

GREAT LAKES FISHERY COMMISSION

Project Completion Report¹

Fishery assessment of the Big Creek, Lake Erie, inflatable barrier and fishway project

by:

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Final report of research conducted for the
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Introduction

The Great Lakes Fishery Commission, through its agents, constructs barriers to block the passage of sea lampreys to spawning areas in tributaries to the Great Lakes. These barriers have been successful in reducing the amount of chemical required to manage sea lamprey populations by eliminating the production of sea lamprey upstream of these barriers. The GLFC is currently evaluating the use of different barrier technologies, including systems to pass non-jumping teleosts across the barrier.

This study estimates the abundance and biomass of the teleost community and its species composition before and after construction (fall 1995) of an inflatable barrier in Big Creek and a removable log barrier on Venison Creek. These data are combined with historical, quantitative fisheries data collected by the Ontario Ministry of Natural Resources, 1980 to 1985. Data, therefore, are available for fish community composition, abundance and biomass above and below two different barrier types before and after placement of the barriers.

Barrier Status

The inflatable barrier was raised in mid-April of 1997, presumably prior to the spring upstream migration of adult sea lampreys. A mechanical failure on April 20th resulted in the collapse of the inflatable barrier. The barrier crest was raised again by May 5th, but could not be restored to complete operational height. High water levels on two occasions in May also resulted in an ineffective barrier. The Big Creek barrier was deflated in early July; thus, the Big Creek barrier was not functioning 'normally' for approximately 21 days during the spawning run (Rod McDonald, Sea Lamprey Control Centre, pers. com.). We contend, therefore, that Year Three results are not indicative of post-barrier conditions in Big Creek. The Venison Creek barrier does not contain a sea lamprey trap or a fishway and as result was not checked for performance during 1997; we assume that it was functional as a barrier to sea lamprey passage.

Methods of Fish Assessment

To prevent escapement of fish from segments of stream that were quantitatively sampled, we used block nets (seine nets) at each of the 5 sites in Big Creek and Venison Creek (Fig. 1). We sampled 2 sites as separate sections; therefore, seven estimates of abundance and biomass were made for 7 stream sections at the 5 sites. Block nets were anchored to both stream banks. Steel fence posts were driven into the stream substrate to provide support for the net. Native rocks were used along the length of net to conform the net bottom to the stream bottom profile. Site lengths ranged from 30 to 83 m (Table 2). Stream width was measured at the top, middle and bottom for each site with the exception of sites 055 (short) and 193 (short) which were only measured at the upper and lower limits. Water depth was measured at 1 m intervals along each transect width. Because of increased water depth at Sea Lamprey Control Centre (SLCC) site 106 and the upper portion of site 182, these sites were not sampled in 1997.

Fish were captured using one or two 24V battery powered backpack fishing units and one 12V backpack electroshocker. Sampling began at the downstream block net and

progressed upstream. For each electroshocker, a pair of netters collected fish. Once sampling began, relatively constant progress upstream was maintained. Sites 027, 049, 182 and double site 193 were sampled 3 times while site 055, also a double site, was sampled 5 times.

Each captured fish was identified and received a fin clip denoting the site of capture. Individual fish were measured (fork length to the nearest mm) but only a subset were weighed. "Larger" fish were weighed on a spring balance while we pooled samples of smaller fish for weighing. All fish from the final sample for site 182 were preserved in a 10% formalin solution and weighed to 0.1g on an electronic balance in the laboratory within 1.5 mo. of collection. These data were supplemented with information on length-weight relationships from the 1995 and 1996 sampling. Where no length-weight relation was available, we used equations of morphometrically similar species of similar size as an approximation. For example, weights of pumpkinseeds were estimated using the length-weight regression derived for rock bass; shiner weights were estimated by using the blacknose dace regression; the greenside darter equation was used to estimate weights for log perch. Weights were calculated from the length-weight regressions for each fish and were combined with those individuals weighed in the field to provide an estimate of the total weight of each species for each sampling. This approximation is less acceptable than weighing all fish; however, the protocol ensures comparability among years.

To estimate fish abundance, we used the Chapman modification of the Petersen mark-recapture experiment (Ricker 1975). The first sampling effort was therefore devoted to applying marks to the population within the stream segment. At all sites, unmarked fish captured in the second sampling effort were marked and, with the exception of sites 049 and the upper portion of site 193, all recaptures were marked again. All fish were then returned to the stream. Abundance was estimated for all species pooled and for all species excluding sculpins and lamprey species. In 1995, the capture of sculpin and lamprey species increased in subsequent sampling efforts and therefore violated the assumption of constant catchability among sampling efforts, requiring a removal of these species from the abundance estimates. In 1996, however, the sculpin population decreased in subsequent catches, though the number of recaptures remained low. In the 1997 sampling effort, sculpin and lamprey had decreased in numbers by the third run, with the exception of site 055, (lower section). As anticipated, the number of sea lampreys caught was low, probably reflecting either the lampricide treatment (spring 1996) or the ineffectiveness of our electroshockers for capturing larval lampreys.

We used the Zippin removal method (Cowx 1983) and the Petersen mark-recapture method (Ricker 1975) to estimate abundance of fish in both stream sections at station SLCC 055. Fish captured in the first and second samplings were marked and returned to the stream section. Fish captured in subsequent samplings were returned to the stream downstream of the lower block net i.e. removed.

The Ontario Ministry of Natural Resources (OMNR) quantitatively sampled sites SLCC 193, 055 and 049 between 1980 and 1985. The OMNR sampled blocked stream sections with a shore-based, generator powered electrofishing system. We used the OMNR raw data and estimated abundance of the fish community, all species pooled, using the Zippin removal method.

Pearson correlations with Bonferroni probabilities were used to determine if the average depth of the sites correlated with the total fish catch and mass. Correlations were tested among sites in the same year and among years at the same site. All data was log transformed.

We used linear regression to determine similarities among catch totals, the Zippin removal method for estimating abundance and the Petersen method of estimating abundance.

We tested the similarity of the fish community composition and biomass estimated for each species using Mann-Whitney (2 cases) and Kruskal-Wallis (3 or more cases) non-parametric tests (Wilkinson 1988). Similarities were tested among sites in the same year and among years at the same site. Both the total catch and the mass were standardized by site volume, with the exception of site 049, which was standardized by site area.

Results

SLCC site 055, a double site, was the only site for which the three abundance estimates, total catch, Zippin depletion and Petersen mark-recapture were available. The population estimates for individual species and groups of species were compiled over the three years and regression analysis compared the similarities among total catch and the Zippin depletion method ($R^2=0.992$), total catch and Petersen mark-recapture ($R^2=0.969$) and the Zippin and Petersen methods of estimating abundance ($R^2=0.981$) (Table 1). Regression estimates were calculated for each comparison (Figure 4). The Petersen-Zippin regression equation was used to convert the Zippin estimates (OMNR) to Petersen estimates for all years and all data sets (Tables 2 and 3).

Fish community structure was similar in 1996 and 1997. Of 5 sites, only Venison Creek site 049 above the barrier showed any significant difference between 1996 and 1997. Mann-Whitney tests of similarity for mass ($p=0.043$) were low. When sites were compared within the year (by river) for Big Creek, only the mass changed ($p=0.004$) between stations 182 and 193 in 1997. No comparison was made above and below the barrier on Big Creek, as station 106 could not be sampled in 1997.

For Venison Creek, the Mann-Whitney analysis of the sites closest together above and below the dam, 049 and 027 respectively, showed a significant difference for catch ($p=0.048$) but not mass ($p=0.079$) in 1997. Above the barrier, sites 049 and 055 were similar in overall catch ($p=0.072$); however, the mass ($p=0.034$) was significantly different. Sites 055 and 027, the furthest apart, above and below the barrier were not significantly different in catch ($p=0.658$) or mass ($p=0.973$). Overall, Kruskal-Wallis tests for community similarity for the 3 sites on Venison Creek, showed no significant changes in either catch ($p=0.139$) or mass ($p=0.152$) in 1997.

Using Mann-Whitney tests for fish community structure within sites for 1995 and 1997, pre and post barrier construction respectively, both the catch and the mass showed a significant difference at two sites. Site 182 on Big Creek and site 049 on Venison Creek, both above the barrier had differences in catch ($p=0.046$ and $p=0.042$) and mass

($p=0.009$ and $p=0.022$) respectively. Over the three years of GLLFAS sampling, 1995, 1996 and 1997, Kruskal-Wallis tests for similarity showed a significant difference only in mass ($p=0.020$) at Big Creek site 182.

Stations 182 and 193 on Big Creek were compared for within year dependence using Pearson correlations with Bonferroni probabilities. Depth, total catch and mass, were correlated; however, none of the variables showed any independence. On Venison Creek, all sites were compared with the same criteria. For sites 027, 049, and 055 total catch and mass were independent of one another, ($p=0.000$). Sites 027, 049 ($p=0.012$) and 027, 055 ($p=0.000$) also found catch and mass to be independent. None of the variables for stations 049 and 055 were independent of one another.

For Big Creek, the Pearson correlation between years for sites 182 and 193, found catch and mass to be independent only of one another for all years, when comparing year, depth, total catch and mass. Comparisons of fish community composition were made using the same variables between years for sites 027 and 055 on Venison Creek. In 1983, no depth measurement was taken for site 049, consequently, site area was used in place of depth. Pearson correlations for site 055 found the total catch to be independent of mass for the 1995, 1996, and 1997 sampling groups, while site 027 had the same result only for the 1996 and 1997 comparison. Station 049 Pearson correlation calculations found no independence among any of the variables during the 1995 to 1997 Great Lakes Lab for Fisheries and Aquatic Sciences (GLLFAS) sampling program.

The Pearson correlations indicate a significant relation between species abundance and depth as well as fish mass and depth. Figures 5 to 9 show the relationship of depth not only to mass and abundance but also species richness. It is probable that differences in site characteristics such as depth and habitat are more important than we suspected.

The bias estimator for Petersen is approximated by $100e^{-(M+1)(C+1)}/N$ percent (Robson and Regier 1964). With the exception of site 049 in 1996 and 1997, all sites had a negligible bias. Site 049 had only one recapture in 1997 and zero in 1996. This has led to underestimated approximation of N for both years and for 'all fish' and 'sculpin and lamprey removed' estimates. In 1996 the approximate bias for the estimate of all fish was 35% and the removal of the sculpin and lamprey reduced the bias to 22%. In 1997, the reverse effect occurred, with the estimate of all fish at 14% and the sculpin and lamprey removed estimate resulting in an increase to 37%.

Fish community structure above and below the barriers for both Big and Venison creeks were compared in Figures 2 and 3.

In this report, the quantitative data has been integrated for all years, 1984 to 1997, and is presented in tabular form.

Table 1 and Figure 4 summarize the comparison among total catch, the Zippin removal method for estimating abundance and the Petersen method of estimating abundance by regression.

Tables 2 and 3 summarize Petersen population estimates calculated for the systems including the transformed OMNR data. We suggest that the species pooled excluding sculpin and lampreys abundance estimates are most appropriate.

Tables 4 and 5 summarize measured and estimated biomass per species for each stream section sampled in 1997.

Figures 5 to 9 summarize the relationship between site depth and abundance, site depth and mass, and site depth and species richness for each site.

Appendix A

Tables A and B summarize Kruskal-Wallis and Mann-Whitney tests of fish community similarities among sites in the same year and among years at the same site. In general, we find on Big Creek, the similarity for mass between sites 193 and 182 was very low, $p=0.004$. On Venison Creek, no detectable differences occurred for either catch or mass between the three sites, 027, 049 and 055; however, there were differences with the individual site comparisons.

Tables C and D summarize the Pearson correlations with Bonferroni probabilities for the Big Creek and Venison Creek sites between sites in the same year and between years at the same sites. The Bartlett chi-square p value and relevant tests are reported. The data sets included correlations for site, depth, catch and mass. For all cases the data was log transformed. When the Bartlett $p>0.050$, individual p values are not significant.

Table E summarizes the bias estimation for the Petersen population estimates, $100e^{-(M+1)(C+1)/N}$ percent, for all sites. Only site 049 had a detectable bias which occurred in both 1996 and 1997.

