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An evaluation of the Fairford Dam fishway, May-June, 1987, with observations on fish movements and sport fishing in the Fairford River.

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ABSTRACT

Between May 6 and June 12, 1987, a total of 8,871 fish passed through the Fairford Dam fishway. The majority (93%) of these fish were white sucker, walleye and sauger. The white suckers were on a spawning run and were the prominent species caught in the fishway trap. The bulk of the white suckers were caught during mid-day or the late afternoon. In contrast, most of the walleye and sauger were caught during the night or in the late afternoon or early evening.

Fish as small as 250 mm F.L. were captured in the fishway trap. The largest fish to negotiate the fishway were carp; some individuals exceeded 750 mm in length and 10 kg in weight. The lowest water velocities recorded in the fishway averaged approximately 0.7 $m.sec^{-1}$. These lower velocities were recorded near the bottom of the baffles in the fishway. Velocities at or exceeding 1.0 $m.sec^{-1}$ existed at the middle and upper portions of the water profile in the fishway. Fish probably used the zone of lowest water velocities in the fishway.

Walleye which moved through the Fairford fishway were recaptured throughout Lake Manitoba. The most common area of recovery was Portage Bay, which is just upstream of the Fairford Dam. A couple of fish, however, were recaptured as far south as Swan Creek in the south basin of Lake Manitoba and as far north as Waterhen Lake, the waterbody connecting Lake Winnipegosis and Lake Manitoba.

Angler catches of walleye and sauger from the Fairford River downstream of the dam generally reflected the proportion of walleye and sauger catches in the fishway trap.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

INTRODUCTION

The Fairford Dam at the outlet of Lake Manitoba was completed in 1961 and was constructed to maintain Lake Manitoba elevation between 247.19m (811 feet) and 247.80 (813 feet) ASL. The dam, which is part of a highway bridge, has 11 bays and discharge is regulated by removing or replacing concrete stoplogs in one or more of these bays. The difference in headwater and tailwater levels is dependent on discharge. At discharges of 30 m^3/s or less, the head at Fairford Dam may be in the order 2-3m. At flows of 300 m^3/s or more, there should be little or no difference in upstream or downstream water levels. Rating curves and design parameters for the Fairford Dam are presented in Appendix 1.

When Fairford Dam was constructed a type of fishway was incorporated in bay 9 (i.e. the third bay from the south bank). This fishway consisted merely of two concrete weirs each containing a 61x76 cm opening. Stoplogs could be placed on the upstream weir. There is no evidence to indicate that this fishway was ever effective in passing fish upstream. The fishway was particularly ineffective at low discharges, when tailwater levels were below the fishway entrance. There is also a possibility that flows through the portals of the fishway may have presented a velocity barrier to fish. Estimated water velocities through these openings were reported to about 2 m/s or greater. Because of the small size of these portals, fish may also have had difficulty finding them.

As early as 1963, commercial fishermen on lakes Manitoba and Winnipegosis expressed concerns that fish were leaving their lakes via the Fairford River and could not return because of the dam. Subsequent fish tagging studies on Lake Manitoba, Lake Winnipegosis and the Lake Waterhen area have never confirmed any significant movements of adult fish from these areas to the Fairford River. Nevertheless, the Canada Fisheries Act requires that any water control structure in an area containing significant fish populations be equipped with a functional fish passage device. Plans were drawn for a new fishway in 1970, but the fishway was never built. In 1974, a Denil-type fishway (Figure 1), was recommended by engineering personnel of the Canada Department of Fisheries. Design plans were completed and funds were allocated for construction. However, tenders exceeded the budgeted amounts and construction was consequently postponed.

In 1982, a new set of plans for the Fairford Dam fishway was drafted based on a preliminary design provided by C. Katapodis of the Canada Department of Fisheries and Oceans (Figure 2). The basic design also involved the Denil-type fishway, the hydraulic performance of which was evaluated in laboratory studies by Katapodis and Rajaratnam (1983). Since the fishway was designed to fit into the existing fishway bay of the dam, there was some concern that fish might have difficulty finding the entrance to the fishway. To alleviate this problem, an attraction water flume with a capacity of 3.0 m^3/s was placed along the side of the fishway. Construction of the fishway and flume was completed in the 1983/84 winter season. Both the fishway and flume are attached to a steel bulkhead which was designed to fit on the upstream weir in bay 9. Except for the baffles and control gates, the fishway and flume were constructed of chemically preserved plywood sheating and timbers. Use of wood materials greatly reduced the cost of the structure. The fishway

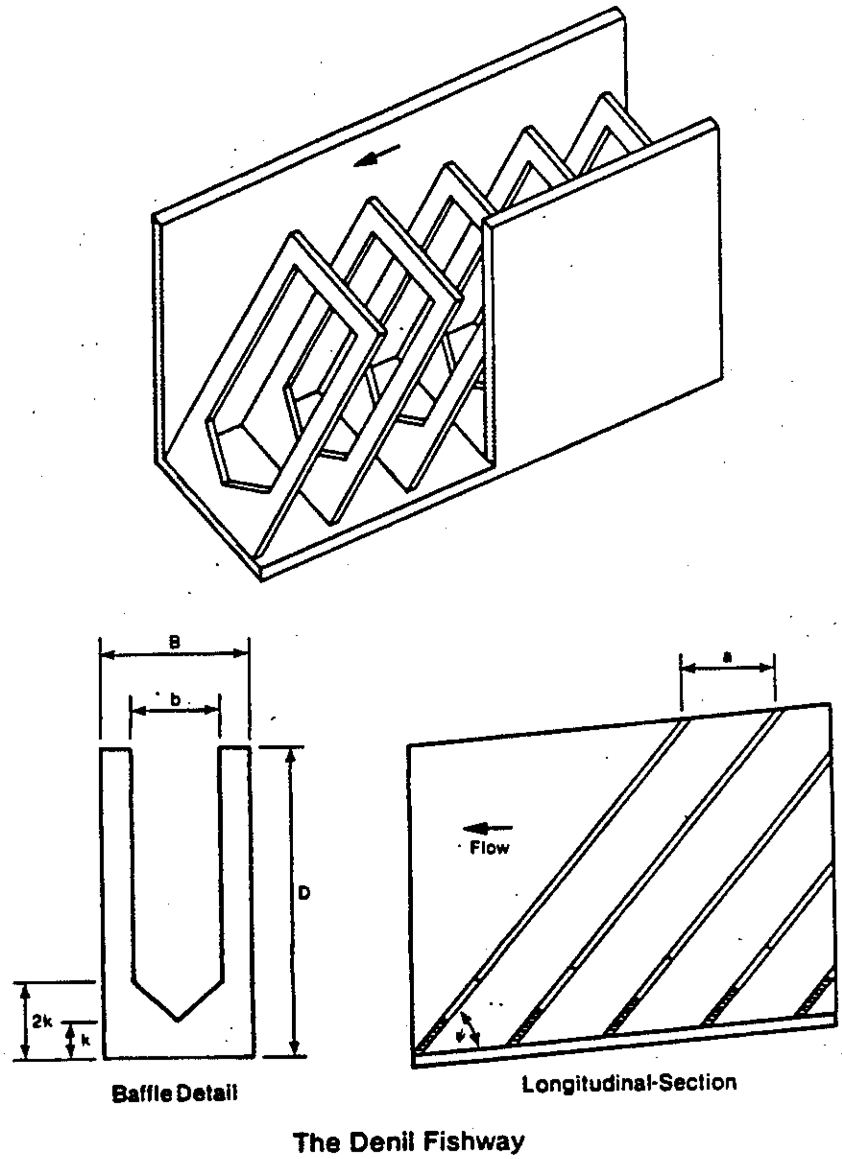

Figure 1: A schematic showing the basic design of a Denil fishway.

has two entrances, one leading into the first segment and a more elevated entrance which leads directly into the third segment. Both entrances are fitted with control gates so that under high tailwater conditions, the first and second segments of the fishway (see Figure 2) can be closed off by dropping the gate on the lower entrance and raising the gate on the higher entrance. Under this arrangement, fish may swim directly upstream through the third section of the fishway. A screened gate in resting pool B can also be swung into place to prevent fish from passing down segments 1 and 2 of the fishway. A more complete description of the Fairford fishway is given by Katapodis et al. (in prep.).

Preliminary assessments of the Fairford fishway were made between April 19 and May 30, and October 3-25, 1984, and from April 15-21, 1985 (D. Macdonald, unpublished data). These assessments were rather sporadic, but indicated that some hundreds of suckers and a few walleye used the fishway. Movements through the fishway were observed mainly during the spring. Relatively small numbers of fish were caught in the October 3-25 period. However, the fishway was only monitored sporadically on seven days.

The assessment of the Fairford fishway in 1987 did not begin until May 6. By this time water temperatures exceeded 10°C and spawning runs of fish were believed to be largely completed. Assessment could not begin earlier because of lack of manpower. The primary objectives of the Fairford fishway assessment were as follows:

1. To determine which fish species utilized the Fairford fishway.
2. To determine the extent to which the various species are successful in negotiating the fishway - i.e. the size range of fish passed by the fishway.

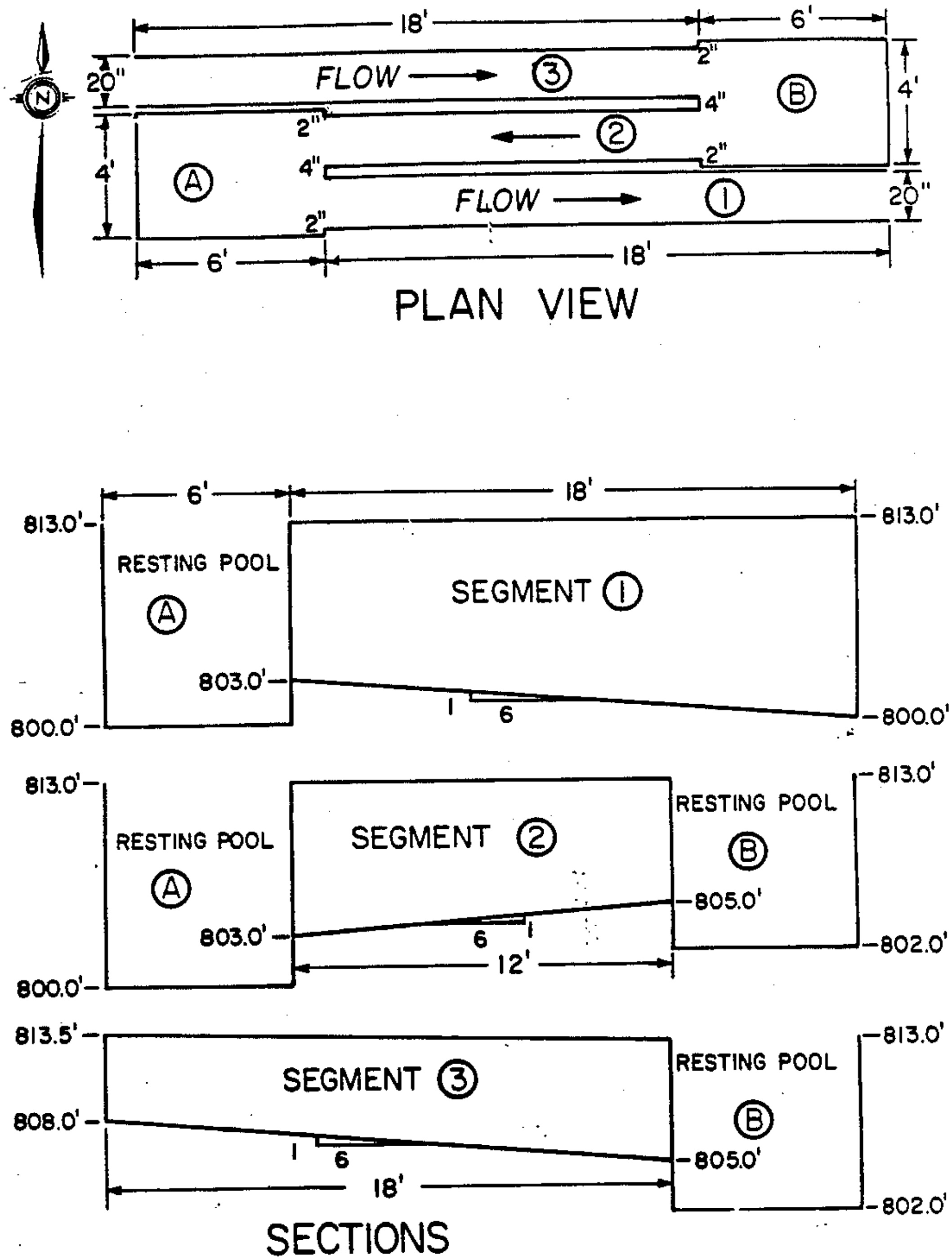

Figure 2: A schematic showing the preliminary design plan for the Fairford fishway. The upper sketch shows the plan view of the fishway. The lower sketches show the 3 sections of the fishway, and include dimensions, slopes and elevations.

