6	-	3	3
Seine	***July***	3	-	6	6	-	3	2
	August	1	-	-	-	-	-	-
	September	3	-	6	6	-	3	2

Table 5. Common and scientific names of fish species captured in the Red and Assi rivers, and selected tributaries, within the City of Winnipeg Ammonia Criteri Area, 1999.

Common Name	Scientific Name	Abbreviation
Bigmouth buffalo	*Ictiobus cyprinellus*	BGBF
Black bullhead	*Ameiurus melas*	BLBL
Black crappie	*Pomoxis nigromaculatus*	BLCR
Brook stickleback	*Culaea inconstans*	BRST
Brown bullhead	*Ameiurus nebulosus*	BRBL
Burbot	*Lota lota*	BURB
Carp	*Cyprinus carpio*	CARP
Channel catfish	*Ictalurus punctatus*	CHCT
Emerald shiner	*Notropis atherinoides*	EMSH
Fathead minnow	*Pimephales promelas*	FTMN
Flathead chub	*Platygobio gracilus*	FLCH
Freshwater drum	*Aplodinotus grunniens*	FRDR
Golden redhorse	*Moxostoma erythrurum*	GLRD
Goldeye	*Hiodon alosoides*	GOLD
Johnny darter	*Etheostoma nigrum*	JHDR
Lake cisco	*Coregonus artedi*	LKCS
Mooneye	*Hiodon tergisus*	MOON
Northern pike	*Esox lucius*	NRPK
Quillback	*Carpiodes cyprinus*	QUIL
Rock bass	*Ambloplites rupestris*	RCBS
River darter	*Percina shumardi*	RVDR
River shiner	*Notropis blennius*	RVSH
Sauger	*Stizostedion canadense*	SAUG
Shorthead redhorse	*Moxostoma macrolepidotum*	SHRD
Silver chub	*Macrhybopsis storeriana*	SLCH
Silver redhorse	*Moxostoma anisurum*	SLRD
Spotfin shiner	*Cyprinella spiloptera*	SFSH
Spottail shiner	*Notropis hudsonius*	SPSH
Stonecat	*Noturus flavus*	STON
Tadpole madtom	*Noturus gyrinus*	TDMD
Trout perch	*Percopsis omiscomaycus*	TRPR
Walleye	*Stizostedion vitreum*	WALL
White bass	*Morone chrysops*	WHBS
White sucker	*Catostomus commersoni*	WHSC
Yellow perch	*Perca flavescens*	YLPR

Table 6. Fish catch, by gear type and season, in the Red River within the City of Winnipeg Ammonia Criteria Study Area,

	Feb/Mar	July					August		September					
Species	Gillnet	Boat Electrofishin	Hoopnet	Gillnet	Backpack Electrofishin	Seine	Hoopnet	Seine	Boat Electrofishin	Hoopnet	Gillnet	Backpack Electrofishin	Seine	Total
Bigmouth buffalo	-	-	-	-	-	-	-	-	3	-	-	-	-	3
Black bullhead	-	-	-	3	-	-	-	-	-	-	-	-	-	3
Black crappie	-	-	-	-	-	-	1	-	1	-	-	2	-	4
Brook stickleback	-	-	-	-	-	1	-	-	-	-	-	-	-	1
Brown bullhead	-	1	-	-	-	-	-	-	-	4	-	-	-	5
Burbot	1	14	-	-	10	-	-	-	1	4	1	4	-	35
Carp	5	20	14	1	4	-	11	-	17	1	2	3	2	80
Channel catfish	3	-	20	10	-	-	293	-	3	129	3	-	1	462
Emerald shiner	-	-	-	-	-	-	-	6	-	-	-	12	86	104
Fathead minnow	-	-	-	-	1	3	-	2	-	-	-	4	1	11
Flathead chub	-	-	-	-	-	3	-	-	-	-	-	3	7	13
Freshwater drum	5	14	14	1	-	2	47	-	14	11	-	-	3	111
Golden redhorse	-	3	1		-	-	-	-	4	-	-	-	-	8
Goldeye	22	35	-	11	3	13	-	-	124	2	2	2	6	220
Lake cisco	19	-	-	-	-	-	-	-	-	-	-	-	-	19
Mooneye	5	-	1	1	-	-	-	-	-	-	-	-	-	7
Northern pike	8	2	1	6	4	-	7	-	1	-	-	1	-	30
Quillback	-	11	9	-	-	-	83	-	4	9	-	1	8	125
Rock bass	-	2	1	-	1	-	-	-	-	-	-	2	1	7
River darter	-	-	-	-	-	1	-	-	-	-	-	-	-	1
River shiner	-	-	-	-	7	10	-	-	-	-	-	10	77	104
Sauger	21	23	2	3	3	-	170	-	162	24	2	21	9	440
Shorthead redhorse	2	13	6	5	1	1	19	-	27	-	1	2	3	80
Silver chub	1	7	-	-	7	10	-	14	-	-	-	17	14	70
Silver redhorse	-	-	1	-	-	-	-	-	3	-	-	-	1	5
Spotfin shiner	-	-	-	-	3	-	-	-	-	-	-	1	2	6
Stonecat	-	-	-	2	3	-	-	-	-	-	2	-	1	8
Trout perch	-	-	-	-	-	1	-	-	-	-	-	-	-	1
Walleye	6	7	1	1	-	1	13	-	10	-	-	3	-	42
White bass	-	-	-	-	-	-	-	-	1	-	-	-	-	1
White sucker	29	43	14	5	3	1	36	-	13	64	-	1	-	209
Total: Fish	127	195	85	49	50	47	680	22	388	248	13	89	222	2215
: Species	13	14	13	12	13	12	10	3	16	9	7	17	16	31
: Locations	32	20	15	15	20	15	7	1	20	15	6	19	14	-
: Sets	33	29	15	15	20	15	26	1	30	15	6	22	15	-

Table 7. Fish catch, by gear type and season, in the Assiniboine River within the City of Winnipeg Ammonia Criteria Study

	Feb/Mar	July					August	September					
Species	**Gillnet**	**Boat Electrofishin**	**Hoopnet**	**Gillnet**	**Backpack Electrofishin**	**Seine**	**Hoopnet**	**Boat Electrofishin**	**Hoopnet**	**Gillnet**	**Backpack Electrofishin**	**Seine**	**Total**
Bigmouth buffalo	-	1	-	-	-	-	1	1	-	-	-	-	3
Black crappie	-	1	-	-	-	-	-	-	-	-	-	-	1
Brown bullhead	-	-	-	1	-	-	-	-	-	-	-	-	1
Burbot	-	-	-	-	-	-	-	-	-	-	-	-	0
Carp	-	32	1	1	-	-	2	30	-	-	-	-	66
Channel catfish	-	3	6	1	-	-	36	5	41	2	-	-	94
Emerald shiner	-	-	-	-	-	1	-	-	-	-	-	-	1
Fathead minnow	-	-	-	-	1	-	-	-	-	-	1	-	2
Flathead chub	-	-	-	-	-	-	-	-	-	-	1	4	5
Freshwater drum	-	5	10	-	-	-	17	25	-	-	-	-	57
Golden redhorse	-	4	-	-	-	-	6	14	1	-	-	-	25
Goldeye	-	4	-	2	-	-	2	7	-	-	-	-	15
Mooneye	-	-	-	2	-	-	-	-	-	-	1	-	3
Northern pike	-	1	-	2	-	-	-	-	-	-	-	-	3
Quillback	-	4	3	-	-	-	7	3	1	-	-	-	18
Rock bass	-	-	-	-	-	-	-	-	-	-	-	-	0
River shiner	-	-	-	-	-	-	-	-	-	-	3	7	10
Sauger	-	13	4	-	-	-	7	45	12	2	1	1	85
Shorthead redhorse	-	63	9	1	1	-	24	167	-	1	1	-	267
Silver chub	-	-	-	-	-	-	-	1	-	-	-	2	3
Silver redhorse	-	8	2	-	-	-	2	1	-	-	1	-	14
Spotfin shiner	-	-	-	-	-	2	-	-	-	-	-	-	2
Spottail shiner	-	-	-	-	-	-	-	-	-	-	-	5	5
Stonecat	-	-	-	-	-	-	-	-	-	1	-	-	1
Walleye	1	4	1	-	1	-	1	4	-	-	-	-	12
White sucker	-	16	1	-	1	-	4	21	1	-	-	-	44
Total: Fish	1	159	37	10	4	3	109	324	56	6	9	19	737
: Species	1	14	9	7	4	2	12	13	5	4	7	5	26
: Locations	6	7	5	5	5	5	4	7	5	5	6	6	-
: Sets	6	10	5	5	5	5	11	17	5	5	6	6	-

Table 8. Fish catch, by tributary and season, in selected tributaries of the Red and Assiniboine rivers within the City of W
Ammonia Criteria Study Area, 1999.

	Bunns Creek			Sturgeon Creek			La Salle River			Seine River			
Species	**July**	**August**	**September**	**July**	**August**	**September**	**July**	**August**	**September**	**July**	**August**	**September**	**Total**
Black bullhead	-	-	1	-	-	-	114	1	3	362	-	-	481
Black crappie	18	-	-	-	-	-	94	5	3	-	-	-	120
Burbot	-	-	-	-	-	-	-	-	2	-	-	-	2
Carp	6	-	-	2	2	-	-	-	1	-	-	-	11
Emerald shiner	1	-	-	-	-	-	20	3	-	-	-	-	24
Fathead minnow	66	-	2	1514	29	4	11	10	1	1	-	-	1638
Freshwater drum	-	-	-	-	-	-	-	-	-	1	-	-	1
Golden redhorse	-	-	-	-	-	-	-	-	-	1	-	-	1
Goldeye	1	-	-	-	-	-	-	-	-	-	-	-	1
Johnny darter	-	-	-	-	-	-	2	-	1	-	-	-	3
Northern pike	1	-	2	2	-	1	-	-	2	-	-	-	8
Rock bass	-	-	-	-	-	-	-	-	8	2	-	-	10
River darter	-	-	-	-	-	-	-	-	-	2	-	-	2
River shiner	16	-	-	2	-	-	18	1	-	-	-	-	37
Sauger	-	-	2	-	-	-	-	-	-	-	-	-	2
Shorthead redhorse	7	-	1	5	1	-	-	-	-	-	-	-	14
Silver chub	23	-	-	-	-	-	2	-	-	-	-	-	25
Spotfin shiner	9	-	-	-	-	-	21	3	1	-	-	-	34
Tadpole madtom	-	-	-	-	-	-	-	-	-	1	-	-	1
Trout perch	1	-	-	-	-	-	-	-	-	1	-	-	2
Walleye	1	-	-	-	-	-	-	-	-	-	-	-	1
White bass	34	-	-	-	-	-	6	-	-	-	-	-	40
White sucker	2	-	-	-	5	2	3	-	-	18	-	-	30
Yellow perch	3	-	-	-	-	-	2	-	-	-	-	-	5
Total: Fish	189	-	8	1525	37	7	293	23	22	389	-	-	2493
: Species	15	-	5	6	4	2	11	6	9	9	-	-	26
: Locations	1	-	1	3	2	1	2	2	1	2	-	-	-
: Hauls	3	-	2	4	2	1	2	2	3	2	-	-	-

Table 9. Catch-per-unit-effort (CPUE) (#fish/hr) by zone and habitat type, for gill nets set in the Red and Assiniboine rivers during February, March, July, and September, 1999.

	By Zone			By Habitat Type (Substrate)									
					Soft		Medium		Hard		All		
Month	**Zone**	**Mean CPUE (#/hr)**	**n**	**Zone**	**Mean CPUE (#/hr)**	**n**	**Mean CPUE (#/hr)**	**n**	**Mean CPUE (#/hr)**	**n**	**Mean CPUE (#/hr)**	**n**
Feb/Mar	1	0.11	12	1-3	0.08	8	0.07	16	0.16	3	0.09	27
	2	0.08	12	3a	0.87	1	0.20	2	0.75	3	0.59	6
	3	0.00	3	4-5	-	-	0.00	3	0.02	3	0.01	6
	3a	0.59	6									
	4	0.00	3	***All***	***0.17***	***9***	***0.08***	***21***	***0.31***	***9***	***-***	***-***
	5	0.02	3									
July	1	0.06	3	1-3	0.43	5	0.60	5	0.46	5	0.50	15
	2	0.52	6	3a	-	-	-	-	-	-	-	-
	3	0.69	6	4-5	0.9	1	0.36	1	0.18	3	0.36	5
	3a	-	-									
	4	0.37	3	***All***	***0.51***	***6***	***0.56***	***6***	***0.36***	***8***	***-***	***-***
	5	0.34	2									
September	1	-	-	1-3	0.18	2	0.61	2	0.68	2	0.49	6
	2	0.49	6	3a	-	-	-	-	-	-	-	-
	3	-	-	4-5	0.85	1	0.00	1	0.00	3	0.17	5
	3a	-	-									
	4	0.28	3	***All***	***0.40***	***3***	***0.41***	***3***	***0.27***	***5***	***-***	***-***
	5	0.00	2									

Table 10. Catch-per-unit-effort (CPUE) (#fish/hr) by zone and habitat type, for hoop nets set in the Red and Assiniboine rivers during July, August, and September, 1999. Hoop net data include downstream catches only.

	By Zone			By Habitat Type (Substrate)								
					Soft		Medium		Hard		All	
Month	**Zone**	**Mean CPUE (#/hr)**	**n**	**Zone**	**Mean CPUE (#/hr)**	**n**	**Mean CPUE (#/hr)**	**n**	**Mean CPUE (#/hr)**	**n**	**Mean CPUE (#/hr)**	**n**
July	1	0.08	2	1-3	0.51	3	0.33	3	0.17	4	0.32	10
	2	0.34	4	4-5	-	-	0.10	1	0.33	3	0.27	4
	3	0.42	4									
	4	0.35	2	***All***	***0.51***	***3***	***0.27***	***4***	***0.24***	***7***	***-***	***-***
	5	0.20	2									
August	1	-	-	2	0.49	8	-	-	0.58	5	0.53	13
	2	0.53	13	3	1.11	6	0.69	3	3.75	4	1.82	13
	3	1.98	12	4	0.46	8	-	-	0.44	3	0.45	11
	4	0.45	11									
	5	-	-	***All***	***0.65***	***22***	***0.69***	***3***	***1.60***	***12***	***-***	***-***
September	1	0.46	-	1-3	0.48	4	1.39	4	0.91	5	0.93	13
	2	1.37	-	4-5	1.28	1	0.32	1	0.18	2	0.49	4
	3	0.70	-									
	4	0.55	-	***All***	***0.64***	***5***	***1.18***	***5***	***0.70***	***7***	***-***	***-***
	5	0.32	-									

Table 11. Catch-per-unit-effort (CPUE) (#fish/hr) by zone and habitat type, for boat electrofishing runs conducted in the Red and Assiniboine rivers during July, August, and September, 1999.

	By Zone			By Habitat Type (Substrate)								
					Soft		Medium		Hard		All	
Month	Zone	Mean CPUE (#/hr)	n	Zone	Mean CPUE (#/hr)	n	Mean CPUE (#/hr)	n	Mean CPUE (#/hr)	n	Mean CPUE (#/hr)	n
July	1a	18.00	3	1a	10.80	1	36.00	1	7.20	1	18.00	3
	1	10.57	3	1-3	35.10	5	33.75	5	35.87	5	34.90	15
	2	41.21	6	3a	0.00	1	29.63	1	30.62	1	20.10	3
	3	40.77	6	4-5	30.69	1	27.48	1	128.10	3	88.50	5
	3a	20.08	3									
	4	107.91	3	***All***	***27.12***	***8***	***32.73***	***8***	***60.15***	***10***	***-***	***-***
	5	59.37	2									
September	1a	43.20	3	1a	39.60	1	54.00	1	36.00	1	43.20	3
	1	29.67	3	1-3	59.27	5	39.23	5	53.31	5	50.60	15
	2	40.15	6	3a	246.12	1	97.78	1	528.09	1	290.70	3
	3	71.47	6	4-5	26.77	1	0.00	1	133.45	3	85.40	5
	3a	290.66	3									
	4	108.86	3	***All***	***76.07***	***8***	***43.49***	***8***	***123.10***	***10***	***-***	***-***
	5	50.26	2									

Table 12. Mean length (mm), weight (g), and condition factor (K), for fish captured in all gear types in the Red and Assiniboine rivers, 1999.

		Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Waterbody**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Bigmouth buffalo	RR	3	590	137	498-748	3	4783	3280	2550-8550	3	2.12	0.11	2.04-2.26
	AR	2	525	153	417-633	2	3550	2576	1600-5500	2	2.18	0.03	2.17-2.20
Black bullhead	RR	3	174	24	158-202	3	67	29	50-100	3	1.21	0.06	1.15-1.27
	AR	-	-	-	-	-	-	-	-	-	-	-	-
Black crappie	RR	2	216	18	203-228	2	175	35	150-200	2	1.45	-	-
	AR	1	240	-	-	1	200	-	-	1	1.45	-	-
Brown bullhead	RR	4	190	15	169-202	3	180	14	100-125	3	1.70	0.44	1.21-2.07
	AR	1	171	-	-	-	-	-	-	-	-	-	-
Burbot	RR	20	317	77	205-525	19	206	171	75-800	19	0.76	0.17	0.55-1.66
	AR	-	-	-	-	-	-	-	-	-	-	-	-
Carp	RR	66	503	102	195-711	66	2626	1430	200-9250	66	1.88	0.25	1.39-2.70
	AR	66	561	84	290-752	65	3378	1271	450-7775	65	1.85	0.29	1.01-2.90
Channel catfish	RR	456	483	154	123-820	449	2205	1841	50-8800	449	1.45	0.19	0.91-2.45
	AR	93	578	139	197-783	90	3173	1850	125-7200	90	1.40	0.18	0.95-1.95
Freshwater drum	RR	101	374	70	196-585	101	815	481	100-2500	101	1.42	0.17	1.00-1.86
	AR	57	395	69	260-603	57	903	569	275-3500	57	1.32	0.17	0.98-1.82
Golden redhorse	RR	8	394	117	205-542	8	1205	997	190-2950	8	1.58	0.34	1.25-2.21
	AR	25	398	92	174-520	23	1259	595	450-2200	23	1.62	0.11	1.41-1.85
Goldeye	RR	173	194	61	96-316	126	152	101	25-425	126	1.18	0.31	0.48-2.02
	AR	17	236	54	159-317	17	187	112	50-450	17	1.28	0.27	0.89-2.00
Mooneye	RR	7	206	28	183-264	7	96	68	50-250	7	1.01	0.26	0.67-1.36
	AR	2	229	32	266-251	2	188	18	175-200	2	1.63	0.52	1.26-2.00
Northern pike	RR	17	439	147	243-710	17	796	780	100-2450	17	0.70	0.17	0.45-1.05
	AR	3	350	25	331-378	2	375	177	250-500	2	0.78	0.20	0.64-0.93

Table 12. (Continued)

		Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Waterbody**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Quillback	RR	116	381	57	148-480	116	1189	418	75-2100	116	2.05	0.23	0.95-2.80
	AR	18	380	48	260-448	18	1140	350	450-1875	18	2.04	0.25	1.69-2.56
Rock bass	RR	5	130	34	93-185	2	100	106	25-175	2	2.20	0.79	1.64-2.76
	AR	-	-	-	-	-	-	-	-	-	-	-	-
Sauger	RR	386	269	34	139-403	385	259	94	25-750	385	1.26	0.23	0.55-1.99
	AR	81	263	38	191-332	81	223	97	60-450	81	1.17	0.22	0.59-1.79
Shorthead redhorse	RR	89	346	50	200-437	87	652	243	100-1150	87	1.48	0.17	1.09-2.13
	AR	269	347	35	155-485	265	612	162	75-1725	265	1.44	0.17	0.77-2.01
Silver redhorse	RR	11	383	98	174-520	11	1014	631	50-2300	11	1.51	0.23	0.95-1.88
	AR	13	439	91	238-520	12	1381	614	225-2100	12	1.47	0.20	0.97-1.68
Walleye	RR	34	439	165	146-735	34	1506	1646	50-5850	34	1.21	0.16	0.94-1.61
	AR	10	479	194	183-750	10	2043	2119	90-5500	10	1.23	0.18	1.02-1.48
White sucker	RR	173	371	40	192-483	172	779	245	100-1600	172	1.47	0.15	0.99-2.19
	AR	44	372	39	216-440	44	775	205	140-1100	44	1.47	0.12	1.26-1.85

Waterbodies

RR = Red River
AR = Assiniboine River

Table 13. Summary of weight-length relationships for fish species captured in the Red and Assiniboine rivers, 1999.

Species	Waterbody	n	Range (mm)	Weight-Length Equation	r^2
Bigmouth buffalo	RR	3	498-748	$\text{Log}_{10}\text{Weight} = -4.34 + 2.87 (\text{Log}_{10}\text{Length})$	-
	AR	2	417-633	$\text{Log}_{10}\text{Weight} = -4.57 + 2.96 (\text{Log}_{10}\text{Length})$	-
Black bullhead	RR	3	163-202	$\text{Log}_{10}\text{Weight} = -4.85 + 2.97 (\text{Log}_{10}\text{Length})$	-
	AR	-	-	-	-
					-
Black crappie	RR	3	210-280	$\text{Log}_{10}\text{Weight} = -2.43 + 2.01 (\text{Log}_{10}\text{Length})$	0.53
	AR	1	240	-	-
Brown bullhead	RR	4	169-255	$\text{Log}_{10}\text{Weight} = -4.18 + 2.72 (\text{Log}_{10}\text{Length})$	-
	AR	1	171	-	-
Burbot	RR	26	204-525	$\text{Log}_{10}\text{Weight} = -4.13 + 2.59 (\text{Log}_{10}\text{Length})$	0.92
	AR	-	-	-	-
Carp	RR	69	195-711	$\text{Log}_{10}\text{Weight} = -4.32 + 2.84 (\text{Log}_{10}\text{Length})$	0.98
	AR	64	290-752	$\text{Log}_{10}\text{Weight} = -4.01 + 2.73 (\text{Log}_{10}\text{Length})$	0.90
Channel catfish	RR	450	173-820	$\text{Log}_{10}\text{Weight} = -5.06 + 3.08 (\text{Log}_{10}\text{Length})$	0.98
	AR	90	192-783	$\text{Log}_{10}\text{Weight} = -4.95 + 3.03 (\text{Log}_{10}\text{Length})$	0.98
Freshwater drum	RR	103	196-585	$\text{Log}_{10}\text{Weight} = -4.52 + 2.87 (\text{Log}_{10}\text{Length})$	0.95
	AR	57	260-603	$\text{Log}_{10}\text{Weight} = -5.15 + 3.10 (\text{Log}_{10}\text{Length})$	0.95
Golden redhorse	RR	8	205-542	$\text{Log}_{10}\text{Weight} = -4.67 + 2.95 (\text{Log}_{10}\text{Length})$	0.96
	AR	23	297-520	$\text{Log}_{10}\text{Weight} = -4.74 + 2.98 (\text{Log}_{10}\text{Length})$	0.98
Goldeye	RR	134	96-316	$\text{Log}_{10}\text{Weight} = -5.12 + 3.07 (\text{Log}_{10}\text{Length})$	0.82
	AR	15	171-317	$\text{Log}_{10}\text{Weight} = -3.92 + 2.59 (\text{Log}_{10}\text{Length})$	0.89
Mooneye	RR	2	183-264	-	-
	AR	2	206-251	-	-
Northern pike	RR	16	183-670	$\text{Log}_{10}\text{Weight} = -5.14 + 2.99 (\text{Log}_{10}\text{Length})$	0.95
	AR	3	331-378	$\text{Log}_{10}\text{Weight} = -18.8 + 8.35 (\text{Log}_{10}\text{Length})$	0.94
Quillback	RR	120	122-480	$\text{Log}_{10}\text{Weight} = -4.69 + 3.00 (\text{Log}_{10}\text{Length})$	0.97
	AR	18	260-448	$\text{Log}_{10}\text{Weight} = -3.18 + 2.41 (\text{Log}_{10}\text{Length})$	0.93
Sauger	RR	401	139-403	$\text{Log}_{10}\text{Weight} = -4.86 + 2.98 (\text{Log}_{10}\text{Length})$	0.81
	AR	80	191-332	$\text{Log}_{10}\text{Weight} = -4.47 + 2.81 (\text{Log}_{10}\text{Length})$	0.82
Shorthead redhorse	RR	90	200-437	$\text{Log}_{10}\text{Weight} = -4.60 + 2.90 (\text{Log}_{10}\text{Length})$	0.93
	AR	262	196-450	$\text{Log}_{10}\text{Weight} = -3.88 + 2.62 (\text{Log}_{10}\text{Length})$	0.84
Silver redhorse	RR	11	170-520	$\text{Log}_{10}\text{Weight} = -5.41 + 3.23 (\text{Log}_{10}\text{Length})$	0.98
	AR	9	380-520	$\text{Log}_{10}\text{Weight} = -3.54 + 2.52 (\text{Log}_{10}\text{Length})$	0.97
Walleye	RR	34	103-735	$\text{Log}_{10}\text{Weight} = -4.53 + 2.85 (\text{Log}_{10}\text{Length})$	0.99
	AR	11	183-750	$\text{Log}_{10}\text{Weight} = -5.19 + 3.10 (\text{Log}_{10}\text{Length})$	0.98
White sucker	RR	173	192-483	$\text{Log}_{10}\text{Weight} = -5.13 + 3.11 (\text{Log}_{10}\text{Length})$	0.91
	AR	44	216-440	$\text{Log}_{10}\text{Weight} = -4.67 + 2.93 (\text{Log}_{10}\text{Length})$	0.94

Table 14. Expected and measure back-calculated growth in 1988 and 1989, for 25 channel catfish captured in the Red and Assiniboine rivers within the City of Winnipeg Ammonia Criteria Study Area, 1999.

Fish #	Age in 1999	1988 Back-calculated Age[1]	1988 Expected Growth (mm)[2]	1988 Measured Growth (mm)[3]	1989 Back-calculated Age[1]	1989 Expected Growth (mm)[2]	1989 Measured Growth (mm)[3]
104	15	4	53	39	5	53	93
4129	13	2	74	100	3	70	67
4132	18	7	40	50	8	38	50
4168	13	2	74	109	3	70	69
4184	14	3	70	74	4	53	40
4228	18	7	40	64	8	38	47
4229	15	4	53	61	5	53	55
4246	16	5	53	59	6	47	48
4281	14	3	70	107	4	53	76
4282	14	3	70	75	4	53	52
4286	13	2	74	95	3	70	81
4426	15	4	53	60	5	53	60
4430	13	2	74	89	3	70	96
4442	17	6	47	45	7	40	53
4536	14	3	70	73	4	53	49
4596	14	3	70	75	4	53	50
4613	14	3	70	56	4	53	67
4616	15	4	53	71	5	53	71
4662	13	2	74	82	**3**	**70**	**70**
4658	14	3	70	55	4	53	44
4618	17	6	47	52	7	40	37
4615	14	3	70	58	4	53	41
4611	15	4	53	57	5	53	35
4607	15	4	53	49	5	53	49
4595	13	2	74	69	3	70	55

[1] = One year interval heading upto that year represents growth for that year (e.g., Age 2 = interval of time between 1st and 2nd year)
[2] = Amount of annual growth (mm) that would be expected for a fish of that age based on average back-calculated growth for that age for all 25 fish
[3] = Annual growth (mm) that was measured for that fish in that particular year

(very light grey) = Measured length less than expected length
(white) = Amount of growth not considered valid due to lack of sharpness of age 1 annulus
(light grey) = Measured length more than expected length
(dark grey) = Measured length = expected length

Table 15. Fish catch, by gear type and year, in the Red River at Winnipeg, 1972-1974 (data from Clarke et al. 1980).

	Hoopnet	Gillnet			Trawl	Seine		Benthic	Total
Species	**May-Sep 1974**	**Jun-Jul 1972**	**Aug 1973**	**Oct 1974**	**Oct 1974**	**Aug 1973**	**Jun-Sep 1974**	**1974**	
Black bullhead	511	-	53	-	-	23	4	30	621
Black crappie	-	-	-	-	2	1	17	-	20
Brown bullhead	1	3	1	-	-	-	-	-	5
Burbot	20	-	-	1	-	-	-	-	21
Carp	54	3	6	-	-	-	-	-	63
Channel catfish	1313	104	55	-	-	10	1	-	1483
Chestnut lamprey	19	-	-	-	2	-	-	-	21
Emerald shiner	-	-	-	-	-	2655	5618	-	8273
Fathead minnow	-	-	-	-	-	6	51	-	57
Freshwater drum	1189	178	195	1	13	4	15	-	1595
Goldeye	7	4	48	3	8	11	4	-	85
Hornyhead chub	-	-	-	-	-	1	-	-	1
Johnny darter	-	-	-	-	-	-	1	-	1
Lake chub	-	-	-	-	-	1	-	-	1
Longnose dace	-	-	-	-	-	2	-	-	2
Mooneye	-	-	7	-	2	-	1	-	10
Northern pike	68	7	11	12	-	1	11	-	110
Pumpkinseed	-	2	-	-	-	-	-	-	2
Quillback	98	2	2	-	2	-	9	-	113
River darter	-	-	-	-	-	-	1	-	1
River shiner	-	-	-	-	-	14	33	-	47
Rock bass	8	-	3	-	-	4	1	-	16
Sauger	1285	97	135	4	5	3	20	-	1549
Shorthead redhorse	15	-	5	1	-	-	1	-	22
Silver chub	-	-	-	-	-	91	17	-	108
Silver lamprey	-	-	-	-	-	-	-	1	1
Silver redhorse	3	-	-	-	-	-	3	-	6
Spottail shiner	-	-	-	-	-	34	-	-	34
Stonecat	17	-	1	-	-	-	1	-	19
Tadpole madtom	1	-	-	-	-	-	-	1	2
Trout perch	-	-	-	-	1	-	2	-	3
Walleye	65	75	47	10	-	-	1	-	198
White bass	1	-	-	-	-	5	-	-	6
White sucker	475	228	204	30	3	2	2	-	944
Yellow perch	2	-	2	-	-	-	4	-	8
Total									
Fish	**5152**	**703**	**775**	**62**	**38**	**2868**	**5818**	**32**	**15448**
Species	**20**	**11**	**16**	**8**	**9**	**18**	**23**	**3**	**35**
Locations	**12**	**4**	**7**	**2**	**1**	**9**	**9**	**-**	**44**
Sets	**90**	**16**	**7**	**3**	**4**	**14**	**30**	**-**	**164**

Table 16. Comparison of catch-per-unit-effort (CPUE) (#fish/hr) between hoop nets set in the Red River in 1974 (Clarke et al. 1980 unpublished data) and 1999.

			July			August			September		
Year	Zone	Species	n	Mean CPUE (#/hr)	Range	n	Mean CPUE (#/hr)	Range	n	Mean CPUE (#/hr)	Range
1974	1	CARP	1	0.01	-	-	-	-	-	-	-
		CHCT	13	0.14	-	5	0.04	-	-	-	-
		FRDR	127	1.35	-	67	0.56	-	-	-	-
		NRPK	4	0.04	-	-	-	-	-	-	-
		QUIL	-	-	-	4	0.03	-	-	-	-
		SAUG	16	0.17	-	15	0.13	-	-	-	-
		SHRD	-	-	-	1	0.01	-	-	-	-
		WALL	1	0.01	-	-	-	-	-	-	-
		WHSC	1	0.01	-	17	0.14	-	-	-	-
		ALL	181	1.93	1.21-2.91	116	0.98	0.41-1.50	-	-	-
		Total Sets	***4***	***1.93***	***1.21-2.91***	***5***	***0.98***	***0.41-1.50***	***-***	***-***	***-***
1999	1	CARP	-	-	-	-	-	-	-	-	-
		CHCT	2	0.03	-	-	-	-	12	0.23	-
		FRDR	-	-	-	-	-	-	-	-	-
		NRPK	-	-	-	-	-	-	-	-	-
		QUIL	1	0.02	-	-	-	-	-	-	-
		SAUG	-	-	-	-	-	-	6	0.12	-
		SHRD	1	0.02	-	-	-	-	1	0.02	-
		WALL	-	-	-	-	-	-	-	-	-
		WHSC	-	-	-	-	-	-	4	0.08	-
		ALL	5	0.08	0.07-0.10	-	-	-	24	0.47	0.24-0.68
		Total Sets	***2***	***0.08***	***0.07-0.10***	***-***	***-***	***-***	***2***	***0.47***	***0.24-0.68***

Table 16. (Continued)

Year	Zone	Species	July n	July Mean CPUE (#/hr)	July Range	August n	August Mean CPUE (#/hr)	August Range	September n	September Mean CPUE (#/hr)	September Range
1974	2	CARP	2	0.01	-	-	-	-	1	0.01	-
		CHCT	301	1.27	-	-	-	-	260	2.17	-
		FRDR	106	0.45	-	22	0.46	-	51	0.43	-
		NRPK	7	0.03	-	-	-	-	-	-	-
		QUIL	15	0.06	-	-	-	-	2	0.02	-
		SAUG	168	0.71	-	7	0.15	-	68	0.57	-
		SHRD	-	-	-	-	-	-	-	-	-
		WALL	6	0.03	-	-	-	-	5	0.04	-
		WHSC	31	0.13	-	20	0.42	-	123	1.03	-
		ALL	763	3.22	0.85-5.91	53	1.10	1.23-1.41	522	4.35	3.64-5.79
		Total Sets	***9***	***3.22***	***0.85-5.91***	***2***	***1.10***	***1.23-1.41***	***4***	***4.35***	***3.64-5.79***
1999	2	CARP	4	0.04	-	1	0.00	-	-	-	-
		CHCT	16	0.17	-	20	0.06	-	73	0.67	-
		FRDR	2	0.02	-	12	0.04	-	4	0.04	-
		NRPK	-	-	-	3	0.01	-	-	-	-
		QUIL	4	0.04	-	30	0.10	-	7	0.06	-
		SAUG	-	-	-	67	0.21	-	10	0.09	-
		SHRD	2	0.02	-	8	0.03	-	15	0.14	-
		WALL	-	-	-	12	0.04	-	-	-	-
		WHSC	4	0.04	-	5	0.02	-	32	0.29	-
		ALL	33	0.35	0.12-0.83	159	0.50	0.26-1.06	144	1.32	0.29-2.63
		Total Sets	***4***	***0.35***	***0.12-0.83***	***13***	***0.50***	***0.26-1.06***	***5***	***1.32***	***0.29-2.63***

Table 16. (Continued)

Year	Zone	Species	July n	July Mean CPUE (#/hr)	July Range	August n	August Mean CPUE (#/hr)	August Range	September n	September Mean CPUE (#/hr)	September Range
1974	3	CARP	12	0.06	-	4	0.03	-	-	-	-
		CHCT	83	0.44	-	119	1.03	-	295	3.99	-
		FRDR	143	0.76	-	30	0.26	-	2	0.03	-
		NRPK	16	0.08	-	-	-	-	-	-	-
		QUIL	4	0.02	-	4	0.03	-	-	-	-
		SAUG	68	0.36	-	7	0.06	-	-	-	-
		SHRD	3	0.16	-	-	-	-	-	-	-
		WALL	4	0.02	-	2	0.03	-	-	-	-
		WHSC	4	0.02	-	23	0.20	-	8	0.11	-
		ALL	382	2.02	0.75-3.50	208	1.82	0.13-6.00	312	4.21	0.56-11.83
		Total Sets	***8***	***2.02***	***0.75-3.50***	***5***	***1.82***	***0.13-6.00***	***2***	***4.21***	***0.56-11.83***
1999	3	CARP	8	0.09	-	10	0.03	-	1	0.01	-
		CHCT	2	0.02	-	273	0.93	-	44	0.33	-
		FRDR	9	0.11	-	35	0.12	-	7	0.05	-
		NRPK	-	-	-	4	0.01	-	-	-	-
		QUIL	5	0.06	-	53	0.18	-	2	0.02	-
		SAUG	-	-	-	103	0.35	-	5	0.04	-
		SHRD	3	0.04	-	11	0.04	-	2	0.02	-
		WALL	-	-	-	1	0.00	-	-	-	-
		WHSC	8	0.09	-	31	0.11	-	28	0.21	-
		ALL	37	0.43	0.11-0.64	521	1.75	0.0-6.82	95	0.71	0.05-2.03
		Total Sets	***4***	***0.43***	***0.11-0.64***	***13***	***1.75***	***0.0-6.82***	***6***	***0.71***	***0.05-2.03***

Table 17. Age-specific mean lengths for selected species captured in the Red and Assiniboine rivers, 1973, 1974, and 1999.

		1973			1974			1999		
	Age		FL (mm)			FL (mm)			FL (mm)	
Species	(yrs)	n	Mean	Range	n	Mean	Range	n	Mean	Range
Carp	1	-	-	-	-	-	-	-	-	-
	2	-	-	-	1	205	-	1	195	-
	3	-	-	-	8	345	250-410	6	326	266-388
	4	1	256	-	7	390	202-472	2	336	310-361
	5	-	-	-	1	515	-	6	447	408-447
	6	-	-	-	1	376	-	3	481	415-514
	7	1	474	-	1	550	-	3	498	449-556
	8	2	500	490-510	4	480	435-520	5	504	459-578
	9	1	498	-	10	552	465-610	12	526	468-567
	10	-	-	-	7	559	530-590	4	521	478-578
	11	-	-	-	2	616	611-620	6	566	512-605
	12	-	-	-	3	590	545-650	2	550	532-568
	13	-	-	-	-	-	-	2	633	555-771
	14	-	-	-	-	-	-	2	644	628-660
	15	-	-	-	1	589	-	4	626	610-650
	16	-	-	-	-	-	-	-	-	-
	17	-	-	-	-	-	-	1	575	-
Channel catfish	1	-	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	4	182	123-233
	3	-	-	-	6	255	240-290	12	230	173-327
	4	-	-	-	70	305	215-380	2	288	249-326
	5	-	-	-	148	336	240-430	1	320	-
	6	-	-	-	182	376	230-455	1	310	-
	7	-	-	-	344	410	102-515	3	379	261-398
	8	-	-	-	323	439	280-605	1	391	-
	9	-	-	-	100	475	362-660	6	475	413-585
	10	-	-	-	23	522	423-640	15	490	432-598
	11	-	-	-	8	594	516-670	13	513	460-604
	12	-	-	-	4	613	545-655	15	573	472-709
	13	-	-	-	-	-	-	9	606	545-658
	14	-	-	-	-	-	-	8	661	552-785
	15	-	-	-	-	-	-	6	711	636-820

Table 17. (Continued)

Species	Age (yrs)	1973 n	1973 FL (mm) Mean	1973 FL (mm) Range	1974 n	1974 FL (mm) Mean	1974 FL (mm) Range	1999 n	1999 FL (mm) Mean	1999 FL (mm) Range
Channel catfish	16	-	-	-	-	-	-	7	682	620-748
(Continued)	17	-	-	-	-	-	-	3	737	702-785
	18	-	-	-	-	-	-	3	741	698-785
Freshwater drum	0	2	75	75-80	-	-	-	-	-	-
	1	-	-	-	-	-	-	-	-	-
	2	25	203	179-228	11	201	183-241	6	260	237-292
	3	45	208	189-269	53	221	180-354	4	276	259-297
	4	29	207	183-228	37	243	192-401	1	293	-
	5	11	230	190-394	11	259	195-405	7	357	332-393
	6	11	243	203-297	6	319	269-346	10	370	310-525
	7	4	337	222-372	11	351	278-397	13	379	341-432
	8	26	333	208-425	18	361	286-412	12	377	313-437
	9	23	369	310-418	8	384	350-426	9	395	340-526
	10	8	388	345-463	9	371	303-438	4	446	395-486
	11	3	367	335-415	1	386	-	4	448	419-472
	12	-	-	-	-	-	-	3	477	428-554
	13	2	413	-	-	-	-	2	467	433-500
	14	-	-	-	-	-	-	2	492	478-505
	15	-	-	-	-	-	-	-	-	-
	16	-	-	-	-	-	-	1	448	-
Goldeye	0	-	-	-	1	64	-	-	-	-
	1	12	116	88-210	2	131	130-132	12	112	96-125
	2	10	215	114-369	1	157	-	38	173	110-243
	3	17	262	160-304	2	260	253-266	22	229	192-258
	4	13	268	184-325	1	290	-	13	254	209-292
	5	2	297	279-315	1	314	-	7	283	268-316
	6	2	294	268-319	1	315	-	4	301	295-308
	7	2	320	318-321	-	-	-	2	284	250-317
	8	-	-	-	-	-	-	2	303	302-303
	9	-	-	-	-	-	-	-	-	-
	10	-	-	-	-	-	-	1	316	-

Table 17. (Continued)

Species	Age (yrs)	1973 n	1973 FL (mm) Mean	1973 FL (mm) Range	1974 n	1974 FL (mm) Mean	1974 FL (mm) Range	1999 n	1999 FL (mm) Mean	1999 FL (mm) Range
Northern pike	0	-	-	-	6	112	89-130	-	-	-
	1	2	255	200-309	-	-	-	-	-	-
	2	-	-	-	1	295	-	5	334	218-565
	3	3	543	520-570	3	331	290-409	3	343	312-378
	4	1	526	-	14	512	482-694	13	430	243-643
	5	3	610	578-671	13	535	396-660	5	611	483-809
	6	-	-	-	6	571	428-677	1	691	-
	7	-	-	-	3	672	630-725	4	690	630-811
	8	1	670	-	6	673	560-905	2	674	627-720
	9	-	-	-	-	-	-	1	709	-
	10	-	-	-	3	703	666-729	-	-	-
	11	-	-	-	1	772	-	-	-	-
	12	-	-	-	-	-	-	1	670	-
	13	-	-	-	-	-	-	-	-	-
	14	-	-	-	-	-	-	-	-	-
	15	-	-	-	-	-	-	-	-	-
	16	-	-	-	1	910	-	-	-	-
Sauger	0	3	104	98-113	8	76	54-107	-	-	-
	1	-	-	-	1	169	-	-	-	-
	2	30	220	119-340	-	-	-	16	237	195-266
	3	47	234	210-315	22	267	237-308	67	272	139-355
	4	22	279	223-355	91	284	241-331	23	294	240-350
	5	21	315	231-353	47	292	262-335	4	286	256-330
	6	4	328	305-363	12	287	245-336	-	-	-
	7	1	375	-	6	301	285-320	-	-	-
	8	-	-	-	2	297	253-340	-	-	-
	9	-	-	-	1	390	-	-	-	-
	10	-	-	-	-	-	-	-	-	-
	11	-	-	-	1	305	-	-	-	-
	12	-	-	-	-	-	-	-	-	-
	13	-	-	-	1	465	-	-	-	-

Table 17. (Continued)

Species	Age (yrs)	1973			1974			1999		
			FL (mm)			FL (mm)			FL (mm)	
		n	Mean	Range	n	Mean	Range	n	Mean	Range
Shorthead redhorse	1	-	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	2	190	180-200
	3	-	-	-	-	-	-	-	-	-
	4	-	-	-	-	-	-	5	271	246-292
	5	-	-	-	-	-	-	6	327	275-420
	6	-	-	-	-	-	-	-	-	-
	7	-	-	-	4	348	-	3	369	352-402
	8	-	-	-	6	356	-	-	-	-
	9	-	-	-	3	366	-	1	344	-
	10	-	-	-	-	-	-	3	383	342-437
	11	-	-	-	1	409	-	-	-	-
	12	-	-	-	-	-	-	-	-	-
	13	-	-	-	-	-	-	-	-	-
	14	-	-	-	1	558	-	-	-	-
	15	-	-	-	-	-	-	1	380	-
Walleye	1	2	184	117-190	-	-	-	-	-	-
	2	17	216	179-279	1	221	-	2	149	146-151
	3	8	254	205-333	3	277	250-320	9	331	183-383
	4	5	343	282-378	12	317	232-445	13	346	206-502
	5	4	351	333-390	11	346	300-420	6	418	288-488
	6	8	370	270-490	7	373	320-500	1	277	-
	7	-	-	-	6	389	319-490	2	430	388-471
	8	1	465	-	-	-	-	2	526	470-581
	9	1	548	-	1	374	-	2	648	615-680
	10	-	-	-	-	-	-	2	730	724-735
	11	-	-	-	1	606	-	-	-	-
	12	-	-	-	3	632	624-637	1	690	-
	13	-	-	-	-	-	-	4	726	713-750
	14	-	-	-	-	-	-	-	-	-
	15	-	-	-	-	-	-	-	-	-
	16	-	-	-	-	-	-	1	698	-

Table 17. (Continued)

		1973			1974			1999		
	Age		FL (mm)			FL (mm)			FL (mm)	
Species	**(yrs)**	**n**	**Mean**	**Range**	**n**	**Mean**	**Range**	**n**	**Mean**	**Range**
White sucker	0	1	78	-	1	100	-	-	-	-
	1	-	-	-	1	110	-	-	-	-
	2	12	348	210-400	-	-	-	1	216	-
	3	77	374	230-434	-	-	-	7	316	246-405
	4	75	387	340-467	4	249	135-425	10	324	192-428
	5	18	415	370-491	8	295	225-407	14	347	257-462
	6	2	424	387-460	6	309	230-425	10	365	295-460
	7	-	-	-	24	359	285-408	11	382	317-483
	8	-	-	-	56	380	305-417	11	362	308-407
	9	-	-	-	139	406	360-472	7	378	343-400
	10	-	-	-	107	414	270-460	8	370	356-384
	11	-	-	-	50	429	308-479	4	382	365-408
	12	-	-	-	20	442	392-494	2	414	387-440
	13	-	-	-	4	440	408-486	2	413	400-426
	14	-	-	-	1	440	-	-	-	-
	15	-	-	-	2	510	485-535	1	431	-
	16	-	-	-	-	-	-	1	428	-

Table 18. Index of Biotic Integrity (IBI) metric classifications for all species (current and documented in the mainstem waters of the Red and Assiniboine rivers near Winnipeg, Manitoba[1].

Common Name	Scientific Name	Classification[2]
LAMPREYS	**PETROMYZONTIDAE**	
Chestnut lamprey	*Ichthyomyzon castaneus*	LR PI
Silver lamprey	*Ichthyomyzon unicuspis*	LR PI
STURGEON	**ACIPENSERIDAE**	
Lake sturgeon	*Acipenser fulvescens*	LR BI IN SL
MOONEYES	**HIODONTIDAE**	
Goldeye	*Hiodon alosoides*	LR IN SN
Mooneye	*Hiodon tergisus*	LR IN SN
MINNOWS	**CYPRINIDAE**	
Bigmouth shiner	*Notropis dorsalis*	MN BI IN SM
Blacknose dace	*Rhinichthys atratulus*	MN BI HW TL IN SL
Carp	*Cyprinus carpio*	MN TL OM
Creek chub	*Semotilus atromaculatus*	MN TL IN PN
Emerald shiner	*Notropis atherinoides*	MN LR IN
Fathead minnow	*Pimephales promelas*	MN TL OM PN
Flathead chub	*Platygobio gracilus*	MN IN
Golden shiner	*Notemigonus crysoleucas*	MN TL IN
Goldfish	*Carassius auratus*	MN OM
Longnose dace	*Rhinichthys cataractae*	MN BI IN SL SN SM
River shiner	*Notropis blennius*	MN IN SL SM
Sand shiner	*Notropis ludibundus*	MN BI IN SN SM
Silver chub	*Macrhybopsis storeriana*	MN BI LR IN SM
Spotfin shiner	*Cyprinella spiloptera*	MN IN
Spottail shiner	*Notropis hudsonius*	MN LR IN
SUCKERS	**CATOSTOMIDAE**	
Bigmouth buffalo	*Ictiobus cyprinellus*	LR TL OM SU
Golden redhorse	*Moxostoma erythrurum*	BI RB IN SL SN SU
Quillback	*Carpiodes cyprinus*	LR TL OM SU
Shorthead redhorse	*Moxostoma macrolepidotum*	BI RB IN SL SN SU
Silver redhorse	*Moxostoma anisurum*	BI RB IN SL SN SU
White sucker	*Catostomus commersoni*	TL OM SL SU

Table 18. (Continued)

Common Name	Scientific Name	Classification[2]
CATFISHES	**ICTALURIDAE**	
Black bullhead	*Ameiurus melas*	TL OM
Brown bullhead	*Ameiurus nebulosus*	OM
Channel catfish	*Ictalurus punctatus*	LR TL PI
Stonecat	*Noturus flavus*	BI IN SN
Tadpole madtom	*Noturus gyrinus*	BI IN
PIKES	**ESOCIDAE**	
Northern pike	*Esox lucius*	PI
MUDMINNOWS	**UMBRIDAE**	
Central mudminnow	*Umbra limi*	TL IN
TROUT AND WHITEFISH	**SALMONIDAE**	
Lake cisco	*Coregonus artedi*	IN SL SN
Lake whitefish	*Coregonus clupeaformis*	BN SL SN
TROUT-PERCHES	**PERCOPSIDAE**	
Trout-perch	*Percopsis omiscomaycus*	BI SN IN
CODFISHES	**GADIDAE**	
Burbot	*Lota lota*	LR PI SL
KILLIFISHES	**FUNDULIDAE**	
Banded killifish	*Fundulus diaphanus*	IN
STICKLEBACKS	**GASTEROSTEIDAE**	
Brook stickleback	*Culaea inconstans*	HW TL IN

Table 18. (Continued)

Common Name	Scientific Name	Classification[2]
TEMPERATE BASSES	**MORONIDAE**	
White bass	*Morone chrysops*	LR PI
SUNFISH	**CENTRARCHIDAE**	
Black crappie	*Pomoxis nigromaculatus*	PI
Bluegill	*Lepomis macrochirus*	IN
Rock bass	*Ambloplites rupestris*	PI SN
White crappie	*Pomoxis annularis*	PI
PERCH	**PERCIDAE**	
Blackside darter	*Percina maculata*	BI IN SL
Iowa darter	*Etheostoma exile*	BI IN
Johnny darter	*Etheostoma nigrum*	BI IN PN
Log perch	*Percina caprodes*	BI IN SL SN
River darter	*Percina shumardi*	LR BI IN SL
Sauger	*Stizostedion canadense*	LR PI SL
Walleye	*Stizostedion vitreum*	LR PI SL
Yellow perch	*Perca flavescens*	IN
CROAKERS	**SCIAENIDAE**	
Freshwater drum	*Aplodinotus grunniens*	LR TL IN

Note:

BI = benthic insectivore species
HW = headwater species
IN = insectivore species
LR = larger river species
MN = minnow species
OM = omnivore species
PN = pioneer species
PI = piscivore species
RB = round-bodied sucker species
SL = simple lithophil species
SM = subterminal mouth minnow species
SN = sensitive species
SU = sucker species
TL = tolerant species

[1] - based on available literature and discussions with Dr. K.W. Stewart, University of Manitoba.
[2] - after Niemela et al. 1999.

Table 19. Classification of Index of Biotic Integrity (IBI) scores, by metric, for studies of the Red River drainage basin.

		Index of Biotic Integrity (IBI) Scores						
		Niemela et al. (1999)			**Present Study**			
Metric #	**Metric Title**	**5**	**3**	**1**	**5**	**3**	**1**	**Comments[1]**
1	Total Number of Fish Species (n)	>16	>8 and ≤16 based on 85 species present	≤8	>16	>8 and ≤16 based on 54 species present	≤8	Used same scoring system since they found that this metric reached an asymptote at a certain drainage area.
2	Proportion of Round-Bodied Suckers (%)	>40	>20 and ≤40	≤20	>40	>20 and ≤40	≤20	They found no relationship with drainage area and so no reason to change from theirs.
3	Proportion of Large River Individuals (%)	varies with drainage area, relationship provided			≥60	≥30 and <60	<30	Derived from their relationship using drainage area figure.
4	Evenness (0-1)	>0.8	>0.6 and ≤0.8	≤0.6	>0.8	>0.6 and ≤0.8	≤0.6	They found no relationship with drainage area and so no reason to change from theirs.
5	Number of Sensitive Species (n)	>6	>3 and ≤6	≤3	>6	>3 and ≤6	≤3	Although there are potentially less sensitive species present, keeping the scoring classification the same as theirs keeps this a discriminating metric.
6	Proportion of Tolerant Individuals (%)	varies with drainage area at sites with drainage area >1500 square miles			**Zones 3 and 3a** <10 **Remaining Zones** <10	 ≥10 and <15 ≥10 and <20	 ≥15 ≥20	Derived from their relationship using drainage area figure.
7	Proportion of Omnivore Biomass (%)	<33	≥33 and <66	≥66	<33	≥33 and <66	≥66	They found no relationship with drainage area and so no reason to change from theirs.
8	Proportion of Insectivore Biomass (%)	>60	>30 and ≤60	≤30	>60	>30 and ≤60	≤30	They found no relationship with drainage area and so no reason to change from theirs.
9	Proportion of Piscivore Biomass (%)	>20 and <30	>10 and ≤20 ≥30 and <40	≤ 10 and ≥40	>20 and <30	>10 and ≤20 ≥30 and <40	≤ 10 and ≥40	They found no relationship with drainage area and so no reason to change from theirs.
10	Catch-Per-Unit-Effort (#fish/hour)	varies with drainage area			>100	>40 and ≤100	≤40	Their CPUE was based on # of fish/unit area. Ours was based on # of fish /electrofishing effort. Scoring criteria was developed based only on range of CPUE.

Table 19. (Continued)

Metric #	Metric Title	Index of Biotic Integrity (IBI) Scores						Comments[1]
		Niemela et al. (1999)			Present Study			
		5	3	1	5	3	1	
11	Proportion of Lithophilic Spawners (%)	>60	>30 and ≤60	≤30	>60	>30 and ≤60	≤30	They found no relationship with drainage area and so no reason to change from theirs.
12	Proportion of Individuals with DELTs (%)	>1	≥1 and <4	≥4	>5	≥5 and <10	≥10	Theirs was based on an evaluation of all fish. Ours is based on an evaluation of fish >200 mm in length. Scoring criteria was developed based on the range of DELT frequencies observed and on evaluation of available literature.

[1] = Words (they and theirs) refers to Niemela et al. (1999)

Table 20. Index of Biotic Integrity (IBI) scores, by metric and comparison, for the fish community of the Red and Assiniboine riv within the City of Winnipeg Ammonia Criteria Study Area, 1999[+].

		First Level Comparison							Second Level Comparison						Third Level Comparison					Fourth Level Comparison	
Metric #	**Metric Title**	**1**	**2**	**3**	**4**	**5**	**1a**	**3a**	**1**	**2**	**3**	**4**	**5**	**3a**	**1**	**2**	**3**	**4**	**5**	**Red River**	**Assiniboin e**
1	Total Number of Fish Species (n)	6	13	15	14	9	7	11	11	15	15	14	9	16	19	26	24	20	16	30	24
	IBI Score	*1*	*3*	*3*	*3*	*3*	*1*	*3*	*3*	*3*	*3*	*3*	*3*	*5*	*5*	*5*	*5*	*5*	*3*	*5*	*5*
2	Proportion of Round-Bodied Suckers (%)	17	50	50	50	33	33	50	17	50	50	50	33	50	33	50	50	50	50	50	50
	IBI Score	*1*	*5*	*5*	*5*	*3*	*3*	*5*	*1*	*5*	*5*	*5*	*3*	*5*	*3*	*5*	*5*	*5*	*5*	*5*	*5*
3	Proportion of Large River Individuals (%)	94	63	56	26	23	92	92	78	68	56	26	23	83	60	69	56	31	46	73	40
	IBI Score	*5*	*5*	*3*	*1*	*1*	*5*	*5*	*5*	*5*	*3*	*1*	*1*	*5*	*5*	*5*	*3*	*3*	*3*	*5*	*3*
4	Evenness (0-1)	0.28	0.57	0.55	0.45	0.41	0.18	0.26	0.45	0.57	0.55	0.45	0.42	0.42	0.61	0.55	0.42	0.47	0.56	0.63	0.55
	IBI Score	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*3*	*1*	*1*	*1*	*1*	*3*	*1*
5	Number of Sensitive Species (n)	2	5	5	4	3	3	4	2	7	5	4	3	6	3	7	7	6	4	8	6
	IBI Score	*1*	*3*	*3*	*3*	*1*	*1*	*3*	*1*	*5*	*3*	*3*	*1*	*3*	*1*	*5*	*5*	*3*	*3*	*5*	*3*
6	Proportion of Tolerant Individuals (%)	6	28	28	31	17	4	4	25	26	28	32	14	13	24	41	40	34	40	46	39
	IBI Score	*5*	*1*	*1*	*1*	*3*	*5*	*5*	*1*	*1*	*1*	*1*	*3*	*5*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
7	Proportion of Omnivore Biomass (%)	43	35	65	52	22	55	32	45	33	65	52	20	44	29	31	56	43	5	27	33
	IBI Score	*1*	*3*	*3*	*3*	*1*	*3*	*5*	*3*	*3*	*3*	*3*	*1*	*3*	*5*	*5*	*3*	*3*	*5*	*5*	*3*
8	Proportion of Insectivore Biomass (%)	19	40	24	39	62	35	20	13	42	24	39	58	13	8	19	20	33	26	10	30
	IBI Score	*1*	*3*	*1*	*3*	*1*	*3*	*1*	*1*	*3*	*1*	*3*	*1*	*1*	*1*	*1*	*1*	*3*	*1*	*1*	*1*
9	Proportion of Piscivore Biomass (%)	38	25	12	9	16	10	48	42	25	12	9	22	43	63	51	24	23	69	63	37
	IBI Score	*1*	*5*	*3*	*1*	*1*	*1*	*1*	*1*	*5*	*3*	*1*	*1*	*1*	*1*	*1*	*5*	*5*	*1*	*1*	*3*

Table 20. (Continued)

		First Level Comparison							Second Level Comparison						Third Level Comparison					Fourth Level Comparison	
Metric #	**Metric Title**	**1**	**2**	**3**	**4**	**5**	**1a**	**3a**	**1**	**2**	**3**	**4**	**5**	**3a**	**1**	**2**	**3**	**4**	**5**	**Red River**	**Assiniboin e**
10	Catch-Per-Unit-Effort (#fish/hour)	16	41	47	108	55	31	155	16	41	47	108	55	155	16	41	47	108	55	54	87
	IBI Score	***1***	***3***	***3***	***5***	***3***	***1***	***5***	***1***	***3***	***3***	***5***	***3***	***5***	***1***	***3***	***3***	***5***	***3***	***3***	***3***
11	Proportion of Lithophilic Spawners (%)	29	58	51	74	77	12	80	32	50	51	74	77	81	49	34	45	68	49	43	62
	IBI Score	***1***	***3***	***3***	***5***	***1***	***1***	***5***	***3***	***3***	***3***	***5***	***1***	***5***	***3***	***3***	***3***	***5***	***3***	***3***	***5***
12	Proportion of Individuals with DELTs (%)	2.9	8.2	10.5	16.2	10.0	2.0	0.6	12.9	9.1	10.5	16.2	9.7	4.1	16.5	8.6	14.2	15.7	24.3	8.3	15.6
	IBI Score	***5***	***3***	***1***	***1***	***1***	***5***	***5***	***1***	***3***	***1***	***1***	***3***	***5***	***1***	***3***	***1***	***1***	***1***	***3***	***1***
	Total IBI Score	**24**	**38**	**30**	**32**	**20**	**30**	**44**	**22**	**40**	**30**	**32**	**22**	**44**	**30**	**38**	**36**	**40**	**30**	**40**	**34**
	Number of Fish Sampled (n)	**34**	**111**	**218**	**454**	**30**	**51**	**169**	**64**	**133**	**218**	**454**	**31**	**244**	**191**	**514**	**525**	**550**	**77**	**2158**	**701**

[1] Metrics and Scoring System based on those used by Karr et al. (1986) and Niemela et al. (1999).

Table 21. Attributes of Index of Biotic Integrity (IBI) Classification, total IBI scores, and integrity classes from Karr et al. (1986) and Niemela et al. (1999).

IBI Score			
Karr et al. (1986)	**Niemela et al. (1999)**	**Integrity Class**	**Attributes**
58-60	51-60	Excellent	Comparable to the best situation without human disturbance; all regionally expected species for the habitat and stream size, including the most intolerant forms, are present with a full array of age (size) classes; balanced trophic structure.
48-52	41-50	Good	Species richness somewhat below expectations, especially due to the loss of the most intolerant forms; some species are present with less than optimal abundances or size distributions; trophic structure shows some signs of stress.
40-44	31-40	Fair	Signs of additional deterioration include loss of intolerant forms, fewer species, highly skewed trophic structure (e.g., increasing frequency of omnivores and other tolerant species); older age classes of top predators may be rare.
28-34	21-30	Poor	Dominated by omnivores, tolerant forms, and habitat generalists; few top carnivores; growth rates and condition factors commonly depressed; hybrids and diseased fish often present.
12-22	12-20	Very Poor	Few fish present, mostly introduced or tolerant forms; hybrids common; disease, parasites, fin damage, and other anomalies regular.
0			No fish, repeated sampling finds no fish.

FIGURES

NEWPCC - North End Water Pollution Control Centre
SEWPCC - South End Water Pollution Control Centre
WEWPCC - West End Water Pollution Control Centre
- Study Area

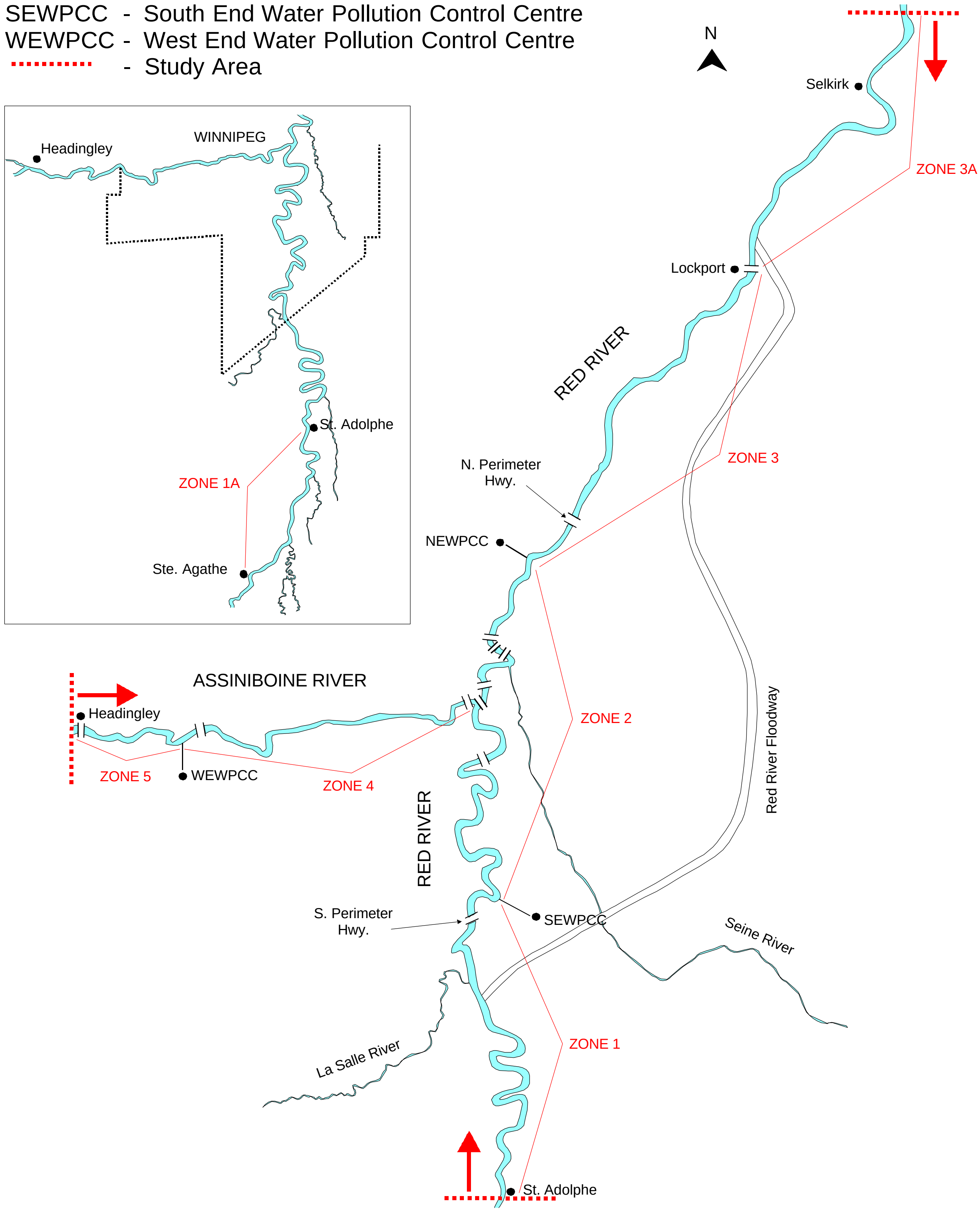


Figure 1. Study area for the City of Winnipeg Ammonia Criteria Study, 1999.

Figure 2. Fish habitat survey segments on the Red River, south of the Forks, and on the Assiniboine River.