Tables F and G are rankings of species by abundance of animals caught per species and biomass of animals caught per species per year for all years sampled.

Catch summaries and abundance estimates from the 1997 sampling effort.

Notes:

1. Communities are diverse; salmonines, centrarchids and small forage fish (sculpins and darters) are common. 34 species were found.
2. The data available for Big and Venison Creek form a good basis for a longer term study which could address fish passage (in addition to community structure and abundance) at two barrier types.
3. The correlation, r^2 , between catch and the Zippin estimate for abundance, catch and the Petersen estimate for abundance and the Zippin and Petersen estimate for abundance were high 0.99, 0.97 and 0.98, respectively, using estimates made for species present in 1995, 1996 and 1997.

4. Sites downstream of the barrier on Big Creek were too deep to sample in 1997; therefore, a comparison was not possible for the fish community pre and post barrier construction at the downstream site SLCC 106.
5. Any difference in the fish community between 1980 and 1997 imposed by insertion of barriers in Big and Venison creek is obscured by variations in depth (morphometry) and, probably, changes of the site (substrate).

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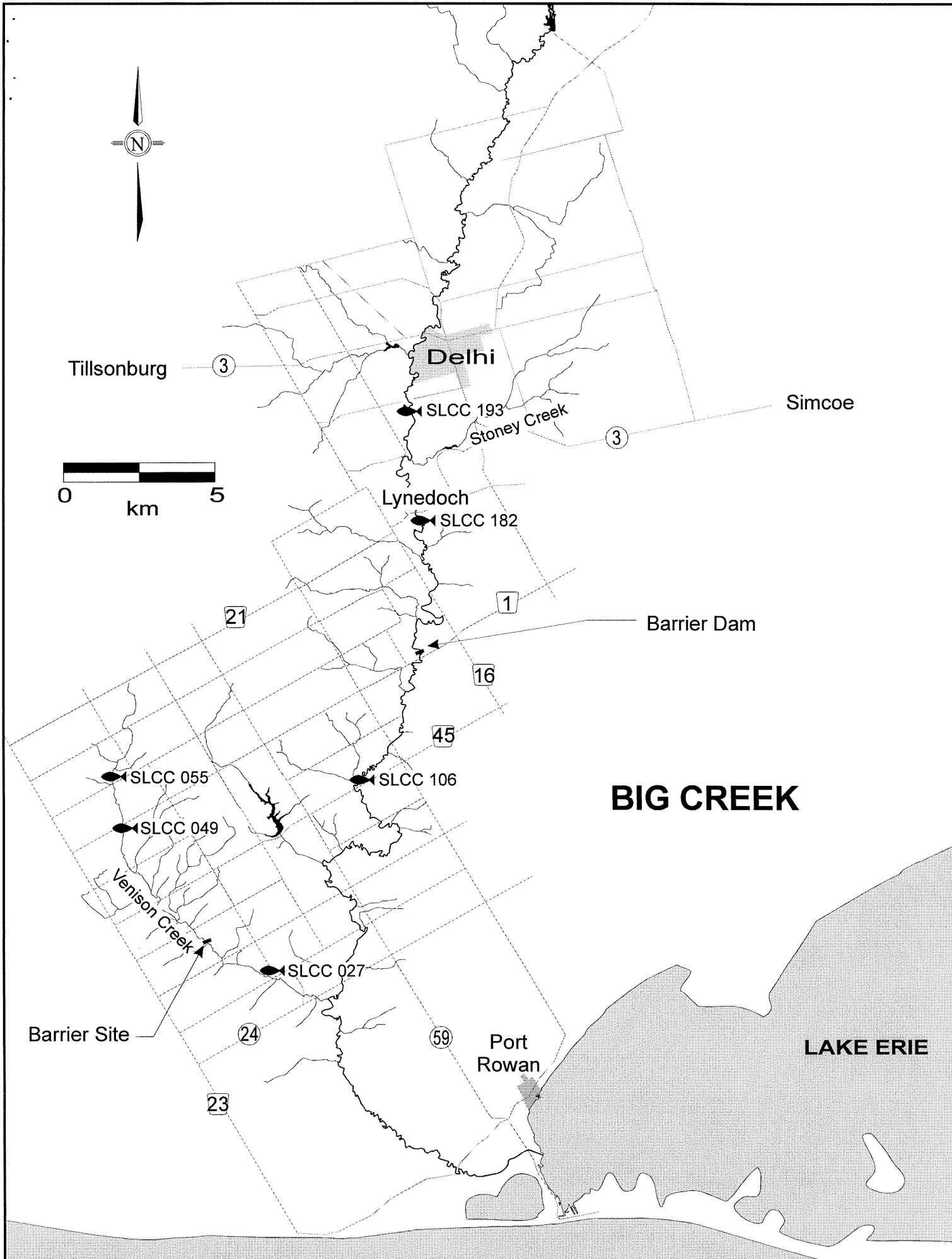
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Tillsonburg (3)

Delhi

Simcoe



Lynedoch

Barrier Dam

BIG CREEK

SLCC 055

SLCC 106

SLCC 049

SLCC 027

Barrier Site

Port Rowan

LAKE ERIE

Big Creek: above and below the barrier

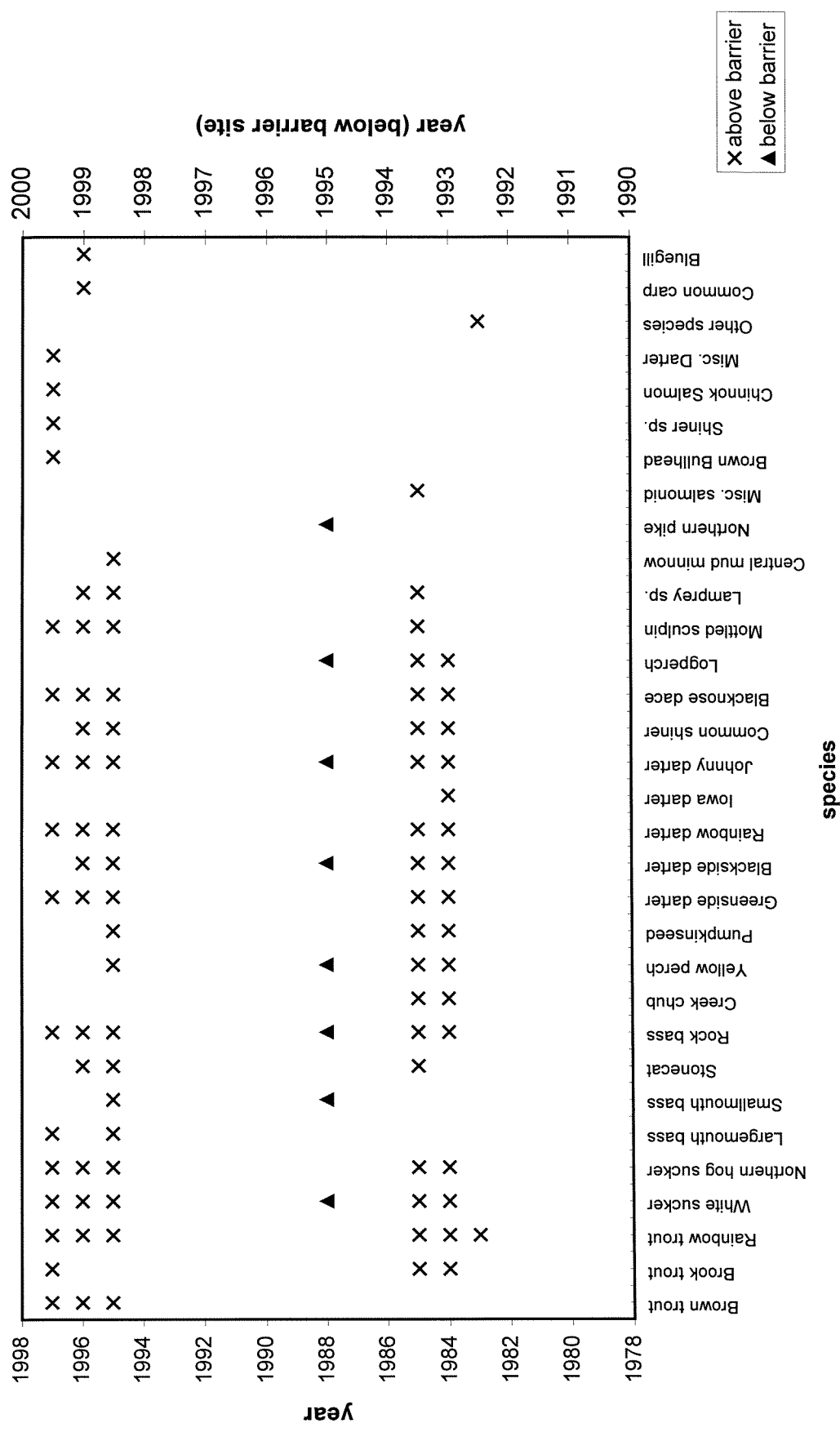


Figure 2

Venison Creek: above and below the barrier

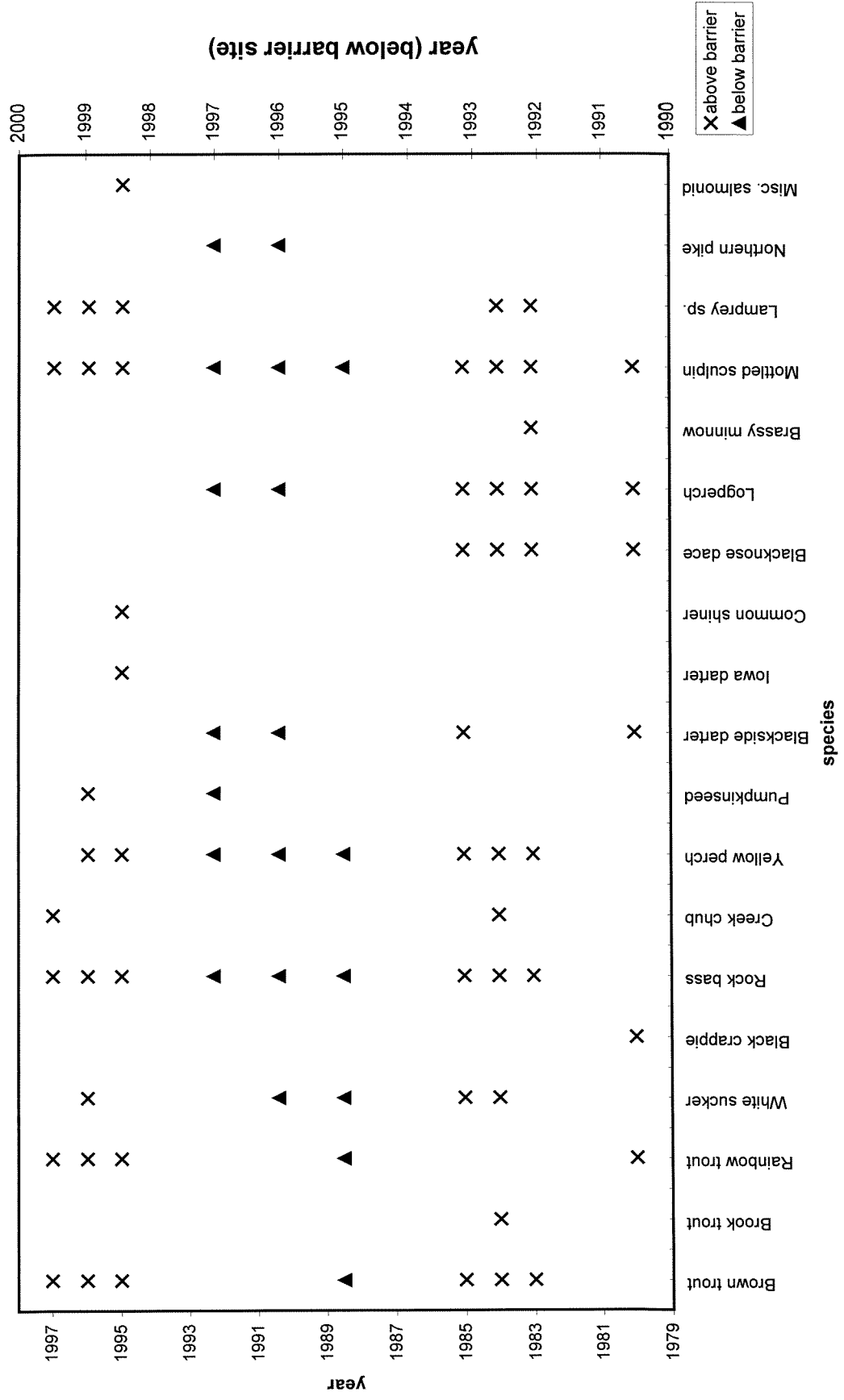


Figure 3

Regression estimates for 1995, 1996, 1997 for total catch, Zippin and Petersen population estimates

