GREAT LAKES FISHERY COMMISSION

Project Completion Report[1]

An Evaluation of the Effect of Sea Lamprey Low - Head Barriers on Teleost Communities Using Available (Historic) Data

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Introduction

Management of sea lamprey populations in the Great Lakes has been accomplished historically through the application of a selective lampricide to natal streams. The Great Lakes Fishery Commission's vision statement for the decade of the 1990s indicates that the integrated sea lamprey management program that supports fish community objectives for each Great Lake will be ecologically sound and socially acceptable. In accord with the intent to reduce the use of chemical control measures by 50%, alternative methods of management have been developed and applied. An important alternative to lampricide application has been the construction of barriers impassable to spawning migrations of adult sea lamprey.

Barrier dam construction in Canada began in earnest in 1970, though the Sea Lamprey Control Centre began early control measures with a variety of other mechanical methods. There are currently (1998) 32 functional sea lamprey barriers of various designs in the Canadian Great Lakes, the most common being the low-head dam. The effects of barriers that block sea lamprey passage on stream fish community structure are, however, only partly understood. The restriction to movements of non-target fish species (particularly cyprinids and non-jumping fish species) and alteration of reproductive potential for fishes may result from barrier dam design.

Information about teleost community structure and abundance are available for some streams with barriers. The major sources of archived and available data are the Sea Lamprey Control Centre (SLCC), the Ontario Ministry of Natural Resources (OMNR) Fish Distribution Data Base, and individual Ontario Ministry of Natural Resources offices. These data were consolidated, provided in electronic form to the BILD (Noakes et al.) project team and submitted in electronic form to the Great Lakes Fishery Commission (GLFC). We also used this database to determine if the insertion of a barrier to block sea lamprey upstream passage altered fish community structure and fish abundance.

Methods

The majority (84%) of the 32 rivers with functional sea lamprey barriers have some data for teleost populations available during the past 40 years of sea lamprey management. Of the streams with barriers, 13 streams have more than two years of data pre- and post-construction, 14 streams have 1 or 2 years pre- and post- construction and one stream has no post- construction data (barrier built in 1998). Four streams have no data on the fish community. The SLCC daily catch record for fish species composition and abundance were summarized and identified by the year of data collection, gear type, and barrier characteristics for the pre- and post- barrier implementation periods. Fish data for the watershed from the OMNR Fish Distribution Data Base and individual offices were integrated into the SLCC database.

Database Limitations

<u>The Sea Lamprey Control Centre Database</u>

- The data archived by the SLCC about fishes captured at barriers began in 1954 for three rivers.
- The SLCC lamprey collection program, however, was not designed to capture teleost fishes; thus, fish are a secondary or "by" catch and as such, were not measured, weighed and, in some cases, were not always counted or identified.
- As the methods of sea lamprey control were modified over the years, so were the trapping methods. As many as 3 different capture methods for teleosts were used in some streams and included electrical barriers with traps, mechanical weirs with traps, portable traps designed for adult sea lamprey capture and the current built-in dam traps or fishways. Concurrent with changes in capture method, information about teleosts also changed (i.e. the size of fish greater or less than 12" is now a number code – but most trap operators still do not estimate fish length).
- Many traps, past and present, are operated under contract for the duration of the sea lamprey-spawning season. This contracting process can lead to fish being identified by inexperienced operators, and may result in 'group identification' such as 'minnows', and the use of, perhaps, inaccurate local or descriptive names. Fish from several rivers in the 1950's were sent to the Royal Ontario Museum for identification. No recent reference collections have been made.
- The Rossport warehouse, which had been used as a record storage facility primarily for Lake Superior data, was destroyed by fire in 1958.

- It is unclear, particularly from the early data, what happened to the fish caught. The policy of releasing fish caught in the trap above the barrier was established with the introduction of the electrical weirs, but this was not always strictly adhered to.

Ontario Ministry of Natural Resources Fish Distribution Data Base

The OMNR Fish Distribution Data Base contains data from the turn of the century. Data are mainly from the OMNR programs, supplemented by data provided by Conservation Authorities, the Royal Ontario Museum, and other small sampling groups, including some data from the Sea Lamprey Control Centre. Even though this immense collection is based on watersheds as a whole, it has limitations for our ability to reconstruct the fish community.

- Data include species, date caught, and the collector/submitter of the data.
- Numbers, size, weight, and equipment used in sampling fish are not provided.
- The database may not be up-to-date or complete, as many OMNR personnel were not aware (1996) of the existence of the Fish Distribution Data Base.

Ontario Ministry of Natural Resources - District Office Information

Some estimates of fish biomass, weights, and lengths are available. Information for some streams, however, was limited to species present.

- Much of the data collected emphasized the sport fishery, particularly salmonids.
- None of the data included catch per unit effort
- Many rivers have not been sampled recently for a variety of reasons.

Data Analysis

We used data available from the SLCC for 8 rivers that had data available for 5 years pre- and post- construction of a barrier (Table 1):

Lake Superior: Stokely Cr., Carp (Sable) R.
Lake Huron: Echo R., Koshkawong Cr., and Still R.
Lake Ontario: Bowmanville Cr., Graham Cr., and Shelter Valley Cr.

In order to examine the comparability of data from individual gear types, catches made in different years using the same capture device were compared within individual streams for the 8 rivers (Table 2). A total of 17 cases were tested, including 2 streams' mechanical weirs, 2 sets of electrical weirs, eight sets of portable traps and 5 permanent barrier traps. In 71% of these cases, species were not significantly different (t-tests or Mann-Whitney tests as noted) from year to year at $p<0.05$. For 15 of the 17 (88%) cases, abundance was not significantly different ($p<0.05$) among years.

Four rivers were sampled with different capture devices fishing concurrently and, in these cases, we tested for differences in the catches based on the same number of sampling days (Table 3) using either Student's t-test or Mann-Whitney U-tests where appropriate. We compared the number of species caught per 'day' and their abundance. Both the number of species and their total abundance were significantly different in 65% of the cases ($p<0.05$).

Consequently, we standardized the catch per unit effort data. Several rivers were sampled with different gear (traps) operating concurrently and a "correction" factor was developed (Table 4). For Koshkawong Creek, a mechanical weir was fished in conjunction with the permanent barrier trap in 1982. The concurrent fishing catches were compared for both total species numbers and abundance per day. The weir sampled a mean of 4.3 species and a log abundance of 1.6 per day, compared with the barrier catch of 2.0 species and a log of abundance of 0.8, for an average difference of 2.17 species and 2.11 for abundance between the sampling equipment. This was combined with data from Stokely Creek, which also had a mechanical weir and a permanent barrier trap fishing concurrently in 1982. The overall correction factor developed for mechanical weirs and a permanent barrier trap is 1.60 times greater for species and 2.12 times greater in abundance for the mechanical weir. Data for creeks with these capture devices were 'corrected' to reflect the permanent trap catches, the current standard capture method employed by the SLCC. For other sampling gears, such as electrical weirs and permanent barriers, where concurrent fishing did not occur, between year comparisons were made within the individual creeks for similar time frames. Portable traps and permanent barrier traps presented complications as the data were from several sources. It had been assumed (SLCC), that portable traps were not as effective as dam traps for a variety of reasons, including susceptibility to vandalism and flooding. However, the portable traps in Bowmanville Creek caught significantly more species and greater abundance than the built-in dam trap. Catches from portable traps in the Echo River were found to be similar to catches in the barrier trap and Shelter Valley Creek portable traps were significantly less effective than the barrier trap ($p<0.05$). For these reasons, corrections were derived for data from a particular stream rather than a common "correction" factor.

In all cases rainbow smelt/smelt were excluded from the database because they were reported inconsistently, and lamprey catches (sea and native lamprey) were also removed. Other species were grouped to preclude inconsistencies in identification, or where questionable identification for an individual species occurred. Data were divided into pre- and post- barrier construction time frames, and subdivided into all fish, all salmonids, and all remaining fish (all fish less salmonids). The Still River only contains 'all fish' because salmonids were caught infrequently (3 individuals over 19 years). A graphical presentation of species composition, pre and post barrier construction, and data summaries for each river are available upon request. In addition to the statistical analysis, the Jaccard Coefficient, measuring the similarity between years was calculated for each creek.

To test for differences as a result of barrier insertion, we grouped data into pre- and post- construction and used the Student's t-test (two-tailed) with equal variances, (unless otherwise stated) for normally distributed data and the non-parametric Mann-Whitney U tests for similarity for the remainder of the data. Abundance estimates were log transformed.

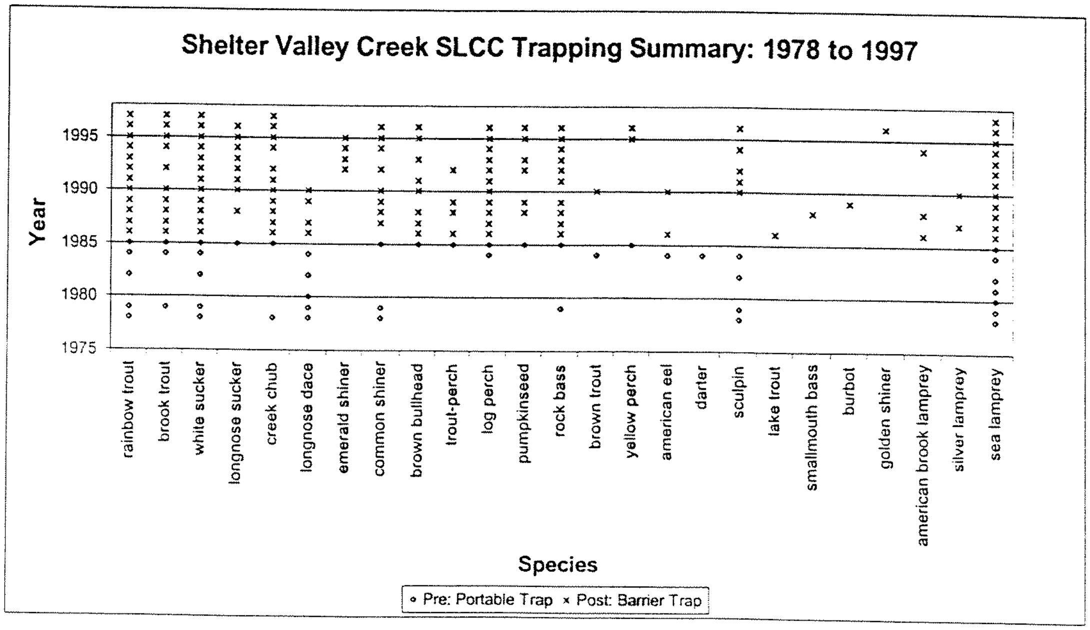
Results

<u>Lake Ontario</u>

Shelter Valley Creek:

The sea lamprey barrier (constructed 1984) in Shelter Valley Creek is located 0.4 km from the stream mouth, and has a built in trap with removable plates (which have never been operated) to allow for late season fish passage. A total of 19 years of data collection yielded 22 species (Figure 1). Total abundance of fish were not significantly different (t-test, $p>0.05$), but the number of species were significantly different ($p<0.05$, Mann-Whitney). For salmonids, the number of species were different post construction, ($p=0.046$) with fewer species caught post barrier construction. For the non-jumping species, the number of species ($p=0.003$) was significantly different (lower). In 1994, the low-head barrier was breached during the spring sea lamprey spawning run and this may be reflected subsequently in the presence of non-jumping species above the barrier. It should be noted that stocking of salmonids – brown and brook trout have occurred in Shelter Valley Creek, prior to the installation of the SLCC low-head barrier.