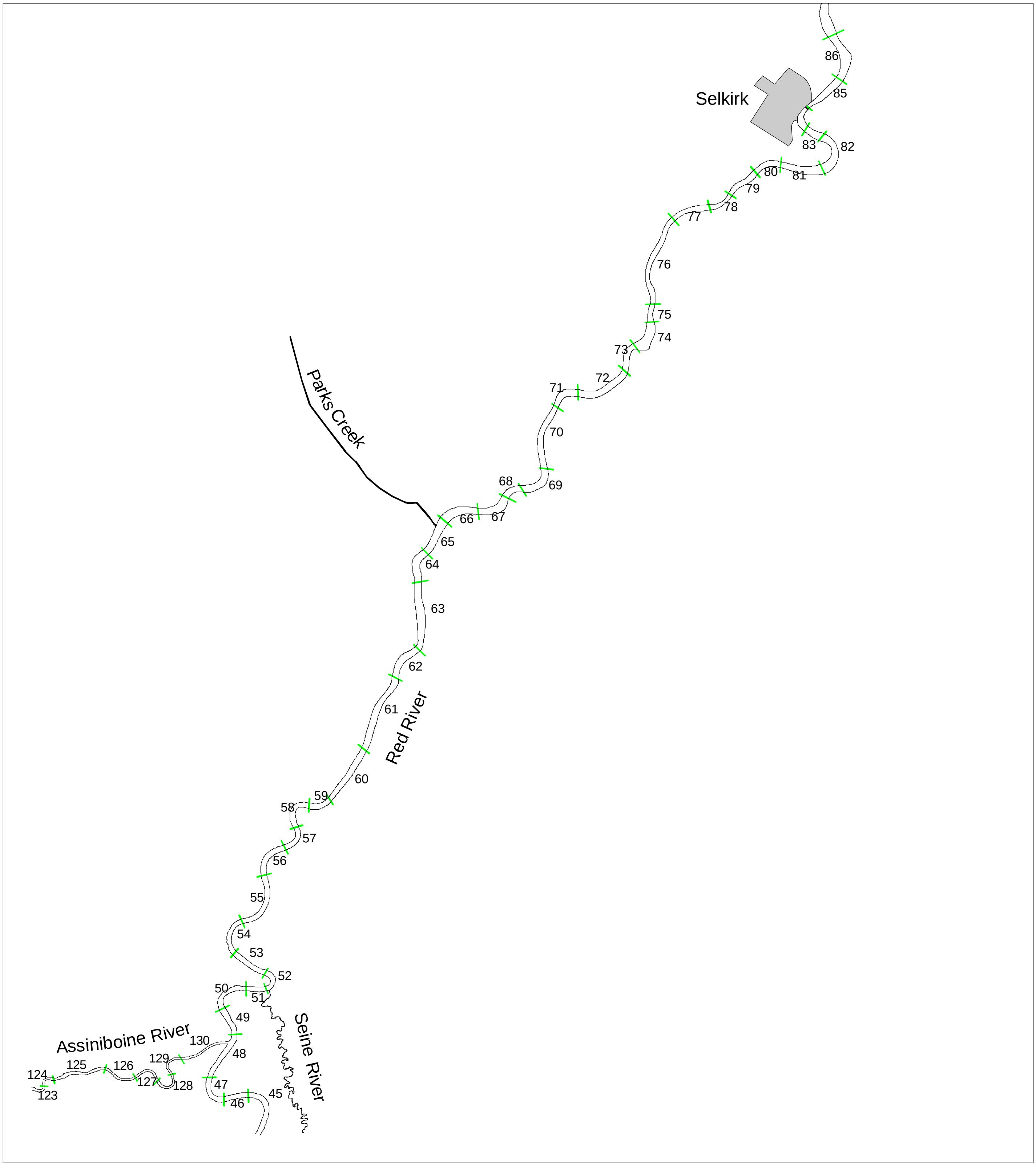


Figure 3. Fish habitat survey segments on the Red River north of the Forks.

Figure 4. Setting gill nets on the Assiniboine River, winter, 1999.

Figure 5. Sampling fish with hoop nets in the Red River, summer, 1999.

Figure 6. Sampling fish with a boat electrofisher in the Red River, summer, 1999.

Figure 7. Sampling fish in the Red River during winter, 1999.

Figure 8. Sampling fish in the Red River during summer, 1999.

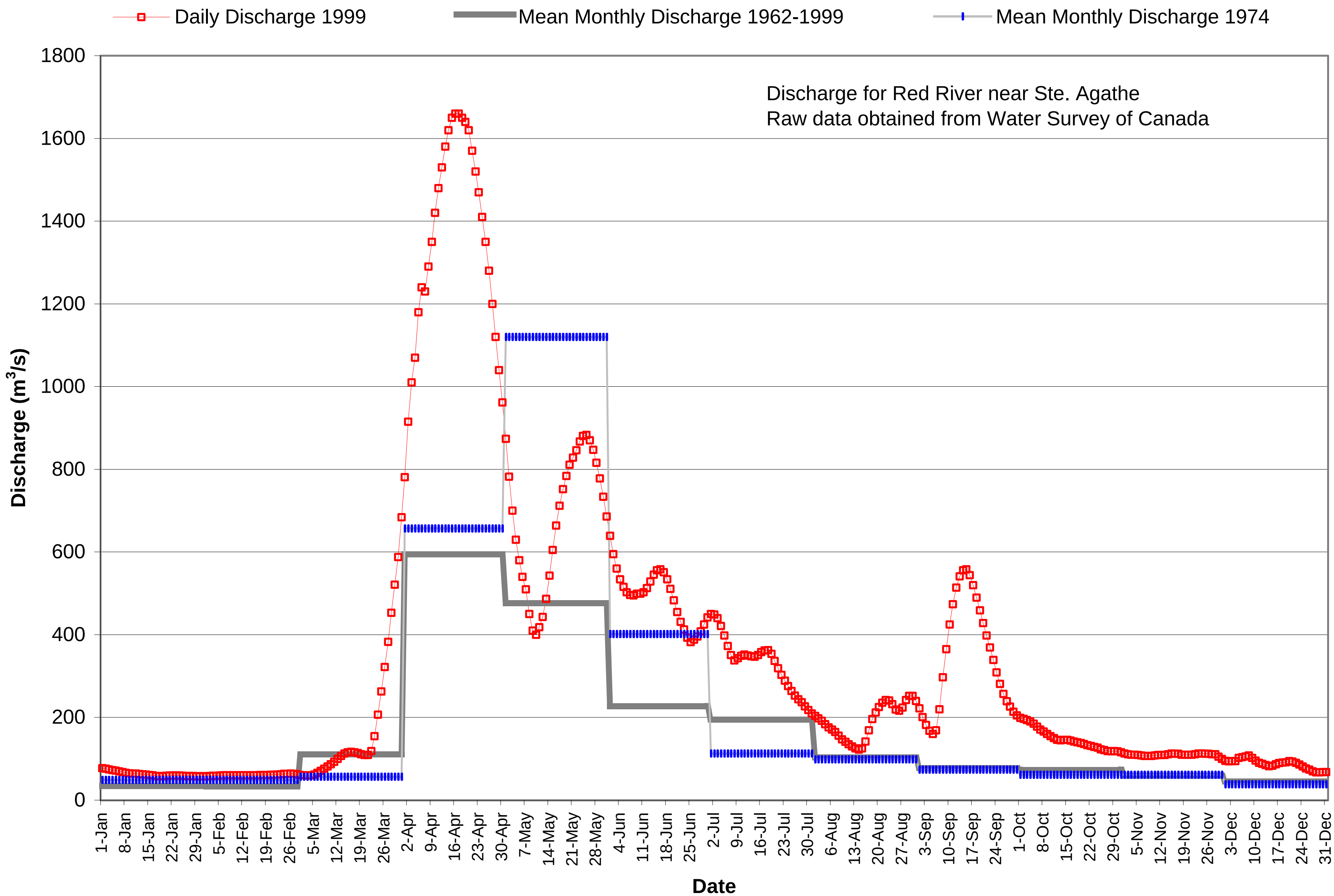


Figure 9. Daily discharge 1999, mean monthly discharge 1962-1999, and mean monthly discharge 1974, for the Red River near Ste. Agathe.

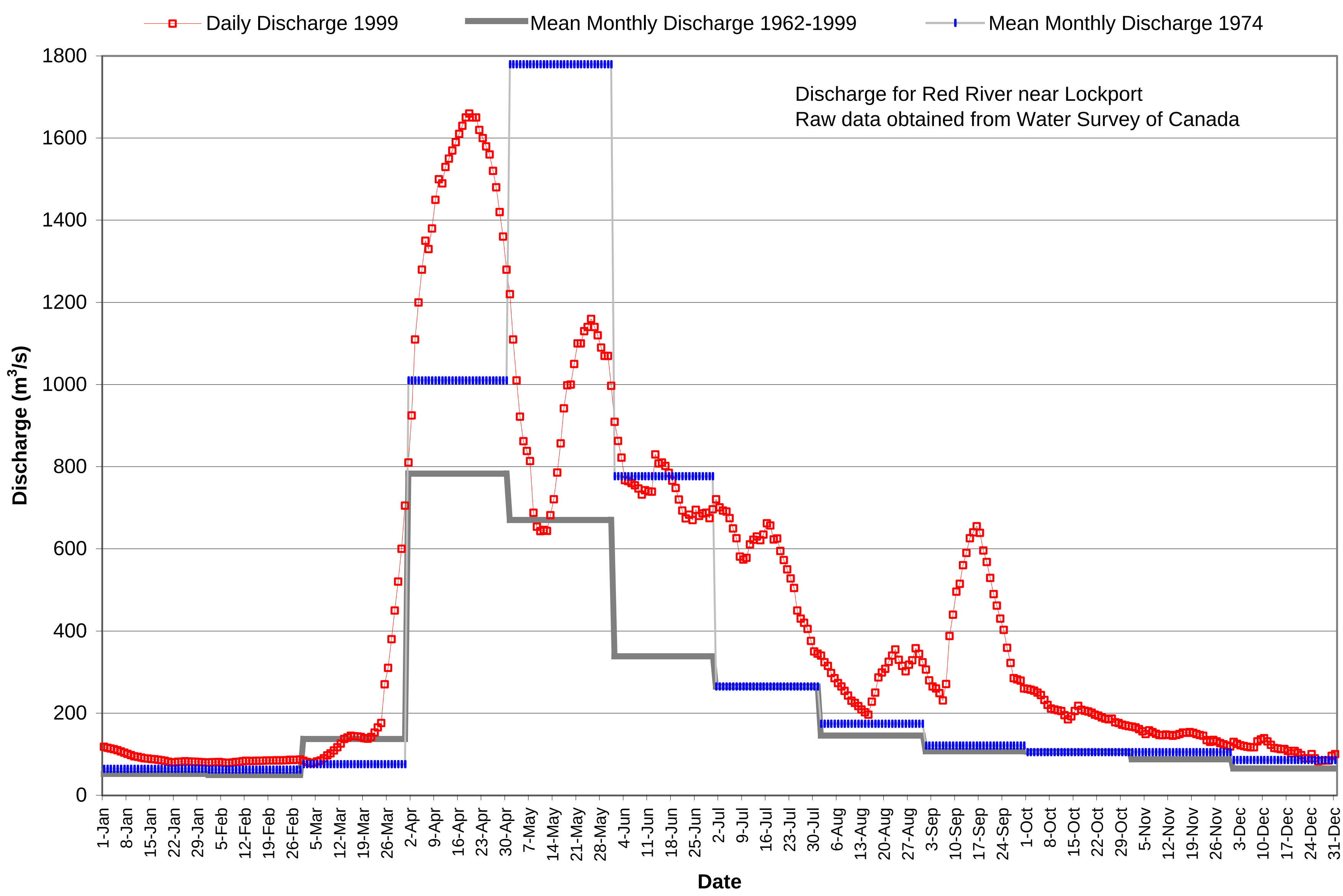


Figure 10. Daily discharge 1999, mean monthly discharge 1962-1999, and mean monthly discharge 1974, for the Red River near Lockport.

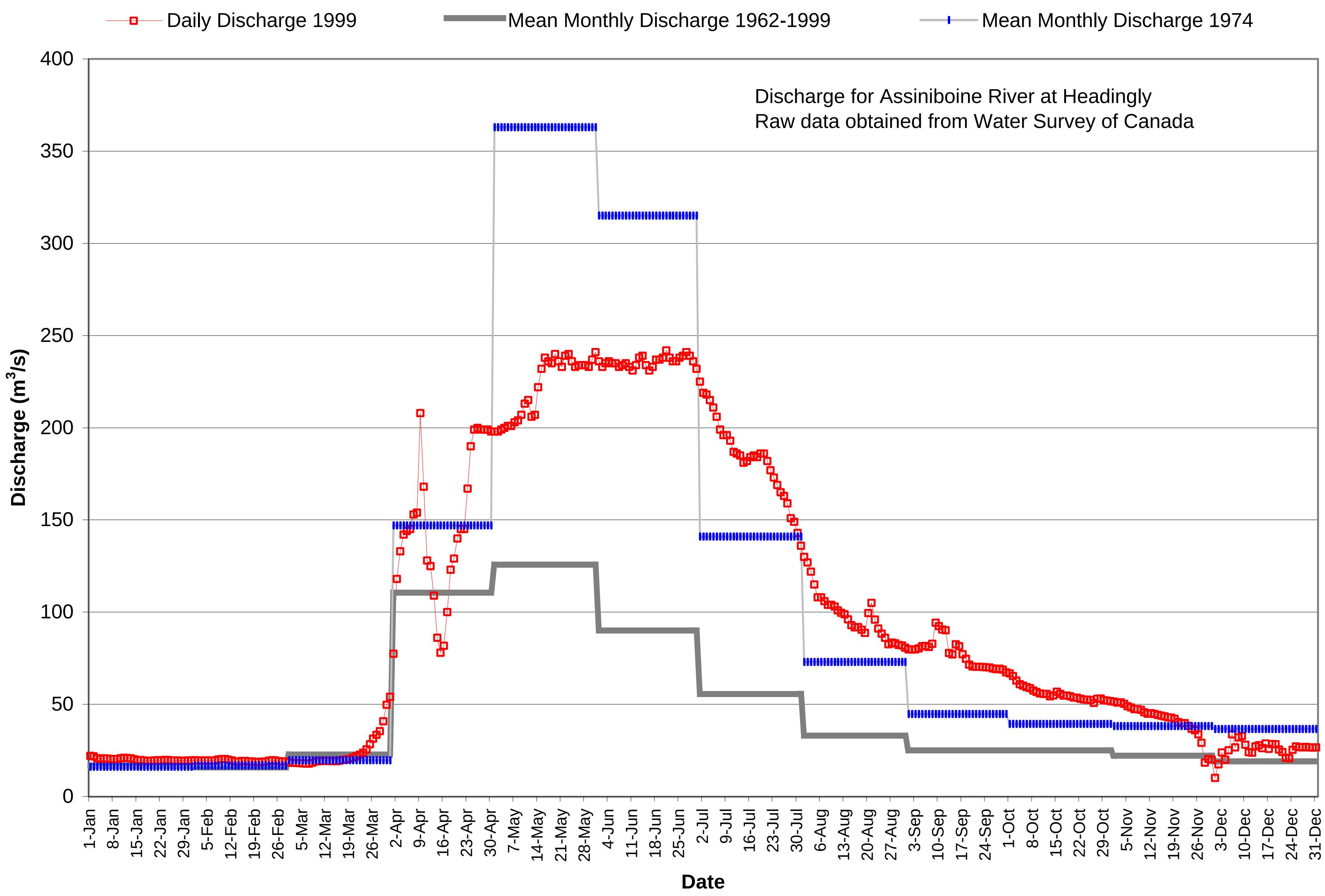


Figure 11. Daily discharge 1999, mean monthly discharge 1962-1999, and mean monthly discharge 1974, for the Assiniboine River at Headingly.

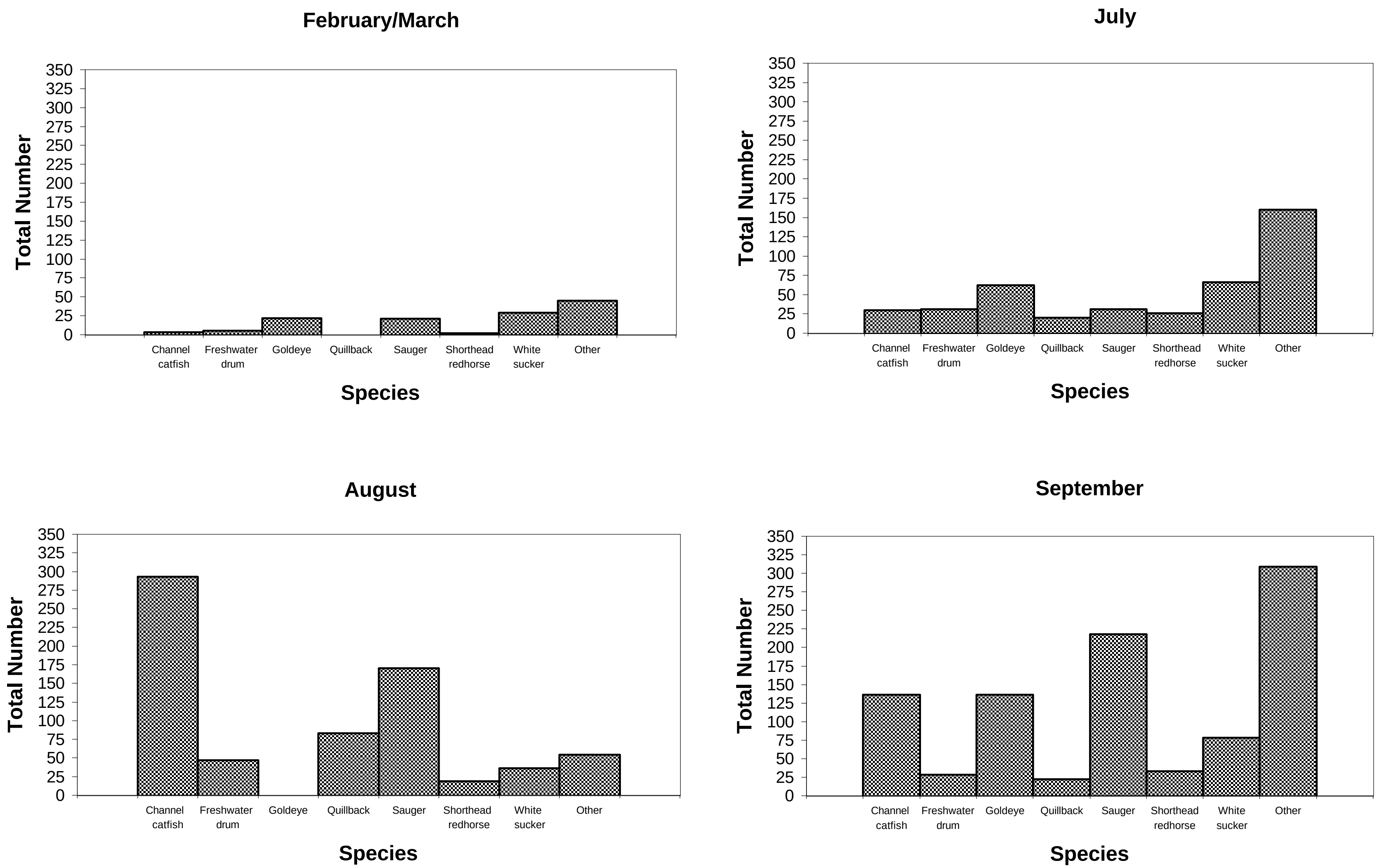


Figure 12. Number of fish, by season, for selected species captured in the Red River within the City of Winnipeg Ammonia Criteria Study Area, 1999.

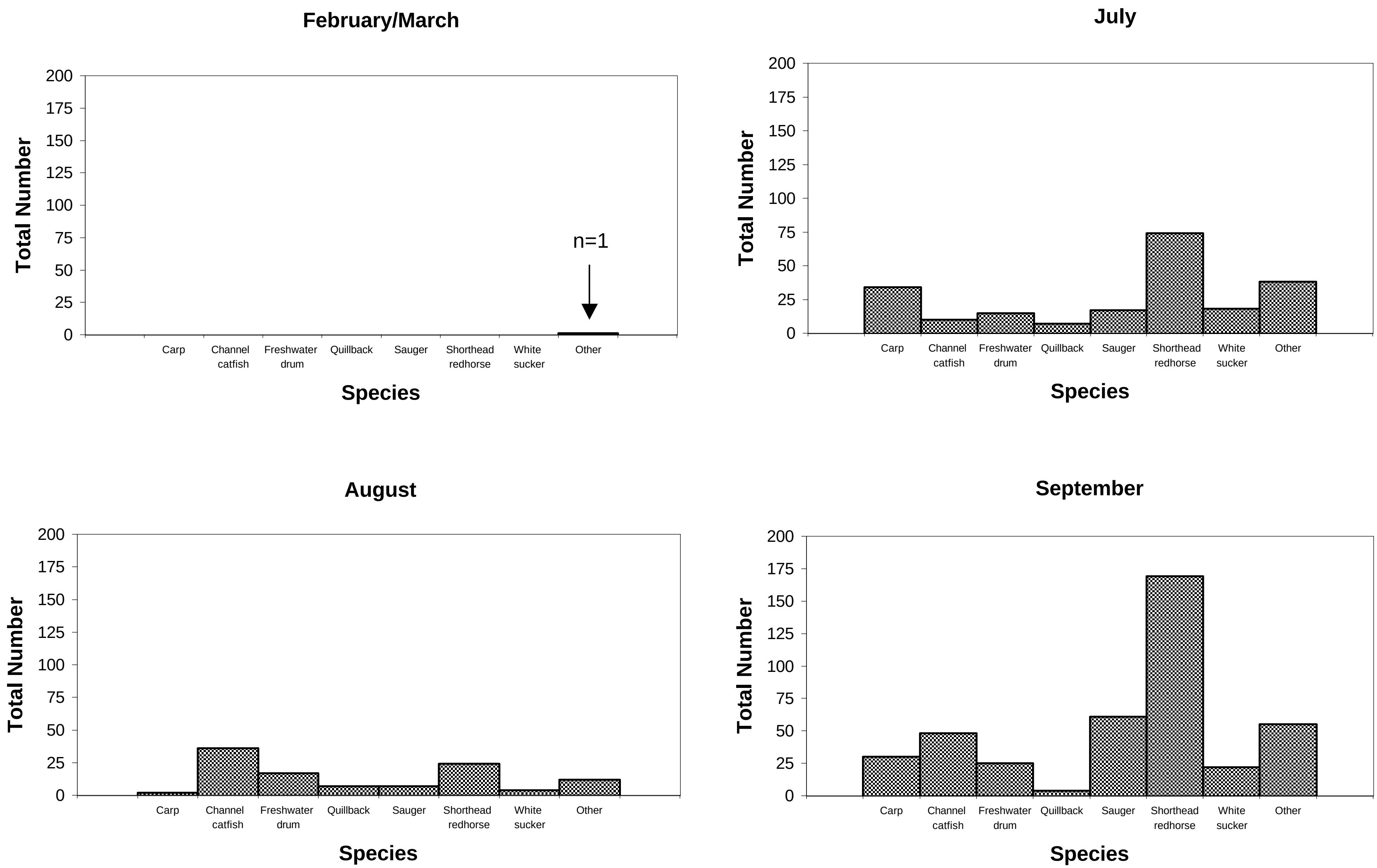


Figure 13. Number of fish, by season, for selected species captured in the Assiniboine River within the City of Winnipeg Ammonia Criteria Study Area, 1999.

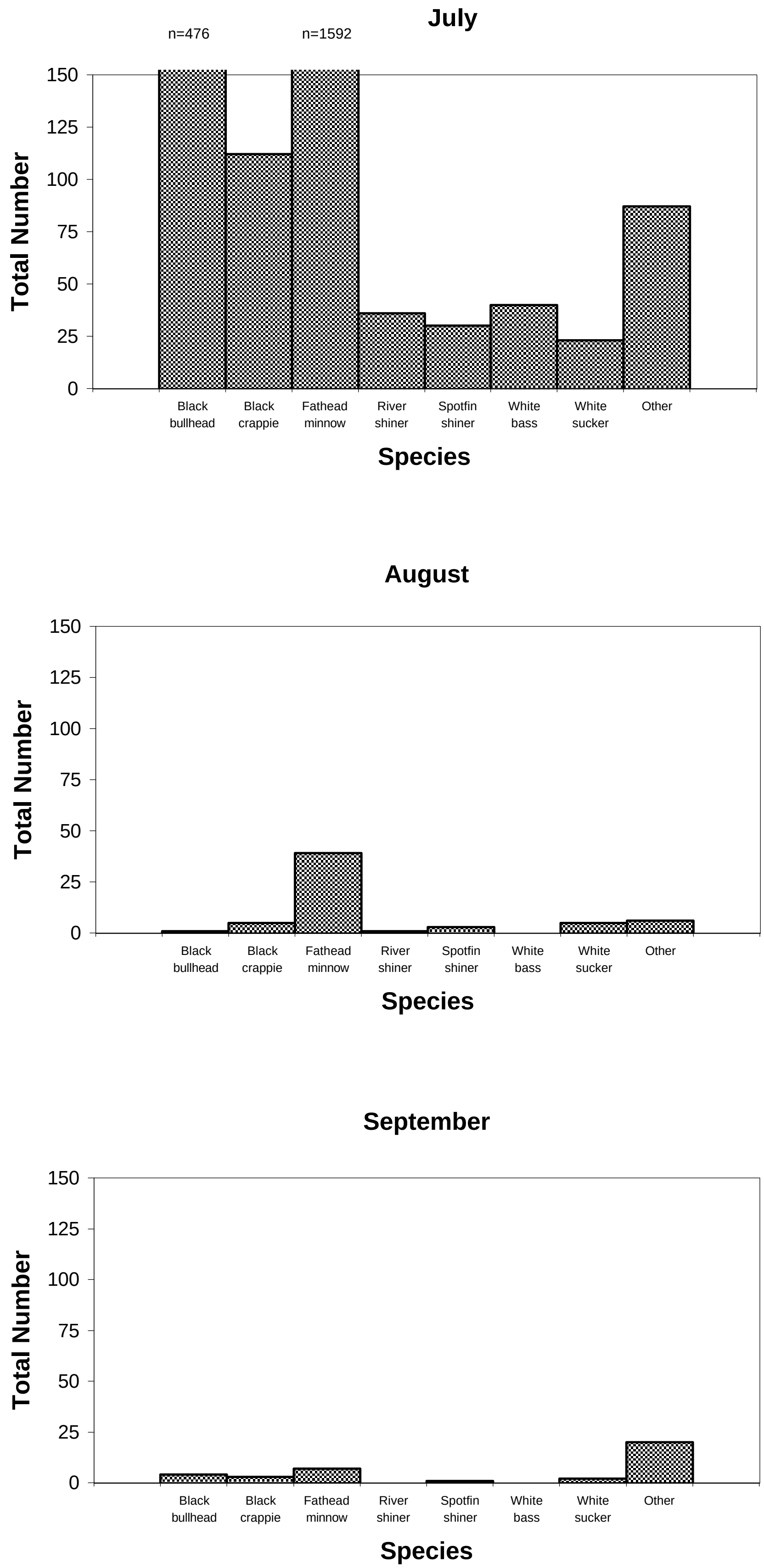


Figure 14. Number of fish, by season, for selected species captured in tributaries within the City of Winnipeg Ammonia Criteria Study Area, 1999.

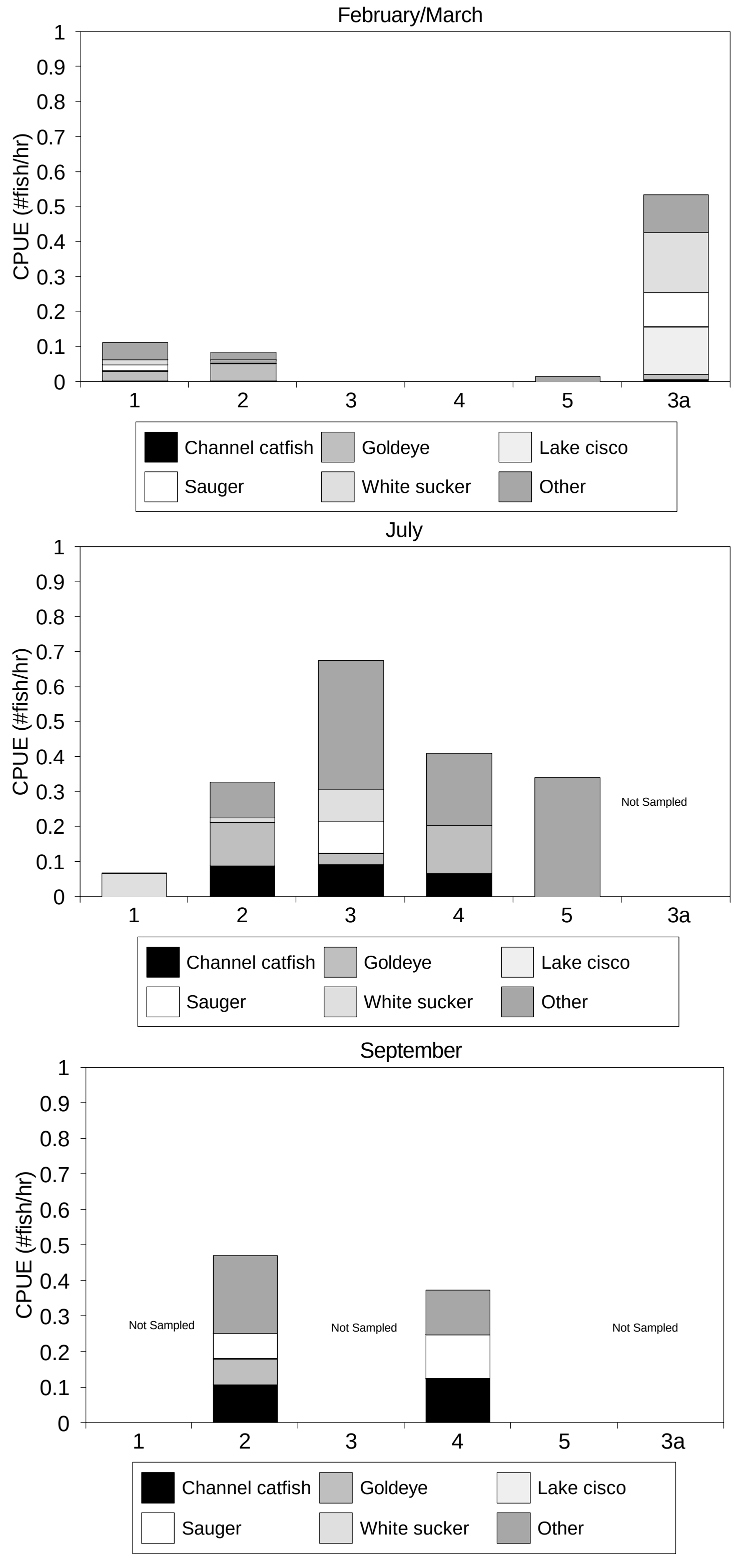


Figure 15 Mean catch-per-unit-effort (CPUE) of gill nets set in the Red and Assiniboine rivers during February, March, July, and September, 1999, by zone and species of fish.

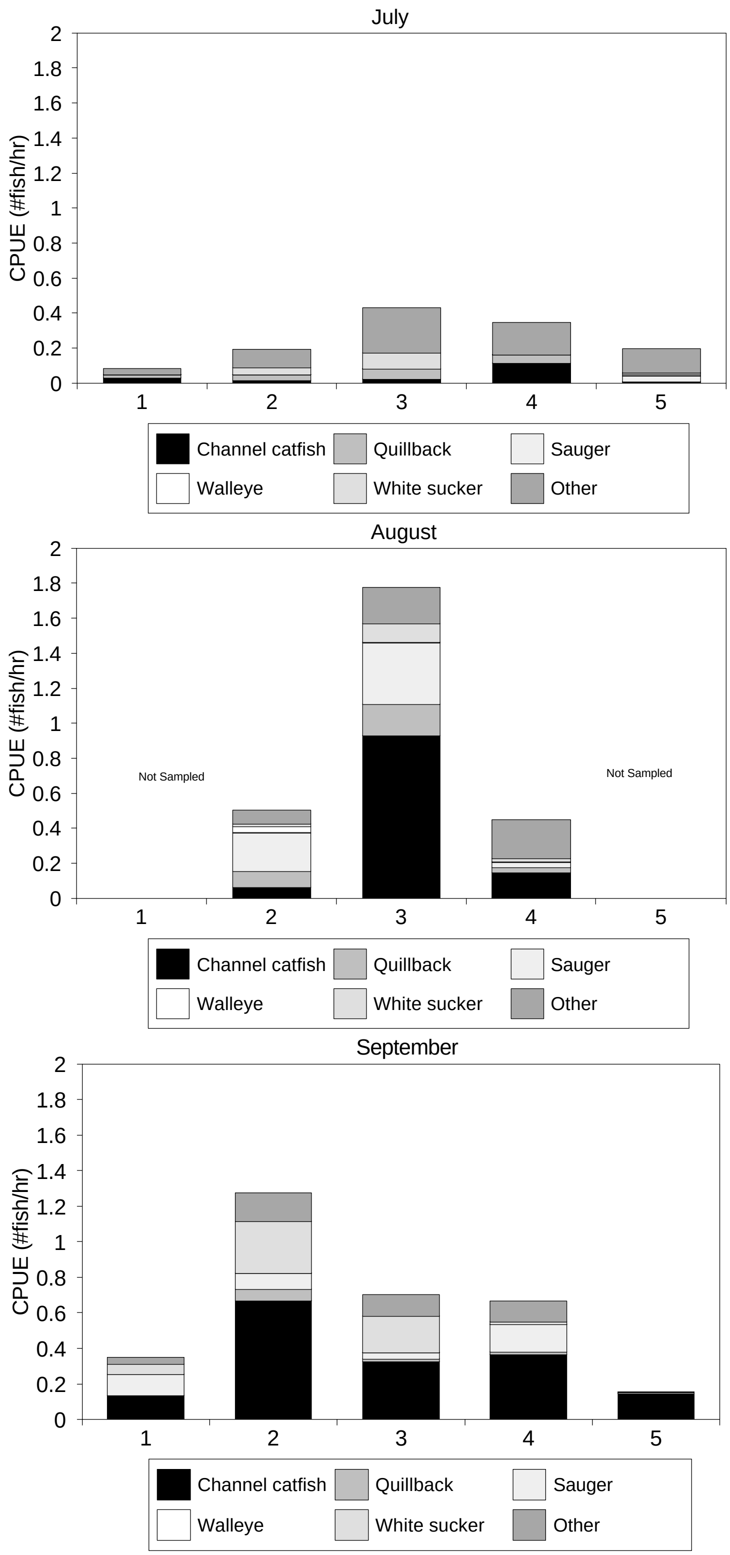


Figure 16 Mean catch-per-unit-effort (CPUE) of hoop nets set in the Red and Assiniboine rivers during July, August, and September, 1999, by zone and species of fish.

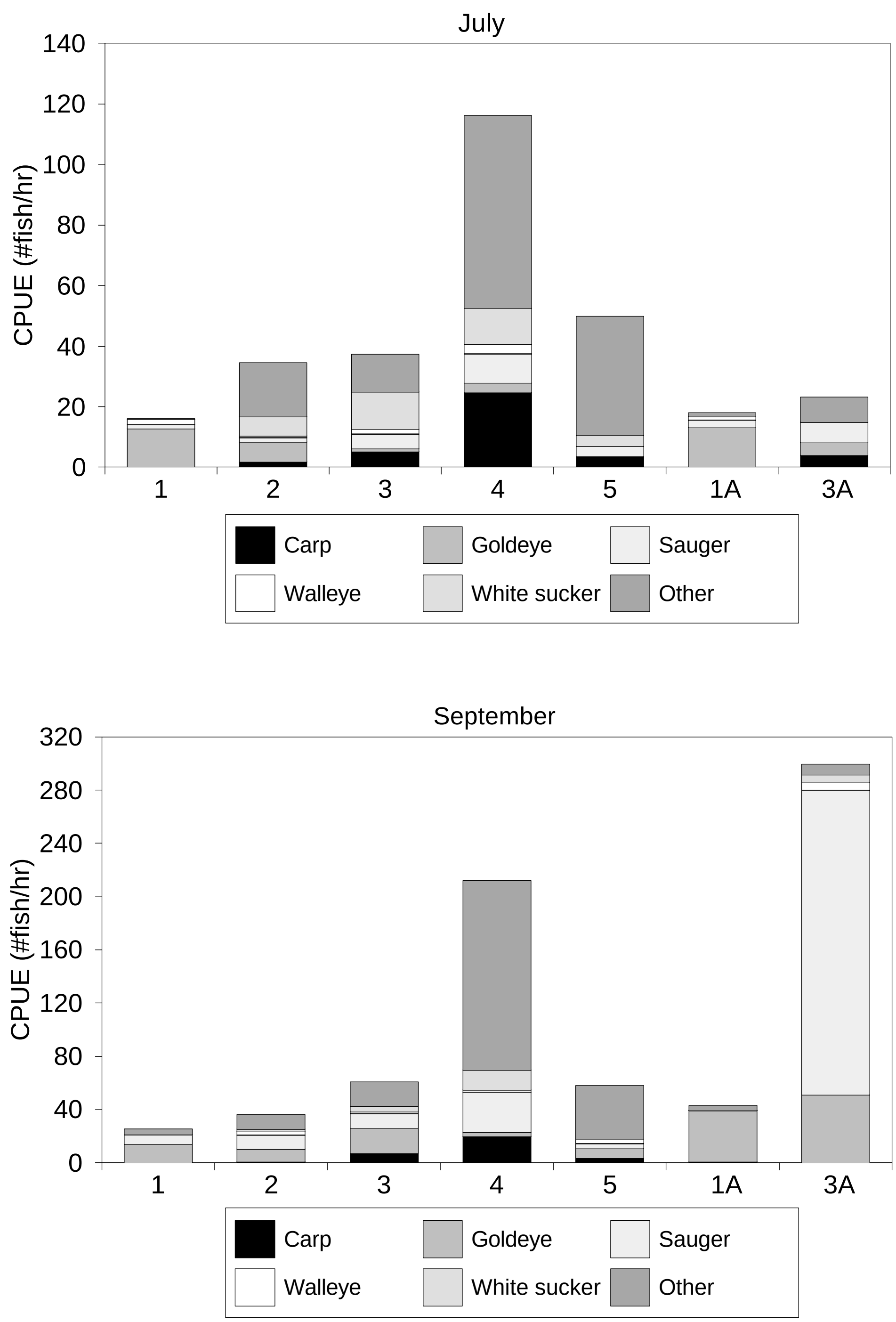


Figure 17 Mean catch-per-unit-effort (CPUE) of boat electrofishing runs in the Red and Assiniboine rivers during July and September, 1999, by zone and species of fish.

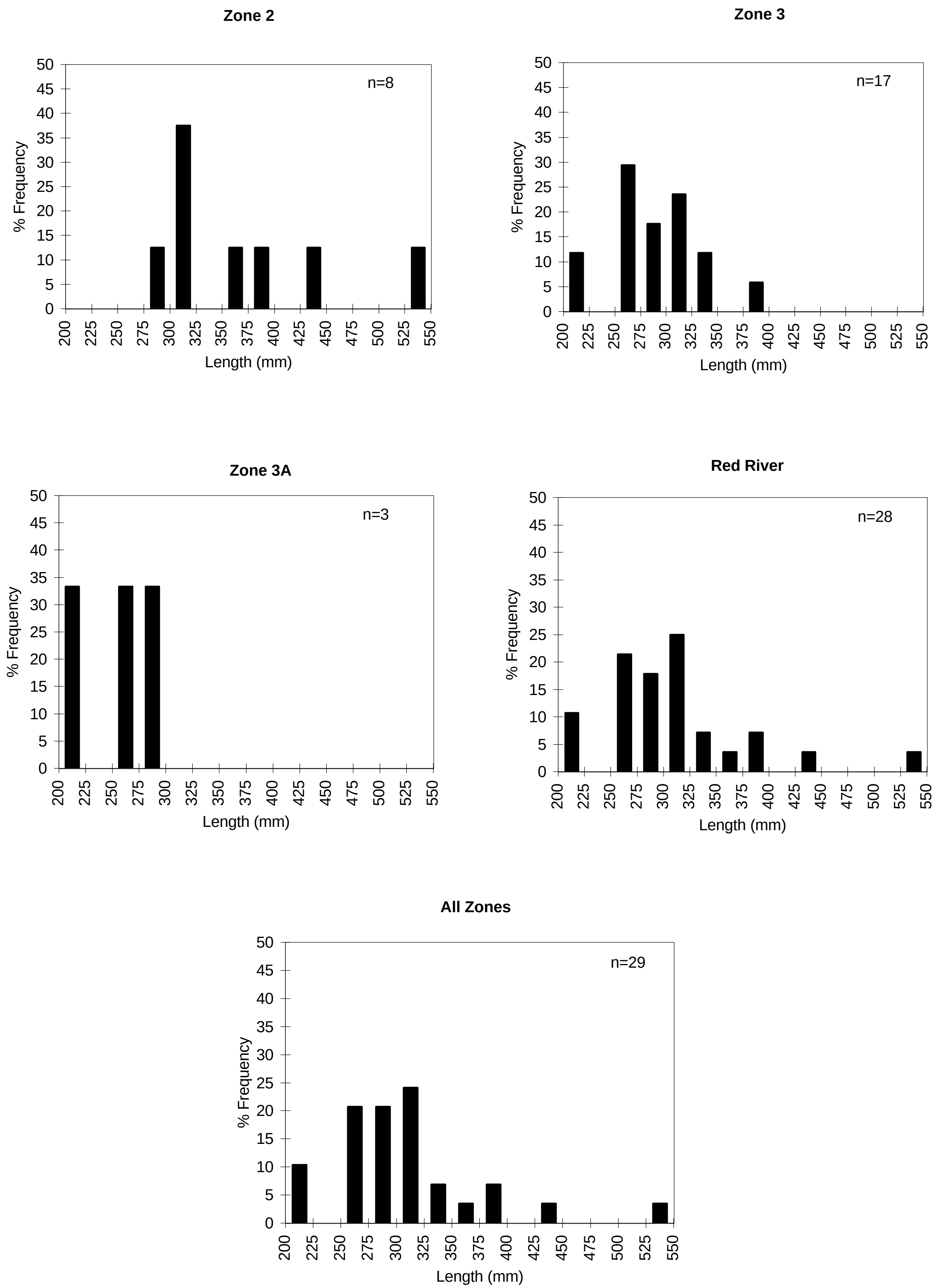


Figure 18. Length-frequency distributions for burbot in zones from which they were captured in the Red and Assiniboine rivers, 1999.

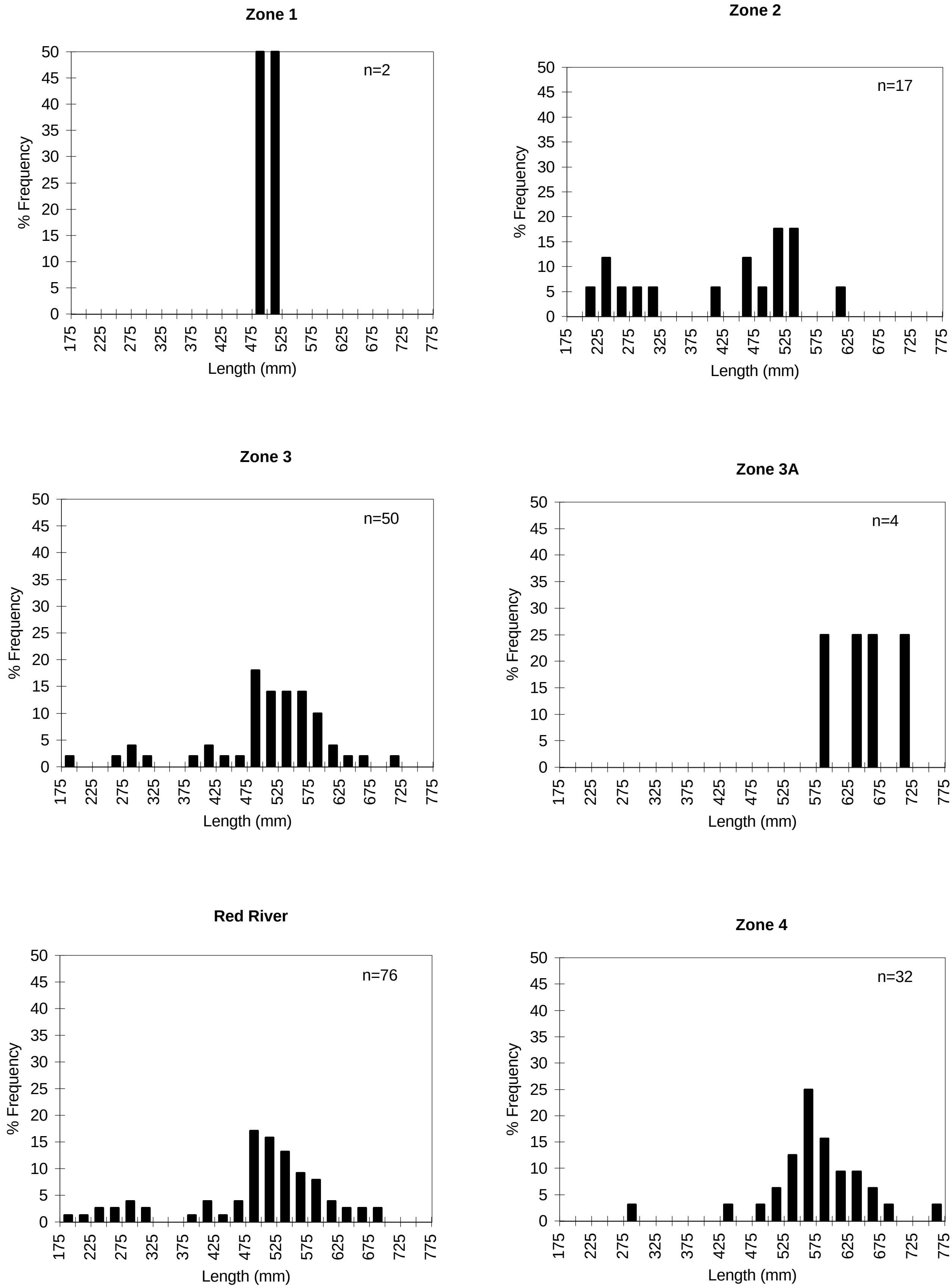
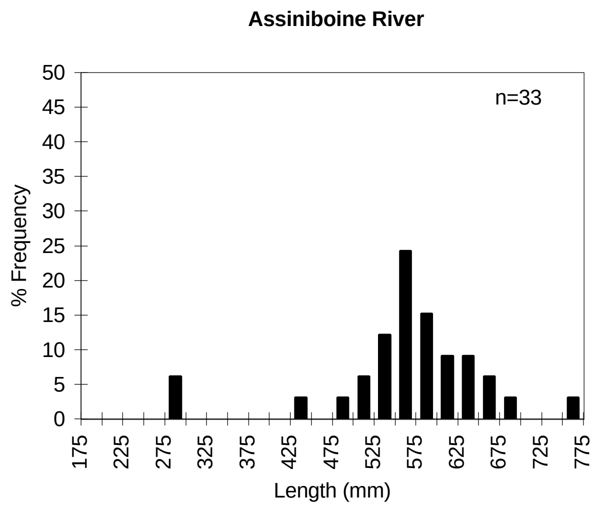


Figure 19. Length-frequency distributions for carp in zones from which they were captured in the Red and Assiniboine rivers, 1999.



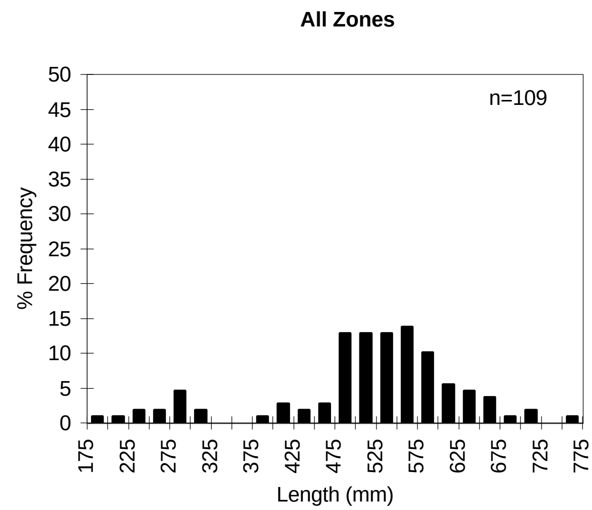


Figure 19. Continued... (carp)

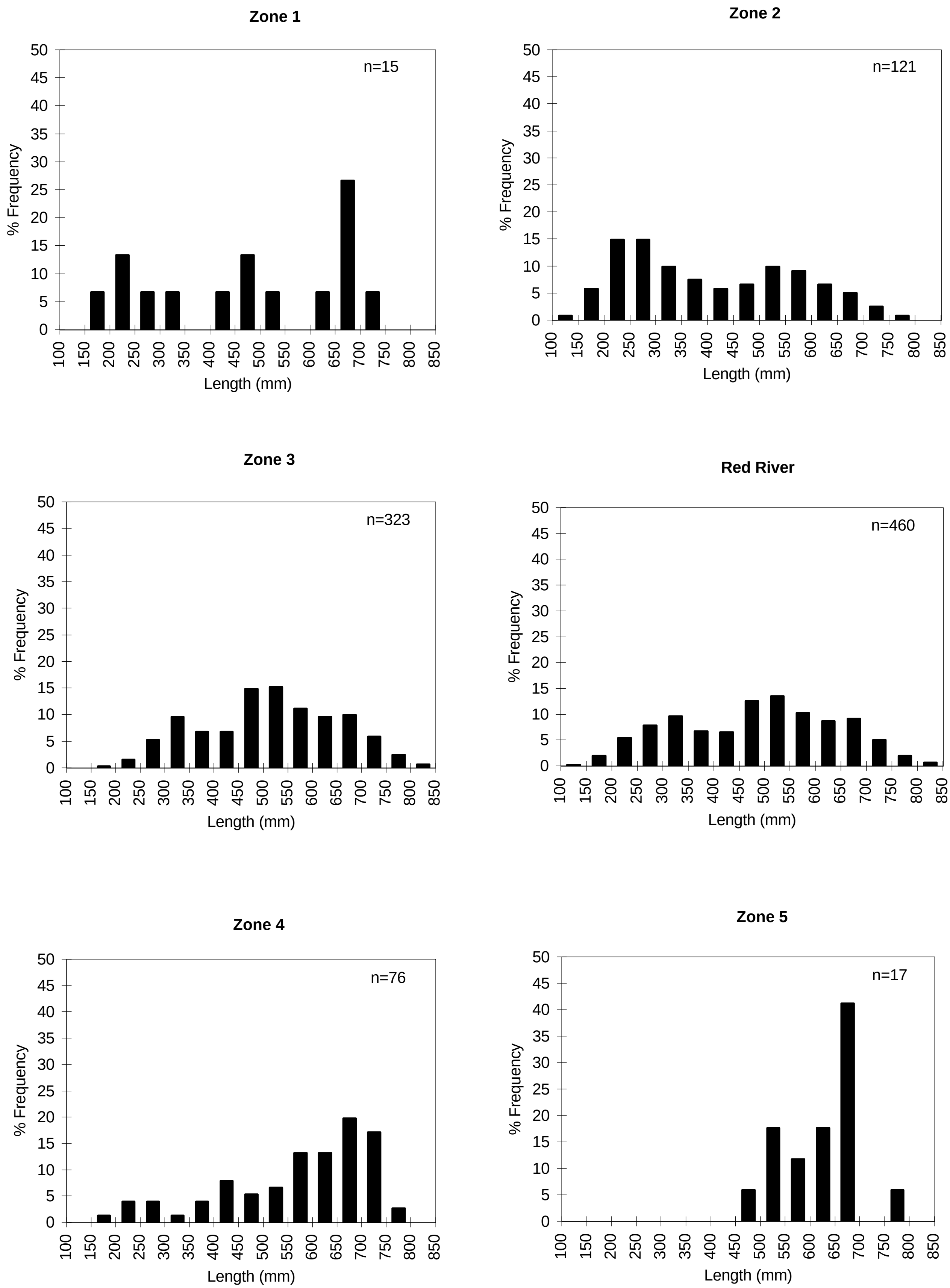


Figure 20. Length-frequency distributions for channel catfish in zones from which they were captured in the Red and Assiniboine rivers, 1999.

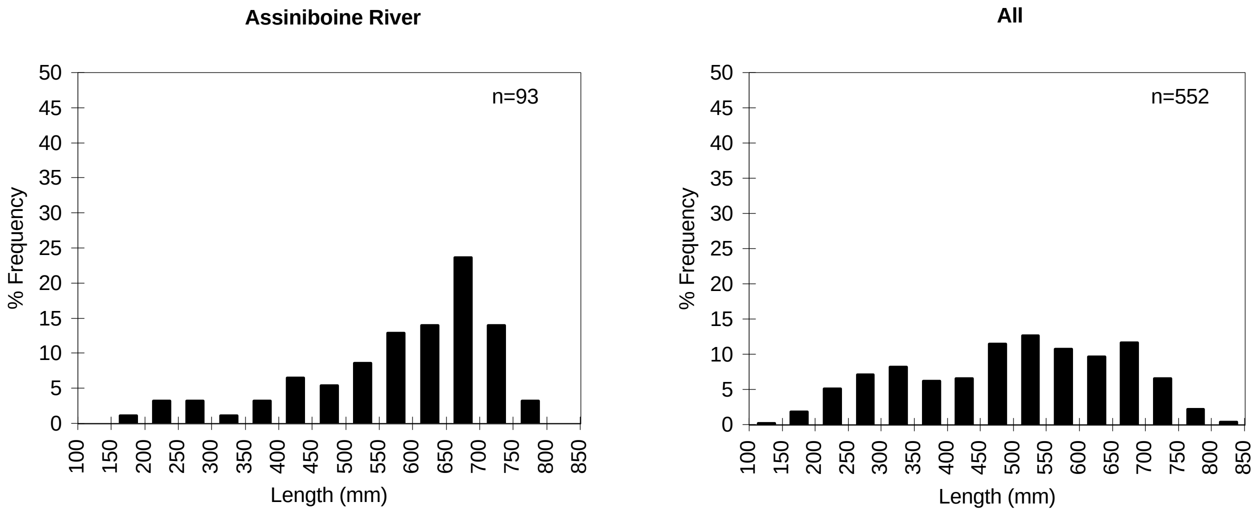


Figure 20. Continued... (channel catfish)

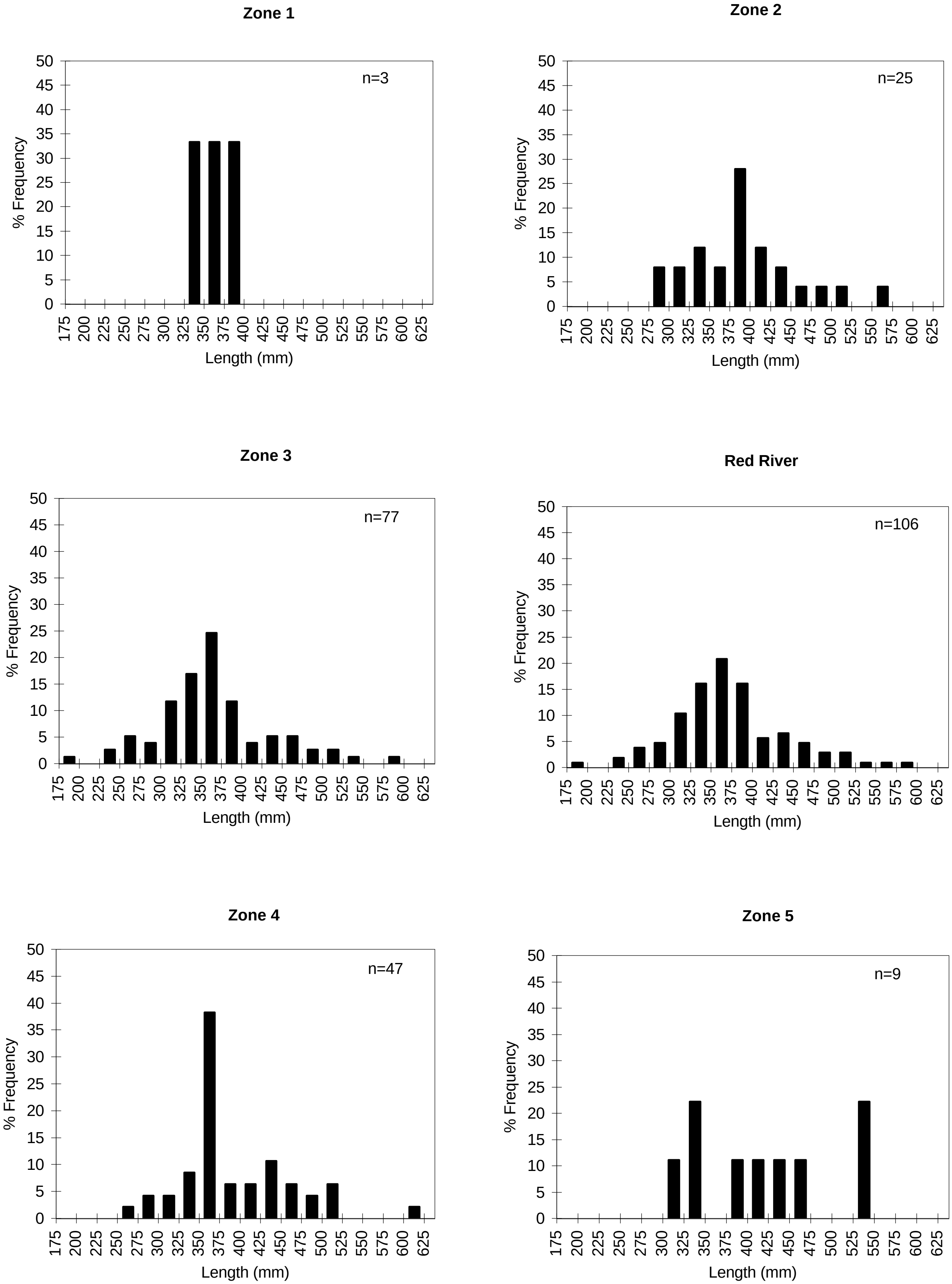
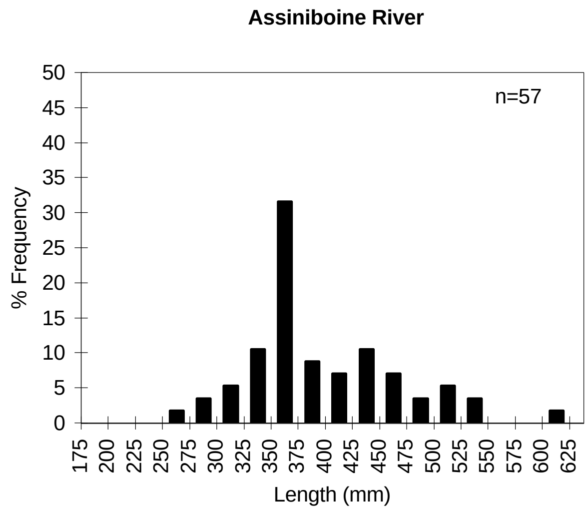


Figure 21. Length-frequency distributions for freshwater drum in zones from which they were captured in the Red and Assiniboine rivers, 1999.



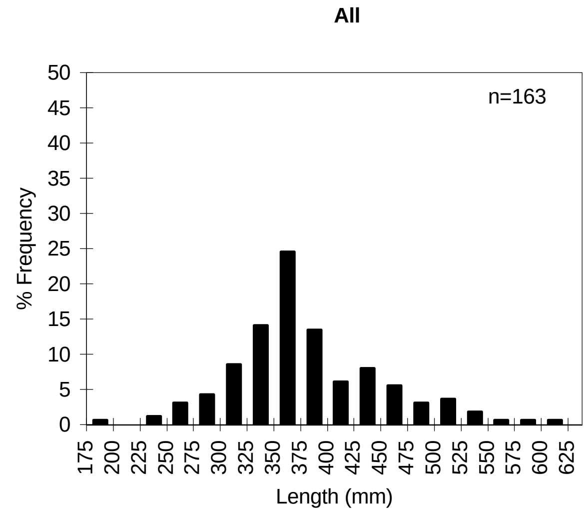


Figure 21. Continued... (freshwater drum)

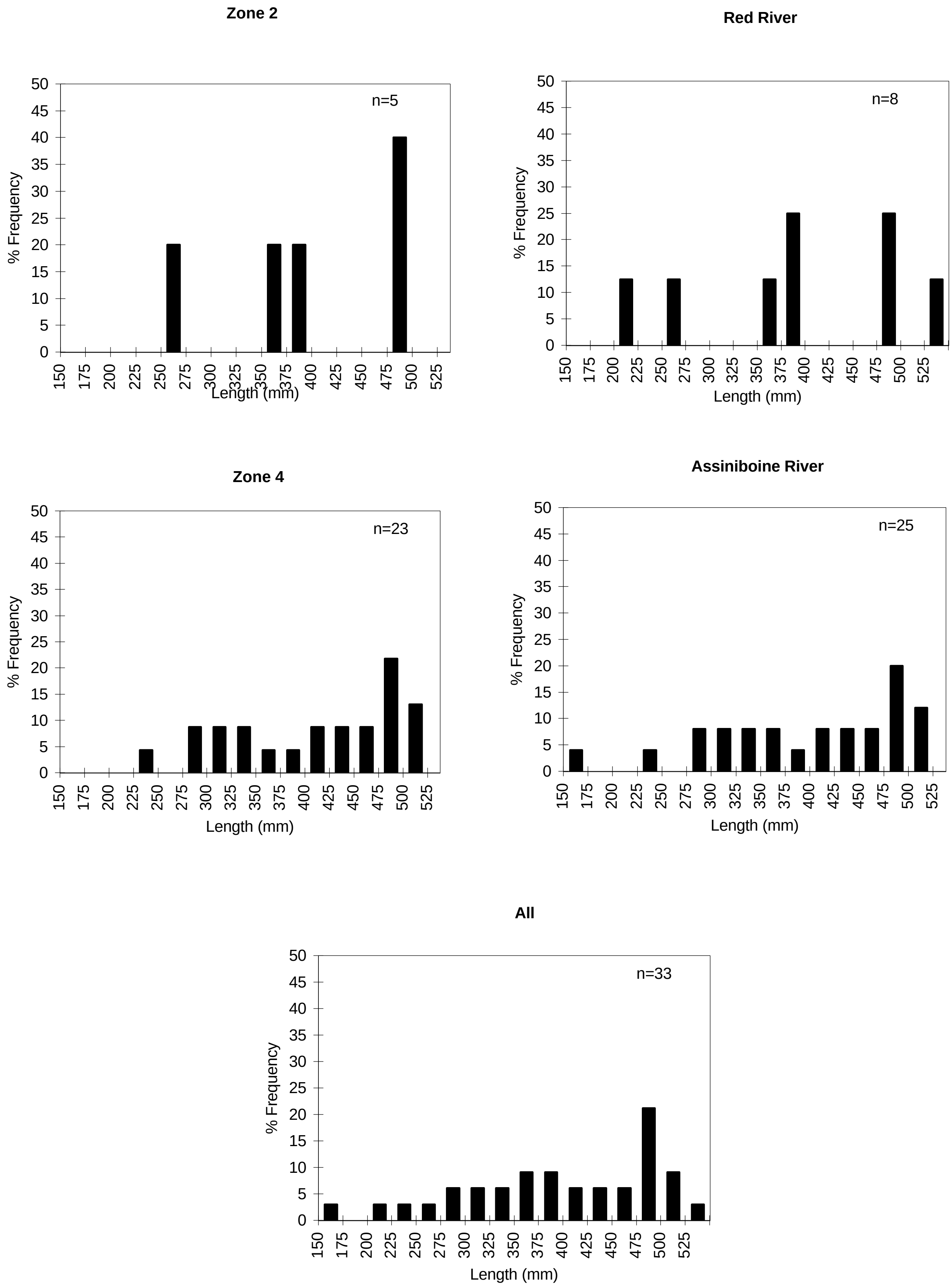


Figure 22. Length-frequency distributions for golden redhorse in zones from which they were captured in the Red and Assiniboine rivers, 1999.

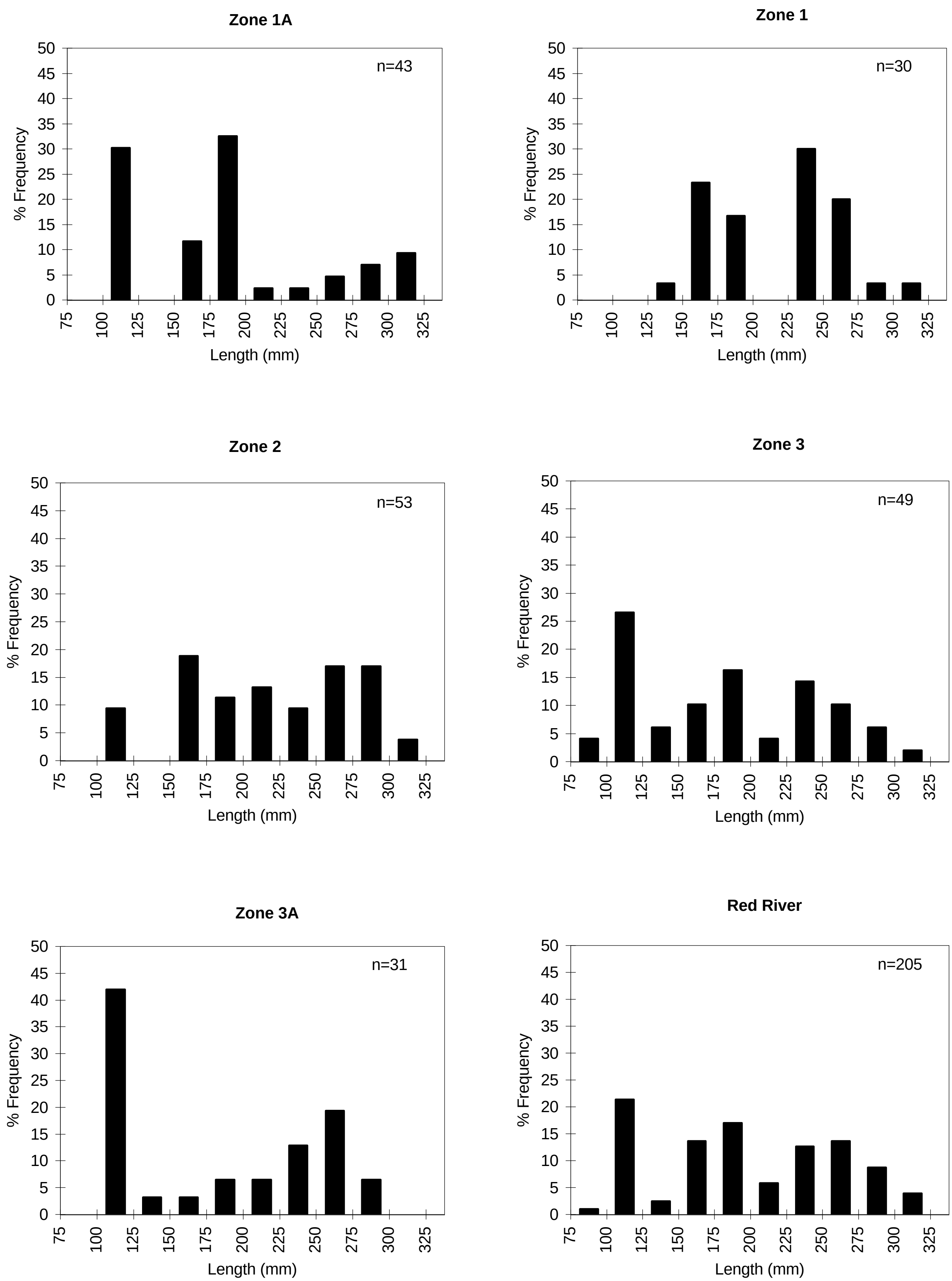


Figure 23. Length-frequency distributions for goldeye in zones from which they were captured in the Red and Assiniboine rivers, 1999.