Site SLC055 : data for 1995, 1996, 1997

sections	Species	catch total	estimate Zippin	estimate Petersen
1997 up stream	Rainbow trout (<150mm) Sculpin&lamprey removed	6 12	7.8 38.71	10 37
1997 downstream	Brown trout (>150mm) Sculpin&lamprey removed	6 24	6.19 44	11 88
	Rainbow trout (<150mm)	5	8.3	8
	Brown trout (<150mm)	14	16.1	33
1996 downstream	Brown trout (>150mm) Rock bass	2 6	2.2 6.6	6 12
	Mottled sculpin	215	302.8	461
	Total species	244	329.7	522
	Sculpin&lamprey removed	29	32.6	60
1996 up stream	Rainbow trout (>150mm) Brown trout (<150mm) Brown trout (>150mm)	3 2 2	3.9 2.2 2.2	4 8 3
	Mottled sculpin	48	82.7	196
	Total species	59	98.3	180
	Sculpin&lamprey removed	11	15.5	20
1995 up stream	Rainbow trout (>150mm) Brown trout (<150mm) Brown trout (>150mm)	2 4 13	2.2 4 14	3 25 14
	Lampetra sp.	9	10.2	10
1995 downstream	Sculpin&lamprey removed Brown trout (>150mm) Salmonid sp. (<90mm)	44 6 2	67.7 6.2 2.2	66 12 3
	Sculpin&lamprey removed	20	20.4	36

total catch vs Zippin		R ² =0.992
<i>Regression Statistics</i>		
Multiple R	0.996055	
R Square	0.992126	
Adjusted R Square	0.991783	
Standard Error	7.778303	
Observations	25	

total catch vs Petersen		R ² =0.969
<i>Regression Statistics</i>		
Multiple R	0.984508	
R Square	0.969255	
Adjusted R Square	0.967919	
Standard Error	24.35228	
Observations	25	

Petersen vs Zippin		R ² =0.981
<i>Regression Statistics</i>		
Multiple R	0.990529	
R Square	0.981148	
Adjusted R Square	0.980329	
Standard Error	19.06905	
Observations	25	

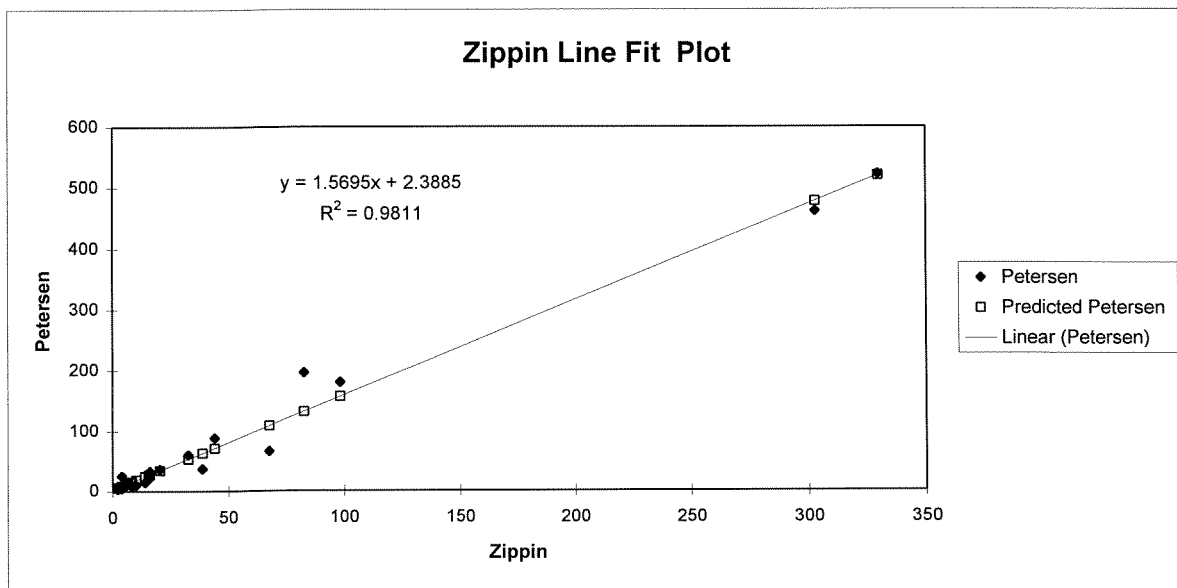
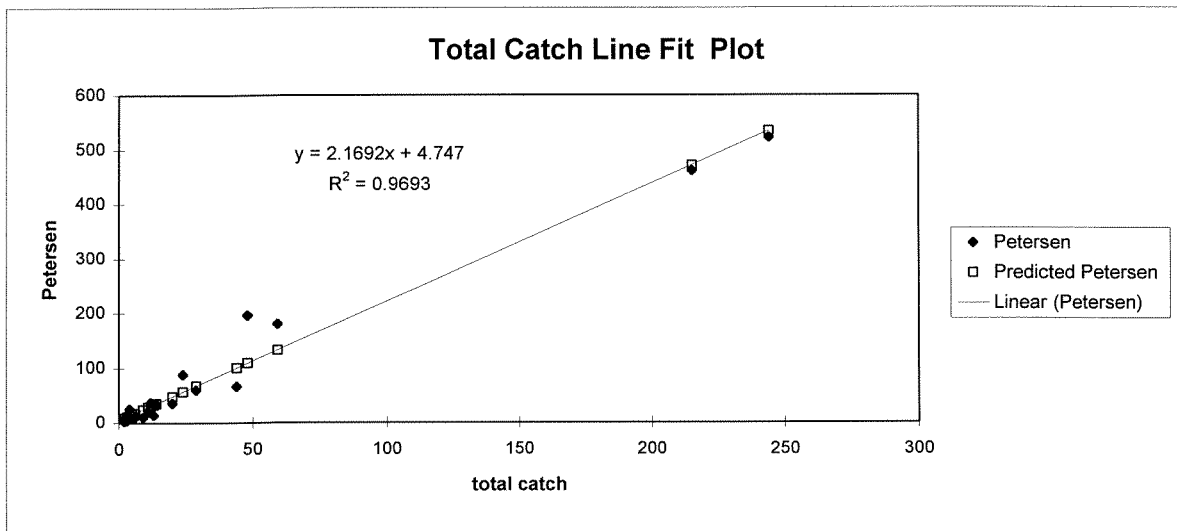
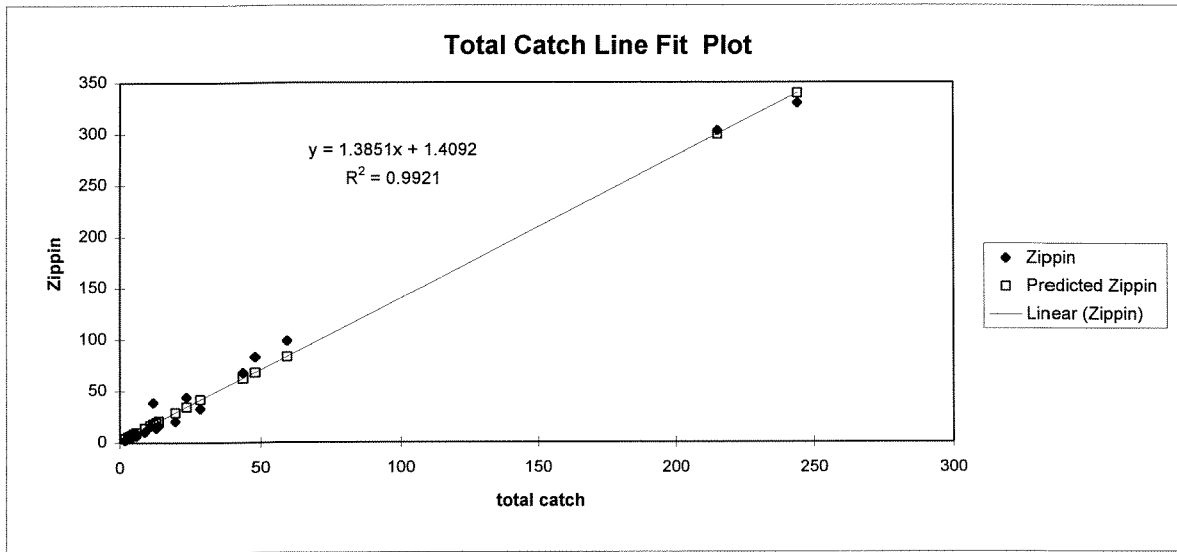


Figure 4

Big Creek and Venison Creek - population estimates
 Population estimates in italics and without confidence limits are original OMNR population estimates calculated by Zippin depletion estimates
 they have been converted to Petersen estimates using regression equation $y=1.595x+2.3885$

	Big Creek - Upstream Sites										Downstream						
	SLCC 183 - OMNR site B1					pooled estimate					only 1 site		SLCC 106				
	Jul 1983	Jul 1984	Jul 1985	Aug 1986	Aug 1987	Aug 1985	60m site	45m site	30m site	40m site	Aug 1986	Aug 1986	Aug 1986	Aug 1986	Aug 1986	Aug 1986	Aug 1986
Petersen - all species	351		718	274	451	189	789	311	1256	48	541	124	488	517	54		
95% conf. int.	na		na	172-429	309-654	104-330	490-1253	187-507	756-2047	29-76	320-895	85-245	300-812	354-749	31-93		
Petersen - excluding sculpin and lamprey	701			192	307	117	443	53	338	44	476	40	294	70	54		
95% conf. int.	na		na	121-301	206-455	65-204	271-713	29-92	196-569	27-71	276-801	8-42	170-495	41-118	31-93		

Venison Creek - Upstream Sites

	SLCC 049 - OMNR site B3										Downstream								
	SLCC 055 - OMNR site E2					SLCC 027					SLCC 027								
	Aug 1983	Aug 1984	Aug 1985	Aug 1986	Aug 1987	Aug 1985	80m site	60m site	40m site	60m site	Aug 1985	Aug 1985	Aug 1985	Aug 1985	Aug 1985	Aug 1985	Aug 1985		
Petersen - all species	26		243	198	313	180	522	203	564	68	216	111	142	147	345	510	43	225	
95% conf. int.	na		na	109-346	222-438	102-308	408-667	126-321	350-895	na	na	na	na	85-247	71-359	152-588	20-83	90-247	106-433
Petersen - excluding sculpin and lamprey	6			36	66	20	60	37	88	53	65	34	54	13	10	4	24	75	92
95% conf. int.	na		na	18-67	42-104	9-38	34-103	17-71	41-168	na	na	na	na	6-25	2-10	1-4	11-47	30-150	41-181

Big Creek and Venison Creek 1997
Calculations of biomass per site

Biomass (g) reported only for those animals actually caught - recaps inored
Bold font weights are field measurements only, italicized weights use field data supplemented with regression calculations,
normal font weights are calculated estimates.