3. To assess the hydraulic performance of the fishway and how it relates to the swimming capabilities of fish utilizing the fishway and to the flows in the Fairford River.

4. To determine the geographic distribution of commercially important species such as walleye, sauger and whitefish which move upstream through the fishway.

A secondary objective was to obtain some estimates of sport fishing effort and success in the Fairford River immediately below the dam.

METHODS

Fish movements through the fishway in the Fairford Dam were assessed on a daily basis during May 6-28 and June 2-12, 1987. Movements were monitored by capturing the fish in a trap fitted to the fishway exit. The trap consisted of a 1.27 x 1.59 x 1.93 m box constructed of two-by-fours and enclosed with a heavy gauge wire mesh (25 x 50 mm). The top of the trap had a hinged wire mesh cover to prevent fish from jumping out of the trap. The entrance to the trap was also fitted with a funnel extending the entire height of trap to prevent trapped fish from finding their way out. When the trap was lifted, the funnel was screened off to prevent fish from being washed out of the trap. The trap was lifted with a block and tackle suspended from the overhead steel beam used to manipulate the stoplogs in the dam. Except on three occasions, the trap was lifted and emptied at least 3 times per day; in the morning, early afternoon and evening. On May 6 and June 2, the fishway trap was installed by mid-afternoon and was lifted in the evening. On June 12, the trap was lifted in the morning and afternoon and then removed. On one occasion, there was evidence that the trap had been tampered with. Although the trap cover was always padlocked, the screen at one corner had been forced back. Some of the fish, especially walleye and sauger, may have been removed from the trap.

All fish species caught in the fishway trap were counted. The fork lengths of all walleye and sauger were measured to the nearest 1.0 mm. An attempt was made to tag as many walleye and sauger as possible using numbered Floy spaghetti tags. Toward the end of the assessment period when tags were in short supply, tagging was restricted to only walleye. Anglers and commercial fishermen were relied upon to voluntarily report tag recaptures. Because of the large numbers of white sucker caught on some days, subsamples of 50 fish were measured. Some lengths were also measured for other incidentally caught species (eg. cisco, carp, burbot, channel catfish, whitefish, and redhorse sucker). Length frequency histograms were plotted for only walleye, sauger, white sucker and cisco.

After each trap lift, water depths were determined at 10 locations within the fishway; these included 3 points in each section and one point at the fishway exit. The distances from the top of the fishway to the water surface were measured with a metric carpenter's tape and these measurements were converted to water depths based upon the known dimensions of the fishway. Upstream and downstream water elevations from staff gauges affixed to the dam were recorded after each trap lift. Water temperatures within the fishway were also measured using a maximum-minimum thermometer. Water and air temperature data are presented in Appendix II. Daily discharge records for the Fairford River were obtained from the Water Resources Branch, Manitoba Department of Natural Resources and the Inland Waters Branch of Environment Canada.

The creel census information gathered consisted of the number of shore and boat fishermen observed on a weekend or week day. Randomly selected anglers were interviewed and asked how long they had fished and how many fish they caught. Any fish they caught were weighed, measured and structures such as otoliths and pectoral fin rays were taken for age determinations.

RESULTS AND DISCUSSION

Fishway Evaluation

A total of 8,871 fish, representing 13 species, were captured moving through the Fairford Dam fishway (Table 1). White sucker, walleye and sauger made up 93% of the run and over half of all fish caught were white sucker. These 3 species, along with cisco, shorthead redhorse and carp, constituted almost 100% of catch. Observations of catches made by anglers fishing downstream of the dam indicated some northern pike and yellow perch were in the river. These species, however, were not observed moving through the fishway.

The largest daily catch of white sucker occurred on May 7 (Figure 3). This catch is believed to have been part of a spawning run as most individuals were in ripe condition; eggs and milt could be expressed easily with slight pressure. After the end of May, very few white sucker were caught. The lack of sucker movements in June may have been due to the higher water temperatures (Figure 4) which curtailed the spawning run.

Although some sexually ripe individuals were observed among the walleye and sauger, the movement of these species through the fishway was not driven by spawning urges. By the time the fishway assessment began, water temperatures had exceeded the upper limit required for the spawning of these species (Figure 4). The daily catches of both walleye and sauger were relatively low during the first part of May compared to later catches. Particularly poor catches were made on May 15 and 16. On these dates the entrance to the lowermost section of the fishway was

Table 1: Species and numbers of fish captured moving through the Fairford dam fishway May 6-June 12, 1987.

Species	Number
White sucker (Catostomus commersoni)	5032
Walleye (Stizostedion vitreum)	2313
Sauger (Stizostedion canadense)	907
Cisco (Coregonus artedii)	352
Shorthead redhorse (Moxostoma macrolepidotum)	175
Carp (Cyprinus carpio)	79
Burbot (Lota lota)	4
Lake whitefish (Coregonus clupeaformis)	3
Freshwater drum (Aplodinotus grunniens)	2
Channel catfish (Ictalurus punctatus)	1
Silver redhorse (Moxostoma anisurum)	1
Quillback sucker (Carpiodes cyprinus)	1
Longnose sucker (Catostomus catostomus)	1
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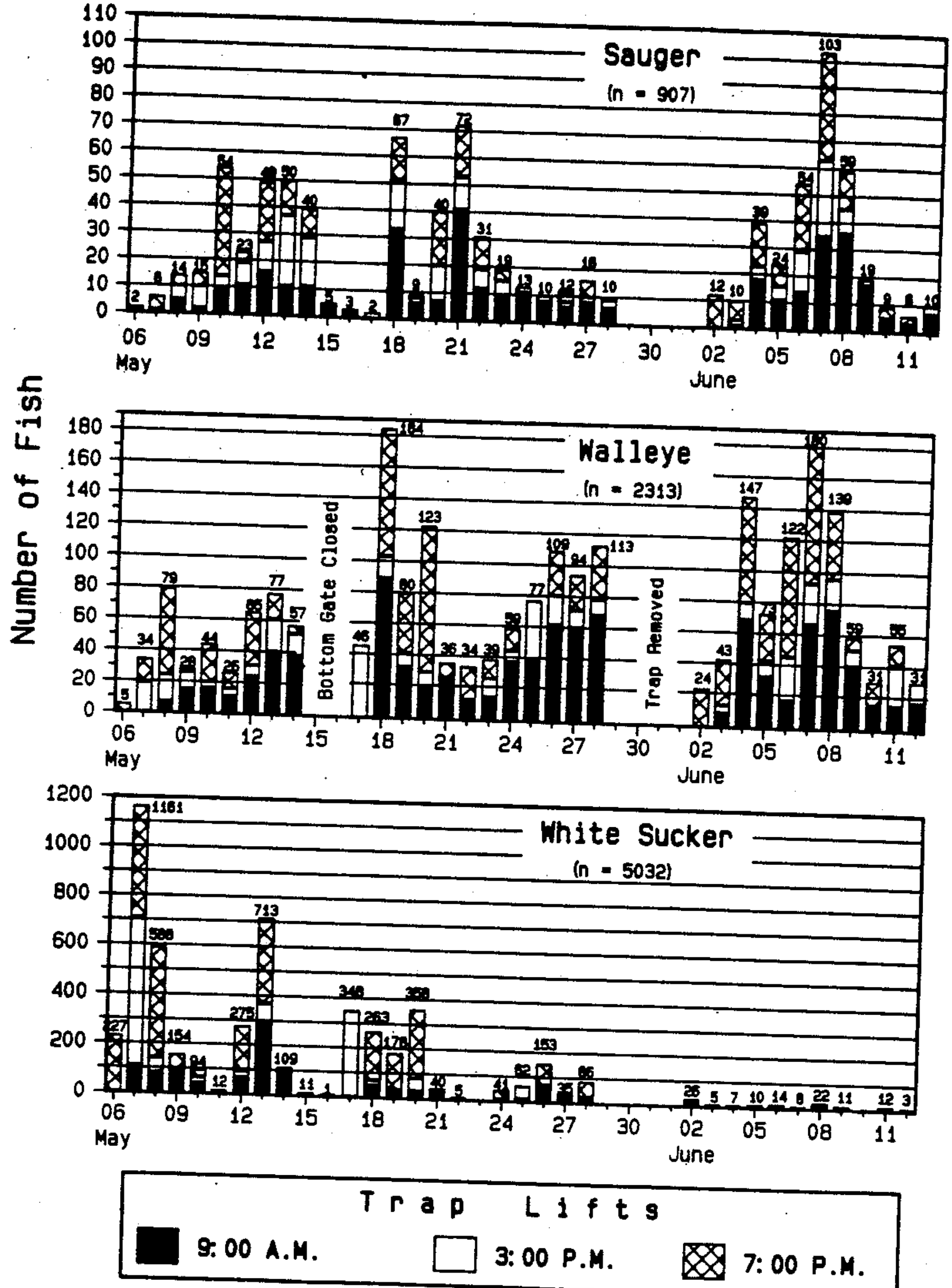

Fig. 3. Catch record for the Fairford fishway (May 6 - June 12, 1987)