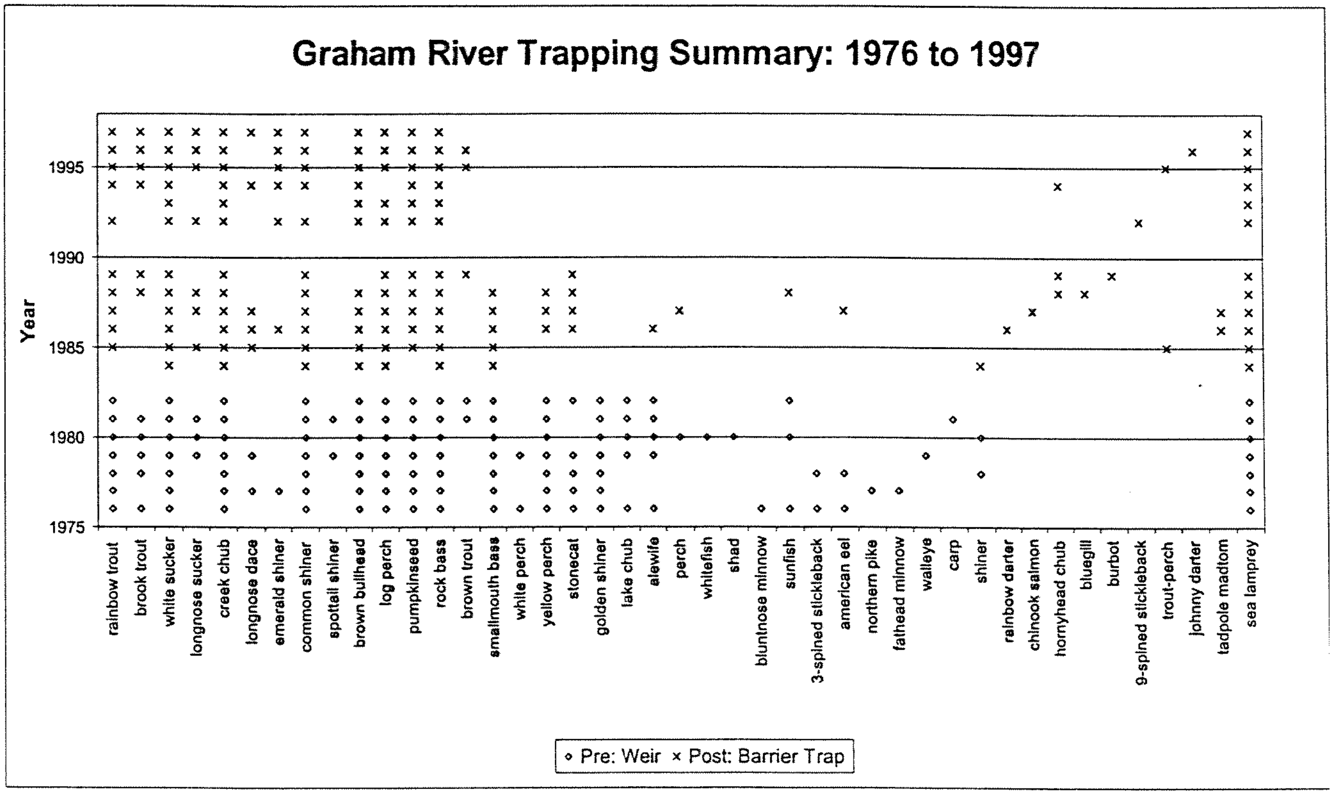
Figure 1: Species found in Shelter Valley Creek SLCC trap catches, 1978 to 1997.



Graham Creek:

The Graham Creek barrier (constructed 1984) is located 1 km from the mouth of the creek. The dam has a built in lamprey trap and the dam crest is a curved-lip design, which may facilitate passage of jumping fish (Barrier Task Force 1988). There have been19 years of fish data collecting using mechanical weirs and the built in trap. Forty-two species were found (figure 2). The OMNR electrofished 2 locations, both above the dam, prior to (1974) and after (1995) dam construction. With future sampling, there may be enough data to test for possible differences in species composition, for a second set of sample locations. Analysis of the SLCC data, using both t-tests and Mann-Whitney analysis revealed significant differences in the species composition for both the all species group (p= 0.004) and the 'forage fish' group (p= 0.006), with fewer fish captured in both groups post barrier construction, with no difference in abundance. After barrier construction, neither the species composition nor the abundance was significantly different for the salmonids group.

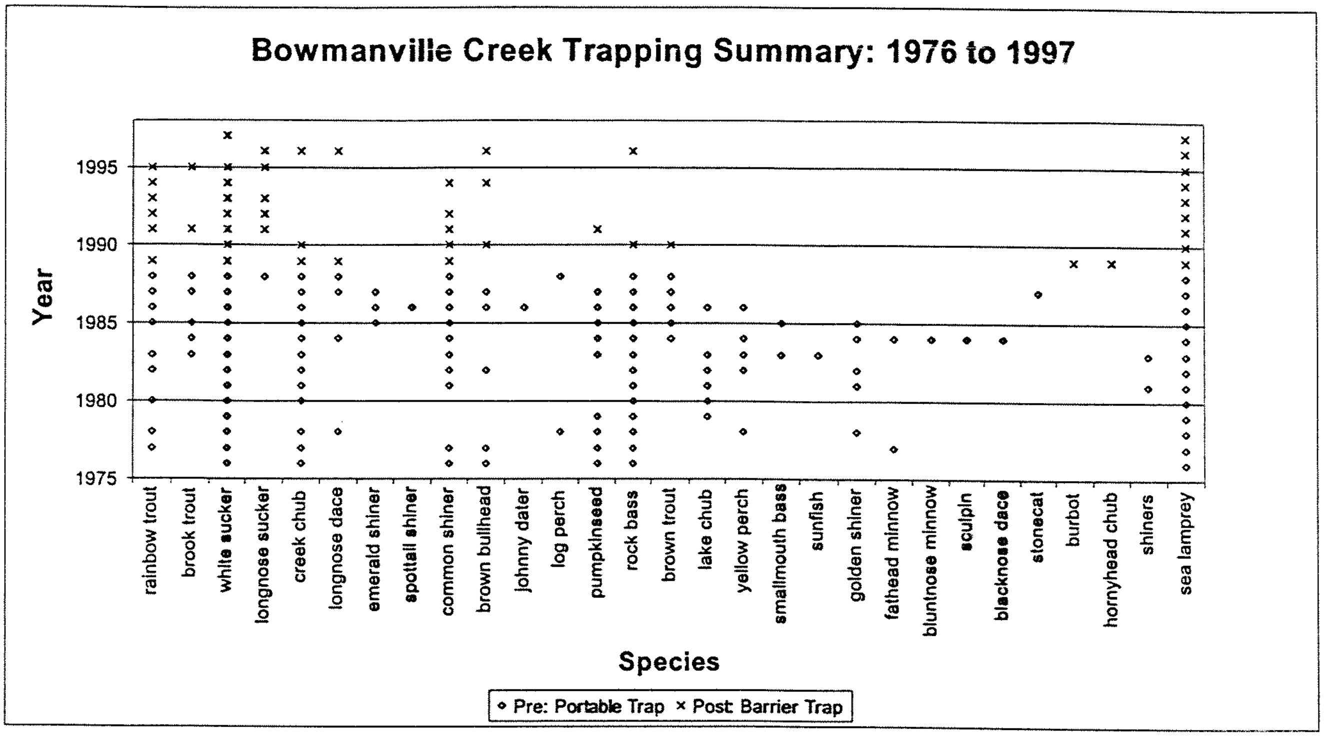
Figure 2: Species found in Graham River SLCC sea lamprey trap catches 1976 to 1997.



Bowmanville Creek:

The Bowmanville Creek dam (constructed 1988) was a modification of an existing barrier to prevent lamprey movement over the original dam and now includes a built in trap. The barrier is located 3.0 km from the stream mouth. The upper river contains a further series of dams. In the 22 years of data collection, 28 species have been found (figure 3). The OMNR data for this river consists of pre dam collections at sites both above and below the present dam location, and post dam collections, (1994 only), at three sites above the dam. This river was stocked with brook and brown trout from 1922 - 1972, on an intermittent basis. Using the SLCC data, none of the three species groups showed any significant difference post construction. Abundance measures for pre- and post-barrier construction was significantly different for the all species (p= 0.026) and the non-jumping groups (p= 0.025) only, with lower catches for both.

Figure 3: Species found in Bowmanville Creek SLCC sea lamprey traps 1976 to 1997.

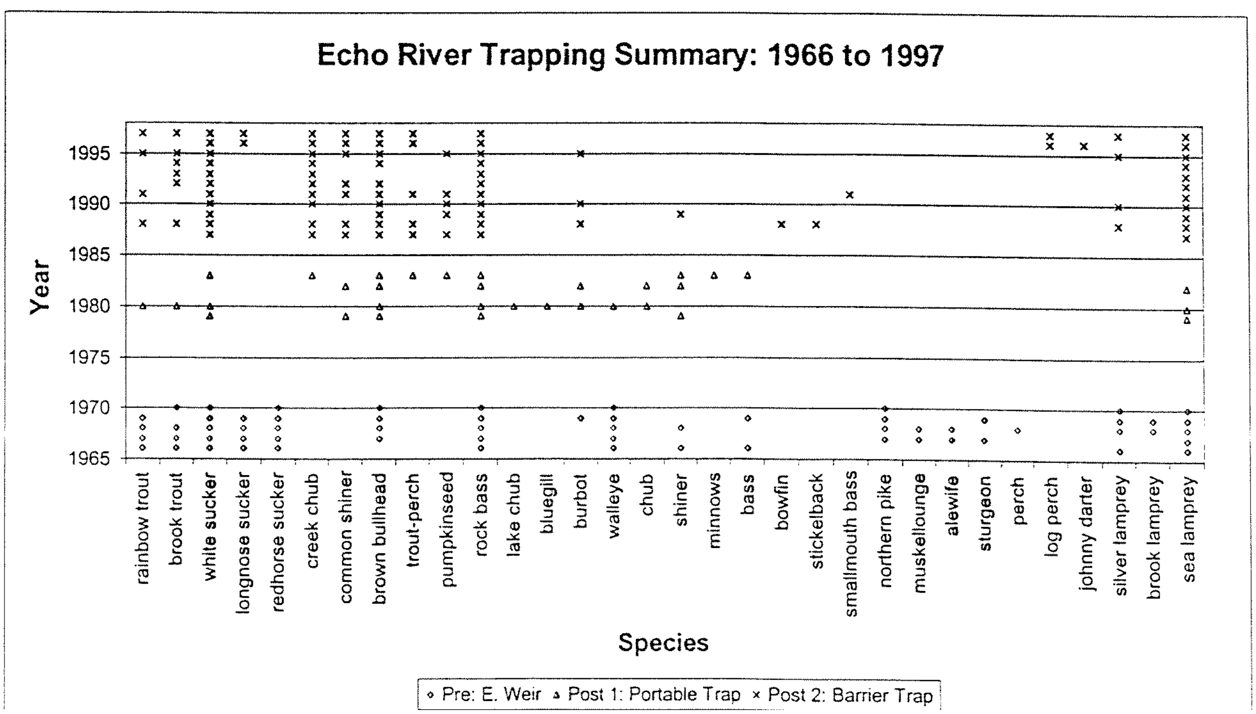


Lake Huron

Echo River:

The Echo River dam is located 2 km north of Echo Lake, approximately 10 km from its entrance to the St. Marys River (Lake Huron). The dam was originally built as a timber crib structure in 1971, and the stream was sampled with portable traps. In 1986, the dam was rebuilt as a low-head barrier complete with a built in trap. In total, fish have been sampled for 20 years in three different traps (electrical weir, portable trap, and dam trap), and 29 fish species were found (Figure 4). Data from the OMNR contained two sites sampled by electrofishing post dam construction, only one of which was above the dam and was not included due to its location (head water lake). Both abundance, ($p= 0.003$) and species numbers, ($p=0.031$) were significantly different (lower post construction) when all species were combined (t-tests). When the data was grouped into salmonids and non-salmonids, the number of species caught was significantly different for the salmonids ($p<0.05$, lower post construction) only. Abundance was not significantly different for either group.

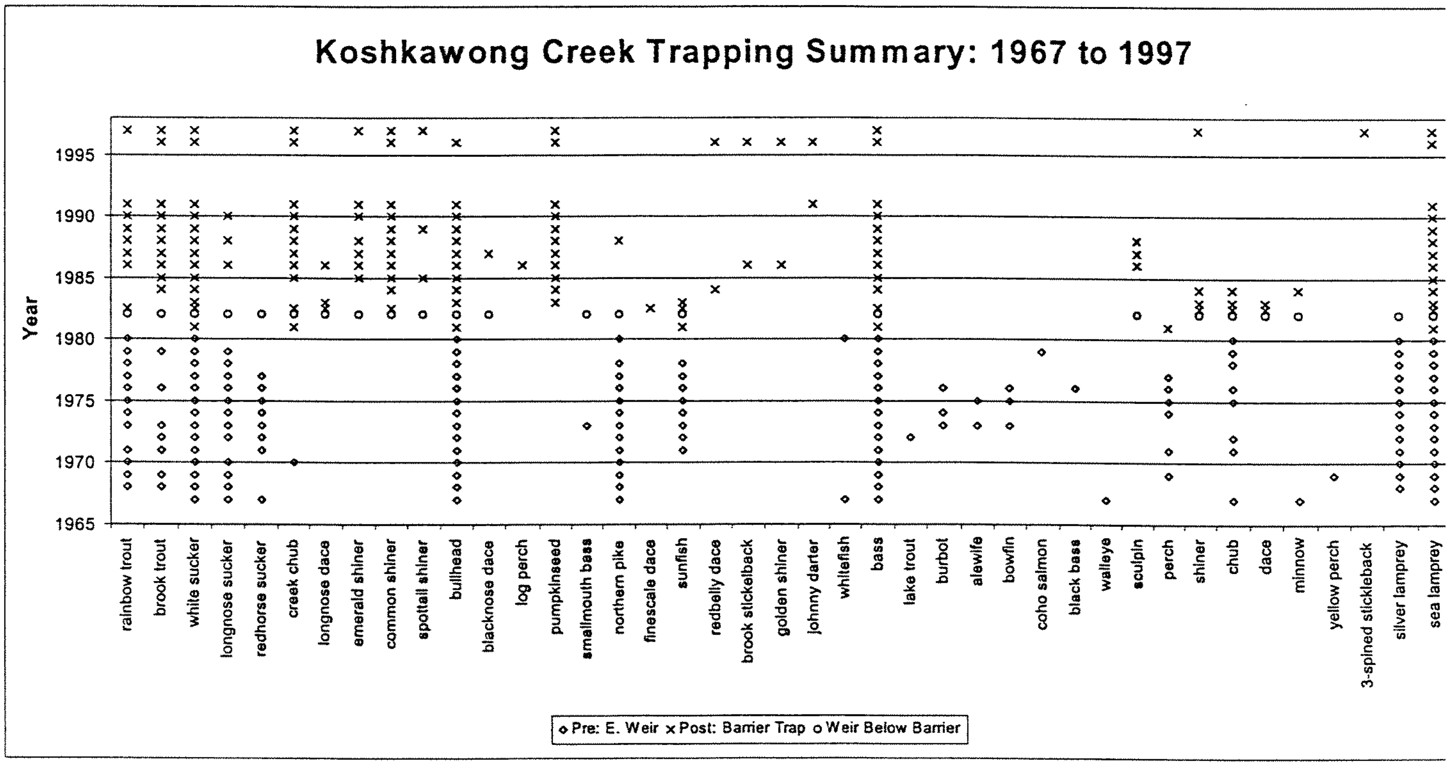
Figure 4: Species found in Echo River SLCC sea lamprey traps 1966 to 1997.