* includes an estimate for fish length and weight

site 182: misc. dace (3 - <0.8 g) have been added to blacknose dace , based on lab. subsample id

Species	SLCC 027	SLCC 049	SLCC 055	SLCC 055	SLCC 055	SLCC 182	SLCC 193	SLCC 193
	(i & g) wt (g)	(B3) wt (g)	(B2) short wt (g)	(B2) long wt (g)	(4) long wt (g)	(B1) short wt (g)	(B1) long wt (g)	
White sucker							16	
Northern hogsucker						789	100	
Rainbow trout		107	73	288	23	136	150	
Brown trout			1080	1047	81	163		
Rock Bass	406		115	102			64	
Pumpkinseed	25							
Largemouth Bass					1			
Brook Trout						97		
Shiner sp.								1
Lamprey sp.				7				
Rainbow darter					64	24*	122	
Johnny darter					21		4	
Greenside darter					13	9	47	
Blackside darter	13							
Blacknose dace	150	267	654	907	6*	88	35	
Mottled sculpin	67				123	164	358*	
Yellow perch	14							
Northern pike	33							
Logperch				27				
Creek Chub								23
Brown Bullhead								12
Misc. darter								12
Chinook Salmon								
Totals	708	374	1922	2377	389	1470	943	

Big Creek and Venison Creek 1997

Weights adjusted to standardized unit of area (g per 1000 m² of stream)

Species	SLCC 027 (i & g) wt (g)	SLCC 049 (B3) wt (g)	SLCC 055 (B2) short wt (g)	SLCC 055 (B2) long wt (g)	SLCC 182 (4) long wt (g)	SLCC 193 (B1) short wt (g)	SLCC 193 (B1) long wt (g)
White sucker					21	1826	23
Northern hogsucker					52	316	141
Rainbow trout		243	383	677		378	213
Brown trout			5687	2457			
Rock Bass	1979		606	239	74		91
Pumpkinseed	122						
Largemouth Bass					1		
Brook Trout						225	
Shiner sp							1
Lamprey sp.				15			
Rainbow darter					58	56	173
Johnny darter					19		6
Greenside darter					12	21	66
Blackside darter	63						
Blacknose dace					5	203	49
Mottled sculpin	729	610	3442	2128	112	380	507
Yellow perch	328						
Northern pike	68						
Logperch	159						
Creek Chub				63			
Brown Bullhead							33
Misc. darter							17
Chinook Salmon							16
Totals	3448	853	10117	5579	353	3404	1338

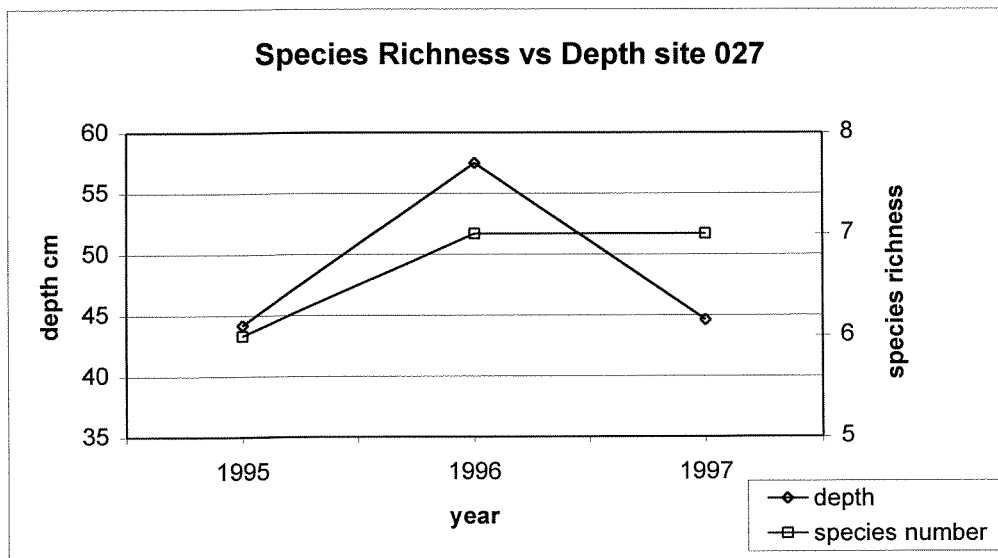
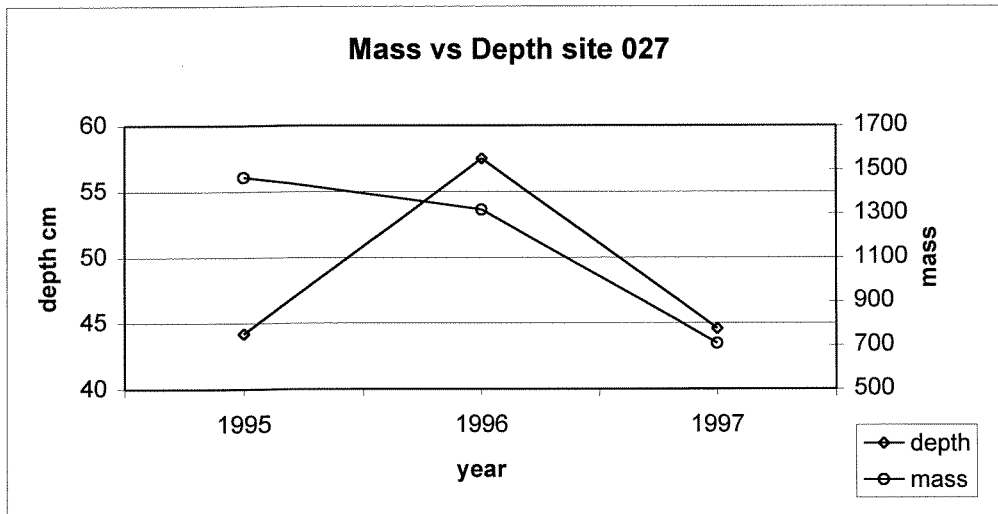
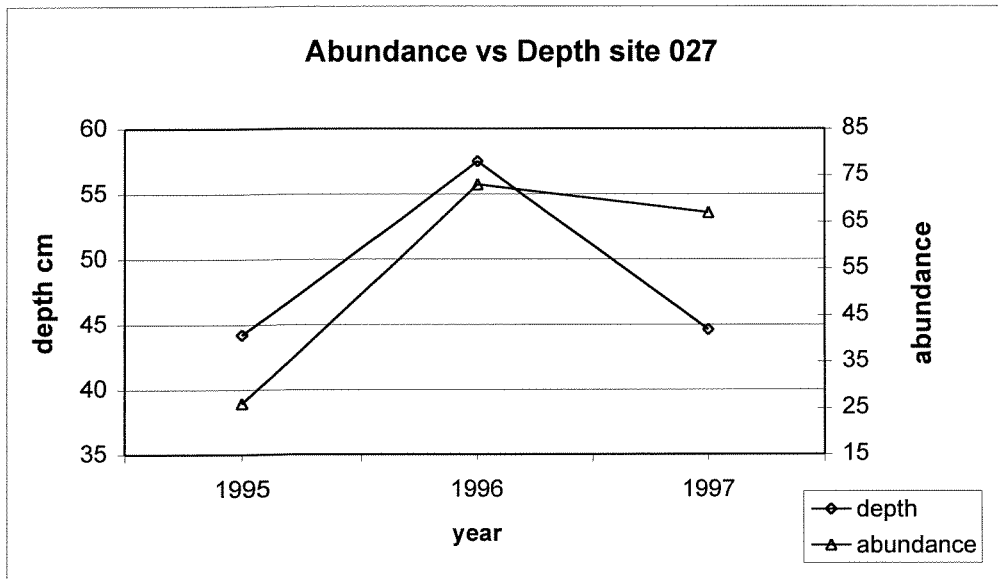


Figure 5

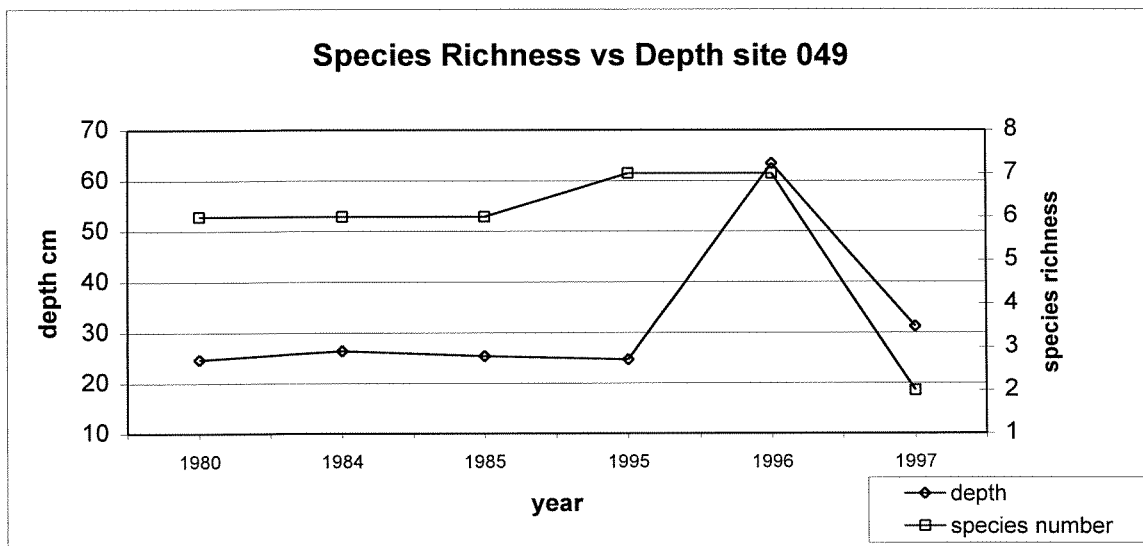
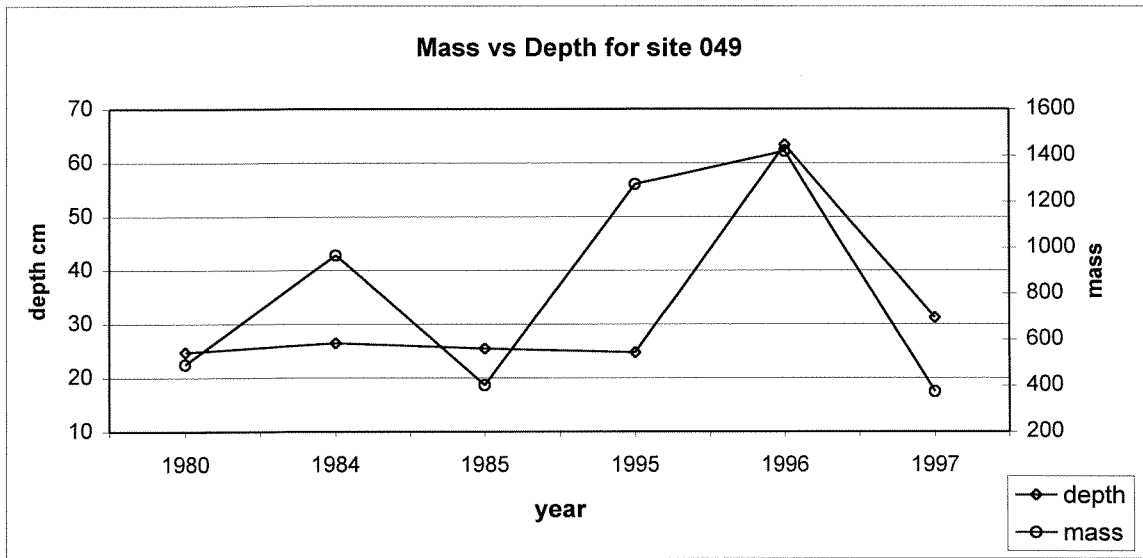
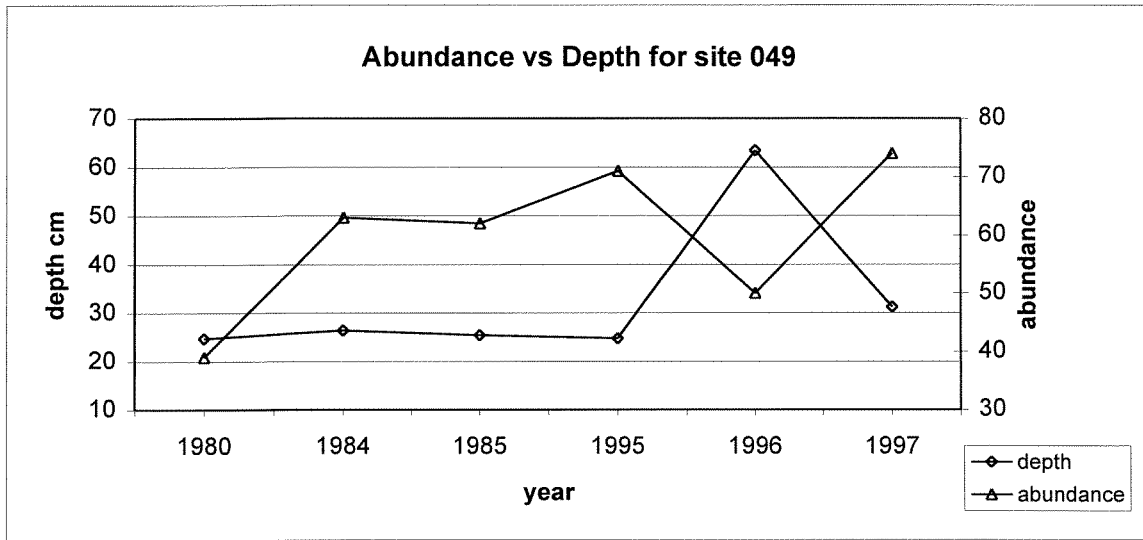


