2007 Bayfield and Nares Inlet Nearshore Community Index Netting (NSCIN) Survey Report

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BNIA volunteer – Michael Penrod with northern pike caught during the 2007 Bayfield and Nares Inlet NSCIN survey

Executive Summary:

During September of 2007, a Nearshore Community Index Netting (NSCIN) survey was conducted in the Bayfield and Nares Inlet area of eastern Georgian Bay. The purpose of the survey was to assess the status of nearshore fish community, with a particular interest in the game-fish component.

We summarized the results of this survey in a hypothetical 'report card' in which we accord an over-all grade of C-. Most indices of species abundance are approximately equivalent to Georgian Bay NSCIN reference values. According to Provincial benchmarks (where applicable), abundance indices for various species captured was invariably 'medium.' Most disconcerting however were low indices of overall fish productivity.

Our assessment is largely based on ranking various diagnostic indicators in this survey with those from reference datasets, most notable the Georgian Bay NSCIN dataset. Based on low indices of overall productivity within this dataset relative to adjacent inland lakes, we hypothesize that fish productivity within the Georgian Bay NSCIN dataset is well below its potential or what one might reasonably expect. Consequently, 'normal' or 'average' indices of relative abundance within this dataset may be those of uniformly depressed fish populations.

The Ministry of Natural Resources' Upper Great Lakes Management Unit (UGLMU) expresses caution with this interpretation however. They postulate that timing (late summer) of the NSCIN survey protocol may be a significant contributor to low catch rates observed in the Georgian Bay NSCIN dataset – including this survey. This issue is discussed in the report.

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1.0 Introduction

In 2006, the Eastern Georgian Bay Stewardship Council (EGBSC) was approached by the Bayfield-Nares Islanders Association (BNIA) to cooperatively conduct a 'fish population assessment' survey in their area of eastern Georgian Bay.

The keen interest displayed by the BNIA has prompted the EGBSC to consider conducting an annual 'fish assessment project' within the Council area. Projects such as this one are intended to assist the Upper Great Lakes Management Unit (UGLMU) with their fisheries assessment and management program.

2. Methods

In an effort to remain consistent with UGLMU and Provincial assessment survey protocols, we conducted a standard "Nearshore Community Index Netting" (NSCIN) survey. The NSCIN survey is designed to evaluate relative abundance and other attributes of fish species that inhabit the littoral zone of Ontario waters. The purpose of our survey was to conduct a broad-spectrum assessment of the status of fish populations within the nearshore fish community. For this purpose, the NSCIN survey protocol was deemed highly appropriate.

> *Addendum: Some concern has been expressed by the UGLMU as to the efficacy of the NSCIN survey protocol on Great Lake waters. They postulate that the late summer time period of the survey may be contributing significantly to low catches observed in the Georgian Bay NSCIN dataset. They note that the Georgian Bay ESTN dataset, a similar survey protocol except that it is conducted in the late spring, consistently has higher catch rates than the Georgian Bay NSCIN dataset.*

2.1 Field Methods:

Survey procedures were as specified in the Ministry's Manual of Instructions for Nearshore Community Index Netting (NSCIN) projects (OMNR, 1999), with the exception of set location. The protocol for NSCIN surveys entails the use of live-capture, 6'-trapnets that are set over-night (approximately 24hr duration). All fish captured were enumerated (Appendix A) and size-sampling, either complete or random, was conducted for each species captured (Appendices C – I). All fish were live-released at the site of captured. Incidental mortality was negligible.

Field operations commenced September 6, 2008 and terminated September 13.

The study area for the survey extended from Nares Inlet in the south to the mouth of Alexander Passage in the north (Figure 1).

Due to the known difficulties in pre-selecting netting sites according to the NSCIN manual, net locations were selected in accordance with the following guidelines:

- Nets were to be approximately evenly dispersed throughout the study in an effort to fish various fish habitats in the proportion of which they occurred in the lake. The intention here was that the catch would reflect the 'whole study area' as accurately as possible.