Koshkawong Creek:

Koshkawong Creek's low-head barrier (constructed 1980) is located 1 km from the stream mouth and contains a built-in trap. An electrical weir fished the river for 14 years and the dam trap operated for 13 years. The barrier trap was not operated between 1991 and 1995; however, it was reopened in 1996. Thirty-nine species were collected (Figure 5). The number of species pre and post barrier construction were not significantly different for any of the three sample groups (t tests); abundance, however, was different, for both all species (p=0.015) and non-salmonids (p=0.014) (lower mean catches post barrier construction). In 1982, a mechanical weir was operated in addition to the dam trap. The removal of the data collected from the weir from the analysis yielded no changes to the results. Three sites were electrofished by the OMNR prior to dam construction.

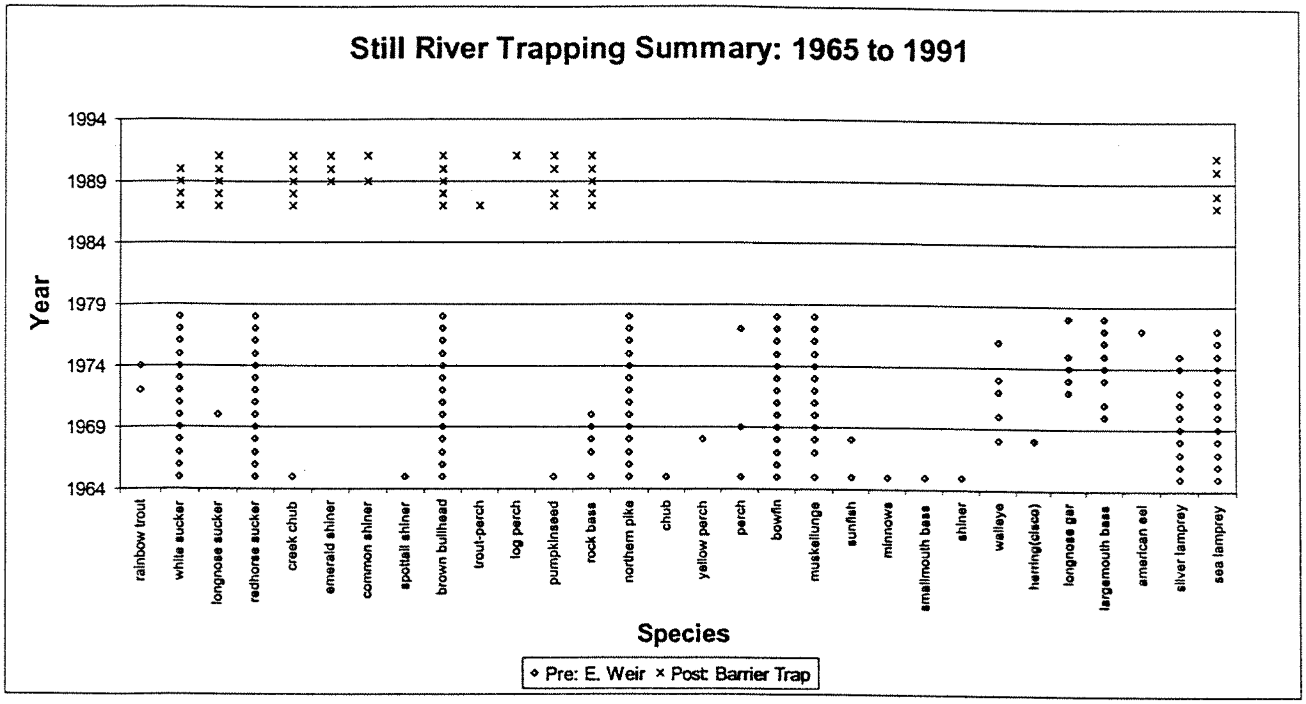
Figure 5: Species found in Koshkawong Creek SLCC sea lamprey traps 1967 to 1997.



Still River:

The Still River barrier (constructed 1986) contains a built-in trap and is located 5 km from the mouth of the river. In the 19 years of fish sampling, 28 species were collected (Figure 6). The OMNR has not sampled the Still River. Salmonids have not been caught in the river on a regular basis (3 individuals in 19 years); thus data analysis was limited to "all fish". Both the species composition (p=0.019) and abundance (p=0.001) were significantly lower post barrier construction (t test).

Figure 6: Species found in Still River SLCC sea lamprey traps, 1965 to 1991.



Lake Superior

Stokely Creek:

The Stokely Creek low-head barrier, with a built-in trap, is located 1 km from the stream mouth. Completed in 1980, the barrier was repaired in 1984. Trapping has taken place on this creek for 20 years, utilizing both electrical weirs and the barrier trap, with 22 species found (Figure 7). For reasons unknown, in 1985 and 1993, no fish and few lampreys were caught in the trap; the data were included in the analysis. OMNR sampling contained sites above the barrier location; however the surveys were conducted only prior to dam construction. The species composition was significantly different only for the non-jumping species (p=0.044); however, abundance was significantly different, p=0.021 for "all fish" and the non-salmonid, p=0.013 groups (Mann-Whitney tests), with lower catches in both species and abundance post barrier construction. In 1982, a mechanical weir was operated in addition to the dam trap. When the data for the weir are removed from the analysis, the abundance of the salmonid group (p=0.016) is significantly lower in the post-barrier sampling period.

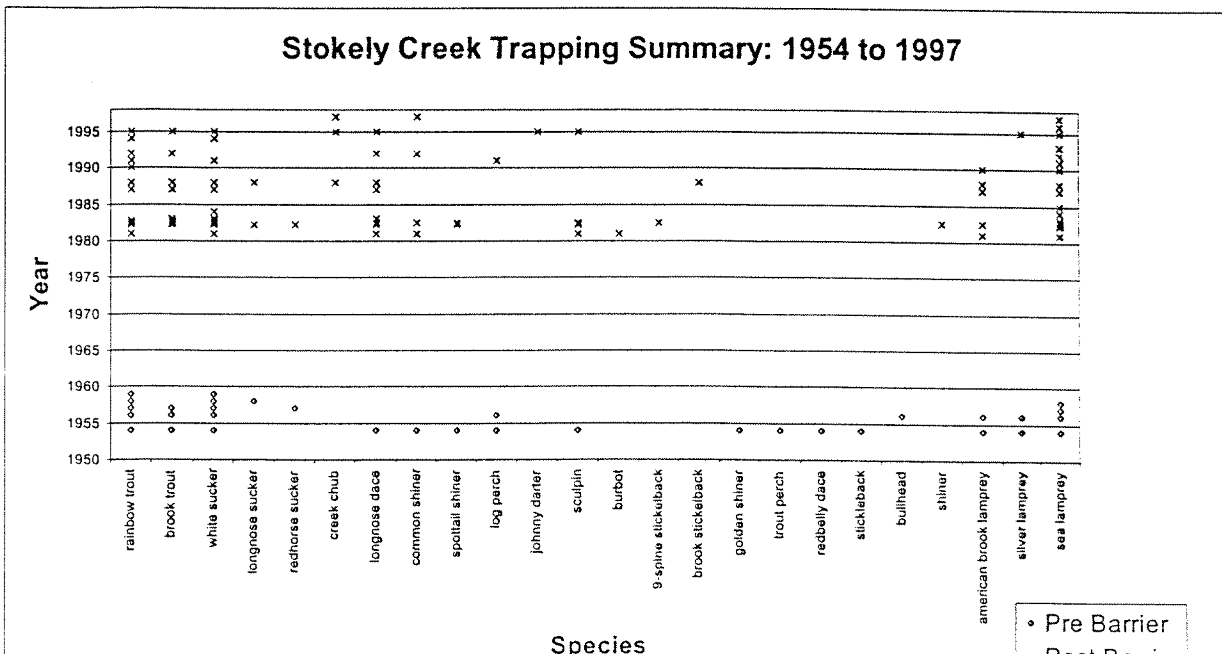
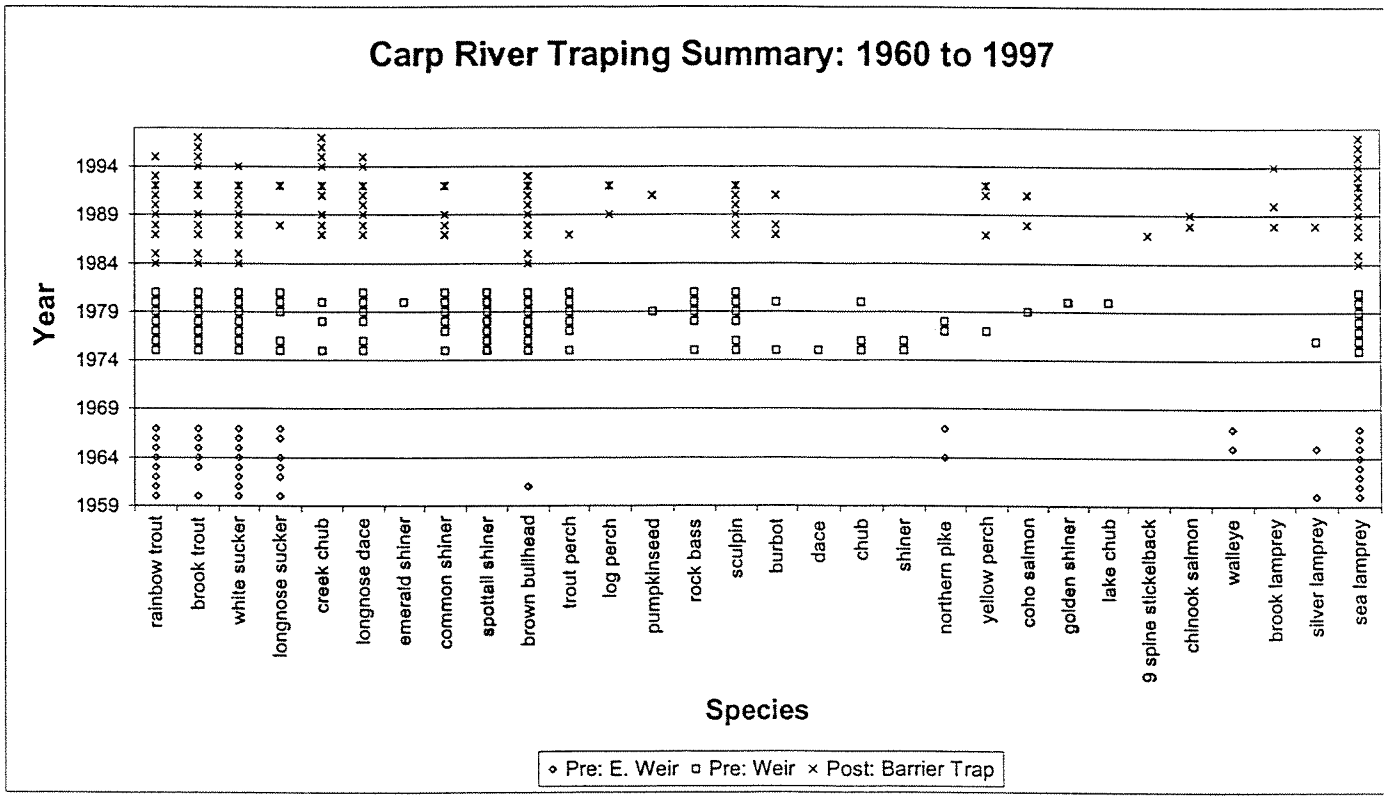


Figure 7: Species found in Stokely Creek SLCC sea lamprey traps 1954 to 1997.