Figure 6

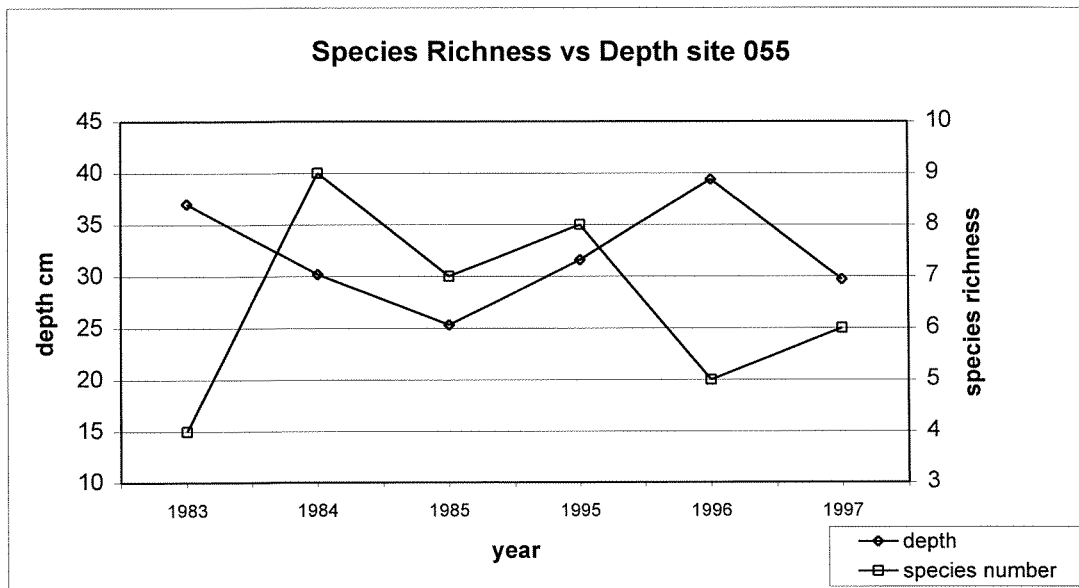
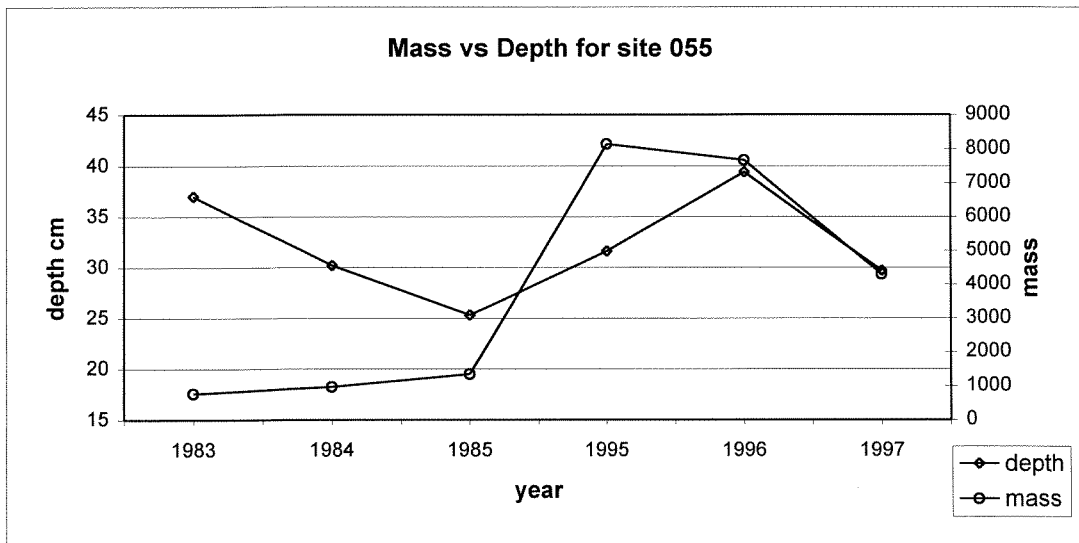
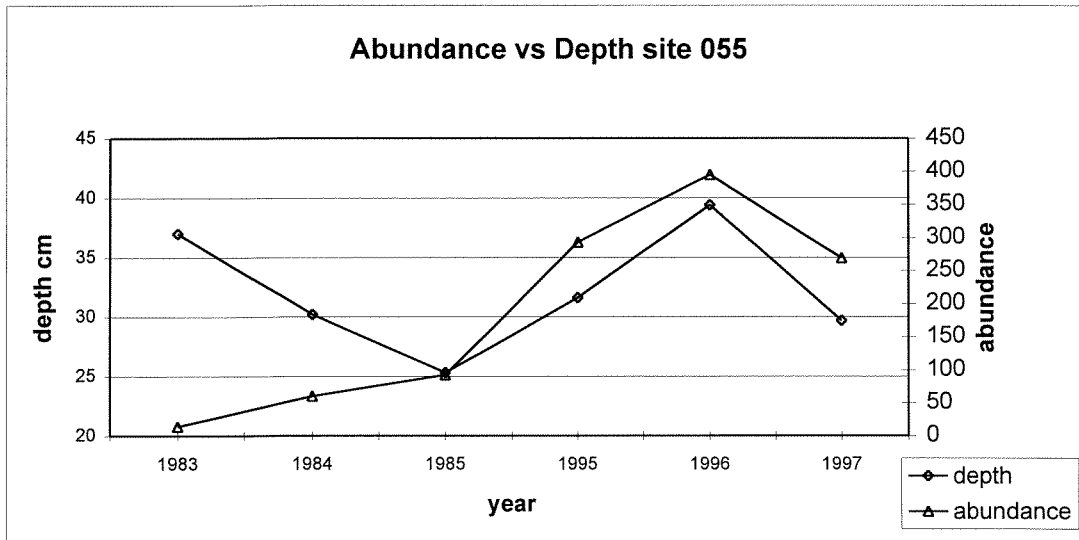


Figure 7

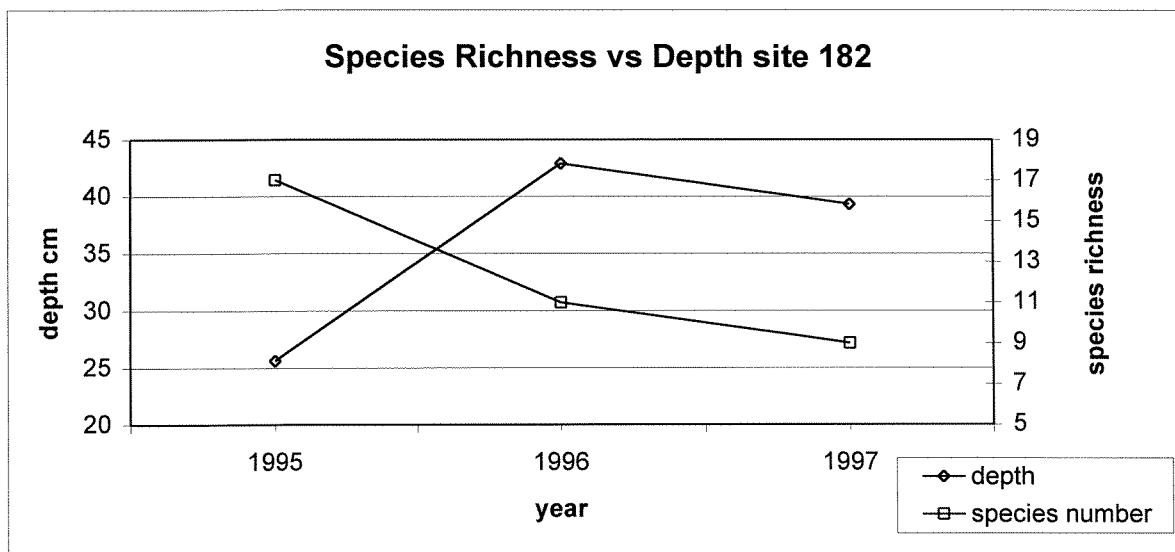
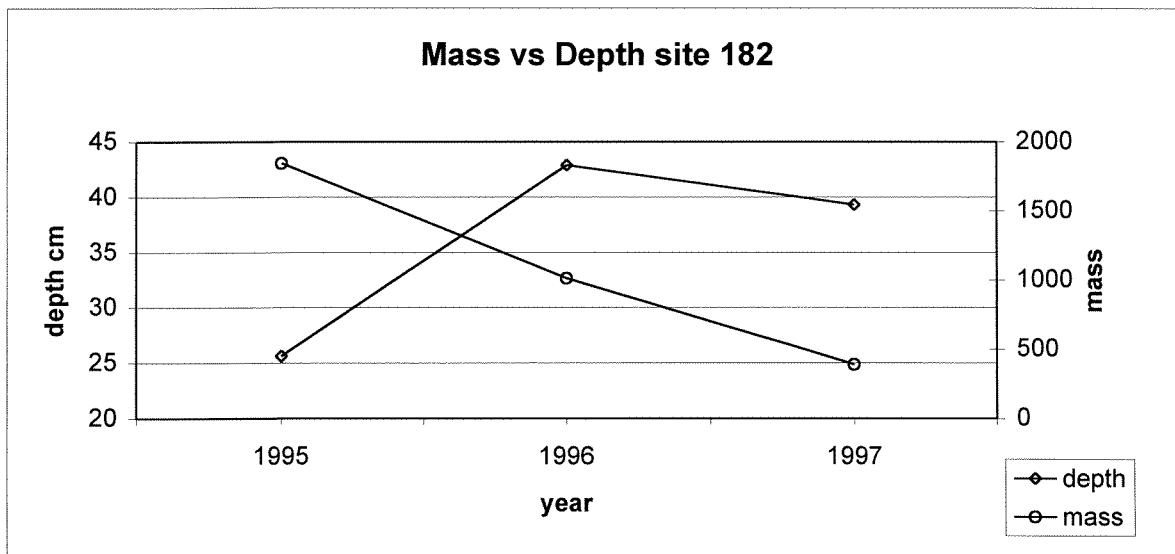
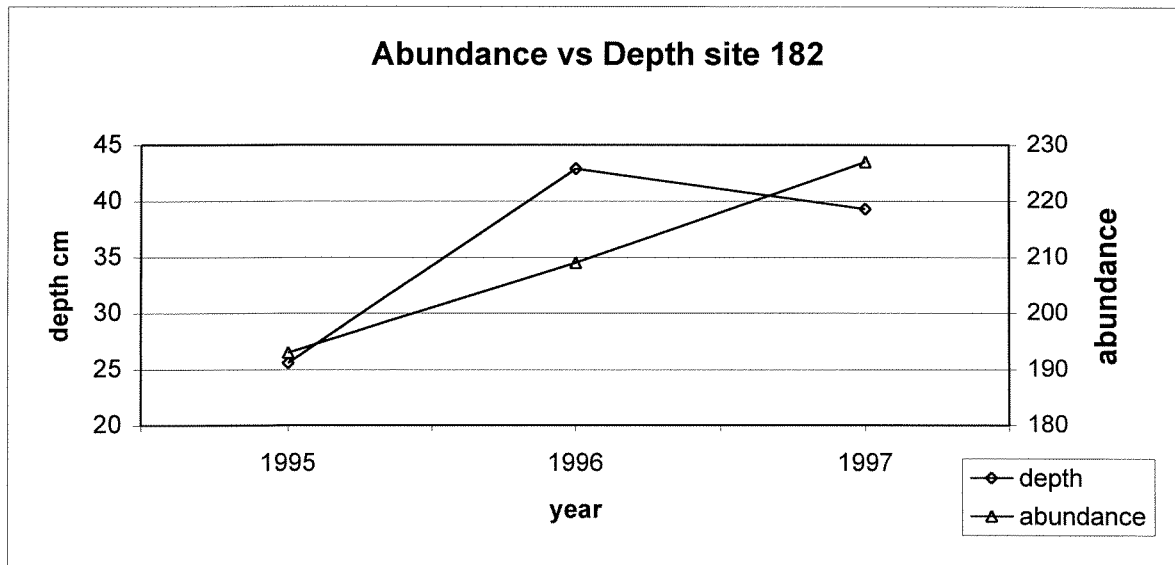