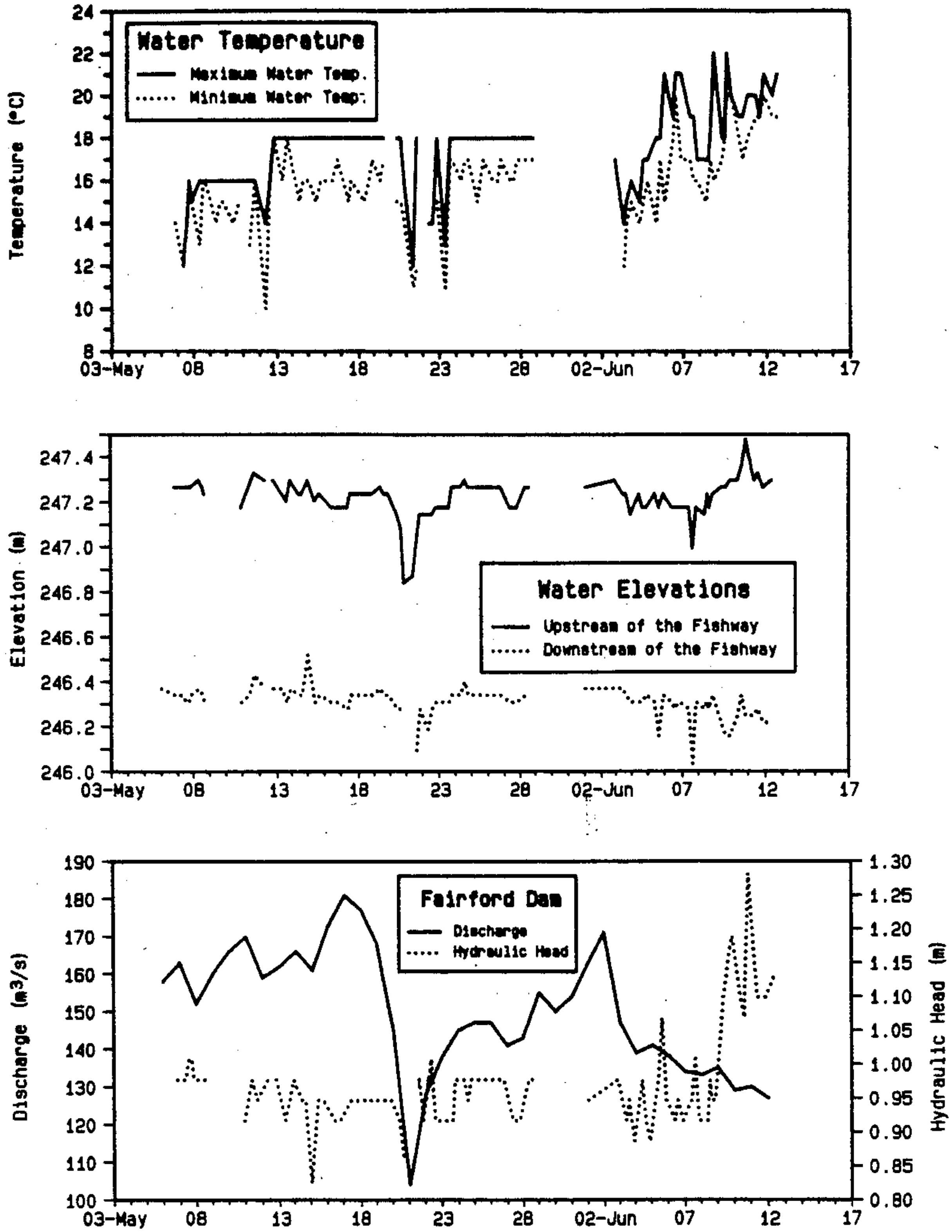

Fig. 5. Physical variables from measurements at Fairford Dam (May 6 to June 12, 1987).

closed and fish were required to negotiate only the upper section. This alteration did not appear to have any significant effect on either the depth of water or velocities within the fishway (Figure 5), and therefore should not have presented a deterrent to fish movements through the fishway. The poor catches were rather a reflection of the natural fluctuations in fish movements.

An interesting phenomenon occurred around May 21. Strong northerly winds on May 20 and 21 accompanied by low temperatures, resulted in a marked seiche on Lake Manitoba and significant drops in water levels and discharge at Fairford Dam (Figure 4). A drop in water temperatures also occurred at the same time (Figure 4). This event resulted in a substantial drop in water levels, discharges and water velocities in the fishway on May 21-22. The reduced water velocities in the fishway, however, did not result in appreciable increases in fish passage through the fishway. To the contrary, except for the sauger on May 21, catches of walleye and sauger during the low flow period tended to drop off (Figure 3). Sauger catches continued to decline up until the fishway trap was removed on May 28, but walleye catches improved from May 23-28.

Good catches of both walleyes and sauger, indicating increased upstream movement, were made for approximately a week after the fishway trap had been re-installed on June 2 (Figure 3). These movements may have been stimulated by the June 3 peak in discharges at Fairford Dam (Figure 4). Daily catches of white sucker in June were negligible in comparison to those made during May.

Peak movments of cisco were observed in May 11; on this date

F a i r f o r d (1987)

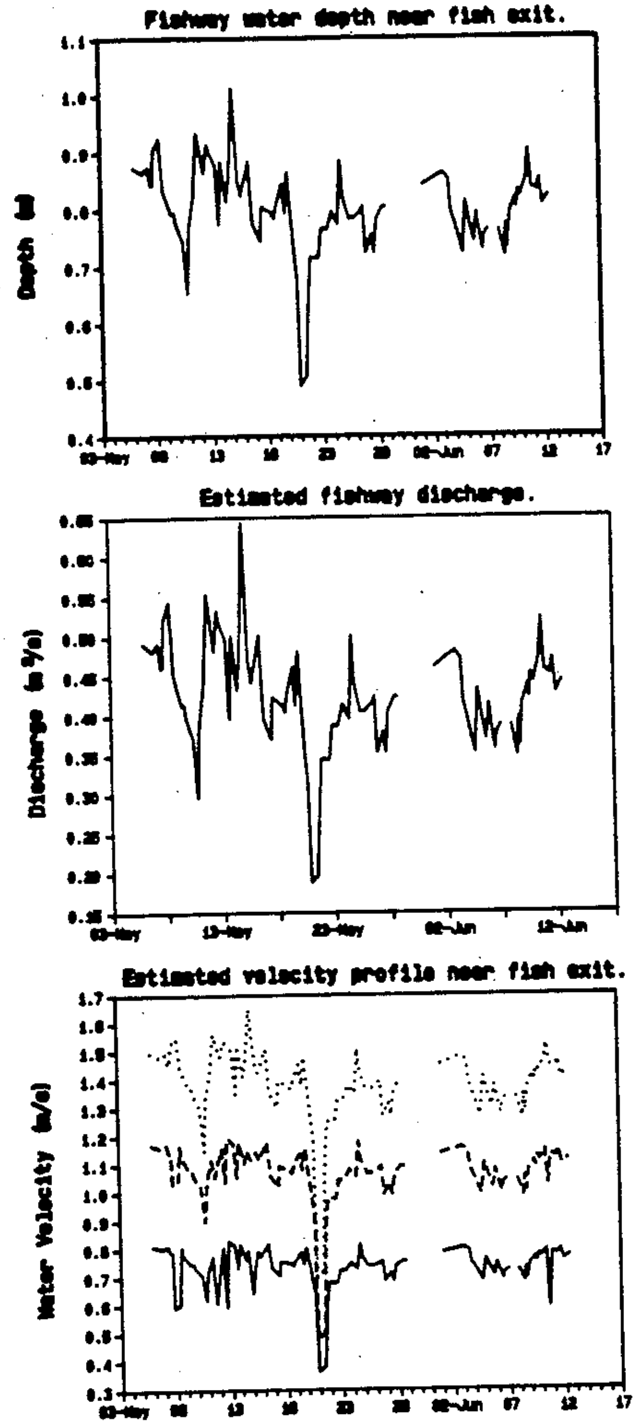

Fig.5 . Depths, discharges and velocities for the Fairford fishway .

102 individuals were caught in the fishway trap. A second peak was noted on May 22. These peaks coincided with relatively poor catches of walleye, sauger and white sucker. Greater numbers of cisco may have passed through the fishway than were observed. Many of the cisco caught in the trap were wedged in the wire mesh. This suggests that slightly smaller fish may have been able to squeeze through the wire mesh of the trap.

Shorthead redhorse suckers were caught moving through the fishway primarily during the latter part of May and early June. Approximately two-thirds of the carp caught in the Fairford Dam fishway were caught in June. Average water temperatures in the Fairford River at this time approached 17°C, which is the optimum spawning temperature for carp. The catches of all other species in the fishway trap were too small and spordic to discern any pattern in movements.

Over 80% of the walleye which utilized the Fairford fishway ranged in size from 300 to 400 mm F.L. (Figure 6). Relatively small numbers of walleye less than 250 mm or greater than 500 mm were observed. A similar size distribution was apparent in the walleye population in the Fairford River downstream of the dam. A creel census of anglers fishing below Fairford Dam indicated most walleye were in the 300-400 mm size range; the ages of the fish were 4 and 5 years. Walleye greater than 400 mm were 6 years old or older.

The lengths of most sauger which were captured moving through the fishway varied between 250 and 350 mm (Figure 6). The length distribution tended to be skewed to the right and few small sauger (<250 mm) were caught. The poor representation of small sauger may again

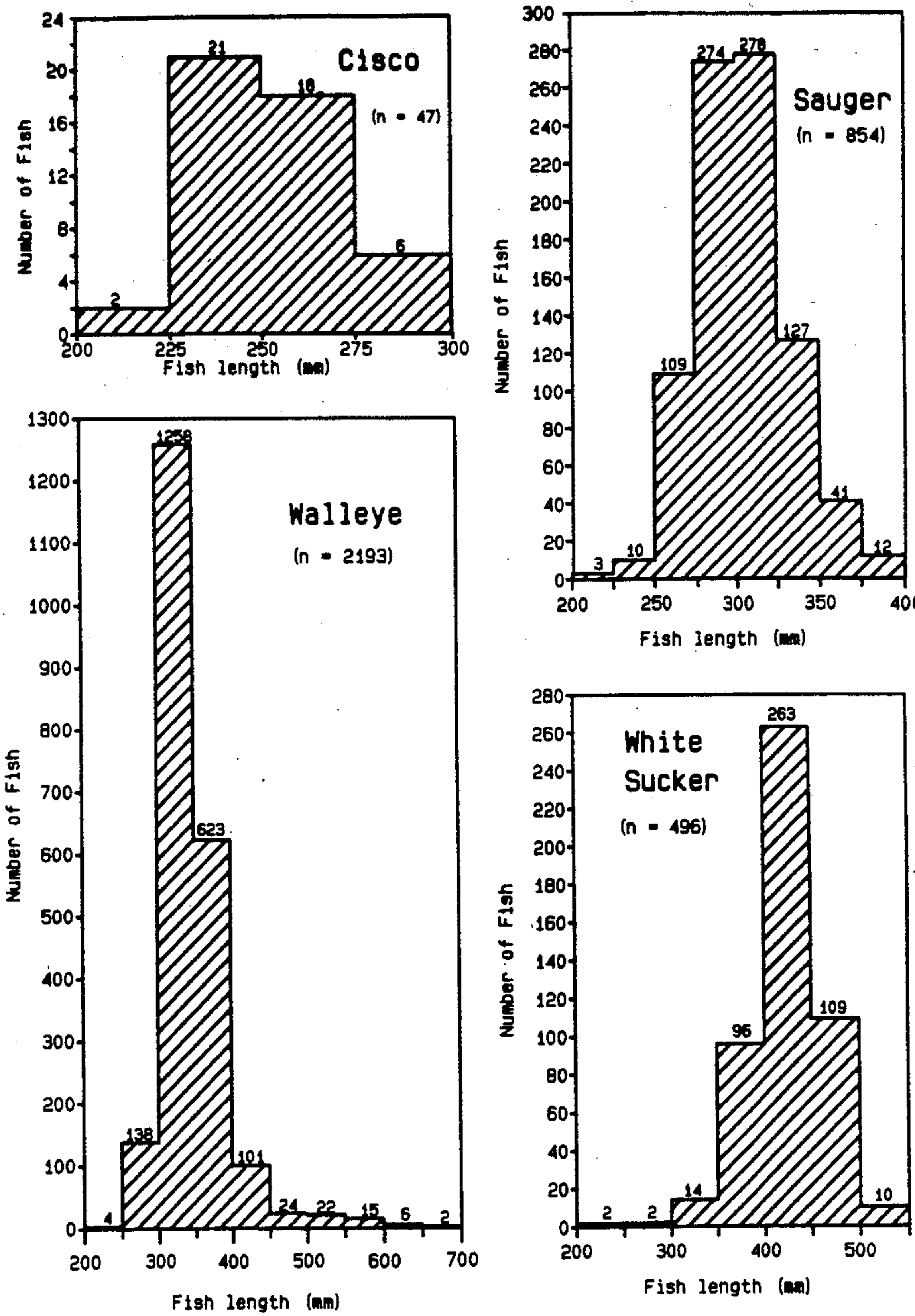

Fig. 6. Fairford fishway - Length frequency distribution

be related to the size selection of the mesh used in the fishway stage. Small sauger were frequently found wedged in the wire mesh. Sauger less than 225 mm were probably able to slip through the 25 x 50 mm mesh. The creel census did not reveal whether sauger less than 250 mm were prevalent in the population since anglers did not normally retain sauger or walleye that were less than 300 mm in length.