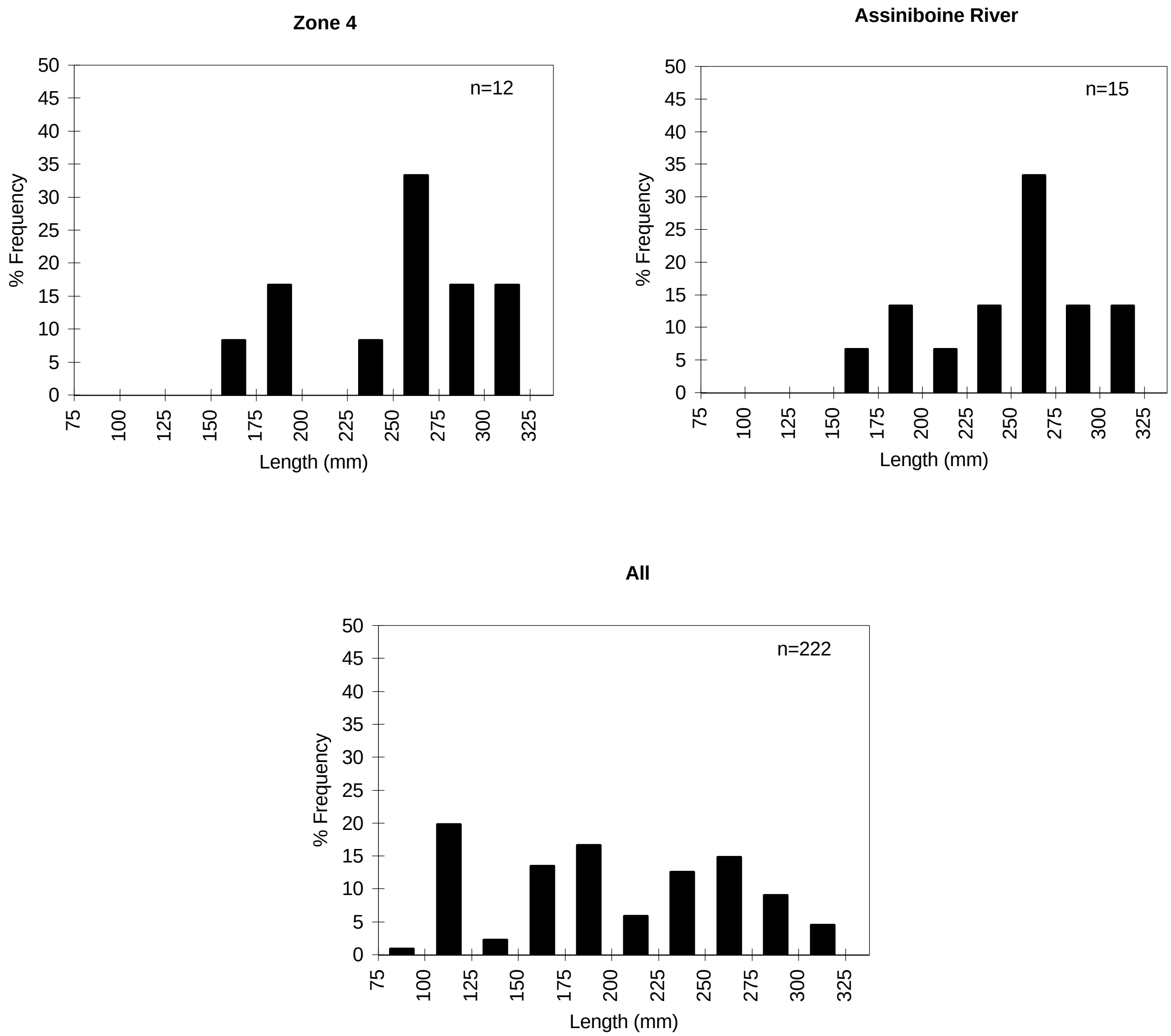


Figure 23. Continued... (goldeye)

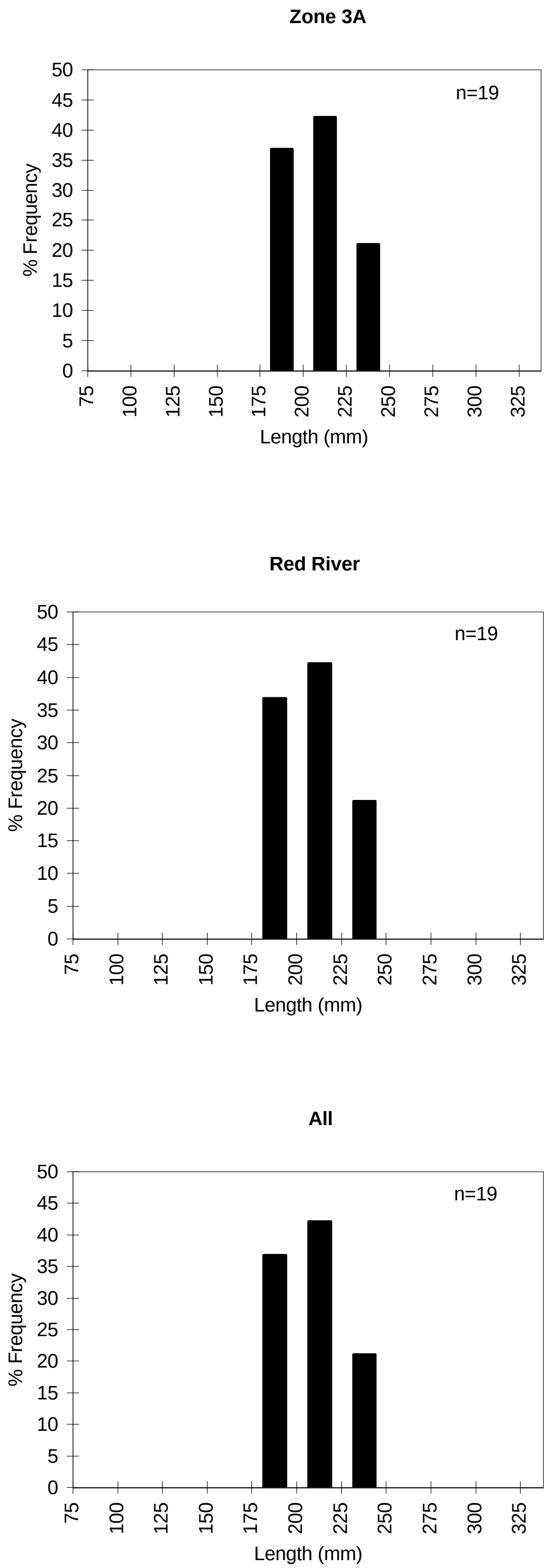


Figure 24. Length-frequency distributions for lake cisco in zones from which they were captured in the Red River, 1999.

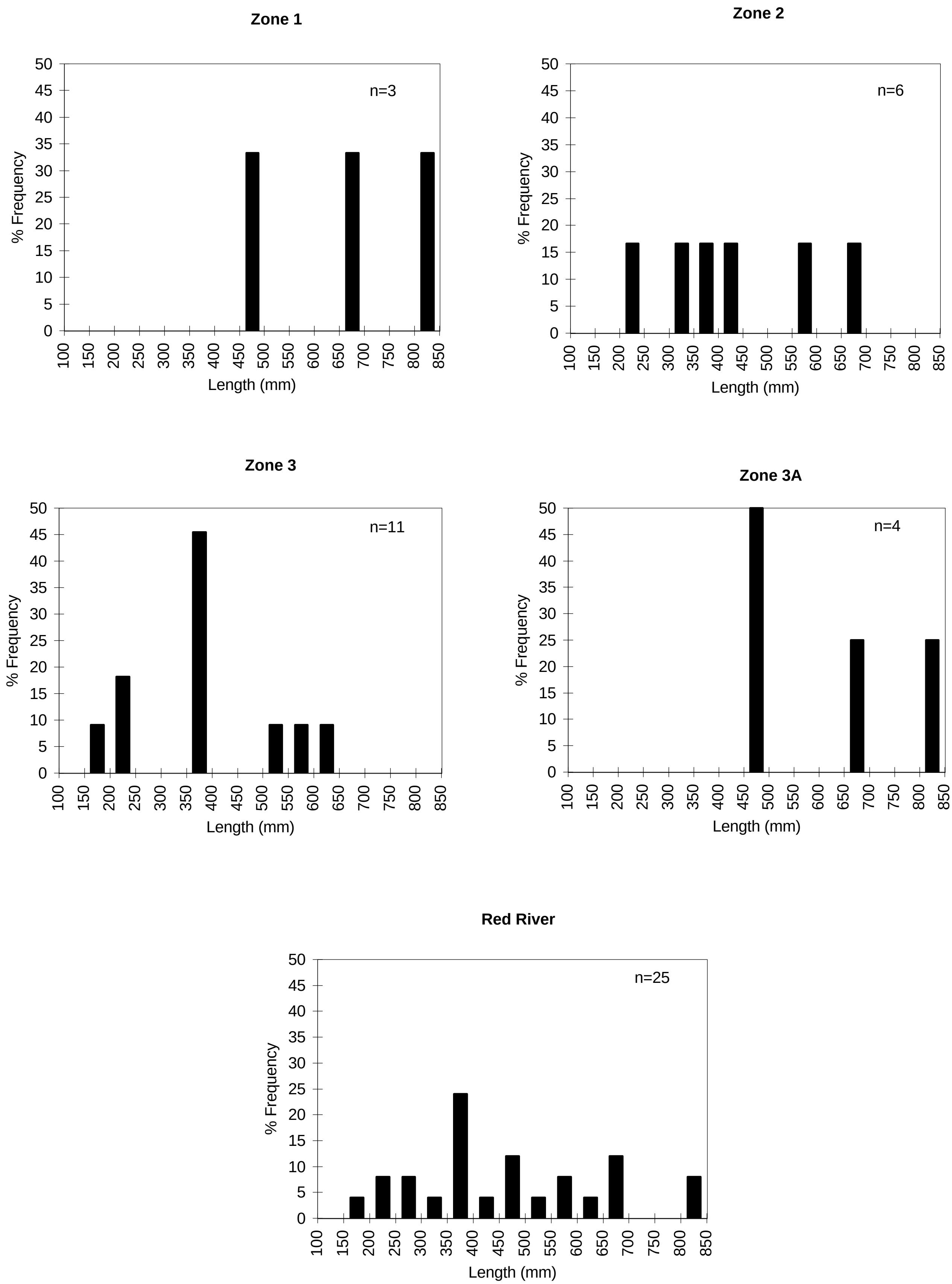
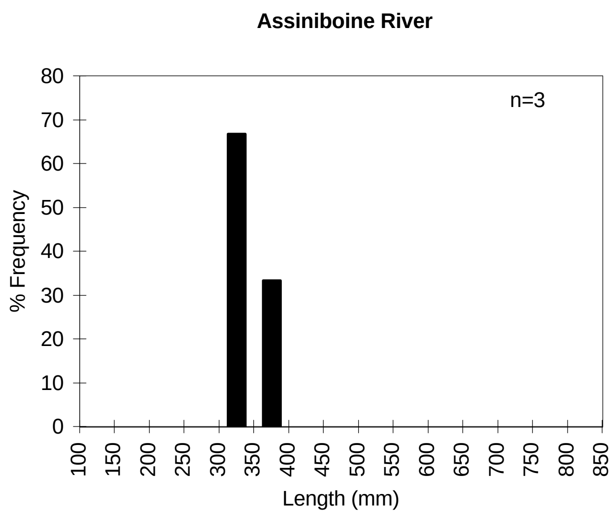


Figure 25. Length-frequency distributions for northern pike in zones from which they were captured in the Red and Assiniboine rivers, 1999.



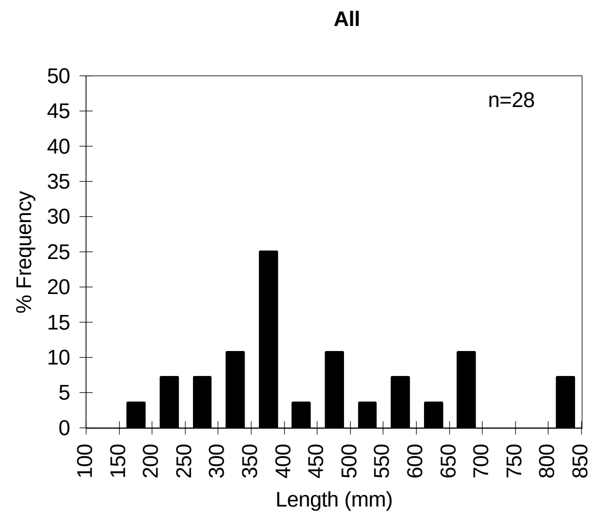


Figure 25. Continued... (northern pike)

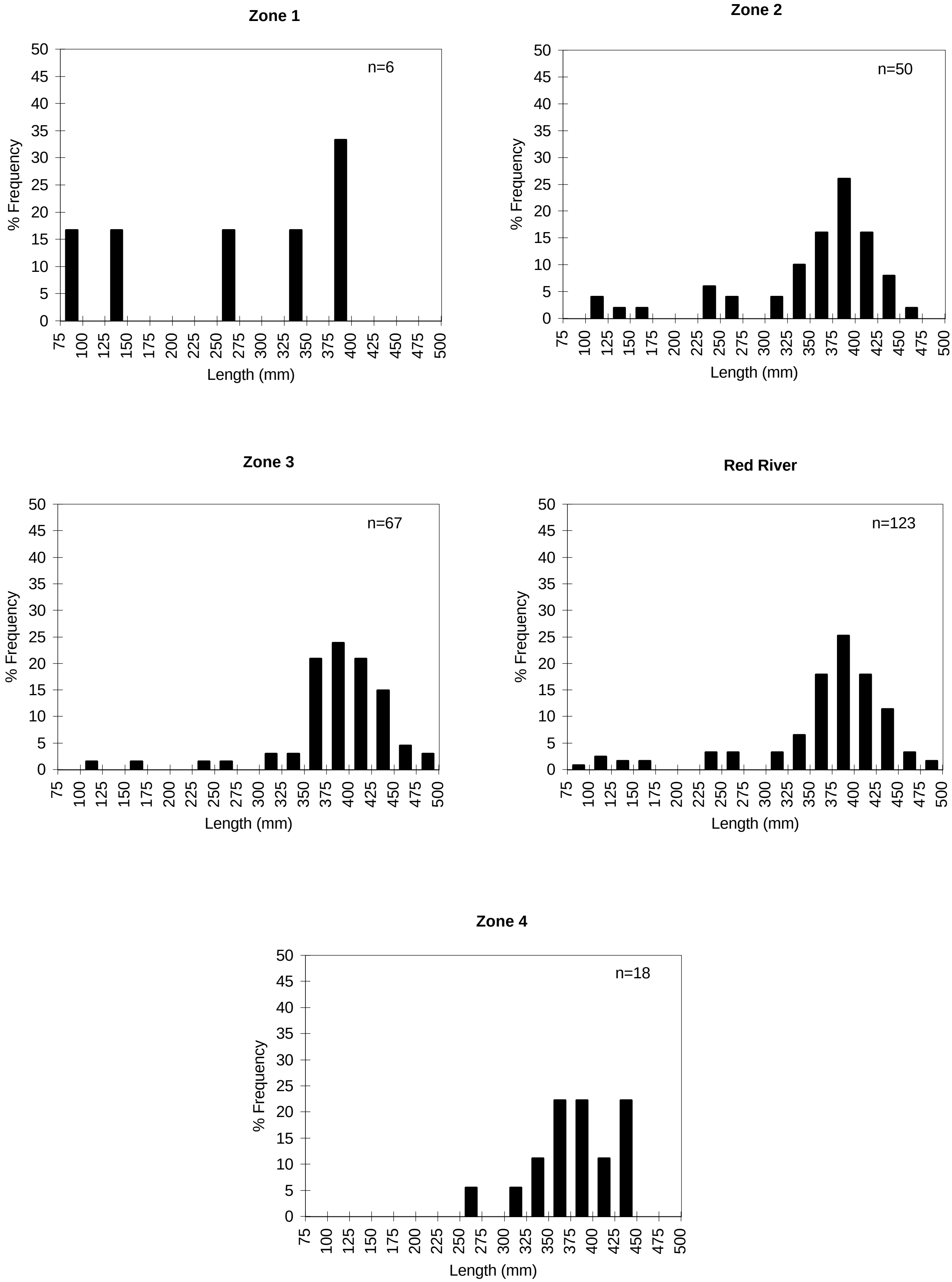
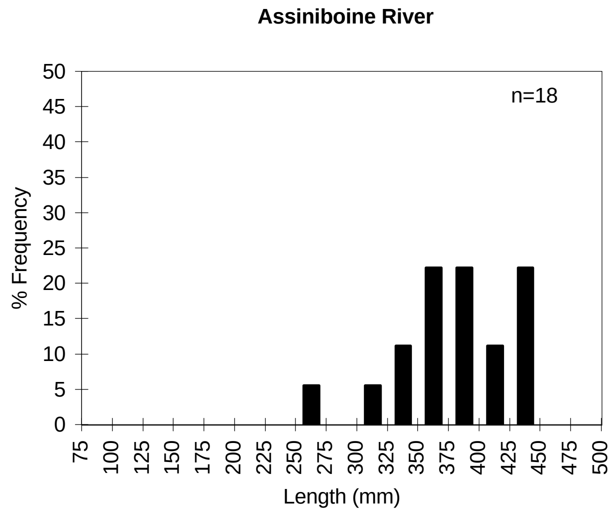


Figure 26. Length-frequency distributions for quillback in zones from which they were captured in the Red and Assiniboine rivers, 1999.



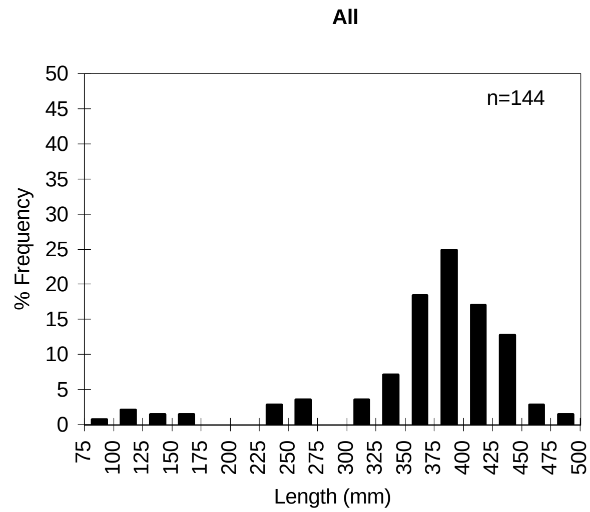


Figure 26. Continued... (quillback)

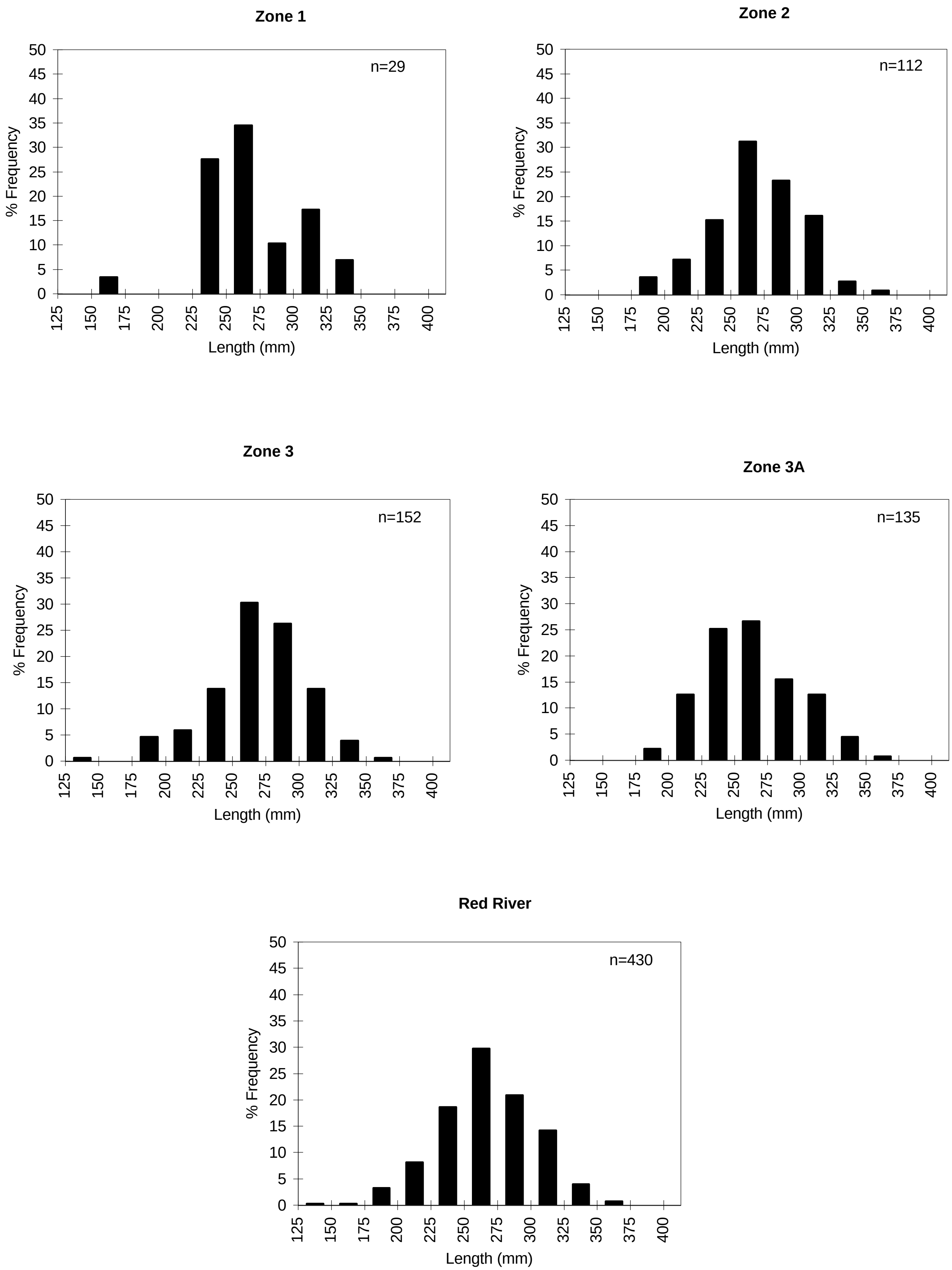
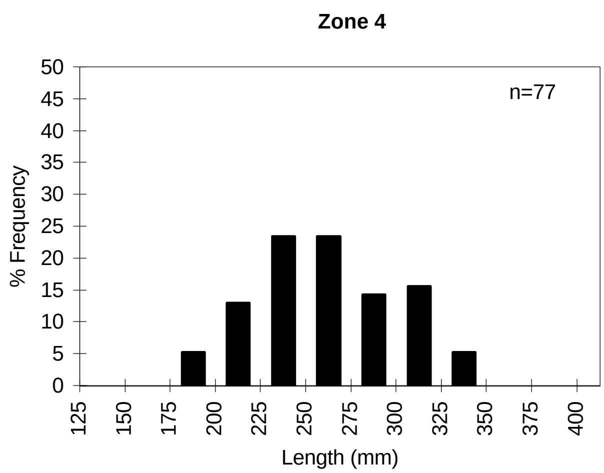
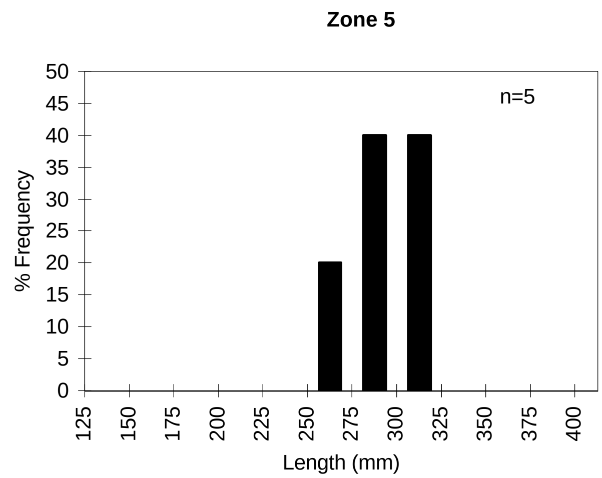
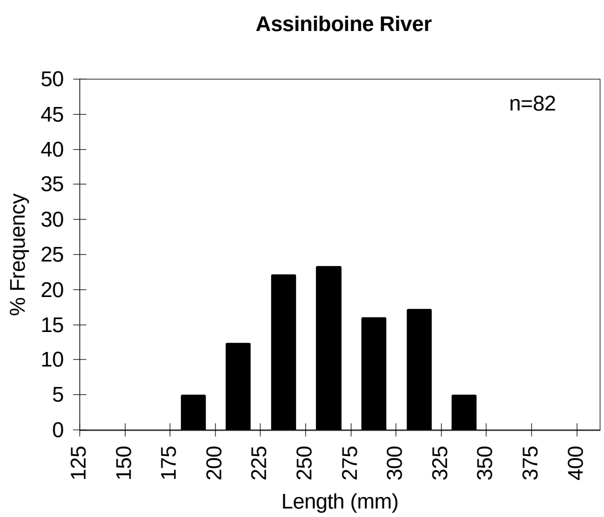


Figure 27. Length-frequency distributions for sauger in zones from which they were captured in the Red and Assiniboine rivers, 1999.







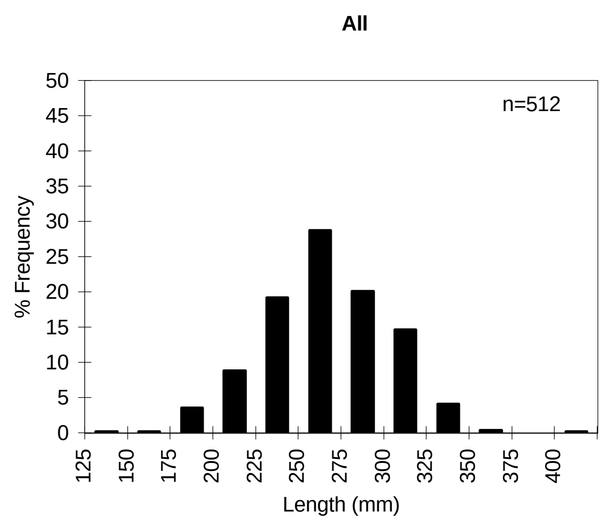


Figure 27. Continued... (sauger)

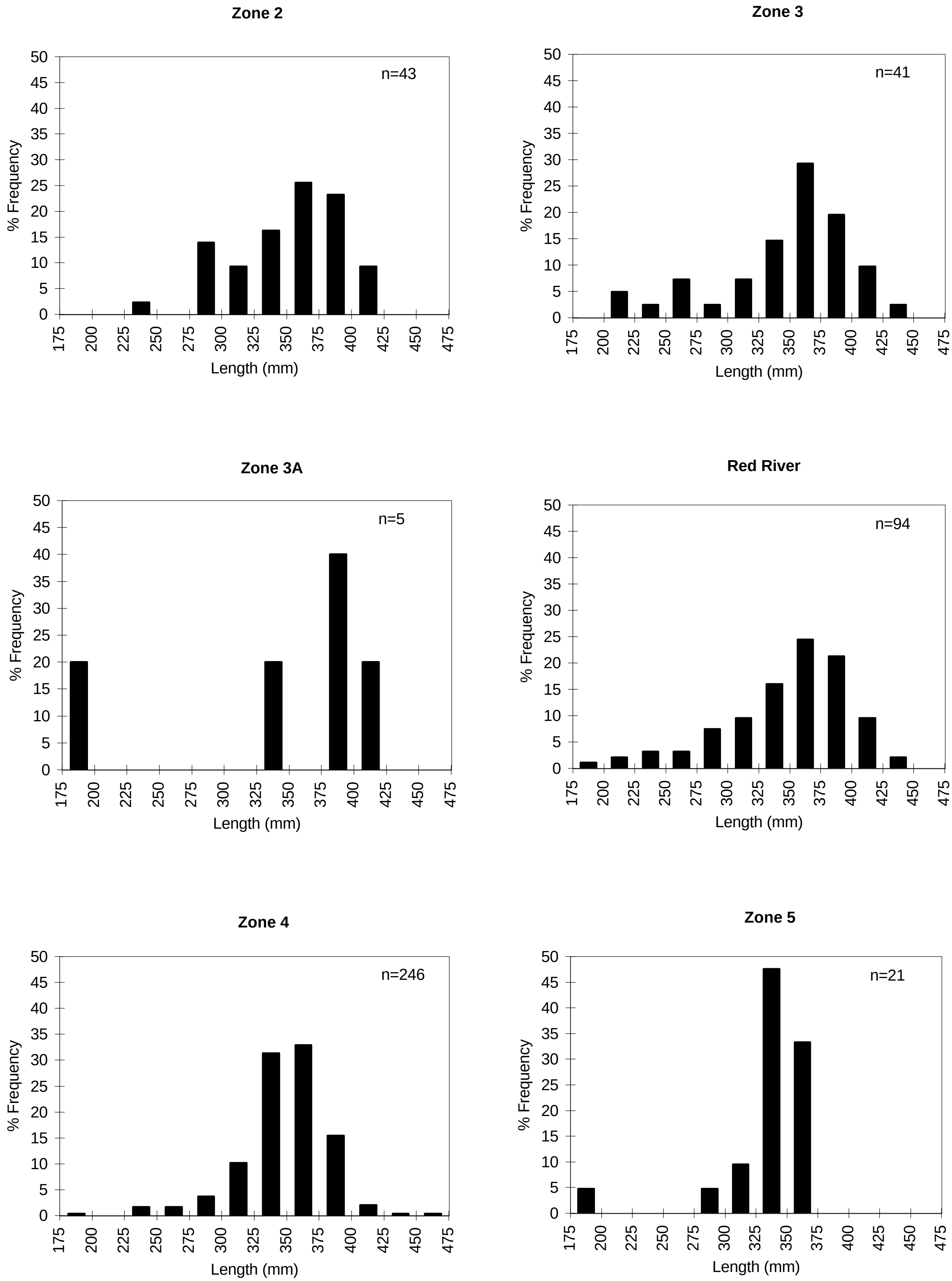


Figure 28. Length-frequency distributions for shorthead redhorse in zones from which they were captured in the Red and Assiniboine rivers, 1999.

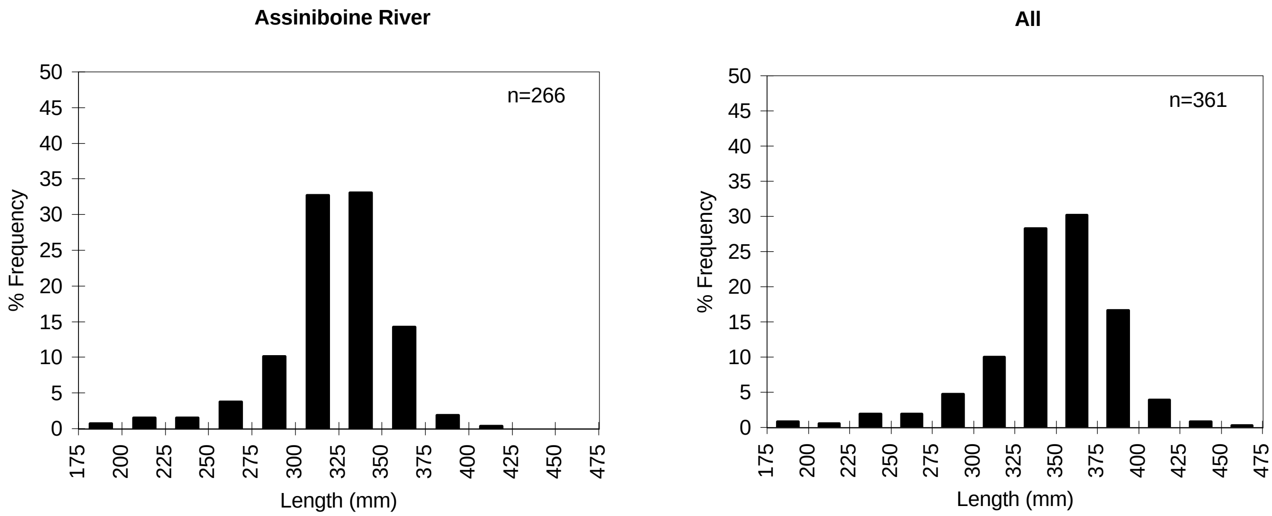


Figure 28. Continued... (shorthead redhorse)

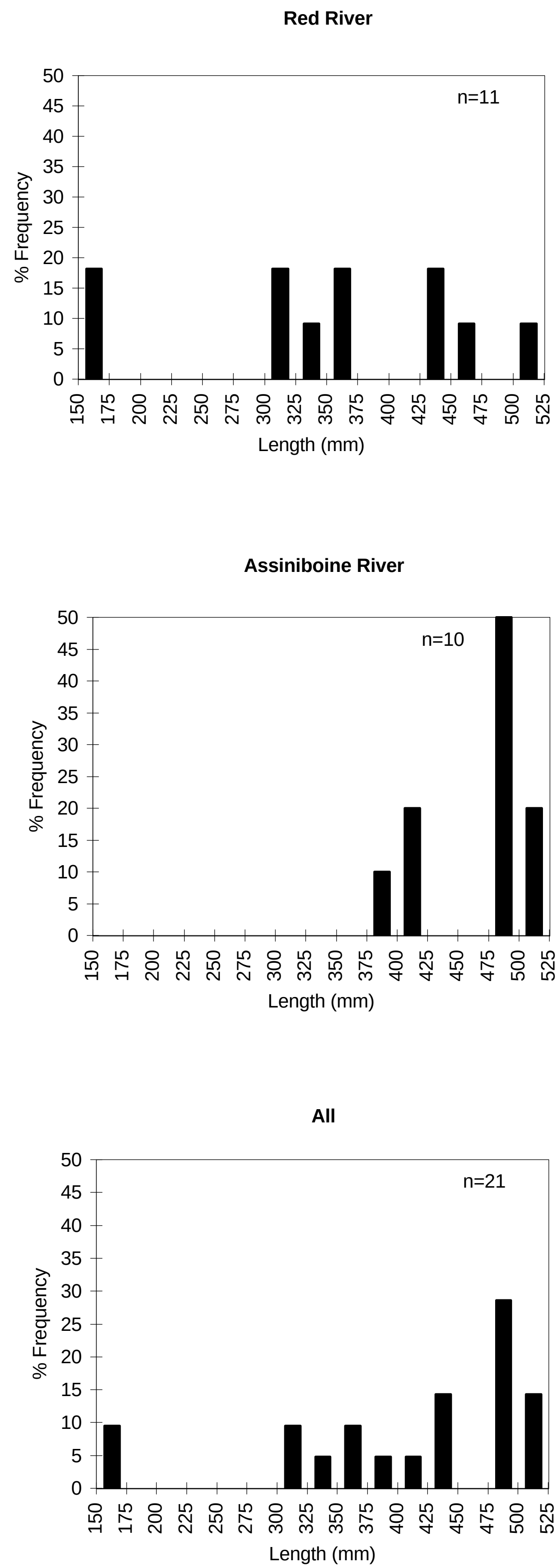


Figure 29. Length-frequency distributions for silver redhorse in zones from which they were captured in the Red and Assiniboine rivers, 1999.

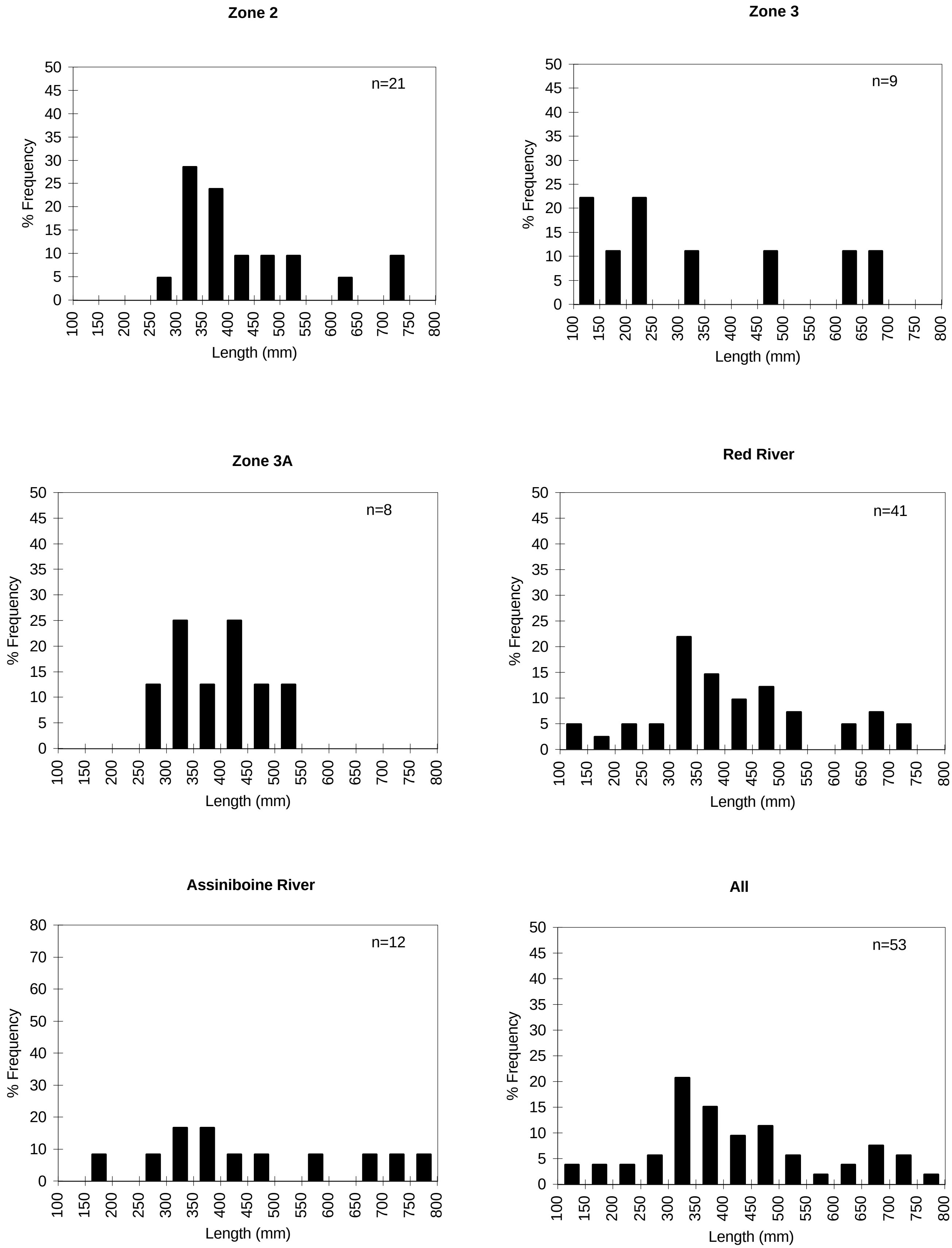


Figure 30. Length-frequency distributions for walleye in zones from which they were captured in the Red and Assiniboine rivers, 1999.

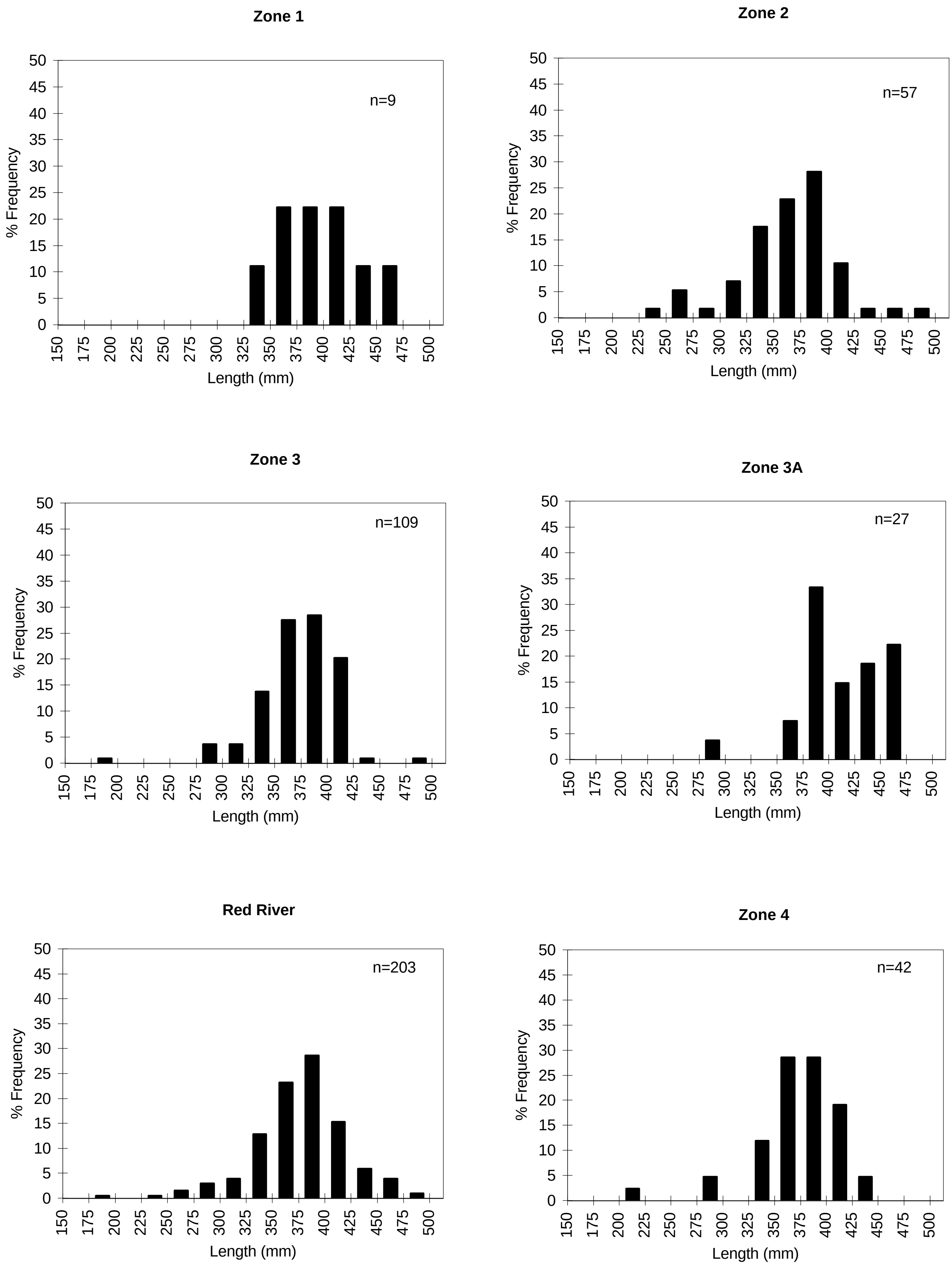


Figure 31. Length-frequency distributions for white sucker in zones from which they were captured in the Red and Assiniboine rivers, 1999.

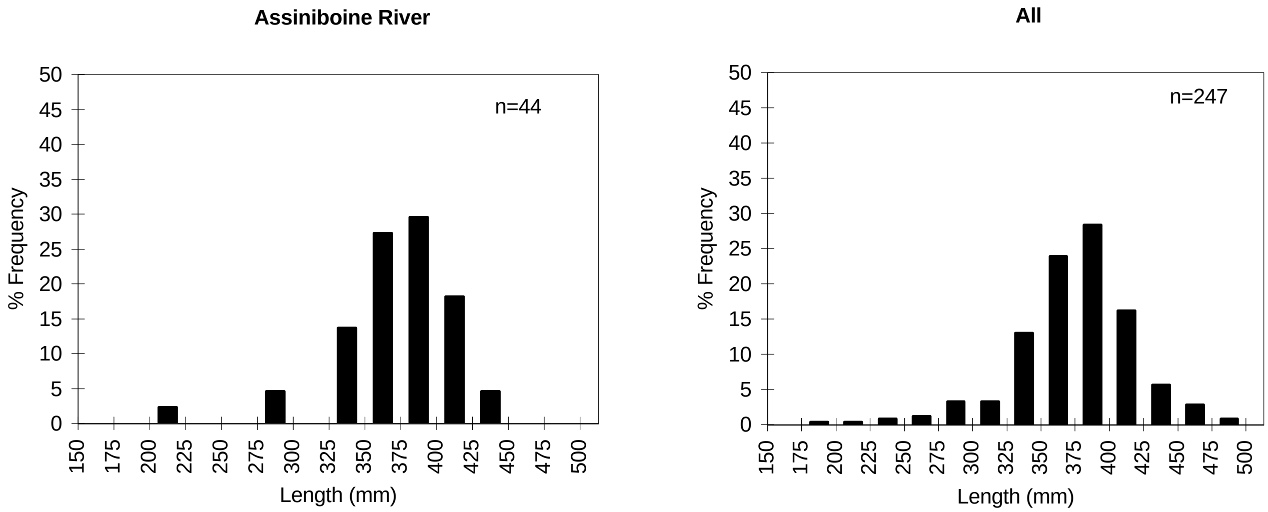


Figure 31. Continued... (white sucker)

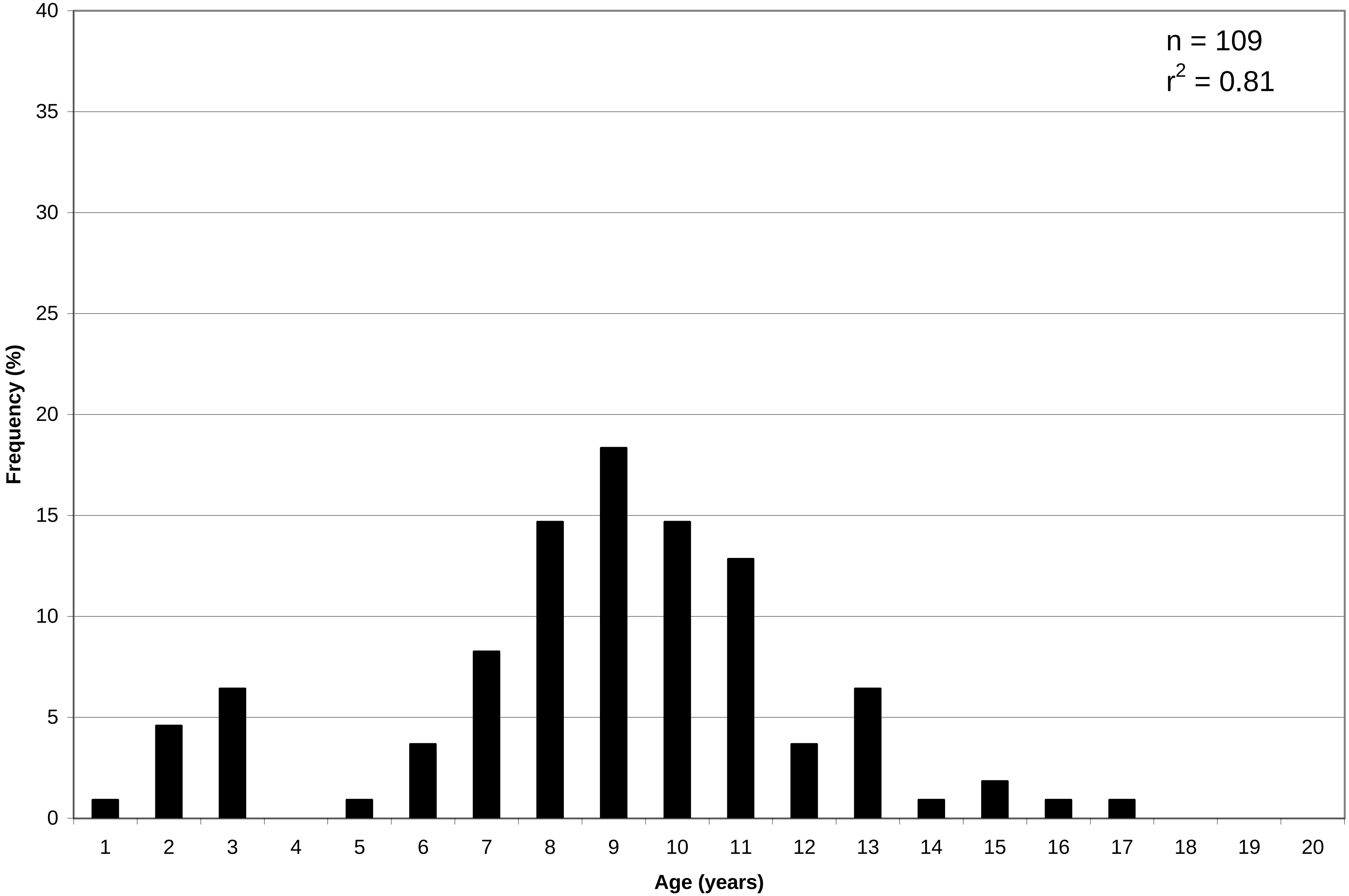


Figure 32. Age-frequency distribution for carp captured in the Red and Assiniboine rivers, 1999.

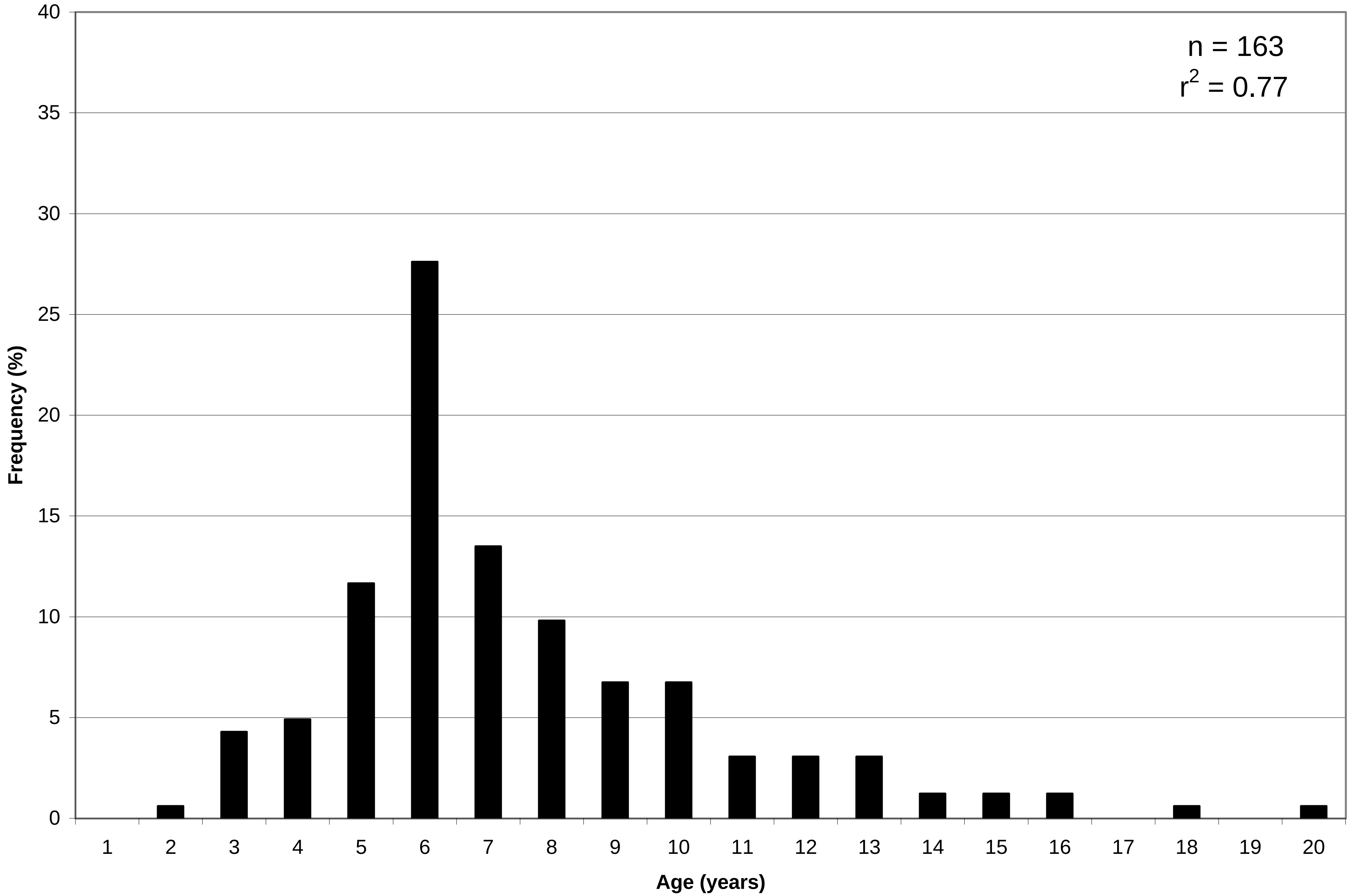


Figure 33. Age-frequency distribution for channel catfish captured in the Red and Assiniboine rivers, 1999.

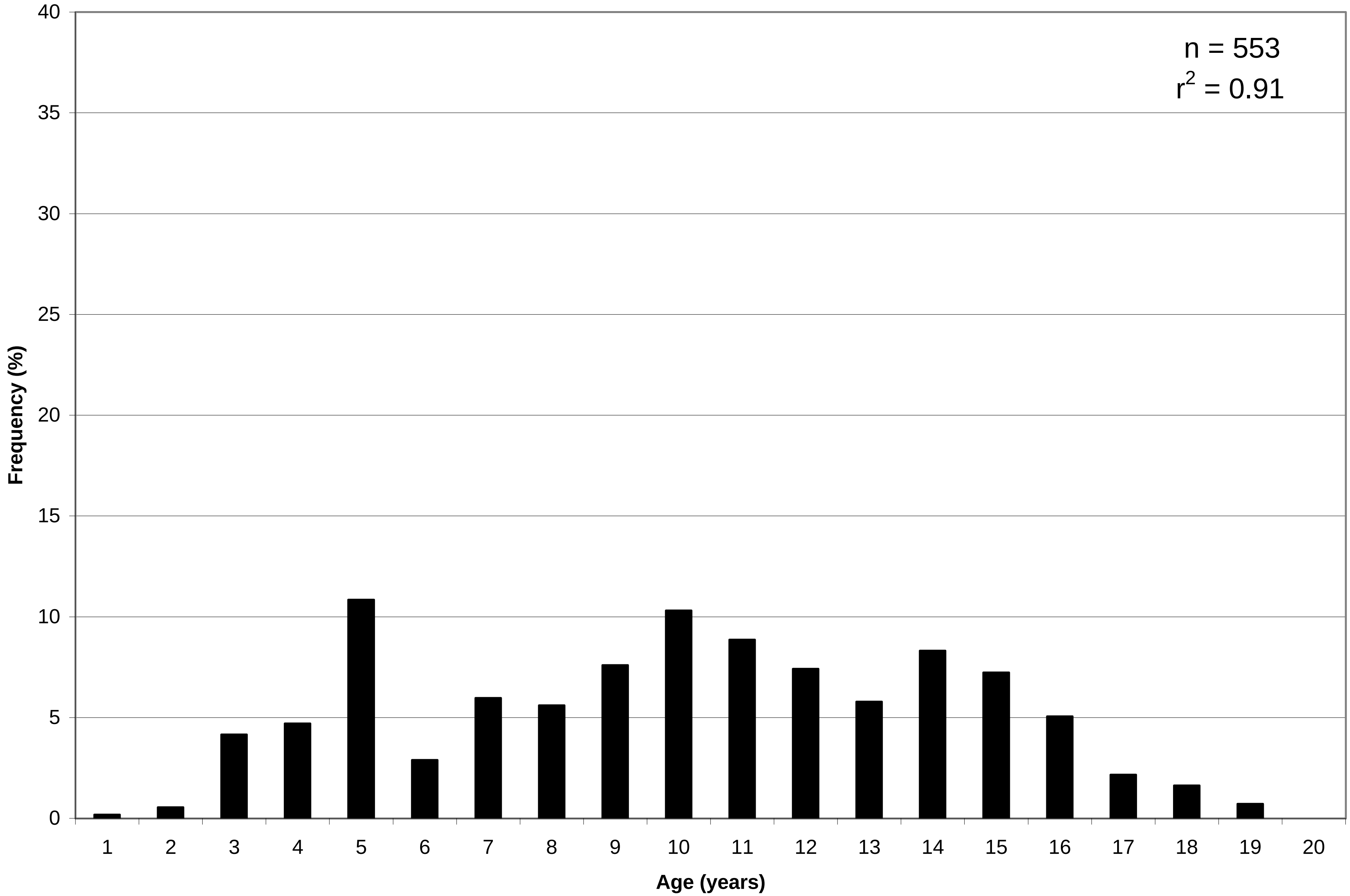


Figure 34. Age-frequency distribution for freshwater drum captured in the Red and Assiniboine rivers, 1999.

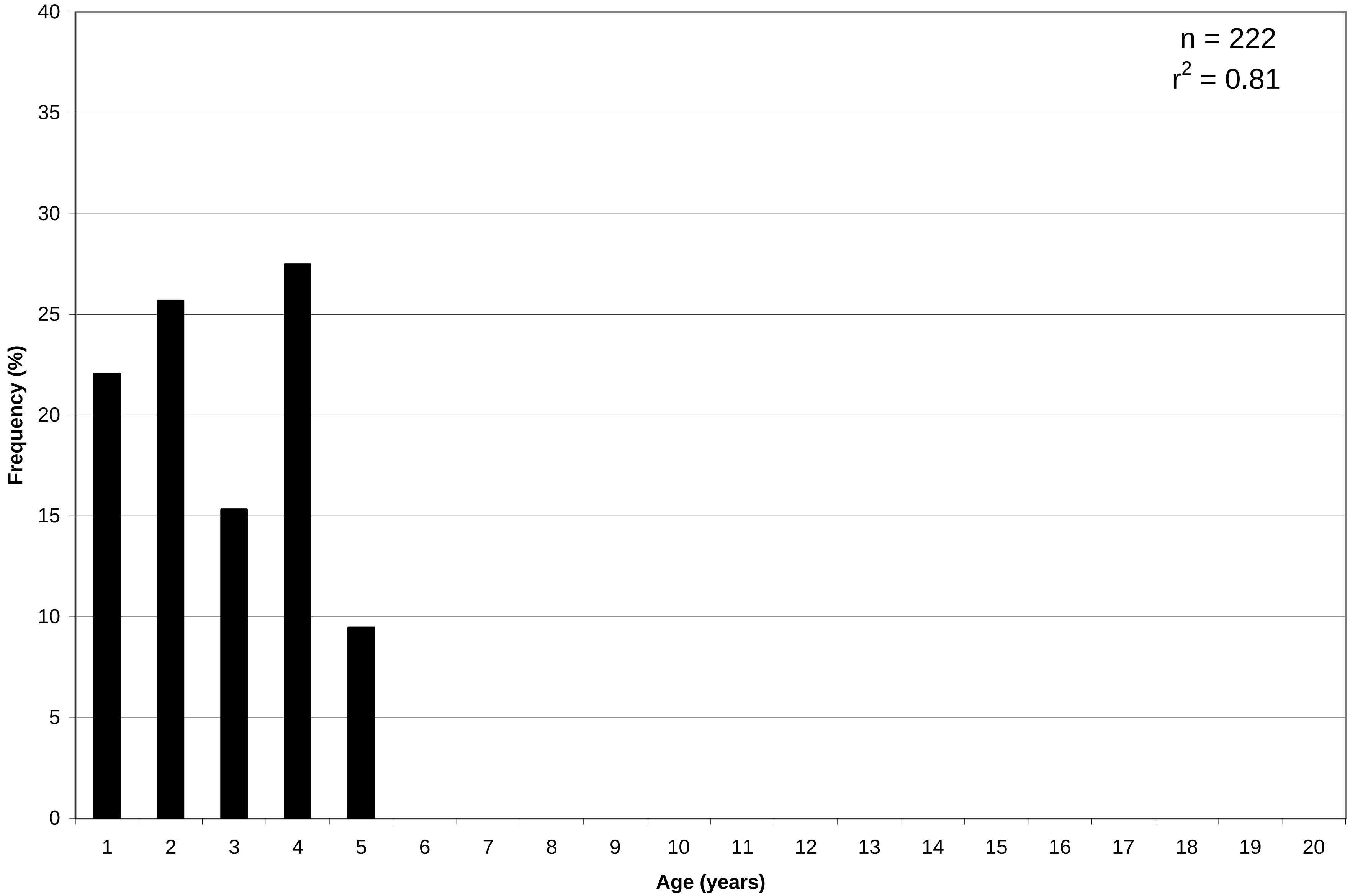


Figure 35. Age-frequency distribution for goldeye captured in the Red and Assiniboine rivers, 1999.

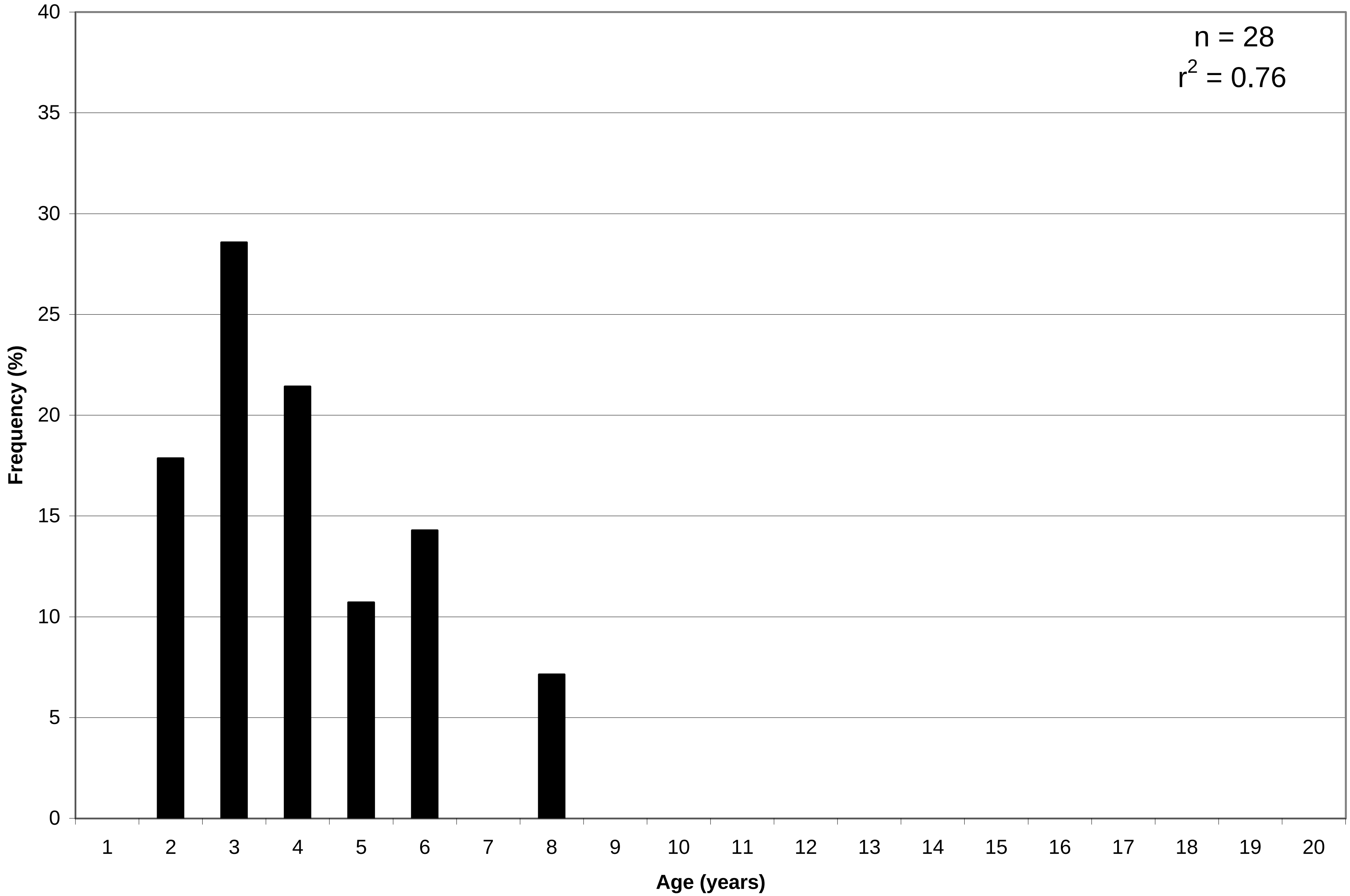


Figure 36. Age-frequency distribution for northern pike captured in the Red and Assiniboine rivers, 1999.