Carp River:

The Carp (Sable) River barrier (constructed 1983) contains a built-in trap and is located 1 km from the stream mouth. Data were collected over 28 years for catches from electrical and mechanical weirs and the permanent barrier trap; 28 species were found (Figure 8). OMNR sampled sites above and below the barrier location prior to the barrier construction. The species composition was not significantly different for any of the species groups, (t-test). Abundance was significantly different for all three species groups, p<0.050, with lower catches in the post sampling period.

Figure 8: Species found in Carp River SLCC sea lamprey traps 1960 to 1997.



Before/after Comparisons using Uncorrected SLCC Data:

We also tested for significant differences pre and post barrier construction using the uncorrected data. We grouped the data by species (the same 3 groups) and their abundance for the total number of species caught by year, and compared the total number of species and their abundance pre- and post- barrier construction. Where possible, we used the Student's t-test (two-tailed) with equal variances (unless noted) with the non-parametric Mann-Whitney U test of similarity used for the remainder of the data. In streams where more than 1 pre- (Carp River) or post- (Echo River) capture device was used, ANOVA testing was used to compare the effects of the trap type between the 3 capture methods.

Shelter Valley Creek:

Catches were divided into the 3 species groups, all fish, all salmonids and all remaining fish. For the total number of species and their abundance, all groups of species were significantly different, p<0.05 (Student's t-tests), with an increase in both abundance and the total number of species found post barrier construction.

Graham Creek:

Student's t-tests were used to test for per and post barrier construction differences for the 3 species groups. No significant differences were found ($p>0.05$) for either the number of species or the abundance of the three species groups throughout the sampling time.

Bowmanville Creek:

The 'all fish' and 'all remaining fish' groups were tested for pre and post barrier construction effects and for both groups, the total number of species and their abundance were significantly different ($p<0.05$, t-test), with lower catches and number of species post construction. No significant difference was found, for either the number of salmonid species or their abundance.

During the years 1981 to 1988, 2 portable traps were fished concurrently each year. The data for the portable traps were combined for year and the data was re-tested for each year using the three species groups. The total number of species for the all fish group was not significantly different ($p>0.05$, t-test). For the 'all salmonids' and 'all remaining fish' groups, the number of species were significantly different ($p<0.05$, t-test), with fewer species found after construction. For the all species groups, their abundance was significantly different, ($p<0.05$, t-test), with lower catches after construction.

Echo River:

For the all fish and the all remaining fish groups, both the number of species sampled and their abundance were significantly different, $p<0.05$, between the time periods, with lower catches occurring in the post time period. No significant difference was found for either the number of species or their abundance for the all salmonids group.

Three different sampling devices were used in the Echo River; an electrical weir prior to a timber crib barrier with portable traps and a second low-head barrier with a built in trap. Differences between the three trapping devices were tested using a one-way ANOVA, for both the 'trap corrected' and raw data, employing the three species groups. Where significant differences occurred, Tukey's post hoc tests were computed for the species group. For the corrected catches, the abundance was significantly different for both the all fish and all remaining fish groups ($p<0.05$). Tukey's post hoc tests indicated that the pre barrier group number of species was significantly different from the post barrier number of species for both species groups, with higher catches in the pre barrier years. The total number of species were significantly different ($p<0.05$) for all three species groups. Tukey's analysis indicated that the new barrier was significantly different from both the electrical weir and the portable traps for both the all fish and all remaining fish species groups, with more species captured in the newest barrier. For the all salmonids group, Tukey's analysis indicated that the electrical weir group was significantly different from the other trapping devices, with more salmonid species captured with the electrical barrier.

Using the uncorrected catches, the abundance for both the all fish and the 'all remaining fish' species groups were significantly different ($p<0.05$) pre- and post- barrier construction. Tukey's post hoc testing for both the all fish and all remaining fish indicated that the pre barrier group abundance was significantly different ($p<0.05$), with higher catches in the pre- barrier years. No significant difference was found in the salmonids group for either the number of species or the abundance.

Koshkawong Creek:

The total number of species and their abundance were compared pre and post barrier construction with and without data from a mechanical weir that was run concurrently with the permanent barrier in 1982. For both the all fish and all remaining fish groups the abundance was significantly different ($p<0.05$) before and after barrier construction, with lower catches in the post barrier construction period. The number of species was not significantly different for any of the three species groups. The removal of the mechanical weir catches from the data analysis did not change the result.

Still River:

Only the all fish species group was tested for before and after barrier changes. The number of species was not significantly different ($p>0.05$), while their abundance was ($p<0.05$).

Stokely Creek:

The total number of species and their abundance were compared pre and post barrier construction with and without the two mechanical weirs run concurrently with the permanent barrier trap in 1982. For all three species groupings the number total number of species was not significantly different between time periods. The abundance was significantly different ($p<0.05$) for all three groups, with lower catches in the permanent barrier trap.

Carp River:

For all three groups of species, no significant differences were found for any of the groups for the number of species, although the abundance of each species group was significantly different ($p<0.05$), with higher catches prior to barrier construction.

Three different sampling devices were used in the Carp River, with an electrical and a mechanical weir prior to the construction of the permanent low-head barrier in 1984. Differences between the three trapping devices were tested with a one-way ANOVA for both the 'trap corrected' and the raw data. Where significant differences occurred, Tukey's post hoc tests were computed for the species groups. For the corrected catches, only the 'all remaining fish' group was significantly different ($p<0.05$) for the number of species. Tukey's post hoc tests indicated that the mechanical weir group was significantly different ($p<0.05$) from both the electrical weir and the permanent barrier, with more species caught with this device. The abundance was significantly different ($p<0.05$) for all three species groups, with Tukey's post hoc test indicating that the mechanical weir was significantly different from both the electrical weir and the permanent trap for all three species groups, with higher catches in this trapping device.

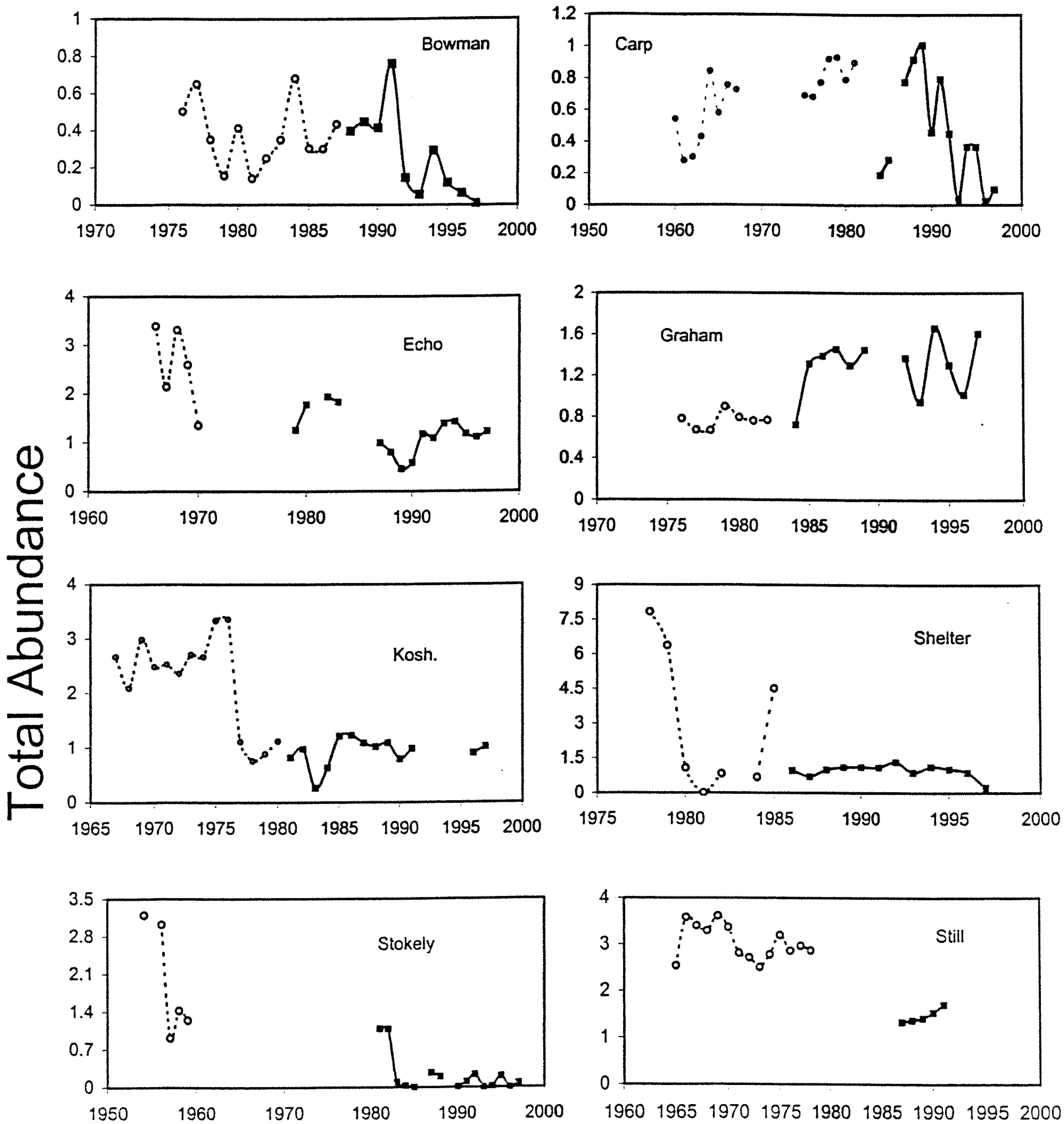
For the raw data, the total number of species were significantly different ($p<0.05$) for both the 'all fish' and the 'all remaining fish' groups. Tukey's post hoc test indicated that the mechanical weir was significantly different ($p<0.05$) from the other sampling devices for both species groups, with more species captured in the mechanical weir. The abundance was significantly different ($p<0.05$) for all three species groups and Tukey's post hoc test indicated the mechanical weir was significantly different ($p<0.05$) from the other devices for all three species groups. The mechanical weir had higher catches for all three species groups.

Other Tests:

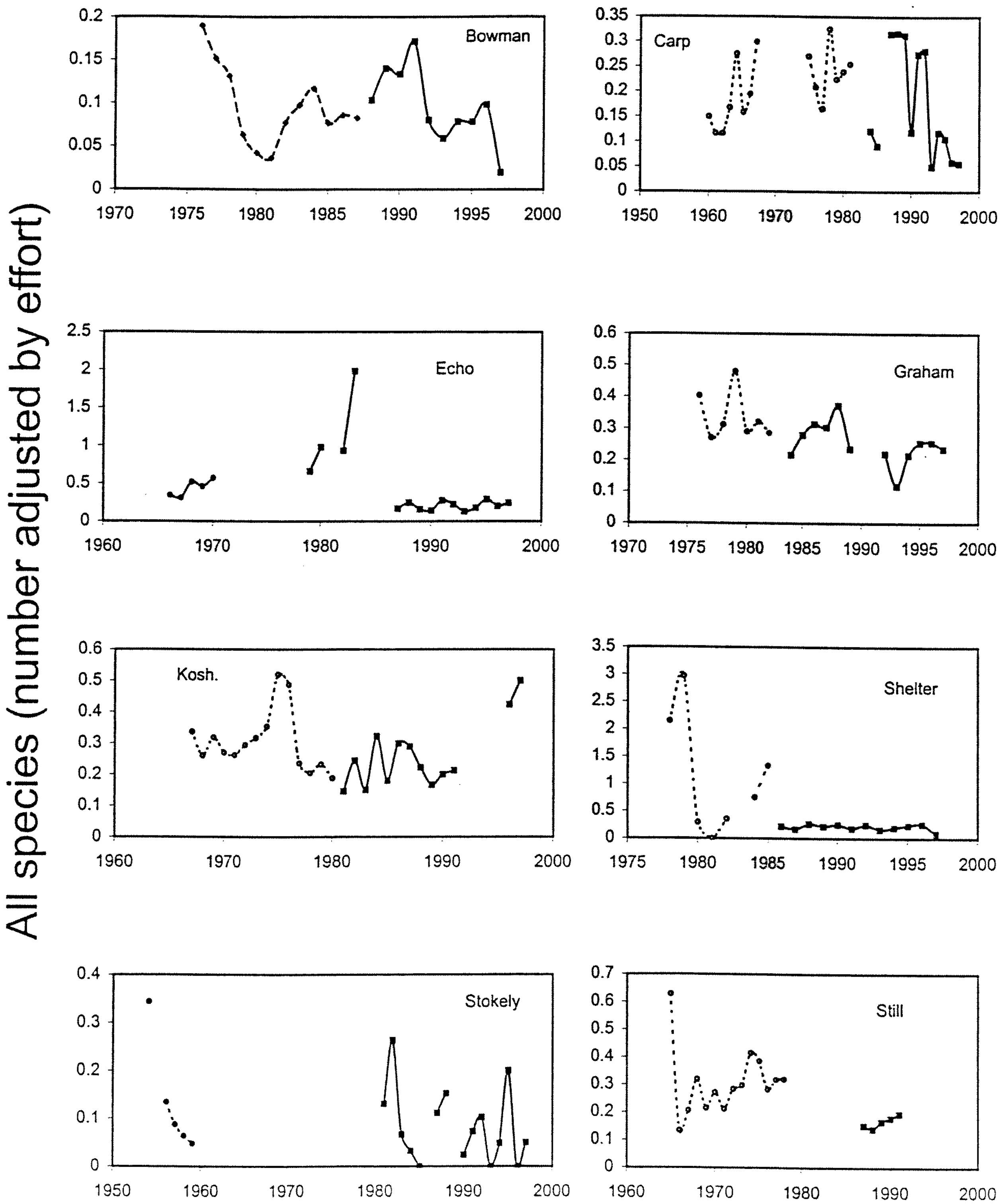
To compare annual trapping effort and annual estimates of the number of fish species and fish abundance before and after barrier dam construction for the 8 streams, we also applied two factor repeated measures analysis of variance model for categorical factors STREAM (8 streams) and TIMEPERIOD (2 time periods). We divided the number in each of the three species groupings by trapping effort to provide a per unit effort index for each species grouping. These effort adjusted species numbers and fish abundance were corrected for trapping method used each year. Effort adjusted fish abundance data were first transformed as: $y= \log_{10}(\text{abundance} + 1)$. Corrections for trap type were then applied to these transformed values. Time periods correspond to before dam construction or after dam construction. Fish species groups are all species, salmonids and non-salmonids. Within each stream and time period, each annual observation was considered a repeated measure. "Between subject effects" indicate if the categorical variables are significant. Significant TIMEPERIOD effects are consistent with the hypothesis that barrier construction influenced the fish variables measured. "Within subject effects" indicate if there is a significant time trend within each STREAM and TIMEPERIOD. The number of years of data available varied for each stream and time period. Although up to 19 years of data were available, the analysis only worked when using 12 years of less.