Figure 8

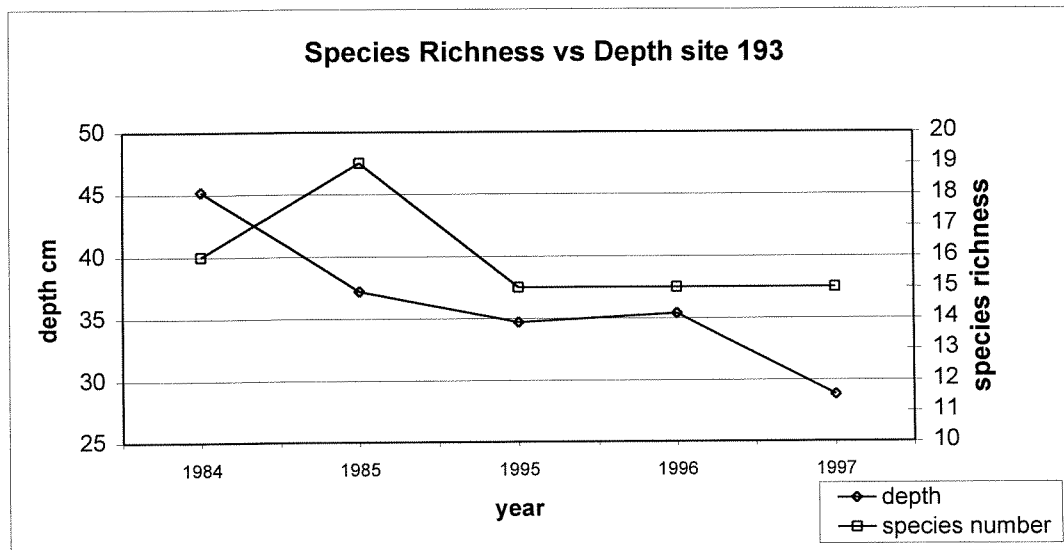
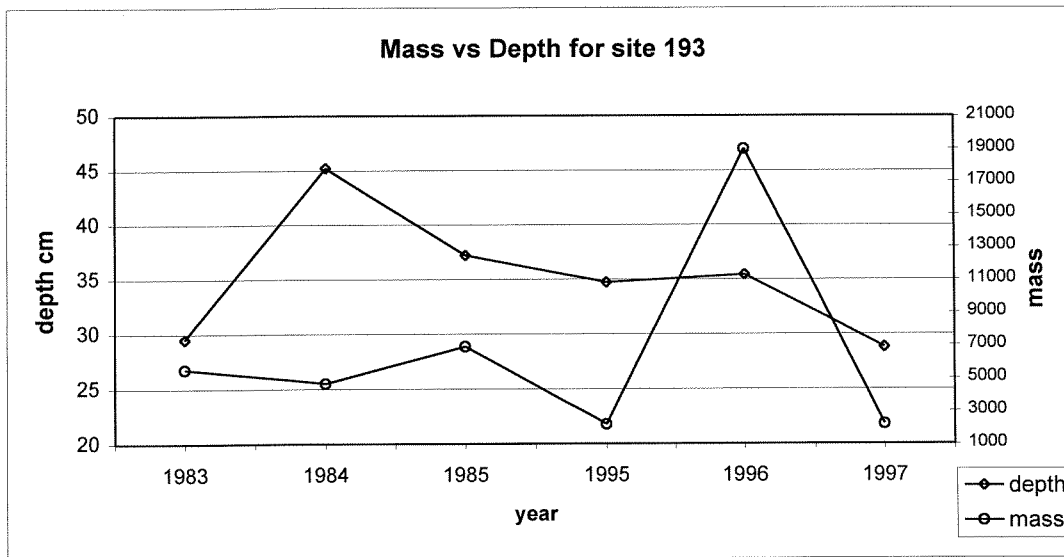
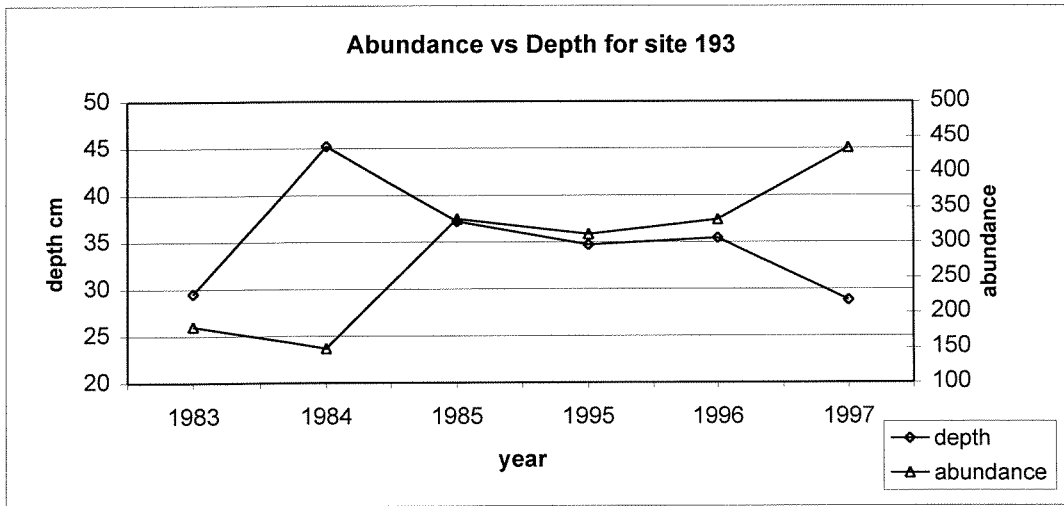


Figure 9

APPENDIX A

Summary of Kruskal-Wallis and Mann/Whitney tests of fish community similarity among sites for the same year and among years for the same site. Total catch and mass are standardized by site volume, with the exception of site 049, which is by site area. Pearson correlations with Bonferroni probabilities for all years for the same site and among sites for the same year. All data has been log transformed. Bias estimates for the Petersen population estimates for all sites, for all available years. Rankings of species by abundance of animals caught per species and biomass of animals caught per species per year for all years sampled. Catch summaries and abundance estimates (with 95% confidence intervals) from 1997 sampling effort. Data are reported for each sampling run for all stream sections sampled.

Kruskal - Wallis (3 site) and Mann - Whitney (2 site) tests of fish community similarity between sites in the same year in terms of numbers of animals caught per species and mass of animals caught per species. Total catch and mass are standardized by site volume, with the exception of site 049, which is by site area. Reported values are probabilities of the communities being identical.

Venison Creek

<u>Year</u>	<u>SLCC Site #s</u>	<u>Catch/volume</u>	<u>Mass/volume</u>
1984	049 055	0.541	0.402
1985	049 055	0.572	0.247
1995	049 055	0.398	0.824
1995	027 049	0.396	0.833
1995	027 055	0.089	0.624
1995	027 049 055	0.454	0.902
1996	049 055	0.557	0.427
1996	027 049	0.295	0.614
1996	027 055	0.686	0.410
1996	027 049 055	0.648	0.889
1997	049 055	0.072	0.034
1997	027 049	0.048	0.079
1997	027 055	0.658	0.973
1997	027 049 055	0.139	0.152

Big Creek

<u>Year</u>	<u>SLCC Site #s</u>	<u>Catch/volume</u>	<u>Mass/volume</u>
1995	106 182 193	0.063	0.217
1995	106 182	0.016	0.111
1995	106 193	0.121	0.200
1995	182 193	0.404	0.549
1996	182 193	0.115	0.006
1997	182 193	0.177	0.004

Kruskal-Wallis (3 or more years) and Mann-Whitney (2 years) tests of fish community similarity between years in the same site in terms of numbers of animals caught per species and mass of animals caught per species. Total catch and mass are standardized by site volume, with the exception of site 049, which is by site area. Reported values are probabilities of the communities being identical.

Venison Creek - SLCC Site 049

<u>Years</u>	<u>Catch/Area</u>	<u>Mass/Area</u>
1980, 83, 84, 85, 95, 96, 97	0.385	0.407
1983, 84, 85, 95, 96, 97	0.217	0.288
1984, 85, 95, 96, 97	0.357	0.293
1985, 95, 96, 97	0.210	0.158
1995, 96, 97	0.107	0.089
1980 1983	0.251	0.157
1980 1984	0.527	0.528
1980 1985	0.786	0.652
1980 1995	0.322	0.291
1980 1996	0.918	0.453
1980 1997	0.184	0.139
1983 1984	0.114	0.599
1983 1985	0.141	0.093
1983 1995	0.445	-----
1983 1996	0.101	0.483
1983 1997	0.013	0.027
1984 1985	0.898	0.250
1984 1995	0.502	0.503
1984 1996	0.641	0.757
1984 1997	0.110	0.186
1985 1995	0.502	0.196
1985 1996	0.877	0.536
1985 1997	0.111	0.184
1995 1996	0.263	0.625
1995 1997	0.042	0.022
1996 1997	0.074	0.043

Venison Creek - SLCC Site 055

<u>Years</u>	<u>Catch/Volume</u>	<u>Mass/Volume</u>
1983, 84, 85, 95, 96, 97	0.536	0.731
1984, 85, 95, 96, 97	0.879	0.971
1985, 95, 96, 97	0.805	0.948
1995, 96, 97	0.568	0.837
1983 1984	0.035	0.082
1983 1985	0.032	0.166
1983 1995	0.017	0.063
1983 1996	0.256	0.107
1983 1997	0.145	0.149
1984 1985	0.790	0.970
1984 1995	0.883	0.977
1984 1996	0.565	0.969
1984 1997	0.359	0.493
1985 1995	0.523	0.662
1985 1996	0.634	0.874
1985 1997	0.643	0.757
1995 1996	0.315	0.634
1995 1997	0.343	0.598
1996 1997	0.847	0.653

Venison Creek - SLCC Site 027

<u>Years</u>	<u>Catch/Volume</u>	<u>Mass/Volume</u>
1995 1996 1997	0.669	0.844
1995 1996	0.622	0.688
1995 1997	0.353	0.589
1996 1997	0.636	0.636

Big Creek - SLCC Site 193

<u>Years</u>	<u>Catch/Volume</u>	<u>Mass/Volume</u>
1984, 85, 95, 96,97	0.669	0.693
1985, 95, 96,97	0.538	0.537
1995, 96, 97	0.902	0.555
1984 1985	0.074	0.213
1984 1995	0.829	0.469
1984 1996	0.751	0.751
1984 1997	0.943	0.887
1985 1995	0.140	0.123
1985 1996	0.376	0.714
1985 1997	0.164	0.225
1995 1996	0.567	0.138
1995 1997	0.769	0.693
1996 1997	0.713	0.361

Big Creek - SLCC Site 182

<u>Years</u>	<u>Catch/Volume</u>	<u>Mass/Volume</u>
1995 1996 1997	0.058	0.020
1995 1996	0.034	0.032
1995 1997	0.046	0.009
1996 1997	0.977	0.370

Pearson Correlations with Bonferroni probabilities

data sets include: site, depth, catch and mass with species as the ID variable (according to Systat)

The Bartlett chi-square p value and relevant tests reported. When Bartlett $p > 0.050$, individual p values are not valid. For all cases the mass and catch values were log transformed.