Only 13% of the cisco and 9% of the white suckers caught in the fishway trap were measured. The data for cisco indicated a length frequency distribution that was also skewed to the right (Figure 6). As previously mentioned, many of the smaller cisco (<225 mm) may have escaped through the wire mesh. The distribution of lengths for white sucker followed a normal distribution with most individuals falling within the 350-500 mm size range. The majority of these fish were mature spawning-run fish.

Examination of the length frequency distributions of walleye, sauger and white sucker over time indicated a slight shift to the smaller size ranges of fish later in the assessment period. Although the modal size class (300-349 mm) remained constant for walleye (Figure 7A), the relative percentage of fish in the 350-399 mm interval decreased from the May 6-10 period to the June 11-15 period and individuals smaller than 300 mm became slightly more prevalent. In the case of sauger (Figure 7B), there was a pronounced shift; the modal frequency dropped from the 300-324 mm interval to the 275-299 mm interval by the end of May. The change in size distributions of white sucker over time (Figure 7C) was not as marked as that observed for sauger.

The sizes of the incidentally caught fish species are

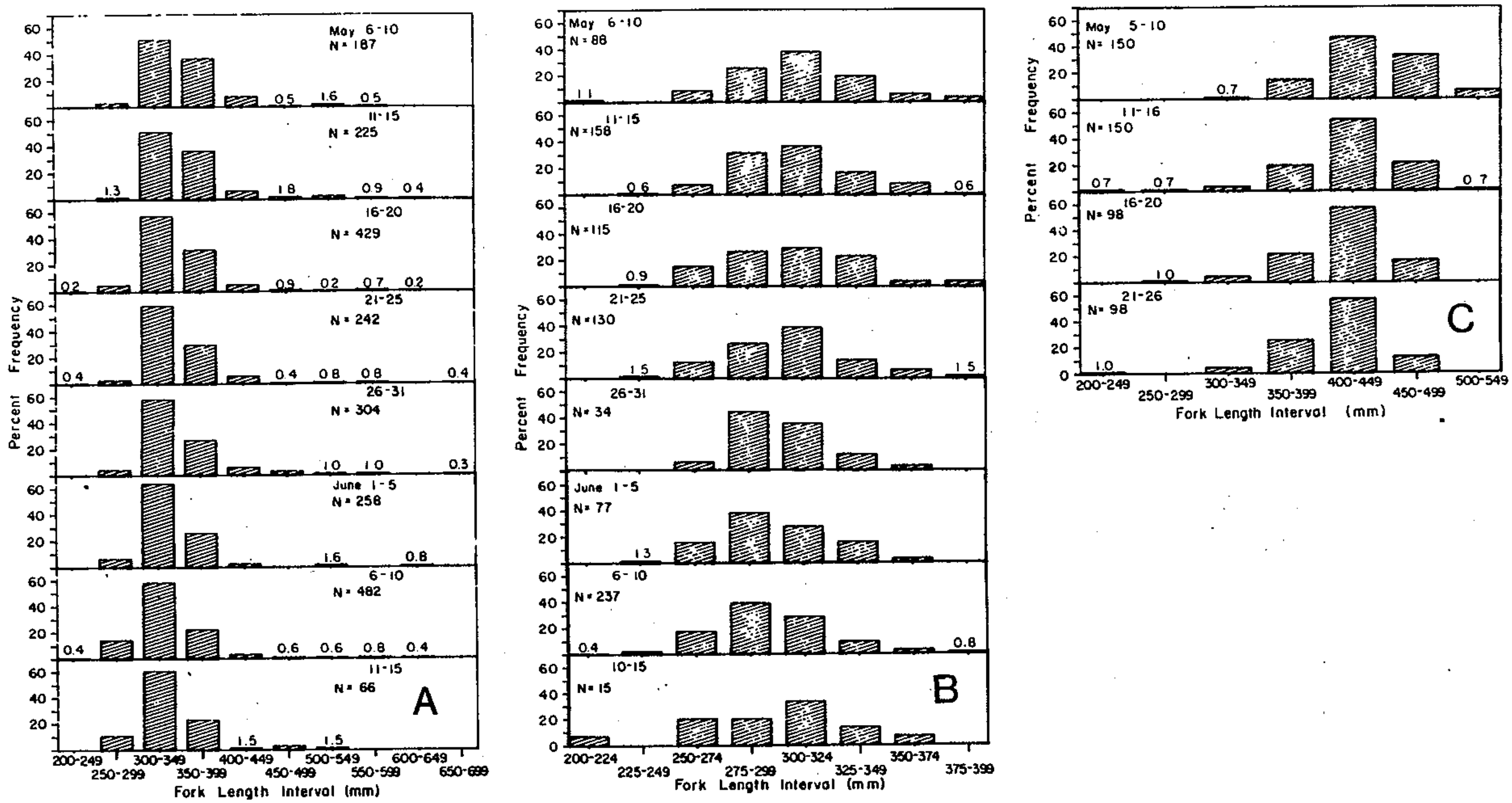

Figure 7: Percentage length frequency distributions for walleye (A), sauger (B) and white sucker (C) caught in the Fairford fishway trap over 5-day periods, May-June, 1987.

presented in Appendix III.

Water velocities in the Fairford fishway were directly correlated to water depths and discharges in the fishway (Figure 5), which in turn were related to flows in the Fairford River (Figure 4). Except for the period May 21-22, water velocities at the three different profiles in the fish were relatively uniform throughout the assessment period. At the lowest profile (20% of fishway depth) velocities varied around 0.7 m/s. Although fish could not be directly observed in the fishway, it is believed that most fish utilized the lower portion of the fishway where the slower velocities existed. This contention is supported by the observations that when the fishway exit was blocked, fish near the exit were forced toward the surface. The fish could not overcome the water velocities in the upper layers and were swept back down the fishway. It was not known if water velocities of 0.7 m/s or less permitted fish to negotiate the entire length of the fishway wthout stopping or whether they held for some time in the two resting pools.

Tag Recoveries and Fish Movements

As indicated previously, the movements of walleye and sauger through the Fairford fishway were extrapolated from the voluntary returns of fish tags recovered by anglers and commercial fishermen. Signs advising fishermen of the tagged fish were posted in areas such as the Lake Manitoba Narrows, the Waterhen and Steeprock areas, etc. where there is appreciable fishing effort. Records were also kept of tagged fish which had been caught in the fishway trap a second time and in a few instances a third time.

Up until May 1, 1988, a total of 216 (10.6%) of the 2,036 walleye that were tagged and released from the fishway trap were recaptured (Table 2). The largest proportion of these recoveries (42%) were fish that were caught a second time in the fishway trap (Recovery Area 1, Figure 8). At least two tagged walleye were recaptured a third time in the fishway trap. More tagged fish than what we observed may have been caught in the trap. On one occasion we found a loose tag in the trap. This indicates that some of the tagged fish may have lost their tags by rubbing against the wire mesh. The average time between release and recapture in the fishway trap was 16.5 days.

The second most significant recovery area was the Fairford River below the dam (Area 2). A total of 78 or 36% of the recoveries were made by anglers fishing within 1 km downstream of the Fairford River. This high rate of recovery is not surprising since the Fairford River is heavily angled each spring. The average time between release and recovery in the Fairford River was 19.1 days. Although some tagged walleye were extant for as much as 122 days, the majorty of recoveries were within 3 weeks of release. Only 24% of the Fairford River walleye recoveries had been extant for more than 20 days.

The large number of tagged walleye recoveries in the fishway trap and in the Fairford River suggests that a high proportion of the walleye may have been swept back over the dam very shortly after they were tagged and released. Although the process of measuring and tagging an individual fish did not normally require more than one minute, the combined stress of being trapped for several hours or more, handling and tagging may have been sufficient to disorient them when they were

Table 2: Numbers of tagged walleye recovered from 7 recovery areas and the number of days between release and recovery.

Recovery Area*	No. of Tag Recoveries	Days Extant Min.	Days Extant Mean	Days Extant Max.
1	91 (42.0 %)	5	16.5	41
2	78 (36.1 %)	0	19.1	122
3	28 (13.0 %)	4	192.5	309
4	14 (6.5 %)	37	184.1	308
5	1 (0.5 %)	-	346	-
6	3 (1.4 %)	161	206	247
7	1 (0.5 %)	-	241	-

*See Figure 8.

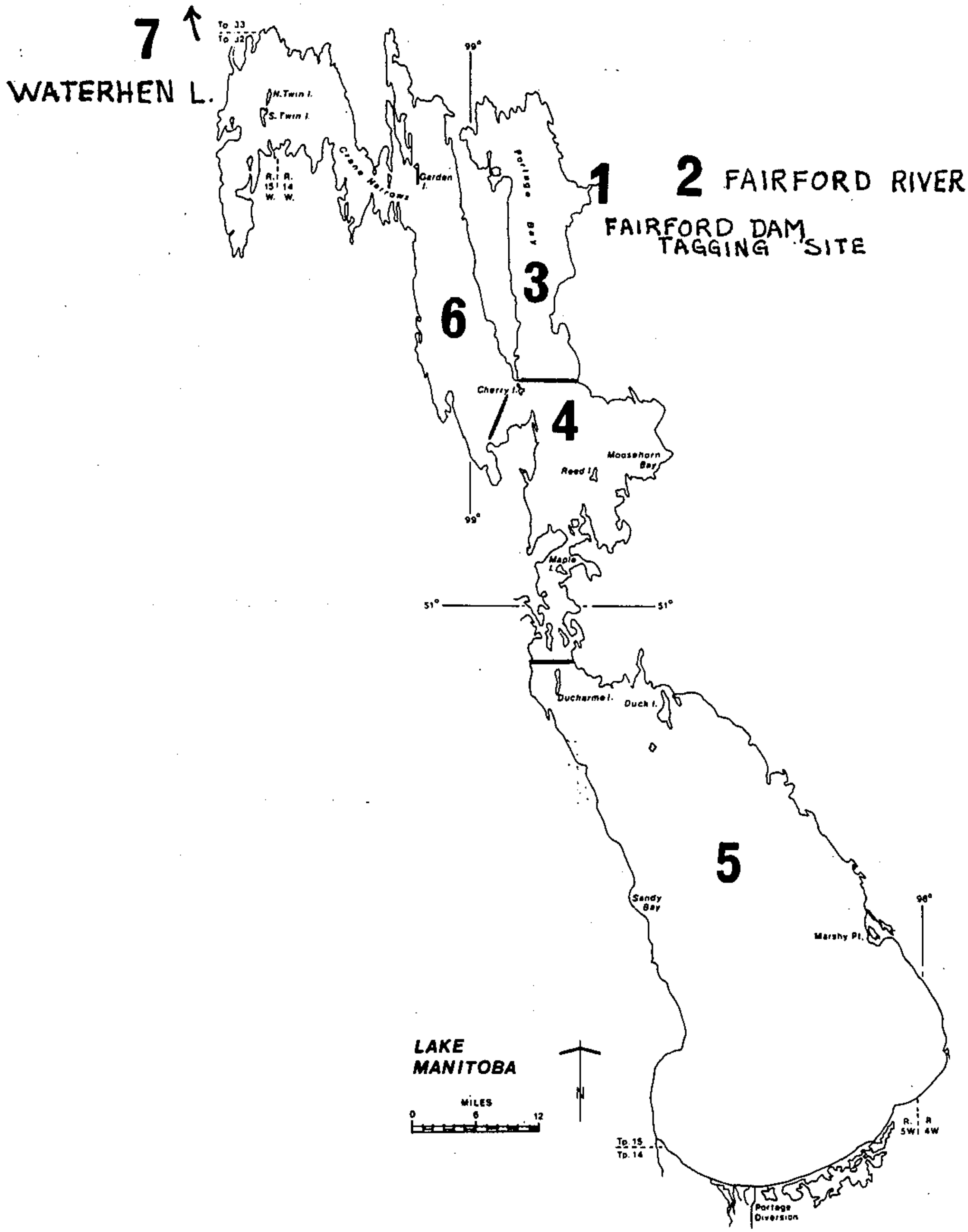

Figure 8. Tag recovery areas in Lake Manitoba.

released. The fish were also thrown back into the water from a height about 2 m. This caused some fish to be temporarily stunned and it was observed that these fish could not recover in time to avoid being swept over the dam. It should be noted that the bays on either side of the fishway were carrying significant flows and it was difficult to throw the fish beyond the influence of these flows.