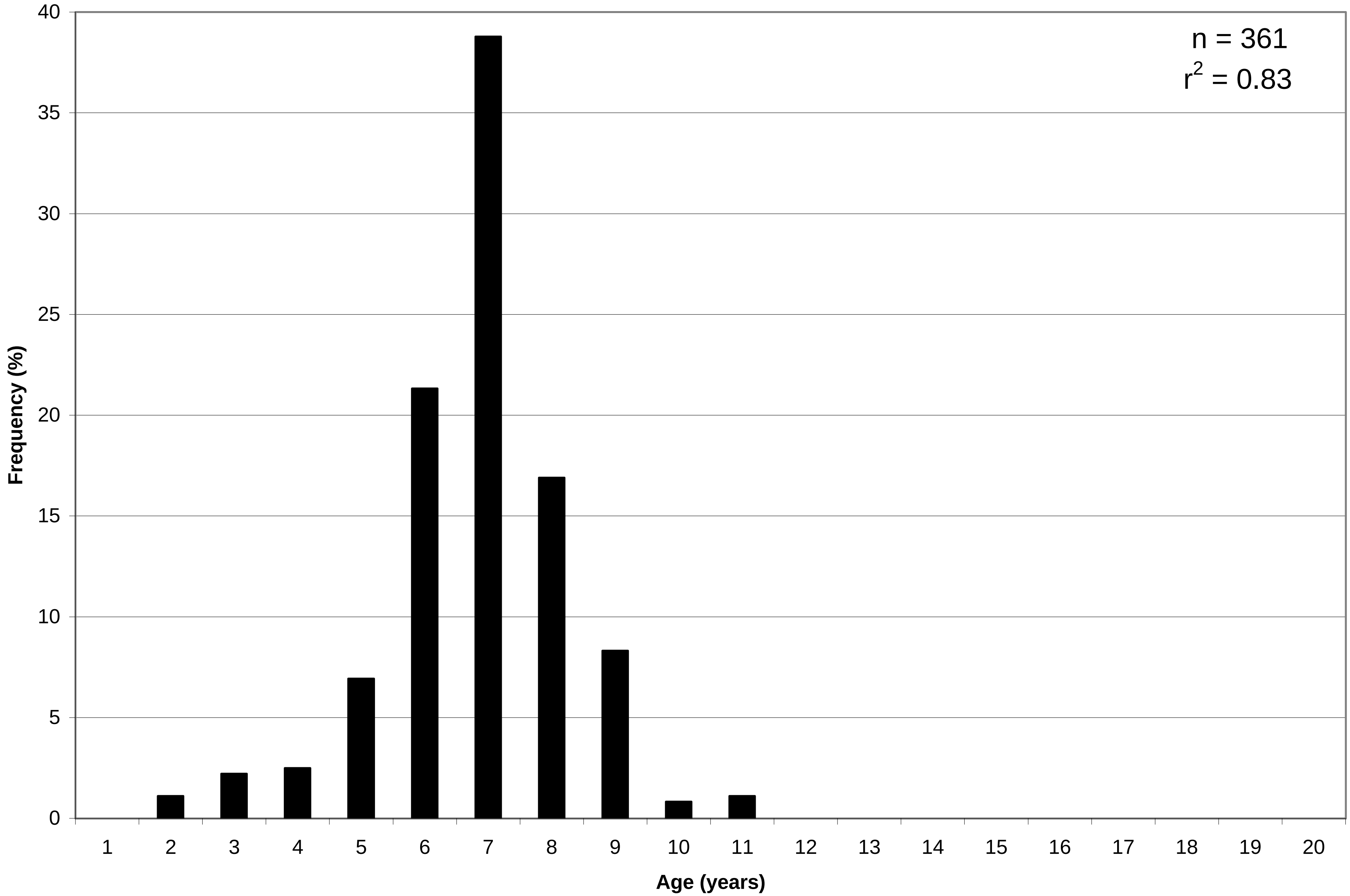


Figure 37. Age-frequency distribution for shorthead redhorse captured in the Red and Assiniboine rivers, 1999.

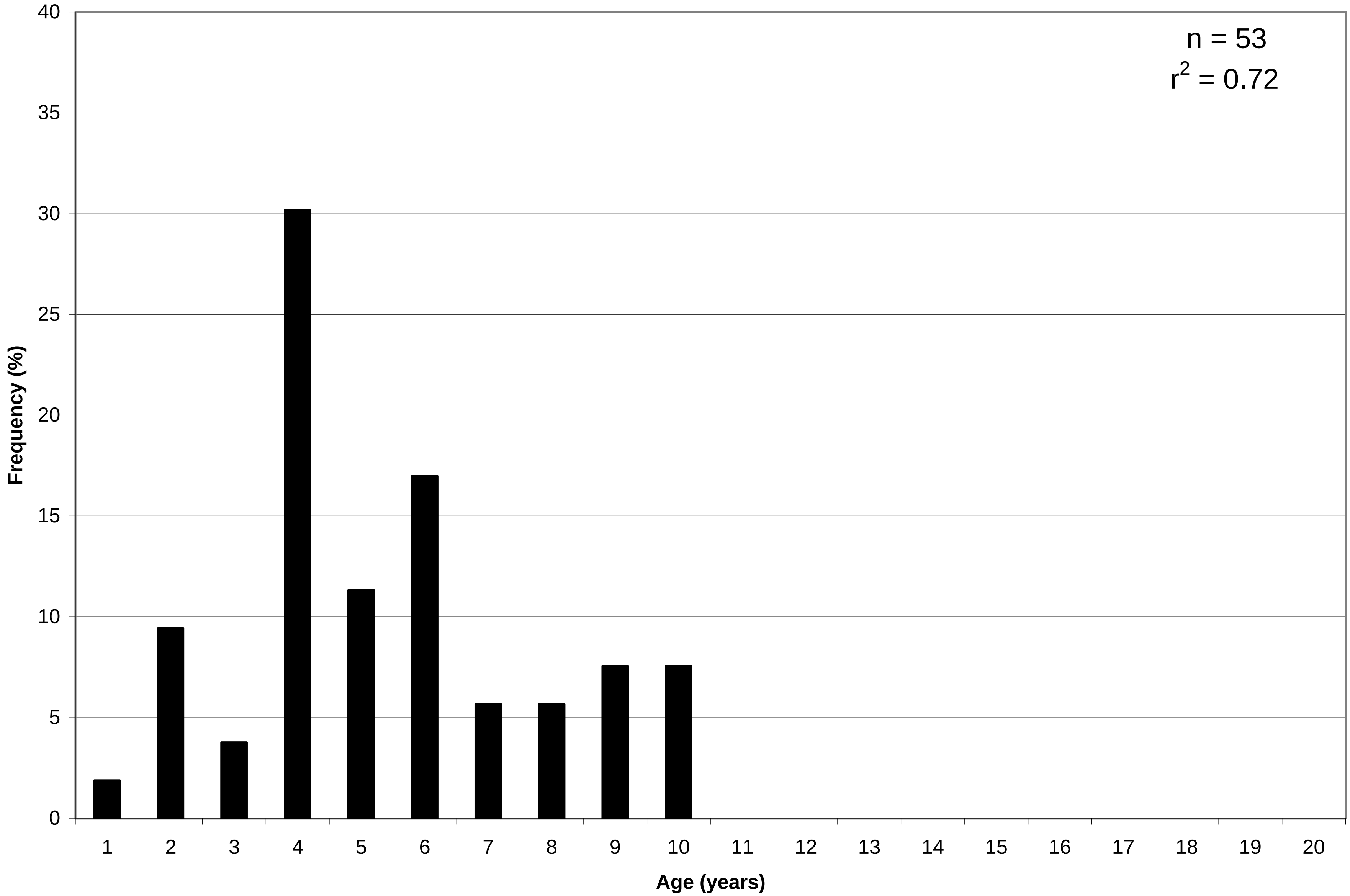


Figure 38. Age-frequency distribution for walleye captured in the Red and Assiniboine rivers, 1999.

13 Year-Old Fish

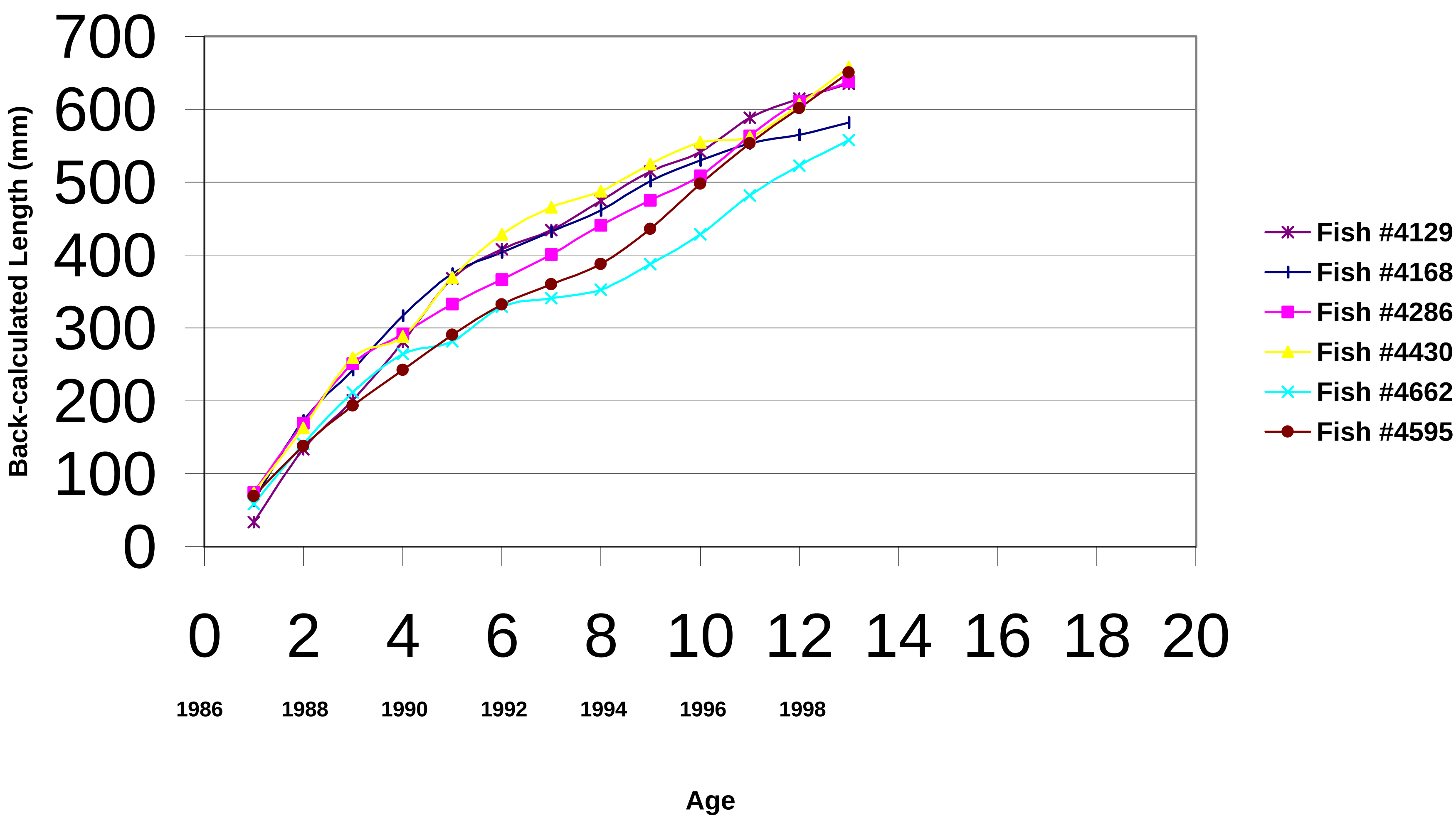


Figure 39. Back-calculated lengths, by age, for thirteen year-old channel catfish captured in the Red and Assiniboine rivers within the City of Winnipeg Ammonia Criteria Study Area, 1999.

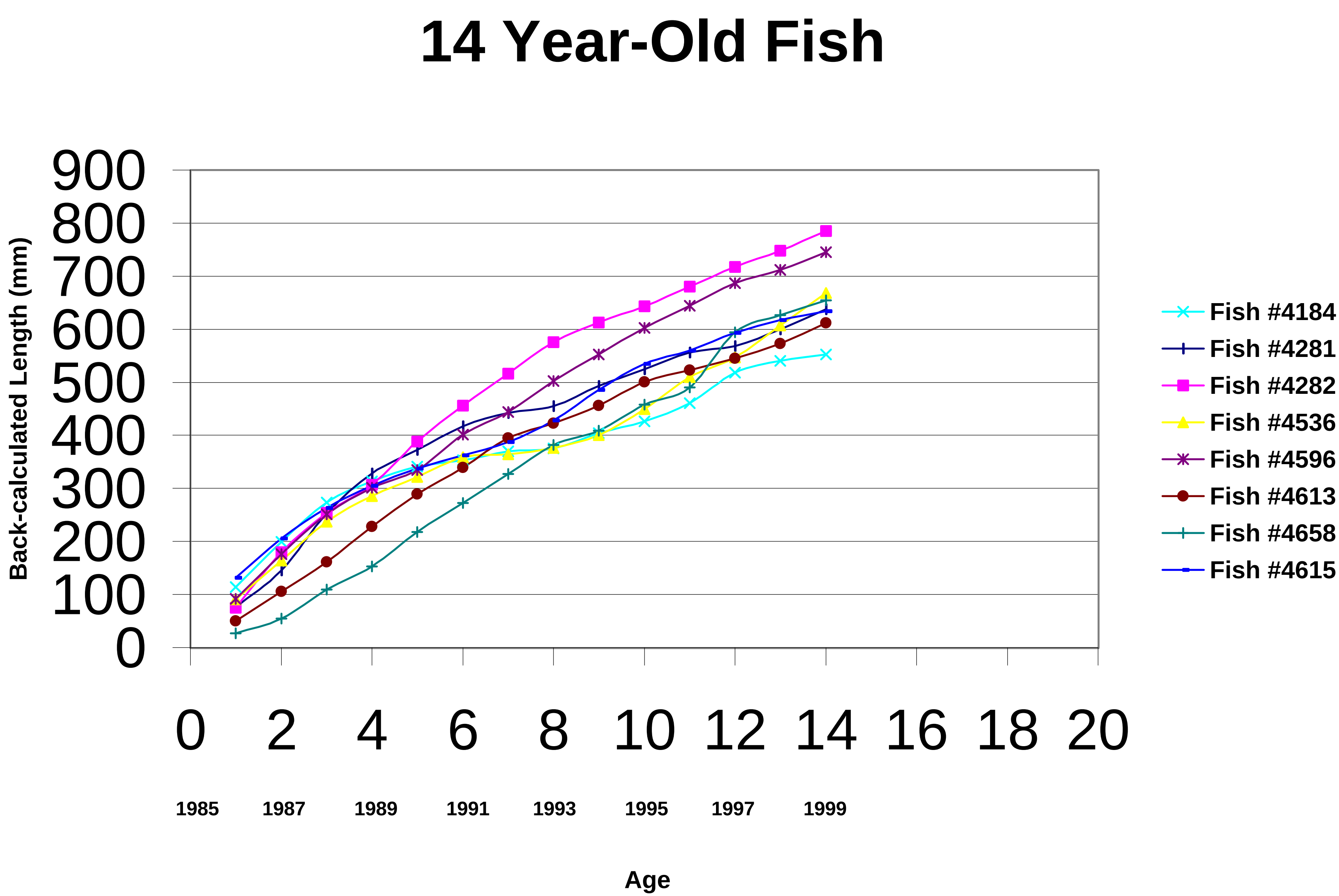


Figure 40. Back-calculated lengths, by age, for fourteen year-old channel catfish captured in the Red and Assiniboine rivers within the City of Winnipeg Ammonia Criteria Study Area, 1999.

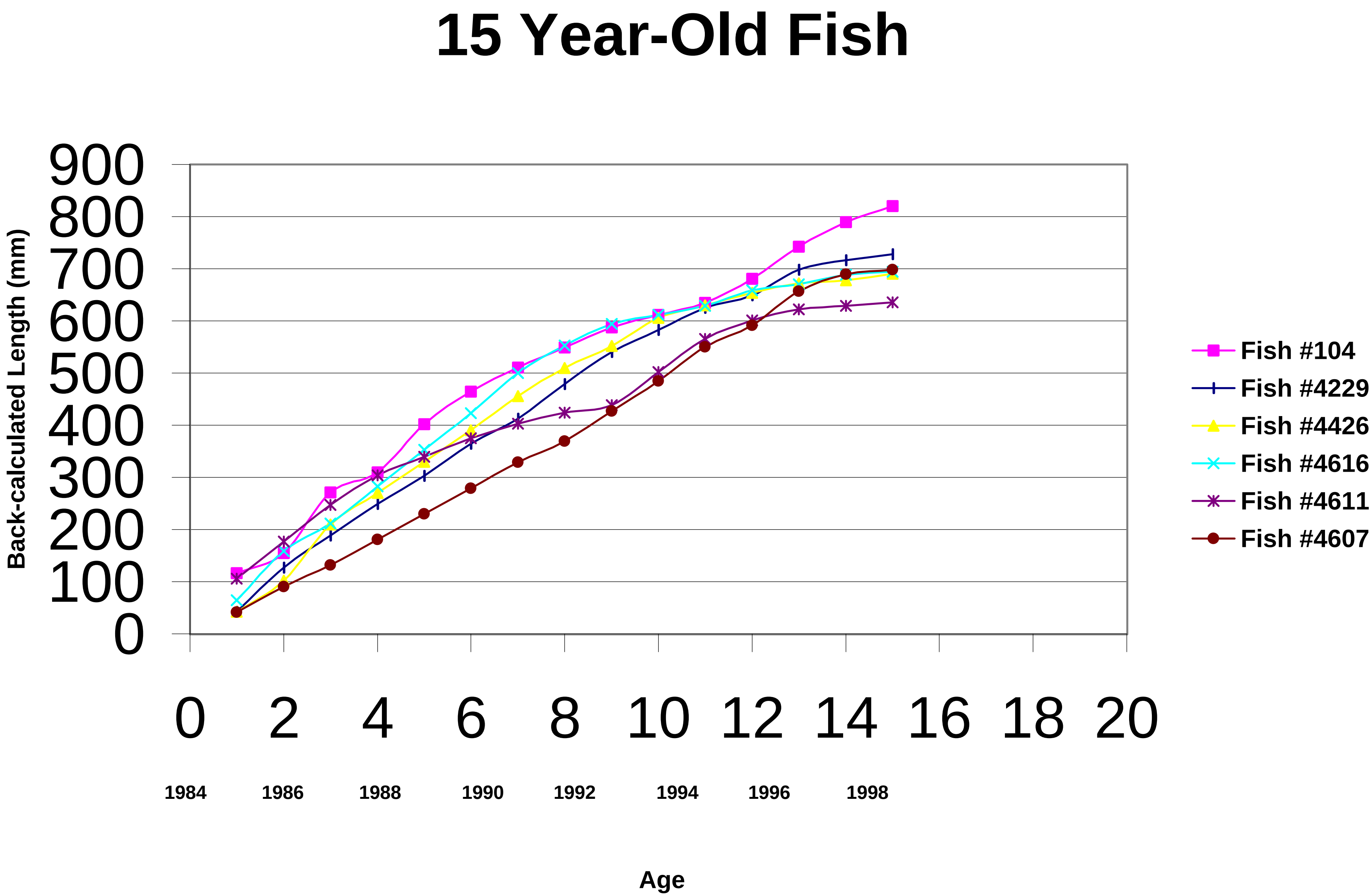


Figure 41. Back-calculated lengths, by age, for fifteen year-old channel catfish captured in the Red and Assiniboine rivers within the City of Winnipeg Ammonia Criteria Study Area, 1999.

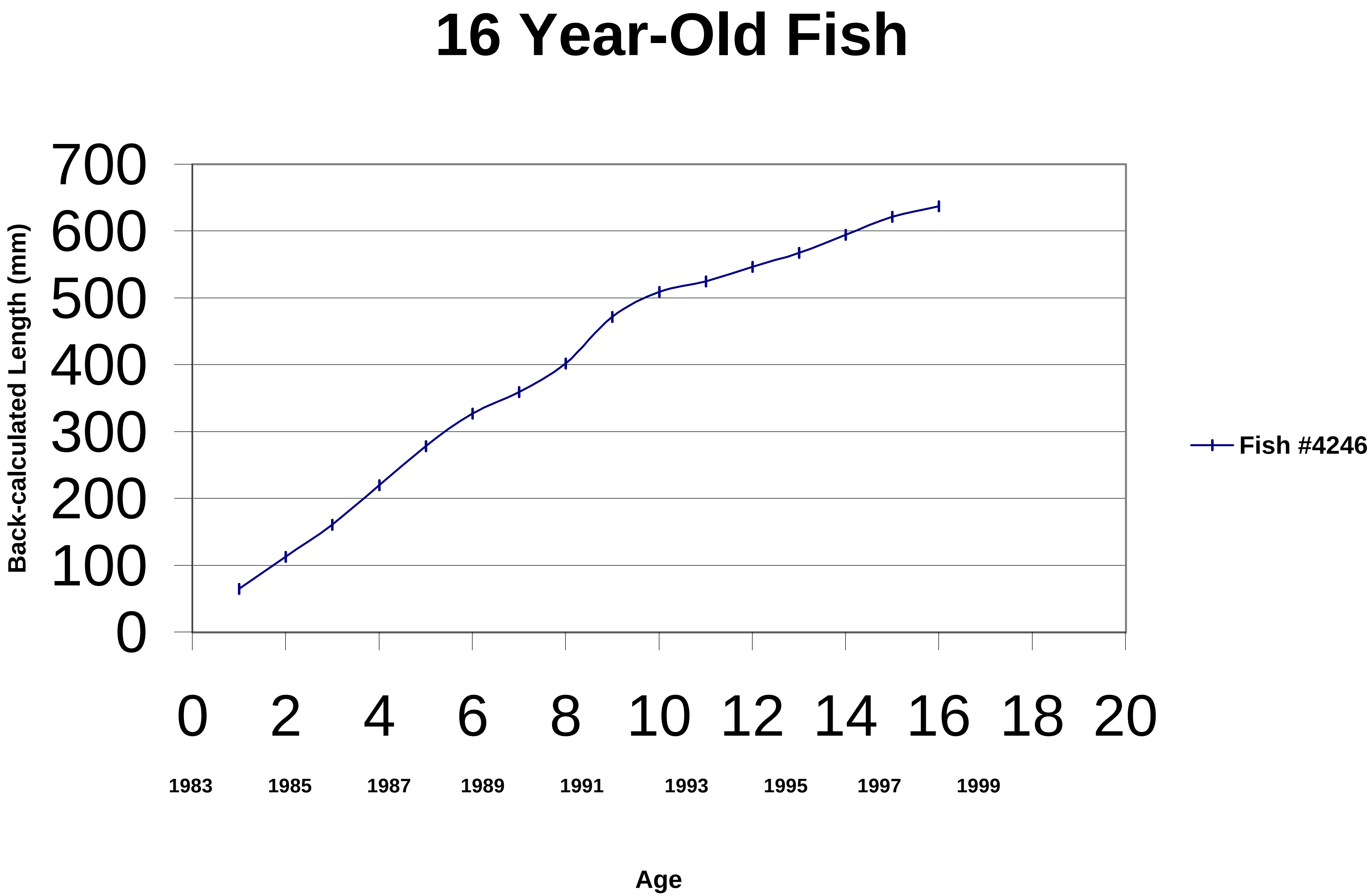


Figure 42. Back-calculated lengths, by age, for sixteen year-old channel catfish captured in the Red and Assiniboine rivers within the City of Winnipeg Ammonia Criteria Study Area, 1999.

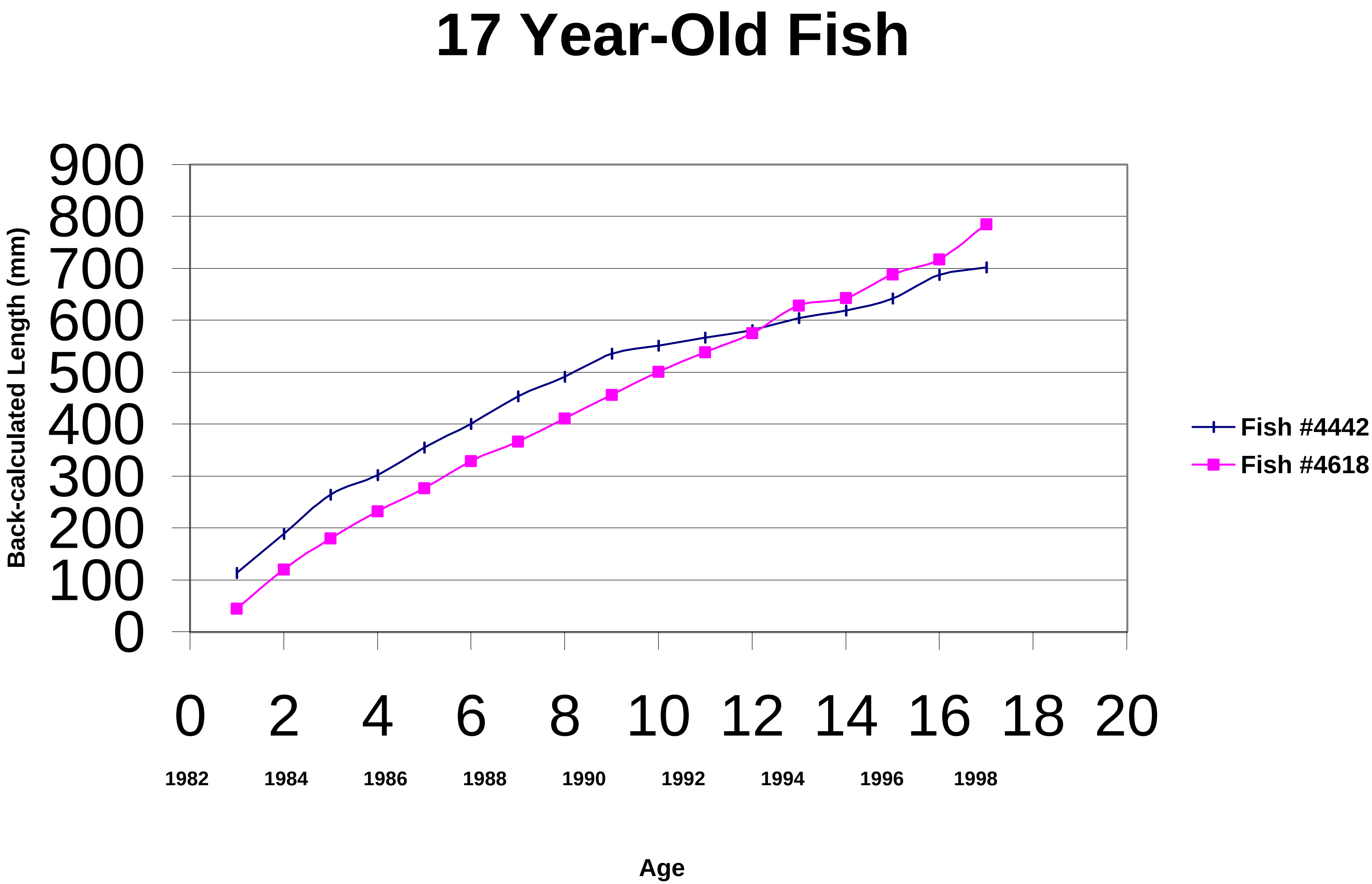


Figure 43. Back-calculated lengths, by age, for seventeen year-old channel catfish captured in the Red and Assiniboine rivers within the City of Winnipeg Ammonia Criteria Study Area, 1999.

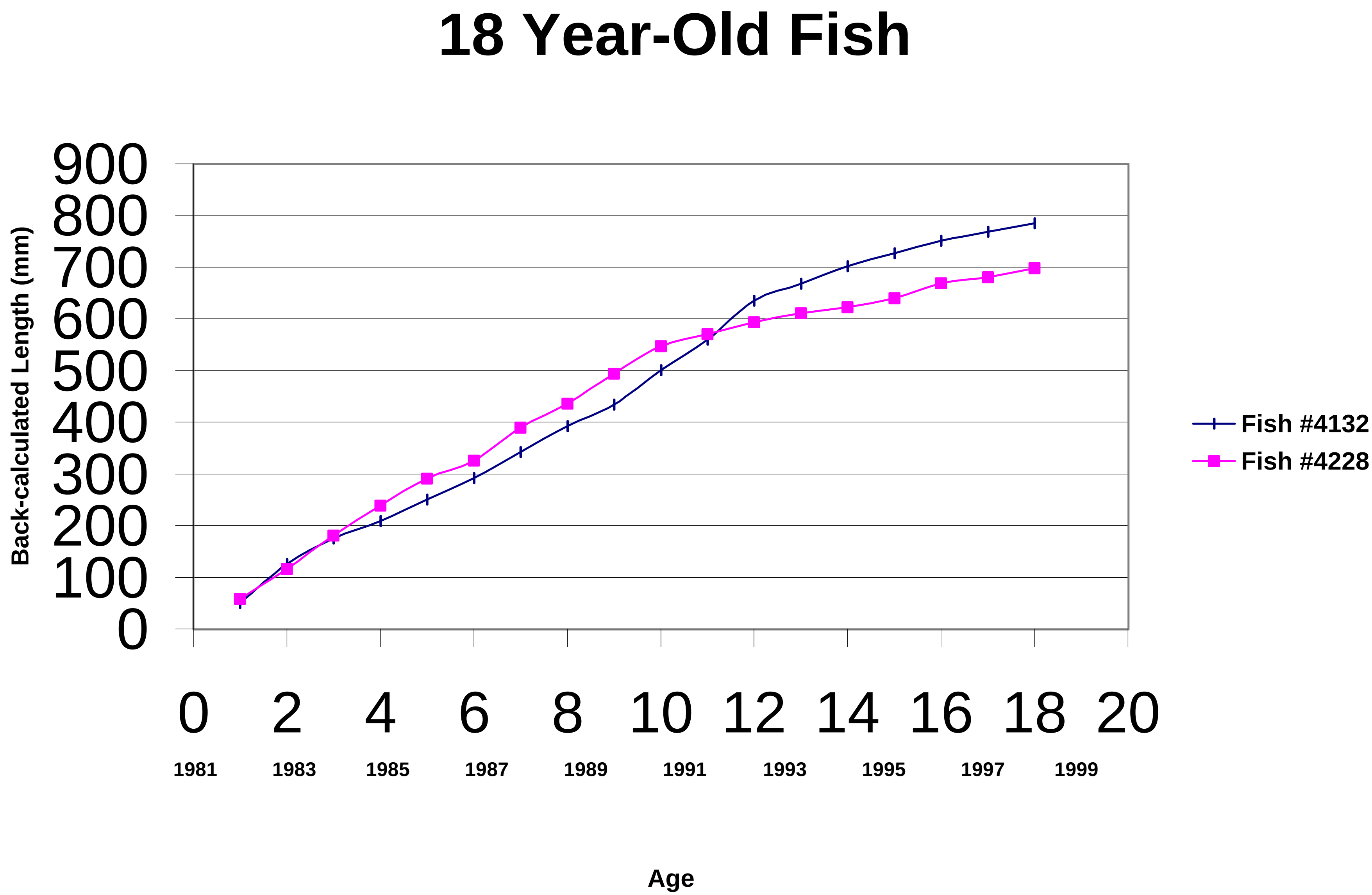


Figure 44. Back-calculated lengths, by age, for eighteen year-old channel catfish captured in the Red and Assiniboine rivers within the City of Winnipeg Ammonia Criteria Study Area, 1999.

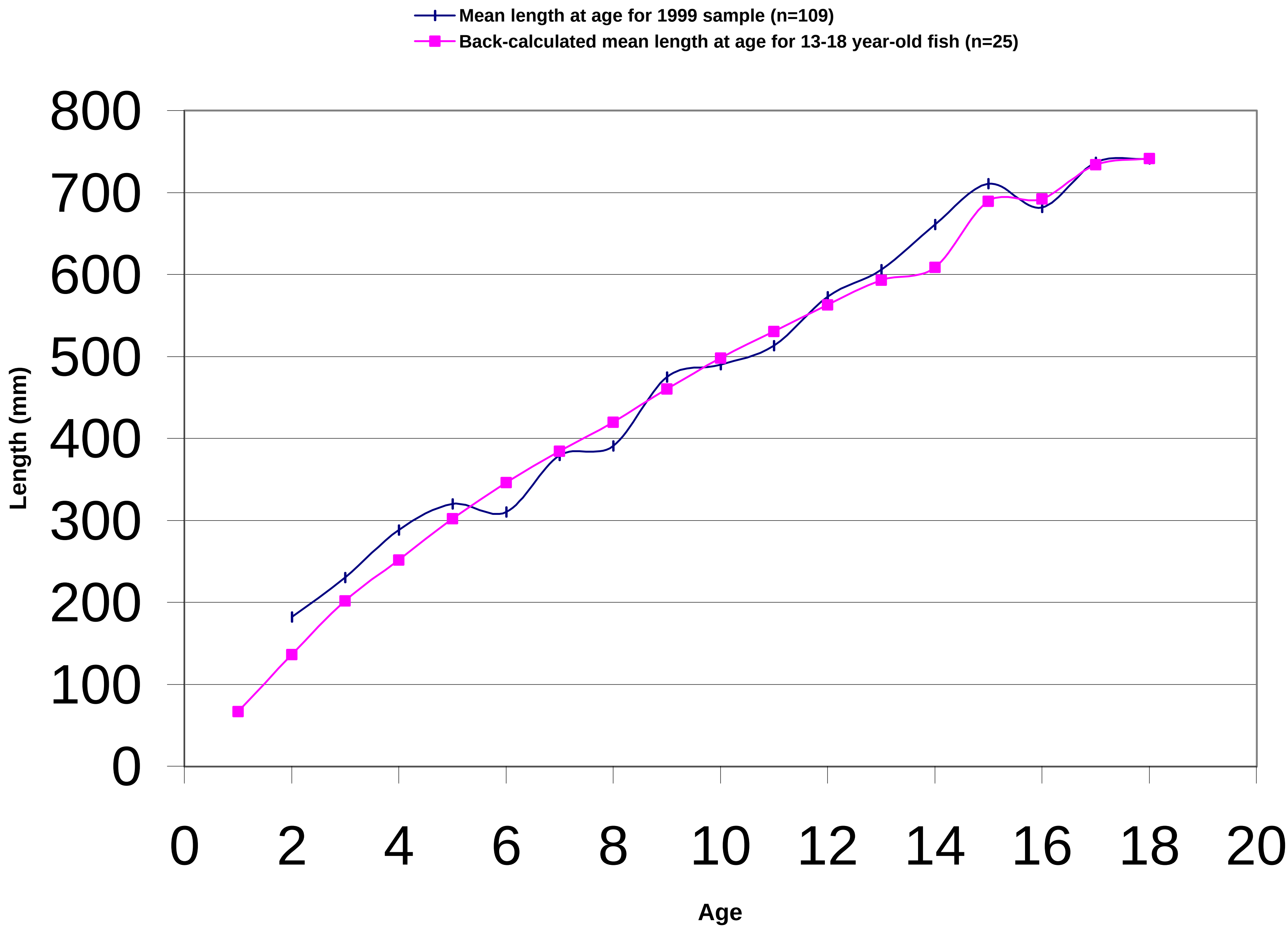


Figure 45. Comparison of mean length at age for 109 channel catfish captured in the Red and Assiniboine rivers in 1999, and back-calculated mean length at age, for twenty-five 13 to 18 year-old channel catfish captured in 1999.

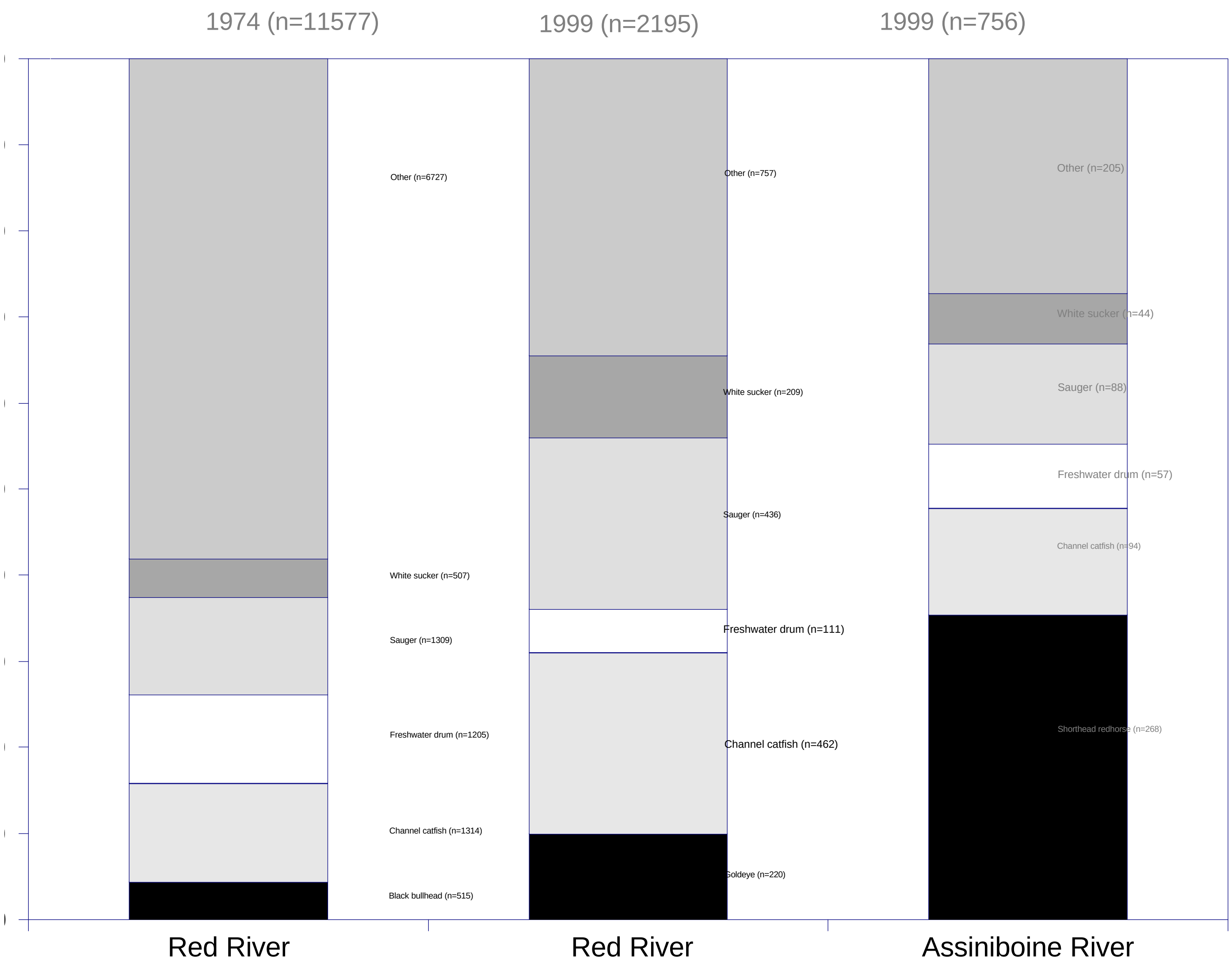


Figure 46 Species composition of fish captured in all gear types in the Red and Assiniboine rivers, 1974 (Clarke et al. 1980) and 1999.

Figure 47 Species composition of fish captured in hoop nets in the Red River, 1974 (Clarke et al. 1980) and 1999.

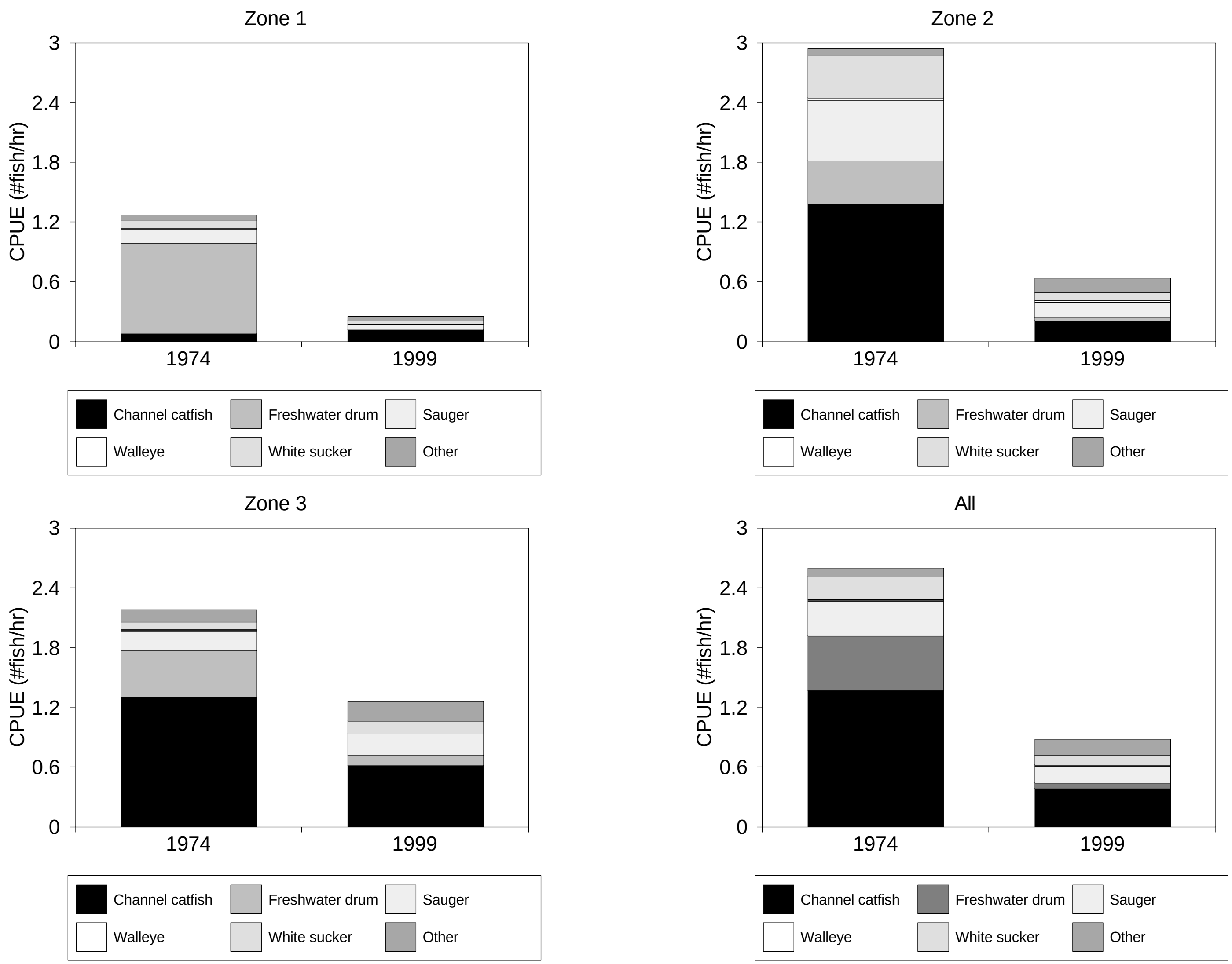


Figure 48. Mean catch-per-unit-effort (CPUE) of hoop nets set in the Red River, 1974 (Clarke et al. 1980) and 1999, by zone and species of fish.

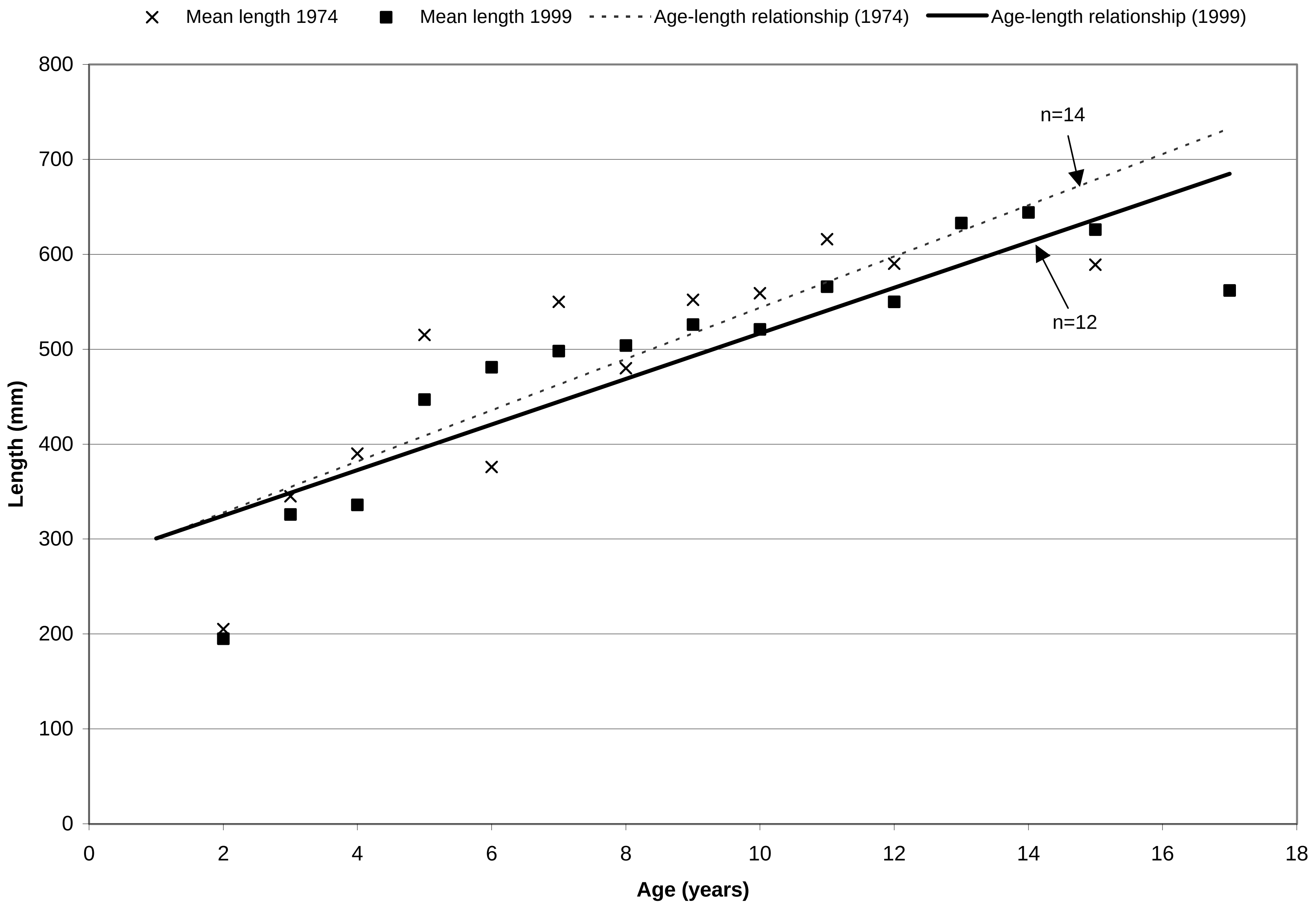


Figure 49. Age-length relationships for carp captured in the Red and Assiniboine rivers, 1974 (Clarke et al. 1980) and 1999.

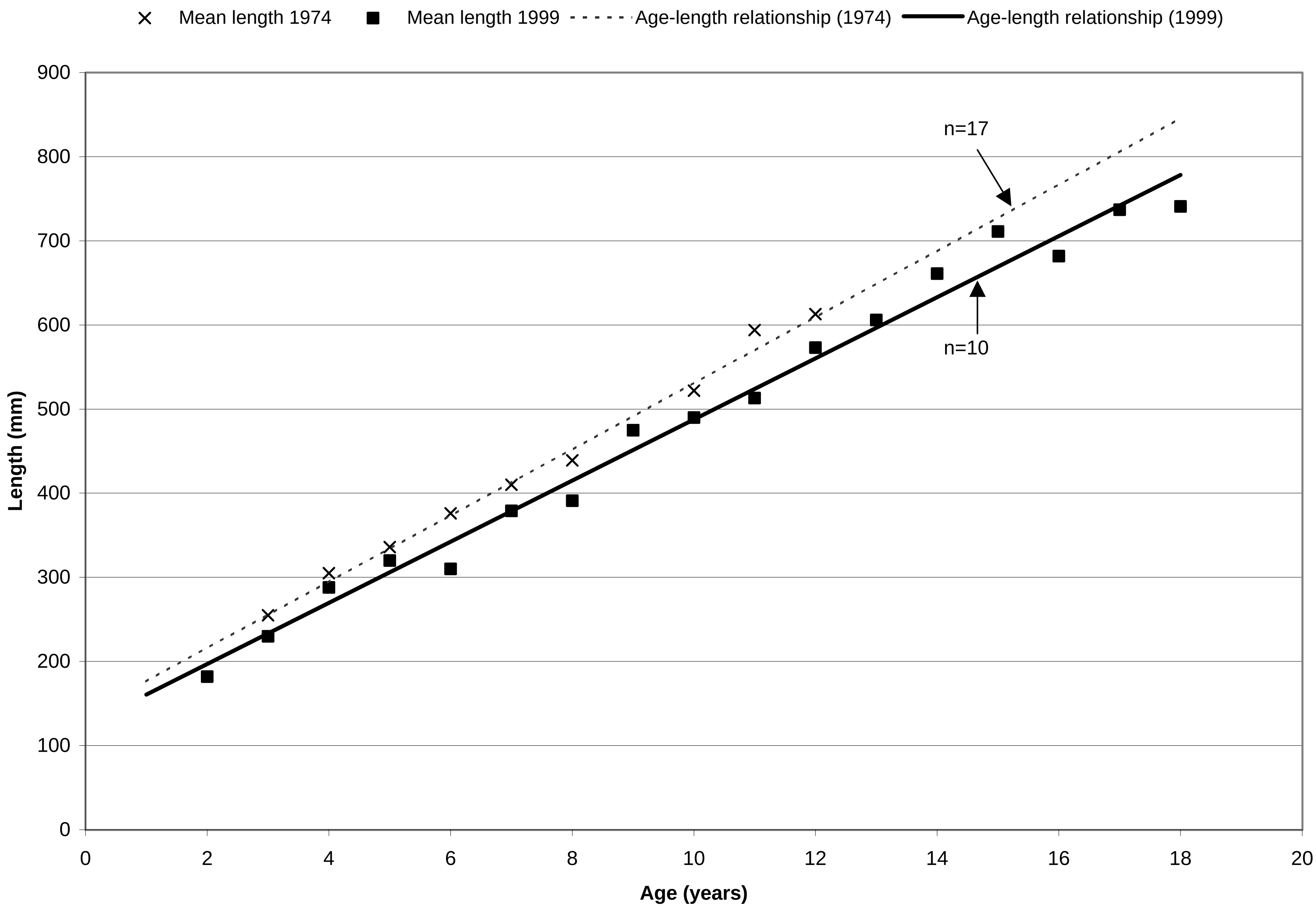


Figure 50. Age-length relationships for channel catfish captured in the Red and Assiniboine rivers, 1974 (Clarke et al.1980) and 1999.

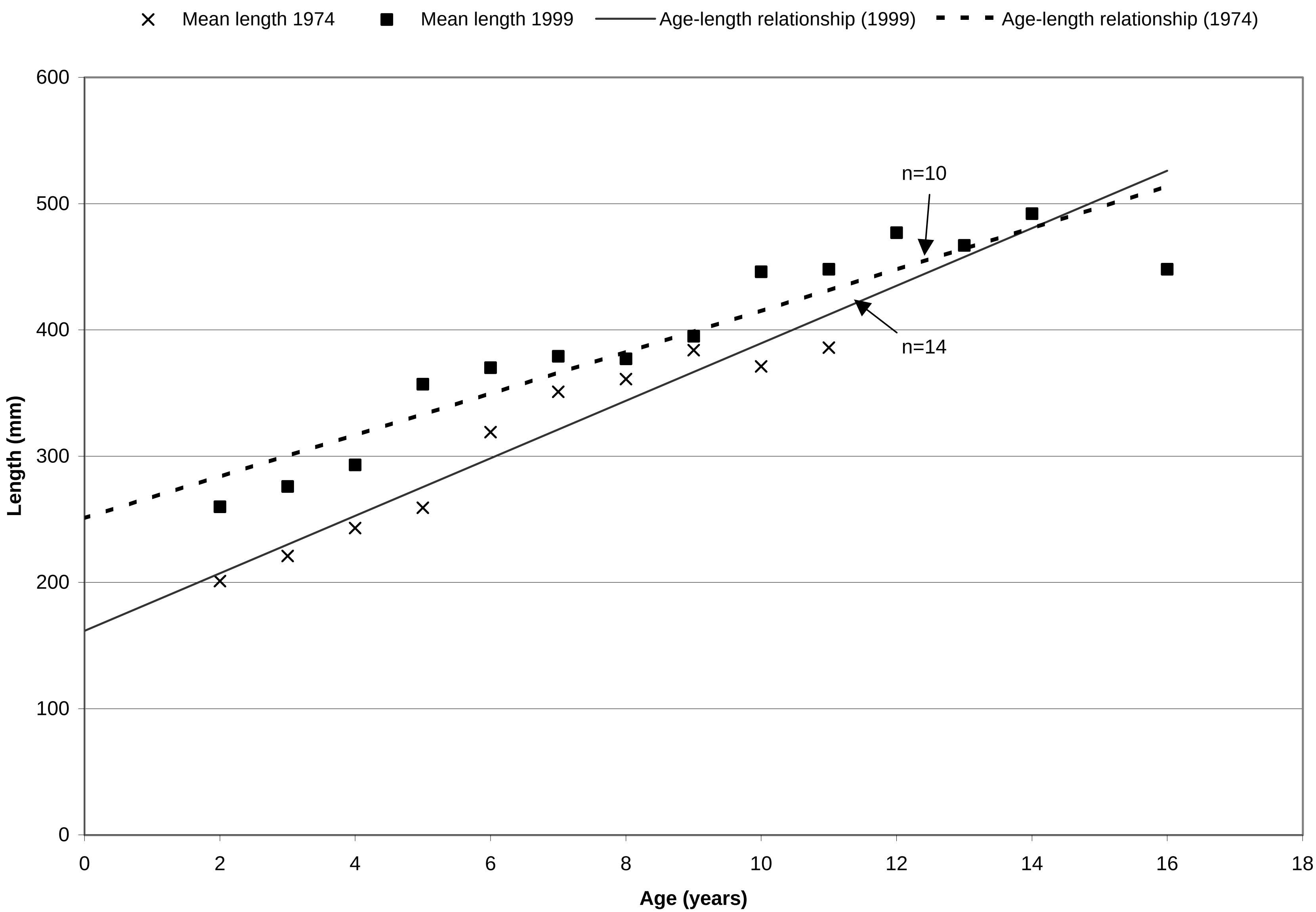


Figure 51. Age-length relationships for freshwater drum captured in the Red and Assiniboine rivers, 1974 (Clarke et al. 1980) and 1999.

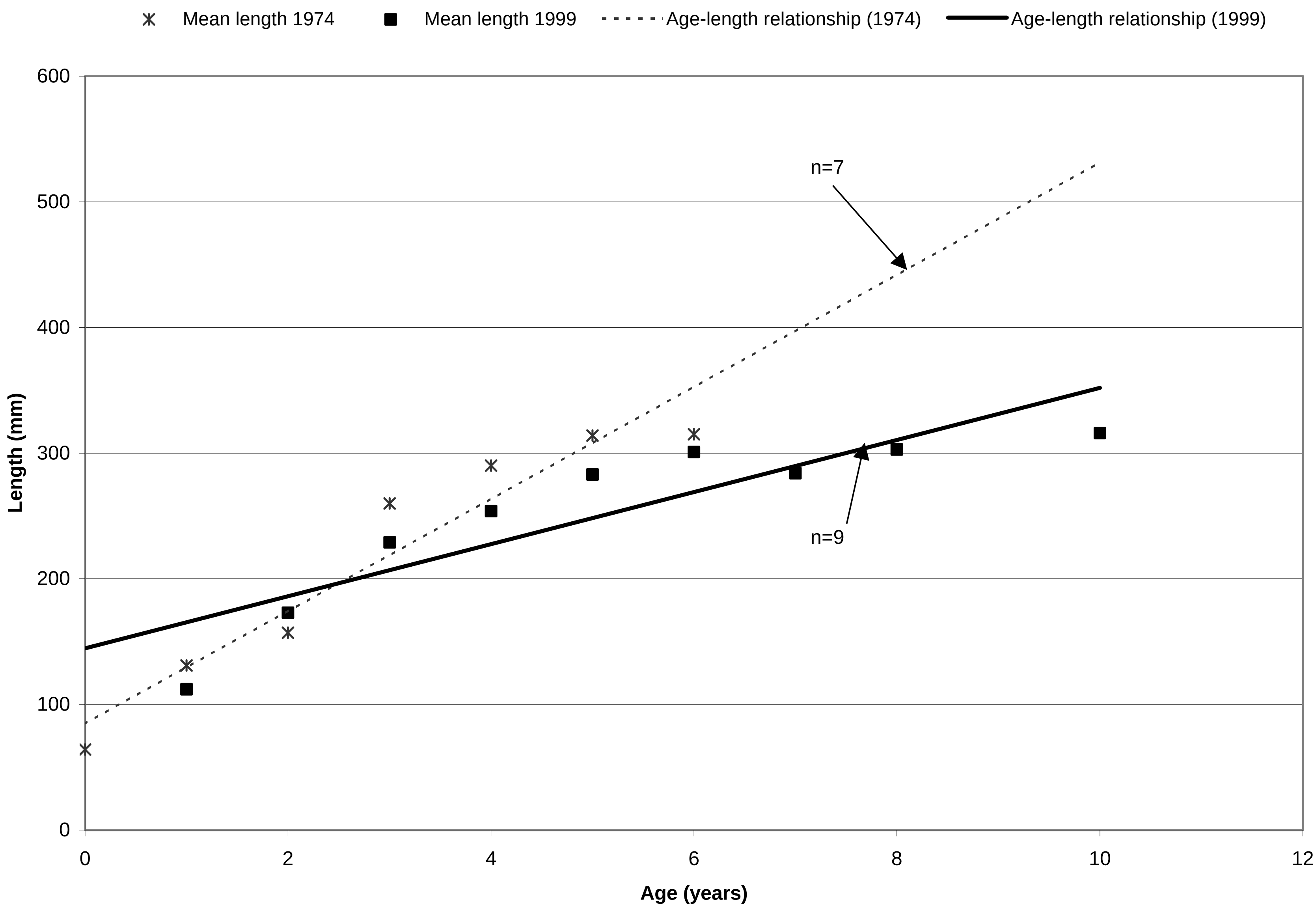


Figure 52. Age-length relationships for goldeye captured in the Red and Assiniboine rivers, 1974 (Clarke et al. 1980) and 1999.

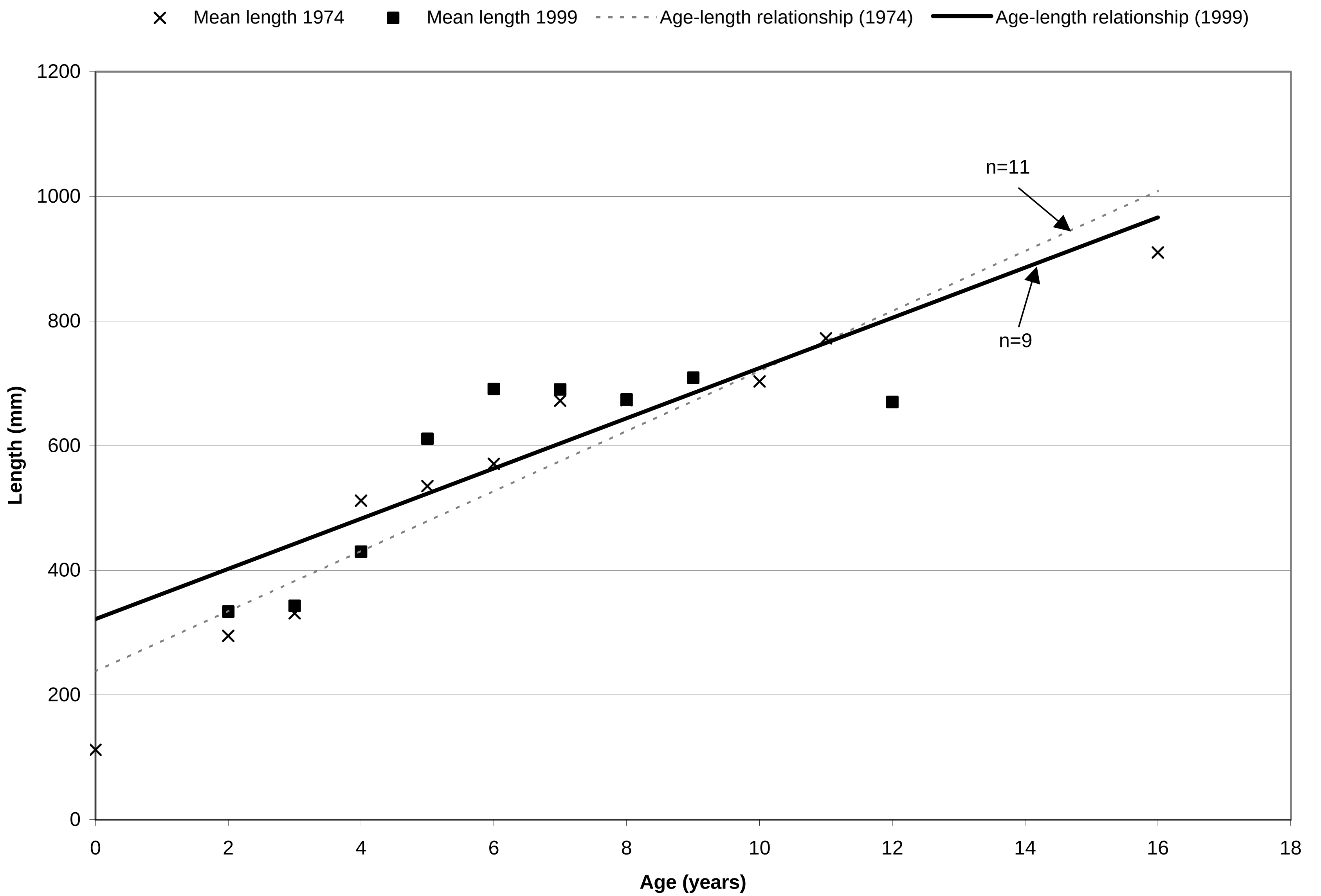


Figure 53. Age-length relationships for northern pike captured in the Red and Assiniboine rivers, 1974 (Clarke et al. 1980) and 1999.

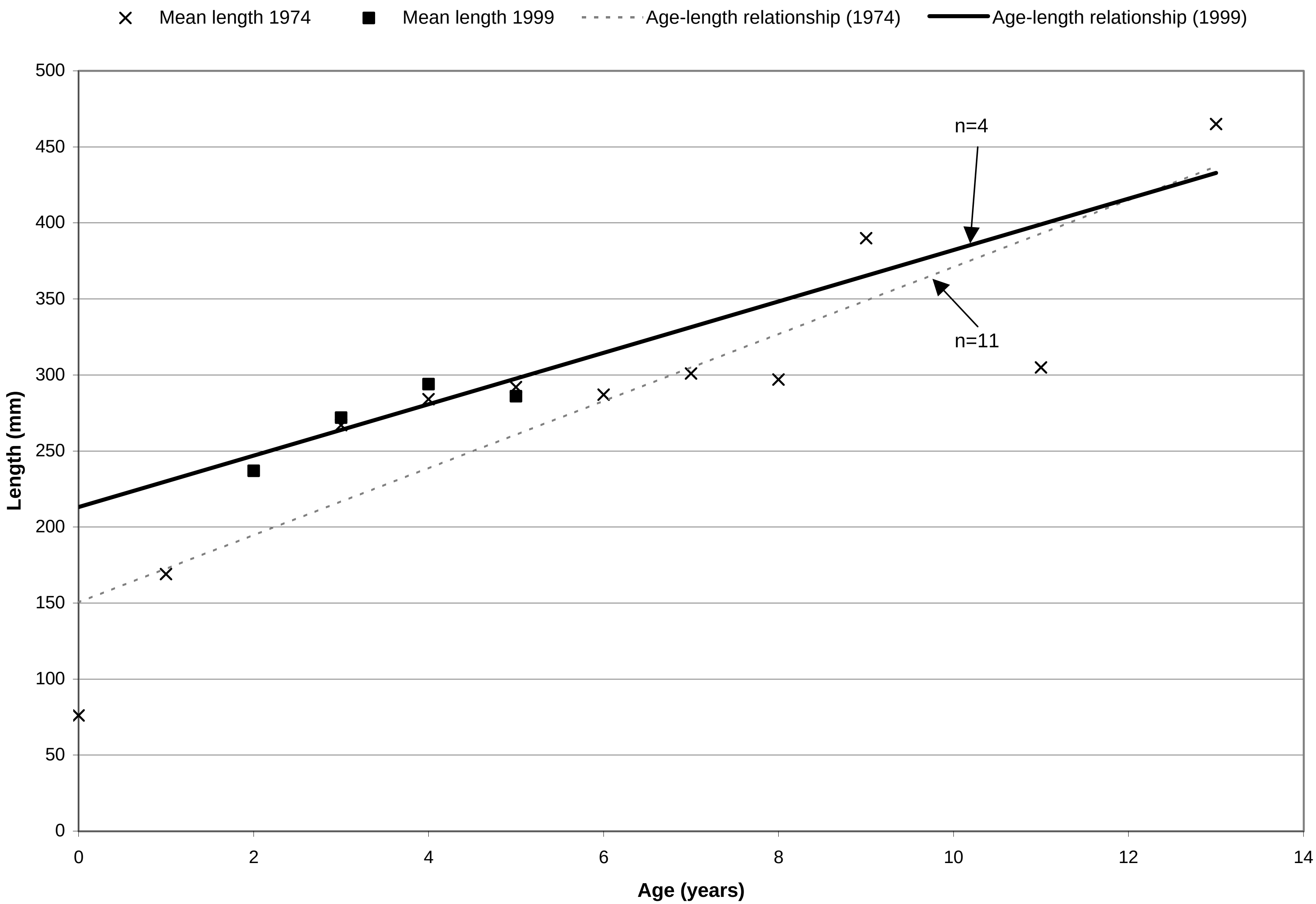


Figure 54. Age-length relationships for sauger captured in the Red and Assiniboine rivers, 1974 (Clarke et al. 1980) and 1999.