Species

There was no effect of barriers (before/after dam, or TIMEPERIOD) on the number of fish species, (Figure 9) although for the 12 years of data that were used, the probability of no TIMEPERIOD effect is only 8.4%. Within subjects i.e. within a stream and within the before/after periods, there were significant effects (time trends), and interactions with STREAM and TIMEPERIOD. Salmonid fish show similar results although the time trend effects within subjects are less significant. Non-salmonids also show similar results with the exception that there are no near significant TIMEPERIOD effect.



Total Abundance
Bowman
Carp
Echo
Graham
Kosh.
Shelter
Stokely
Still


All species (number adjusted by effort)
Bowman
Carp
Echo
Graham
Kosh.
Shelter
Stokely
Still

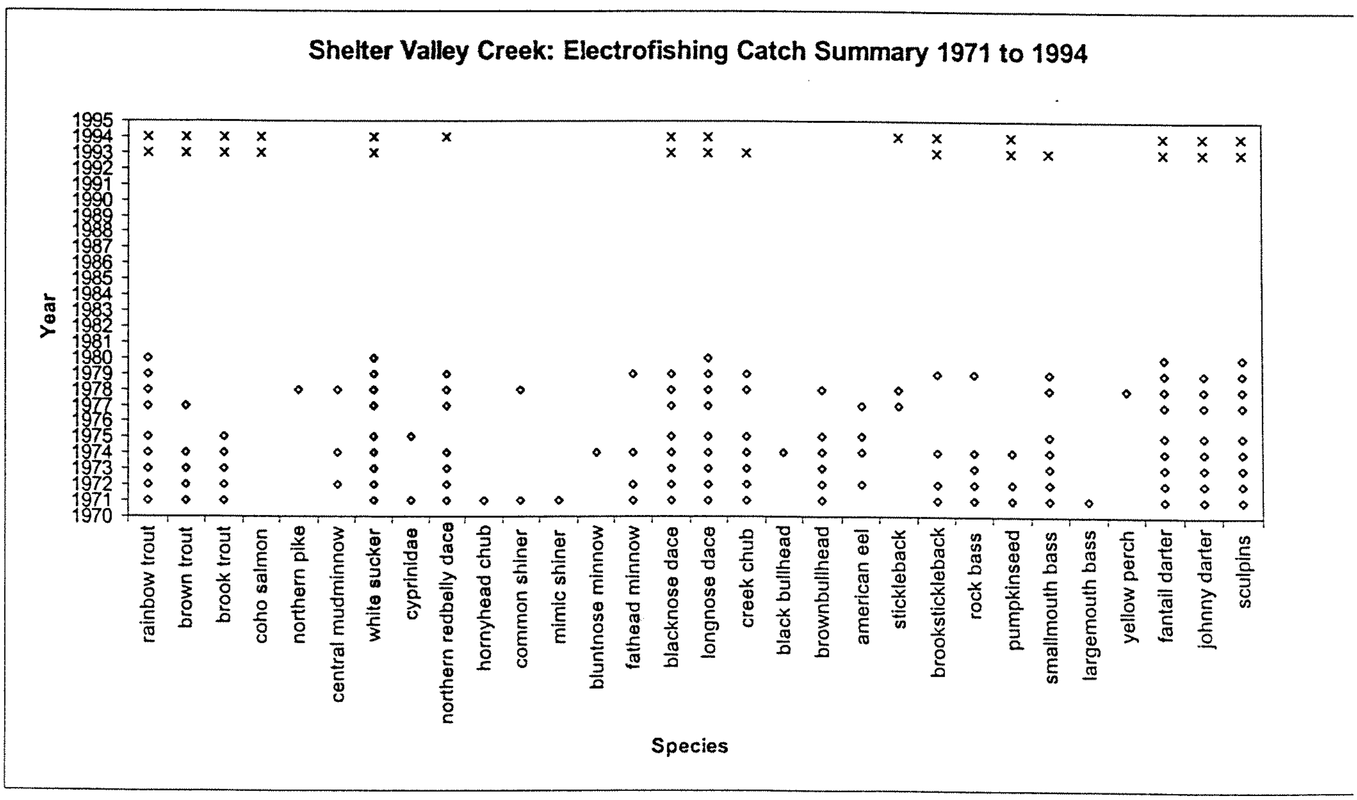
Abundance

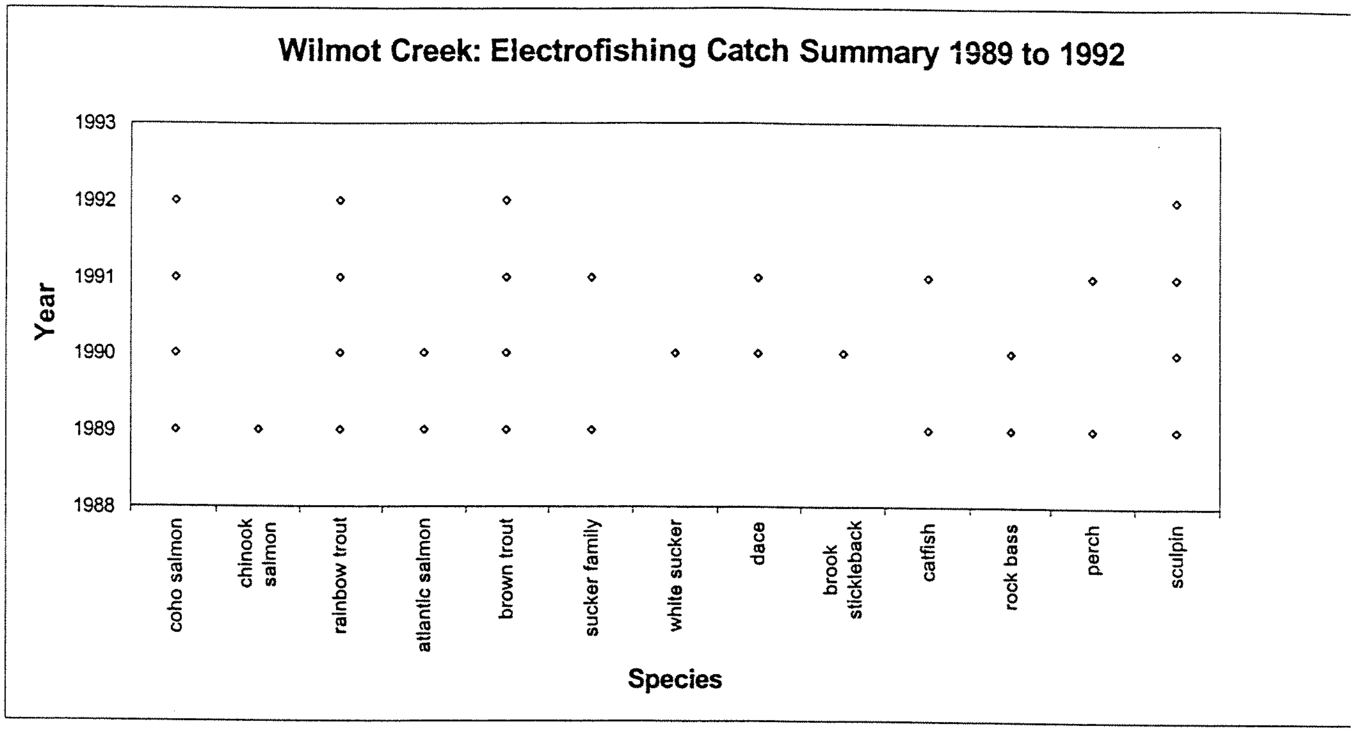
Abundance measures for all fish show no effects of STREAM or TIMEPERIOD nor any time trend effects (Figure 10). Salmonids do show indications of a STREAM effect, a significant time trend and an interaction with stream. Non-salmonids, on the other hand, show no significant effects.

OMNR Quantitative Data:

The OMNR conduct electrofishing surveys on creeks in Ontario. Shelter Valley and Wilmot Creeks were among those surveyed and were electrofished on a regular basis, with years of sampling for each creek. Shelter Valley Creek had 5 sites electrofished both prior to (1971 to 1979) and following (1993, 1994) the SLCC low-head barrier installation. One site was electrofished only prior to the barrier construction. For Wilmot Creek, which does not have a barrier, 2 sites were electrofished from 1989 to 1991 and 3 sites were sampled annually from 1989 to 1992. For both creeks, we tested the sites for differences 'between times' and 'within the stream' effects using Kruskal-Wallis tests of similarity, to examine differences for streams with and without a barrier. Shelter Valley Creek had more species (31) than Wilmot Creek (11) (Figure 11), and Zippin estimates of abundance were calculated for fish at each site for each year.

Figure 11: Summary of species found in Shelter Valley (1971 - 1994) and Wilmot Creeks (1989 - 1992) electrofishing surveys.





In Shelter Valley Creek, for all years, abundance of fish was not significantly different among the stream sites. The number of species was significantly different in the pre (1971 to 1974) and post (1993 and 1994) sampling periods. In Wilmot Creek, the abundance of fish was not significantly different for any of the years among sites, but the number of species was significantly different in 1989 and 1990, $p<0.05$.

Within the individual sites in Shelter Valley Creek, only 1 site, SV1, had significant differences in the abundance of fishes caught in both the pre and pre/post comparisons, $p<0.05$. Significant differences in the number of species were found in all sites when compared within the individual site over time, pre and pre/post construction ($p<0.05$). For Wilmot Creek, the abundance did not change within the sites over time ($p>0.05$); however, the species were significantly different ($p<0.05$) at 3 of the sites (02, 03, 04) between the sampling periods.

Summary

Of the 31 Canadian streams with functional barriers to sea lamprey passage, 13 streams have more than two years of data for fish populations before and after construction. Data were collected from electrical barriers with traps, portable traps, mechanical weirs with traps and traps built into barriers, all operated by the SLCC, and a variety of sampling gears used by the OMNR. Significant effects of different sampling gear were apparent in the data and these were "corrected" for in order to standardize the data. For 7 streams with more than 17 years of sampling pre and post barrier dam construction, the fish community (all species), was subdivided into salmonid and non-salmonid (re: non-jumping) species. When all fish species were considered together, 8 streams were compared for before and after effects (Table 5). For the all species group, 4 of the rivers (50%) were different in the number of species and 6 (75%) were different in their total abundance. The salmonids species 5 (71%) and abundance were the same in 6 (86%) of the 7 creeks. The number of species in the non-salmonid group were significantly different in 3 (42%) of the 7 creeks and their abundance was different in 4 (57%). Repeated measures analysis of variance indicated that there were trends within a stream but, overall, there were no before/after significant differences in species numbers (by group) or abundance.

Table 5: Summary of results of statistical comparisons for 8 streams, 'all species' group, and 7 streams for the 'all salmonids' and 'all remaining fish' species groups.

	Sig. Decrease after barrier construction at $p < 0.05$ corrected data		Sig. increase after barrier construction at $p < 0.05$ corrected data		Sig. Decrease after barrier construction at $p < 0.05$ uncorrected data		Sig. increase after barrier construction at $p < 0.05$ uncorrected data	
Variable measured	No	Yes	no	yes	No	Yes	no	yes
All species	4	4	8	0	6	2	7	1
# salmonid species	5	2	7	0	7	0	6	1
# remaining species	4	3	7	0	5	2	6	1
Total abundance	2	6	8	0	2	6	7	1
Salmonid abund.	6	1	7	0	5	2	6	1
All other sp. Abund.	3	4	7	0	2	5	6	1
Grand Total	24	20	44	0	27	17	38	6

Table 6: Total number of species gained and lost for the individual streams, SLCC trapping data.