For 1997:

Big Creek:

Sites 193 & 182

Values tested	Bartlett p	significant?	p
depth, catch, mass	0.026	none	

Venison Creek:

Sites 027, 049, 055

Values tested	Bartlett p	significant?	p
site, depth, catch, mass	0.000	catch, mass	0.000
		site, depth	0.000

Sites 049, 055

depth, catch, mass	0.090		
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Site 027, 049

depth, catch, mass	0.026	catch, mass	0.012
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Site 027, 055

depth, catch, mass	0.000	catch, mass	0.000
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Pearson Correlations with Bonferroni probabilities

data sets include: year, depth, catch and mass with species as the ID variable (according to Systat)

The Bartlett chi-square p value and relevant tests reported. When Bartlett $p > 0.050$, individual p values are not valid. For all cases the mass and catch values were log transformed.

Big Creek:

Site 182

Years	Values tested	Bartlett p	significant?	p
1995, 1996, 1997	year, depth, catch, mass	0.000	catch, mass	0.000
1995, 1996	year, depth, catch, mass	0.000	catch, mass	0.001
1995, 1997	depth, catch, mass	0.006	catch, mass	0.008
1996, 1997	year, depth, catch, mass	0.000	catch, mass	0.011
	depth, catch, mass	0.017	catch, mass	0.006

Site 193

Years	Values tested	Bartlett p	significant?	p
1984, 85, 95, 96, 97	year, depth, catch, mass	0.000	catch, mass	0.000
1985, 95, 96 97	depth, catch, mass	0.000	catch, mass	0.000
1995, 96, 97	depth, catch, mass	0.000	catch, mass	0.001
1984, 1985	depth, catch, mass	0.000	catch, mass	0.000
1984, 1995	depth, catch, mass	0.000	catch, mass	0.000
1984, 1996	depth, catch, mass	0.001	catch, mass	0.000
1984, 1997	depth, catch, mass	0.001	catch, mass	0.000
	year, depth, catch, mass	0.000	catch, mass	0.000
1985, 1995	depth, catch, mass	0.000	catch, mass	0.000
1985, 1996	depth, catch, mass	0.001	catch, mass	0.000
1985, 1997	depth, catch, mass	0.000	catch, mass	0.000
1995, 1996	depth, catch, mass	0.006	catch, mass	0.005
1995, 1997	depth, catch, mass	0.003	catch, mass	0.001
	year, depth, catch, mass	0.000	catch, mass	0.001
1996, 1997	depth, catch, mass	0.034	catch, mass	0.033

Pearson Correlations with Bonferroni probabilities
 data sets include: year, depth, catch and mass with species as the ID variable (according to Systat)
 The Bartlett chi-square p value and relevant tests reported. When Bartlett p >0.050, individual p values are not valid.
 For all cases the mass and catch values were log transformed.
 Venison Creek

Site	Years	Values tested	Bartlett p	significant?	p
Site 027	1995, 1996, 1997	year, depth, catch, mass	0.168		
	1995, 1996	depth, catch, mass	0.522		
	1995, 1997	depth, catch, mass	0.091		
	1996, 1997	year, depth, catch, mass	0.000	catch, mass	0.021
Site 055	1983, 84, 85, 95, 96, 97	year, depth, catch, mass	0.000	significant?	p
	1984, 85, 95, 96, 97	depth, catch, mass	0.000	catch, mass	0.000
	1985, 95, 96, 97	year, depth, catch, mass	0.000	catch, mass	0.000
	1985, 96, 97	year, depth, catch, mass	0.000	catch, mass	0.000
	1983, 1984	year, depth, catch, mass	0.000	year, depth	0.000
	1983, 1985	year, depth, catch, mass	0.000	year, depth	0.000
	1983, 1995	year, depth, catch, mass	0.000	year, depth	0.000
	1983, 1996	depth, catch, mass	0.033	none	
	1983, 1997	depth, catch, mass	0.035	none	
	1984, 1985	depth, catch, mass	0.148		
Site 055	1984, 1995	year, depth, catch, mass	0.001	catch, mass	0.001
	1984, 1996	year, depth, catch, mass	0.000	mass, depth	0.004
	1984, 1997	year, depth, catch, mass	0.002	catch, mass	0.001
	1985, 1995	year, depth, catch, mass	0.000	catch, mass	0.017
	1985, 1996	depth, catch, mass	0.012	catch, mass	0.008
	1985, 1997	depth, catch, mass	0.013	mass, depth	0.036
	1985, 1996	depth, catch, mass	0.023	catch, mass	0.007
	1985, 1997	depth, catch, mass	0.057		
	1985, 1997	year, depth, catch, mass	0.004	catch, mass	0.001
	1985, 1997	year, depth, catch, mass	0.000	catch, mass	0.027
1996, 1997	depth, catch, mass	0.014	catch, mass	0.013	

Pearson Correlations with Bonferroni probabilities

data sets include: year, depth, catch and mass with species as the ID variable (according to Systat)

The Bartlett chi-square p value and relevant tests reported. When Bartlett $p > 0.050$, individual p values are not valid.

For all cases the mass and catch values were log transformed.

Venison Creek

Site 049

1983 has no listed depth: depth comparisons were used where possible otherwise, area was substituted

Years	Values tested	Bartlett p	significant?	p	significant?	p
1980, 83, 84, 85, 95, 96, 9	year, area, catch, mass	0.000	catch, mass	0.000		
	area, catch, mass	0.000	catch, mass	0.000		
1983, 84, 85, 95, 96, 97	year, area, catch, mass	0.006	catch, mass	0.002		
	area, catch, mass	0.005	catch, mass	0.001		
1984, 85, 95, 96, 97	year, area, depth, catch, mass	0.000	area, year	0.003	year, depth	0.031
	year, depth, catch, mass	0.006	catch, mass	0.034	year, depth	0.018
	year, area, catch, mass	0.001	catch, mass	0.034	area, year	0.002
	area, catch, mass	0.044	catch, mass	0.017		
	depth, catch, mass	0.025	catch, mass	0.017		
1985, 95, 96 97	year, area, depth, catch, mass	0.000	none			
	year, depth, catch, mass	0.043	none			
	year, area, catch, mass	0.057				
	area, catch, mass	0.109				
1995, 96, 97	depth, catch, mass	0.064				
	year, depth, catch, mass	0.182				
	year, area, catch, mass	0.000	year, area	0.000		
	area, catch, mass	0.341				
	depth, catch, mass	0.287				
depth not used for 1980, 1983						
1980, 1983	area, catch, mass	0.000	catch, mass	0.000		
1980, 1984	area, catch, mass	0.008	catch, mass	0.011		
1980, 1985	year, area, catch, mass	0.000	catch, mass	0.001	area, year	0.000
	area, catch, mass	0.001	catch, mass	0.000		
1980, 1995	area, catch, mass	0.027	catch, mass	0.024		
1980, 1996	area, catch, mass	0.071				
1980, 1997	area, catch, mass	0.056				
depth not used						
1983, 1984	area, catch, mass	0.037	catch, mass	0.019		
1983, 1985	area, catch, mass	0.000	catch, mass	0.000		
1983, 1995	area, catch, mass	0.045	catch, mass	0.024		
1983, 1996	year, area, catch, mass	0.000	area, year	0.000		
	area, catch, mass	0.092				
1983, 1997	year, area, catch, mass	0.000	catch, mass	0.019	area, year	0.000
	area, catch, mass	0.023	catch, mass	0.009		
1984, 1985	area, catch, mass	0.052				
1984, 1995	area, catch, mass	0.258				
1984, 1996	year, depth, catch, mass	0.000	depth, year	0.000		
	year, area, catch, mass	0.000	area, year	0.000		
	area, catch, mass	0.371				
1984, 1997	area, catch, mass	0.612				
1985, 1995	area, catch, mass	0.099				
1985, 1996	year, depth, catch, mass	0.000	depth, year	0.000		
	year, area, catch, mass	0.000	area, year	0.000		
	area, catch, mass	0.207				
1985, 1997	area, catch, mass	0.050				
	year, area, catch, mass	0.000	area, year	0.000		
1995, 1996	area, catch, mass	0.443				
1995, 1997	area, catch, mass	0.351				
1996, 1997	area, catch, mass	0.443				

Bias estimation for Petersen population estimates:

by site by year

$$\text{bias estimator} = 100e^{-(M+1)(C+1)/N}$$

Big Creek:

site		<i>N</i>	bias estimator	length m	area m ²	depth cm	volume m ³
site 106							
1995	all fish	54	1.640E-03		213.4	63.7	13594
site 182		<i>N</i>	bias estimator				
1995							
65m site	all fish	541	2.273E-04	65	934.4	21.6	20183
(ds)	sculpin and lamprey removed	476	6.144E-04				
30m site	all fish	48	3.539E-05	30	371.2	38.7	14365
(us)	sculpin and lamprey removed	44	3.059E-05				
1996							
60m site	all fish	498	5.209E-10	60	888	35.5	31524
(ds)	sculpin and lamprey removed	294	5.209E-10				
30m site	all fish	124	6.684E-01	30	393.8	52.4	20635
(us)	sculpin and lamprey removed	40	3.679E+01				
1997							
69m site	all fish	517	5.209E-10	69	1101.7	39.3	43297
(ds)	sculpin and lamprey removed	70	6.144E-04				
site 193		<i>N</i>	bias estimator				
1995							
30m site	all fish	274	4.263E-06	30	410	16.4	6724
(ds)	sculpin and lamprey removed	192	4.140E-06				
60m site	all fish	451	5.201E-10	60	1020	49.1	50082
(us)	sculpin and lamprey removed	307	1.043E-08				
1996							
30m site	all fish	189	4.588E-03	30	533	40.4	21533.2
(ds)	sculpin and lamprey removed	117	4.540E-03				
45m site	all fish	789	1.121E-05	45	631.1	41.4	26127.54
(us)	sculpin and lamprey removed	443	3.025E-05				
1997							
30m site	all fish	311	8.262E-05	30	432	28.9	12484.8
(ds)	sculpin and lamprey removed	53	4.989E-03				
40m site	all fish	1256	8.362E-05	40	705.3	28.4	20030.5
(us)	sculpin and lamprey removed	338	6.090E-04				

Bias estimation for Petersen population estimates:

by site by year

$$\text{bias estimator} = 100e^{-(M+1)(C+1)/N}$$

Venison Creek:

site 027		<i>N</i>	bias estimator	length m	area m ²	depth cm	volume m ³
1995	all fish	43	2.366E-01	40	211.2	44.2	9335
	sculpin and lamprey removed	24	6.738E-01				
1996	all fish	124	7.245E-01	50	273.8	57.5	15744
	sculpin and lamprey removed	75	7.013E-01				
1997	all fish	225	2.479E-01	40	205.3	44.6	9156
	sculpin and lamprey removed	92	6.812E-01				
site 049							
1995	all fish	147	6.186E-04	40	231.2	24.7	5711
	sculpin and lamprey removed	13	7.859E-01				
1996	all fish	345	35.223	57	418.4	63.4	26527
	sculpin and lamprey removed	10	22.313				
1997	all fish	510	13.534	60	438	31.2	13666
	sculpin and lamprey removed	4	36.788				
site 055							
1995							
80m site (ds)	all fish	313	1.316E-12	80	364	29	10556
	sculpin and lamprey removed	66	3.956E-06				
35m site (us)	all fish	198	4.540E-03	35	195.1	34.8	6789
	sculpin and lamprey removed	36	9.119E-02				
1996							
80m site (ds)	all fish	522	1.241E-25	80	402.7	39.1	15746
	sculpin and lamprey removed	60	1.670E-03				
26m site (us)	all fish	180	1.670E-03	26	134.3	43.6	5855
	sculpin and lamprey removed	20	2.479E-01				
1997							
83m site (ds)	all fish	564	1.125E-05	83	426.1	29.7	12655
	sculpin and lamprey removed	88	2.565E-01				
40m site (us)	all fish	203	1.171E-05	40	190	31.9	6061
	sculpin and lamprey removed	37	2.547E-01				