Approximately 22% of the walleye were recovered upstream in Lake Manitoba, mostly from the Portage Bay area (Area 3). Most of the recoveries in Portage Bay came from the vicinity of Steeprock and the northern end of the bay. One tagged walleye was recaptured from Basket Creek, a small stream flowing into the northwest corner of Portage Bay (Figure 8). This recovery was from a walleye spawning run. Based on the pattern of tag recoveries from other areas, walleye which moved out of Portage Bay tended to move southward into the Moosehorn Bay and Lake Manitoba Narrows areas (Area 4). Two tagged walleye were recaptured at the Lake Manitoba Narrows by anglers within 38 days of release. The days extant for tagged walleye recoveries in Areas 3 and 4 was approximately 190 days (Table 2). This was due to the fact that the majority of walleye recaptures were made by commercial fishermen fishing during the winter season. The tag recoveries also suggested that walleye released at the Fairford Dam moved into the south basin of Lake Manitoba (Area 5). One walleye was recaptured in the spawning run at Swan Creek 341 days after release. A small percentage of walleye (~2.0%) moved northwest and as far as Waterhen Lake (Table 2).

A total of 44 (6.7%) of the 657 sauger that were tagged and released from the Fairford fishway were recaptured. Over half (54.6%) of the sauger recoveries were made by anglers fishing in the Fairford River below the dam; most of the recoveries were made within about a month of release (Table 3). Almost a third (31.8%) of the sauger recoveries were from the fishway trap and generally within about two weeks from the time of release. Six sauger were recaptured upstream of the dam. These recoveries were all made during the 1987/88 winter and came from the Portage Bay, Lake Manitoba Narrows and Crane River areas. The poor recovery rate of sauger in Lake Manitoba was due to the fact that most of the sauger tagged at the Fairford Dam were small fish (<250 mm F.L.), and therefore not fully vulnerable to commercial fishermen's gillnets.

Creel Census

The creel census conducted on the Fairford River was limited . Information was only collected on six days in May, beginning on May 10, the day after the season opening day. On five of these days anywhere from 1 to 16 anglers were interviewed and their catches sampled. On these days counts were also made of all shore and boat anglers fishing in the Fairford River within sight of the dam. On one day (May 21), an angler count was made, but no anglers were interviewed. In the interviews, anglers were asked how many hours they fished. The average number of hours fished by each angler each day was determined. This daily value was then multiplied by the total number of anglers observed that day to arrive at the total fishing effort. This information is summarized in Appendix IV.

Based on the total weights of fish species sampled from the angler catches, the average weights of walleye, sauger, yellow perch and northern pike caught per angler hour were determined. These values are presented in Table 4. Walleye contributed the highest proportion of the angler catches; based on the 5 days of observations, anglers caught an average of 120 gm of walleye per hour throughout most of May. Angler success for walleye was highest on May 10 (∿200 gm/hr) at the season opening. Although the data are limited, they suggest that walleye catches progressively declined throughout May.

In terms of weight, the angler success rate for sauger (∿30 gm/hr) was one quarter of that for walleye. A similar success rate was noted for yellow perch. This observation, however, may be biased, since it is based on the sampling of only one angler's catch. The catch rate for yellow perch was more likely in the order of 15 gm/hr. Northern pike were probably the third more prevalent species in anglers' creels with catching success being around 20 gm/hr.

Angler success rates presented in Table 4 were multiplied by the total effort values to obtain estimates of the total daily catches of each species (Table 5). Although angling success for walleye was highest during the season opening weekend (May 9-10), the greatest harvest of walleye occurred during th long-weekend in May (on May 15 and 16). This was due to the greater number of anglers and higher fishing effort.

The harvest of sauger from the Fairford River was much smaller than that for walleye (Table 5). The average daily catch of sauger during May (5.7 kg) was only 15 percent of the averge daily catch of walleye (37.2 kg). This was probably similar to the proportion of walleye and sauger in the catches in the fishway trap. In terms of numbers, sauger represented 39 percent of the walleye catch. However,

Table 3: Numbers of tagged sauger recovered from 5 of 7 recovery areas and the number of days between release and recovery.

Recovery Area*	No. of Tag Recoveries	Days Extant		
		Min.	Mean	Max.
1	14 (31.8%)	5	16.3	30
2	24 (54.6%)	3	27.5	97
3	2 (4.5%)	308	316.0	324
4	2 (4.5%)	253	271.5	290
6	2 (4.5%)	284	292.0	300

*See Figure 8.

Table 4: Estimated hourly catches in terms of weight of several species of fish by anglers fishing in the Fairford River during May, 1987. Estimates based on angler interviews and samples of angler catches.

Date	Total No. of Angler Hours	Weight of fish caught/angler hr*(gm)			
		Walleye	Sauger	Y. Perch	N. Pike
May 10	36.5	198.9	40.6	-	-
12	6	46.7	53.3	163.3	-
15	66	143.6	17.4	15.6	37.3
16	81	114.6	0.4	-	6.4
24	86	98.4	33.3	14.5	62.3

*Determined by dividing the total weight of a species sampled by the number of angler hours as reported in creel census interviews.

Table 5: Estimated total daily catches of several fish species taken by anglers fishing in the Fairford River during May, 1987.

Date	Total Effort (hr)	Estimated total daily catch (kg) of			
		Walleye	Sauger	Y. Perch	N. Pike
May 10+	130	25.9	5.3	-	-
12†	142	6.6	7.6	23.2	-
15*	286	41.1	5.0	4.5	10.7
16*	720	82.5	0.3	-	4.6
24+	303	29.8	10.1	4.4	18.9

+Sundays
*Friday and Saturday of May long-weekend
†Weekday (Tuesday)

since the walleye were anywhere from 50 to 100 percent larger or heavier than sauger, the ratio of sauger to walleye could be in the order of 15-20 percent in terms of weight. Disregarding the catch of yellow perch on May 12, the total daily catches of northern pike may have 2 or 3 times greater than the yellow perch catches. Pike catches also appeared to be greater than the sauger catches; this assumes that catches of pike were relatively consistent from day to day.

CONCLUSIONS AND RECOMMENDATIONS

Observations of fish movements through the Fairford Dam fishway during May and June, 1987, revealed that the fishway was effective in passing most species and sizes of fish found in the Fairford River. Since the period of assessment encompassed both peak discharges and low flow conditions in the Fairford River (Appendix Id), it is concluded that the Fairford fishway should be capable of passing fish under most flow conditions experienced in the Fairford River. With one exception, estimated water velocities within the Fairford fishway tended to remain relatively constant despite rather wide variations in discharges. It can only be speculated as to how effectively fish might use the fishway under extreme flow conditions. Under exceptionally high flows, there will be a smaller difference between headwater and tailwater elevations. This circumstance will create greater backwater effects in the fishway which should serve to reduce water velocities in much of the fishway and result in the easier passage of fish. High flows may, however, also tend to mask the attraction water flows so that fish may have greater difficulty in finding the fishway entrance. Under extreme low flow conditions, it is conceivable that much of the flow would be through the fishway and the attraction water flume. Greatly reduced flows in the Fairford River below the dam, however, may result in fewer fish being attracted upstream to the dam and into the vicinity of the fishway.

Although the present study provided a good assessment of the effectiveness of the Fairford fishway in passing fish, a number of questions remain unanswered. The most obvious gap in the fishway assessment is the lack of information during the spawning-run periods of fish. The assessment of the Fairford fishway began after the peak walleye spawning season. Had the assessment began earlier in April, it is speculated that much larger numbers of walleye, as well as white suckers, may have been observed moving through the fishway. An early spring assessment would perhaps also have provided information on the use of the fishway by northern pike. Observations by Katapodis et al. (in prep.) noted that pike do use a Denil type fishway, but only under low velocity conditions. The present study indicated that both cisco and lake whitefish used the Fairford fishway. Since both species are fall spawners and frequent the Fairford River - Lake St. Martin area, some fall assessment is necessary to determine the significance of the Fairford fishway to cisco and lake whitefish stocks. Although some assessment of fall movements was done by D. MacDonald, it did not provide a thorough evaluation of whitefish and cisco utilization of the fishway.

Another area which has not been investigated is the configuration of flow patterns at the Fairford Dam and their influence on fish movements downstream of the dam and in the vicinity of the fishway. Placement of the stoplogs in the Fairford Dam in such a manner that causes most of the flow to pass over the dam in the vicinity of the fishway may increase the attraction of fish to the fishway. This may result in fish being better able to find the entrance to the fishway, thereby improving its effectiveness in passing fish.

A final area of investigation that has not been pursued adequately is the significance of the Fairford fishway to all fish stocks in the area. Although the present study provided some insight to the effect of the fishway on walleye stocks, it raised other questions. For example, why were the walleye using the fishway to move upstream? Was this movement simply a response to river flows or did the movement represent post-spawning adults on a return migration? Do the walleye in this area represent a number of spawning stocks or are they a discrete population? Similar questions might be posed for the other fish species observed.

The present study has provided only a partial assessment of the effectiveness of the Fairford fishway and its significance to fish populations in the area. To obtain a comprehensive assessment of the Fairford fishway it is recommended that the following studies be conducted at some point in the future.

1. Monitoring of fish movements through the Fairford fishway beginning with ice break-up and continuing through until freeze-up. Although it would be preferable to conduct this monitoring on a regular daily basis, this may not be possible because of the lack of funds and staff. However, daily monitoring should be conducted during the spring and fall migration periods; eg. from break-up until approximately July 1 and from mid-September, when the waters begin to cool to freeze-up. During the interim period, monitoring should be frequent enough to provide statistically significant results.

2. During the monitoring of the fishway, all species moving through the fishway should be tagged so that

their subsequent distribution may be determined.

3. Efforts should be made to capture and tag fish in the Fairford River downstream of the dam to obtain some estimate of the proportion of downstream fish which utilize the fishway and the speed with which they can find the fishway.

4. Further assessments should be made of the Fairford fishway under various flow conditions. These assessments should also involve the manipulation of stoplog placement in the bays surrounding the fishway to determine how different patterns of flow over the dam affect the attraction of fish to the fishway entrance.

Further assessment of the Fairford fishway is strongly recommended. Since it has now been shown that the Denil-type fishway will pass a variety of freshwater fish species and sizes of fish, there will be greater pressure for the inclusion of fish passage facilities in water control structures which obstruct fish movements. A large data base on existing fishways, such as that in the Fairford Dam, will facilitate the design of better, more effective fishways for freshwater fish.

LITERATURE CITED

Katapodis, C., A. J. Derksen and B. L. Christensen, (in prep.). An assessment of Denil fishways in the Fairford and Cowan dams.

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A number of the figures presented in this report were prepared by Mr. C. Katapodis of the Freshwater Institute, Department of Fisheries and Oceans. I should like to express my thanks to him for allowing me to use these figures.

Dave Green, Laureen Livingston and Barry Cherepak assisted in some of the data analysis. Coreene Caverly typed the manuscript.

APPENDIX I

Information on the hydraulic design parameters of the Fairford Dam, rating curves for headwater and tailwater elevations and discharges at Fairford Dam during the period Jan. 1 - June 30, 1987.

Appendix Ia: Parameters for Fairford Dam.