Creek	Number of Species Lost	Number of Species Gained
Shelter Valley Creek	1	7
Graham Creek	12	9
Bowmanville Creek	15	2
Echo River	7	13
Koshkawong Creek	11	15
Still River	19	4
Stokely Creek	5	6
Carp River	20	4

Table 7: Species lost or gained when that loss or gain occurred in 2 or more streams, SLCC trapping data.

Number of Streams	Individual Species Lost	Individual Species Gained
4	golden shiner spottail shiner northern pike walleye	burbot johnny darter log perch
3	smallmouth bass lake chub yellow perch shiners redhorse sucker	emerald shiner 9-spined stickleback trout perch common shiner
2	emerald shiner whitefish bluntnose minnow fathead minnow muskellunge alewife chub bowfin silver lamprey	smallmouth bass golden shiner chinook salmon hornyhead chub creek chub brook stickleback american brook lamprey

From the OMNR electrofishing data, the fish species composition was different both within the creek among sites in the same year and over time at the same sites in both Wilmot and Shelter Valley Creeks; the former stream has no barriers. The abundance of fish was significantly different ($p<0.05$) at only one of the sites in Shelter

Valley Creek between time periods i.e. before and after barrier construction. There were fewer fish species in Wilmot (11) than in Shelter Valley (31) Creek.

Overall, all analyses using corrected (for sampling gear), and raw data indicated that, for the 8 streams with an extensive data base that we examined, there was no significant difference in the total number of fish species before and after barrier insertion. Abundance was significantly lower in 75% (6 of 8) streams. The species within the community never the less, was variable; however, in Wilmot Creek (no barrier) variability in the community also existed. Quantitative electrofishing data for fishes in Shelter Valley and Wilmot Creek supported the inferences made from the fixed sampling devices used at SLCC low-head barriers.

There also was no apparent pattern to the loss/gain in fish species before/after barrier construction (Tables 6 and 7). Four streams (Table 7) "lost" golden shiner, spottail shiner, northern pike and walleye; however, four streams "gained" burbot, johnny darter and log perch. We can think of no reason(s) why these species were commonly lost/gained.

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Table 1

River	Year Built	Type/Features	Distance form Mouth/ Confluence (km)	Data: Pre	Collection Method	Data: Post	Collection Method	Total Species	Pre-Years	Post-Years
Lake Superior										
Stokely Cr.	1980: 1984	low head dam built in trap jumping pool	1.0 km	1954-1959 5 yrs	electric weir	1981-1997 15 yrs	dam trap & weir traps: 1982 - weirs above & below dam	22	5	15
Carp (Sable) R.	1983	low head dam built in trap jumping pool	1.0 km	1975-1981 1960-1967 15 yrs	electric weir/weir	1984-1997 13 yrs	dam trap	28	15	13
Lake Huron										
Echo R.	1971 1986	timber cribs low head dam built in trap with connecting pipe	2.0 km	1966-1970 5 yrs	electric weir	1979-1997 (no 1986) 15 yrs	portable traps dam trap from 1987 -	29	5	15
Kashkawong R.	1980,81	low head dam built in trap jumping pool	1.0 km	1967-1980 14 yrs	electric weir	1981-1991 1996 - 1997 13 yrs	dam trap & weir trap (1982)	39	14	13
Still R.	1986	low head dam built in trap with connecting pipe jumping pool	5.0 km	1965-1978 14 yrs	electric weir	1987-1991 5 yrs	dam trap	28	14	5
Lake Ontario										
Bowmanville Cr.	1988	remedial works existing dam	3.0 km	1986-1987 12 yrs	portable trap	1988-1997 9 yrs	dam trap portable trap	28	12	9
Graham R.	1984	low head dam built in trap jumping pool curved lip	1.0 km	1976-1982 7 yrs	portable traps/ weir	1984-1997 12 yrs	dam trap	42	7	12
Shelter Valley Cr.	1985	low head dam built in trap jumping pool removable steel plates for fish passage	0.4 km	1978-1985 7yrs	portable traps	1986-1997 12 yrs	dam trap	22	7	12

Table 2: Competency of sampling gear from year to year
Sampling gear from different years were tested at different locations:

Carp River: mechanical weirs
Koshkawong River : electrical weirs
Still River: electrical weirs, dam traps
Stokely Creek: dam traps
Bowmanville Creek: dam traps, portable traps
Echo River dam traps, portable traps
Shelter Valley Creek: dam traps, portable traps
Graham Creek: mechanical weirs, portable traps

Graham Creek, the Carp and Still Rivers, (dam traps only), were normally distributed, with log transformations for abundance. The remaining data was not normally distributed, even with log transformations.
A Student's t-test, 2-tailed, with unequal variance, was used for data analysis for both the Carp and Still River data.
The non-parametric Mann-Whitney - U test analyzed the remaining data. (Kruskal-Wallis test- 2 case scenario - analogous to the t-test)

river	data set	normal?	test	data set N - days	mean	t value	p	DF	95% sig p<0.05	99% sig p<0.01
Graham Creek	total	yes	1976	29	5.966					
mechanical weirs	sps	yes	1977	36	5.278	1.544	0.128	55.1	no	no
1976/1977										
	log	yes	1976	29	1.444					
	abun	yes	1977	36	1.239	1.841	0.071	56.1	no	no
Carp River	total	yes	weir75	23	4.652					
mech. weirs	species	yes	weir76	23	2.696	3.93	0.000	31	*	**
1975 - 1976										
	log	yes	weir75	23	1.351					
	abun.	yes	weir76	23	1.174	1.076	0.288	44	no	no
Still River	log	yes	dam87	46	1.137					
dam traps	abun	~yes	dam88	43	0.991	1.21	0.23	70	no	no
1987 vs 1988										

river	data set	normal?	test	data set N	Mann-Whitney	X^2 approx.	p	DF	95% sig p<0.05	99% sig p<0.01	mean
Still River	total	yes	dam87	46							2.2826
dam traps	sps	no	dam88	43	1220.5	4.264	0.039	1	*	no	1.6977
1987 vs 1988											
Graham Creek	total	no	1976	6							1
portable traps	sps	no	1977	5	12	0.489	0.484	1	no	no	1.2
1976/1977											
	log	no	1976	6							0.563
	abun	no	1977	5	21	1.251	0.263	1	no	no	0.371
Bowmanville	total	no	dam89	50							0.5
dams 1989-1990	species	no	dam90	45	1148	0.04	0.842	1	no	no	0.5111
	log	no	dam89	50							0.2535
	abun	no	dam90	45	1160.50	0.092	0.761	1	no	no	0.2383
Bowmanville Ck.	total	no	1987E	51							1.6863
portable traps	sps	no	1988E	36	1088	2.287	0.13	1	no	no	1.1944
1987 E/1988 E											
	log	no	1987E	51							0.5643
	abun	no	1988E	36	1058	1.516	0.218	1	no	no	0.4329
Bowmanville Ck.	total	no	1987W	51							1.4118
portable traps	sps	no	1988W	36	908.5	0.007	0.933	1	no	no	1.4722
1987 W/1988 W											
	log	no	1987W	51							0.5091
	abun	no	1988W	36	938.5	0.033	0.857	1	no	no	0.491
Bowmanville	total	no	trap w	36							1.4722
traps 1988	species	no	trap e	36	597.500	0.349	0.555	1	no	no	1.1944
	log	no	trap w	36							0.491
	abun	no	trap e	36	621.000	0.097	0.755	1	no	no	0.4329

Stokely Creek	total	no	dam81	46							1.1956
dam traps	species	yes	dam82	38	499.50	11.9	0.001	1	*	**	2.2368
1981 - 1982											
	log	no	dam81	46							0.6162
	abun	yes	dam82	38	687.50	2.876	0.095	1	no	no	0.8068
Koshkawong	total	no	weir 79	73							0.6438
electric weirs	sps	no	weir80	71	2616.500	1.465	0.226	1	no	no	0.9014
1979 vs 1980											
	log	no	weir79	73							0.2866
	abun	no	weir80	71	2583.500	1.688	0.194	1	no	no	0.4139
Still Rver	total	no	weir77	61							1.7213
electric weirs	sps	yes	weir78	54	1419.000	1.702	0.192	1	no	no	2.0556
1977 vs 1978											
	log	no	weir77	61							0.8057
	abun	yes	weir78	54	1346.000	2.789	0.09	1	no	no	1.0104
Echo River	total	no	trap82	17							1.2941
portable traps	sps	no	trap83	13	140.5	1.843	0.175	1	no	no	1.0769
	log	yes	trap82	17							0.7729
	abun	no	trap83	13	134	0.98	0.322	1	no	no	0.5892
Echo River	total	no	dam87	42							1.3095
dam traps	sps	no	dam88	45	864	0.508	0.476	1	no	no	1.3778
	log	no	dam87	42							0.5667
	abun	no	dam88	45	892.5	0.207	0.649	1	no	no	0.5862
Shelter Valley R.	total	no	dam86	51							1.2745
dam 1986 vs	sps	no	dam87	56	1589.000	1.519	0.218	1	no	no	1.0357
dam 1987											
	log	no	dam86	51							0.5624
	abun	no	dam87	56	1571.500	1.212	0.271	1	no	no	0.4187
Shelter Valley	total	no	trap rt	36							0.3611
trap1 vs trap2	sps	no	trap tr	35	720.500	1.967	0.161	1	no	no	0.1714
1984											
	log	no	trap rt	36							0.1066
	abun	no	trap tr	35	712.500	1.622	0.203	1	no	no	0.0617
Shelter Valley	total	no	trap84 rt	36							0.3611
trap 1984 rt vs	sps	yes	trap85	42	185.000	35.603	0.000	1	*	**	1.9286
trap 1985											
	log	no	trap84 rt	36							0.1066
	abun	~yes	trap85	42	153.000	38.939	0.000	1	*	**	0.6176
Shelter Valley	total	no	trap84 tr	35							0.1714
trap 1984 tr vs	sps	yes	trap85	42	118.000	44.188	0.000	1	*	**	1.9286
trap 1985											
	log	no	trap84 tr	35							0.0617
	abun	~yes	trap85	42	116.000	43.793	0.000	1	*	**	0.6176

mechanical weirs: Carp River: the abundance was unchanged but the species were significantly different.
Graham Creek: no significant difference for either species or abundance

electrical weirs: Koshkawong and Still Rivers: neither species nor abundance changed with the years.

portable traps: Bowmanville, Graham, Echo: neither species nor abundance changed with the years.
Shelter Valley: 1984 traps: no change in species or abundance.
Shelter Valley: 1984 vs 1985 traps: both species composition and abundance were significantly different.

dam traps: Bowmanville, Echo, Shelter Valley: neither species nor abundance changed with the years.
Still, Stokley: species were significantly different (p=0.001), but no change in abundance.

for the Bowmanville cases - both the portable traps and the dam traps caught the same number of species and abundance
for both the Carp and the Stokley cases the abundance was unchanged but the number of species was significantly different
In the Still and Koshkawong rivers, the number of species and abundance was unchanged in two years.

Table 3: Test of gear types

On several rivers, more than one type of sampling gear was used at a time. In these cases, the types have been compared for efficiency based on the same number of days sampling. The number of species caught per 'day' and the abundance was compared in each case.

For Graham Creek, there are two years for comparison purposes, between a mechanical weir and a portable trap.
In 1976, the Carp compared a mechanical weir to a portable trap.
Koshkawong Creek, has a one year comparison between the dam trap and a mechanical weir, and 2 years of electrical barriers vs the 1982 dam
Stokely also has comparisons between mechanical weirs and dam traps.
There was not enough data to compare an electrical weir and a portable trap, and the electrical weirs were never run with a dam trap, for this reason the Koshkawong and Still River data was used to compare electrical and dam traps..(longest running electrical barriers)
Bowmanville, Echo, and Shelter Valley data was also used to test the difference between dam and portable traps.