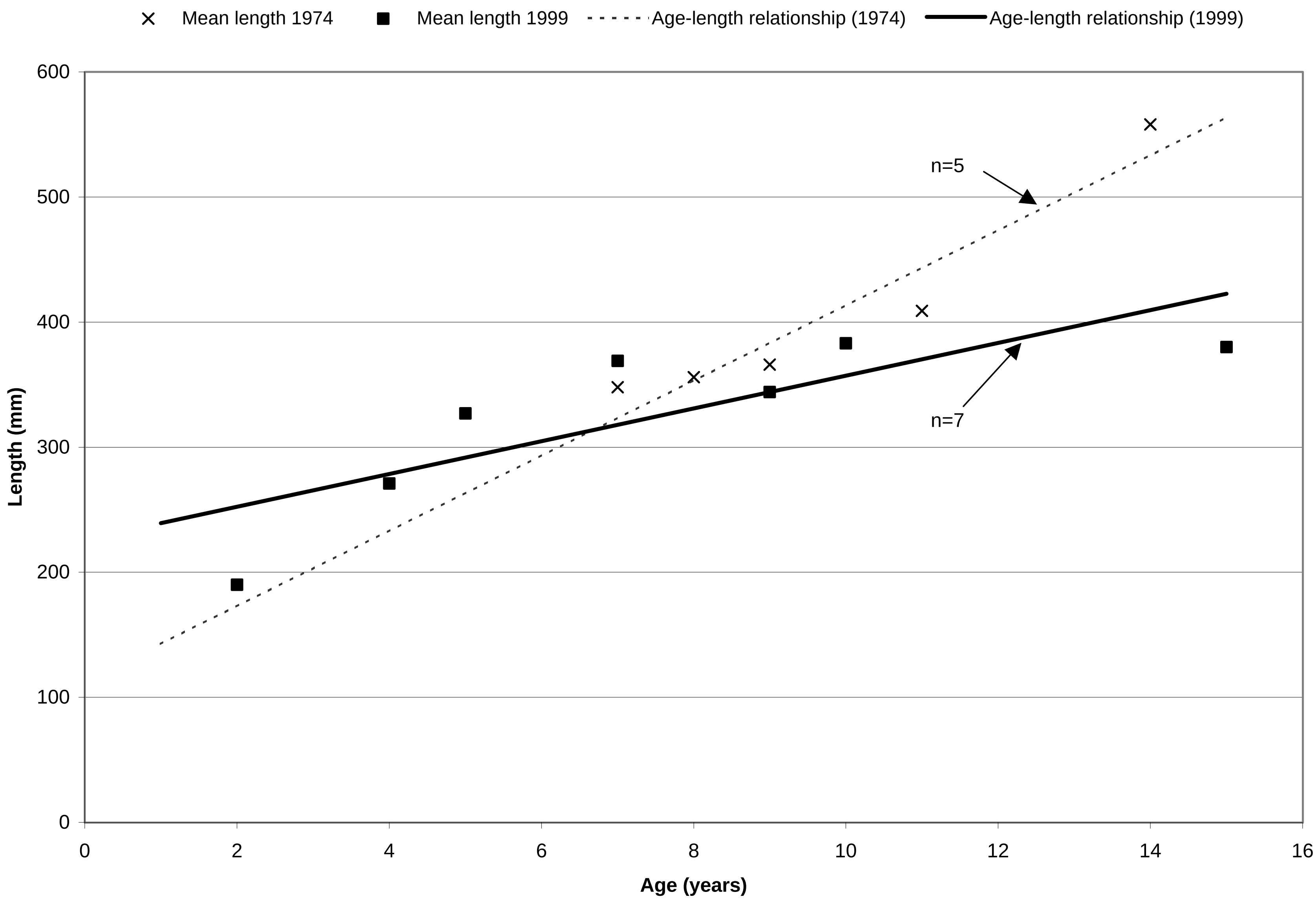


Figure 55. Age-length relationships for shorthead redhorse captured in the Red and Assiniboine rivers, 1974 (Clarke et al. 1980) and 1999.

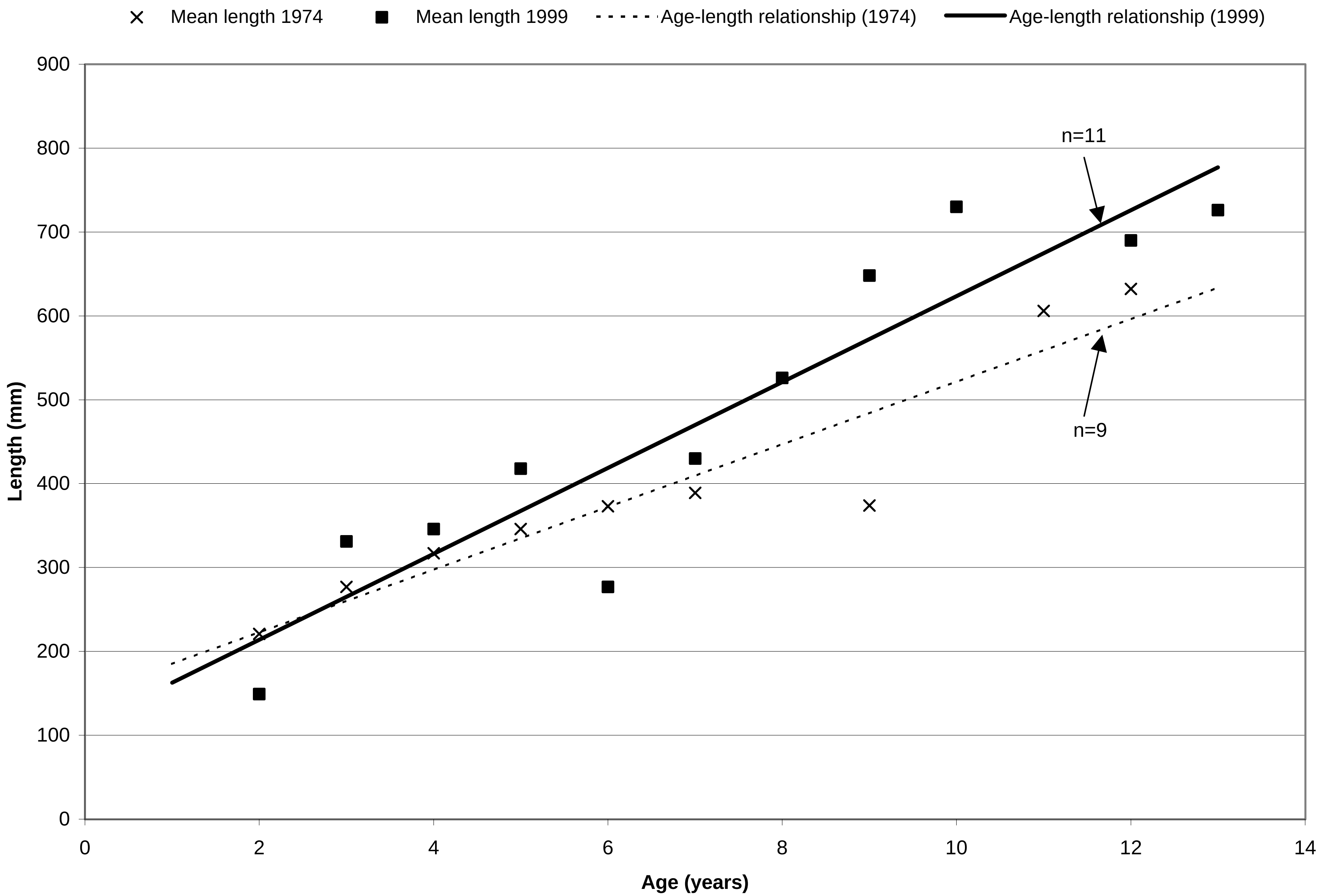


Figure 56. Age-length relationships for walleye captured in the Red and Assiniboine rivers, 1974 (Clarke et al. 1980) and 1999.

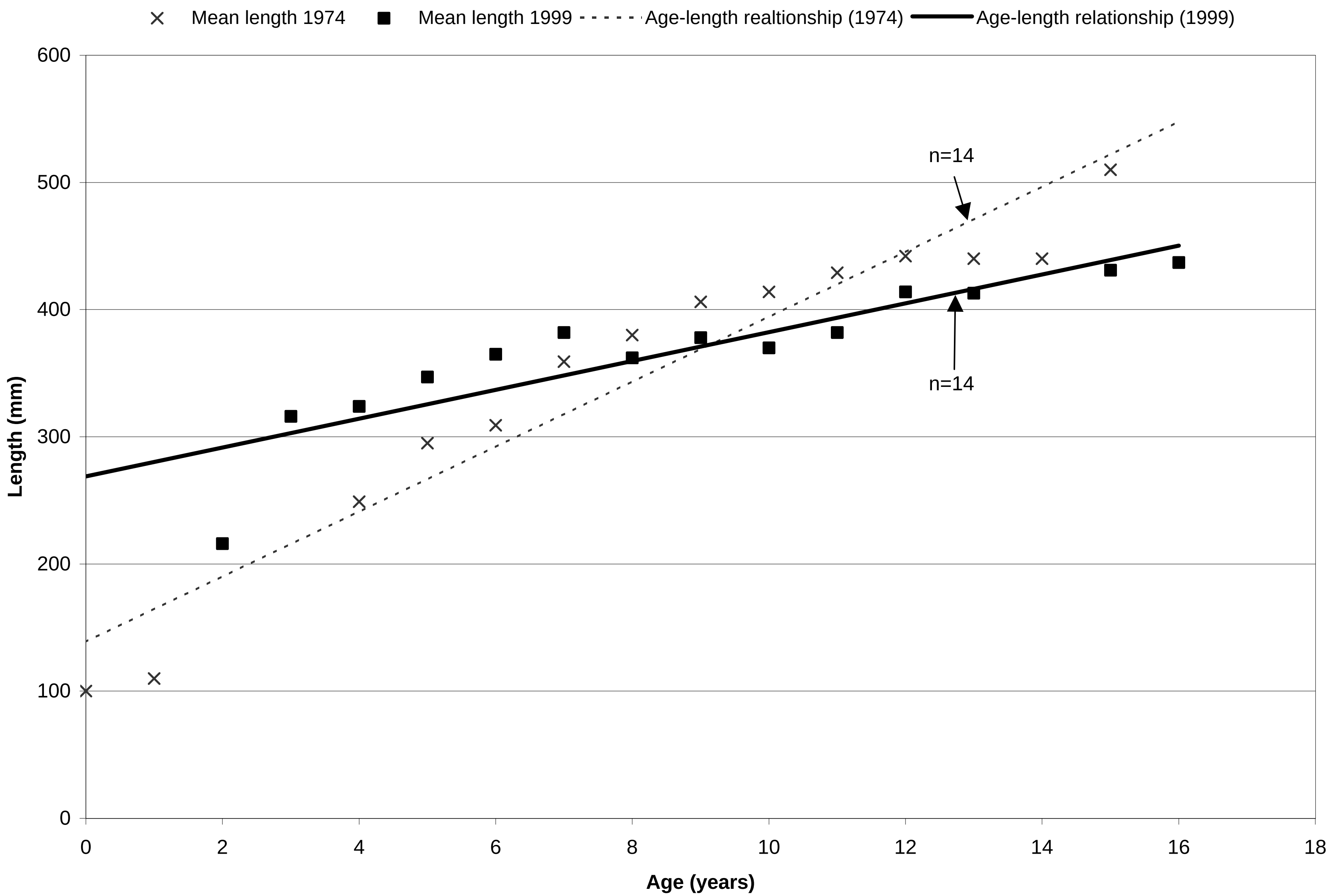
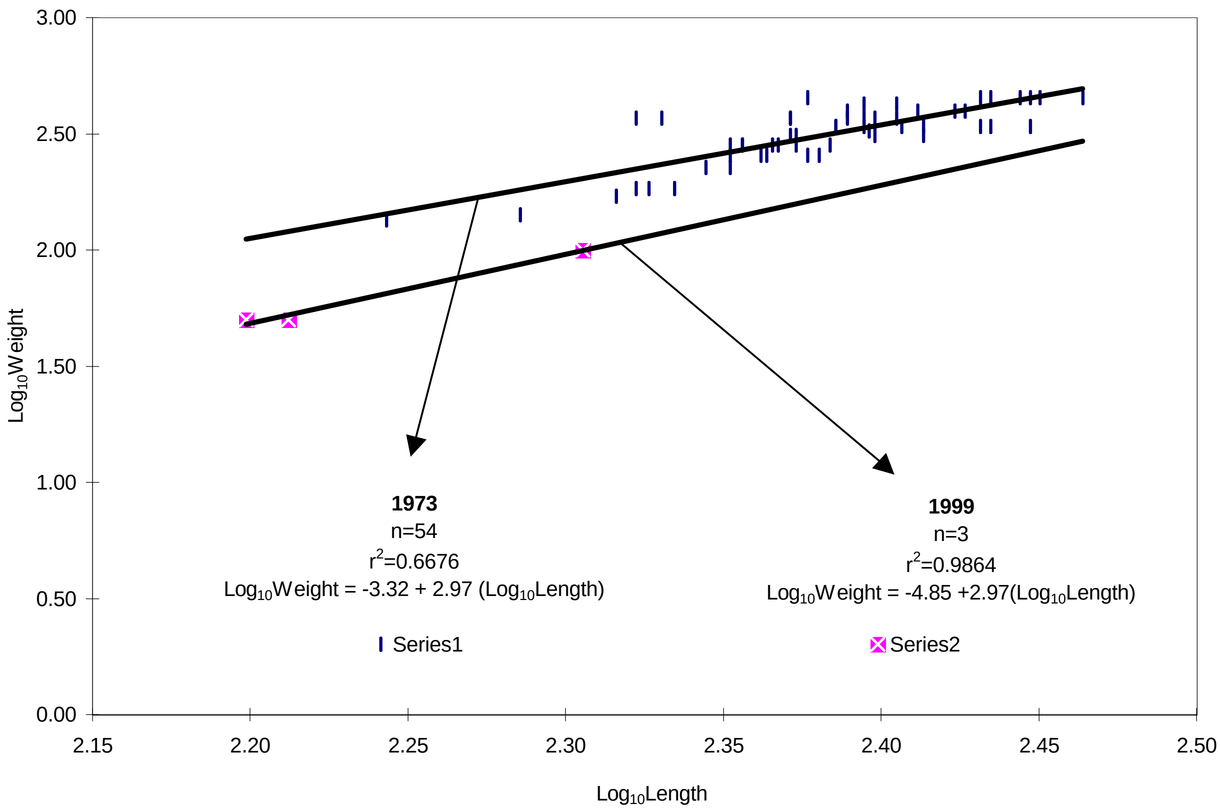
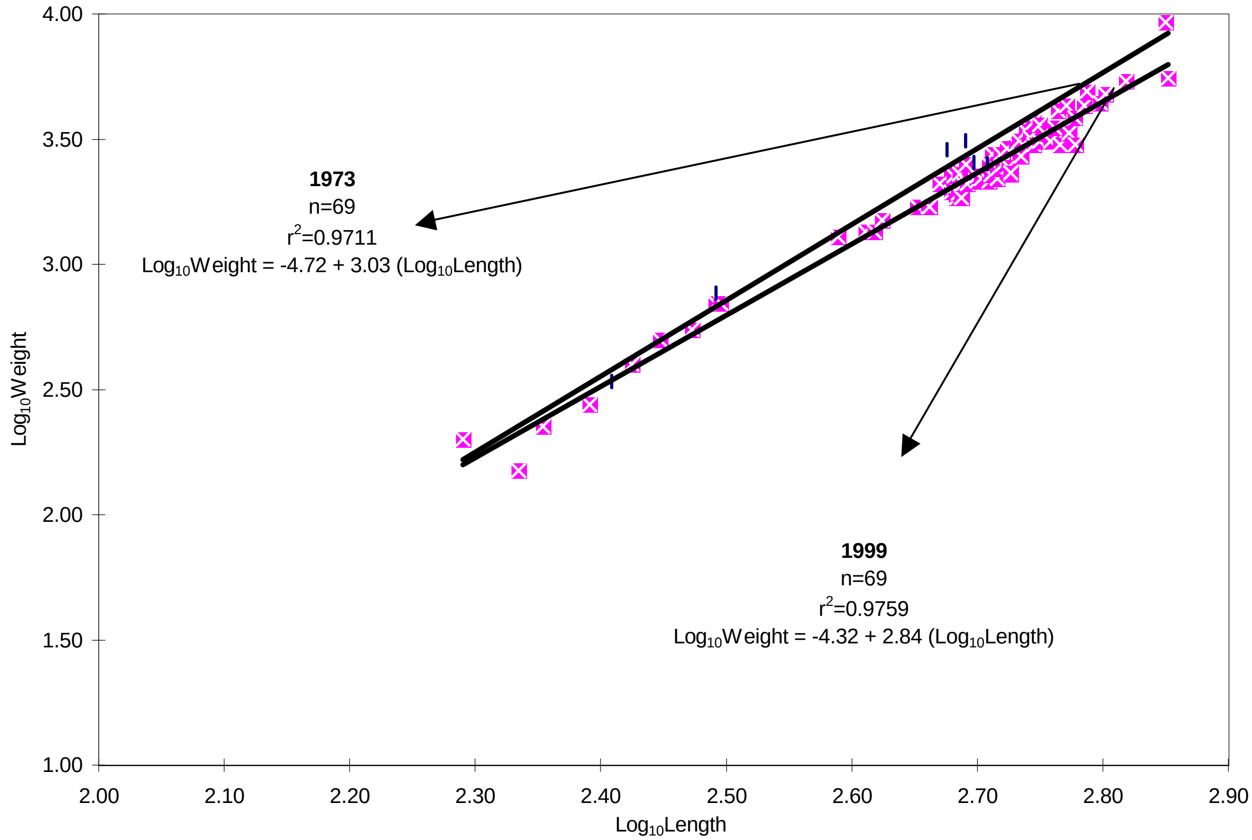


Figure 57. Age-length relationships for white sucker captured in the Red and Assiniboine rivers, 1974 (Clarke et al. 1980) and 1999.



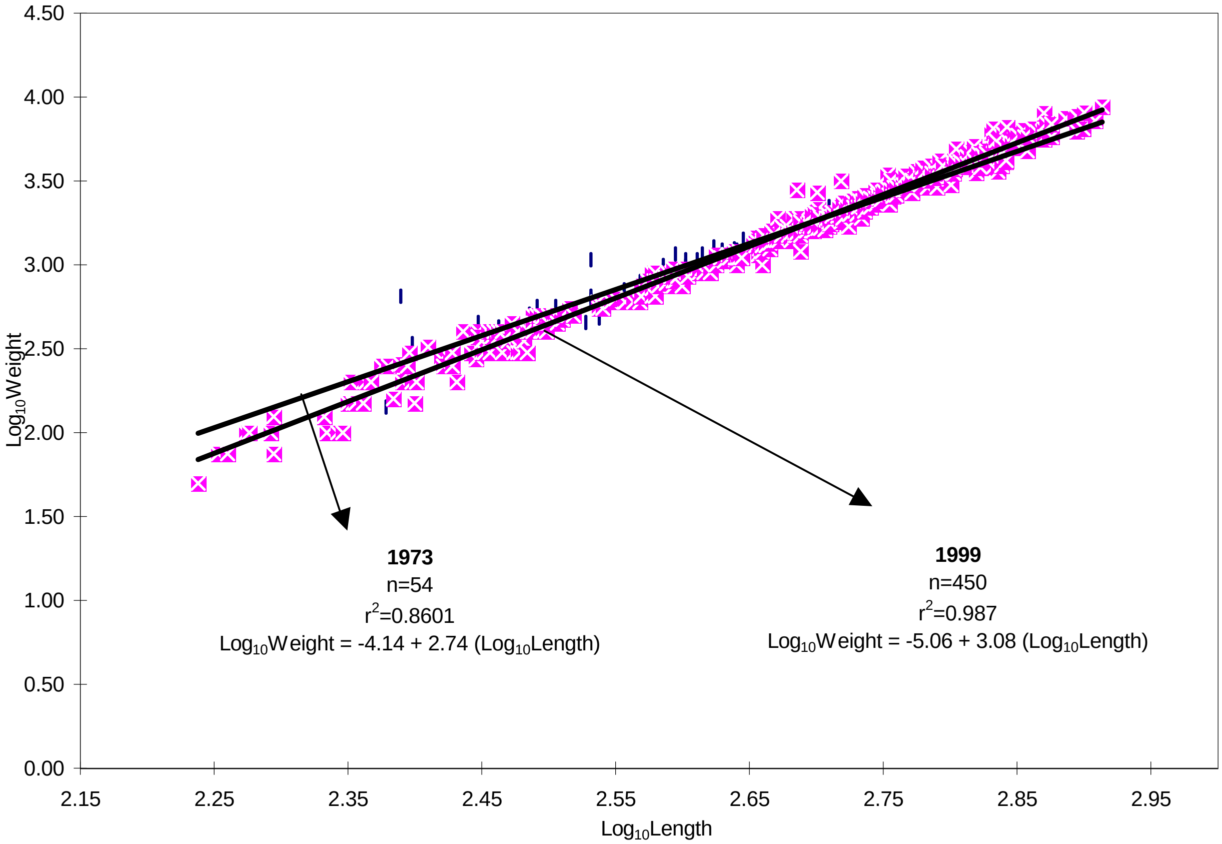
1973			Weight-Length Relationship			1999		
n	Length (mm)	Weight (g)	**1973** Weight (g)	Length Interval (mm)	**1999** Weight (g)	n	Length (mm)	Weight (g)
54	175-291	135-454	36	100	12	3	163-202	5-100

Figure 58. Weight-length relationships for black bullhead captured in the Red River, 1973 (Clarke et al. 1980) and 1999.



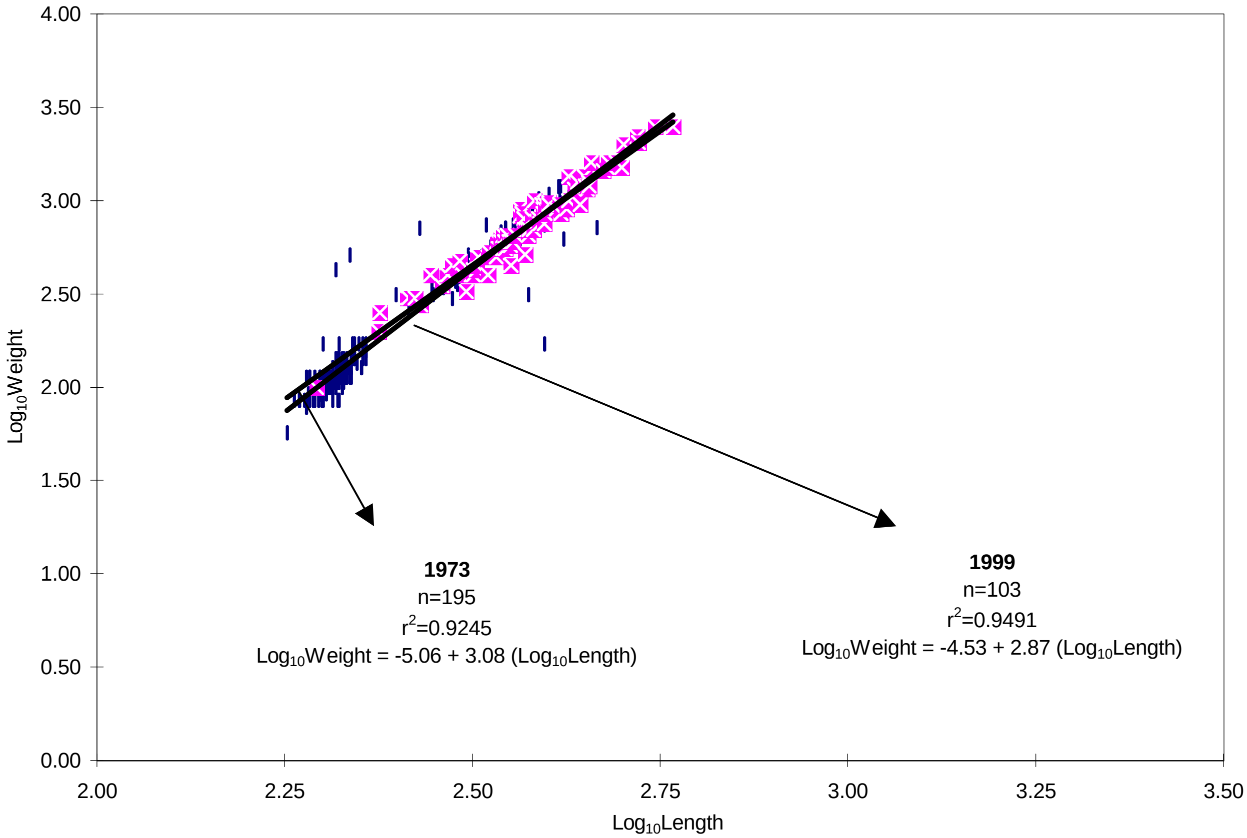
1973			Weight-Length Relationship			1999		
n	Length (mm)	Weight (g)	**1973** Weight (g)	Length Interval (mm)	**1999** Weight (g)	n	Length (mm)	Weight (g)
6	256-510	340-2863	610	300	518	69	195-711	150-9250
			2870	500	2213			
			4986	600	3715			

Figure 59. Weight-length relationships for carp captured in the Red River, 1973 (Clarke et al. 1980) and 1999.



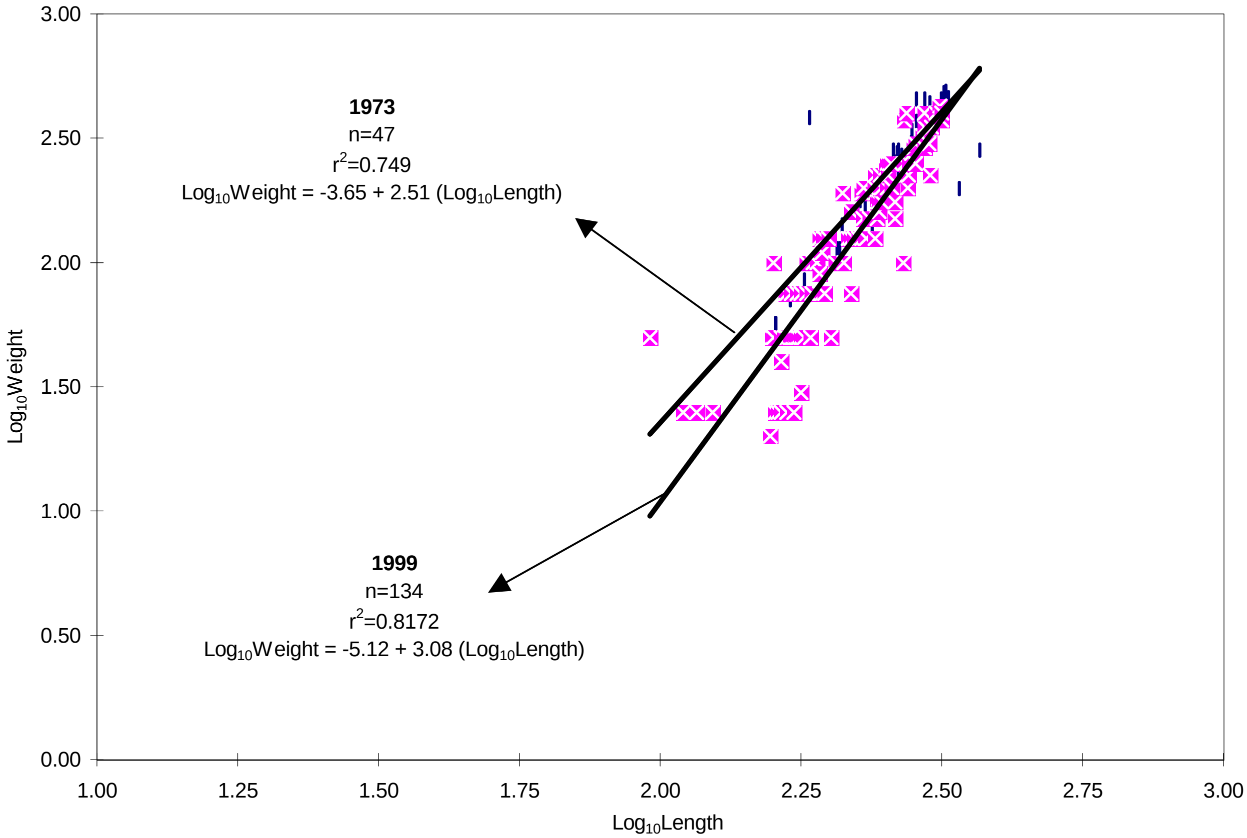
1973			Weight-Length Relationship			**1999**		
n	Length (mm)	Weight (g)	**1973** Weight (g)	Length Interval (mm)	**1999** Weight (g)	n	Length (mm)	Weight (g)
54	239-512	142-2218	154	200	106	450	173-820	50-11000
			1036	400	900			
			3167	600	3138			

Figure 60. Weight-length relationships for channel catfish captured in the Red River, 1973 (Clarke et al. 1980) and 1999.



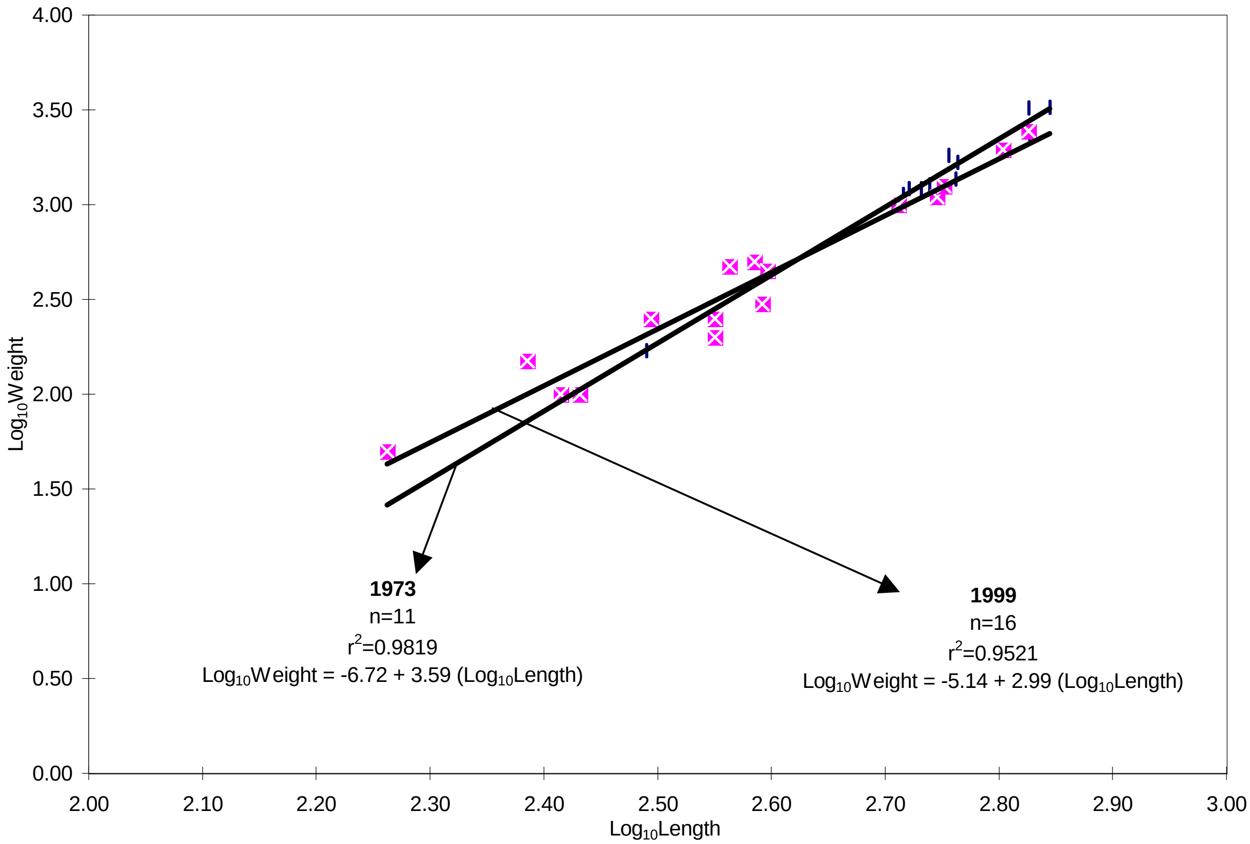
1973			Weight-Length Relationship			**1999**		
n	Length (mm)	Weight (g)	**1973** Weight (g)	Length Interval (mm)	**1999** Weight (g)	n	Length (mm)	Weight (g)
195	179-463	57-1191	371	300	388	103	196-585	100-3500
			900	400	887			
			1790	500	1682			

Figure 61. Weight-length relationships for freshwater drum captured in the Red River, 1973 (Clarke et al. 1980) and 1999.



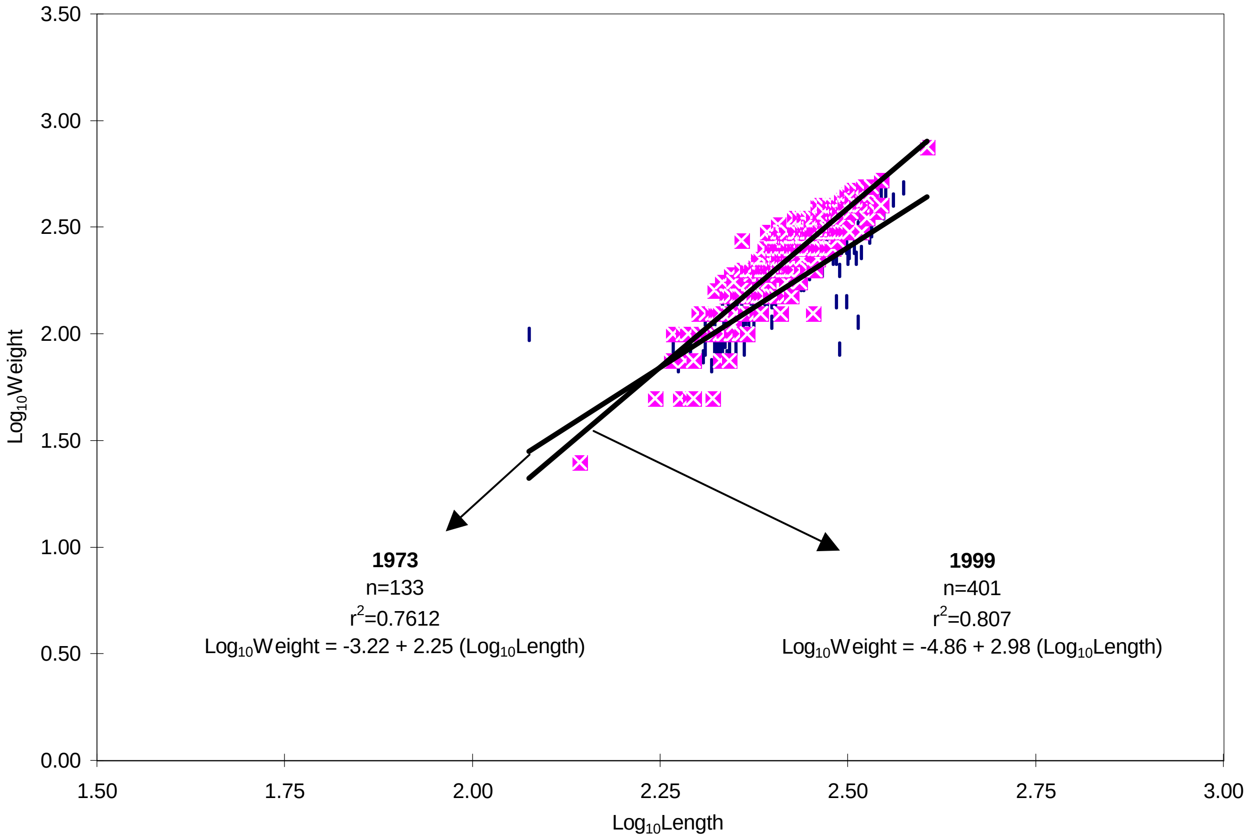
1973			Weight-Length Relationship			1999		
n	Length (mm)	Weight (g)	**1973** Weight (g)	Length Interval (mm)	**1999** Weight (g)	n	Length (mm)	Weight (g)
47	160-369	57-482	23	100	10	134	96-316	20-450
			134	200	88			

Figure 62. Weight-length relationships for goldeye captured in the Red River, 1973 (Clarke et al. 1980) and 1999.



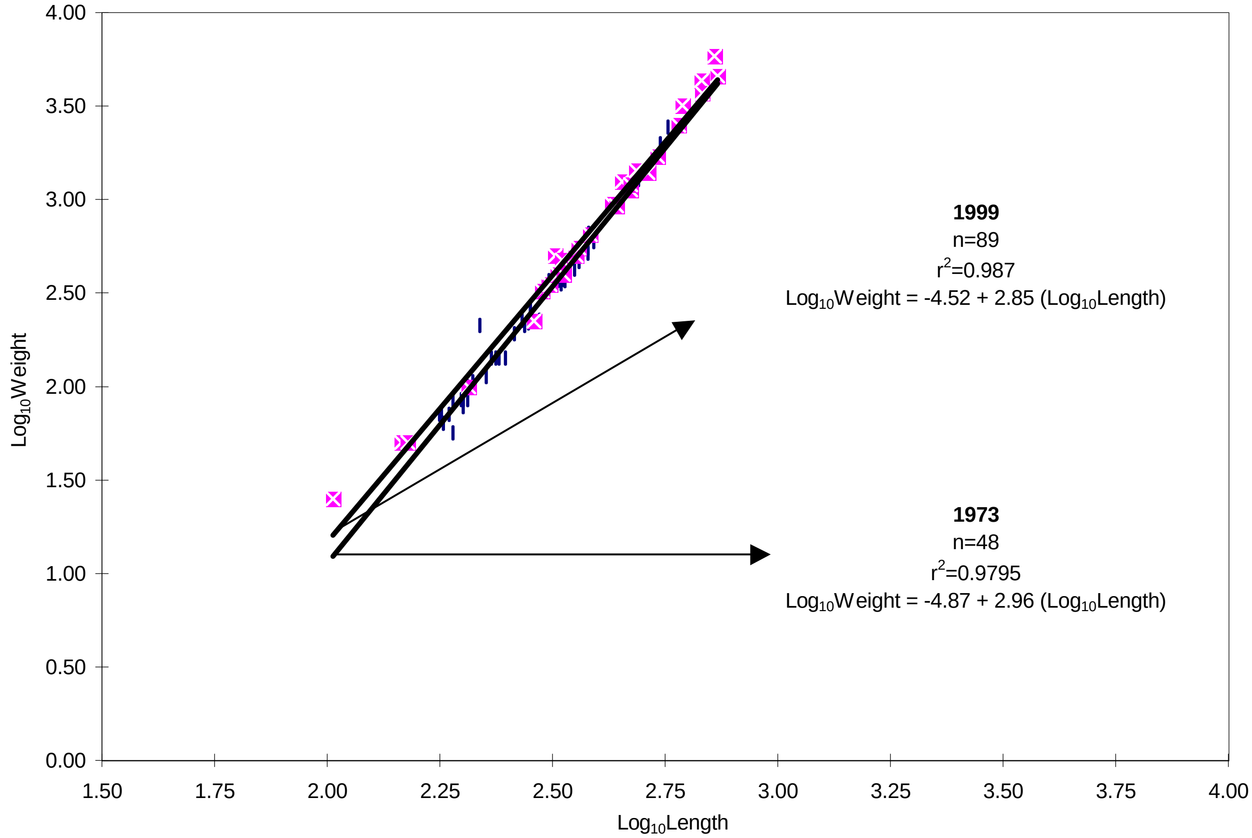
1973			Weight-Length Relationship			1999		
n	Length (mm)	Weight (g)	**1973** Weight (g)	Length Interval (mm)	**1999** Weight (g)	n	Length (mm)	Weight (g)
11	309-699	170-3260	35	200	55	16	183-670	50-5150
			149	300	185			

Figure 63. Weight-length relationships for northern pike captured in the Red River, 1973 (Clarke et al. 1980) and 1999.



1973			Weight-Length Relationship			**1999**		
n	Length (mm)	Weight (g)	**1973** Weight (g)	Length Interval (mm)	**1999** Weight (g)	n	Length (mm)	Weight (g)
133	119-375	85-481	91	200	99	401	139-403	25-750
			225	300	332			

Figure 64. Weight-length relationships for sauger captured in the Red River, 1973 (Clarke et al. 1980) and 1999.



1973			Weight-Length Relationship			1999		
n	Length (mm)	Weight (g)	**1973** Weight (g)	Length Interval (mm)	**1999** Weight (g)	n	Length (mm)	Weight (g)
48	177-548	57-1984	87	200	109	89	200-437	25-5850
			289	300	346			
			679	400	786			

Figure 65. Weight-length relationships for walleye captured in the Red River, 1973 (Clarke et al. 1980) and 1999.

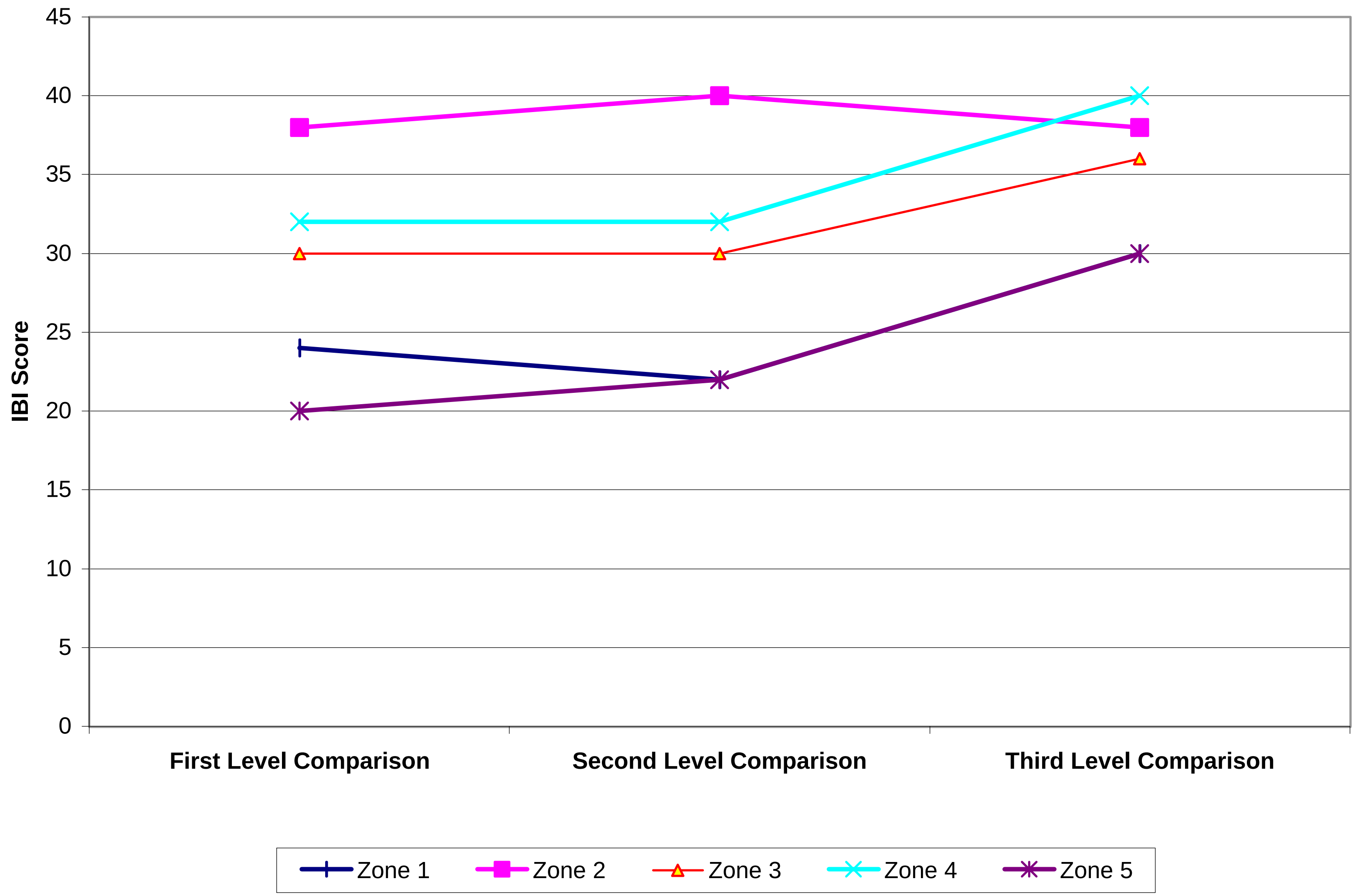


Figure 66. Index of Biotic Integrity (IBI) scores, by zone, for first, second, and third level comparisons of the fish community of the Red (zones 1, 2, and 3) and Assiniboine (zones 4 and 5) rivers within the City of Winnipeg Ammonia Criteria Study Area, 1999.

APPENDICES

APPENDIX 1

Quantification of habitat types, by zone and segment, in the Red and Assiniboine rivers, 1999.

Table A1.1. Quantification of habitat types, by zone and segment, in the Red and Assiniboine rivers, 1999.

Zone	Segment	Habitat Type (%)		
		1[A]	2[B]	3[C]
1	1	50	33	17
	2	50	42	8
	3	58	33	8
	4	33	42	25
	5	42	42	17
	6	50	42	8
	7	42	58	-
	8	33	58	8
	9	50	50	-
	10	50	42	8
	11	83	8	8
	12	25	67	8
	13	33	67	-
	14	33	50	17
	15	8	50	33
	16	33	58	8
	17	17	42	42
	18	33	42	25
	19	8	67	25
	20	42	58	-
	21	42	58	-
	22	42	42	17
	23	33	33	33
	24	42	42	17
	25	42	42	17
	26	42	58	-
	All	***39***	***47***	***14***
2	27	33	67	-
	28	42	58	-
	29	50	42	8
	30	25	67	8
	31	42	58	-
	32	25	50	25
	33	25	67	8
	34	25	58	17
	35	42	50	8
	36	33	58	8
	37	8	83	8
	38	17	83	-
	39	25	42	33
	40	25	75	-
	41	17	67	17

Table A1.1. (Continued)

Zone	Segment	Habitat Type (%) 1[A]	2[B]	3[C]
2 (Continued)	42	8	83	8
	43	17	75	8
	44	33	58	8
	45	25	75	-
	46	42	33	25
	47	8	67	25
	48	50	50	-
	49	8	58	33
	50	17	58	25
	51	17	67	17
	52	8	75	17
	53	50	33	17
	54	50	50	-
	55	50	42	8
	56	25	42	33
	57	58	33	8
	All	***29***	***59***	***12***
3	58	42	42	8
	59	67	8	25
	60	58	33	8
	61	58	17	25
	62	17	33	50
	63	-	17	83
	64	-	8	92
	65	-	-	100
	66	-	8	92
	67	-	-	100
	68	-	-	100
	69	-	-	100
	70	-	-	100
	71	-	-	100
	72	-	-	100
	73	-	8	92
	74	17	25	58
	All	***16***	***12***	***73***
3A	75	-	8	92
	76	-	-	100
	77	-	-	100

Table A1.1. (Continued)

Zone	Segment	Habitat Type (%) 1[A]	2[B]	3[C]
3A (Continued)	78	-	-	100
	79	25	17	58
	80	8	8	83
	81	8	25	67
	82	25	17	58
	83	25	50	25
	84	17	50	33
	85	58	-	42
	86	92	-	8
	All	***22***	***15***	***64***
Red River	***All***	***28***	***40***	***32***
4	109	8	-	92
	110	-	17	83
	111	-	17	83
	112	33	8	58
	113	-	-	100
	114	8	17	75
	115	17	25	58
	116	25	8	67
	117	50	-	50
	118	-	17	83
	119	-	-	100
	120	17	-	83
	121	-	-	100
	122	33	-	67
	123	8	-	92
	124	8	-	92
	125	17	-	83
	126	75	8	17
	127	33	17	50
	128	75	-	25
	129	67	-	33
	130	42	25	33
	All	***24***	***6***	***70***
5	101	42	25	33
	102	-	67	33
	103	-	25	75

Table A1.1. (Continued)

Zone	Segment	Habitat Type (%) 1[A]	2[B]	3[C]
5 (Continued)	104	-	17	83
	105	-	33	67
	106	-	-	100
	107	-	17	83
	108	-	17	83
	All	***5***	***24***	***71***
Assiniboine River	***All***	***19***	***10***	***71***
RR/AR	***All***	***26***	***33***	***41***

Category:

[A]1 (Soft)

- any combination of substrates with soft compaction
- mud/silt/clay with medium compaction
- any presence of sand elevates substrate to category 2 or 3

[B]2 (Medium)

- sand/mud/silt/clay with hard compaction
- sand/mud/silt or clay as dominant substrate with gravel as secondary with medium compaction
- sand with medium compaction

[C]3 (Hard)

- any presence of cobble/boulder/rip-rap in substrate mix
- gravel as dominant substrate with medium or hard compaction
- sand as dominant substrate with gravel as secondary substrate and hard compaction

APPENDIX 2

Water velocities measured in the Red and Assiniboine rivers, 1999.

Table A2.1. Water velocities measured in Zone 1A of the Red River, 1999.

Location	UTM (14U) NAD 83 E	UTM (14U) NAD 83 N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 1A										
Hard										
LHB	631162	5490320	27-Jul	H	2.50	-	-	0.50	0.52	0.32
								2.00	0.11	-
Q1	-	-	-	-	3.00	-	-	0.60	0.62	0.57
								2.40	0.52	-
MID	-	-	-	-	3.70	-	-	0.74	0.83	0.71
								2.96	0.58	-
LHB	-	-	19-Sep	H	4.68	-	-	0.94	0.61	0.52
								3.74	0.43	-
Q1	-	-	-	-	4.85	-	-	0.97	0.73	0.62
								3.88	0.52	-
MID	-	-	-	-	4.74	-	-	0.95	0.76	0.64
								3.79	0.51	-
Medium										
LHB	635959	5499913	27-Jul	M	3.25	-	-	0.65	0.40	0.39
								2.60	0.38	-
Q1	-	-	-	-	4.70	-	-	0.94	0.59	0.56
								3.76	0.52	-
MID	-	-	-	-	4.70	-	-	0.94	0.67	0.61
								3.76	0.54	-
LHB	-	-	19-Sep	M	3.16	-	-	0.63	0.42	0.39
								2.53	0.36	-
Q1	-	-	-	-	5.53	-	-	1.11	0.56	0.57
								4.42	0.58	-
MID	-	-	-	-	6.62	-	-	1.32	0.70	0.70
								5.30	0.69	-

Table A2.1. (Continued)

Location	UTM (14U) NAD 83 E	N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 1A										
Soft										
RHB	636174	5501120	27-Jul	S	2.30	-	-	0.46	0.60	0.56
								1.84	0.51	-
Q1	-	-	-	-	4.50	-	-	0.90	0.83	0.75
								3.60	0.67	-
MID	-	-	-	-	4.80	-	-	0.96	0.69	0.63
								3.84	0.56	-
RHB	-	-	19-Sep	S	4.32	-	-	0.86	0.84	0.75
								3.46	0.67	-
Q1	-	-	-	-	6.17	-	-	1.23	0.95	0.87
								4.94	0.80	-
MID	-	-	-	-	5.55	-	-	1.11	0.86	0.80
								4.44	0.74	-

Codes:

LHB = Left Hand Bank
MID = Mid-Channel
RHB = Right Hand Bank
Q1 = 1st Quartile
H = Hard
M = Medium
S = Soft
TC = Tributary Confluence

BC = Bunns Creek
LR = La Salle River
PC = Parks Creek
OC = Omands Creek
SR = Seine River
SC = Sturgeon Creek
RR = Red River
AR = Assiniboine River

NEWPCC = North End Water Pollution Control Centre
SEWPCC = South End Water Pollution Control Centre
WEWPCC = West End Water Pollution Control Centre

Table A2.2. Water velocities measured in Zone 1 of the Red River, 1999.

Location	UTM (14U) NAD 83 E	UTM (14U) NAD 83 N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 1										
Segment 4										
LHB	636525	5506277	4-Mar	M	2.30	0.46	1.80	1.30	0.13	0.13
MID	-	-	-	-	8.10	0.52	7.60	4.30	0.26	0.26
Segment 5										
LHB	637041	5506817	9-Mar	M	2.30	0.66	1.64	1.00	0.22	0.22
MID	-	-	-	-	3.30	0.43	2.87	1.40	0.52	0.52
Segment 6										
LHB	636996	5507548	4-Mar	S	2.70	0.40	2.30	1.50	0.21	0.21
MID	-	-	-	-	5.90	0.60	5.30	3.00	0.21	0.21
Segment 8										
LHB	635332	5507228	4-Mar	S	4.30	0.72	3.60	2.40	0.27	0.27
MID	-	-	-	-	6.40	0.60	5.80	3.30	0.38	0.38
Segment 10										
RHB	636937	5508801	3-Mar	S	2.30	0.60	1.70	1.50	0.29	0.29
MID	-	-	-	-	3.40	0.47	2.90	1.90	0.35	0.35

Table A2.2. (Continued)

Location	UTM (14U) NAD 83 E	UTM (14U) NAD 83 N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 1										
Segment 16										
LHB	634859	5511040	3-Mar	S	3.00	0.72	2.30	1.80	0.25	0.25
RHB	-	-	-	-	2.50	0.62	1.90	1.60	0.23	0.23
Segment 17										
RHB	634768	5512080	3-Mar	S	2.40	0.74	1.70	1.50	0.22	0.22
MID	-	-	-	-	2.70	0.57	2.10	1.60	0.30	0.30
Segment 18										
RHB	633868	5513233	9-Mar	S	2.00	0.68	1.32	1.10	0.16	0.16
MID	-	-	-	-	3.40	0.69	2.71	2.00	0.22	0.22
RHB	-	-	26-Jul	S	1.50	-	-	0.90	0.19	0.19
Q1	-	-	-	-	3.30	-	-	0.70	0.51	0.45
								2.60	0.38	-
MID	-	-	-	-	3.50	-	-	0.70	0.54	0.49
								2.80	0.44	-
LHB	-	-	18-Sep	S	3.29	-	-	0.66	0.48	0.44
								2.63	0.39	-
Q1	-	-	-	-	4.94	-	-	0.99	0.60	0.58
								3.95	0.56	-
MID	-	-	-	-	5.54	-	-	1.11	0.75	0.67
								4.43	0.58	-

Table A2.2. (Continued)

Location	UTM (14U) NAD 83 E	N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 1										
Segment 18 (Continued)										
RHB	-	-	26-Jul	TC/LR	2.00	-	-	0.40	0.19	0.18
								1.60	0.17	-
LHB	-	-	18-Sep	TC/LR	3.72	-	-	0.74	0.09	0.10
								2.98	0.10	-
Segment 19										
RHB	633823	5515122	9-Mar	M	1.70	0.58	1.12	1.13	0.27	0.27
MID	-	-	-	-	3.80	0.83	2.97	2.33	0.18	0.18
RHB	-	-	26-Jul	M	1.40	-	-	0.80	0.21	0.21
Q1	-	-	-	-	3.80	-	-	0.80	0.47	0.43
								3.00	0.39	-
MID	-	-	-	-	5.70	-	-	1.10	0.54	0.53
								4.60	0.52	-
RHB	-	-	18-Sep	M	3.63	-	-	0.73	0.63	0.62
								2.90	0.60	-
Q1	-	-	-	-	5.77	-	-	1.15	0.71	0.68
								4.62	0.65	-
MID	-	-	-	-	7.40	-	-	1.48	0.84	0.78
								5.92	0.72	-

Table A2.2. (Continued)

Location	UTM (14U) NAD 83 E	N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 1										
Segment 21										
LHB	633045	5574834	1-Mar	M	2.40	0.53	1.90	1.50	0.22	0.22
RHB	-	-	-	-	3.70	0.42	3.28	2.00	0.27	0.27
Segment 23										
LHB	-	-	26-Jul	H	2.30	-	-	0.50	0.38	0.36
								1.80	0.34	-
Q1	-	-	-	-	3.50	-	-	0.70	0.45	0.40
								2.80	0.35	-
MID	-	-	-	-	6.20	-	-	1.20	0.48	0.47
								5.00	0.45	-
LHB	-	-	18-Sep	H	2.08	-	-	0.42	0.48	0.44
								1.66	0.39	-
Q1	-	-	-	-	3.50	-	-	0.70	0.69	0.66
								2.80	0.62	-
MID	-	-	-	-	6.80	-	-	1.36	0.76	0.69
								5.44	0.61	-
Segment 25										
RHB	634684	5517798	1-Mar	H	3.70	0.43	3.27	2.10	0.13	0.13
LHB	-	-	-	-	4.60	0.44	4.16	-	0.03	0.03
Segment 26										
LHB	634996	5517554	1-Mar	S	2.40	0.50	1.90	1.40	0.27	0.27
RHB	-	-	-	-	2.80	0.56	2.24	1.70	0.36	0.36

Table A2.3. Water velocities measured in Zone 2 of the Red River, 1999.

Location	UTM (14U) NAD 83 E	UTM (14U) NAD 83 N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 2										
Segment 27										
RHB	-	-	26-Jul	SEWPCC	1.00	-	-	0.60	0.34	0.34
Q1	-	-	-	-	2.00	-	-	0.40	0.50	0.47
								1.60	0.44	-
MID	-	-	-	-	4.20	-	-	0.80	0.54	0.46
								3.40	0.37	-
LHB	-	-	18-Sep	SEWPCC	3.57	-	-	0.71	0.63	0.56
								2.86	0.49	-
MID	-	-	-	-	5.94	-	-	1.19	0.84	0.73
								4.75	0.62	-
RHB	-	-	-	-	2.38	-	-	0.48	0.55	0.51
								1.90	0.46	-
Segment 29										
LHB	-	-	9-Jul	S	2.40	-	-	0.50	0.21	0.21
								1.90	0.20	-
Q1	-	-	-	-	6.90	-	-	1.40	0.53	0.46
								5.50	0.39	-
MID	-	-	-	-	7.50	-	-	1.50	0.51	0.49
								6.00	0.46	-
LHB	-	-	12-Sep	S	4.40	-	-	0.88	0.65	0.57
								3.52	0.48	-
Q1	-	-	-	-	5.25	-	-	1.05	0.76	0.71
								4.20	0.66	-
MID	-	-	-	-	7.25	-	-	1.45	0.87	0.81
								5.80	0.75	-

Table A2.3. (Continued)

Location	UTM (14U) NAD 83 E	N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 2										
Segment 33										
LHB	634298	5519551	26-Feb	M	1.70	0.32	1.40	1.00	0.14	0.14
RHB	-	-	-	-	3.50	0.30	3.20	1.90	0.15	0.15
Segment 34										
LHB	633459	5520646	26-Feb	S	2.00	0.28	1.72	1.14	0.19	0.19
RHB	-	-	-	-	-	0.37	1.63	1.20	0.24	0.24
LHB	-	-	9-Jul	S	3.30	-	-	0.70	0.33	0.31
								2.60	0.28	-
Q1	-	-	-	-	4.40	-	-	0.90	0.49	0.44
								3.50	0.38	-
MID	-	-	-	-	5.20	-	-	1.00	0.56	0.50
								4.20	0.43	-
LHB	-	-	12-Sep	S	2.55	-	-	0.51	0.38	0.42
								2.04	0.46	-
Q1	-	-	-	-	4.10	-	-	0.82	0.54	0.52
								3.28	0.49	-
MID	-	-	-	-	5.00	-	-	4.00	0.52	0.52

Table A2.3. (Continued)

Location	UTM (14U) NAD 83 E	N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 2										
Segment 37										
LHB	-	-	23-Feb	M	2.52	0.36	2.16	1.45	0.26	0.26
MID	-	-	-	-	2.85	0.35	2.50	1.60	0.10	0.10
RHB	-	-	-	-	2.85	0.56	2.29	1.65	0.26	0.26
Segment 38										
LHB	634138	5522888	26-Feb	M	2.50	0.31	2.19	1.40	0.30	0.30
RHB	-	-	-	-	3.75	0.52	3.23	2.10	0.23	0.23
LHB	-	-	9-Jul	M	3.70	-	-	0.70	0.48	0.41
								3.00	0.34	-
Q1	-	-	-	-	4.90	-	-	1.00	0.67	0.55
								3.90	0.43	-
MID	-	-	-	-	5.50	-	-	1.10	0.70	0.61
								4.40	0.52	-
LHB	-	-	12-Sep	M	2.50	-	-	0.50	0.62	0.54
								2.00	0.46	-
Q1	-	-	-	-	4.85	-	-	0.97	0.67	0.61
								3.88	0.55	-
MID	-	-	-	-	5.60	-	-	1.12	0.72	0.67
								4.45	0.62	-
Segment 40										
RHB	-	-	7-Mar	M	1.60	0.46	1.14	1.03	0.09	0.09
MID	-	-	-	-	5.30	0.34	5.00	2.80	0.22	0.22

Table A2.3. (Continued)

Location	UTM (14U) NAD 83 E	N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 2										
Segment 43										
LHB	633528	5523360	23-Feb	H	4.64	0.88	3.76	2.80	0.17	0.17
MID	-	-	-	-	5.00	0.32	4.68	2.60	0.21	0.21
RHB	-	-	-	-	4.30	0.37	3.93	2.30	0.14	0.14
RHB	-	-	9-Jul	H	1.20	-	-	0.70	0.62	0.62
Q1	-	-	-	-	2.40	-	-	0.50	0.60	0.54
								1.90	0.48	-
MID	-	-	-	-	5.60	-	-	1.10	0.64	0.60
								4.50	0.55	-
RHB	-	-	13-Sep	H	6.20	-	-	1.24	0.94	0.77
								4.96	0.60	-
Q1	-	-	-	-	3.87	-	-	0.77	0.73	0.65
								3.10	0.57	-
MID	-	-	-	-	2.53	-	-	0.51	0.30	0.27
								2.02	0.24	-
Segment 44										
RHB	634112	5524124	26-Feb	M	2.30	0.46	1.84	1.38	0.15	0.15
LHB	-	-	-	-	4.60	0.58	4.00	2.60	0.21	0.21

Table A2.3. (Continued)

Location	UTM (14U) NAD 83 E	UTM (14U) NAD 83 N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 2										
Segment 50										
RHB	-	-	25-Feb	H	4.10	0.57	3.53	2.30	0.24	0.24
LHB	-	-	-	-	5.80	0.65	5.15	2.50	0.22	0.22
LHB	-	-	8-Jul	H	1.35	-	-	0.80	0.31	0.51
								1.20	0.71	-
Q1	-	-	-	-	3.35	-	-	0.70	0.61	0.54
								2.70	0.46	-
MID	-	-	-	-	6.00	-	-	4.80	0.42	0.42
RHB	-	-	13-Sep	H	6.04	-	-	1.21	0.72	0.66
								4.83	0.59	-
Q1	-	-	-	-	4.87	-	-	0.96	0.77	0.64
								3.86	0.51	-
MID	-	-	-	-	5.30	-	-	0.66	0.46	0.45
								2.64	0.43	-
Segment 51										
LHB	-	-	25-Feb	M	4.80	0.65	4.15	2.70	0.23	0.23
RHB	-	-	-	-	5.00	0.61	4.39	2.80	0.25	0.25
Segment 52										
RHB	635714	5529450	7-Mar	M	2.70	0.45	2.25	1.60	0.03	0.03
MID	-	-	-	-	6.40	0.58	5.80	3.50	0.17	0.17
LHB	-	-	22-Jul	TC/SR	1.80	-	-	0.40	0.07	0.05
								1.40	0.03	-
LHB	-	-	17-Sep	TC/SR	1.71	-	-	0.34	0.12	0.12
								1.37	0.12	-

Table A2.3. (Continued)

Location	UTM (14U) NAD 83 E	UTM (14U) NAD 83 N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 2										
Segment 55										
LHB	636278	5532851	25-Feb	S	2.80	0.38	2.42	1.60	0.16	0.16
RHB	-	-	-	-	4.90	0.49	4.41	2.70	0.21	0.21
Segment 56										
RHB	635786	5533574	25-Feb	H	2.20	0.80	1.40	1.50	0.21	0.21
LHB	-	-	-	-	3.80	0.68	3.12	1.56	0.26	0.26
LHB	-	-	8-Jul	H	5.25	-	-	1.05	0.76	0.63
								4.20	0.50	-
Q1	-	-	-	-	5.10	-	-	1.00	0.64	0.59
								4.10	0.54	-
MID	-	-	-	-	1.10	-	-	0.66	0.29	0.29
LHB	-	-	13-Sep	H	5.73	-	-	1.15	0.70	0.69
								4.58	0.68	-
Q1	-	-	-	-	2.28	-	-	0.46	0.43	0.38
								1.82	0.32	-
MID	-	-	-	-	1.07	-	-	0.21	0.33	0.30
								0.82	0.27	-

Table A2.4. Water velocities measured in Zone 3 of the Red River, 1999.