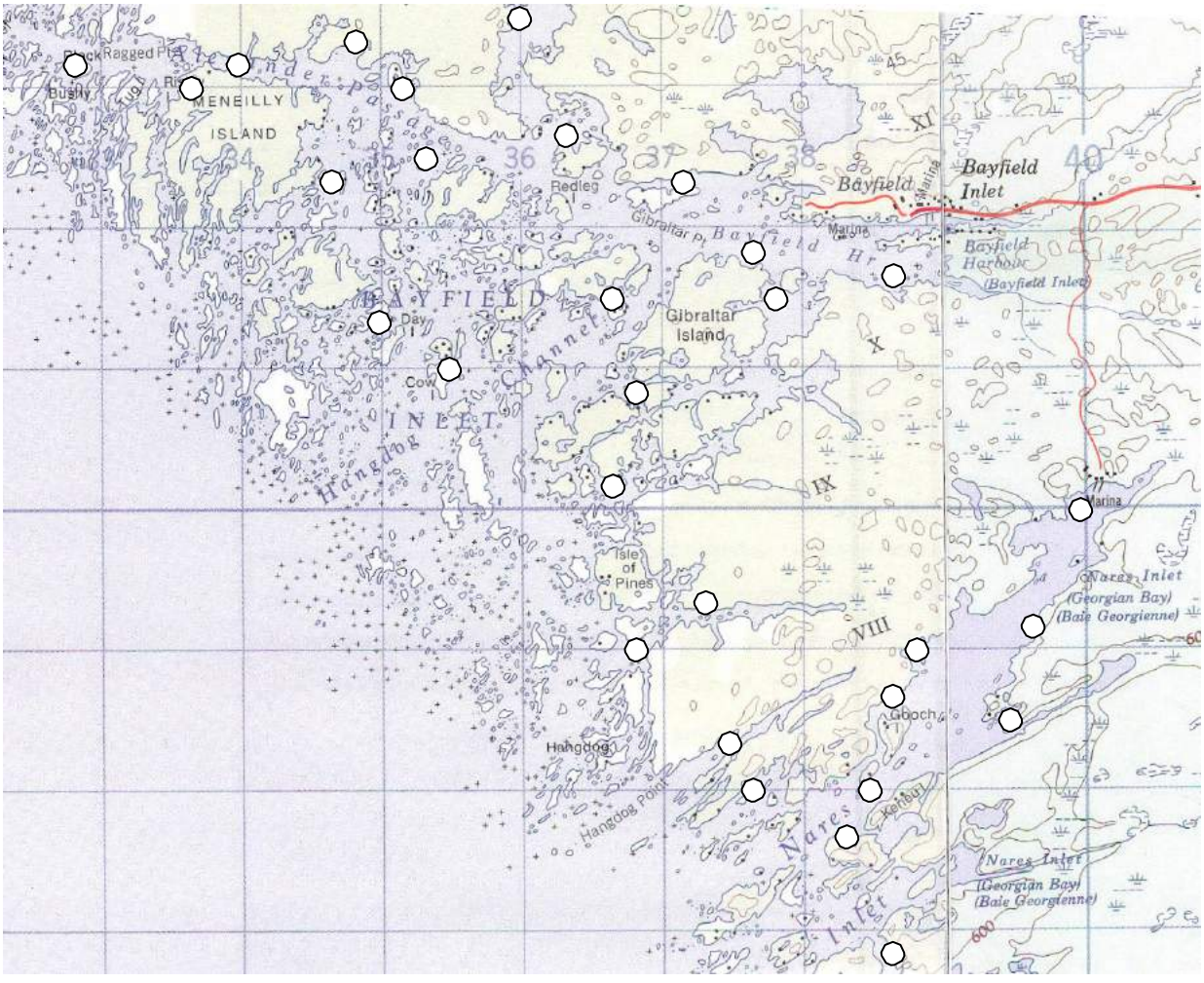
- The site had to be suitable for the net to fish effectively. (Consequently – factors such as: contour of the lake bottom, absence of obstructions, depth, sufficient lead length, etc. were considered.)
- Nets were to be set far enough apart (> 500 m) such that they were not competing with each other.
- Avoid areas of potential conflict where there is human habitation.
- Avoid areas where nets could act as a navigational hazard.