T-tests were performed on all normally distributed data, 2-tailed, unequal variance, and a Mann - Whitney U-test (non-parametric) was used for th data that could not be normalized with log transformations.

river	data set	normal?	test	data set N - days	mean	t value	p	DF	95% sig p<0.05	99% sig p<0.01
Koshkawong	total	yes	m. weir	35	4.343					
Creek	species	yes	dam	38	2	6.792	0.000	61	*	**
1982										
	log	yes	m. weir	35	1.583					
	abun.	yes	dam	38	0.752	7.311	0.000	71	*	**
Still River	total	yes	dam87	46	2.283					
dam 1987 vs	sps	yes	e. weir78	54	2.056	-0.971	0.334	91.8	no	no
electric weir 1978										
	log	yes	dam87	46	1.137					
	abun	yes	e. weir78	54	1.010	-1.098	0.275	88.8	no	no

Mann Whitney

river	data set	normal?	test	N - days	Mann-Whitney	X^2 approx.	p	DF	95% sig p<0.05	99% sig p<0.01	mean
Stokely Creek	total	no	m. weir	13							2.1538
weir/dam - 1982	species	yes	dam	13	79	0.082	0.774	1	no	no	2.0769
	log	no	m. weir	13							1.727
	abun.	yes	dam	13	35.5	6.413	0.011	1	*	no	0.809
Still River	total	yes	dam87	46							2.283
dam 1987 vs	sps	no	e. weir77	61	1059.000	5.149	0.023	1	*	no	1.7213
electric weir 1977											
	log	yes	dam87	46							1.137
	abun	no	e. weir77	61	873.000	11.199	0.001	1	*	**	0.8057
Still River	total	no	dam88	43							1.6977
dam 1988 vs	sps	yes	e. weir78	54	1318.5	1.372	0.241	1	no	no	2.0556
e. weir 1978											
	log	~yes	dam88	43							0.991
	abun	yes	e. weir78	54	1202	0.089	0.765	1	no	no	1.0104
Still River	total	no	dam88	43							1.6977
dam 1988 vs	sps	no	e. weir78	61	1297	0.01	0.921	1	no	no	1.7213
e. weir 1977											
	log	~yes	dam88	43							0.991
	abun	no	e. weir78	61	1028.5	3.561	0.059	1	no	no	0.8057

river	data set	normal?	test	data set N - days	Mann-Whitney	X^2 approx.	p	DF	95% sig p<0.05	99% sig p<0.01	
Carp Creek	total	no	ptrap	23							0.7826
1976 ptrap/weir	species	yes	weir	23	51.50	23.054	0.000	1	*	**	2.696
	log	no	ptrap	23							0.3136
	abun	yes	weir	23	60.500	20.503	0.000	1	*	**	1.174

Graham	total	no	weir	13							5.3077
Creek	species	no	ptrap	6	12.000	6.003	0.014	1	*	no	1
1976											
	log	~yes	weir	13							1.4263
	abun	no	ptrap	6	12.000	5.627	0.018	1	*	no	0.5634
Graham	total	yes	weir	16							6.0625
Creek	species	no	ptrap	5	4.500	8.971	0.003	1	*	**	1.2
1977											
	log	yes	weir	16							1.4765
	abun	no	ptrap	5	4.500	8.609	0.003	1	*	**	0.3715
Koshkawong	total	yes	dam82	45							1.889
1982 dam vs	sps	no	eweir80	71	990.500	13.017	0.000	1	*	**	0.9014
1980 eweir											
	log	yes	dam82	45							0.749
	abun	no	eweir80	71	955.500	13.651	0.000	1	*	**	0.4139
Koshkawong	total	yes	dam82	45							1.889
dam82 vs eweir79	sps	no	eweir79	73	833.500	22.29	0.000	1	*	**	0.6438
1982 dam vs	log	no	dam82	45							0.749
1979 eweir	abun	no	eweir79	73	777.000	24.713	0.000	1	*	**	0.2866
Bowmanville	total	no	dam89	50							0.5
1989 dam vs	sps	no	west trap	36	1245.500	10.7	0.001	1	*	**	1.4722
trap west 1988											
	log	no	dam89	50							0.2535
	abun	no	west trap	36	1174.000	6.546	0.001	1	*	no	0.491
Bowmanville	total	no	dam90	45							0.5111
1990 dam vs	sps	no	west trap	36	1124.500	10.473	0.001	1	*	**	1.4722
trap west 1989											
	log	no	dam90	45							0.2383
	abun	no	west trap	36	1069.000	6.983	0.008	1	*	**	0.491
Bowmanville	total	no	dam89	50							0.5
1989 dam vs	sps	no	east trap	36	1216.000	9.035	0.003	1	*	**	1.1944
trap east 1988											
	log	no	dam89	50							0.2535
	abun	no	east trap	36	1123.500	4.392	0.036	1	*	no	0.4329
Bowmanville	total	no	dam90	45							0.5111
1990 dam vs	sps	no	east trap	36	1089.500	8.414	0.004	1	*	**	1.1944
trap east 1988											
	log	no	dam90	45							0.2383
	abun	no	east trap	36	1021.000	4.688	0.03	1	*	no	0.4329
Echo trap/dam	total	yes	dam87	25							1.92
comparisons	sps	no	trap82	17	164	1.664	0.197	1	no	no	1.2941
dam 1987 -					mean	t value	p				
trap 1982	log	yes	dam87	25	0.829						0.829
	abun	~ yes	trap82	17	0.773	-0.341	0.735	1	no	no	0.773
Echo trap/dam	total	yes	dam87	25							1.92
dam 1987 -	sps	no	trap83	13	109.5	2.797	0.094	1	no	no	1.0769
trap 1983											
	log	yes	dam87	25							0.8289
	abun	no	trap83	13	130.5	0.995	0.319	1	no	no	0.5892
Echo trap/dam	total	no	dam88	34							1.2941
dam 1988 -	sps	yes	trap82	17	299	0.044	0.834	1	no	no	1.2941
trap 1982											
	log	no	dam88	34							0.5445
	abun	no	trap82	17	362.5	2.19	0.139	1	no	no	0.7729

Echo trap/dam	total	no	dam88	34							1.2941
dam 1988 -	sps	no	trap83	13	189	0.626	0.429	1	no	no	1.0769
trap 1983											
	log	no	dam88	34							0.5445
	abun	no	trap83	13	227.5	0.025	0.875	1	no	no	0.5892
Shelter Valley R.	total	yes	trap85	42							1.9286
dam 1986 vs	sps	no	dam86	51	1394.000	6.629	0.01	1	*	no	1.2745
trap 1985											
	log	yes	trap85	42							0.6176
	abun	no	dam86	51	1244.000	1.82	0.177	1	no	no	0.5624
Shelter Valley R.	total	yes	trap85	42							1.9286
dam87 vs trap85	sps	no	dam87	56	1650.000	13.831	0.000	1	*	**	1.0357
dam 1987	log	~yes	trap85	42							0.6176
trap 1985	abun	no	dam87	56	1537.000	6.92	0.009	1	*	**	0.4187
Shelter Valley	total	no	dam86	41							1.4146
trap 1984 rt vs	sps	no	trap84	39	1240.500	20.718	0.000	1	*	**	0.359
dam 1986											
	log	no	dam86	41							0.6265
	abun	no	trap84	39	126.000	22.22	0.000	1	*	**	0.10617
Shelter Valley	total	no	dam87	41							0.8049
trap 1984 rt vs	sps	no	trap84	39	1004.000	4.985	0.026	1	*	no	0.359
dam 1987											
	log	no	dam87	41							0.3279
	abun	no	trap84	39	1047.000	7.172	0.007	1	*	**	0.10617

mechanical weir/dam trap: significantly different for both species and abundance

electrical weir/dam trap: Koshkawong: sig. different for both species and abundance
Still: 1987/1977: sig. ($p<0.05$) for species and $p<0.01$ for abundance

mechanical weir/portable trap: significantly different for both species and abundance

portable trap/dam trap: Bowmanville and Shelter Valley Creeks: significantly different for both species and abundance
Echo: no difference for either species or abundance

With the exception of Stokely Creek, which did not have a sig. different number of species,
in all cases there were significant differences in both the number of species and their abundance, based on gear types.
In Bowmanville Creek, a significant difference was found for the number of species for each year and either trap and
total abundance was sig. different for either trap vs 1990, however for 1988, significant differences only occurred at the $p<0.05$ level in both traps

Table 4: Correction factor for gear types

Not all rivers ran concurrent traps for efficiency testing. For thoses that did not, I used the closest years available for comparison purpose

WEIR VS DAM TRAP	N			SPS	(log) ABUN	'CORRECTION' FACTOR:	
Koshkawong Creek species:			mean				
	35	weir82	4.343	2.17			
	38	dam82	2.000			SPS	ABUN
Koshkawong Creek abundance (log):						1.60	2.12
	35	weir82	1.583		2.11		
	38	dam82	0.752				
Stokely Creek species:							
	13	weir82	2.154	1.04			
	13	dam82	2.077				
Stokely Creek abundance (log):							
	13	weir82	1.727		2.13		
	13	dam82	0.809				

RESULTS: WEIR ~ 1.6 x MORE EFFECTIVE THAN DAM FOR SPS, & 2.1 x MORE EFFECTIVE FOR ABUNDANCE

PORTABLE TRAP VS WEIR:

Carp Creek species:	N		mean	SPS	(log) ABUN	'CORRECTION' FACTOR:	
	23	weir76	2.696				
	23	ptrap76	0.7826	3.44		SPS	ABUN
Carp Creek abundance (log) :						4.60	3.42
	23	weir76	1.174				
	23	ptrap76	0.314		3.74		
Graham Creek:							
species	13	weir76	5.3076				
	6	ptrap76	1.000	5.31			
abundance (log)	13	weir76	1.426				
	6	ptrap76	0.563		2.53		
Graham Creek:							
species	16	weir77	6.063				
	5	ptrap77	1.200	5.05			
abundance (log)	16	weir77	1.477				
	5	ptrap77	0.371		3.98		

RESULTS: WEIR TRAP ~ 5x GREATER NUMBER OF SPECIES, & 3.4 x GREATER IN ABUNDANCE

DAM VS ELECTRIC WEIR:

Koshkawong River:	N		mean	SPS	(log) ABUN	'CORRECTION' FACTOR:	
species	45	dam82	1.888				
	71	e. weir80	0.90	2.09		SPS	ABUN
abundance (log)	45	dam82	0.749				
	71	e. weir80	0.414		1.81	2.12	1.95
Koshkawong River:							
species	45	dam82	1.888				
	73	e. weir79	0.644	2.93			
abundance (log)	45	dam82	0.749				
	73	e. weir79	0.286		2.62		
Still River: only the 1987 dam trap vs the electric weir of 1977 showed a significant difference							
species	46	dam87	2.2826				
	61	e. weir77	1.7213	1.33			
abundance (log)	46	dam87	1.1371				
	61	e. weir77	0.8057		1.41		

RESULTS: DAM TRAP ~ 2x MORE EFFICIENT IN SAMPLING FOR BOTH SPECIES AND ABUNDANCE

DAM VS PORTABLE TRAP:

It is generally assumed that a dam trap is more efficient than a portable trap: however for the Bowmanville River I have found that the portable trap is more efficient - in the singular! For the Echo River I have found no difference between the dam and portable traps. For the Shelter Valley Creek the 1984 traps were significantly less efficient than the dam trap catches. The 1984 trap was also significantly less than the 1985 trap catch. The 1984 trap was used due to its location, and similarity to previous years catches.(trap comments from - SL Barrier Workshop, Draft 4 ,1994)

A visual check for other rivers also shows a wide disparagy for portable traps; some is weather related, others vandalism,others may be 'an act of God' - for portable traps there may be no standard comparison factor.

1988 traps used Bowmanville Creek:	N		mean	SPS	(log) ABUN	'CORRECTION' FACTOR: SPS	ABUN
species	36	trapwest	1.472				
	50	dam89	0.5	2.94			
abundance (log)	36	trapwest	0.491				
	50	dam89	0.253		1.94	2.64	1.88
sig. at 0.05%							
Bowmanville Creek:							
species	36	trapeast	1.194				
	50	dam89	0.500	2.39			
abundance (log)	36	trapeast	0.433				
	50	dam89	0.253		1.71		
sig at 0.05%							
Bowmanville Creek:							
species	36	trapwest	1.472				
	45	dam90	0.511	2.88			
abundance (log)	36	trapwest	0.491				
	45	dam90	0.238		2.06		
Bowmanville Creek:							
species	36	trapeast	1.194				
	45	dam90	0.511	2.34			
abundance (log)	36	trapeast	0.433				
	45	dam90	0.2383		1.82		

RESULTS: THE PORTABLE TRAPS WERE MORE EFFICIENT IN CATCHING ~2.6x MORE SPECIES AND ~1.8x GREATER ABUNDANCE

Shelter Valley Creek: rectangle trap	N		mean	SPS	(log) ABUN	'CORRECTION' FACTOR: SPS	ABUN
species	41	dam86	1.4146				
1986 vs 1984 rt	39	trap84 rt	0.359	3.94			
abundance (log)	41	dam86	0.627				
	39	trap84 rt	0.106		5.90	4.66	6.05
Shelter Valley Creek:							
species	41	dam87	0.8049				
1987 vs 1984 rt	39	trap84 rt	0.359	2.24			
abundance (log)	41	dam87	0.328				
	39	trap84 rt	0.106		3.09		
Shelter Valley Creek: triangle trap	N						
species	38	dam86	1.3158				
1986 vs 1984 tri	35	trap84 tri	0.1714	7.68			
abundance (log)	38	dam86	0.606				
	35	trap84 tri	0.062		9.82		
Shelter Valley Creek:							
species	39	dam87	0.8205				
1987 vs 1984 tri	35	trap84 tri	0.1714	4.79			
abundance (log)	39	dam87	0.333				
	35	trap84 tri	0.0617		5.39		

RESULTS: FOR SHELTER VALLEY CREEK THE DAM TRAP IS ~ 4.7x MORE EFFICIENT FOR SPECIES & 6.05x MORE EFFICIENT FOR ABUNDANCE -OVER ALL. IN 1985 ONLY 1 TRAP WAS RUN & IT WAS MORE EFFICIENT THAN THE PREVIOUS YEAR - NO DIFFERENT FROM THE 1986 DAM TRAP (not corrected).