Location	UTM (14U) NAD 83 E	UTM (14U) NAD 83 N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 3										
Segment 58										
LHB	-	-	22-Jul	NEWPCC	5.60	-	-	1.10	0.32	0.38
								4.50	0.43	-
RHB	-	-	-	-	4.70	-	-	0.90	0.56	0.46
								3.80	0.36	-
LHB	-	-	17-Sep	NEWPCC	3.29	-	-	0.66	0.32	0.30
								2.63	0.27	-
RHB	-	-	-	-	4.66	-	-	0.93	0.63	0.58
								3.73	0.52	
LHB	-	-	-	-	1.27	-	-	0.25	0.25	0.23
								1.02	0.20	-
RHB	-	-	-	-	5.48	-	-	1.10	0.94	0.71
								4.38	0.48	-
Segment 59										
LHB	637184	5534686	22-Jul	NEWPCC	3.60	-	-	0.70	0.45	0.41
								2.90	0.37	-
RHB	-	-	-	-	5.40	-	-	1.10	0.83	0.71
								4.30	0.58	-
RHB	-	-	17-Sep	NEWPCC	7.51	-	-	1.50	0.59	0.62
								6.01	0.65	-
RHB	-	-	13-Jul	M	2.75	-	-	0.60	0.28	0.18
								2.20	0.08	-
Q1	-	-	-	-	6.00	-	-	1.20	0.55	0.58
								4.80	0.60	-
MID	-	-	-	-	8.00	-	-	1.60	0.35	0.30
								6.40	0.24	-

Table A2.4. (Continued)

Location	UTM (14U) NAD 83 E	N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 3										
Segment 59 (Continued)										
								6.40	0.24	-
RHB	-	-	14-Sep	M	4.30	-	-	0.86	0.47	0.43
								3.44	0.38	-
Q1	-	-	-	-	6.00	-	-	1.20	0.47	0.48
								4.80	0.48	-
MID	-	-	-	-	6.30	-	-	1.26	0.53	0.52
								5.04	0.51	-
Segment 60										
RHB	637184	5534686	22-Jul	NEWPCC	6.00	-	-	4.80	0.41	0.43
								1.20	0.44	-
LHB	-	-	12-Jul	S	1.80	-	-	Surface	0.31	0.31
Q1	-	-	-	-	3.70	-	-	Surface	0.47	0.47
MID	-	-	-	-	5.30	-	-	Surface	0.60	0.60
LHB	-	-	14-Sep	S	1.25	-	-	0.25	0.08	0.08
								1.00	0.07	-
Q1	-	-	-	-	2.85	-	-	0.57	0.24	0.26
								2.28	0.27	-
MID	-	-	-	-	3.78	-	-	0.76	0.54	0.49
								3.02	0.43	-
RHB	637613	5534942	22-Jul	TC/BC	0.80	-	-	0.50	0.06	0.06
RHB	637613	5534942	17-Sep	TC/BC	2.47	-	-	0.49	0.13	0.12
								1.98	0.11	-

Table A2.4. (Continued)

Location	UTM (14U) NAD 83 E	N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 3										
Segment 61										
LHB	-	-	12-Jul	M	1.80	-	-	Surface	0.33	0.33
Q1	-	-	-	-	3.20	-	-	Surface	0.55	0.55
MID	-	-	-	-	3.80	-	-	0.80	0.82	0.63
								3.00	0.43	-
LHB	-	-	14-Sep	M	1.92	-	-	0.38	0.38	0.33
								1.54	0.27	-
Q1	-	-	-	-	4.55	-	-	0.91	0.65	0.60
								3.64	0.54	-
MID	-	-	-	-	5.19	-	-	1.04	0.68	0.64
								4.14	0.59	-
Segment 65										
LHB	-	-	12-Jul	H	0.80	-	-	0.50	0.44	0.44
MID	-	-	-	-	2.70	-	-	0.50	1.12	0.86
								2.20	0.59	-
Q1	-	-	-	-	2.00	-	-	0.40	0.76	0.68
								1.60	0.60	-
LHB	-	-	22-Jul	TC/PC	1.10	-	-	0.70	0.06	0.06
LHB	-	-	23-Jul	TC/PC	-	-	-	-	0.07	0.07

Table A2.4. (Continued)

Location	UTM (14U) NAD 83 E	N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 3										
Segment 65 ***(Continued)***										
LHB	-	-	15-Sep	H	0.70	-	-	0.40	0.61	0.61
Q1	-	-	-	-	1.74	-	-	0.35	0.93	0.88
								1.40	0.83	-
MID	-	-	-	-	2.35	-	-	0.50	0.89	0.90
								1.90	0.90	-
LHB	-	-	17-Sep	TC/PC	0.61	-	-	0.37	0.05	0.05
Segment 68										
RHB	643319	5544821	27-Feb	H	2.50	0.35	2.15	1.40	0.71	0.71

Table A2.4. (Continued)

Location	UTM (14U) NAD 83 E	N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 3										
Segment 71										
LHB	645298	5547736	27-Feb	H	2.70	0.63	2.07	1.70	0.53	0.53
RHB	-	-	-	-	2.30	1.03	1.27	1.88	0.57	0.57
Segment 72										
RHB	646536	5548445	8-Mar	H	2.00	0.62	1.38	1.31	0.30	0.30
MID	-	-	-	-	3.20	0.79	2.40	2.00	0.17	0.17
RHB	-	-	13-Jul	H	1.75	-	-	0.40	0.64	0.59
								1.40	0.54	-
Q1	-	-	-	-	3.00	-	-	0.60	0.82	0.79
								2.40	0.75	-
MID	-	-	-	-	3.80	-	-	0.80	1.07	0.91
								3.00	0.75	-
RHB	-	-	15-Sep	H	1.90	-	-	0.40	0.67	0.66
								1.50	0.64	-
Q1	-	-	-	-	2.90	-	-	0.60	0.86	0.87
								2.30	0.87	-
MID	-	-	-	-	3.00	-	-	0.60	1.11	1.06
								2.40	1.00	-

Table A2.4. (Continued)

Location	UTM (14U) NAD 83 E	N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 3										
Segment 74										
MID	647471	5549740	8-Mar	S	4.60	0.82	3.78	2.70	0.33	0.33
RHB	-	-	-	-	2.90	0.71	2.19	1.80	0.21	0.21
LHB	-	-	13-Jul	S	1.50	-	-	0.30	0.22	0.21
								1.20	0.19	-
Q1	-	-	-	-	3.90	-	-	0.80	0.53	0.53
								3.10	0.53	-
MID	-	-	-	-	5.00	-	-	1.00	0.72	0.65
								4.00	0.58	-
LHB	-	-	15-Sep	S	0.61	-	-	0.00	0.00	0.21
								0.40	0.42	-
Q1	-	-	-	-	1.80	-	-	0.40	0.84	0.79
								1.40	0.73	-
MID	-	-	-	-	3.30	-	-	0.60	1.02	1.02
								2.60	1.02	-

Table A2.5. Water velocities measured in Zone 3A of the Red River, 1999.

Location	UTM (14U) NAD 83 E	UTM (14U) NAD 83 N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 3A										
Segment 76										
LHB	647728	5552346	2-Mar	H	3.60	0.90	2.70	2.20	0.13	0.13
RHB	-	-	-	-	4.00	0.80	3.20	2.40	0.30	0.30
RHB	647624	5552338	11-Mar	H	1.30	0.70	0.60	1.00	0.14	0.14
MID	-	-	-	-	3.50	0.80	2.70	2.10	0.53	0.53
LHB	-	-	23-Jul	H	3.50	-	-	0.70	0.83	0.67
								2.30	0.50	-
RHB	-	-	16-Sep	H	1.73	-	-	0.35	0.84	0.72
								1.38	0.60	-
Q1	-	-	-	-	1.83	-	-	0.37	0.94	0.84
								1.46	0.73	-
MID	-	-	-	-	2.49	-	-	0.50	1.19	1.09
								1.99	0.98	-
Segment 79										
RHB	650224	5554352	2-Mar	M	3.40	0.85	2.55	2.10	0.03	0.03
LHB	-	-	-	-	5.70	1.30	4.40	3.50	0.16	0.16

Table A2.5. (Continued)

Location	UTM (14U) NAD 83 E	N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 3A										
Segment 82										
RHB	653137	5555167	11-Mar	H	3.30	0.78	2.50	1.80	0.12	0.12
MID	-	-	-	-	4.60	0.96	3.60	2.20	0.20	0.20
Segment 83										
RHB	652665	5555781	2-Mar	M	5.00	0.60	4.40	2.20	0.10	0.10
LHB	-	-	-	-	5.90	0.78	5.10	3.40	0.14	0.14
RHB	-	-	23-Jul	M	1.25	-	-	0.70	0.25	0.25
Q1	-	-	-	-	2.00	-	-	0.40	0.30	0.28
								1.60	0.25	-
MID	-	-	-	-	3.30	-	-	0.70	0.47	0.45
								2.60	0.42	-
RHB	-	-	16-Sep	M	1.26	-	-	0.25	0.42	0.36
								1.01	0.30	-
Q1	-	-	-	-	2.62	-	-	0.52	0.61	0.54
								2.10	0.46	-
MID	-	-	-	-	3.90	-	-	0.78	0.66	0.62
								3.12	0.58	-

Table A2.5. (Continued)

Location	UTM (14U) NAD 83 E	N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 3A										
Segment 86										
RHB	653429	5558004	11-Mar	S	1.50	0.76	0.80	1.20	0.09	0.09
MID	-	-	-	-	4.30	0.73	3.57	2.51	0.21	0.21
RHB	-	-	23-Jul	S	0.90	-	-	0.50	0.19	0.19
Q1	-	-	-	-	4.30	-	-	0.90	0.45	0.44
								2.60	0.42	-
MID	-	-	-	-	5.00	-	-	1.00	0.49	0.46
								3.00	0.43	-
RHB	-	-	16-Sep	S	1.35	-	-	0.27	0.42	0.37
								1.08	0.31	-
Q1	-	-	-	-	1.72	-	-	0.34	0.52	0.46
								1.38	0.40	-
MID	-	-	-	-	1.93	-	-	0.39	0.56	0.53
								1.54	0.50	-

Table A2.6. Water velocities measured in Zone 4 of the Assiniboine River, 1999.

Location	UTM (14U) NAD 83 E	N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 4										
Segment 109										
LHB	620180	5525194	16-Jul	WEWPCC	1.40	-	-	0.30	1.24	1.11
								1.10	0.97	-
LHB	620180	5525194	8-Sep	WEWPCC	1.00	-	-	0.60	0.86	0.86
Segment 113										
LHB	-	-	14-Jul	H	1.45	-	-	0.30	1.05	1.01
								1.20	0.96	-
Q1	-	-	-	-	1.75	-	-	0.40	1.00	0.80
								1.40	0.59	-
MID	-	-	-	-	1.75	-	-	0.40	1.03	0.87
								1.40	0.70	-
LHB	-	-	8-Sep	H	0.80	-	-	0.48	0.86	0.86
Q1	-	-	-	-	1.00	-	-	0.60	0.70	0.70
MID	-	-	-	-	1.15	-	-	0.23	0.95	0.84
								0.90	0.73	-
Segment 115										
LHB	623461	5524365	6-Mar	H	1.75	0.43	1.32	1.05	0.30	0.30

Table A2.6. (Continued)

Location	UTM (14U) NAD 83 E	N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 4										
Segment 118										
RHB	-	-	16-Jul	TC/SC	1.55	-	-	0.30	0.06	0.05
								1.20	0.03	-
RHB	-	-	8-Sep	TC/SC	1.60	-	-	0.32	0.38	0.33
								1.28	0.28	-

Table A2.6. (Continued)

Location	UTM (14U) NAD 83 E	N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 4										
Segment 122										
RHB	627854	5526064	6-Mar	M	1.80	0.60	1.20	1.20	0.23	0.23
LHB	-	-	-	-	2.40	0.65	1.75	1.50	0.12	0.12
Segment 123										
LHB	-	-	14-Jul	H	1.80	-	-	0.40	0.73	0.68
								1.40	0.62	-
MID	-	-	-	-	1.65	-	-	0.30	1.24	1.21
								1.30	1.17	-
LHB	-	-	10-Sep	H	1.26	-	-	0.26	0.75	0.63
								1.01	0.50	-
Q1	-	-	-	-	1.50	-	-	0.30	1.20	1.05
								1.20	0.90	-
MID	-	-	-	-	1.57	-	-	0.31	1.22	1.06
								1.26	0.89	-
Segment 125										
RHB	-	-	16-Jul	TC/OC	0.90	-	-	0.50	0.07	0.07
RHB	-	-	10-Sep	TC/OC	1.95	-	-	0.39	0.08	0.08
					1.95	-	-	1.56	0.08	-

Table A2.6. (Continued)

Location	UTM (14U) NAD 83 E	N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 4										
Segment 128										
RHB	-	-	14-Jul	S	1.20	-	-	0.30	0.56	0.55
								1.00	0.54	-
Q1	-	-	-	-	2.70	-	-	0.50	0.88	0.77
								2.20	0.65	-
MID	-	-	-	-	3.00	-	-	0.60	1.06	0.95
								2.40	0.83	-
RHB	-	-	10-Sep	S	1.07	-	-	0.21	0.31	0.29
								0.86	0.27	-
Q1	-	-	-	-	2.38	-	-	0.48	0.49	0.45
								1.96	0.40	-
MID	-	-	-	-	4.66	-	-	0.93	0.56	0.50
								3.73	0.43	-

Table A2.7. Water velocities measured in Zone 5 of the Assiniboine River, 1999.

Location	UTM (14U) NAD 83 E	N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 5										
Segment 101										
RHB	-	-	5-Mar	H	1.30	0.73	0.57	1.00	0.17	0.17
LHB	-	-	-	-	1.50	0.73	0.77	1.10	0.10	0.10
Segment 102										
LHB	-	-	16-Jul	M	2.25	-	-	0.50	0.92	0.83
								1.80	0.73	-
Q1	-	-	-	-	2.60	-	-	0.50	1.17	0.90
								2.10	0.63	-
MID	-	-	-		2.00	-	-	0.40	1.41	1.32
								1.60	1.22	-
LHB	-	-	8-Sep	M	1.20	-	-	0.20	0.60	0.57
								1.00	0.54	-
Q1	-	-	-	-	1.60	-	-	0.30	0.55	0.50
								1.30	0.45	-
MID	-	-	-	-	1.55	-	-	0.30	0.59	0.58
								1.25	0.57	-
Segment 104										
LHB	616588	5524749	5-Mar	H	1.30	0.71	0.69	1.00	0.12	0.12
RHB	-	-	-	-	1.40	0.70	0.70	1.00	0.19	0.19

Table A2.7. (Continued)

Location	UTM (14U) NAD 83 E	N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 5										
Segment 104 (Continued)										
RHB	-	-	16-Jul	H	1.80	-	-	0.40	0.87	0.76
								1.40	0.65	-
MID	-	-	-	-	2.30	-	-	0.50	1.13	1.02
								1.80	0.91	-
RHB	-	-	8-Sep	H	1.60	-	-	0.30	0.75	0.60
								1.30	0.45	-
Q1	-	-	-	-	1.40	-	-	0.28	0.89	0.76
								1.12	0.63	-
MID	-	-	-	-	1.45	-	-	0.29	0.96	0.84
								1.16	0.72	-

Table A2.7. (Continued)

Location	UTM (14U) NAD 83 E	N	Date	Habitat Type	Total Depth (m)	Ice Thickness (cm)	Water Depth (m)	Depth of Observation (m)	Velocity (m/s)	Mean Velocity (m/s)
ZONE 5										
Segment 108										
LHB	618606	5524627	5-Mar	H	0.70	0.56	0.14	0.63	0.22	0.22
RHB	-	-	-	-	1.10	0.62	0.55	0.90	0.30	0.30
LHB	619709	5524973	16-Jul	WEWPCC	1.80	-	-	0.40	1.20	1.04
								1.40	0.87	-
RHB	-	-	-	-	2.00	-	-	0.40	0.83	0.75
								1.60	0.67	-
LHB	-	-	-	-	1.80	-	-	0.40	0.76	0.71
								1.40	0.65	-
RHB	-	-	-	-	2.00	-	-	0.40	1.20	0.90
								1.60	0.60	-
LHB	619709	5524973	8-Sep	WEWPCC	0.50	-	-	0.25	1.08	1.08
RHB	-	-	-	-	1.15	-	-	0.92	0.76	0.92
								0.23	1.09	-
LHB	-	-	-	-	1.00	-	-	0.60	0.54	0.54
RHB	-	-	-	-	1.55	-	-	1.24	0.70	0.70
								0.31	0.70	-

APPENDIX 3

Location of sampling sites, by river and zone, for all gear types used, and seasons fished, in the Red and Assiniboine rivers, and selected tributaries, Within the City of Winnipeg Ammonia Criteria Study Area, 1999.

Table A3.1. Location of sampling sites, by river and zone, for all gear types used, and se fished, in the Red and Assiniboine rivers, and selected tributaries, within the of Winnipeg Ammonia Criteria Study Area, 1999.

Waterbody	Zone	Segment	Habitat Type	Date	Gear Type	Gear #
Assiniboine River	4	108	P	16-Jul-99	Boat electrofishing	E-22
	4	108	P	16-Jul-99	Boat electrofishing	E-23
	4	108	P	16-Jul-99	Boat electrofishing	E-25
	4	108	P	16-Jul-99	Boat electrofishing	E-26
	4	108	P	8-Sep-99	Boat electrofishing	E-49
	4	108	P	8-Sep-99	Boat electrofishing	E-50
	4	108	P	8-Sep-99	Boat electrofishing	E-51
	4	108	P	8-Sep-99	Boat electrofishing	E-52
	4	108	P	9-Sep-99	Boat electrofishing	E-54
	4	108	P	10-Sep-99	Boat electrofishing	E-60
	4	108	P	10-Sep-99	Boat electrofishing	E-61
	4	108	P	10-Sep-99	Boat electrofishing	E-62
	4	108	P	10-Sep-99	Boat electrofishing	E-64
	4	109	P	16-Jul-99	Boat electrofishing	E-24
	4	109	P	8-Sep-99	Boat electrofishing	E-48
	4	109	P	9-Sep-99	Boat electrofishing	E-53
	4	109	P	10-Sep-99	Boat electrofishing	E-63
	4	111	S	14-Aug-99	Hoopnet	HN-34
	4	111	S	15-Aug-99	Hoopnet	HN-37
	4	111	S	16-Aug-99	Hoopnet	HN-41
	4	111	S	10-Sep-99	Seine	S-35
	4	112	M	10-Sep-99	Backpack electrofishing	BE-26
	4	113	H	13-Jul-99	Hoopnet	HN-13
	4	113	H	14-Jul-99	Backpack electrofishing	BE-12
	4	113	H	14-Jul-99	Boat electrofishing	E-15
	4	113	H	14-Jul-99	Gillnet	GN-52
	4	113	H	14-Jul-99	Seine	S-12
	4	113	H	14-Aug-99	Hoopnet	HN-35
	4	113	H	15-Aug-99	Hoopnet	HN-38
	4	113	H	16-Aug-99	Hoopnet	HN-42
	4	113	H	9-Sep-99	Backpack electrofishing	BE-23
	4	113	H	9-Sep-99	Gillnet	GN-60
	4	113	H	9-Sep-99	Seine	S-32
	4	113	H	10-Sep-99	Hoopnet	HN-61
	4	113	H	11-Sep-99	Boat electrofishing	E-65
	4	115	H	5-Mar-99	Gillnet	GN-28
	4	116	S	15-Aug-99	Hoopnet	HN-39
	4	116	S	16-Aug-99	Hoopnet	HN-43

Table A3.1. (Continued)

Waterbody	Zone	Segment	Habitat Type	Date	Gear Type	Gear #
Assiniboine River	4	117	S	14-Aug-99	Hoopnet	HN-36
	4	117	S	15-Aug-99	Hoopnet	HN-40
	4	117	S	16-Aug-99	Hoopnet	HN-44
	4	122	M	5-Mar-99	Gillnet	GN-29
	4	123/124	H/S	13-Jul-99	Hoopnet	HN-15
	4	123/124	H/S	14-Jul-99	Backpack electrofishing	BE-14
	4	123/124	H/S	14-Jul-99	Boat electrofishing	E-17
	4	123/124	H/S	14-Jul-99	Gillnet	GN-54
	4	123/124	H/S	14-Jul-99	Seine	S-14
	4	123/124	H/S	10-Sep-99	Gillnet	GN-64
	4	123/124	H/S	10-Sep-99	Hoopnet	HN-62
	4	123/124	H/S	11-Sep-99	Boat electrofishing	E-66
	4	125	H	10-Sep-99	Backpack electrofishing	BE-27
	4	125	H	10-Sep-99	Seine	S-36
	4	126	M	27-Feb-99	Gillnet	GN-12
	4	128	S	13-Jul-99	Hoopnet	HN-14
	4	128	S	14-Jul-99	Backpack electrofishing	BE-13
	4	128	S	14-Jul-99	Boat electrofishing	E-16
	4	128	S	14-Jul-99	Gillnet	GN-53
	4	128	S	14-Jul-99	Seine	S-13
	4	128	S	9-Sep-99	Hoopnet	HN-60
	4	128	S	10-Sep-99	Boat electrofishing	E-57
	4	128	S	10-Sep-99	Gillnet	GN-63
	5	101	M	4-Mar-99	Gillnet	GN-25
	5	102	M	14-Jul-99	Hoopnet	HN-16
	5	102	M	16-Jul-99	Backpack electrofishing	BE-15
	5	102	M	16-Jul-99	Boat electrofishing	E-20
	5	102	M	16-Jul-99	Gillnet	GN-55
	5	102	M	16-Jul-99	Seine	S-15
	5	102	M	8-Sep-99	Hoopnet	HN-58
	5	102	M	9-Sep-99	Backpack electrofishing	BE-24
	5	102	M	9-Sep-99	Gillnet	GN-61
	5	102	M	9-Sep-99	Seine	S-33
	5	102	M	10-Sep-99	Boat electrofishing	E-58
	5	104	H	4-Mar-99	Gillnet	GN-26
	5	104	H	14-Jul-99	Hoopnet	HN-17
	5	104	H	16-Jul-99	Backpack electrofishing	BE-16
	5	104	H	16-Jul-99	Boat electrofishing	E-21

Table A3.1. (Continued)

Waterbody	Zone	Segment	Habitat Type	Date	Gear Type	Gear #
Assiniboine River	5	104	H	16-Jul-99	Gillnet	GN-56
	5	104	H	16-Jul-99	Seine	S-16
	5	104	H	8-Sep-99	Hoopnet	HN-59
	5	104	H	9-Sep-99	Backpack electrofishing	BE-25
	5	104	H	9-Sep-99	Gillnet	GN-62
	5	104	H	9-Sep-99	Seine	S-34
	5	104	H	10-Sep-99	Boat electrofishing	E-59
	5	105	H	10-Sep-99	Backpack electrofishing	BE-28
	5	105	H	10-Sep-99	Seine	S-37
	5	108	H	4-Mar-99	Gillnet	GN-27
Bunns Creek	3	60	TC	12-Jul-99	Boat electrofishing	E-8
	3	60	TC	22-Jul-99	Boat electrofishing	E-28
	3	60	TC	28-Jul-99	Seine	S-21
	3	60	TC	17-Sep-99	Boat electrofishing	E-88
	3	60	TC	30-Sep-99	Seine	S-54
	3	60	TC	30-Sep-99	Backpack electrofishing	BE-49
La Salle River	1	18	TC	26-Jul-99	Boat electrofishing	E-39
	1	18	TC	28-Jul-99	Backpack electrofishing	BE-21
	1	18	TC	29-Jul-99	Seine	S-24
	1	18	TC	29-Jul-99	Seine	S-25
	1	18	TC	23-Aug-99	Seine	S-29
	1	18	TC	23-Aug-99	Seine	S-30
	1	18	TC	20-Sep-99	Boat electrofishing	E-100
	1	18	TC	30-Sep-99	Seine	S-53
	1	18	TC	30-Sep-99	Backpack electrofishing	BE-46
Omands Creek	4	125	TC	16-Jul-99	Boat electrofishing	E-19
	4	125	TC	9-Sep-99	Boat electrofishing	E-56
Parks Creek	3	65	TC	12-Jul-99	Boat electrofishing	E-11
	3	65	TC	22-Jul-99	Boat electrofishing	E-29
	3	65	TC	17-Sep-99	Boat electrofishing	E-89
	3	65	TC	17-Sep-99	Backpack electrofishing	BE-41

Table A3.1. (Continued)

Waterbody	Zone	Segment	Habitat Type	Date	Gear Type	Gear #
Red River	1	4	M	3-Mar-99	Gillnet	GN-22
	1	5	M	8-Mar-99	Gillnet	GN-34
	1	6	S	3-Mar-99	Gillnet	GN-23
	1	8	S	3-Mar-99	Gillnet	GN-24
	1	10	S	2-Mar-99	Gillnet	GN-19
	1	16	S	2-Mar-99	Gillnet	GN-20
	1	17	S	2-Mar-99	Gillnet	GN-21
	1	17	S	23-Aug-99	Seine	S-28
	1	18	S	8-Mar-99	Gillnet	GN-35
	1	18	S	26-Jul-99	Backpack electrofishing	BE-18
	1	18	S	26-Jul-99	Boat electrofishing	E-38
	1	18	S	26-Jul-99	Gillnet	GN-57
	1	18	S	26-Jul-99	Hoopnet	HN-18
	1	18	S	26-Jul-99	Seine	S-18
	1	18	S	19-Sep-99	Backpack electrofishing	BE-42
	1	18	S	19-Sep-99	Backpack electrofishing	BE-43
	1	18	S	19-Sep-99	Hoopnet	HN-75
	1	18	S	19-Sep-99	Seine	S-50
	1	18	S	20-Sep-99	Boat electrofishing	E-93
	1	18	S	20-Sep-99	Boat electrofishing	E-94
	1	19	M	8-Mar-99	Gillnet	GN-36
	1	19	M	26-Jul-99	Backpack electrofishing	BE-19
	1	19	M	26-Jul-99	Boat electrofishing	E-40
	1	19	M	26-Jul-99	Gillnet	GN-58
	1	19	M	26-Jul-99	Hoopnet	HN-19
	1	19	M	26-Jul-99	Seine	S-19
	1	19	M	19-Sep-99	Backpack electrofishing	BE-44
	1	19	M	19-Sep-99	Hoopnet	HN-76
	1	19	M	20-Sep-99	Boat electrofishing	E-95
	1	21	M	28-Feb-99	Gillnet	GN-13
	1	23	H	26-Jul-99	Backpack electrofishing	BE-20
	1	23	H	26-Jul-99	Boat electrofishing	E-41
	1	23	H	26-Jul-99	Gillnet	GN-59
	1	23	H	26-Jul-99	Hoopnet	HN-20
	1	23	H	26-Jul-99	Seine	S-20
	1	23	H	19-Sep-99	Backpack electrofishing	BE-45
	1	23	H	19-Sep-99	Hoopnet	HN-77

Table A3.1. (Continued)

Waterbody	Zone	Segment	Habitat Type	Date	Gear Type	Gear #
Red River	1	23	H	19-Sep-99	Seine	S-51
	1	23	H	20-Sep-99	Boat electrofishing	E-96
	1	24	H	19-Sep-99	Seine	S-52
	1	25	H	28-Feb-99	Gillnet	GN-14
	1	26	S	28-Feb-99	Gillnet	GN-15
	2	27	P	26-Jul-99	Boat electrofishing	E-42
	2	27	P	26-Jul-99	Boat electrofishing	E-43
	2	27	P	26-Jul-99	Boat electrofishing	E-44
	2	27	P	20-Sep-99	Boat electrofishing	E-97
	2	27	P	20-Sep-99	Boat electrofishing	E-98
	2	27	P	20-Sep-99	Boat electrofishing	E-99
	2	28	S	9-Aug-99	Hoopnet	HN-21
	2	28	S	10-Aug-99	Hoopnet	HN-24
	2	28	S	11-Aug-99	Hoopnet	HN-27
	2	28	S	13-Aug-99	Hoopnet	HN-32
	2	29	S	8-Jul-99	Hoopnet	HN-04
	2	29	S	9-Jul-99	Backpack electrofishing	BE-03
	2	29	S	9-Jul-99	Boat electrofishing	E-4
	2	29	S	9-Jul-99	Gillnet	GN-43
	2	29	S	9-Jul-99	Seine	S-02
	2	29	S	9-Aug-99	Hoopnet	HN-22
	2	29	S	10-Aug-99	Hoopnet	HN-25
	2	29	S	11-Aug-99	Hoopnet	HN-28
	2	29	S	12-Aug-99	Hoopnet	HN-30
	2	29	S	11-Sep-99	Hoopnet	HN-63
	2	29	S	12-Sep-99	Backpack electrofishing	BE-29
	2	29	S	12-Sep-99	Boat electrofishing	E-67
	2	29	S	12-Sep-99	Gillnet	GN-65
	2	29	S	12-Sep-99	Seine	S-38
	2	33	H	25-Feb-99	Gillnet	GN-07
	2	33	H	9-Aug-99	Hoopnet	HN-23
	2	33	H	10-Aug-99	Hoopnet	HN-26
	2	33	H	11-Aug-99	Hoopnet	HN-29
	2	33	H	12-Aug-99	Hoopnet	HN-31
	2	33	H	13-Aug-99	Hoopnet	HN-33
	2	34	S	25-Feb-99	Gillnet	GN-08
	2	34	S	8-Jul-99	Hoopnet	HN-05
	2	34	S	9-Jul-99	Backpack electrofishing	BE-04

Table A3.1. (Continued)

Waterbody	Zone	Segment	Habitat Type	Date	Gear Type	Gear #
Red River	2	34	S	9-Jul-99	Boat electrofishing	E-5
	2	34	S	9-Jul-99	Gillnet	GN-44
	2	34	S	9-Jul-99	Seine	S-03
	2	34	S	11-Sep-99	Hoopnet	HN-64
	2	34	S	12-Sep-99	Backpack electrofishing	BE-30
	2	34	S	12-Sep-99	Boat electrofishing	E-68
	2	34	S	12-Sep-99	Gillnet	GN-66
	2	36	M	12-Sep-99	Seine	S-39
	2	37	M	22-Feb-99	Gillnet	GN-01
	2	37	M	12-Sep-99	Seine	S-40
	2	38	M	25-Feb-99	Gillnet	GN-09
	2	38	M	8-Jul-99	Hoopnet	HN-06
	2	38	M	9-Jul-99	Backpack electrofishing	BE-05
	2	38	M	9-Jul-99	Boat electrofishing	E-6
	2	38	M	9-Jul-99	Gillnet	GN-45
	2	38	M	9-Jul-99	Seine	S-04
	2	38	M	11-Sep-99	Hoopnet	HN-65
	2	38	M	12-Sep-99	Backpack electrofishing	BE-31
	2	38	M	12-Sep-99	Boat electrofishing	E-69
	2	38	M	12-Sep-99	Gillnet	GN-67
	2	40	M	6-Mar-99	Gillnet	GN-30
	2	43	M	22-Feb-99	Gillnet	GN-02
	2	43	H	7-Jul-99	Hoopnet	HN-01
	2	43	H	8-Jul-99	Boat electrofishing	E-1
	2	43	H	8-Jul-99	Gillnet	GN-40
	2	43	H	9-Jul-99	Seine	S-05
	2	43	H	22-Jul-99	Backpack electrofishing	BE-17
	2	43	H	12-Sep-99	Hoopnet	HN-66
	2	43	H	13-Sep-99	Boat electrofishing	E-70
	2	43	H	13-Sep-99	Gillnet	GN-68
	2	44	M	25-Feb-99	Gillnet	GN-10
	2	47	S	13-Sep-99	Seine	S-41
	2	50	H	24-Feb-99	Gillnet	GN-03
	2	50	H	7-Jul-99	Hoopnet	HN-02
	2	50	H	8-Jul-99	Backpack electrofishing	BE-01
	2	50	H	8-Jul-99	Boat electrofishing	E-2
	2	50	H	8-Jul-99	Gillnet	GN-41
	2	50	H	22-Jul-99	Seine	S-17

Table A3.1. (Continued)

Waterbody	Zone	Segment	Habitat Type	Date	Gear Type	Gear #
Red River	2	50	H	12-Sep-99	Hoopnet	HN-67
	2	50	H	13-Sep-99	Backpack electrofishing	BE-34
	2	50	H	13-Sep-99	Boat electrofishing	E-71
	2	50	H	13-Sep-99	Gillnet	GN-69
	2	51	M	24-Feb-99	Gillnet	GN-04
	2	52	M	6-Mar-99	Gillnet	GN-31
	2	52	M	13-Sep-99	Backpack electrofishing	BE-32
	2	52	M	13-Sep-99	Seine	S-42
	2	54	M	13-Sep-99	Seine	S-43
	2	55	S	24-Feb-99	Gillnet	GN-05
	2	56	H	24-Feb-99	Gillnet	GN-06
	2	56	H	7-Jul-99	Hoopnet	HN-03
	2	56	H	8-Jul-99	Backpack electrofishing	BE-02
	2	56	H	8-Jul-99	Boat electrofishing	E-3
	2	56	H	8-Jul-99	Gillnet	GN-42
	2	56	H	8-Jul-99	Seine	S-01
	2	56	H	12-Sep-99	Hoopnet	HN-68
	2	56	H	13-Sep-99	Backpack electrofishing	BE-33
	2	56	H	13-Sep-99	Boat electrofishing	E-72
	2	56	H	13-Sep-99	Gillnet	GN-70
	3	58	P	22-Jul-99	Boat electrofishing	E-31
	3	58	P	22-Jul-99	Boat electrofishing	E-32
	3	58	S	17-Aug-99	Hoopnet	HN-45
	3	58	S	18-Aug-99	Hoopnet	HN-49
	3	58	P	17-Sep-99	Boat electrofishing	E-86
	3	59	M	12-Jul-99	Hoopnet	HN-10
	3	59	M	13-Jul-99	Backpack electrofishing	BE-09
	3	59	M	13-Jul-99	Boat electrofishing	E-12
	3	59	M	13-Jul-99	Gillnet	GN-49
	3	59	M	13-Jul-99	Seine	S-09
	3	59	P	22-Jul-99	Boat electrofishing	E-33
	3	59	P	22-Jul-99	Boat electrofishing	E-34
	3	59	M	17-Aug-99	Hoopnet	HN-46
	3	59	M	18-Aug-99	Hoopnet	HN-50
	3	59	M	19-Aug-99	Hoopnet	HN-52
	3	59	M	19-Aug-99	Hoopnet	HN-53
	3	59	M	20-Aug-99	Hoopnet	HN-55
	3	59	M	20-Aug-99	Hoopnet	HN-56
	3	59	M	13-Sep-99	Hoopnet	HN-69

Table A3.1. (Continued)

Waterbody	Zone	Segment	Habitat Type	Date	Gear Type	Gear #
Red River	3	59	M	14-Sep-99	Backpack electrofishing	BE-35
	3	59	M	14-Sep-99	Boat electrofishing	E-73
	3	59	M	17-Sep-99	Backpack electrofishing	BE-40
	3	59	P	17-Sep-99	Boat electrofishing	E-83
	3	59	P	17-Sep-99	Boat electrofishing	E-84
	3	59	P	17-Sep-99	Boat electrofishing	E-85
	3	60	S	11-Jul-99	Hoopnet	HN-07
	3	60	S	12-Jul-99	Backpack electrofishing	BE-06
	3	60	S	12-Jul-99	Boat electrofishing	E-7
	3	60	S	12-Jul-99	Gillnet	GN-46
	3	60	S	12-Jul-99	Seine	S-06
	3	60	P	22-Jul-99	Boat electrofishing	E-30
	3	60	S	13-Sep-99	Hoopnet	HN-70
	3	60	S	14-Sep-99	Backpack electrofishing	BE-36
	3	60	S	14-Sep-99	Boat electrofishing	E-74
	3	60	S	14-Sep-99	Seine	S-44
	3	60	P	17-Sep-99	Boat electrofishing	E-82
	3	61	M	11-Jul-99	Hoopnet	HN-08
	3	61	M	12-Jul-99	Backpack electrofishing	BE-07
	3	61	M	12-Jul-99	Boat electrofishing	E-9
	3	61	M	12-Jul-99	Gillnet	GN-47
	3	61	M	12-Jul-99	Seine	S-07
	3	61	M	17-Aug-99	Hoopnet	HN-47
	3	61	M	13-Sep-99	Hoopnet	HN-71
	3	61	M	14-Sep-99	Backpack electrofishing	BE-37
	3	61	M	14-Sep-99	Boat electrofishing	E-75
	3	61	M	14-Sep-99	Seine	S-45
	3	61	M	14-Sep-99	Seine	S-46
	3	62	H	17-Aug-99	Hoopnet	HN-48
	3	62	H	18-Aug-99	Hoopnet	HN-51
	3	62	H	19-Aug-99	Hoopnet	HN-54
	3	62	H	20-Aug-99	Hoopnet	HN-57
	3	65	H	11-Jul-99	Hoopnet	HN-09
	3	65	H	12-Jul-99	Backpack electrofishing	BE-08
	3	65	H	12-Jul-99	Boat electrofishing	E-10
	3	65	H	12-Jul-99	Gillnet	GN-48
	3	65	H	12-Jul-99	Seine	S-08
	3	65	H	14-Sep-99	Hoopnet	HN-72
	3	65	H	15-Sep-99	Backpack electrofishing	BE-38
	3	65	H	15-Sep-99	Boat electrofishing	E-76
	3	65	H	15-Sep-99	Seine	S-47

Table A3.1. (Continued)

Waterbody	Zone	Segment	Habitat Type	Date	Gear Type	Gear #
Red River	3	69	H	15-Sep-99	Backpack electrofishing	BE-39
	3	69	H	15-Sep-99	Seine	S-48
	3	71	H	26-Feb-99	Gillnet	GN-11
	3	72	H	7-Mar-99	Gillnet	GN-32
	3	72	H	12-Jul-99	Hoopnet	HN-11
	3	72	H	13-Jul-99	Backpack electrofishing	BE-10
	3	72	H	13-Jul-99	Boat electrofishing	E-13
	3	72	H	13-Jul-99	Gillnet	GN-50
	3	72	H	13-Jul-99	Seine	S-10
	3	72	H	14-Sep-99	Hoopnet	HN-73
	3	72	H	15-Sep-99	Boat electrofishing	E-77
	3	74	S	7-Mar-99	Gillnet	GN-33
	3	74	S	12-Jul-99	Hoopnet	HN-12
	3	74	S	13-Jul-99	Backpack electrofishing	BE-11
	3	74	S	13-Jul-99	Boat electrofishing	E-14
	3	74	S	13-Jul-99	Gillnet	GN-51
	3	74	S	13-Jul-99	Seine	S-11
	3	74	S	14-Sep-99	Hoopnet	HN-74
	3	74	S	15-Sep-99	Boat electrofishing	E-78
	3	74	S	15-Sep-99	Seine	S-49
	1A	-	H	27-Jul-99	Boat electrofishing	E-45
	1A	-	H	19-Sep-99	Boat electrofishing	E-90
	1A	-	M	27-Jul-99	Boat electrofishing	E-46
	1A	-	M	19-Sep-99	Boat electrofishing	E-91
	1A	-	S	27-Jul-99	Boat electrofishing	E-47
	1A	-	S	19-Sep-99	Boat electrofishing	E-92
	3A	76	H	1-Mar-99	Gillnet	GN-16
	3A	76	H	10-Mar-99	Gillnet	GN-37
	3A	76	H	23-Jul-99	Boat electrofishing	E-35
	3A	76	H	16-Sep-99	Boat electrofishing	E-79
	3A	79	M	1-Mar-99	Gillnet	GN-17
	3A	82	H	10-Mar-99	Gillnet	GN-38
	3A	83	M	1-Mar-99	Gillnet	GN-18
	3A	83	M	23-Jul-99	Boat electrofishing	E-36
	3A	83	M	16-Sep-99	Boat electrofishing	E-80

Table A3.1. (Continued)

Waterbody	Zone	Segment	Habitat Type	Date	Gear Type	Gear #
Red River	3A	86	S	10-Mar-99	Gillnet	GN-39
	3A	86	S	23-Jul-99	Boat electrofishing	E-37
	3A	86	S	16-Sep-99	Boat electrofishing	E-81
Sturgeon Creek	4	118	TC	28-Jul-99	Seine	S-22
	4	118	TC	28-Jul-99	Seine	S-23
	4	118	TC	29-Jul-99	Seine	S-27
	4	118	TC	24-Aug-99	Seine	S-31
	4	118	TC	30-Sep-99	Seine	S-55
	4	118	TC	28-Jul-99	Backpack electrofishing	BE-22
	4	118	TC	16-Jul-99	Boat electrofishing	E-18
	4	118	TC	9-Sep-99	Boat electrofishing	E-55
Seine River	2	52	TC	29-Jul-99	Seine	S-26
	2	52	TC	30-Sep-99	Backpack electrofishing	BE-47
	2	52	TC	30-Sep-99	Backpack electrofishing	BE-48
	2	52	TC	22-Jul-99	Boat electrofishing	E-27
	2	52	TC	17-Sep-99	Boat electrofishing	E-87

Habitat:

H = Hard
M = Medium
S = Soft
H/S = Hard/Soft
TC = Tributary Confluence
P = Plume

APPENDIX 4

Results of fishing conducted in the Red and Assiniboine rivers, 1999.

Table A4.1. Results of gill netting conducted in the Red and Assiniboine rivers, 1999.

Date	Waterbody	Zone	Segment	Habitat Type	Set #	Duration (hrs)	BLBL	BRBL	BURB	CARP	CHCT	FRDR	GOLD	LKCS	MOON	NRPK	SAUG	SHRD	SLCH	STON	WALL	WHSC	Total Catch	Comments
22-Feb-99	RR	2	37	M	GN-01	18.00																	0	approximately 80% channel coverage
22-Feb-99	RR	2	43	M	GN-02	18.75							1				1						2	approximately 80% channel coverage
24-Feb-99	RR	2	50	M	GN-03	22.75																	0	set from LHB
24-Feb-99	RR	2	51	M	GN-04	23.50																	0	set from RHB
24-Feb-99	RR	2	55	S	GN-05	23.25							2		1								3	set from LHB
24-Feb-99	RR	2	56	H	GN-06	23.75																	0	set from RHB
25-Feb-99	RR	2	33	M	GN-07	21.75							1		1		1						3	set from LHB; 15% channel coverage
25-Feb-99	RR	2	34	M	GN-08	22.00							2										2	approximately 60% channel coverage
25-Feb-99	RR	2	38	M	GN-09	22.00					1		1		1							1	4	approximately 80% channel coverage
25-Feb-99	RR	2	44	M	GN-10	22.50																	0	approximately 80% channel coverage
26-Feb-99	RR	3	71	H	GN-11	19.75																	0	set from LHB
27-Feb-99	AR	4	126	M	GN-12	21.75																	0	set from RHB
28-Feb-99	RR	1	21	M	GN-13	22.25						1				1	1						3	approximately 65-70% channel coverage
28-Feb-99	RR	1	25	H	GN-14	22.50				4		4	2									1	11	approximately 65-70% channel coverage
28-Feb-99	RR	1	26	S	GN-15	22.25											2						2	approximately 45-50% channel coverage
1-Mar-99	RR	3A	76	H	GN-16	19.75			1					1			7	2				14	25	set from RHB to LHB
1-Mar-99	RR	3A	79	M	GN-17	26.00								2									2	set from RHB to MID
1-Mar-99	RR	3A	83	M	GN-18	24.75							1	1			1					5	8	set from RHB to MID
2-Mar-99	RR	1	10	S	GN-19	21.00																1	1	set from RHB to MID
2-Mar-99	RR	1	16	S	GN-20	20.50																	0	set from LHB to MID
2-Mar-99	RR	1	17	S	GN-21	20.75																	0	set from RHB to MID
3-Mar-99	RR	1	4	M	GN-22	22.75										1							1	set from LHB to RHB
3-Mar-99	RR	1	6	S	GN-23	25.75																	0	set from LHB to RHB
3-Mar-99	RR	1	8	S	GN-24	21.75							4									1	5	set from LHB to MID
4-Mar-99	AR	5	101	M	GN-25	26.25																	0	set from RHB to LHB
4-Mar-99	AR	5	104	H	GN-26	23.75																	0	set from LHB to RHB
4-Mar-99	AR	5	108	H	GN-27	19.00															1		1	set from LHB to RHB
5-Mar-99	AR	4	115	H	GN-28	18.50																	0	set from LHB
5-Mar-99	AR	4	122	M	GN-29	24.75																	0	set from LHB to RHB
6-Mar-99	RR	2	40	M	GN-30	27.25							4										4	set from RHB to MID
6-Mar-99	RR	2	52	M	GN-31	22.00							2		1	1							4	set from RHB to MID
7-Mar-99	RR	3	72	H	GN-32	22.25																	0	set from RHB to MID
7-Mar-99	RR	3	74	M	GN-33	24.25																	0	set from RHB to MID
8-Mar-99	RR	1	5	M	GN-34	25.50							1										1	set from LHB to MID
8-Mar-99	RR	1	18	S	GN-35	22.75											2				1		3	set from RHB to MID
8-Mar-99	RR	1	19	M	GN-36	23.25					1					1						1	3	set from RHB to MID
10-Mar-99	RR	3A	76	H	GN-37	27.00								1			2						3	set from RHB to MID
10-Mar-99	RR	3A	82	H	GN-38	23.00				1	1		1	10			1				1	5	20	set from RHB to MID
10-Mar-99	RR	3A	86	S	GN-39	19.50								4	1	4	3		1		4		17	set from RHB to MID
8-Jul-99	RR	2	43	H	GN-40	23.10					1					1							2	
8-Jul-99	RR	2	50	H	GN-41	22.90	1				2										1		4	
8-Jul-99	RR	2	56	H	GN-42	21.80	2				3							2				1	8	
9-Jul-99	RR	2	29	S	GN-43	2.90																	0	
9-Jul-99	RR	2	34	S	GN-44	3.83							3			1							4	
9-Jul-99	RR	2	38	M	GN-45	5.42					1		7										8	set from LHB
12-Jul-99	RR	3	60	S	GN-46	5.08					1							1				1	3	

Table A4.1. (Continued)

Date	Waterbody	Zone	Segment	Habitat Type	Set #	Duration (hrs)	BLBL	BRBL	BURB	CARP	CHCT	FRDR	GOLD	LKCS	MOON	NRPK	SAUG	SHRD	SLCH	STON	WALL	WHSC	Total Catch	Comments
12-Jul-99	RR	3	61	M	GN-47	6.83				1	1				1	1		1					5	
12-Jul-99	RR	3	65	H	GN-48	5.72							1			2						1	4	
13-Jul-99	RR	3	59	M	GN-49	7.08						1					1	1					3	
13-Jul-99	RR	3	72	H	GN-50	4.25										1	1			2		1	5	
13-Jul-99	RR	3	74	S	GN-51	3.75					1						1						2	set from RHB
14-Jul-99	AR	4	113	H	GN-52	4.58																	0	
14-Jul-99	AR	4	128	S	GN-53	5.58					1		2		2								5	set from RHB
14-Jul-99	AR	4	123/124	H/S	GN-54	4.50				1													1	
16-Jul-99	AR	5	102	M	GN-55	5.58										1		1					2	
16-Jul-99	AR	5	104	H	GN-56	6.17		1								1							2	
26-Jul-99	RR	1	18	S	GN-57	4.58																	0	set from LHB
26-Jul-99	RR	1	19	M	GN-58	4.50																	0	set from RHB
26-Jul-99	RR	1	23	H	GN-59	5.67																1	1	set from LHB
9-Sep-99	AR	4	113	H	GN-60	4.67																	0	set from LHB
9-Sep-99	AR	5	102	M	GN-61	4.50																	0	set from LHB
9-Sep-99	AR	5	104	H	GN-62	4.67																	0	set from RHB
10-Sep-99	AR	4	128	S	GN-63	7.10					2						2	1		1			6	set from RHB
10-Sep-99	AR	4	123/124	H/S	GN-64	4.40																	0	set from LHB
12-Sep-99	RR	2	29	S	GN-65	2.75												1					1	set from LHB
12-Sep-99	RR	2	34	S	GN-66	3.50																	0	set from LHB
12-Sep-99	RR	2	38	M	GN-67	6.75							1				1						2	set from LHB
13-Sep-99	RR	2	43	H	GN-68	6.60					1		1										2	set from RHB
13-Sep-99	RR	2	50	H	GN-69	4.75			1		1						1			2			5	set from RHB
13-Sep-99	RR	2	56	H	GN-70	3.25				2	1												3	set from LHB
Total							3	1	2	9	19	6	37	19	8	16	28	10	1	5	8	34	206	

Codes

Waterbodies:

AR = Assiniboine River
RR = Red River

Habitat:

H = Hard
M = Medium
S = Soft
H/S = Hard/Soft

General:

LHB = Left Hand Bank (looking U/S)
MID = Mid-Channel
RHB = Right Hand Bank (looking U/S)
U/S = Upstream

Species:

BLBL = Black Bullhead
BRBL = Brown Bullhead
BURB = Burbot
CARP = Carp
CHCT = Channel Catfish
FRDR = Freshwater Drum
GOLD = Goldeye
LKCS = Lake Cisco
MOON = Mooneye
NRPK = Northern Pike
SAUG = Sauger
SHRD = Shorthead Redhorse
SLCH = Silver Chub
STON = Stonecat
WALL = Walleye
WHSC = White Sucker

Note: All gillnet gangs constructed of 6 - 22.9 m long, 1.8 m deep, panels of 38, 51, 76, 108, and 127 mm mesh.

Table A4.2. Results of boat electrofishing conducted in the Red and Assiniboine rivers, and other selected tributar

Date	Waterbody	Zone	Segment	Habitat Type	Run #	Voltage DC (Watts)	Pulse Width (m/s)	Pulse Rate (pps)	Effort (secs)	BGBF	BLCR	BRBL	BURB	CARP	CHCT	FRDR	GLRD	GOLD	NRPK	QUIL	RCBS	SAUG	SHRD	SLCH	SLRD	WALL	WHSC	WHBS	Total Catch
8-Jul-99	RR	2	43	H	E-1	530	2.5	60	700														1				2		3
8-Jul-99	RR	2	50	H	E-2	530	2.5	60	691				4			1	2	2				1	1		1		5		17
8-Jul-99	RR	2	56	H	E-3	530	2.5	60	865					1		3				1							1		6
9-Jul-99	RR	2	29	S	E-4	530	2.5	60	696									5		1		1			1				8
9-Jul-99	RR	2	34	S	E-5	530	2.5	60	1027					2				2		1					1				6
9-Jul-99	RR	2	38	M	E-6	530	2.5	60	580											3			2		1	1	2		9
12-Jul-99	RR	3	60	S	E-7	530	2.5	60	1840					5		1		2		1		2	2			1	13		27
12-Jul-99	BC	3	60	TC	E-8	530	2.5	60	269										1	2		1			1		1		6
12-Jul-99	RR	3	61	M	E-9	530	2.5	60	2150				6	4		4				1		4	1			2	5		27
12-Jul-99	RR	3	65	H	E-10	530	2.5	60	503					1		1							3				3		8
12-Jul-99	PC	3	65	TC	E-11	530	2.5	60	208																	1			1
13-Jul-99	RR	3	59	M	E-12	530	2.5	60	633				1			1						2					1		5
13-Jul-99	RR	3	72	H	E-13	530	2.5	60	914				1														1		2
13-Jul-99	RR	3	74	S	E-14	530	2.5	60	747					1		2		1				3					4		11
14-Jul-99	AR	4	113	H	E-15	530	2.5	60	1000							1		2				3	34		2	1	7		50
14-Jul-99	AR	4	128	S	E-16	530	2.5	60	821					1				1		2					1	1	1		7
14-Jul-99	AR	4	123/124	H/S	E-17	530	2.5	60	414					2	1	1	2						4			1	2		13
16-Jul-99	SC	4	118	TC	E-18	530	2.5	60	666	1												1	1		1				4
16-Jul-99	OC	4	125	TC	E-19	530	2.5	60	250					1									3		2		1		7
16-Jul-99	AR	5	102	M	E-20	530	2.5	60	655								1						3				1		5
16-Jul-99	AR	5	104	H	E-21	530	2.5	60	355					1		1			1			1	5						9
16-Jul-99	AR	4	108	P	E-22	530	2.5	60	284					9		2		1		2		7	1						22
16-Jul-99	AR	4	108	P	E-23	530	2.5	60	263		1			1									5		1		2		10
16-Jul-99	AR	4	109	P	E-24	530	2.5	60	230					1									6		1		2		10
16-Jul-99	AR	4	108	P	E-25	530	2.5	60	316					15															15
16-Jul-99	AR	4	108	P	E-26	530	2.5	60	278					1	2		1					1	1			1			7
22-Jul-99	SR	2	52	TC	E-27	530	2.5	60	428												1								1
22-Jul-99	BC	3	60	TC	E-28	530	2.5	60	417					1		1			1		1		1				3		8
22-Jul-99	PC	3	65	TC	E-29	530	2.5	60	444					1								1							2
22-Jul-99	RR	3	60	P	E-30	530	2.5	60	342																				0
22-Jul-99	RR	3	58	P	E-31	530	2.5	60	356																		1		1
22-Jul-99	RR	3	58	P	E-32	530	2.5	60	230																				0
22-Jul-99	RR	3	59	P	E-33	530	2.5	60	315					1													1		2
22-Jul-99	RR	3	59	P	E-34	530	2.5	60	275																				0
23-Jul-99	RR	3A	76	H	E-35	375	2.5	60	1058			1	2	1								4			1				9
23-Jul-99	RR	3A	83	M	E-36	375	2.5	60	972					2				3				1	1		1				8
23-Jul-99	RR	3A	86	S	E-37	375	2.5	60	600																				0
26-Jul-99	RR	1	18	S	E-38	530	2.5	60	1000									2											2
26-Jul-99	LR	1	18	TC	E-39	530	2.5	60	400									5											5
26-Jul-99	RR	1	19	M	E-40	530	2.5	60	504													1				1			2
26-Jul-99	RR	1	23	H	E-41	530	2.5	60	352									1											1
26-Jul-99	RR	2	27	P	E-42	530	2.5	60	200																				0
26-Jul-99	RR	2	27	P	E-43	530	2.5	60	150																				0
26-Jul-99	RR	2	27	P	E-44	530	2.5	60	200								1	1		1									3
27-Jul-99	RR	1A	-	H	E-45	500	2.5	60	1000									2											2
27-Jul-99	RR	1A	-	M	E-46	500	2.5	60	1000									6				2	1			1			10
27-Jul-99	RR	1A	-	S	E-47	500	2.5	60	1000									3											3

Table A4.2. (Continued)

Date	Waterbody	Zone	Segment	Habitat Type	Run #	Voltage DC (Watts)	Pulse Width (m/s)	Pulse Rate (pps)	Effort (secs)	BGBF	BLCR	BRBL	BURB	CARP	CHCT	FRDR	GLRD	GOLD	NRPK	QUIL	RCBS	SAUG	SHRD	SLCH	SLRD	WALL	WHSC	WHBS	Total Catch
8-Sep-99	AR	4	109	P	E-48	530	2.5	60	180								2					2	12						16
8-Sep-99	AR	4	108	P	E-49	530	2.5	60	263														7						7
8-Sep-99	AR	4	108	P	E-50	530	2.5	60	270														2						2
8-Sep-99	AR	4	108	P	E-51	530	2.5	60	300							1							7						8
8-Sep-99	AR	4	108	P	E-52	530	2.5	60	325																				0
9-Sep-99	AR	4	109	P	E-53	530	2.5	60	203					3								7	17			1			28
9-Sep-99	AR	4	108	P	E-54	530	2.5	60	256					1		5	2	1				7	14			1	4		35
9-Sep-99	SC	4	118	TC	E-55	530	2.5	60	378					2		5	2			1		3	6						19
9-Sep-99	OC	4	125	TC	E-56	530	2.5	60	229						1	1						3							5
10-Sep-99	AR	4	128	S	E-57	530	2.5	60	538					1			1	2											4
10-Sep-99	AR	5	102	M	E-58	530	2.5	60	421																				0
10-Sep-99	AR	5	104	H	E-59	530	2.5	60	573					1	1		1	2				1	9			1			16
10-Sep-99	AR	4	108	P	E-60	530	2.5	60	186					1		1						2	15				1		20
10-Sep-99	AR	4	108	P	E-61	530	2.5	60	232					1		5						1	18	1			6		32
10-Sep-99	AR	4	108	P	E-62	530	2.5	60	297					10		3				1		2	22			1	5		44
10-Sep-99	AR	4	109	P	E-63	530	2.5	60	220					1			1	2				5	2				1		12
10-Sep-99	AR	4	108	P	E-64	530	2.5	60	230	1				9	2	2	1					3	6						24
11-Sep-99	AR	4	113	H	E-65	530	2.5	60	683						1	1	2					6	26		1		3		40
11-Sep-99	AR	4	123/124	H/S	E-66	530	2.5	60	445							1	2			1		2	4				1		11
12-Sep-99	RR	2	29	S	E-67	530	2.5	60	466									3				1	2		1	1	1		9
12-Sep-99	RR	2	34	S	E-68	530	2.5	60	1154						1			3				10	4			1			19
12-Sep-99	RR	2	38	M	E-69	530	2.5	60	514									1				2	1						4
13-Sep-99	RR	2	43	H	E-70	530	2.5	60	990					1		1		3				1	1			2			9
13-Sep-99	RR	2	50	H	E-71	530	2.5	60	660													1				1			2
13-Sep-99	RR	2	56	H	E-72	530	2.5	60	623					1	1	1		3									1		7
14-Sep-99	RR	3	59	M	E-73	530	2.5	60	588					1		1						4	1						7
14-Sep-99	RR	3	60	S	E-74	530	2.5	60	1285					1		1		10				1	1				2		16
14-Sep-99	RR	3	61	M	E-75	530	2.5	60	1182				1	2		5		12				1	1						22
15-Sep-99	RR	3	65	H	E-76	530	2.5	60	591					2	1	4	1	4				4	5				3		24
15-Sep-99	RR	3	72	H	E-77	530	2.5	60	550					2				2					1			1	1		7
15-Sep-99	RR	3	74	S	E-78	530	2.5	60	789					1				5				6	4				2		18
16-Sep-99	RR	3A	76	H	E-79	530	2.5	60	559								1	3				72	2			1	3		82
16-Sep-99	RR	3A	83	M	E-80	530	2.5	60	405									4				7							11
16-Sep-99	RR	3A	86	S	E-81	530	2.5	60	863							1		19				37				2			59
17-Sep-99	RR	3	60	P	E-82	530	2.5	60	253																				0
17-Sep-99	RR	3	59	P	E-83	530	2.5	60	220																				0
17-Sep-99	RR	3	59	P	E-84	530	2.5	60	243																				0
17-Sep-99	RR	3	59	P	E-85	530	2.5	60	308					1				1											2
17-Sep-99	RR	3	58	P	E-86	530	2.5	60	217									2				2							4
17-Sep-99	SR	2	52	TC	E-87	530	2.5	60	1119								1	2				1							4
17-Sep-99	BC	3	60	TC	E-88	530	2.5	60	434					3					1	3		1	1		1	1			11
17-Sep-99	PC	3	65	TC	E-89	530	2.5	60	361					1				1		1		3						1	7
19-Sep-99	RR	1A	-	H	E-90	530	2.5	60	1000	1								7					1		1				10
19-Sep-99	RR	1A	-	M	E-91	530	2.5	60	1000									15											15
19-Sep-99	RR	1A	-	S	E-92	530	2.5	60	1000					1				10											11
20-Sep-99	RR	1	18	BW	E-93	530	2.5	60	363									1				2	1						4
20-Sep-99	RR	1	18	S	E-94	530	2.5	60	1072	2								7				3							12

Table A4.2. (Continued)

Date	Waterbody	Zone	Segment	Habitat Type	Run #	Voltage DC (Watts)	Pulse Width (m/s)	Pulse Rate (pps)	Effort (secs)	BGBF	BLCR	BRBL	BURB	CARP	CHCT	FRDR	GLRD	GOLD	NRPK	QUIL	RCBS	SAUG	SHRD	SLCH	SLRD	WALL	WHSC	WHBS	Total Catch
20-Sep-99	RR	1	19	M	E-95	530	2.5	60	404									1				1							2
20-Sep-99	RR	1	23	H	E-96	530	2.5	60	466		1							2				1							4
20-Sep-99	RR	2	27	P	E-97	530	2.5	60	183									1					1						2
20-Sep-99	RR	2	27	P	E-98	530	2.5	60	200																				0
20-Sep-99	RR	2	27	P	E-99	530	2.5	60	205								1					1							2
20-Sep-99	LR	1	18	TC	E-100	530	2.5	60	1047									2											2
TOTAL										5	2	1	15	99	11	58	25	170	4	22	2	242	270	1	19	25	93	1	1065

Codes

Waterbodies:
AR = Assiniboine River
BC = Bunns Creek
LR = La Salle River
OC = Omands Creek
PC = Parks Creek
RR = Red River
SR = Seine River
SC = Sturgeon Creek

Segment:
H = Hard
M = Medium
S = Soft

Habitat:
H = Hard
M = Medium
S = Soft
H/S = Hard/Soft
BW = Backwater
TC = Tributary Confluence
P = Plume

General:
LHB = Left Hand Bank (looking U/S)
MID = Mid-Channel
RHB = Right Hand Bank (looking U/S)
U/S = Upstream
D/S = Downstream

Species:
BGBF = Bigmouth Buffalo
BLCR = Black Crappie
BRBL = Brown Bullhead
BURB = Burbot
CARP = Carp
CHCT = Channel Catfish
FRDR = Freshwater Drum
GLRD = Golden Redhorse
GOLD = Goldeye
QUIL = Quillback
RCBS = Rock Bass
SAUG = Sauger
SHRD = Shorthead Redhorse
SLCH = Silver Chub
SLRD = Silver Redhorse
WALL = Walleye
WHSC = White Sucker
WHBS = White Bass

Electrofishing Runs (Comments)
E-01 = LHB
E-02 = LHB
E-03 = LHB
E-04 = LHB
E-05 = LHB
E-06 = LHB
E-07 = LHB
E-08 = 100 m U/S from confluence
E-09 =LHB
E-10 = LHB
E-11 = LHB
E-12 = LHB
E-13 = LHB
E-14 = LHB
E-15 = LHB
E-16 = RHB
E-17 = RHB
E-18 = LHB
E-19 = LHB
E-20 = LHB
E-21 = RHB
E-22 = 0-200 m in D/S plume (LHB)
E-23 = 400-600 m in D/S plume (LHB)
E-24 = 800-1000 m in D/S plume (LHB)
E-25 = 0-200 m in D/S plume (RHB)
E-26 = 400-600 m in D/S plume (RHB)
E-27 = approximately 50 m U/S
E-28 = approximately 50 m U/S
E-29 = LHB
E-30 = 1000-2000 m in D/S plume; 20 m off shore (RHB)
E-31 = 200-400 m in D/S plume (LHB)
E-32 = 200-400 m in D/S plume (RHB)
E-33 = 600-800 m in D/S plume (LHB)
E-34 = 600-800 m in D/S plume (RHB)
E-35 = LHB/RHB
E-36 = RHB
E-37 = RHB
E-38 = LHB
E-39 = LHB
E-40 = RHB
E-41 = LHB
E-42 = LHB
E-43= LHB
E-44 = RHB
E-45 = UTM's 631162/5490320 to 631451/5490569
E-46 = UTM's 635959/5499913 to 631483/5490505
E-47 = UTM's 636174/5501120 to 636595/5501339
E-48 = 800-1000 m in D/S plume (LHB)
E-49 = 400-600 m in D/S plume (LHB)
E-50 = 400-600 m in D/S plume (RHB)
E-51 = 0-200 m in D/S plume (LHB)
E-52 = 0-200 m in D/S plume (RHB)
E-53 = 800-1000 m in D/S plume (LHB)
E-54 = 400-600 m in D/S plume (LHB)
E-55 = 100 m U/S; and D/S up to Charleswood Bridge (AR)
E-56 = 50 m U/S; and D/S 100 m in (AR)
E-57 = LHB
E-58 = RHB
E-59 = LHB
E-60 = 800-1000 m in D/S plume (LHB)
E-61 = 400-600 m in D/S plume (LHB)
E-62 = 0-200 m in D/S plume (LHB)
E-63 = 400-600 m in D/S plume (RHB)
E-64 = 0-200 m in D/S plume (RHB)
E-65 = LHB
E-66 = RHB
E-67 = LHB
E-68 = LHB
E-69 = LHB
E-70 = LHB
E-71 = RHB
E-72 = LHB
E-73 = LHB
E-74 = RHB
E-75 = LHB
E-76 = LHB
E-77 = LHB
E-78 = LHB
E-79 = RHB
E-80 = RHB
E-81 = LHB
E-82 = 1000-1200 m in D/S plume (RHB)
E-83 = 600-800 m in D/S plume (RHB)
E-84 = 200-400 m in D/S plume (RHB)
E-85 = 600-800 m in D/S plume (LHB)
E-86 = 200-400 m in D/S plume (LHB)
E-87 = U/S to Belgium Club (RR)
E-88 = TC
E-89 = TC
E-90 = LHB
E-91 = LHB
E-92 = RHB
E-93 = Backwater section
E-94 = LHB
E-95 = LHB
E-96 = LHB
E-97 = LHB
E-98 = MID
E-99 = RHB
E-100 = from (LR) bridge (Pembina Hwy) and D/S into (RR)

Table A4.3. Results of hoopnetting conducted in the Red and Assiniboine rivers, 1999.