- Discharge over Fairford Dam

Maximum	-	337.0 m^3/s	(11,900 cfs)
Minimum	-	1.4 m^3/s	(50 cfs)
Average	-	175.6 m^3/s	(6,200 cfs)

- Headwater Elevations

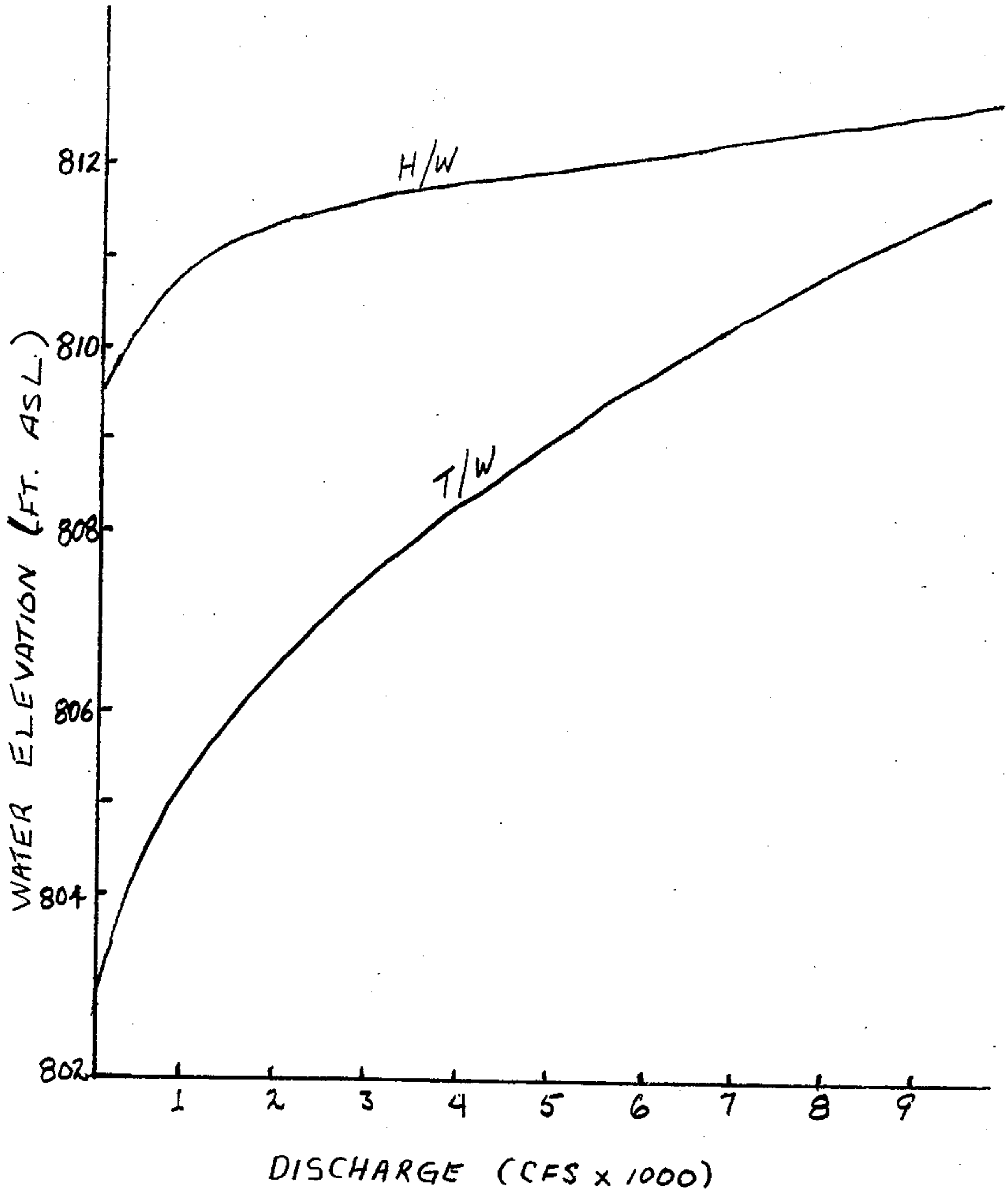
Maximum	-	247.9 m	(813.27 ft)
Minimum	-	247.1 m	(810.54 ft)
Average	-	247.5 m	(812.11 ft)

- Tailwater Elevations

Maximum	-	247.7 m	(812.77 ft)
Minimum	-	244.6 m	(802.61 ft)

- Elevation of Dam Sill

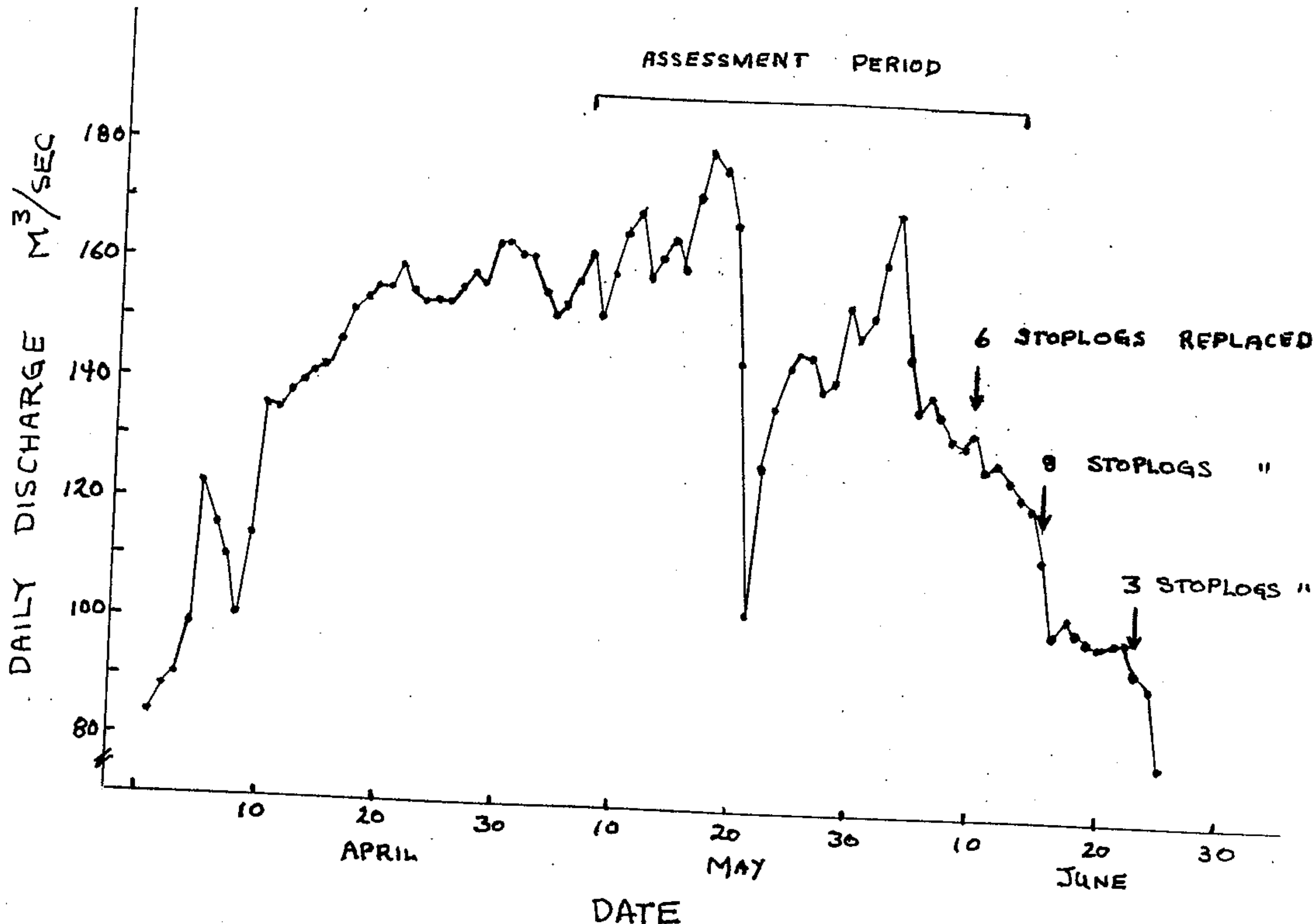
- 244.7 (802.87 ft)



Appendix Ib: Rating curves for headwater (H/W) and tailwater (T/W) elevations at Fairford Dam. (From Water Resources Branch, Manitoba Department of Natural Resources).

Appendix Ic: Fairford River near Fairford, daily discharges in $M^3.S^{-1}$ for January 1 - June 30, 1987.

Day	Jan	Feb	Mar	Apr	May	Jun
1	63.5	62.7	65.0	83.8	162	163
2	64.6	61.9	65.0	88.3	162	171
3	63.5	62.7	64.8	90.3	156	147
4	63.7	63.0	65.0	98.5	152	139
5	63.3	63.2	65.3	122	154	141
6	62.4	63.3	65.4	115	158	138
7	63.2	62.4	64.9	110	163	134
8	63.6	62.7	63.8	100	152	133
9	62.5	63.0	64.5	114	160	135
10	62.8	62.4	65.0	136	166	129
11	63.4	62.5	65.4	135	170	130
12	63.1	60.8	64.9	138	159	127
13	63.7	61.3	64.7	140	162	125
14	64.0	61.2	63.9	142	166	123
15	67.5	61.8	64.5	143	161	114
16	64.7	61.9	64.8	147	173	102
17	63.8	61.7	64.7	152	181	105
18	62.4	61.6	66.0	154	177	102
19	63.3	62.0	66.8	156	168	101
20	63.3	62.6	67.2	156	145	99.9
21	62.6	61.6	70.2	160	104	101
22	63.3	61.3	72.6	155	128	101
23	64.5	61.0	71.7	154	138	95.9
24	64.1	61.4	73.9	154	145	93.9
25	64.5	60.9	77.2	154	147	80.0
26	64.6	62.4	81.3	156	147	68.6
27	63.5	62.5	84.8	159	141	70.4
28	62.8	62.9	85.1	157	143	66.6
29	62.7		85.0	164	155	62.3
30	62.5		85.7	164	150	58.5
31	63.0		85.3		154	
Mean	63.6	62.1	70.1	137	155	112
dam^3	170,000	150,000	188,000	354,000	415,000	290,000
Max	67.5	63.3	85.7	164	181	171
Min	62.4	60.8	63.8	83.8	104	58.5



Appendix Id: Daily discharges in the Fairford River at the Fairford Dam between April 1 and June 25, 1987.

APPENDIX II

Water temperatures recorded at Fairford dam and air temperatures recorded at Gypsumville during the period May 1 - June 12, 1987.

Appendix IIa: Minimum, maximum and average daily water temperatures recorded at Fairford Dam, May 6-28, 1987 and average daily air temperatures recorded at Gypsumville during May, 1987.

Date	Water Temp. °C Min.	Av.	Max.	Av. Air Temp.*
May 1		-		11.0
2		-		10.0
3		-		13.8
4		-		15.5
5		-		18.0
6		14.0		13.2
7	12.0	14.0	16.0	14.2
8	13.0	14.5	16.0	23.5
9	14.0	15.0	16.0	7.2
10	14.0	15.0	16.0	11.8
11	13.0	15.0	16.0	7.2
12	14.0	16.0	18.0	20.5
13	16.0	17.0	18.0	16.5
14	15.0	16.5	18.0	10.0
15	15.0	16.5	18.0	21.5
16	16.0	17.0	18.0	12.2
17	15.0	16.5	18.0	18.0
18	15.0	17.0	18.0	11.5
19	16.0	17.0	18.0	11.5
20	14.0	15.5	18.0	8.5
21	11.0	13.0	18.0	4.0
22	11.0	14.0	18.0	8.0
23	11.0	15.5	18.0	11.2
24	16.0	17.0	18.0	17.5
25	15.0	17.0	18.0	17.0
26	16.0	17.0	18.0	11.5
27	16.0	17.0	18.0	14.8
28	17.0	17.5	18.0	15.0
29		-		15.0
30		-		18.5
31		-		20.5

*Based on air temperatures recorded at Gypsumville at 8 AM and 1 PM.