Table 1

Lake Ontario Summary - Canadian SLCC Data

Number	River	Year Built	Type/Features	Distance form Mouth/ Confluence (km)	Dam Location Latitude Longitude	Data: Pre	Collection Method	Data: Post	Collection Method	Total Species *	Pre-Years	Post-Years
92	Credit R	1980-81	reconstructed old mill dam fishway	15.0 km	43 34 30 79 41 47	1980-1981 2 years	portable traps	1982 1 year	3 traps run 2 portable dam trap	14	2	1
100	Humber R	1981-82	flood control dam built in traps	4.0 km	43 39 07 79 29 44	1980-1981 2 years	2 portable traps	1982-1995 14 years	dam trap	50	2	14
117	Duffins Cr	1980, 1984	low head dam built in trap jumping pool	6.0 km	43 50 52 79 03 17	1976-1980 2 years	portable trap	1982-1995	dam trap 15 years	25	2* traps lost	15
131	**Bowmanville Cr**	1988	remedial works existing dam	3.0 km	43 54 30 78 41 30	1976-1988 13 years	portable trap	1989-1997 9 years	dam trap portable trap	27	13	9
133	**Graham R**	1984	low head dam built in trap jumping pool curved lip	1.0 km	43 54 16 78 35 00	1976-1982 7 years	portable traps/ weir	1984-1997 12 years	dam trap	29	7	12
141	Port Britain Cr	1989	low head dam	1.0 km	43 56 13 78 22 02	0		1990-1995 6 years	dam trap	19	0	5
154	Grafton Cr	1987	low head dam	.250 km	43 58 11 70 03 19	1981 1 year	portable trap	1988-1989 2 years	dam trap	11	'1' 2 weeks	2
157	**Shelter Valley Cr**	1985	low head dam built in trap jumping pool removable steel plates for fish passage	0.4 km	43 58 20 78 00 05	1978-1985 7 years	portable traps	1986-1997 12 years	dam trap	19	7	12
161	Lakeport Cr	1984	low head dam built in trap jumping pool	1.0 km	43 59 14 77 54 04	0		1985-1988 4 years	dam trap	12	--	4
242	Salmon R	1974-1980	modified old mill dam	2.84 km	77 13 44 44 11 44**	1976-1980	portable traps	1976-1980 5 years?	portable traps	15		5?

* number of species used for data analysis

Table 2

Lake Erie Summary - Canadian SLCC Data

Number	River	Year Built	Type/Features	Distance form Mouth/ Confluence (km)	Dam Location Latitude Longitude	Data: Pre	Collection Method	Data: Post	Collection Method	Total Species *	Pre- Years	Post- Years
99	Little Otter Cr	1990	low head dam	1 km	42 44 44 80 49 53	1980-1989 2 years	portable traps: Big Otter Cr Stoney Cr Little Otter Cr	1992-1994 2 years	Dam trap Little Otter Cr	18	2	2
101	Clear Cr	1989	low head dam	1 km	42 34 56 80 35 20	0		1990 1 year	dam trap	3	0	1
111	Forestville Cr	1988	low head dam	1 km	42 40 45 80 22 05	0		1989 1 year	dam trap	13	0	1
112	Normandale Cr	1988	low head dam	0.1 km	42 42 33 80 18 34	0		0		0	0	0
121	Young's Cr	1970's 1994	OMNR dam remedial work to make barrier	0.3 km	42 45 22 80 15 34	1980-1994? 7 years	portable traps	1980-1995 2 years	portable traps	29	7?	2?
** actual dam is a highway culvert with an extended lip												
104	Big Creek	1995	inflatable barrier	42 km	42 46 37 80 30 20	1980-1995 5 years	portable traps: Big Cr Main (Delhi) Stoney Cr			26	5	
	Venison Cr	1995	stop log dam	3.9 km	42 39 40 80 34 17	1980-1986 2 years	Venison Cr Lehman's dam (trib)			10	2	

*number of species used for data analysis

Table 3

Lake Huron Summary - Canadian SLCC Data

Number	River	Year Built	Type/Features	Distance form Mouth/ Confluence (km)	Dam Location Latitude Longitude	Data: Pre	Collection Method	Data: Post	Collection Method	Total Species *	Pre-Years	Post-Years
1492	Saugeen R	1970	multi purpose dam with OMNR built in trap fishway	4.0 km	44 30 16 81 19 44	0		1980, 1981 2 yrs	Portable traps (2), dam trap	14	0	2
1343	Sturgeon R	1979	low head dam fish passing gate, jumping pool	1.0 km	44 43 47 79 43 26	0		1980, 1981 2 yrs	portable traps (2)	17	0	2
726	**Still R**	1986	low head dam built in trap with connecting pipe jumping pool	5.0 km	45 48 31 80 30 55	1965-1978 14 yrs	E. Weir	1987-1991 5 yrs	dam trap	24	14	5
606	French R	1970	remedial work to chute	15.0 km	46 00 80 31	0		0		?	--	--
313	Manitou R	1983	remedial work to natural falls	1.0 km	45 36 11 82 06 04	1967-1975 9 yrs	E. Weir	1984 1 yr	portable traps (2)	19	9	1
102	Harris Cr. (Mississagi R)	1950's	modified highway culvert	14.0 km (confluence)	46 18 83 02	0		0		?	--	--
62	**Koshkawog Cr**	1980,81	low head dam built in trap jumping pool	1.0 km	46 09 42 83 50 21	1967-1980 14 yrs	E. Weir	1981-1991 1996, 1997 13 yrs	dam trap & weir trap (1982)	34	14	13
10	**Echo R**	1971 1986	timber cribs low head dam built in trap with connecting pipe	2.0 km	46 34 25 83 56 05	1966-1970 5 yrs	E. Weir	1979-1997 (no 1986) 15 yrs	portable traps dam trap from 1987 -	26	5	15

* number of species used for data analysis

Table 4

Lake Superior Summary - Canadian SLCC Data

Number	River	Year Bulit	Type/Features	Distance from Mouth/ Confluence (km)	Dam Location Latitude Longitude	Data: Pre:	Collection Method	Data: Post-	Collection Method	Total Species *	Pre- Years	Post- Years
05	Big Carp	1994	inflatible barrier	1.2 km	46 30 21 84 27 07	1960-1967 8 yrs	electric weir	1997 2 yr	built in trap	21	8	2
24	Sheppard Cr (Goulais R.)	1984	low head dam gabian baskets (unknown if functional) - jumping pool	0.4 km (to Goulais R.)	46 45 84 12	1956-1960 (Goulais R.) 5 yrs	electric weir	0		15 Goulais R.	5** Goulais R.	?
36	Stokely Cr	1980: 1984	low head dam built in trap jumping pool	1.0 km	46 48 43 84 24 26	1954-1959 5 yrs	electric weir	1981-1997 15 yrs	dam trap & weir traps: 1982 - weirs above & below dam	18	5	15
54	Carp (Sable) R.	1983	low head dam built in trap jumping pool	1.0 km	46 57 13 84 34 23	1975-1981 1960-1967 16 yrs	electric weir/weir	1984-1997 13 yrs	dam trap	26	15	13
56	Gimlet Cr (Pancake R.)	1979	low head dam jumping pool	0.1 km (to Pancake)	46 50 84 39	1960-1967 (Pancake) 8 yrs	electric weir	1980-1995 1987-89/93&94 traps on Pancake	portable traps, weir,nets (above & below dam)	Gimlet: 14 Panc: 29	? 8 yrs	10
509	Black Sturgeon	1966-68	modified provincial dam	16.0 km	48 55 19 88 23 22	0		1987	portable traps	4	0	1
517	Wolf R.	1987	low head dam built in trap jumping pool	7 km	48 49 07 88 32 05	1981, 1987 2 years	portable traps (2)	1988-1991 1994-1995	dam trap 6 years	18	2	6
571	Neebing-McIntyre River(s)	1993	velocity barrier	4.6 km	48 24 16 89 16 10	1987-1988 1957-1959 5 yrs	electric weir portable traps	1994-1995 2 yrs	trap (built in)	22	5	2

* number of species used for data analysis

Summary of data collected by Trevor Middel and Lisa O'Connor

Trev.: T. Middel: data from both Population data base and M. Jones

OMNR: L. O'Connor: data from Fish Distribution Database, individual OMNR offices and M. Jones - all referenced for this project only

SLCC data: data collected and summarized from the Sea Lamprey Control Centre; 'top' refers to data (possibly) available in storage at this time

Lake	Watershed Code	Twnship	Year Built	Barrier	Trev.	Year	SLCC	Have	Omnr	Year	None	same?	Watershed Code	Twnship	Pair	Trev.	Year	SLCC	Have	Omnr	Year	None
Superior	2BF11		1980/1984	Stokely	n		y	h	y	1954-83			2BF04		Pancake	n		y	h	y	1958-77	
	2AB8&9		1993	Neeb /MacIntyre	n		y	h	y	1941-87			2AB3		Whitefish(Kam)	n		n		n		n
	2BF01		1994	Big Carp	n		y	h	y	1965-85			2BF01		Little Carp	n		y	top	y	1958-85	
	2BF05		1983	Carp	y	1983-84	y	h	y	1954-84			2BF11		Harmony	n		y	top	y	1954	
	2AC14		1987	Wolf	n		y	h	y	1949-78			2AE05		Gravel	n		y	top	n		
	2BF03		1984	Sheppard(Goulais)	n		y-goulais		y	1982					--------							
	2BF04		1979	Gimlet	n		y	h	y	1958					--------							
	2AC09		1966-68	(Black) Sturgeon	n		y	h	y	1976					--------							
not barrier streams	2AE04			Cypress	n		y	top	n				2AD01		Cash	n		n		n		n
Lake Huron																						
	2CG09		1983	Manitou	n		y	h	y	1965-83			2CG10		Blue Jay	n		y	top	n		
	2EA09		1986	Still	n		y	h	y	1958-66**			2EA10		Naiscoot	n		y?	top?	n		
	2ED04		1979	Sturgeon	y	1982-90	y	h	y	1957-88			2ED11		Mad (Nottawsaga)	y	1985	y?	top?	n		
													2ED12		Pine	y	1982-90	(no 1984)		n		
	2CA3		1971/86	Echo	n		y	h	y	1960-75			2CA01		Root	n		y	top	n		
	2CA09		1980/81	Koshkawong	n		y	h	y	1958-76			2CA09		Browns	n				n		n
	2FC01		1970	Saugeen	y*		y	h	y	1923-85					--------				no data in FDDB			
	2DD01, 2DB01		1970	French	n		n	n	y	1929-49	n				--------							
	2CC02		1950's	Harris(Mississagi)	n		n	n	n	n	n											
													2ED04		Nottawsaga					y	1986-88	

* data not included

** SLCC data - no further study by OMNR

Lake			Year Built	Barrier	Trev.	Year	SLCC	Have	Omnr	Year	None				Pair	Trev.	Year	SLCC	Have	Omnr	Year	None
Erie	2GC07		1988	Forestville	n		y	h	y	1974			2GC07		Fishers	y	81, 84-85			Y	72, 81, 84-85	
	2GC5		1989	Clear	n		y	h	y	1929-81			2GC05		South Otter	n				Y	1974, 80	
	2GC8		1995	Big Creek	y	1983-85	y	h	y	1955-85			2GC04		Big Otter (?)	n				Y	1930..84	
	2GC8		1995	Venison	y	80, 83-85	y	h	y	1955-85*					--------							
	2GC7		1970's/94	Young's	y	81, 83-90	y	h	y	1944-88			2GC05		South Otter	n						
	2GC7		1988	Normandale	y	1984-85	n		y	1980-85	n				--------							
	2GC5		1990	Little Otter	n		y	h	y	1955-80												
Lake Ontario																						
	2HC10		1980/84	Duffins	y	1983, 87	y	h	y	1943-87			2HC11		Lynde	n				n		
	Northumberland		1987	Grafton	n		y	h	n				Northumberland	Township	Salem	y	1981			n		
	Township		1985	Shelter Valley	n		y	h	y	1971-94			2HD05		Wilmot	y	83, 89-92			y		
	(all 3 rivers)		1984	Colbourne(Lkport)	y	1981	y	h	y	1974					--------							
	2HB02		1980/81	Credit	y	81-86,89-91	y	h	y	1923-87			2HB04		Bronte	n				n		
	2HD05		1984	Graham	y	1984	y	h	y	1974-95					--------							
	2HD05		1989	Port Britain	n		y	h	y	1974					--------							
	2HM02		1974-80	Salmon River	n		y	h	y	1924-79					--------							
	2HD04		1988	Bowmanville	y	1983	y	h	y	1931-94			2HD04		Soper	y	1984			y	1931-74	
	2HC04, 3, 5		1981/82	Humber	y	82, 87	y	h	y	1917-87												
	2HD07		1996	Cobourg	y	1984	n		n													

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