Date	Waterbody	Zone	Segment	Habitat Type	Set #	Direction	Duration (hrs)	BGBF	BLCR	BRBL	BURB	CARP	CHCT	FRDR	GLRD	GOLD	MOON	NRPK	QUIL	RCBS	SAUG	SHRD	SLRD	WALL	WHSC	Total Catch	Comments
7-Jul-99	RR	2	43	H	HN-01	US	23.28						1	2											1	4	set from RHB
7-Jul-99	RR	2	50	H	HN-02	DS	21.50														2					2	set from RHB
7-Jul-99	RR	2	56	H	HN-03	US	22.42						5													5	set from LHB
8-Jul-99	RR	2	29	S	HN-04	DS	25.42					1												1		2	set from LHB
8-Jul-99	RR	2	34	S	HN-05	US	25.35					4	10						3			2			2	21	
8-Jul-99	RR	2	38	M	HN-06	US	24.67							1						1					1	3	
11-Jul-99	RR	3	60	S	HN-07	US	22.25						1	4								2			7	14	set from LHB
11-Jul-99	RR	3	61	M	HN-08	DS	22.70							2											1	3	set DS of sewage plant
11-Jul-99	RR	3	65	H	HN-09	US	22.50					1	1	3								1			1	7	
12-Jul-99	RR	3	59	M	HN-10	US	21.92					7		1	1				5							14	
12-Jul-99	RR	3	72	H	HN-11	US	18.67							1			1									2	set from RHB
12-Jul-99	RR	3	74	S	HN-12	DS	19.08					1						1							1	3	set from LHB
13-Jul-99	AR	4	113	H	HN-13	US	22.50															6	1			7	
13-Jul-99	AR	4	128	S	HN-14	DS	19.50					1							1		1					3	
13-Jul-99	AR	4	123/124	H/S	HN-15	US	20.65						5	1					2							8	
14-Jul-99	AR	5	102	M	HN-16	US	47.75							2							1		1		1	5	
14-Jul-99	AR	5	104	H	HN-17	US	48.33						1	7							2	3		1		14	
26-Jul-99	RR	1	18	S	HN-18	US	29.50						1						1							2	set from LHB
26-Jul-99	RR	1	19	M	HN-19	US	29.62																			0	set from RHB
26-Jul-99	RR	1	23	H	HN-20	US	30.83						1									1	1			3	set from LHB
9-Aug-99	RR	2	28	S	HN-21	US	20.92						4						1		1	1		2		9	set from LHB
9-Aug-99	RR	2	29	S	HN-22	US	22.33														6			1		7	set from LHB
9-Aug-99	RR	2	33	H	HN-23	US	22.58						2								15	2		1	4	24	set from RHB
10-Aug-99	RR	2	28	S	HN-24	US	21.58							3					4		4					11	set from LHB
10-Aug-99	RR	2	29	S	HN-25	US	22.75												9		9	2				20	set from LHB
10-Aug-99	RR	2	33	H	HN-26	US	22.17		1			1		3					2		4	1		3	1	16	set from RHB
11-Aug-99	RR	2	28	S	HN-27	US	23.50						1	1				1	2			1				6	set from LHB
11-Aug-99	RR	2	29	S	HN-28	US	22.00							2					3		6					11	set from LHB
11-Aug-99	RR	2	33	H	HN-29	US	23.50						1	1							3			1		6	set from RHB
12-Aug-99	RR	2	29	S	HN-30	US	47.92											1	6		5			1		13	set from LHB
12-Aug-99	RR	2	33	H	HN-31	US	27.25							2							8			3		13	set from RHB
13-Aug-99	RR	2	28	S	HN-32	US	20.00						12						3							15	set from LHB
13-Aug-99	RR	2	33	H	HN-33	US	20.00											1			6	1				8	set from RHB
14-Aug-99	AR	4	111	S	HN-34	US	20.00						10						1			3				14	downstream end of island
14-Aug-99	AR	4	113	H	HN-35	US	20.50								2						1	1			1	5	set from LHB
14-Aug-99	AR	4	117	S	HN-36	US	17.67						2									3				5	set from LHB
15-Aug-99	AR	4	111	S	HN-37	US	22.83						2	1	4	2			1		1	3			2	16	downstream end of island
15-Aug-99	AR	4	113	H	HN-38	US	21.25						2	2							3	3		1	1	12	set from LHB
15-Aug-99	AR	4	116	S	HN-39	US	22.17	1				2	3	8					3		1	1				19	set from RHB
15-Aug-99	AR	4	117	S	HN-40	US	26.25						3	1												4	set from LHB
16-Aug-99	AR	4	111	S	HN-41	US	22.40						11									3				14	downstream end of island
16-Aug-99	AR	4	113	H	HN-42	US	23.92						2	3								5	2			12	set from LHB
16-Aug-99	AR	4	116	S	HN-43	US	22.08						1	2					2		1	1				7	set from RHB
16-Aug-99	AR	4	117	S	HN-44	US	21.83															1				1	set from LHB
17-Aug-99	RR	3	58	S	HN-45	US	28.67					3		1					2			1			1	8	set from LHB
17-Aug-99	RR	3	59	M	HN-46	US	24.92					4	80	9							12	1		1		107	set from LHB and RHB
17-Aug-99	RR	3	61	M	HN-47	US	23.53						9						14							23	set from RHB

Table A4.3. (Continued)

Date	Waterbody	Zone	Segment	Habitat Type	Set #	Direction	Duration (hrs)	BGBF	BLCR	BRBL	BURB	CARP	CHCT	FRDR	GLRD	GOLD	MOON	NRPK	QUIL	RCBS	SAUG	SHRD	SLRD	WALL	WHSC	Total Catch	Comments
17-Aug-99	RR	3	62	H	HN-48	US	19.33					2	83	1				4	12		14	7			9	132	set from RHB
18-Aug-99	RR	3	58	S	HN-49	US	18.67																			0	set from LHB
18-Aug-99	RR	3	59	M	HN-50	US	17.08						10	3							1				3	17	set from LHB and RHB
18-Aug-99	RR	3	62	H	HN-51	US	21.08						5	1					2		27	1			3	39	set from RHB
19-Aug-99	RR	3	59	M	HN-52	US	22.58																			0	set from LHB and RHB
19-Aug-99	RR	3	59	M	HN-53	US	22.58						1	10							5				1	17	set from LHB and RHB
19-Aug-99	RR	3	62	H	HN-54	US	22.33						49								1					50	set from RHB
20-Aug-99	RR	3	59	M	HN-55	US	24.42						1	4					21						1	27	set from LHB and RHB
20-Aug-99	RR	3	59	M	HN-56	US	25.33					1	2	6												9	set from LHB and RHB
20-Aug-99	RR	3	62	H	HN-57	US	22.58						33						2		43	1			13	92	set from RHB
8-Sep-99	AR	5	102	M	HN-58	US	50.80						15								1					16	set from LHB; at segment 102.
8-Sep-99	AR	5	104	H	HN-59	DS	51.30																			0	set from RHB; at segment 104.
9-Sep-99	AR	4	128	S	HN-60	US	31.20						26						1		10				1	38	set from RHB; at segment 128.
10-Sep-99	AR	4	113	H	HN-61	US	19.70								1						1					2	set from LHB; at segment 113.
10-Sep-99	AR	4	123/124	H/S	HN-62	US	19.80																			0	set from RHB; at segment 124.
11-Sep-99	RR	2	29	S	HN-63	DS	22.50																			0	set from LHB; at segment 29.3
11-Sep-99	RR	2	34	S	HN-64	US	23.70				1		19								1				1	22	set from LHB; at segment 34.2
11-Sep-99	RR	2	38	M	HN-65	US	24.30			1	1		4													6	set from LHB; at segment 38.3
12-Sep-99	RR	2	43	H	HN-66	US	20.00						33								1				2	36	set from RHB; at segment 43.4
12-Sep-99	RR	2	50	H	HN-67	US	20.40						16						2						2	20	set from RHB; at segment 50.2
12-Sep-99	RR	2	56	H	HN-68	US	20.50						1	4					5		8				27	45	set from LHB; at segment 56.3
13-Sep-99	RR	3	59	M	HN-69	US	22.20			1	2		37	3												43	set from RHB; at segment 12.2
13-Sep-99	RR	3	60	S	HN-70	US	23.10			1				1							2				8	12	set from LHB; at segment 60.4
13-Sep-99	RR	3	61	M	HN-71	US	24.00							3							2				10	15	set from LHB; at segment 61.4
14-Sep-99	RR	3	65	H	HN-72	US	21.80						7			2			2		1				6	18	set from LHB
14-Sep-99	RR	3	72	H	HN-73	US	21.70																		1	1	set from RHB
14-Sep-99	RR	3	74	S	HN-74	US	21.80					1													3	4	set from LHB; at segment 0.2-0
19-Sep-99	RR	1	18	S	HN-75	US	24.80						5												1	6	set from LHB; at segment 18.3
19-Sep-99	RR	1	19	M	HN-76	DS	25.60														3					3	set from RHB; at segment19.3
19-Sep-99	RR	1	23	H	HN-77	US	26.30			1			7								6				3	17	set from LHB; at segment 23.4
Total								1	1	4	4	29	525	99	8	4	1	8	112	1	219	58	5	16	120	1215	

Codes

Waterbodies:
AR = Assiniboine River
RR = Red River

Segment:
H = Hard
M = Medium
S = Soft

Habitat:
H = Hard
M = Medium
S = Soft
H/S = Hard/Soft

General:
LHB = Left Hand Bank
MID = Mid-Channel
RHB = Right Hand Bank
US = Upstream
DS = Downstream

Species:
BGBF = Bigmouth Buffalo
BLCR = Black Crappie
BRBL = Brown Bullhead
BURB = Burbot
CARP = Carp
CHCT = Channel Catfish
FRDR = Freshwater Drum
GLRD = Golden Redhorse
GOLD = Goldeye
MOON = Mooneye
NRPK = Northern Pike
QUIL = Quillback
RCBS = Rock Bass
SAUG = Sauger
SHRD = Shorthead Redhorse
SLCH = Silver Chub
SLRD = Silver Redhorse
WALL = Walleye
WHSC = White Sucker

Note: All hoopnets constructed of 6.45 cm^2 nylon mesh with 1.2 m diameter openings and 10 m long wing attachments.

Table A4.4. Results of backpack electrofishing conducted in the Red and Assiniboine rivers, and other selected tr

Date	Waterbody	Zone	Segment	Habitat Type	Run #	Voltage DC (Watts)	Pulse Width (m/s)	Pulse Rate (pps)	Effort (secs)	BLCR	BRBL	BURB	CARP	EMSH	FLCH	FTMN	GOLD	JHDR	NRPK	QUIL	RCBS	RVSH	SAUG	SHRD	SLCH	SLRD	SFSH	STON	WALL	WHSC	Total Catch
8-Jul-99	RR	2	50	H	BE-01	300	4.0	80	604			1	2				1										1				5
8-Jul-99	RR	2	56	H	BE-02	300	4.0	80	599				1									1						1			3
9-Jul-99	RR	2	29	S	BE-03	300	4.0	80	396								1														1
9-Jul-99	RR	2	34	S	BE-04	300	4.0	80	412							1			1			2	1								5
9-Jul-99	RR	2	38	M	BE-05	300	4.0	80	410			1					1										2				4
12-Jul-99	RR	3	60	S	BE-06	300	4.0	80	445			1	1																		2
12-Jul-99	RR	3	61	M	BE-07	300	4.0	80	450			4									1	1			5			1			12
12-Jul-99	RR	3	65	H	BE-08	300	4.0	80	421			1													2					1	4
13-Jul-99	RR	3	59	M	BE-09	300	4.0	80	400														2	1							3
13-Jul-99	RR	3	72	H	BE-10	300	4.0	80	400																						0
13-Jul-99	RR	3	74	S	BE-11	300	4.0	80	405													1									1
14-Jul-99	AR	4	113	H	BE-12	300	4.0	80	400																						0
14-Jul-99	AR	4	128	S	BE-13	300	4.0	80	400							1								1					1	1	4
14-Jul-99	AR	4	123/124	H/S	BE-14	300	4.0	80	432																						0
16-Jul-99	AR	5	102	M	BE-15	300	4.0	80	435																						0
16-Jul-99	AR	5	104	H	BE-16	300	4.0	80	397																						0
22-Jul-99	RR	2	43	H	BE-17	300	4.0	80	394																			1			1
26-Jul-99	RR	1	18	S	BE-18	300	4.0	80	411													2									2
26-Jul-99	RR	1	19	M	BE-19	300	4.0	80	400			2							2												4
26-Jul-99	RR	1	23	H	BE-20	300	4.0	80	400										1											2	3
28-Jul-99	LR	1	18	T	BE-21	300	4.0	80	270																					1	1
28-Jul-99	SC	4	118	T	BE-22	300	4.0	80	270				2			88															90
9-Sep-99	AR	4	113	H	BE-23	400	6.0	30	400					1								1		1							3
9-Sep-99	AR	5	102	M	BE-24	400	6.0	30	410								1					1									2
9-Sep-99	AR	5	104	H	BE-25	400	6.0	30	400																						0
10-Sep-99	AR	4	112	M	BE-26	400	6.0	30	388							1						1									2
10-Sep-99	AR	4	125	H	BE-27	300	6.0	30	400														1			1					2
10-Sep-99	AR	5	105	H	BE-28	400	4.0	30	417																						0
12-Sep-99	RR	2	29	S	BE-29	300	6.0	30	443	1													1		1						3
12-Sep-99	RR	2	34	S	BE-30	300	6.0	30	400											1		1		1						1	4
12-Sep-99	RR	2	38	M	BE-31	300	6.0	30	420	1							1														2
13-Sep-99	RR	2	52	M	BE-32	300	6.0	30	414														2								2
13-Sep-99	RR	2	56	H	BE-33	300	6.0	30	400				1																		1
13-Sep-99	RR	2	50	H	BE-34	400	6.0	30	505				1								1		2						1		5
14-Sep-99	RR	3	59	M	BE-35	400	6.0	30	400												1				1				1		3
14-Sep-99	RR	3	60	S	BE-36	400	6.0	30	424				1	2		4			1			2	2						1		13
14-Sep-99	RR	3	61	M	BE-37	400	6.0	30	431			2										5	2		2						11
15-Sep-99	RR	3	65	H	BE-38	400	6.0	30	400						1								1		1						3
15-Sep-99	RR	3	69	H	BE-39	400	6.0	30	404			1			2								1	1	9						14
17-Sep-99	RR	3	59	M	BE-40	300	6.0	30	457					1								1			2						4
17-Sep-99	PC	3	65	TC	BE-41	400	6.0	30	440					8			1														9
19-Sep-99	RR	1	18	S	BE-42	400	6.0	30	214			1											3								4
19-Sep-99	RR	1	18	S	BE-43	400	6.0	30	219														5								5
19-Sep-99	RR	1	19	M	BE-44	300	6.0	30	416														1				1				2
19-Sep-99	RR	1	23	H	BE-45	300	6.0	30	455					1								1			1						3
30-Sep-99	LR	1	18	T	BE-46	300	4.0	80	611	2	3	2	1					1	1		8										18

Table A4.4 (Continued)

Date	Waterbody	Zone	Segment	Habitat Type	Run #	Voltage DC (Watts)	Pulse Width (m/s)	Pulse Rate (pps)	Effort (secs)	BLCR	BRBL	BURB	CARP	EMSH	FLCH	FTMN	GOLD	JHDR	NRPK	QUIL	RCBS	RVSH	SAUG	SHRD	SLCH	SLRD	SFSH	STON	WALL	WHSC	Total Catch
30-Sep-99	SR	2	52	T	BE-47	300	4.0	80	347														2								2
30-Sep-99	SR	2	52	T	BE-48	300	4.0	80	260																						0
30-Sep-99	BC	3	60	T	BE-49	300	4.0	80	300																						0
TOTAL										4	3	16	10	13	3	95	6	1	6	1	11	20	26	5	24	1	4	3	4	6	262

Codes

Waterbodies:
AR = Assiniboine River
BC = Bunns Creek
LR = La Salle River
OC = Omands Creek
PC = Parks Creek
RR = Red River
SR = Seine River
SC = Sturgeon Creek

Habitat:
H = Hard
M = Medium
S = Soft
H/S = Hard/Soft
TC = Tributary Confluence
T = Tributary

Species:
BLCR = Black Crappie
BLBL = Black Bullhead
BURB = Burbot
CARP = Carp
EMSH = Emerald Shiner
FLCH = Flathead Chub
FTMN = Fathead Minnow
GOLD = Goldeye
JHDR = Johnny Darter
NRPK = Northern Pike
QUIL = Quillback
RCBS = Rock Bass
RVSH = River Shiner
SAUG = Sauger
SHRD = Shorthead Redhorse
SLCH = Silver Chub
SLRD = Silver Redhorse
SFSH = Spotfin Shiner
STON = Stonecat
WALL = Walleye
WHSC = White Sucker

General
LHB = Left Hand Bank
MID = Mid-Channel
RHB = Right Hand Bank
U/S = Upstream
D/S = Downstream

Back-Pack Electrofishing (Comments)
BE-01 = LHB
BE-02 = LHB
BE-03 = LHB; little vegetation along shoreline
BE-04 = LHB
BE-05 = LHB
BE-06 = LHB
BE-07 = LHB
BE-08 = LHB
BE-09 =LHB
BE-10 = LHB
BE-11 = LHB; cobble/boulder shoreline
BE-12 = LHB; sampled within macrophyte cover; high velocities
BE-13 = LHB; fish catch found in back eddies
BE-14 = LHB
BE-15 = LHB; @ (102.3 to 102.1); emergent macrophytes, steep banks
BE-16 = LHB; @ (104.4 to 104.2); emergent macrophytes
BE-17 = LHB; D/S of BDI walking bridge
BE-18 = LHB; homogenous habitat along shoreline associated with steep/muddy banks
BE-19 = LHB
BE-20 = LHB; macrophytes abundant; some riffle habitat mixed with back eddies
BE-21 = LHB; @ St.Norbert
BE-22 = RHB; @Woodhaven Street Bridge
BE-23 = LHB
BE-24 = LHB
BE-25 = RHB; @ (104.2 TO 104.4)
BE-26 = RHB
BE-27 = RHB; @ railway bridge directly U/S of OC
BE-28 = RHB
BE-29 = LHB
BE-30 = LHB
BE-31 = LHB
BE-32 = LHB
BE-33 = RHB
BE-34 = RHB
BE-35 = RHB
BE-36 = RHB
BE-37 = RHB
BE-38 = LHB
BE-39 = RHB
BE-40 = LHB
BE-41 = LHB; @Parks Creek (TC)
BE-42 = LHB; @ (18.1)
BE-43 = LHB; @ (18.2)
BE-44 = RHB; @ (19.4 to 19.2) plus LHB
BE-45 = RHB
BE-46 = LHB; @ St.Norbert
BE-47 = RHB; 50 m D/S of Provencher Bridge
BE-48 = RHB; 50 m D/S of Provencher Bridge
BE-49 = RHB; U/S of Red River

Table A4.5. Results of seine hauls conducted in the Red and Assiniboine rivers, and selected tributaries, 1999.

Date	Waterbody	Zone	Segment	Habitat Type	Set #	BLBL	BLCR	BRST	CARP	CHCT	EMSH	FLCH	FRDR	FTMN	GLRD	GOLD	JHDR	NRPK	QUIL	RCBS	RVDR	RVSH	SAUG	SHRD	SLCH	SLRD	SPSH	SFSH	STON	TDMD	TRPR	WALL	WHBS	WHSC	YLPR	Total Catch
8-Jul-99	RR	2	56	H	S-01											2						1														3
9-Jul-99	RR	2	29	S	S-02									1		1						2									1			1		6
9-Jul-99	RR	2	34	S	S-03											1						1			1											3
9-Jul-99	RR	2	38	M	S-04																															0
9-Jul-99	RR	2	43	H	S-05																															0
12-Jul-99	RR	3	60	S	S-06							1	2								1				1											5
12-Jul-99	RR	3	61	M	S-07																				1											1
12-Jul-99	RR	3	65	H	S-08																			1	3											4
13-Jul-99	RR	3	59	M	S-09																	2														2
13-Jul-99	RR	3	72	H	S-10							2		2		7									4							1				16
13-Jul-99	RR	3	74	S	S-11			1								1																				2
14-Jul-99	AR	4	113	H	S-12																															0
14-Jul-99	AR	4	128	S	S-13																															0
14-Jul-99	AR	4	123/124	H/S	S-14																															0
16-Jul-99	AR	5	102	M	S-15																							2								2
16-Jul-99	AR	5	104	H	S-16						1																									1
22-Jul-99	RR	2	50	H	S-17																															0
26-Jul-99	RR	1	18	S	S-18																	4														4
26-Jul-99	RR	1	19	M	S-19																															0
26-Jul-99	RR	1	23	H	S-20											1																				1
28-Jul-99	BC	3	60	T	S-21		18		6		1			66		1		1				16		7	23			9			1	1	34	2	1	187
28-Jul-99	SC	4	118	T	S-22									154								2		4										4		164
28-Jul-99	SC	4	118	T	S-23									1272				2						1												1275
29-Jul-99	LR	1	18	T	S-24	2	4				20			6			2					18			2			19					2		2	77
29-Jul-99	LR	1	18	T	S-25	112	90							5																			4	3		214
29-Jul-99	SR	2	52	T	S-26	362							1	1	1					2	1									1	1			18		388
29-Jul-99	SC	4	118	T	S-27									17																				1		18
23-Aug-99	RR	1	17	S	S-28						6			2											14											22
23-Aug-99	LR	1	18	T	S-29		4																					3								7
23-Aug-99	LR	1	18	T	S-30	1	1				3			10								1														16
24-Aug-99	SC	4	118	T	S-31				2					12										1										1		16
9-Sep-99	AR	4	113	H	S-32																															0
9-Sep-99	AR	5	102	M	S-33																															0
9-Sep-99	AR	5	104	H	S-34																	2														2
10-Sep-99	AR	4	111	S	S-35																	5			1		5									11
10-Sep-99	AR	4	125	H	S-36							4											1		1											6
10-Sep-99	AR	5	105	H	S-37																															0
12-Sep-99	RR	2	29	S	S-38									1																						1
12-Sep-99	RR	2	36	M	S-39				2		4											12	1		2			1								22
12-Sep-99	RR	2	37	M	S-40						65					1			2				2		1	1										72
13-Sep-99	RR	2	47	S	S-41						4														3											7
13-Sep-99	RR	2	52	M	S-42							6										9	1													16
13-Sep-99	RR	2	54	M	S-43						7									1					2											10
14-Sep-99	RR	3	60	S	S-44						3		3			2						14	1	2	1											26
14-Sep-99	RR	3	61	M	S-45					1	1					2						4														8
14-Sep-99	RR	3	61	M	S-46						2											4	1													7
15-Sep-99	RR	3	65	H	S-47											1			1						2											4

Table A4.5. (Continued)

Date	Waterbody	Zone	Segment	Habitat Type	Set #	BLBL	BLCR	BRST	CARP	CHCT	EMSH	FLCH	FRDR	FTMN	GLRD	GOLD	JHDR	NRPK	QUIL	RCBS	RVDR	RVSH	SAUG	SHRD	SLCH	SLRD	SPSH	SFSH	STON	TDMD	TRPR	WALL	WHBS	WHSC	YLPR	Total Catch
15-Sep-99	RR	3	69	H	S-48																				1				1							2
15-Sep-99	RR	3	74	S	S-49							1											1													2
19-Sep-99	RR	1	18	S	S-50														2				1	1												4
19-Sep-99	RR	1	23	H	S-51														1																	1
19-Sep-99	RR	1	24	H	S-52														2			34	1		2			1								40
30-Sep-99	LR	1	18	T	S-53		1							1				1										1								4
30-Sep-99	BC	3	60	T	S-54	1								2				2						1												6
30-Sep-99	SC	4	118	T	S-55									4				1																		5
Total						478	118	1	10	1	117	14	6	1556	1	20	2	7	8	3	2	131	10	18	65	1	5	36	1	1	3	2	40	30	3	2690

Codes

Waterbodies:
AR = Assiniboine River
BC = Bunns Creek
LR = La Salle River
OC = Omands Creek
PC = Parks Creek
RR = Red River
SR = Seine River
SC = Sturgeon Creek

Habitat:
H = Hard
M = Medium
S = Soft
H/S = Hard/Soft
T = Tributary

General:
LHB = Left Hand Bank
MID = Mid-Channel
RHB = Right Hand Bank
US = Upstream
DS = Downstream

Species:
BLBL = Black Bullhead
BLCR = Black Crappie
BRST = Brook Stickleback
CARP = Carp
CHCT = Channel Catfish
EMSH = Emerald Shiner
FLCH = Flathead Chub
FRDR = Freshwater Drum
FTMN = Fathead Minnow
GLRD = Golden Redhorse
GOLD = Goldeye
JHDR = Johnny Darter
NRPK = Northern Pike
QUIL = Quillback
RCBS = Rock Bass
RVDR = River Darter
RVSH = River Shiner
SAUG = Sauger
SHRD = Shorthead Redhorse
SLCH = Silver Chub
SLRD = Silver Redhorse
SFSH = Spotfin Shiner
SPSH = Spottail Shiner
STON = Stonecat
TDMD = Tadpole Madtom
TRPR = Trout Perch
WALL = Walleye
WHBS = White Bass
WHSC = White Sucker
YLPR = Yellow Perch

Seine Haul (Comments)

S-01 = LHB; two seine hauls
S-02 = LHB; mid-water seine
S-03 = LHB; @ Bishop Grandin Bridge
S-04 = LHB
S-05 = RHB
S-06 = LHB; cobble shoreline; 200 m U/S of North Perimeter Bridge
S-07 = LHB
S-08 = LHB
S-09 = LHB;
S-10 = RHB; mix of cobble and mud along shoreline
S-11 = LHB; cobble and boulder shoreline
S-12 = RHB; deep and very fast velocities
S-13 = RHB
S-14 = LHB; extremely fast velocities
S-15 = LHB
S-16 = RHB; two seine hauls
S-17 = RHB; D/S of 50.3 @rip rap
S-18 = LHB; apx 7 m of shoreline sampled
S-19 = RHB; no suitable seining locations (steep mud banks)
S-20 = LHB; @23.3; apx 30 m of shoreline sampled
S-21 = U/S of RR; mud shoreline, submerged logs, pools close to being a
S-22 = @ Woodbridge Street
S-23 = @ Portage Ave (Grant's Mill); sedges, tall grasses, and other emergent macrophytes present
S-24 = @ D/S of LaBarriere Park; heavily bouldered section
S-25 = @ U/S of Pembina Hwy; muddy substrate/submergent vegetation present
S-26 = RHB; @ Bishop Grandin; muddy substrate, heavily vegetated on U/S of bridge
S-27 = RHB; @ U/S of Grant's Mill; muddy substrate, emergent veg; only a representative sample
S-28 = LHB; @ Floodway Lagoon; soft muddy substrate, little veg; only a representative sample
S-29 = @ D/S of LaBarriere Park road crossing; rocky substrate; only a representative sample
S-30 = @ St.Norbert; variety of habitats sampled U/S and D/S of Hwy 75 bridge; only a representative sample
S-31 = RHB; @ (Grant Mills); mud substrate, emergent veg; only a representative sample
S-32 = RHB; no catch; very effective seine haul
S-33 = RHB; no catch; very effective seine haul
S-34 = RHB; @ 104.2
S-35 = D/S end of island
S-36 = RHB; @ railway bridge U/S of Omans Creek; seined between two islands
S-37 = RHB; no catch; velocities too fast to effectively seine
S-38 = RHB; out side bend; good seine haul over flooded vegetation
S-39 = LHB; @ St. Vital boatlaunch
S-40 = RHB; @ Crescent Drive boatlaunch
S-41 = RHB; @ D/S of Redboine Docks; good seine in natural habitat; clay with macrophytes
S-42 = RHB; @ Pritchard Docks boat launch
S-43 = RHB; @ D/S of Redwood Bridge; seined approx 20 m of gravel beach
S-44 = LHB; @ boat launch at North Perimeter Hwy; concrete and soft clay
S-45 = LHB; @ boat launch @ Yacht Club
S-46 = RHB; @ boat launch across from Yacht Club
S-47 = LHB; mud substrate, overhanging trees
S-48 = RHB; riffle habitat near boat launch
S-49 = LHB; homogenous mud bottom
S-50 = LHB @18.1; D/S of floodway gates; cobble substrate
S-51 = LHB; mud/natural bottom, some veg on bottom
S-52 = LHB; @Maple Grove boat launch; gravel/mud substrate/no veg
S- 53 = @St. Norbert
S-54 = U/S of Red River
S-55 = D/S of Grant's Mill and at end of Woodbridge Street

** Seine constructed of 1.5 m deep, 8 m long panel with a mesh size of 3.2 mm.

APPENDIX 5

Mean length, weight and relative condition factor (K) for selected species captured in the Red and Assiniboine rivers, 1999.

Table A5.1. Mean length, weight, and relative condition factor (K) for bigmouth buffalo captured in the Red and Assiniboine rivers, 1999.

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Zone**	**Month**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Bigmouth buffalo	1a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	1	748	-	-	1	8550	-	-	1	2.04	-	-
		Jul-Sep	***1***	***748***	***-***	***-***	***1***	***8550***	***-***	***-***	***1***	***2.04***	***-***	***-***
	1	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	2	511	18	498-524	2	2900	494	2550-3250	2	2.16	0.13	2.06-2.26
		Jul-Sep	***2***	***511***	***18***	***498-524***	***2***	***2900***	***494***	***2550-3250***	***2***	***2.16***	***0.13***	***2.06-2.26***
	2	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***
	3	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***

Table A5.1. (Continued)

Species	Zone	Month	Length (mm)				Weight (g)				Condition Factor (K)			
			n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Bigmouth buffalo	3a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***
	RR	***Jul-Sep***	***3***	***590***	***137***	***498-748***	***3***	***4783***	***3280***	***2550-8550***	***3***	***2.12***	***0.11***	***2.04-2.26***
	4	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	1	417	-	-	1	1600	-	-	1	2.20	-	-
		Sep	1	633	-	-	1	5500	-	-	1	2.17	-	-
		Jul-Sep	***2***	***525***	***153***	***417-633***	***2***	***3550***	***2576***	***1600-5500***	***2***	***2.18***	***0.03***	***2.17-2.20***
	5	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***
	AR	***Jul-Sep***	***2***	***525***	***153***	***417-633***	***2***	***3550***	***2576***	***1600-5500***	***2***	***2.18***	***0.03***	***2.17-2.20***

RR = Red River
AR = Assiniboine River

Table A5.2. Mean length, weight, and relative condition factor (K) for black bullhead captured in the Red and Assiniboine rivers, 1999.

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Zone**	**Month**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Black bullhead	1a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	1	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**				
	2	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	3	174	24	158-202	3	67	29	50-100	3	1.21	0.06	1.15-1.27
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	3	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Table A5.2. (Continued)

Species	Zone	Month	Length (mm)				Weight (g)				Condition Factor (K)			
			n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Black bullhead	3a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	RR	***Jul-Sep***	***3***	***174***	***24***	***158-202***	***3***	***67***	***29***	***50-100***	***3***	***1.21***	***0.06***	***1.15-1.27***
	4	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	5	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	AR	***Jul-Sep***	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

RR = Red River
AR = Assiniboine River

Table A5.3. Mean length, weight, and relative condition factor (K) for black crappie captured in the Red and Assiniboine rivers, 1999.

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Zone**	**Month**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Black crappie	1a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	1	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	1	203	-	-	1	150	-	-	1	1.79	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**				
	2	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	1	228	-	-	1	200	-	-	1	1.69	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	3	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Table A5.3. (Continued)

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	Zone	Month	n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Black crappie	3a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	RR	***Jul-Sep***	***2***	***216***	***18***	***203-228***	***2***	***175***	***35***	***150-200***	***2***	***1.45***	***1.74***	**-**
	4	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	1	240	-	-	1	200	-	-	1	1.45	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	5	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	AR	***Jul-Sep***	***1***	***240***	**-**	**-**	***1***	***200***	**-**	**-**	***1***	***1.45***	**-**	**-**

RR = Red River
AR = Assiniboine River

Table A5.4. Mean length, weight, and relative condition factor (K) for brown bullhead captured in the Red and Assiniboine rivers, 1999.

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	Zone	Month	n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Brown bullhead	1a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***
	1	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	1	202	-	-	1	100	-	-	1	1.21	-	-
		Jul-Sep	***1***	***202***	***-***	***-***	***1***	***100***	***-***	***-***	***1***	***1.21***		
	2	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	1	200	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***1***	***200***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***
	3	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	2	180	15	169-190	2	113	18	100-125	2	1.95	0.18	1.82-2.07
		Jul-Sep	***2***	***180***	***15***	***169-190***	***2***	***113***	***18***	***100-125***	***2***	***1.95***	***0.18***	***1.82-2.07***

Table A5.4. (Continued)

Species	Zone	Month	Length (mm) n	Mean	SD	Range	Weight (g) n	Mean	SD	Range	Condition Factor (K) n	Mean	SD	Range
Brown bullhead	3a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	1	255	-	-	1	300	-	-	1	1.81	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***1***	***255***	***-***	***-***	***1***	***300***	***-***	***-***	***1***	***1.81***	***-***	***-***
	RR	***Jul/Sep***	***4***	***190***	***15***	***169-202***	***3***	***180***	***14***	***100-125***	***3***	***1.70***	***0.44***	***1.21-2.07***
	4	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***
	5	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	1	171	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***1***	***171***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***
	AR	***Jul-Sep***	***1***	***171***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***

RR = Red River
AR = Assiniboine River

Table A5.5. Mean length, weight, and relative condition factor (K) for burbot captured in the Red and Assiniboine rivers, 1999.

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Zone**	**Month**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Burbot	1a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	-	-	-	-	-	-	-	-	-	-	-	-
	1	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	-	-	-	-	-	-	-	-	-	-	-	-
	2	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	4	319	33	282-362	4	231	55	150-275	4	0.71	0.11	0.58-0.83
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	3	451	72	381-525	3	558	227	350-800	3	0.59	0.04	0.55-0.63
		Jul-Sep	***7***	***376***	***85***	***282-525***	***7***	***371***	***222***	***150-800***	***7***	***0.66***	***0.10***	***0.55-0.83***
	3	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	8	284	44	205-341	8	194	56	100-250	8	0.86	0.21	0.63-1.16
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	3	321	67	257-390	3	350	141	250-450	3	0.78	0.02	0.76-0.79
		Jul-Sep	***11***	***294***	***50***	***205-390***	***10***	***225***	***95***	***100-450***	***10***	***0.84***	***0.19***	***0.63-1.16***

Table A5.5. (Continued)

Species	Zone	Month	Length (mm)				Weight (g)				Condition Factor (K)			
			n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Burbot	3a	Feb/Mar	1	-	-	-	-	-	-	-	-	-	-	-
		Jul	2	238	22	222-253	2	100	35	75-125	2	0.73	0.06	0.69-0.77
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***2***	***238***	***22***	***222-253***	***2***	***100***	***35***	***75-125***	***2***	***0.73***	***0.06***	***0.69-0.77***
	RR	***Jul-Sep***	***20***	***317***	***77***	***205-525***	***19***	***266***	***171***	***75-800***	***19***	***0.76***	***0.17***	***0.55-1.66***
	4	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	-	-	-	-	-	-	-	-	-	-	-	-
	5	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	-	-	-	-	-	-	-	-	-	-	-	-
	AR	***Jul-Sep***	-	-	-	-	-	-	-	-	-	-	-	-

RR = Red River
AR = Assiniboine River

Table A5.6. Mean length, weight, and relative condition factor (K) for carp captured in the Red and Assiniboine rivers, 1999.

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Zone**	**Month**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Carp	1a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	1	478	-	-	1	2325	-	-	1	2.13	-	-
		Jul-Sep	***1***	***478***	***-***	***-***	***1***	***2325***	***-***	***-***	***1***	***2.13***	***-***	***-***
	1	Feb/Mar	4	500	16	478-514	4	2644	477	2225-3325	4	2.10	0.25	1.85-2.45
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***
	2	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	8	480	77	310-541	8	2081	741	700-3125	8	1.84	0.27	1.52-2.35
		Aug	1	600	-	-	1	3000	-	-	1	1.39	-	-
		Sep	4	417	136	226-515	4	1706	1161	225-2750	4	1.93	0.07	1.86-2.01
		Jul-Sep	***13***	***470***	***102***	***226-541***	***13***	***2037***	***879***	***225-3125***	***13***	***1.83***	***0.25***	***1.39-2.35***
	3	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	24	468	115	195-711	24	2103	1175	200-5550	24	1.88	0.28	1.54-2.70
		Aug	10	561	51	488-658	10	3300	1129	2100-5400	10	1.81	0.20	1.51-2.13
		Sep	15	524	67	388-628	15	2846	951	1290-4000	15	1.92	0.19	1.60-2.21
		Jul-Sep	***49***	***504***	***98***	***195-711***	***49***	***2575***	***1187***	***200-5550***	***49***	***1.88***	***0.24***	***1.51-2.70***

Table A5.6. (Continued)

Species	Zone	Month	Length (mm)				Weight (g)				Condition Factor (K)			
			n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Carp	3a	Feb/Mar	1	650	-	-	1	8500	-	-	1	3.10	-	-
		Jul	3	644	60	590-708	3	6117	2575	4300-9250	3	2.19	0.37	1.88-2.61
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***3***	***644***	***60***	***590-708***	***3***	***6117***	***2575***	***4300-9250***	***3***	***2.19***	***0.37***	***1.88-2.61***
	RR	***Jul-Sep***	***66***	***503***	***102***	***195-711***	***66***	***2626***	***1430***	***200-9250***	***66***	***1.88***	***0.25***	***1.39-2.70***
	4	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	33	571	78	290-752	33	3280	1217	450-7775	33	1.72	0.33	1.01-2.90
		Aug	2	597	21	582-612	2	4100	566	3700-4500	2	1.92	0.06	1.88-1.96
		Sep	29	556	82	361-660	28	3573	1287	900-5300	28	1.99	0.12	1.71-2.18
		Jul-Sep	***64***	***565***	***78***	***290-572***	***63***	***3437***	***1235***	***450-7775***	***63***	***1.84***	***0.29***	***1.01-2.90***
	5	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	1	295	-	-	1	600	-	-	1	2.34	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	1	542	-	-	1	2500	-	-	1	1.57	-	-
		Jul-Sep	***2***	***419***	***175***	***295-542***	***2***	***1550***	***1344***	***600-2500***	***2***	***1.95***	***0.54***	***1.57-2.34***
	AR	***Jul-Sep***	***66***	***561***	***84***	***290-752***	***65***	***3378***	***1271***	***450-7775***	***65***	***1.85***	***0.29***	***1.01-2.90***

RR = Red River
AR = Assiniboine River

Table A5.7. Mean length, weight, and relative condition factor (K) for channel catfish captured in the Red and Assiniboine rivers, 1999.

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Zone**	**Month**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Channel catfish	1a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***
	1	Feb/Mar	1	213	-	-	1	100	-	-	1	1.30	-	-
		Jul	2	476	331	242-710	2	2630	3493	160-5100	2	1.28	0.21	1.13-1.42
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	12	496	174	188-680	12	2738	2356	100-6350	12	1.55	0.27	1.20-2.04
		Jul-Sep	***14***	***493***	***185***	***188-710***	***14***	***2722***	***2374***	***100-6350***	***14***	***1.52***	***0.27***	***1.13-2.04***
	2	Feb/Mar	1	327	-	-	1	350	-	-	1	1.00	-	-
		Jul	22	382	160	180-680	21	1198	1290	75-4250	21	1.30	0.14	0.98-1.66
		Aug	20	572	160	225-785	20	3306	2120	200-7675	20	1.45	0.18	1.03-1.76
		Sep	78	369	139	123-690	75	1075	1130	50-4950	75	1.37	0.21	0.91-2.13
		Jul-Sep	***120***	***405***	***163***	***123-785***	***116***	***1482***	***1598***	***50-7675***	***116***	***1.37***	***0.20***	***0.91-2.13***
	3	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	5	408	187	182-616	5	1580	1651	75-3500	5	1.39	0.27	1.02-1.73
		Aug	273	536	130	205-820	270	2709	1830	250-8800	270	1.49	0.17	1.12-2.45
		Sep	44	374	100	237-652	44	924	877	250-3900	44	1.45	0.15	1.11-1.88
		Jul-Sep	***322***	***512***	***139***	***182-820***	***319***	***2445***	***1834***	***75-8800***	***319***	***1.48***	***0.17***	***1.02-2.45***

Table A5.7. (Continued)

Species	Zone	Month	Length (mm) n	Length (mm) Mean	Length (mm) SD	Length (mm) Range	Weight (g) n	Weight (g) Mean	Weight (g) SD	Weight (g) Range	Condition Factor (K) n	Condition Factor (K) Mean	Condition Factor (K) SD	Condition Factor (K) Range
Channel catfish	3a	Feb/Mar	1	820	-	-	1	11000	-	-	1	2.00	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***
	RR	***Jul-Sep***	***456***	***483***	***154***	***123-820***	***449***	***2205***	***1841***	***50-8800***	***449***	***1.45***	***0.19***	***0.91-2.45***
	4	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	9	452	130	237-618	9	1594	1235	200-3550	9	1.37	0.20	0.97-1.69
		Aug	35	595	142	192-748	35	3449	1971	125-6900	35	1.39	0.18	0.95-1.78
		Sep	32	574	147	231-783	29	3148	1940	200-7200	29	1.41	0.17	1.17-1.77
		Jul-Sep	***76***	***569***	***148***	***192-783***	***73***	***3101***	***1952***	***125-7200***	***73***	***1.40***	***0.18***	***0.95-1.78***
	5	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	1	780	-	-	1	5700	-	-	1	1.20	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	16	606	67	478-670	16	3347	1240	1300-5300	16	1.42	0.21	1.03-1.95
		Jul-Sep	***17***	***617***	***77***	***478-780***	***17***	***3485***	***1330***	***1300-5700***	***17***	***1.41***	***0.21***	***1.03-1.95***
	AR	***Jul-Sep***	***93***	***578***	***139***	***197-783***	***90***	***3173***	***1850***	***125-7200***	***90***	***1.40***	***0.18***	***0.95-1.95***

RR = Red River
AR = Assiniboine River

Table A5.8. Mean length, weight, and relative condition factor (K) for freshwater drum captured in the Red and Assiniboine rivers, 1999.

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Zone**	**Month**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Freshwater drum	1a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	-	-	-	-	-	-	-	-	-	-	-	-
	1	Feb/Mar	3	361	26	340-390	3	683	166	575-875	3	1.43	0.07	1.35-1.48
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	-	-	-	-	-	-	-	-				
	2	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	7	420	79	320-554	7	1143	698	425-2500	7	1.39	0.09	1.30-1.52
		Aug	12	401	56	314-524	12	939	480	400-2200	12	1.36	0.21	1.00-1.79
		Sep	6	344	41	292-394	6	579	136	400-750	6	1.43	0.19	1.23-1.72
		Jul-Sep	***25***	***392***	***65***	***292-554***	***25***	***910***	***524***	***400-2500***	***25***	***1.39***	***0.18***	***1.00-1.79***
	3	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	22	397	79	196-526	22	932	495	100-2050	22	1.36	0.15	1.00-1.73
		Aug	35	344	66	235-585	35	657	430	200-2500	35	1.48	0.18	1.19-1.86
		Sep	18	375	57	270-503	18	816	446	275-2000	18	1.42	0.16	1.09-1.70
		Jul-Sep	***75***	***367***	***71***	***196-585***	***75***	***776***	***463***	***100-2500***	***75***	***1.43***	***0.17***	***1.00-1.86***

Table A5.8. (Continued)

Species	Zone	Month	Length (mm)				Weight (g)				Condition Factor (K)			
			n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Freshwater drum	3a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	1	445	-	-	1	1350	-	-	1	1.53	-	-
		Jul-Sep	***1***	***445***	***-***	***-***	***1***	***1350***	***-***	***-***	***1***	***1.53***	***-***	***-***
	RR	***Jul-Sep***	***101***	***374***	***70***	***196-585***	***101***	***815***	***481***	***100-2500***	***101***	***1.42***	***0.17***	***1.00-1.86***
	4	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	5	384	92	260-505	5	830	530	275-1675	5	1.34	0.15	1.17-1.56
		Aug	17	394	78	309-603	17	940	789	375-3500	17	1.31	0.16	1.05-1.65
		Sep	25	390	57	587-512	25	861	417	300-1900	25	1.35	0.20	0.98-1.82
		Jul-Sep	***47***	***391***	***67***	***260-603***	***47***	***886***	***577***	***275-3500***	***47***	***1.34***	***0.18***	***0.98-1.82***
	5	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	10	414	78	313-545	10	980	547	375-1925	10	1.26	0.10	1.13-1.40
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***10***	***414***	***78***	***313-545***	***10***	***980***	***547***	***375-1925***	***10***	***1.26***	***0.10***	***1.13-1.40***
	AR	***Jul-Sep***	***57***	***395***	***69***	***260-603***	***57***	***903***	***569***	***275-3500***	***57***	***1.32***	***0.17***	***0.98-1.82***

RR = Red River
AR = Assiniboine River

Table A5.9. Mean length, weight, and relative condition factor (K) for golden redhorse captured in the Red and Assiniboine rivers, 1999.

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Zone**	**Month**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Golden redhorse	1a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	1	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**				
	2	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	3	340	70	262-396	3	533	281	225-775	3	1.25	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	2	494	-	-	2	2000	141	1900-2100	2	1.66	0.12	1.58-1.74
		Jul-Sep	***5***	***402***	***98***	***262-494***	***5***	***1120***	***831***	***225-2100***	***5***	***1.41***	***0.23***	***1.25-1.74***
	3	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	1	394	-	-	1	900	-	-	1	1.47	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	1	205	-	-	1	190	-	-	1	2.21	-	-
		Jul-Sep	***2***	***300***	***134***	***205-394***	***2***	***545***	***502***	***190-900***	***2***	***1.84***	***0.52***	***1.47-2.21***

Table A5.9. (Continued)

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Zone**	**Month**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Golden redhorse	3a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	1	542	-	-	1	2950	-	-	1	1.85	-	-
		Jul-Sep	***1***	***542***	***-***	***-***	***1***	***2950***	***-***	***-***	***1***	***1.85***	***-***	***-***
	RR	***Jul-Sep***	***8***	***394***	***117***	***205-542***	***8***	***1205***	***997***	***190-2950***	***8***	***1.58***	***0.34***	***1.25-2.21***
	4	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	3	430	112	305-520	3	1408	887	450-2200	3	1.58	0.01	1.56-1.59
		Aug	6	398	107	236-502	5	1390	607	450-2000	5	1.64	0.10	1.56-1.79
		Sep	14	410	71	297-504	14	1216	576	450-2000	14	1.63	0.13	1.41-1.85
		Jul-Sep	***23***	***409***	***83***	***236-520***	***22***	***1282***	***599***	***450-2200***	***22***	***1.62***	***0.11***	***1.41-1.85***
	5	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	1	370	-	-	1	750	-	-	1	1.48	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	1	174	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***2***	***272***	***139***	***174-370***	***1***	***750***	***-***	***-***	***1***	***1.48***	***-***	***-***
	AR	***Jul-Sep***	***25***	***398***	***92***	***174-520***	***23***	***1259***	***595***	***450-2200***	***23***	***1.62***	***0.11***	***1.41-1.85***

RR = Red River
AR = Assiniboine River

Table A5.10. Mean length, weight, and relative condition factor (K) for goldeye captured in the Red and Assiniboine rivers, 1999.

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	Zone	Month	n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Goldeye	1a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	11	230	60	164-316	11	145	126	30-400	11	0.93	0.22	0.53-1.27
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	32	167	59	102-316	19	112	88	50-375	19	1.11	0.22	0.99-1.61
		Jul-Sep	***43***	***183***	***65***	***102-316***	***30***	***124***	***103***	***30-400***	***30***	***1.05***	***0.24***	***0.53-1.61***
	1	Feb/Mar	7	241	56	147-306	6	214	97	50-350	6	1.15	0.22	0.22-1.44
		Jul	4	173	6	166-179	4	50	-	-	4	0.98	0.10	0.87-1.09
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	14	238	28	176-295	14	160	58	50-290	14	1.13	0.13	0.87-1.36
		Jul-Sep	***18***	***224***	***37***	***106-295***	***18***	***130***	***69***	***50-290***	***18***	***1.10***	***0.13***	***0.87-1.36***
	2	Feb/Mar	13	256	32	193-298	13	198	67	50-275	13	1.13	0.20	0.68-1.43
		Jul	21	198	40	160-278	20	60	113	25-400	20	0.93	0.42	0.48-1.94
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	18	218	75	107-309	13	237	105	90-400	13	1.27	0.16	1.05-1.61
		Jul-Sep	***39***	***207***	***59***	***107-309***	***33***	***154***	***127***	***25-400***	***33***	***1.07***	***0.38***	***0.48-1.94***
	3	Feb/Mar	4	212	55	145-259	3	140	56	75-175	3	1.06	0.06	1.01-1.13
		Jul	8	189	42	145-270	7	75	29	50-125	7	1.05	0.30	0.51-1.50
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	39	194	64	96-314	26	190	89	75-245	26	1.44	0.33	1.00-2.02
		Jul-Sep	***47***	***193***	***61***	***96-314***	***33***	***165***	***93***	***50-425***	***33***	***1.36***	***0.29***	***0.51-2.02***

Table A5.10. (Continued)

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Zone**	**Month**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Goldeye	3a	Feb/Mar	2	279	1	278-280	2	325	-	-	2	1.50	0.02	1.48-1.51
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	26	172	65	101-257	12	200	53	100-250	12	1.42	0.14	1.16-1.54
		Jul-Sep	***26***	***172***	***65***	***101-257***	***12***	***200***	***53***	***100-250***	***12***	***1.42***	***0.14***	***1.16-1.54***
	RR	***Jul-Sep***	***173***	***194***	***61***	***96-316***	***126***	***152***	***101***	***25-425***	***126***	***1.18***	***0.31***	***0.48-2.02***
	4	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	7	234	64	164-317	7	186	146	50-450	7	1.24	0.38	0.89-2.00
		Aug	2	240	76	186-294	2	200	141	100-300	2	1.37	0.26	1.18-1.55
		Sep	5	257	42	197-308	5	215	84	100-325	5	1.21	0.08	1.11-1.31
		Jul-Sep	***14***	***243***	***55***	***164-317***	***14***	***198***	***117***	***50-450***	***14***	***1.25***	***0.27***	***0.89-2.00***
	5	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	1	159	-	-	1	50	-	-	1	1.24	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	2	226	23	209-242	2	175	35	150-200	2	1.53	0.16	1.41-1.64
		Jul-Sep	***3***	***203***	***42***	***159-242***	***3***	***133***	***76***	***50-200***	***3***	***1.43***	***0.20***	***1.24-1.64***
	AR	***Jul-Sep***	***17***	***236***	***54***	***159-317***	***17***	***187***	***112***	***50-450***	***17***	***1.28***	***0.27***	***0.89-2.00***

RR = Red River
AR = Assiniboine River

Table A5.11. Mean length, weight, and relative condition factor (K) for lake cisco captured in the Red and Assiniboine rivers, 1999.

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Zone**	**Month**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Lake cisco	1a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	1	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**				
	2	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	3	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Table A5.11. (Continued)

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Zone**	**Month**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Lake Cisco	3a	Feb/Mar	19	209	15	187-230	18	90	37	50-200	18	0.95	0.28	0.51-1.64
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	RR	***Jul-Sep***	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	4	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	5	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	AR	***Jul-Sep***	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

RR = Red River
AR = Assiniboine River

Table A5.12. Mean length, weight, and relative condition factor (K) for mooneye captured in the Red and Assiniboine rivers, 1999.

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Zone**	**Month**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Mooneye	1a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	1	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**				
	2	Feb/Mar	4	196	15	183-210	4	75	-	-	4	1.03	0.23	0.81-1.22
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	3	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	2	230	49	195-264	2	150	141	50-250	2	1.02	0.48	0.67-1.36
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***2***	***230***	***49***	***195-264***	***2***	***150***	***141***	***50-250***	***2***	***1.02***	***0.48***	***0.67-1.36***

Table A5.12. (Continued)

Species	Zone	Month	Length (mm)				Weight (g)				Condition Factor (K)			
			n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Mooneye	3a	Feb/Mar	1	200	-	-	1	75	-	-	1	0.94	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***
	RR	***Jul-Sep***	***7***	***206***	***28***	***183-264***	***7***	***96***	***68***	***50-250***	***7***	***1.01***	***0.26***	***0.67-1.36***
	4	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	2	229	32	266-251	2	188	18	175-200	2	1.63	0.52	1.26-2.00
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***2***	***229***	***32***	***266-251***	***2***	***188***	***18***	***175-200***	***2***	***1.63***	***0.52***	***1.26-2.00***
	5	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***
	AR	***Jul-Sep***	***2***	***229***	***32***	***266-251***	***2***	***188***	***18***	***175-200***	***2***	***1.63***	***0.52***	***1.26-2.00***

RR = Red River
AR = Assiniboine River

Table A5.13. Mean length, weight, and relative condition factor (K) for northern pike captured in the Red and Assiniboine rivers, 1999.

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	Zone	Month	n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Northern pike	1a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	-	-	-	-	-	-	-	-	-	-	-	-
	1	Feb/Mar	3	661	165	483-809	3	2858	2013	825-4850	3	0.84	0.10	0.73-0.92
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	-	-	-	-	-	-	-	-	-	-	-	-
	2	Feb/Mar	1	445	-	-	1	600	-	-	1	0.68	-	-
		Jul	2	305	87	243-366	2	313	230	150-475	2	1.01	0.05	0.97-1.05
		Aug	3	513	183	312-670	3	1267	1109	250-2450	3	0.76	0.11	0.64-0.82
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***5***	***430***	***178***	***243-670***	***5***	***885***	***950***	***150-2450***	***5***	***0.86***	***0.16***	***0.64-1.05***
	3	Feb/Mar	12	630	88	404-720	12	2185	835	500-3500	12	0.82	0.09	0.71-0.98
		Jul	7	403	154	260-710	7	564	809	100-2350	7	0.55	0.07	0.45-0.66
		Aug	4	483	118	385-636	4	975	696	450-1950	4	0.77	0.07	0.73-0.88
		Sep	1	565	-	-	1	1250	-	-	1	0.69	-	-
		Jul-Sep	***12***	***443***	***140***	***260-710***	***12***	***758***	***743***	***100-2350***	***12***	***0.64***	***0.13***	***0.45-0.88***

Table A5.13. (Continued)

Species	Zone	Month	Length (mm)				Weight (g)				Condition Factor (K)			
			n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Northern pike	3a	Feb/Mar	4	606	167	460-811	4	2144	2195	400-5150	4	0.68	0.25	0.41-0.97
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	RR	***Jul-Sep***	***17***	***439***	***147***	***243-710***	***17***	***796***	***780***	***100-2450***	***17***	***0.70***	***0.17***	***0.45-1.05***
	4	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	5	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	3	350	25	331-378	2	375	177	250-500	2	0.78	0.20	0.64-0.93
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	3	350	25	331-378	2	375	177	250-500	2	0.78	0.20	0.64-0.93
	AR	***Jul-Sep***	***3***	***350***	***25***	***331-378***	***2***	***375***	***177***	***250-500***	***2***	***0.78***	***0.20***	***0.64-0.93***

RR = Red River
AR = Assiniboine River

Table A5.14. Mean length, weight, and relative condition factor (K) for quillback captured in the Red and Assiniboine rivers, 1999.

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Zone**	**Month**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Quillback	1a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***
	1	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	1	375	-	-	1	500	-	-	1	0.95	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***1***	***375***	***-***	***-***	***1***	***500***	***-***	***-***	***1***	***0.95***	***-***	***-***
	2	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	10	298	78	148-387	10	623	417	75-1325	10	1.99	0.18	1.79-2.31
		Aug	30	374	39	248-438	30	1073	300	300-1700	30	2.00	0.30	1.67-2.62
		Sep	7	418	27	380-455	7	1529	178	1400-1850	7	2.11	0.27	1.81-2.64
		Jul-Sep	***47***	***364***	***61***	***148-455***	***47***	***1045***	***412***	***75-1850***	***47***	***2.01***	***0.21***	***1.67-2.64***
	3	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	9	411	38	355-471	9	1378	333	950-2000	9	1.96	0.17	1.75-2.24
		Aug	53	392	46	243-480	53	1295	372	400-1200	53	2.10	0.21	1.77-2.80
		Sep	6	366	107	156-447	6	1211	604	90-1800	6	2.14	0.14	1.99-2.37
		Jul-Sep	***68***	***392***	***52***	***156-480***	***68***	***1299***	***386***	***90-2100***	***68***	***2.09***	***0.21***	***1.75-2.80***

Table A5.14. (Continued)

Species	Zone	Month	Length (mm)				Weight (g)				Condition Factor (K)			
			n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Quillback	3a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***
	RR	***Jul-Sep***	***116***	***381***	***57***	***148-480***	***116***	***1189***	***418***	***75-2100***	***116***	***2.05***	***0.23***	***0.95-2.80***
	4	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	7	368	68	260-435	7	1089	508	450-1875	7	2.09	0.28	1.69-2.56
		Aug	7	389	26	355-420	7	1121	138	950-1300	7	1.91	0.19	1.75-2.25
		Sep	4	387	44	349-448	4	1263	335	900-1700	4	2.17	0.22	1.89-2.40
		Jul-Sep	***18***	***380***	***48***	***260-448***	***18***	***1140***	***350***	***450-1875***	***18***	***2.04***	***0.25***	***1.69-2.56***
	5	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***
	AR	***Jul-Sep***	***18***	***380***	***48***	***260-448***	***18***	***1140***	***350***	***450-1875***	***18***	***2.04***	***0.25***	***1.69-2.56***

RR = Red River
AR = Assiniboine River

Table A5.15. Mean length, weight, and relative condition factor (K) for rock bass captured in the Red and Assiniboine rivers, 1999.

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	Zone	Month	n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Rock bass	1a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	1	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	2	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	1	185	-	-	1	175	-	-	1	2.76	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	2	128	6	123-132	-	-	-	-	-	-	-	-
		Jul-Sep	***3***	***157***	***40***	***123-185***	***1***	***175***	**-**	**-**	***1***	***2.76***	**-**	**-**
	3	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	1	93	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	1	115	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***2***	***104***	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Table A5.15. (Continued)

Species	Zone	Month	Length (mm)				Weight (g)				Condition Factor (K)			
			n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Rock bass	3a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	-	-	-	-	-	-	-	-	-	-	-	-
	RR	***Jul-Sep***	***5***	***130***	***34***	***93-185***	***2***	***100***	***106***	***25-175***	***2***	***2.20***	***0.79***	***1.64-2.76***
	4	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	-	-	-	-	-	-	-	-	-	-	-	-
	5	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	-	-	-	-	-	-	-	-	-	-	-	-
	AR	***Jul-Sep***	-	-	-	-	-	-	-	-	-	-	-	-

RR = Red River
AR = Assiniboine River

Table A5.16. Mean length, weight, and relative condition factor (K) for sauger captured in the Red and Assiniboine rivers, 1999.

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Zone**	**Month**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Sauger	1a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	2	238	23	222-254	2	125	35	100-150	2	0.91	-	0.91-0.92
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***2***	***238***	***23***	***222-254***	***2***	***125***	***35***	***100-150***	***2***	***0.91***	***-***	***0.91-0.92***
	1	Feb/Mar	5	254	17	225-272	5	182	66	100-250	5	1.08	0.26	0.88-1.46
		Jul	1	279	-	-	1	200	-	-	1	0.92	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	15	275	31	237-335	15	226	69	150-375	15	1.07	0.12	0.87-1.26
		Jul-Sep	***16***	***275***	***30***	***237-335***	***16***	***224***	***67***	***150-375***	***16***	***1.06***	***0.12***	***0.87-1.26***
	2	Feb/Mar	2	251	18	238-263	2	150	35	125-175	2	0.94	0.02	0.93-0.96
		Jul	5	235	29	208-273	4	113	52	50-175	4	0.75	0.14	0.55-0.86
		Aug	67	279	27	222-350	67	250	62	100-400	67	1.15	0.18	0.83-1.81
		Sep	29	266	35	193-308	29	228	81	50-400	29	1.16	0.09	0.65-1.60
		Jul-Sep	***10***	***273***	***31***	***193-350***	***100***	***238***	***72***	***50-400***	***100***	***1.14***	***0.19***	***0.55-1.81***
	3	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	16	234	53	139-343	16	144	95	25-400	16	1.03	0.26	0.55-1.58
		Aug	102	278	25	225-350	102	313	70	200-525	102	1.46	0.18	1.08-1.99
		Sep	27	265	36	210-334	27	226	102	75-475	27	1.17	0.26	0.77-1.76
		Jul-Sep	***145***	***270***	***34***	***139-150***	***145***	***278***	***98***	***25-525***	***145***	***1.36***	***0.26***	***0.55-1.99***

Table A5.16. (Continued)

Species	Zone	Month	Length (mm)				Weight (g)				Condition Factor (K)			
			n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Sauger	3a	Feb/Mar	14	245	33	186-305	12	151	51	100-240	12	0.89	0.12	0.74-1.09
		Jul	6	229	9	216-240	6	117	26	100-150	6	1.04	0.13	0.90-1.28
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	116	266	35	194-403	166	253	98	100-750	116	1.29	0.13	0.99-1.76
		Jul-Sep	***122***	***264***	***36***	***194-403***	***122***	***247***	***100***	***100-750***	***122***	***1.28***	***0.14***	***0.90-1.76***
	RR	***Jul-Sep***	***386***	***269***	***34***	***139-403***	***385***	***259***	***94***	***25-750***	***385***	***1.26***	***0.23***	***0.55-1.99***
	4	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	13	240	36	191-300	13	167	51	100-275	13	1.22	0.25	0.92-1.79
		Aug	7	292	24	272-332	7	314	80	250-450	7	1.25	0.12	1.09-1.41
		Sep	56	262	38	196-329	56	225	98	60-400	56	1.18	0.20	0.77-1.60
		Jul-Sep	***76***	***261***	***39***	***191-332***	***76***	***223***	***97***	***60-450***	***76***	***1.19***	***0.20***	***0.77-1.79***
	5	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	3	276	15	260-290	3	142	14	125-150	3	0.69	0.15	0.59-0.85
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	2	310	11	302-318	2	350	71	300-400	2	1.17	0.11	1.09-1.24
		Jul-Sep	***5***	***289***	***22***	***260-318***	***5***	***225***	***120***	***125-400***	***5***	***0.88***	***0.29***	***0.59-1.24***
	AR	***Jul-Sep***	***81***	***263***	***38***	***191-332***	***81***	***223***	***97***	***60-450***	***81***	***1.17***	***0.22***	***0.59-1.79***

RR = Red River
AR = Assiniboine River

Table A5.17. Mean length, weight, and relative condition factor (K) for shorthead redhorse captured in the Red and Assiniboine rivers, 1999.

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Zone**	**Month**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Shorthead redhorse	1a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	1	301	-	-	1	400	-	-	1	1.47	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	1	243	-	-	1	225	-	-	1	1.57	-	-
		Jul-Sep	***2***	***272***	***41***	***243-301***	***2***	***313***	***124***	***225-400***	***2***	***1.52***	***0.07***	***1.47-1.57***
	1	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	1	340	-	-	1	550	-	-	1	1.40	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	2	372	91	308-436	2	800	495	450-1150	2	1.46	0.11	1.39-1.54
		Jul-Sep	***3***	***361***	***67***	***308-436***	***3***	***717***	***379***	***450-1150***	***3***	***1.44***	***0.08***	***1.39-1.54***
	2	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	8	304	44	246-380	8	419	185	200-750	8	1.41	0.10	1.32-1.61
		Aug	8	354	49	275-414	8	697	251	375-1100	8	1.54	0.23	1.09-1.80
		Sep	25	360	30	304-407	24	699	185	400-1075	24	1.47	0.14	1.16-1.70
		Jul-Sep	***41***	***348***	***42***	***246-414***	***40***	***643***	***224***	***200-1100***	***40***	***1.47***	***0.16***	***1.09-1.80***
	3	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	13	334	63	200-437	13	569	270	100-1050	13	1.41	0.13	1.24-1.59
		Aug	11	368	18	343-389	11	755	129	600-975	11	1.50	0.14	1.24-1.70
		Sep	16	336	62	217-415	15	660	279	250-1100	15	1.54	0.25	1.22-2.13
		Jul-Sep	***40***	***344***	***55***	***200-437***	***39***	***656***	***248***	***100-1100***	***39***	***1.49***	***0.19***	***1.22-2.13***

Table A5.17. (Continued)

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	Zone	Month	n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Shorthead redhorse	3a	Feb/Mar	2	300	170	180-420	2	688	866	75-1300	2	1.52	0.33	1.29-1.75
		Jul	1	395	-	-	1	900	-	-	1	1.46	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	2	370	34	346-394	2	870	255	690-1050	2	1.69	0.04	1.67-1.72
		Jul-Sep	***3***	***378***	***28***	***346-395***	***3***	***880***	***181***	***690-1050***	***3***	***1.61***	***0.14***	***1.46-1.72***
	RR	***Jul-Sep***	***89***	***346***	***50***	***200-437***	***87***	***652***	***243***	***100-1150***	***87***	***1.48***	***0.17***	***1.09-2.13***
	4	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	61	351	45	155-485	61	614	196	75-1725	61	1.40	0.19	0.77-2.01
		Aug	21	355	32	273-403	21	652	145	350-850	21	1.45	0.19	1.06-1.76
		Sep	166	346	31	229-437	162	612	148	200-1250	162	1.46	0.14	1.20-1.88
		Jul-Sep	***248***	***348***	***35***	***155-485***	***244***	***616***	***161***	***75-1725***	***244***	***1.44***	***0.16***	***0.77-2.01***
	5	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	12	344	17	316-375	12	556	132	400-825	12	1.35	0.20	1.14-1.88
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	9	329	58	196-390	9	581	235	150-950	9	1.56	0.20	1.29-1.99
		Jul-Sep	***21***	***337***	***39***	***196-390***	***21***	***567***	***178***	***150-950***	***21***	***1.44***	***0.22***	***1.14-1.99***
	AR	***Jul-Sep***	***269***	***347***	***35***	***155-485***	***265***	***612***	***162***	***75-1725***	***265***	***1.44***	***0.17***	***0.77-2.01***

RR = Red River
AR = Assiniboine River

Table A5.18. Mean length, weight, and relative condition factor (K) for silver redhorse captured in the Red and Assiniboine rivers, 1999.