Appendix IIb: Minimum, maximum and average daily water and air temperatures recorded at the Fairford Dam and Gypsumville, respectively, from June 1-12, 1987.

	Water Temp °C			Av. Air
Date	Min.	Av.	Max.	Temp. *
June 1		-		18.8
2	-	17.0	-	12.5
3	12.0	14.5	16.0	8.5
4	14.0	15.5	17.0	10.0
5	14.0	17.0	21.0	16.2
6	17.0	19.0	21.0	17.5
7	16.0	17.0	19.0	13.5
8	15.0	16.5	18.0	13.5
9	16.0	19.0	22.0	18.0
10	17.0	18.0	20.0	18.0
11	19.0	19.5	21.0	17.0
12	19.0	19.5	21.0	20.5

*Based on air temperatures recorded at Gypsumville at 8 AM and 1 PM.

APPENDIX III

Length measurements of fish species incidentally caught in the Fairford fishway trap, May - June, 1987.

Appendix III: Fork length measurements of fish species incidentally caught in the Fairford fishway trap, May and June, 1987.

Species	Date Caught	F.L. (mm)
Lake whitefish	May 9	408
Lake whitefish	May 11	422
Lake whitefish	May 22	418
Shorthead redhorse	May 12	341
Shorthead redhorse	May 12	362
Shorthead redhorse	May 20	364
Shorthead redhorse	May 20	352
Shorthead redhorse	May 20	342
Shorthead redhorse	May 20	366
Silver redhorse	May 19	515
Quillback sucker	May 20	376
Longnose sucker	May 7	226
Carp	May 19	692
Carp	May 19	780
Carp	May 19	768
Carp	May 19	750
Carp	May 19	730
Carp	May 22	700
Carp	Jun 2	700
Carp	Jun 2	730

APPENDIX IV

Angler counts at Fairford River, May, 1987.

Appendix IV: Results of angler counts and estimates of sportfishing effort on the Fairford River within sight of the Fairford Dam during May, 1987.

	Date	Time	N. Shore	S. Shore	#Boats/ #Anglers	Total	Av. Daily Total	Total * Effort	No. Anglers Sampled	Hrs. Fished	Angler Hours	Hrs./Angler
+Sunday	May 10	1:00 PM	35	14	3/5	54			8	3.0	24	
		2:00 PM	25	21	0	46	46.3	130	4	3.0	12	2.81
		4:00 PM	29	5	3/5	39			1	0.5	0.5	
Tuesday	May 12	10:00 AM	14	11	0	25						
		1:00 PM	9	11	1/2	22	23.7	142	1	6.0	6.0	6.00
		6:00 PM	12	12	0	24						
++Friday	May 15	8:30 AM	14	0	0	14			2	9.0	18.0	
		1:30 PM	27	12	3/7	46	34.7	286	4	7.0	28.0	8.25
		5:00 PM	24	16	2/4	44			2	10.0	20.0	
++Saturday	May 16	8:30 AM	64	36	2/4	104			8	8.0	64.0	
		12:00 PM	72	35	7/13	120	124.3	720	3	3.0	9.0	5.79
		5:00 PM	68	40	25/41	149			2	3.0	6.0	
									1	2.0	2.0	
Thursday	May 21	2:00 PM	6	6	2/5	17	17.0		-			
Sunday	May 24	10:00 AM	41	26	4/9	76			4	2.0	8.0	
		3:00 PM	37	18	2/5	60	56.3	303	2	2.0	4.0	
		6:00 PM	23	9	1/1	33			3	6.0	18.0	5.38
									2	8.0	16.0	
									2	8.0	16.0	
									3	8.0	24.0	

*Total Fishing Effort = Average Daily Number of Anglers X Average Number of Hours Angled Each Day

+Season opening

++May long weekend

APPENDIX V

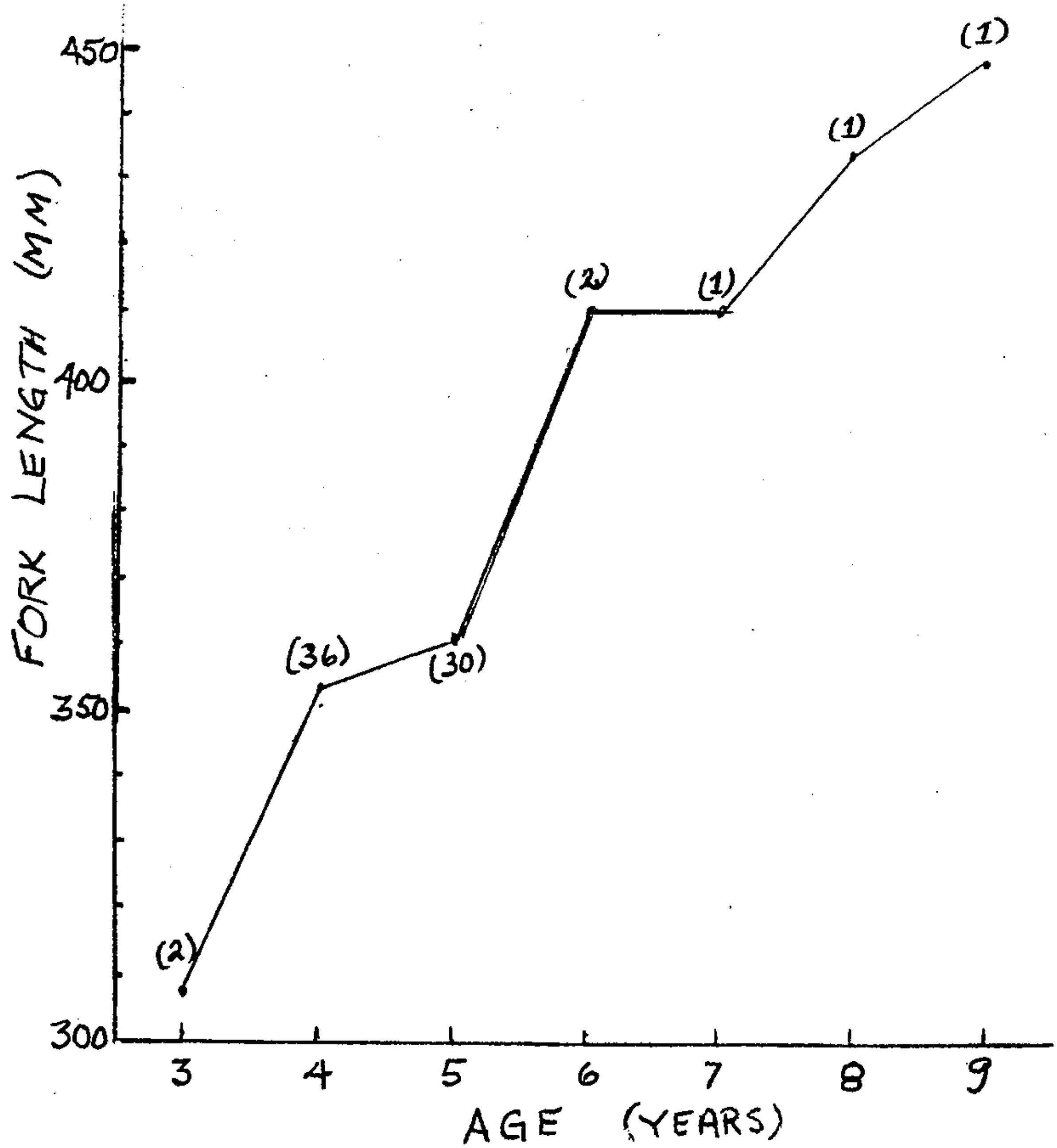
Vital statistics on fish species caught by anglers fishing in the Fairford River, May, 1987.

Appendix Va: Fork lengths, weights and ages of 73 walleye caught by anglers in the Fairford River, May, 1987.

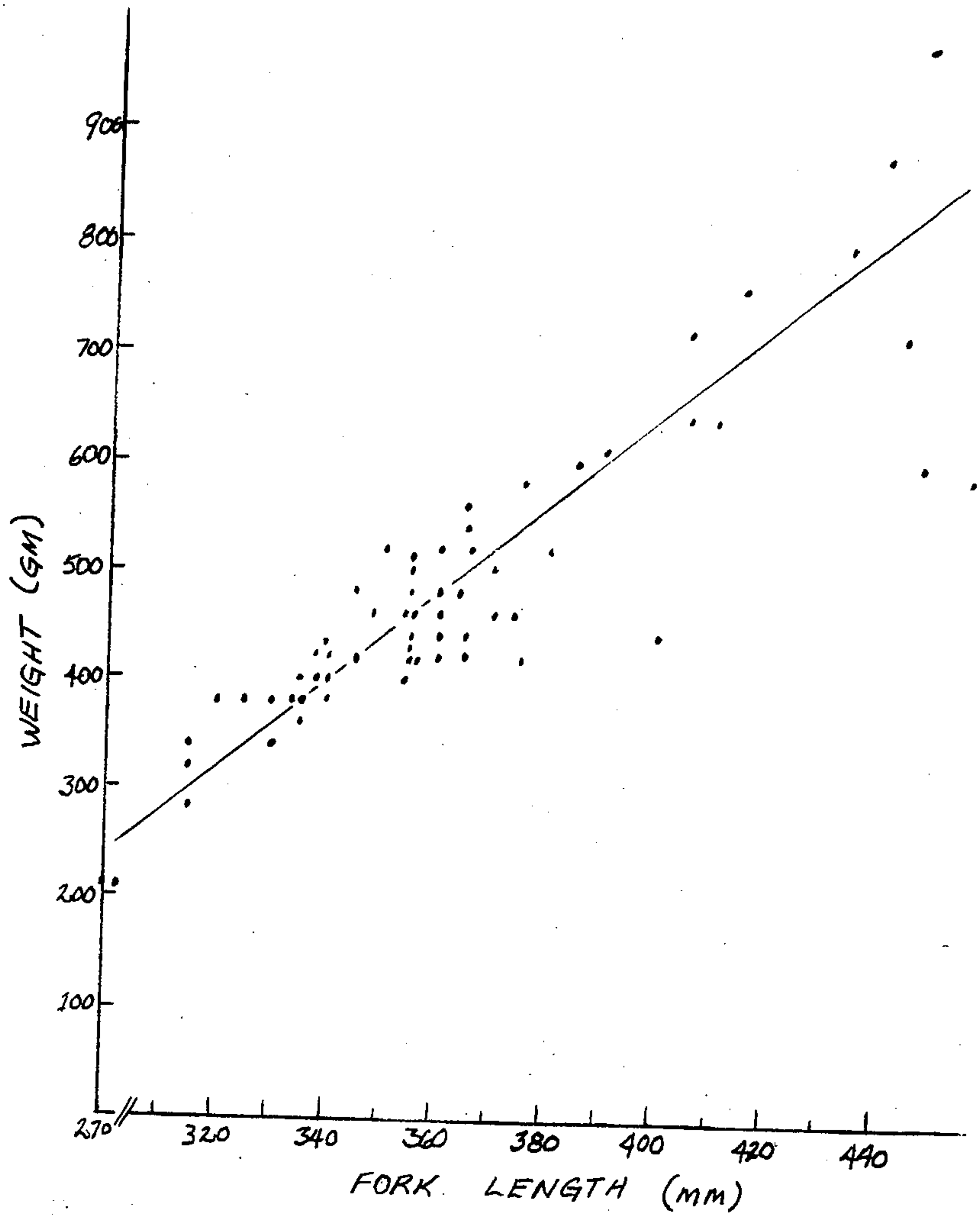
Date	Fork Length(mm)	Weight(gm)	Age(years)
May 10	434	800	8+
May 10	400	440	5+
May 10	364	480	4+
May 10	450	600	4+
May 10	366	520	4+
May 10	354	460	5+
May 10	346	420	5+
May 10	446	720	6+
May 10	360	440	5+
May 10	348	460	5+
May 10	365	540	4+
May 10	338	400	4+
May 10	448	980	9+
May 12	315	280	4+
May 15	380	500	4+
May 15	354	400	4+
May 15	335	360	4+
May 15	374	460	5+
May 15	375	580	5+
May 15	338	420	5+
May 15	356	420	5+
May 15	365	420	5+
May 15	355	430	5+
May 15	410	640	7+
May 15	355	420	5+
May 15	360	480	5+
May 15	340	420	5+
May 15	320	280	4+
May 15	390	610	5+
May 15	270	210	3+
May 15	340	400	4+
May 15	355	510	4+
May 15	345	420	3+
May 15	378	620	4+
May 15	330	380	4+
May 16	380	520	5+
May 16	335	360	5+
May 16	370	460	4+
May 16	365	560	5+

Appendix Va, cont'd.