Big Creek - Species rankings, species composing at least 5% of the catch

Species	Sites upstream from barrier location SLCC 193 - OMNR site B1			Sites upstream from barrier location SLCC 182			Downstream SLCC 106 Aug 1995
	Jul 1984	Jul 1985	Aug 1996	Aug 1995	Aug 1996	Aug 1997	
Brown trout							
Brook trout							
Rainbow trout	3	1	4			3	
White sucker			5			9	6
Northern hog sucker	3			3	4	4	
Smallmouth bass							
Rock bass	1	2		5			3
Yellow perch	7	6		8	5		1
Greenside darter							3
Blackside darter							
Rainbow darter	5	3	3	5	3	2	6
Johnny darter				2	2	3	
Blacknose dace	1	4	1	4	4		2
Logperch	5	5					5
Mottled sculpin			2	1	1	1	
Lamprey sp.							
Northern pike							

Big Creek - Species rankings, species composing at least 5% of site biomass

Species	Sites upstream from barrier location SLCC 193 - OMNR site B1			Sites upstream from barrier location SLCC 182			Downstream SLCC 106 Aug 1995
	Jul 1984	Jul 1985	Aug 1996	Aug 1995	Aug 1996	Aug 1997	
Brown trout							
Brook trout							
Rainbow trout	3	1	2			3	
White sucker	4		1			4	
Northern hog sucker	1	3		2	4	5	1
Smallmouth bass							
Rock bass	2	2	6	1	3	2	3
Yellow perch							
Greenside darter							
Blackside darter							
Rainbow darter							
Johnny darter							
Blacknose dace							
Logperch							
Mottled sculpin							
Lamprey sp.							
Northern pike							
Common carp							2

Venison Creek - Species rankings, species composing at least 5% of the catch

Species	Sites upstream from proposed barrier location					Downstream					
	SLCC 055 - OMNR site B2 Aug 1983	Aug 1984	Aug 1985	Aug 1996	Aug 1997	SLCC 049 - OMNR site B3 Aug 1980	Jul 1983	Sep 1984	Aug 1985	Aug 1996	Aug 1997
Brown trout	2	2	2	2	3						
Brook trout											
Rainbow trout				5	2						
White sucker		3									
Northern hog sucker											
Smallmouth bass							3		2	2	1
Rock bass	2	2	3	4							1
Yellow perch											3
Greenside darter											
Blackside darter											
Rainbow darter											
Johnny darter											
Blacknose dace							2	2	3		
Logperch											4
Mottled sculpin	1	1	1	1	1		2	1	1	1	1
Lamprey sp.	2			3				4			
Northern pike											

Venison Creek - Species rankings, species composing at least 5% of site biomass

Species	Sites upstream from proposed barrier location					Downstream					
	SLCC 055 - OMNR site B2 Aug 1983	Aug 1984	Aug 1985	Aug 1996	Aug 1997	SLCC 049 - OMNR site B3 Aug 1980	Jul 1983	Sep 1984	Aug 1985	Aug 1996	Aug 1997
Brown trout	1	2	2	1	1						
Brook trout		5									4
Rainbow trout				3	3						
White sucker		1	1	4							2
Northern hog sucker											
Smallmouth bass											
Rock bass	2	4	4	4	4						
Yellow perch											3
Greenside darter											5
Blackside darter											
Rainbow darter											
Johnny darter											
Blacknose dace							3	4	3		
Logperch											
Mottled sculpin	3	3	3	2	2		2	1	2	2	4
Lamprey sp.								5			
Northern pike											

Venison Creek August 19, 1997

OMNR Site I + g - SLCC Site 027 - Downstream of barrier

1997 site length 40m area = 205.3 m² or 0.02053 ha, avg. depth = 44.6 cm

run 1: 29 min run 2: 22 min run 3: 22 min

1996 site length 50m area = 273.8 m² or 0.02738 ha, avg. depth = 57.5 cm

1995 site length 40m area = 211.2 m² or 0.02112 ha, avg. depth = 44.2 cm

Run #1 counts only include live, clipped fish

species	Run #1		Run #2		total caught Runs 1 & 2	mortality Runs 1 & 2	clipped & released Runs 1 & 2	Run #3		
	Total	New	Total	New				Total	New	Recap
Brown trout <150mm	11	7	4	3	18	0	18	10	7	3
Brown trout >150mm										
Brook trout										
Rainbow trout <150mm										
Rainbow trout >150mm										
White sucker										
Northern hog sucker										
Largemouth bass										
Rock bass										
Creek chub										
Yellow perch										
Pumpkinseed										
Greenside darter										
Blackside darter										
Rainbow darter										
lowa darter										
Johnny darter										
Common shiner										
Blacknose dace										
Logperch	3	1	0	1	4	1	3			
Brassy minnow										
Mottled sculpin	16	11	10	1	27	0	27	8	7	1
Lamprey sp.										
Northern pike	1	1	0	1	2	0	2			
Brown Bullhead										
Shiner sp.										
Chinook Salmon										
Misc. Darter										
Totals	31	23	17	6	54	1	53	24	19	5
Sculpin & lamprey removed	15	12	7	5	27	1	26	16	12	4

Petersen estimates (Chapman mod.)	Low			High		
	Est.	Low	High	Est.	Low	High
Sculpin & lamprey removed	16	35	67	92	41	181
All species combined	54	110	206	225	106	433

Venison Creek August 19, 1997

OMNR Site B3 - SLCC Site 049 - Upstream of barrier

1997 site length 60m area = 438 m² or 0.0438 ha, avg. depth = 31.2 cm
 run 1: 29 min run 2: 24 min run 3: 20 min

1996 site length 57m area = 418.4 m² or 0.04184 ha, avg. depth = 63.4 cm

1995 site length 40m area = 231.2 m² or 0.02312 ha, avg. depth = 24.7 cm

Run #1 counts only include live, clipped fish

Species	Run #1			Run #2			Run #3		
	Total	New	Recap	Total	New	Recap	Total	New	Recap
Brown trout <150mm									
Brown trout >150mm									
Brook trout									
Rainbow trout <150mm	1	1	0				1	1	0
Rainbow trout >150mm									
White sucker									
Northern hog sucker									
Largemouth bass									
Rock bass									
Creek chub									
Yellow perch									
Pumpkinseed									
Greenside darter									
Blackside darter									
Rainbow darter									
Iowa darter									
Johnny darter									
Common shiner									
Blacknose dace									
Logperch									
Brassy minnow									
Mottled sculpin	34	27	3				58	14	1
Lamprey sp.									
Northern pike									
Brown Bullhead									
Shiner sp.									
Chinook Salmon									
Misc. Darter									
Totals	34	28	3	25	24	3	59	15	1
Sculpin & lamprey removed	0	1	0	1	1	0	1	1	0

total caught mortality clipped & released
 Runs 1 & 2 Runs 1 & 2 Runs 1 & 2

Petersen estimates (Chapman mod.)	Run #1			Run #2			Run #3		
	Low	Est.	High	Low	Est.	High	Low	Est.	High
Sculpin & lamprey removed	0	2	2	1	2	2	1	4	4
All species combined	103	254	508	152	510	888			

Big Creek August 20, 1997

OMNR B1 - SLCC Site 193 - Upstream of barrier - lower section

1997 site length 30m area = 432 m² or 0.0432 ha, avg. depth = 28.9 cm

run 1: 21 min run 2: 16 min run 3: 12 min

1996 site length 30m area = 533 m² or 0.0533 ha, avg. depth = 40.4 cm

1995 site length 30m area = 410.0 m² or 0.041 ha, avg. depth = 16.4 cm

Run #1 counts only include live, clipped fish

species	Run #1		Run #2		clipped & released Runs 1 & 2	Run #3	
	Total	New	Total	New		Total	New
Brown trout <150mm	1				1	0	1
Brown trout >150mm	1				1	0	1
Brook trout <150mm	1	0	1		2	0	2
Brook trout >150mm	12	12	4		28	0	28
Rainbow trout <150mm							
Rainbow trout >150mm							
White sucker	3	2	1	1	5	0	5
Northern hog sucker							
Largemouth bass							
Rock bass							
Creek chub							
Yellow perch							
Pumpkinseed	1				1	1	0
Greenside darter							
Blackside darter	6	8	8	0	14	1	13
Rainbow darter							
Iowa darter							
Johnny darter							
Common shiner	11	8	6	2	19	0	19
Blacknose dace							
Logperch							
Brassy minnow	24	27	27	0	52	1	51
Mottled sculpin							
Lamprey sp.							
Northern pike							
Brown Bullhead							
Shiner sp.							
Chinook Salmon							
Misc. Darter							
Totals	60	62	54	8	123	3	120
Sculpin & lamprey removed	36	35	27	8	22	2	20

Petersen estimates (Chapman mod.)	Low	Est.	High
Sculpin & lamprey removed	79	148	264
All species combined	229	427	763

	Low	Est.	High
Totals	35	22	13
Sculpin & lamprey removed	24	15	9

Big Creek August 20, 1997

OMNR B1 - SLCC Site 193 - Upstream of barrier - upper section

1997 site length 40m area = 705.3 m² or 0.07053 ha, avg. depth = 28.4 cm

run 1: 21 min run 2: 25 min run 3: 19 min

1996 site length 45m area = 631.1 m² or 0.06311 ha, avg. depth = 41.4 cm

1995 site length 60m area = 1020.0 m² or 0.1020 ha, avg. depth = 49.1 cm

the northern hog sucker caught in run 2 was thought to be a recap already - however this was later found to be 'untrue' - the fish, while appearing clipped was not marked in the second run and was not re-captured at a later time (and has thus been left out of the clipped and released section)

Run #1 counts only include live, clipped fish

species	Run #1			Run #2			clipped & released			Run #3		
	Total	New	Recap	Total	New	Recap	total caug Runs 1 & Runs 1 & 2	mortality Runs 1 & Runs 1 & 2	clipped & released Runs 1 & Runs 1 & 2	Total	New	Recap
Brown trout <150mm												
Brown trout >150mm												
Brook trout												
Rainbow trout <150mm	3	11	1	10	1		14	0	13	12	9	3
Rainbow trout >150mm												
White sucker	2	2	0	2	0		4	0	4	2	1	1
Northern hog sucker	1	1	0	1	0		1	0	0	2	2	0
Largemouth bass												
Rock bass	1	1	0	1	0		1	0	1			
Creek chub												
Yellow perch												
Pumpkinseed												
Greenside darter	2	8	0	8	0		10	0	10	2	1	1
Blackside darter												
Rainbow darter	28	19	0	19	0		47	3	44	12	11	1
Iowa darter												
Johnny darter												
Common shiner												
Blacknose dace	6	19	1	18	1		25	4	20	8	3	5
Logperch												
Brassy minnow												
Mottled sculpin	62	58	1	57	1		120	1	118	40	38	2
Lamprey sp.												
Northern pike												
Brown Bullhead	1	1	0	1	0		1	0	1			
Shiner sp.	1	1	0	1	0		1	1	0			
Chinook Salmon	1	1	0	1	0		1	1	0			
Misc. Darter	4						4	0	4			
Totals	107	125	3	122	3		232	12	216	80	67	13
Sculpin & lamprey removed	45	67	2	65	2		112	11	98	40	29	11

Petersen estimates (Chapman mod.)	Low			High		
	Est.	Low	High	Est.	Low	High
Sculpin & lamprey removed	1043	376	2051	338	196	589
All species combined	3402	1363	6804	1256	756	2047