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	Zone	Month	n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Silver redhorse	1a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	1	435	-	-	1	1325	-	-	1	1.61	-	-
		Jul-Sep	***1***	***435***	***-***	***-***	***1***	***1325***	***-***	***-***	***1***	***1.61***	***-***	***-***
	1	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	1	174	-	-	1	50	-	-	1	0.95	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***1***	***174***	***-***	***-***	***1***	***50***	***-***	***-***	***1***	***0.95***	***-***	***-***
	2	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	4	365	60	310-448	4	806	432	450-1400	4	1.54	0.12	1.41-1.69
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	1	373	-	-	1	800	-	-	1	1.54	-	-
		Jul-Sep	***5***	***367***	***52***	***310-448***	***5***	***805***	***379***	***450-1400***	***5***	***1.54***	***0.10***	***1.41-1.69***
	3	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	1	451	-	-	1	1350	-	-	1	1.47	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	1	317	-	-	1	600	-	-	1	1.88	-	-
		Jul-Sep	***2***	***384***	***95***	***317-451***	***2***	***975***	***530***	***600-1350***	***2***	***1.68***	***0.29***	***1.47-1.88***

Table A5.18. (Continued)

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Zone**	**Month**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Silver redhorse	3a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	2	499	30	478-520	2	1900	566	1500-2300	2	1.50	0.19	1.37-1.64
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***2***	***499***	***30***	***478-520***	***2***	***1900***	***566***	***1500-2300***	***2***	***1.50***	***0.19***	***1.37-1.64***
	RR	***Jul-Sep***	***11***	***383***	***98***	***174-520***	***1***	***1014***	***631***	***50-2300***	***11***	***1.51***	***0.23***	***0.95-1.88***
	4	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	9	424	100	238-505	8	1256	652	225-1775	8	1.45	0.23	0.97-1.68
		Aug	2	512	12	503-520	2	1950	212	1800-2100	2	1.45	0.06	1.41-1.49
		Sep	1	486	-	-	1	1725	-	-	1	1.50	-	-
		Jul-Sep	***12***	***444***	***93***	***238-520***	***11***	***1425***	***624***	***225-2100***	***11***	***1.45***	***0.20***	***0.97-1.68***
	5	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	1	380	-	-	1	900	-	-	1	1.64	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***1***	***380***	***-***	***-***	***1***	***900***	***-***	***-***	***1***	***1.64***	***-***	***-***
	AR	***Jul-Sep***	***13***	***439***	***91***	***238-520***	***12***	***1381***	***614***	***225-2100***	***12***	***1.47***	***0.20***	***0.97-1.68***

RR = Red River
AR = Assiniboine River

Table A5.19. Mean length, weight, and relative condition factor (K) for walleye captured in the Red and Assiniboine rivers, 1999.

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	Zone	Month	n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Walleye	1a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	1	470	-	-	1	1125	-	-	1	1.08	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***1***	***470***	***-***	***-***	***1***	***1125***	***-***	***-***	***1***	***1.08***	***-***	***-***
	1	Feb/Mar	1	690	-	-	1	4300	-	-	1	1.31	-	-
		Jul	3	704	21	680-718	3	4392	609	3700-4850	3	1.25	0.08	1.18-1.34
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***3***	***704***	***21***	***680-718***	***3***	***4392***	***609***	***3700-4850***	***3***	***1.25***	***0.08***	***1.18-1.34***
	2	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	3	548	163	438-735	3	2217	2066	925-4600	3	1.11	0.04	1.08-1.16
		Aug	12	408	101	310-603	12	904	677	350-2500	12	1.16	0.12	1.02-1.53
		Sep	5	413	176	288-724	5	1505	2432	225-5850	5	1.16	0.23	0.94-1.54
		Jul-Sep	***20***	***430***	***134***	***288-735***	***20***	***1251***	***1483***	***225-5850***	***20***	***1.15***	***0.14***	***0.94-1.54***
	3	Feb/Mar	5	393	93	280-502	5	600	350	300-1175	5	0.97	0.28	0.66-1.37
		Jul	4	280	225	146-615	4	850	1567	50-3200	4	1.39	0.19	1.14-1.61
		Aug	1	678	-	-	1	4350	-	-	1	1.40	-	-
		Sep	2	393	131	300-485	2	875	778	325-1425	2	1.23	0.03	1.20-1.25
		Jul-Sep	***7***	***369***	***223***	***146-678***	***7***	***1357***	***1752***	***50-4350***	***7***	***1.35***	***0.16***	***1.14-1.61***

Table A5.19. (Continued)

Species	Zone	Month	Length (mm)				Weight (g)				Condition Factor (K)			
			n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Walleye	3a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	3	389	60	332-451	3	792	406	475-1250	3	1.27	0.11	1.19-1.36
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***3***	***389***	***60***	***332-451***	***3***	***792***	***406***	***475-1250***	***3***	***1.27***	***0.11***	***1.16-1.36***
	RR	***Jul-Sep***	***34***	***439***	***165***	***146-735***	***34***	***1506***	***1646***	***50-5850***	***34***	***1.21***	***0.16***	***0.94-1.61***
	4	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	4	688	74	581-750	4	4363	1193	2900-5500	4	1.33	0.17	1.15-1.48
		Aug	1	342	-	-	1	500	-	-	1	1.25	-	-
		Sep	3	300	103	183-378	3	347	235	90-550	3	1.17	0.26	1.02-1.47
		Jul-Sep	***8***	***499***	***215***	***183-750***	***8***	***2374***	***2269***	***90-5500***	***8***	***1.26***	***0.19***	***1.02-1.48***
	5	Feb/Mar	1	488	-	-	1	1450	-	-	1	1.25	-	-
		Jul	1	388	-	-	1	650	-	-	1	1.11	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	1	412	-	-	1	790	-	-	1	1.13	-	-
		Jul-Sep	***2***	***400***	***17***	***388-412***	***2***	***720***	***99***	***650-790***	***2***	***1.12***	***0.01***	***1.11-1.13***
	AR	***Jul-Sep***	***10***	***479***	***194***	***183-750***	***10***	***2043***	***2119***	***90-5500 10***	***1***	***1.23***	***0.18***	***1.02-1.48***

RR = Red River
AR = Assiniboine River

Table A5.20. Mean length, weight, and relative condition factor (K) for white sucker captured in the Red and Assiniboine rivers, 1999.

			Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Zone**	**Month**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
White sucker	1a	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***
	1	Feb/Mar	4	392	27	360-418	4	888	238	625-1200	4	1.45	0.15	1.32-1.64
		Jul	1	335	-	-	1	475	-	-	1	1.26	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	4	410	43	358-460	4	1094	348	725-1500	4	1.55	0.08	1.45-1.63
		Jul-Sep	***5***	***395***	***50***	***335-460***	***5***	***970***	***409***	***475-1500***	***5***	***1.49***	***0.14***	***1.26-1.64***
	2	Feb/Mar	1	322	-	-	1	450	-	-	1	1.35	-	-
		Jul	14	342	45	246-405	14	577	207	175-900	14	1.37	0.09	1.18-1.50
		Aug	5	345	77	255-445	5	670	409	300-1300	5	1.52	0.21	1.27-1.81
		Sep	34	378	32	315-463	34	815	203	475-1300	34	1.48	0.10	1.23-1.74
		Jul-Sep	***53***	***365***	***43***	***246-463***	***53***	***739***	***247***	***175-1300***	***53***	***1.46***	***0.12***	***1.18-1.81***
	3	Feb/Mar	2	430	45	398-462	2	1250	495	900-1600	2	1.53	0.14	1.43-1.62
		Jul	45	358	40	192-408	44	657	193	100-950	44	1.39	0.13	0.99-1.62
		Aug	31	381	39	280-483	31	901	240	300-1600	31	1.60	0.19	1.28-2.19
		Sep	36	381	21	342-422	36	817	151	550-1250	36	1.47	0.12	1.33-1.74
		Jul-Sep	***112***	***372***	***36***	***192-483***	***111***	***777***	***219***	***100-1600***	***111***	***1.47***	***0.17***	***0.99-2.19***

Table A5.20. (Continued)

Species	Zone	Month	Length (mm)				Weight (g)				Condition Factor (K)			
			n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
White sucker	3a	Feb/Mar	24	410	40	298-470	24	1133	327	375-1700	24	1.60	0.12	1.42-1.96
		Jul	-	-	-	-	-	-	-	-	-	-	-	-
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	3	424	36	385-457	3	1267	236	1000-1450	3	1.66	0.12	1.52-1.75
		Jul-Sep	***3***	***424***	***36***	***385-457***	***3***	***1267***	***236***	***1000-1450***	***3***	***1.66***	***0.12***	***1.52-1.75***
	RR	***Jul-Sep***	***173***	***371***	***40***	***192-483***	***172***	***779***	***245***	***100-1600***	***172***	***1.47***	***0.15***	***0.99-2.19***
	4	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	15	372	42	292-440	15	575	219	400-1100	15	1.44	0.12	1.29-1.71
		Aug	4	370	35	335-400	4	750	235	350-1000	4	1.45	0.09	1.36-1.56
		Sep	22	380	19	348-413	22	826	139	600-1100	22	1.49	0.13	1.26-1.85
		Jul-Sep	***41***	***376***	***30***	***292-440***	***41***	***793***	***180***	***400-1100***	***41***	***1.47***	***0.12***	***1.26-1.85***
	5	Feb/Mar	-	-	-	-	-	-	-	-	-	-	-	-
		Jul	3	315	93	216-400	3	522	393	140-925	3	1.41	0.03	1.39-1.45
		Aug	-	-	-	-	-	-	-	-	-	-	-	-
		Sep	-	-	-	-	-	-	-	-	-	-	-	-
		Jul-Sep	***3***	***315***	***93***	***216-400***	***3***	***522***	***393***	***140-925***	***3***	***1.41***	***0.03***	***1.39-1.45***
	AR	***Jul-Sep***	***44***	***372***	***39***	***216-440***	***44***	***775***	***205***	***140-1100***	***44***	***1.47***	***0.12***	***1.26-1.85***

RR = Red River
AR = Assiniboine River

APPENDIX 6

Weight-length relationships for selected species captured in the Red and Assiniboine rivers, 1999.

Table A6.1. Weight-length relationships for bigmouth buffalo captured in the Red and Assiniboine rivers, 1999.

Species	Zone	Month	n	Range (mm)	Weight-Length Equation	r^2
Bigmouth buffalo	1a	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	1	748	-	-
		Jul-Sep	***1***	***748***	***-***	***-***
	1	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	2	498-524	$Log_{10}Weight = -9.45 + 4.76 (Log_{10}Length)$	1.00
		Jul-Sep	***2***	***498-524***	$Log_{10} Weight = -9.45+ 4.76 (Log_{10} Length)$	***1.00***
	2	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	3	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	3a	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	RR	***Jul-Sep***	***3***	***498-748***	$Log_{10} Weight = -4.34 + 2.87 (Log_{10} Length)$	***1.00***
	4	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	1	417	-	-
		Sep	1	633	-	-
		Jul-Sep	***1***	***417-633***	$Log_{10} Weight = -4.54 + 2.95 (Log_{10} Length)$	***1.00***
	5	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	AR	***Jul-Sep***	***2***	***417-633***	$Log_{10} Weight = -4.57 + 2.96 (Log_{10} Length)$	***1.00***

Table A6.2. Weight-length relationships for black bullhead captured in the Red and Assiniboine rivers, 1999.

Species	Zone	Month	n	Range (mm)	Weight-Length Equation	r^2
Black bullhead	1a	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**
	1	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**
	2	Feb/Mar	-	-	-	-
		Jul	3	163-202	$Log_{10}Weight = -4.85 + 2.97 (Log_{10}Length)$	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***3***	***163-202***	$\boldsymbol{Log_{10} Weight = -4.85 + 2.97 (Log_{10} Length)}$	**-**
	3	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**
	3a	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**
	RR	***Jul-Sep***	***3***	***163-202***	$\boldsymbol{Log_{10} Weight = -4.85 + 2.97 (Log_{10} Length)}$	**-**
	4	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**
	5	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**
	AR	***Jul-Sep***	**-**	**-**	**-**	**-**

Table A6.3. Weight-length relationships for black crappie captured in the Red and Assiniboine rivers, 1999.

Species	Zone	Month	n	Range (mm)	Weight-Length Equation	r^2
Black crappie	1a	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	1	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	1	203	-	-
		Jul-Sep	***1***	***203***	***-***	***-***
	2	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	1	228	-	-
		Sep	1	210	-	-
		Jul-Sep	***2***	***210-228***	***-***	***-***
	3	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	3a	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	RR	***Jul-Sep***	***3***	***210-280***	$\mathit{Log_{10}\,Weight = -2.43 + 2.01\,(Log_{10}\,Length)}$	***0.53***
	4	Feb/Mar	-	-	-	-
		Jul	1	240	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***1***	***240***	***-***	***-***
	5	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	AR	***Jul-Sep***	***1***	***240***	***-***	***-***

Table A6.4. Weight-length relationships for brown bullhead captured in the Red and Assiniboine rivers, 1999.

Species	Zone	Month	n	Range (mm)	Weight-Length Equation	r^2
Brown bullhead	1a	Feb/Mar	123	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	1	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	1	202	-	-
		Jul-Sep	***1***	***202***	***-***	***-***
	2	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	1	200	-	-
		Jul-Sep	***1***	***200***	***-***	***-***
	3	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	2	169-190	$\log_{10}\text{Weight} = -2.24 + 1.91 (\log_{10}\text{Length})$	-
		Jul-Sep	***2***	***169-190***	$\boldsymbol{\log_{10}\text{Weight} = -2.24+ 1.91 (\log_{10}\text{Length})}$	***-***
	3a	Feb/Mar	-	-	-	-
		Jul	1	255	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***1***	***255***	***-***	***-***
	RR	***Jul-Sep***	***4***	***169-255***	$\boldsymbol{\log_{10}\text{Weight} = -4.18+ 2.72 (\log_{10}\text{Length})}$	***-***
	4	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	5	Feb/Mar	-	-	-	-
		Jul	1	171	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***1***	***171***	***-***	***-***
	AR	***Jul-Sep***	***1***	***171***	***-***	***-***

Table A6.5. Weight-length relationships for burbot captured in the Red and Assiniboine rivers, 1999.

Species	Zone	Month	n	Range (mm)	Weight-Length Equation	r^2
Burbot	1a	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	1	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	1	276	-	-
		Jul-Sep	***1***	***276***	***-***	***-***
	2	Feb/Mar	-	-	-	-
		Jul	4	150-275	$Log_{10}Weight = -3.40 + 2.30 (Log_{10}Length)$	0.74
		Aug	-	-	-	-
		Sep	3	381-525	$Log_{10}Weight = -4.11 + 2.57 (Log_{10}Length)$	0.99
		Jul-Sep	***7***	***150-525***	$\boldsymbol{Log_{10} Weight = -3.84 + 2.47 (Log_{10} Length)}$	***0.97***
	3	Feb/Mar	-	-	-	-
		Jul	11	205-341	$Log_{10}Weight = -2.37 + 1.89 (Log_{10}Length)$	0.76
		Aug	-	-	-	-
		Sep	5	204-390	$Log_{10}Weight = -6.05 + 3.36 (Log_{10}Length)$	0.98
		Jul-Sep	***16***	***204-390***	$\boldsymbol{Log_{10} Weight = -4.26 + 2.65 (Log_{10} Length)}$	***0.84***
	3a	Feb/Mar	1	290	-	-
		Jul	2	222-253	$Log_{10}Weight = -7.29 + 3.90 (Log_{10}Length)$	1.00
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***2***	***222-253***	$\boldsymbol{Log_{10} Weight = -7.29 + 3.90 (Log_{10} Length)}$	***1.00***
	RR	***Jul-Sep***	***26***	***204-525***	$\boldsymbol{Log_{10} Weight = -4.13 + 2.59 (Log_{10} Length)}$	***0.92***
	4	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	5	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	AR	***Jul-Sep***	***-***	***-***	***-***	***-***

Table A6.6. Weight-length relationships for carp captured in the Red and Assiniboine rivers, 1999.

Species	Zone	Month	n	Range (mm)	Weight-Length Equation	r^2
Carp	1a	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	1	478	-	-
		Jul-Sep	***1***	***478***	***-***	***-***
	1	Feb/Mar	4	478-514	$Log_{10}Weight = -7.30 + 3.97 (Log_{10}Length)$	0.57
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	2	Feb/Mar	-	-	-	-
		Jul	8	310-541	$Log_{10}Weight = -3.26 + 2.44 (Log_{10}Length)$	0.96
		Aug	1	600	-	-
		Sep	6	216-515	$Log_{10}Weight = -5.08 + 3.13 (Log_{10}Length)$	0.99
		Jul-Sep	***-***	***216-600***	***$Log_{10} Weight = -4.55 + 2.93 (Log_{10} Length)$***	***0.98***
	3	Feb/Mar	-	-	-	-
		Jul	24	195-711	$Log_{10}Weight = -3.67 + 2.60 (Log_{10}Length)$	0.99
		Aug	10	488-658	$Log_{10}Weight = -5.73 + 3.36 (Log_{10}Length)$	0.90
		Sep	16	388-628	$Log_{10}Weight = -3.78 + 2.65 (Log_{10}Length)$	0.94
		Jul-Sep	***50***	***195-711***	***$Log_{10} Weight = -3.78 + 2.68 (Log_{10} Length)$***	***0.98***
	3a	Feb/Mar	1	650	-	-
		Jul	3	590-708	$Log_{10}Weight = -8.44 + 4.34 (Log_{10}Length)$	0.93
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***3***	***590-708***	***$Log_{10} Weight = -8.44 + 4.34 (Log_{10} Length)$***	***0.93***
	RR	***Jul-Sep***	***69***	***195-711***	***$Log_{10} Weight = -4.32 + 2.84 (Log_{10} Length)$***	***0.98***
	4	Feb/Mar	-	-	-	-
		Jul	32	290-752	$Log_{10}Weight = -3.64 + 2.58 (Log_{10}Length)$	0.84
		Aug	2	582-612	$Log_{10}Weight = -7.19 + 3.89 (Log_{10}Length)$	1.00
		Sep	28	361-660	$Log_{10}Weight = -4.83 + 3.04 (Log_{10}Length)$	0.98
		Jul-Sep	***62***	***290-752***	***$Log_{10} Weight = -4.09 + 2.76 (Log_{10} Length)$***	***0.88***
	5	Feb/Mar	-	-	-	-
		Jul	1	295	-	-
		Aug	-	-	-	-
		Sep	1	542	-	-
		Jul-Sep	***2***	***295-542***	***$Log_{10} Weight = -3.01+ 2.34 (Log_{10} Length)$***	***1.00***
	AR	***Jul-Sep***	***64***	***290-752***	***$Log_{10} Weight = -4.01 + 2.73 (Log_{10} Length)$***	***0.90***

Table A6.7. Weight-length relationships for channel catfish captured in the Red and Assiniboine rivers, 1999.

Species	Zone	Month	n	Range (mm)	Weight-Length Equation	r^2
Channel catfish	1a	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	1	Feb/Mar	1	213	-	-
		Jul	2	412-710	$Log_{10}Weight = -5.46 + 3.21 (Log_{10}Length)$	1.00
		Aug	-	-	-	-
		Sep	12	188-680	$Log_{10}Weight = -5.41 + 3.26 (Log_{10}Length)$	0.99
		Jul-Sep	***14***	***188-710***	$Log_{10}Weight = -5.45+ 3.24 (Log_{10}Length)$	***0.99***
	2	Feb/Mar	1	237	-	-
		Jul	21	197-680	$Log_{10}Weight = -5.13 + 3.09 (Log_{10}Length)$	0.99
		Aug	20	225-785	$Log_{10}Weight = -4.81 + 2.98 (Log_{10}Length)$	0.98
		Sep	75	173-690	$Log_{10}Weight = -5.21 + 3.14 (Log_{10}Length)$	0.98
		Jul-Sep	***116***	***173-785***	$Log_{10}Weight = -5.15 + 3.11 (Log_{10}Length)$	***0.99***
	3	Feb/Mar	-	-	-	-
		Jul	5	182-616	$Log_{10}Weight = -5.62 + 3.29 (Log_{10}Length)$	0.99
		Aug	270	248-820	$Log_{10}Weight = -4.77 + 2.98 (Log_{10}Length)$	0.98
		Sep	45	237-652	$Log_{10}Weight = -4.59 + 2.90 (Log_{10}Length)$	0.98
		Jul-Sep	***320***	***182-820***	$Log_{10}Weight = -4.85 + 3.01 (Log_{10}Length)$	***0.98***
	3a	Feb/Mar	1	820	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	RR	***Jul-Sep***	***450***	***173-820***	$Log_{10}Weight = -5.06 + 3.08 (Log_{10}Length)$	***0.98***
	4	Feb/Mar	-	-	-	-
		Jul	9	237-618	$Log_{10}Weight = -5.09 + 3.08 (Log_{10}Length)$	0.98
		Aug	35	192-748	$Log_{10}Weight = -5.00 + 3.05 (Log_{10}Length)$	0.98
		Sep	29	231-783	$Log_{10}Weight = -4.75 + 2.97 (Log_{10}Length)$	0.99
		Jul-Sep	***73***	***192-783***	$Log_{10}Weight = -4.91 + 3.01 (Log_{10}Length)$	***0.98***
	5	Feb/Mar	-	-	-	-
		Jul	1	780	-	-
		Aug	-	-	-	-
		Sep	16	478-670	$Log_{10}Weight = -6.98 + 3.76 (Log_{10}Length)$	0.93
		Jul-Sep	***17***	***478-780***	$Log_{10}Weight = -6.07 + 3.43 (Log_{10}Length)$	***0.91***
	AR	***Jul-Sep***	***90***	***192-783***	$Log_{10}Weight = -4.95 + 3.03 (Log_{10}Length)$	***0.98***

Table A6.8. Weight-length relationships for freshwater drum captured in the Red and Assiniboine rivers, 1999.

Species	Zone	Month	n	Range (mm)	Weight-Length Equation	r^2
Freshwater drum	1a	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	1	Feb/Mar	3	340-390	$Log_{10}Weight = -5.39 + 3.21 (Log_{10}Length)$	0.96
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	2	Feb/Mar	-	-	-	-
		Jul	7	320-554	$Log_{10}Weight = -5.37 + 3.19 (Log_{10}Length)$	0.99
		Aug	12	315-542	$Log_{10}Weight = -5.33 + 3.37 (Log_{10}Length)$	0.90
		Sep	6	292-394	$Log_{10}Weight = -2.24 + 1.97 (Log_{10}Length)$	0.98
		Jul-Sep	***25***	***292-554***	$Log_{10}Weight = -4.91 + 3.02 (Log_{10}Length)$	***0.93***
	3	Feb/Mar	-	-	-	-
		Jul	21	196-526	$Log_{10}Weight = -4.54 + 2.84 (Log_{10}Length)$	0.97
		Aug	35	337-485	$Log_{10}Weight = -4.17 + 2.73 (Log_{10}Length)$	0.96
		Sep	21	270-585	$Log_{10}Weight = -5.71 + 3.33 (Log_{10}Length)$	0.94
		Jul-Sep	***77***	***196-585***	$Log_{10}Weight = -4.43 + 2.83 (Log_{10}Length)$	***0.95***
	3a	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	1	445	-	-
		Jul-Sep	***1***	***445***	***-***	***-***
	RR	***Jul-Sep***	***103***	***196-585***	$Log_{10}Weight = -4.52 + 2.87 (Log_{10}Length)$	***0.95***
	4	Feb/Mar	-	-	-	-
		Jul	5	260-505	$Log_{10}Weight = -3.99 + 2.65 (Log_{10}Length)$	0.99
		Aug	17	309-603	$Log_{10}Weight = -5.72 + 3.32 (Log_{10}Length)$	0.97
		Sep	25	287-512	$Log_{10}Weight = -5.45 + 3.22 (Log_{10}Length)$	0.92
		Jul-Sep	***47***	***260-603***	$Log_{10}Weight = -5.27 + 3.15 (Log_{10}Length)$	***0.94***
	5	Feb/Mar	-	-	-	-
		Jul	10	313-545	$Log_{10}Weight = -4.85 + 2.98 (Log_{10}Length)$	0.98
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***10***	***313-545***	$Log_{10}Weight = -4.85 + 2.98 (Log_{10}Length)$	***0.98***
	AR	***Jul-Sep***	***57***	***260-603***	$Log_{10}Weight = -5.15 + 3.10 (Log_{10}Length)$	***0.95***

Table A6.9. Weight-length relationships for golden redhorse captured in the Red and Assiniboine rivers, 1999.

Species	Zone	Month	n	Range (mm)	Weight-Length Equation	r^2
Golden redhorse	1a	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	-	-	-	-
	1	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	-	-	-	-
	2	Feb/Mar	-	-	-	-
		Jul	3	262-396	$Log_{10}Weight = -4.89 + 2.99 (Log_{10}Length)$	1.00
		Aug	-	-	-	-
		Sep	2	494	-	-
		Jul-Sep	***5***	***262-494***	$Log_{10} Weight = -6.08 + 3.47 (Log_{10} Length)$	***0.99***
	3	Feb/Mar	-	-	-	-
		Jul	1	394	-	-
		Aug	-	-	-	-
		Sep	1	205	-	-
		Jul-Sep	***2***	***205-394***	$Log_{10} Weight = -3.22 + 2.38 (Log_{10} Length)$	***1.00***
	3a	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	1	542	-	-
		Jul-Sep	***1***	***542***	-	-
	RR	***Jul-Sep***	***8***	***205-542***	$Log_{10} Weight = -4.67 + 2.95 (Log_{10} Length)$	***0.96***
	4	Feb/Mar	-	-	-	-
		Jul	3	305-520	$Log_{10}Weight = -4.74 + 2.98 (Log_{10}Length)$	1.00
		Aug	5	299-502	$Log_{10}Weight = -4.49 + 2.88 (Log_{10}Length)$	0.99
		Sep	14	297-504	$Log_{10}Weight = -4.78 + 2.99 (Log_{10}Length)$	0.98
		Jul-Sep	***22***	***297-504***	$Log_{10} Weight = -4.70 + 2.96 (Log_{10} Length)$	***0.96***
	5	Feb/Mar	-	-	-	-
		Jul	1	520	-	-
		Aug	-	-	-	-
		Sep	1	179	-	-
		Jul-Sep	***2***	***174-520***	-	-
	AR	***Jul-Sep***	***23***	***297-520***	$Log_{10} Weight = -4.74 + 2.98 (Log_{10} Length)$	***0.98***

Table A6.10. Weight-length relationships for goldeye captured in the Red and Assiniboine rivers, 1999.

Species	Zone	Month	n	Range (mm)	Weight-Length Equation	r^2
Goldeye	1a	Feb/Mar	-	-	-	-
		Jul	11	164-316	$Log_{10}Weight = -5.96 + 3.39 (Log_{10}Length)$	0.93
		Aug	-	-	-	-
		Sep	18	167-316	$Log_{10}Weight = -5.03 + 3.03 (Log_{10}Length)$	0.91
		Jul-Sep	***29***	***164-316***	$Log_{10}Weight = -5.26 + 3.11 (Log_{10}Length)$	***0.90***
	1	Feb/Mar	6	183-306	$Log_{10}Weight = -6.90 + 3.81 (Log_{10}Length)$	0.95
		Jul	9	157-179	$Log_{10}Weight = -6.89 + 3.84 (Log_{10}Length)$	0.28
		Aug	-	-	-	-
		Sep	14	178-295	$Log_{10}Weight = -5.91 + 3.40 (Log_{10}Length)$	0.94
		Jul-Sep	***-***	***-***	$Log_{10}Weight = -5.95 + 3.41 (Log_{10}Length)$	***0.94***
	2	Feb/Mar	13	193-298	$Log_{10}Weight = -5.67 + 3.30 (Log_{10}Length)$	0.85
		Jul	19	159-292	$Log_{10}Weight = -8.92 + 4.67 (Log_{10}Length)$	0.92
		Aug	-	-	-	-
		Sep	14	168-309	$Log_{10}Weight = -3.75 + 2.53 (Log_{10}Length)$	0.87
		Jul-Sep	***33***	***159-309***	$Log_{10}Weight = -7.51 + 4.08 (Log_{10}Length)$	***0.88***
	3	Feb/Mar	-	-	-	-
		Jul	3	157-270	$Log_{10}Weight = -0.57 + 1.06 (Log_{10}Length)$	0.78
		Aug	-	-	-	-
		Sep	31	96-314	$Log_{10}Weight = -3.46 + 2.41 (Log_{10}Length)$	0.89
		Jul-Sep	***34***	***96-314***	$Log_{10}Weight = -3.36 + 2.36 (Log_{10}Length)$	***0.85***
	3a	Feb/Mar	2	278-280	-	-
		Jul	3	173-231	$Log_{10}Weight = -5.31 + 3.14 (Log_{10}Length)$	0.99
		Aug	-	-	-	-
		Sep	12	187-257	$Log_{10}Weight = -4.97 + 3.05 (Log_{10}Length)$	0.88
		Jul-Sep	***15***	***173-257***	$Log_{10}Weight = -6.51 + 3.73 (Log_{10}Length)$	***0.92***
	RR	***Jul-Sep***	***134***	***96-316***	$Log_{10}Weight = -5.12 + 3.07 (Log_{10}Length)$	***0.82***
	4	Feb/Mar	-	-	-	-
		Jul	6	171-317	$Log_{10}Weight = -4.27 + 2.72 (Log_{10}Length)$	0.86
		Aug	2	186-294	$Log_{10}Weight = -3.44 + 2.39 (Log_{10}Length)$	1.00
		Sep	5	197-308	$Log_{10}Weight = -4.06 + 2.65 (Log_{10}Length)$	0.99
		Jul-Sep	***13***	***171-317***	$Log_{10}Weight = -4.06 + 2.64 (Log_{10}Length)$	***0.90***
	5	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	2	209-242	$Log_{10}Weight = -2.37 + 1.96 (Log_{10}Length)$	1.00
		Jul-Sep	***2***	***209-242***	$Log_{10}Weight = -2.37 + 1.96 (Log_{10}Length)$	***0.89***
	AR	***Jul-Sep***	***15***	***171-317***	$Log_{10}Weight = -3.92 + 2.59 (Log_{10}Length)$	***0.89***

Table A6.11. Weight-length relationships for lake cisco captured in the Red and Assiniboine rivers, 1999.

Species	Zone	Month	n	Range (mm)	Weight-Length Equation	r^2
Lake cisco	1a	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**
	1	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**
	2	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**
	3	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**
	3a	Feb/Mar	18	187-230	$Log_{10}Weight = -5.86 + 3.55 (Log_{10}Length)$	0.37
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	18	187-230	$Log_{10}Weight = -5.86 + 3.55 (Log_{10}Length)$	0.37
	RR	***Jul-Sep***	18	187-230	$Log_{10}Weight = -5.86 + 3.55 (Log_{10}Length)$	0.37
	4	Feb/Mar	-	-		-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**
	5	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**
	AR	***Jul-Sep***	**-**	**-**	**-**	**-**

Table A6.12. Weight-length relationships for mooneye captured in the Red and Assiniboine rivers, 1999.

Species	Zone	Month	n	Range (mm)	Weight-Length Equation	r^2
Mooneye	1a	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**
	1	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**
	2	Feb/Mar	4	183-210	$Log_{10}Weight = -5.10 + 3.07 (Log_{10}Length)$	0.44
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	4	183-210	$Log_{10}Weight = -5.10 + 3.07 (Log_{10}Length)$	0.44
	3	Feb/Mar	1	200	-	-
		Jul	2	195-264	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***2***	***195-264***	**-**	**-**
	3a	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**
	RR	***Jul-Sep***	***2***	***195-264***	**-**	**-**
	4	Feb/Mar	-	-	-	-
		Jul	2	206-251	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***2***	***206-251***	**-**	**-**
	5	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	**-**	**-**	**-**	**-**
	AR	***Jul-Sep***	***2***	***206-251***	**-**	**-**

Table A6.13. Weight-length relationships for northern pike captured in the Red and Assiniboine rivers, 1999.

Species	Zone	Month	n	Range (mm)	Weight-Length Equation	r^2
Northern pike	1a	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	1	Feb/Mar	3	483-809	$Log_{10}Weight = -6.33 + 3.45 (Log_{10}Length)$	0.99
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	2	Feb/Mar	1	445	-	-
		Jul	2	243-366	$Log_{10}Weight = -4.53 + 2.81 (Log_{10}Length)$	1.00
		Aug	3	312-670	$Log_{10}Weight = -4.89 + 2.88 (Log_{10}Length)$	0.98
		Sep	-	-	-	-
		Jul-Sep	***5***	***243-670***	$Log_{10}Weight = -4.23 + 2.67 (Log_{10}Length)$	***0.99***
	3	Feb/Mar	4	460-811	$Log_{10}Weight = -8.85 + 4.32 (Log_{10}Length)$	0.99
		Jul	5	260-391	$Log_{10}Weight = -4.73 + 2.77 (Log_{10}Length)$	0.97
		Aug	4	385-636	$Log_{10}Weight = -4.71 + 2.84 (Log_{10}Length)$	0.99
		Sep	2	183-565	$Log_{10}Weight = -4.76 + 2.86 (Log_{10}Length)$	1.00
		Jul-Sep	***11***	***183-636***	$Log_{10}Weight = -5.47+ 3.10 (Log_{10}Length)$	***0.96***
	3a	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	RR	***Jul-Sep***	***16***	***183-670***	$Log_{10}Weight = -5.14 + 2.99 (Log_{10}Length)$	***0.95***
	4	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	5	Feb/Mar	-	-	-	-
		Jul	3	331-378	$Log_{10}Weight = -18.8 + 8.35 (Log_{10}Length)$	0.94
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***3***	***331-378***	$Log_{10}Weight = -18.8 + 8.35 (Log_{10}Length)$	***0.94***
	AR	***Jul-Sep***	***3***	***331-378***	$Log_{10}Weight = -18.8 + 8.35 (Log_{10}Length)$	***0.94***

Table A6.14. Weight-length relationships for quillback captured in the Red and Assiniboine rivers, 1999.

Species	Zone	Month	n	Range (mm)	Weight-Length Equation	r^2
Quillback	1a	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	1	Feb/Mar	-	-	-	-
		Jul	1	375	-	-
		Aug	-	-	-	-
		Sep	3	263-394	$Log_{10}Weight = -3.91 + 2.68 (Log_{10}Length)$	0.99
		Jul-Sep	***4***	***263-394***	***$Log_{10} Weight = -2.18 + 1.97 (Log_{10} Length)$***	0.99
	2	Feb/Mar	-	-	-	-
		Jul	10	148-387	$Log_{10}Weight = -4.55 + 2.94 (Log_{10}Length)$	0.99
		Aug	30	248-438	$Log_{10}Weight = -4.14 + 2.89 (Log_{10}Length)$	0.92
		Sep	10	122-455	$Log_{10}Weight = -5.11 + 3.16 (Log_{10}Length)$	0.98
		Jul-Sep	***50***	***122-455***	***$Log_{10} Weight = -4.91 + 3.08 (Log_{10} Length)$***	***0.98***
	3	Feb/Mar	-	-	-	-
		Jul	7	355-471	$Log_{10}Weight = -3.73 + 2.63 (Log_{10}Length)$	0.94
		Aug	53	243-480	$Log_{10}Weight = -3.48 + 2.54 (Log_{10}Length)$	0.94
		Sep	6	156-447	$Log_{10}Weight = -4.32 + 2.86 (Log_{10}Length)$	1.00
		Jul-Sep	***66***	***156-480***	***$Log_{10} Weight = -3.88 + 2.69 (Log_{10} Length)$***	***0.97***
	3a	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	RR	***Jul-Sep***	***120***	***122-480***	***$Log_{10} Weight = -4.69 + 3.00 (Log_{10} Length)$***	***0.97***
	4	Feb/Mar	-	-	-	-
		Jul	7	260-435	$Log_{10}Weight = -3.45 + 2.52 (Log_{10}Length)$	0.96
		Aug	7	355-420	$Log_{10}Weight = -1.38 + 1.70 (Log_{10}Length)$	0.85
		Sep	4	349-448	$Log_{10}Weight = -2.91 + 2.32 (Log_{10}Length)$	0.93
		Jul-Sep	***18***	***260-448***	***$Log_{10} Weight = -3.18 + 2.41 (Log_{10} Length)$***	***0.93***
	5	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	AR	***Jul-Sep***	***18***	***260-448***	***$Log_{10} Weight = -3.18+ 2.41 (Log_{10} Length)$***	***0.93***

Table A6.15. Weight-length relationships for sauger captured in the Red and Assiniboine rivers, 1999.

Species	Zone	Month	n	Range (mm)	Weight-Length Equation	r^2
Sauger	1a	Feb/Mar	-	-	-	-
		Jul	2	222-254	$Log_{10}Weight = -5.01 + 3.01 (Log_{10}Length)$	1.00
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***2***	***222-254***	$\boldsymbol{Log_{10} Weight = -5.01 + 3.01 (Log_{10} Length)}$	***1.00***
	1	Feb/Mar	5	225-272	$Log_{10}Weight = -9.23 + 4.77 (Log_{10}Length)$	0.76
		Jul	1	279	-	-
		Aug	-	-	-	-
		Sep	20	233-345	$Log_{10}Weight = -2.95 + 2.17 (Log_{10}Length)$	0.86
		Jul-Sep	***21***	***233-345***	$\boldsymbol{Log_{10} Weight = -2.94 + 2.17 (Log_{10} Length)}$	***0.85***
	2	Feb/Mar	2	238-263	$Log_{10}Weight = -5.91 + 3.36 (Log_{10}Length)$	1.00
		Jul	4	209-273	$Log_{10}Weight = -8.12 + 4.25 (Log_{10}Length)$	0.93
		Aug	67	222-350	$Log_{10}Weight = -3.03 + 3.21 (Log_{10}Length)$	0.74
		Sep	34	175-308	$Log_{10}Weight = -5.19 + 3.10 (Log_{10}Length)$	0.86
		Jul-Sep	***105***	***175-350***	$\boldsymbol{Log_{10} Weight = -4.71 + 2.89 (Log_{10} Length)}$	***0.80***
	3	Feb/Mar	-	-	-	-
		Jul	15	139-343	$Log_{10}Weight = -4.20 + 2.66 (Log_{10}Length)$	0.86
		Aug	102	228-350	$Log_{10}Weight = -2.91 + 2.21 (Log_{10}Length)$	0.77
		Sep	35	175-334	$Log_{10}Weight = -5.63 + 3.27 (Log_{10}Length)$	0.83
		Jul-Sep	***152***	***139-350***	$\boldsymbol{Log_{10} Weight = -5.51 + 3.26 (Log_{10} Length)}$	***0.81***
	3a	Feb/Mar	12	277-305	$Log_{10}Weight = -5.71 + 3.27 (Log_{10}Length)$	0.86
		Jul	5	216-240	$Log_{10}Weight = -8.21 + 4.37 (Log_{10}Length)$	0.70
		Aug	-	-	-	-
		Sep	116	194-403	$Log_{10}Weight = -4.23 + 2.73 (Log_{10}Length)$	0.94
		Jul-Sep	***121***	***194-403***	$\boldsymbol{Log_{10} Weight = -4.48 + 2.83 (Log_{10} Length)}$	***0.93***
	RR	***Jul-Sep***	***401***	***139-403***	$\boldsymbol{Log_{10} Weight = -4.86 + 2.98 (Log_{10} Length)}$	***0.81***
	4	Feb/Mar	-	-	-	-
		Jul	15	191-300	$Log_{10}Weight = -1.34 + 1.48 (Log_{10}Length)$	0.56
		Aug	7	272-332	$Log_{10}Weight = -4.26 + 2.74 (Log_{10}Length)$	0.85
		Sep	58	196-329	$Log_{10}Weight = -5.01 + 3.03 (Log_{10}Length)$	0.88
		Jul-Sep	***80***	***191-332***	$\boldsymbol{Log_{10} Weight = -4.47 + 2.81 (Log_{10} Length)}$	***0.82***
	5	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	AR	***Jul-Sep***	***80***	***191-332***	$\boldsymbol{Log_{10} Weight = -4.47 + 2.81 (Log_{10} Length)}$	***0.82***

Table A6.16. Weight-length relationships for shorthead redhorse captured in the Red and Assiniboine rivers, 1999.

Species	Zone	Month	n	Range (mm)	Weight-Length Equation	r^2
Shorthead redhorse	1a	Feb/Mar	-	-	-	-
		Jul	1	301	-	-
		Aug	-	-	-	-
		Sep	1	243	-	-
		Jul-Sep	***2***	***272***	***-***	***-***
	1	Feb/Mar	-	-	-	-
		Jul	1	340	-	-
		Aug	-	-	-	-
		Sep	3	308-436	$Log_{10}Weight = -3.95 + 2.65 (Log_{10}Length)$	0.99
		Jul-Sep	***4***	***308-436***	$\boldsymbol{Log_{10}Weight = -4.10 + 2.71 (Log_{10}Length)}$	***0.99***
	2	Feb/Mar	-	-	-	-
		Jul	8	246-380	$Log_{10}Weight = -4.95 + 3.04 (Log_{10}Length)$	0.98
		Aug	8	275-414	$Log_{10}Weight = -3.44 + 2.46 (Log_{10}Length)$	0.86
		Sep	25	304-407	$Log_{10}Weight = -4.64 + 2.91 (Log_{10}Length)$	0.86
		Jul-Sep	***41***	***246-414***	$\boldsymbol{Log_{10}Weight = -4.46 + 2.93 (Log_{10}Length)}$	***0.92***
	3	Feb/Mar	-	-	-	-
		Jul	12	200-437	$Log_{10}Weight = -4.84 + 2.99 (Log_{10}Length)$	0.98
		Aug	10	343-389	$Log_{10}Weight = -3.59 + 2.51 (Log_{10}Length)$	0.66
		Sep	18	246-415	$Log_{10}Weight = -4.11 + 2.72 (Log_{10}Length)$	0.88
		Jul-Sep	***40***	***200-437***	$\boldsymbol{Log_{10}Weight = -4.58 + 2.90 (Log_{10}Length)}$	***0.93***
	3a	Feb/Mar	2	180-420	$Log_{10}Weight = -5.71 + 3.36 (Log_{10}Length)$	1.00
		Jul	1	395	-	-
		Aug	-	-	-	-
		Sep	2	346-394	-	-
		Jul-Sep	***3***	***346-395***	$\boldsymbol{Log_{10}Weight = -3.75 + 2.59 (Log_{10}Length)}$	***0.86***
	RR	***Jul-Sep***	***90***	***200-437***	$\boldsymbol{Log_{10}Weight = -4.60 + 2.90 (Log_{10}Length)}$	***0.93***
	4	Feb/Mar	-	-	-	-
		Jul	58	199-450	$Log_{10}Weight = -4.50 + 2.86 (Log_{10}Length)$	0.81
		Aug	21	273-403	$Log_{10}Weight = -2.86 + 2.22 (Log_{10}Length)$	0.71
		Sep	162	229-437	$Log_{10}Weight = -3.68 + 2.54 (Log_{10}Length)$	0.89
		Jul-Sep	***241***	***199-450***	$\boldsymbol{Log_{10}Weight = -3.91 + 2.63 (Log_{10}Length)}$	***0.84***
	5	Feb/Mar	-	-	-	-
		Jul	12	316-375	$Log_{10}Weight = -6.88 + 3.79 (Log_{10}Length)$	0.68
		Aug	-	-	-	-
		Sep	9	196-390	$Log_{10}Weight = -3.71 + 2.56 (Log_{10}Length)$	0.97
		Jul-Sep	***21***	***196-390***	$\boldsymbol{Log_{10}Weight = -3.72 + 2.55 (Log_{10}Length)}$	***0.87***
	AR	***Jul-Sep***	***262***	***196-450***	$\boldsymbol{Log_{10}Weight = -3.88 + 2.62 (Log_{10}Length)}$	***0.84***

Table A6.17. Weight-length relationships for silver redhorse captured in the Red and Assiniboine rivers, 1999.

Species	Zone	Month	n	Range (mm)	Weight-Length Equation	r^2
Silver redhorse	1a	Feb/Mar	-	-	-	-
		Jul	1	435	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***1***	***435***	***-***	***-***
	1	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	1	174	-	-
		Jul-Sep	***1***	***174***	***-***	***-***
	2	Feb/Mar	-	-	-	-
		Jul	4	310-448	$Log_{10}Weight = -5.29 + 3.18 (Log_{10}Length)$	0.98
		Aug	-	-	-	-
		Sep	2	170-373	$Log_{10}Weight = -4.84 + 3.01 (Log_{10}Length)$	1.00
		Jul-Sep	***6***	***170-448***	$\boldsymbol{Log_{10} Weight = -4.91 + 3.03 (Log_{10} Length)}$	***0.99***
	3	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	1	317	-	-
		Jul-Sep	***1***	***317***	***-***	***-***
	3a	Feb/Mar	-	-	-	-
		Jul	2	478-520	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***2***	***470-520***	***-***	***-***
	RR	***Jul-Sep***	***11***	***170-520***	$\boldsymbol{Log_{10} Weight = -5.41 + 3.23 (Log_{10} Length)}$	***0.98***
	4	Feb/Mar	-	-	-	-
		Jul	6	380-498	$Log_{10}Weight = -3.59 + 2.54 (Log_{10}Length)$	0.97
		Aug	2	503-520	$Log_{10}Weight = -9.27 + 4.63 (Log_{10}Length)$	1.00
		Sep	1	486	-	-
		Jul-Sep	***9***	***380-520***	$\boldsymbol{Log_{10} Weight = -3.54 + 2.52 (Log_{10} Length)}$	***0.97***
	5	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	AR	***Jul-Sep***	***9***	***380-520***	$\boldsymbol{Log_{10} Weight = -3.54 + 2.52 (Log_{10} Length)}$	***0.97***

Table A6.18. Weight-length relationships for walleye captured in the Red and Assiniboine rivers, 1999.

Species	Zone	Month	n	Range (mm)	Weight-Length Equation	r^2
Walleye	1a	Feb/Mar	-	-	-	-
		Jul	1	470	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***1***	***470***	***-***	***-***
	1	Feb/Mar	1	680	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***1***	***680***	***-***	***-***
	2	Feb/Mar	-	-	-	-
		Jul	3	438-725	$Log_{10}Weight = -5.28 + 3.12 (Log_{10}Length)$	0.99
		Aug	12	310-603	$Log_{10}Weight = -4.48 + 2.82 (Log_{10}Length)$	0.98
		Sep	5	288-724	$Log_{10}Weight = -6.23 + 3.50 (Log_{10}Length)$	1.00
		Jul-Sep	***21***	***288-735***	$Log_{10}Weight = -5.18 + 3.07 (Log_{10}Length)$	***0.98***
	3	Feb/Mar	5	280-502	$Log_{10}Weight = -2.62 + 2.06 (Log_{10}Length)$	0.88
		Jul	4	151-615	$Log_{10}Weight = -4.75 + 2.94 (Log_{10}Length)$	0.99
		Aug	1	678	-	-
		Sep	4	103-485	$Log_{10}Weight = -3.92 + 2.61 (Log_{10}Length)$	0.98
		Jul-Sep	***9***	***103-678***	$Log_{10}Weight = -4.47 + 2.84 (Log_{10}Length)$	***0.99***
	3a	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	3	332-451	$Log_{10}Weight = -5.35 + 3.18 (Log_{10}Length)$	0.97
		Jul-Sep	***3***	***332-451***	$Log_{10}Weight = -5.35 + 3.18 (Log_{10}Length)$	***0.97***
	RR	***Jul-Sep***	***34***	***103-735***	$Log_{10}Weight = -4.53 + 2.85 (Log_{10}Length)$	***0.99***
	4	Feb/Mar	1	488	-	-
		Jul	6	277-750	$Log_{10}Weight = -6.06 + 3.41 (Log_{10}Length)$	0.99
		Aug	1	342	-	-
		Sep	4	183-412	$Log_{10}Weight = -3.91 + 2.59 (Log_{10}Length)$	0.99
		Jul-Sep	***11***	***183-750***	$Log_{10}Weight = -5.19 + 3.10 (Log_{10}Length)$	***0.98***
	5	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	AR	***Jul-Sep***	***11***	***183-750***	$Log_{10}Weight = -5.19 + 3.10 (Log_{10}Length)$	***0.98***

Table A6.19. Weight-length relationships for white sucker captured in the Red and Assiniboine rivers, 1999.

Species	Zone	Month	n	Range (mm)	Weight-Length Equation	r^2
White sucker	1a	Feb/Mar	-	-	-	-
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***-***	***-***	***-***	***-***
	1	Feb/Mar	4	360-418	$Log_{10}Weight = -6.65 + 3.70 (Log_{10}Length)$	0.88
		Jul	1	335	-	-
		Aug	-	-	-	-
		Sep	4	358-460	$Log_{10}Weight = -4.87 + 3.02 (Log_{10}Length)$	0.98
		Jul-Sep	***5***	***335-460***	$\boldsymbol{Log_{10} Weight = -5.58 + 3.26 (Log_{10} Length)}$	***0.97***
	2	Feb/Mar	1	322	-	-
		Jul	14	246-405	$Log_{10}Weight = -5.53 + 3.27 (Log_{10}Length)$	0.95
		Aug	5	255-445	$Log_{10}Weight = -3.76 + 2.58 (Log_{10}Length)$	0.97
		Sep	37	265-463	$Log_{10}Weight = -5.79 + 3.37 (Log_{10}Length)$	0.92
		Jul-Sep	***56***	***246-463***	$\boldsymbol{Log_{10} Weight = -5.27 + 3.17 (Log_{10} Length)}$	***0.94***
	3	Feb/Mar	-	-	-	-
		Jul	40	192-408	$Log_{10}Weight = -4.71 + 2.94 (Log_{10}Length)$	0.94
		Aug	31	280-483	$Log_{10}Weight = -3.87 + 2.64 (Log_{10}Length)$	0.86
		Sep	37	342-722	$Log_{10}Weight = -4.64 + 2.93 (Log_{10}Length)$	0.79
		Jul-Sep	***108***	***192-483***	$\boldsymbol{Log_{10} Weight = -4.86 + 3.01 (Log_{10} Length)}$	***0.89***
	3a	Feb/Mar	24	298-470	$Log_{10}Weight = -5.16 + 3.10 (Log_{10}Length)$	0.95
		Jul	-	-	-	-
		Aug	-	-	-	-
		Sep	3	385-457	$Log_{10}Weight = -2.76 + 2.23 (Log_{10}Length)$	0.96
		Jul-Sep	***3***	***385-457***	$\boldsymbol{Log_{10}Weight = -2.76 + 2.23 (Log_{10}Length)}$	***0.96***
	RR	***Jul-Sep***	***173***	***192-483***	$\boldsymbol{Log_{10} Weight = -5.13 + 3.11 (Log_{10} Length)}$	***0.91***
	4	Feb/Mar	-	-	-	-
		Jul	16	216-440	$Log_{10}Weight = -4.43 + 2.83 (Log_{10}Length)$	0.98
		Aug	4	335-400	$Log_{10}Weight = -5.50 + 3.26 (Log_{10}Length)$	0.97
		Sep	22	348-413	$Log_{10}Weight = -4.47 + 2.86 (Log_{10}Length)$	0.74
		Jul-Sep	***42***	***216-440***	$\boldsymbol{Log_{10} Weight = -4.65 + 2.93 (Log_{10} Length)}$	***0.95***
	5	Feb/Mar	-	-	-	-
		Jul	2	330-400	$Log_{10}Weight = -5.35 + 3.19 (Log_{10}Length)$	1.00
		Aug	-	-	-	-
		Sep	-	-	-	-
		Jul-Sep	***2***	***330-400***	$\boldsymbol{Log_{10} Weight = -5.35 + 3.19 (Log_{10} Length)}$	***1.00***
	AR	***Jul-Sep***	***44***	***216-440***	$\boldsymbol{Log_{10} Weight = -4.67 + 2.93 (Log_{10} Length)}$	***0.94***

APPENDIX 7

Age-specific mean length, weight and relative condition factor (K) for selected species captured in the Red and Assiniboine rivers, 1999.

Table A7.1. Age-specific mean length, weight, and relative condition factor (K) for carp captured in the Red and Assiniboine rivers, 1999.

		Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Age (yrs)**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Carp	1	-	-	-	-	-	-	-	-	-	-	-	-
	2	1	195	-	-	1	200	-	-	1	2.69	-	-
	3	6	326	51	266-388	6	765	340	400-1290	6	2.10	0.13	1.89-2.27
	4	2	336	31	310-361	2	825	177	700-950	2	2.18	0.23	2.01-2.35
	5	6	447	34	408-447	6	1645	219	1350-1925	6	1.85	0.18	1.60-2.01
	6	3	481	58	415-514	3	2317	988	1350-3325	3	2.00	0.39	1.67-2.45
	7	3	498	51	449-556	3	2367	651	1700-3000	3	1.89	0.16	1.74-2.07
	8	5	504	46	459-578	5	2450	677	1700-3500	5	1.88	0.14	1.76-2.11
	9	12	526	32	468-567	12	2685	481	2100-3600	12	1.84	0.19	1.51-2.07
	10	4	521	48	478-578	4	2782	703	2300-3800	4	1.95	0.19	1.68-2.12
	11	6	566	38	512-605	6	3495	869	2150-4500	6	1.89	0.15	1.60-2.03
	12	2	550	25	532-568	2	3225	883	2600-3850	2	1.91	0.26	1.72-2.10
	13	2	633	110	555-771	2	4625	1308	3700-5550	2	1.85	0.44	1.54-2.16
	14	2	644	23	628-660	2	4850	636	4400-5300	2	1.81	0.05	1.77-1.84
	15	4	626	19	610-650	4	5738	1886	4300-8500	4	2.30	0.53	1.89-3.09
	16	-	-	-	-	-	-	-	-	-	-	-	-
	17	1	575	-	-	1	4150	-	-	1	2.18	-	-
	All	***59***	***501***	***102***	***195-711***	***59***	***2714***	***1489***	***200-8500***	***59***	***1.96***	***0.27***	***1.51-3.10***

Table A7.2. Age-specific mean length, weight, and relative condition factor (K) for channel catfish captured in the Red and Assiniboine rivers, 1999.

		Length (mm)				Weight (g)				Condition Factor (K)			
Species	Age (yrs)	n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Channel catfish	1	-	-	-	-	-	-	-	-	-	-	-	-
	2	4	182	45	123-233	4	113	66	50-200	4	1.83	0.59	1.31-2.69
	3	12	230	58	173-327	12	216	171	25-500	12	1.49	0.64	0.42-2.90
	4	2	288	54	249-326	2	400	141	300-500	2	1.63	0.35	1.44-1.94
	5	1	320	-	-	1	500	-	-	1	1.52	-	-
	6	1	310	-	-	1	500	-	-	1	1.67	-	-
	7	3	379	19	261-398	3	650	87	600-750	3	1.21	0.23	0.95-1.39
	8	1	391	-	-	1	900	-	-	1	1.51	-	-
	9	6	475	61	413-585	6	1541	785	900-3050	6	1.34	0.09	1.26-1.52
	10	15	490	44	432-598	15	1653	519	1000-3050	15	1.37	0.17	1.03-1.84
	11	13	513	43	460-604	13	1919	580	1200-3000	13	1.37	0.10	1.23-1.61
	12	15	573	68	472-709	15	3000	1285	1500-5900	15	1.51	0.13	1.19-1.74
	13	9	606	41	545-658	9	3344	974	2100-4900	9	1.46	0.19	1.26-1.89
	14	8	661	74	552-785	8	4568	1511	2200-7000	8	1.53	0.16	1.30-1.69
	15	6	711	61	636-820	6	6033	2667	3750-11000	6	1.59	0.26	1.23-1.99
	16	7	682	48	620-748	7	4621	1123	3300-5900	7	1.44	0.17	1.20-1.65
	17	3	737	43	702-785	3	5900	600	5300-6500	3	1.48	0.12	1.34-1.56
	18	3	741	44	698-785	3	6058	1692	4300-7675	3	1.46	0.17	1.26-1.59
	All	***109***	***512***	***166***	***123-820***	***109***	***2594***	***2076***	***25-11000***	***109***	***1.46***	***0.29***	***0.42-2.90***

Table A7.3. Age-specific mean length, weight, and relative condition factor (K) for freshwater drum captured in the Red and Assiniboine rivers, 1999.

		Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Age (yrs)**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Freshwater drum	1	-	-	-	-	-	-	-	-	-	-	-	-
	2	6	260	23	237-292	6	265	82	200-400	6	1.49	0.23	1.07-1.85
	3	4	276	19	259-297	4	331	80	275-450	4	1.57	0.21	1.27-1.73
	4	1	293	-	-	1	300	-	-	1	1.19	-	-
	5	7	357	23	332-393	7	615	154	450-850	7	1.34	0.19	0.98-1.53
	6	10	370	59	310-525	10	728	442	325-1925	10	1.33	0.14	1.09-1.49
	7	13	379	30	341-432	13	707	207	450-1150	13	1.27	0.17	0.99-1.52
	8	12	377	32	313-437	12	765	218	375-1250	12	1.40	0.17	1.21-1.70
	9	9	395	60	340-526	9	903	487	550-2050	9	1.37	0.13	1.13-1.56
	10	4	446	38	395-486	4	1190	308	850-1550	4	1.32	0.08	1.19-1.38
	11	4	448	32	419-472	4	1300	349	800-1600	4	1.42	0.26	1.09-1.70
	12	3	477	54	428-554	3	1613	628	1100-2500	3	1.47	0.16	1.32-1.70
	13	2	467	47	433-500	2	1225	389	950-1500	2	1.19	0.02	1.17-1.20
	14	2	492	19	478-505	2	1588	124	1500-1675	2	1.34	0.05	1.30-1.37
	15	-	-	-	-	-	-	-	-	-	-	-	-
	16	1	448	-	-	1	1100	-	-	1	1.22	-	-
	All	***102***	***387***	***69***	***196-554***	***102***	***863***	***470***	***100-2500***	***102***	***1.36***	***0.17***	***0.98-1.85***

Table A7.4. Age-specific mean length, weight, and relative condition factor (K) for goldeye captured in the Red and Assiniboine rivers, 1999.

		Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Age (yrs)**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Goldeye	1	12	112	9	96-125	-	-	-	-	-	-	-	-
	2	38	173	28	110-243	31	62	38	20-150	31	1.00	0.43	0.48-2.57
	3	22	229	21	192-258	22	166	49	75-250	22	1.36	0.29	0.72-2.02
	4	13	254	30	209-292	13	208	95	75-375	13	1.21	0.35	0.51-1.88
	5	7	283	21	268-316	7	296	99	175-400	7	1.27	0.32	0.88-1.94
	6	4	301	7	295-308	4	331	24	300-350	4	1.22	0.11	1.11-1.36
	7	2	284	47	250-317	2	313	194	175-450	2	1.27	0.20	1.12-1.40
	8	2	303	1	302-303	2	288	88	225-350	2	1.04	0.31	0.81-1.26
	9	-	-	-	-	-	-	-	-	-	-	-	-
	10	1	316	-	-	1	375	-	-	1	1.18	-	-
	All	***101***	***207***	***60***	***96-317***	***82***	***162***	***111***	***20-450***	***82***	***1.18***	***0.38***	***0.48-2.57***

Table A7.5. Age-specific mean length, weight, and relative condition factor (K) for northern pike captured in the Red and Assiniboine rivers, 1999.

		Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Age (yrs)**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Northern pike	1	-	-	-	-	-	-	-	-	-	-	-	-
	2	5	334	139	218-565	3	133	58	100-200	3	0.51	0.06	0.44-0.57
	3	3	343	33	312-378	3	333	144	250-500	3	0.79	0.14	0.63-0.93
	4	13	430	98	243-643	12	596	543	150-2250	12	0.71	0.19	0.41-1.05
	5	5	611	131	483-809	4	2300	1832	825-4850	4	0.80	0.07	0.73-0.92
	6	1	691	-	-	1	2900	-	-	1	0.87	-	-
	7	4	690	83	630-811	4	2987	1456	2000-5150	4	0.86	0.08	0.79-0.97
	8	2	674	66	627-720	2	2770	1131	1900-3500	2	0.85	0.12	0.77-0.94
	9	1	709	-	-	1	3500	-	-	1	0.98	-	-
	10	-	-	-	-	-	-	-	-	-	-	-	-
	11	-	-	-	-	-	-	-	-	-	-	-	-
	12	1	670	-	-	1	2450	-	-	1	0.81	-	-
	All	***40***	***510***	***164***	***218-811***	***35***	***1477***	***1365***	***100-5150***	***35***	***0.75***	***0.16***	***0.41-1.04***

Table A7.6. Age-specific mean length, weight, and relative condition factor (K) for sauger captured in the Red and Assiniboine rivers, 1999.

Species	Age (yrs)	Length (mm)				Weight (g)				Condition Factor (K)			
		n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Sauger	1	-	-	-	-	-	-	-	-	-	-	-	-
	2	16	237	23	195-266	16	185	60	50-250	16	1.33	0.27	0.64-1.76
	3	67	272	32	139-355	67	264	83	25-475	67	1.27	0.20	0.77-1.81
	4	23	294	29	240-350	23	312	95	200-525	23	1.21	0.18	0.93-1.50
	5	4	286	31	256-330	4	310	64	250-400	4	1.32	0.17	1.11-1.49
	All	***110***	***272***	***34***	***139-350***	***110***	***264***	***89***	***139-350***	***110***	***1.28***	***0.21***	***0.67-1.81***

Table A7.7. Age-specific mean length, weight, and relative condition factor (K) for shorthead redhorse captured in the Red and Assiniboine rivers, 1999.

		Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Zone**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
Shorthead redhorse	1	-	-	-	-	-	-	-	-	-	-	-	-
	2	2	190	14	180-200	2	88	18	75-100	2	1.26	0.03	1.25-1.29
	3	-	-	-	-	-	-	-	-	-	-	-	-
	4	5	271	21	246-292	5	290	74	200-400	5	1.44	0.14	1.32-1.60
	5	6	327	50	275-420	6	563	369	300-1300	6	1.45	0.15	1.35-1.75
	6	-	-	-	-	-	-	-	-	-	-	-	-
	7	3	369	28	352-402	3	733	236	550-1000	3	1.42	0.14	1.26-1.53
	8	-	-	-	-	-	-	-	-	-	-	-	-
	9	1	344	-	-	1	600	-	-	1	1.47	-	-
	10	3	383	48	342-437	3	800	229	600-1050	3	1.41	0.13	1.26-1.50
	11	-	-	-	-	-	-	-	-	-	-	-	-
	12	-	-	-	-	-	-	-	-	-	-	-	-
	13	-	-	-	-	-	-	-	-	-	-	-	-
	14	-	-	-	-	-	-	-	-	-	-	-	-
	15	1	380	-	-	1	750	-	-	1	1.37	-	-
	All	***21***	***318***	***67***	***180-437***	***21***	***521***	***316***	***75-1300***	***21***	***1.42***	***0.13***	***1.25-1.75***

Table A7.8. Age-specific mean length, weight, and relative condition factor (K) for walleye captured in the Red and Assiniboine rivers, 1999.

		Length (mm)				Weight (g)				Condition Factor (K)			
Species	Age (yrs)	n	Mean	SD	Range	n	Mean	SD	Range	n	Mean	SD	Range
Walleye	1	-	-	-	-	-	-	-	-	-	-	-	-
	2	2	149	4	146-151	2	50	-	-	2	1.53	0.11	1.45-1.61
	3	9	331	61	183-383	9	437	164	90-650	9	1.15	0.13	1.01-1.47
	4	13	346	74	206-502	13	498	265	100-1175	13	1.12	0.15	0.77-1.37
	5	6	418	69	288-488	6	860	452	225-1450	6	1.07	0.25	0.65-1.36
	6	1	277	-	-	1	135	-	-	1	0.82	-	-
	7	2	430	59	388-471	2	888	336	650-1125	2	1.09	0.03	1.07-1.11
	8	2	526	78	470-581	2	2013	1256	1125-2900	2	1.28	0.28	1.08-1.48
	9	2	648	46	615-680	2	3450	354	3200-3700	2	1.28	0.14	1.18-1.38
	10	2	730	7	724-735	2	5225	883	4600-5850	2	1.35	0.27	1.16-1.54
	11	-	-	-	-	-	-	-	-	-	-	-	-
	12	1	690	-	-	1	4300	-	-	1	1.31	-	-
	13	4	726	17	713-750	4	5031	380	4625-5500	4	1.32	0.11	1.22-1.46
	14	-	-	-	-	-	-	-	-	-	-	-	-
	15	-	-	-	-	-	-	-	-	-	-	-	-
	16	1	698	-	-	1	3900	-	-	1	1.15	-	-
	All	***47***	***434***	***169***	***146-750***	***47***	***1495***	***1743***	***50-5850***	***47***	***1.18***	***0.19***	***0.65-1.61***

Table A7.9. Age-specific mean length, weight, and relative condition factor (K) for white sucker captured in the Red and Assiniboine rivers, 1999.

		Length (mm)				Weight (g)				Condition Factor (K)			
Species	**Age (yrs)**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**	**n**	**Mean**	**SD**	**Range**
White sucker	1	-	-	-	-	-	-	-	-	-	-	-	-
	2	1	216	-	-	1	140	-	-	1	1.38	-	-
	3	7	316	56	246-405	7	471	240	175-900	7	1.39	0.21	1.18-1.81
	4	10	324	72	192-428	10	552	355	100-1200	10	1.43	0.13	1.30-1.70
	5	14	347	48	257-462	14	638	330	225-1600	14	1.42	0.08	1.30-1.62
	6	10	365	47	295-460	10	705	330	350-1500	10	1.38	0.18	0.98-1.54
	7	11	382	46	317-483	11	820	334	500-1600	11	1.42	0.12	1.23-1.60
	8	11	362	29	308-407	11	657	173	400-925	11	1.35	0.14	1.03-1.54
	9	7	378	22	343-400	7	768	123	550-950	7	1.42	0.09	1.34-1.62
	10	8	370	10	356-384	7	729	68	625-850	7	1.44	0.08	1.31-1.55
	11	4	382	20	365-408	4	775	95	700-900	4	1.38	0.05	1.33-1.43
	12	2	414	37	387-440	2	950	212	800-1100	2	1.34	0.06	1.29-1.38
	13	2	413	18	400-426	2	1063	194	925-1200	2	1.49	0.08	1.44-1.55
	14	-	-	-	-	-	-	-	-	-	-	-	-
	15	1	431	-	-	1	1200	-	-	1	1.49	-	-
	16	1	428	-	-	1	1250	-	-	1	1.59	-	-
	All	***89***	***360***	***51***	***192-483***	***88***	***702***	***301***	***100-1600***	***88***	***1.41***	***0.12***	***0.98-1.81***