Date	Fork Length(mm)	Weight(gm)	Age(years)
May 16	340	420	4+
May 16	360	460	5+
May 16	365	440	5+
May 16	330	340	4+
May 16	385	600	5+
May 16	335	380	4+
May 16	340	380	5+
May 16	330	360	4+
May 16	355	460	4+
May 16	334	380	4+
May 16	355	500	4+
May 16	345	420	4+
May 16	350	520	5+
May 16	360	520	5+
May 16	355	440	4+
May 16	345	420	4+
May 24	315	320	4+
May 24	380	520	5+
May 24	345	480	4+
May 24	320	320	4+
May 24	405	640	5+
May 24	360	420	4+
May 24	360	460	4+
May 24	415	760	4+
May 24	345	420	4+
May 24	320	380	5+
May 24	440	880	4+
May 24	405	720	5+
May 24	355	480	4+
May 24	335	380	5+
May 24	335	400	5+
May 24	375	420	6+
May 24	360	460	4+



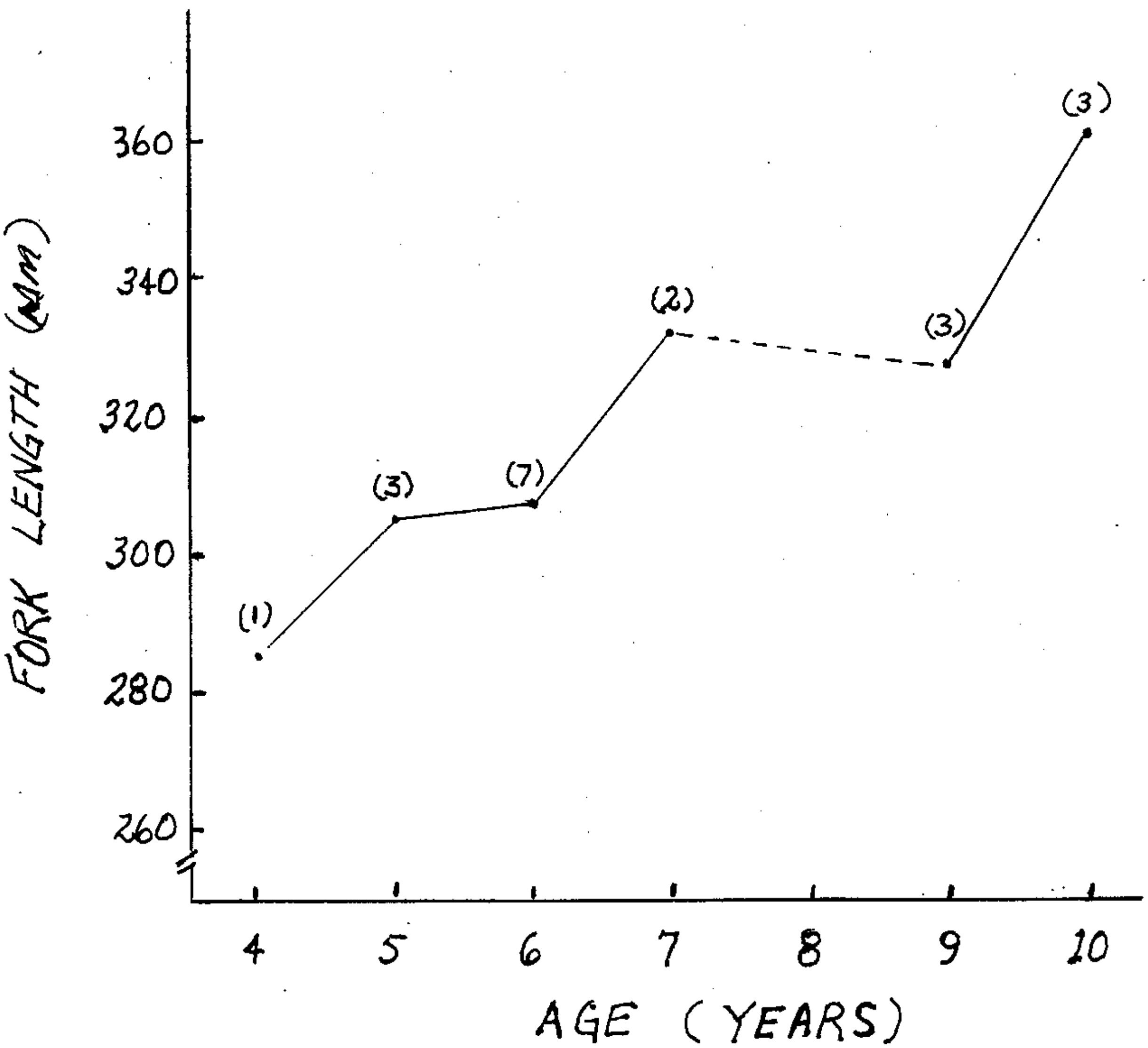
Appendix Vb: Age-specific lengths of walleye caught by anglers fishing in the Fairford River, May, 1987. Numbers of fish are shown in parentheses.



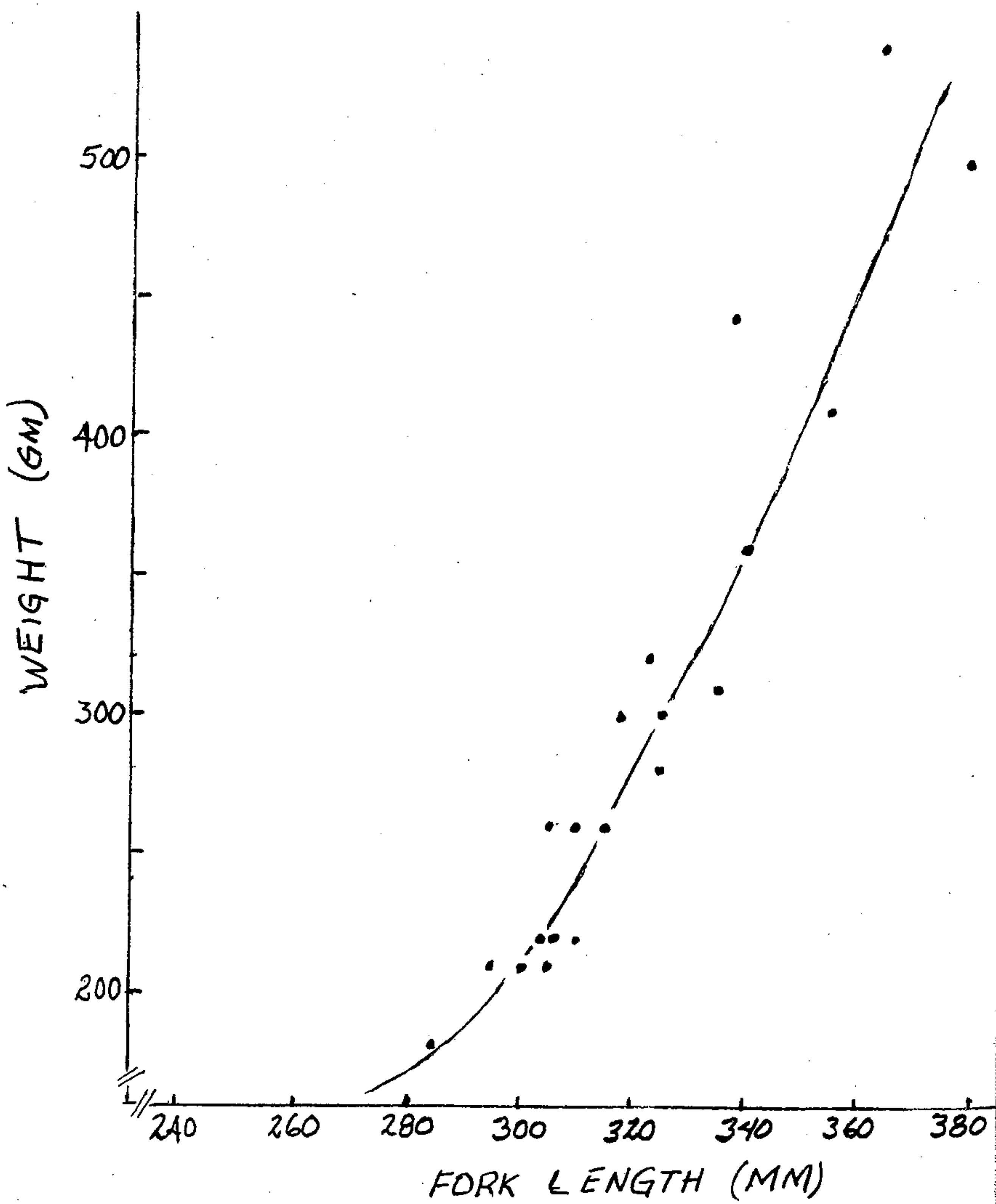
Appendix Vc: Length-weight relations of walleye caught by anglers fishing in the Fairford River, May, 1987. The line is eye-fitted.

Appendix Vd: Fork lengths, weights and ages of 20 sauger caught by anglers in the Fairford River, May, 1987.

Date	Fork Length(mm)	Weight(gm)	Age(years)
May 10	338	442	10+
May 10	365	540	9+
May 10	380	500	9+
May 12	323	320	9+
May 15	325	280	9+
May 15	335	310	9+
May 15	318	300	6+
May 15	310	260	6+
May 16	325	300	7+
May 24	305	200	5+
May 24	310	220	6+
May 24	355	410	5+
May 24	300	210	6+
May 24	305	210	6+
May 24	295	210	5+
May 24	304	220	6+
May 24	315	260	5+
May 24	340	360	7+
May 24	285	180	4+
May 24	305	260	6+



Appendix Ve: Age-specific lengths of sauger caught by anglers fishing in the Fairford River in May, 1987. Numbers in parentheses are numbers of fish.



Appendix Vf: Length-weight relationship of sauger caught by anglers in the Fairford River, May, 1987. The curve is eye-fitted.

Appendix Vg: Fork lengths, weights and ages of 9 northern pike caught by anglers in the Fairford River, May, 1987.

Date	Fork Length(mm)	Weight(gm)	Age(years)
May 10	510	-	-
May 15	575	1380	5+
May 15	540	1080	5+
May 16	610	520	4+
May 23	390	400	2+
May 23	565	1340	4+
May 23	360	420	-
May 23	620	1720	7+
May 23	530	1000	4+

Appendix Vh: Fork lengths and weights of 16 yellow perch caught by anglers in the Fairford River, May, 1987.

Date	Fork Length(mm)	Weight(gm)
May 10	241	280
May 10	241	220
May 10	240	240
May 10	250	240
May 15	250	210
May 15	255	260
May 15	235	220
May 15	275	340
May 24	235	180
May 24	195	110
May 24	180	80
May 24	210	160
May 24	234	180
May 24	245	200
May 24	260	240
May 24	190	100