Finding suitable net set locations was particularly challenging for this survey. Most troublesome, was finding sites with adequate depth while using the full 120 meter extension of the lead. This situation was exacerbated by low Georgian Bay water levels. Consequently, large areas in amongst off-shore shoals were unsuitable for sampling.

Net set locations are shown in Figure 1.

Figure 1. Study area showing location of trapnet sets.

(Note: This figure is intended to indicate the dispersion of net sets throughout the study area. For UTM coordinates of individual net sets, see Appendix J.)



2.2 Data Analysis and Interpretation

We used *Catch-Per-Unit-Effort-by-number* (CPUE-no), *Catch-Per-Unit-Effort-by-weight* (CPUE-wt) and *Probability-of-Capture* (PoC) as indices of relative abundance.

CPUE-no and CPUE-wt are the average number and weight of all fish, or a particular species of fish, caught per unit of effort. In our case, the unit of effort was an over-night net set. PoC is the probability that a particular species will be caught in any individual net set. For instance, a PoC of 0.5 indicates half of the net sets caught one or more fish of a specified species. It can also be viewed as a 50% probability of capture.

We compare the indices of species abundance observed in this survey with three reference datasets:

1. The first reference dataset, and the one with which legitimate comparisons can be made - is a collection of eight NSCIN surveys conducted from 1996 to the present in areas along the north and east shore of Georgian Bay (Appendix B). We refer to this as the Georgian Bay NSCIN dataset.

2. The second reference dataset, used to set our indices of abundance within a Provincial context - is the Provincial NSCIN dataset. This dataset is comprised of 86 NSCIN surveys conducted on 48 waterbodies from 1991 to 1998. (*Regrettably, updates to this dataset have not been made since original publication in 2000. It is doubtful however, that thresholds for "low", "medium" and "high" abundance are likely to change significantly*.)

   Within the Provincial NSCIN database, individual species benchmarks of "low", "medium" and "high" abundance have been set according to ranking values within the dataset. CPUE values below the 25th percentile value are accorded "low" abundance. CPUE values above the 75th percentile value are accorded "high" abundance. Those in between are accorded "medium" abundance (Brereton, 2000).

3. The third reference dataset is a collection of 19 synoptic trap-net surveys conducted by the Parry Sound Area of the Ministry of Natural Resources, from 1982 to 2004. There is little validity in making comparisons with this dataset due to significant differences in methodology. However, we use this dataset simply to provide some context of overall fish productivity relative to inland lakes adjacent to our study area.

3.0 Results:

3.1 Fish Community Results

3.1.1 Overall Fish Productivity:

In 30 over-night trapnet sets we captured a grand total of 393 fish weighing approximately 230 kilograms (Appendix A).

Overall catch-per-unit-effort in terms of number (CPUE-no) was 13.1 fish per net set (Appendix A). This is well below the mean value of 20.9 from eight NSCIN surveys conducted on the east and north shores of Georgian Bay from 1996 to 2007 (Appendix B).

Our overall catch-per-unit-effort-by-weight (CPUE-wt) was 7.677 kilograms per net set (Appendix A). NSCIN surveys conducted prior to 2005 on Georgian Bay do not include this statistic and we are unable to make a benchmark comparison with this reference dataset. However, the 2005 NSCIN survey conducted in the Sturgeon Bay area of eastern Georgian Bay had an over-all CPUE-wt of 20.617 kg. per net set (McIntyre, 2005); almost three times higher than this survey. Also, although not directly comparable, the Parry Sound synoptic 6'-trapnet data set has an over-all CPUE-wt of 13.088 kg per net set; considerably greater than that observed in this survey.

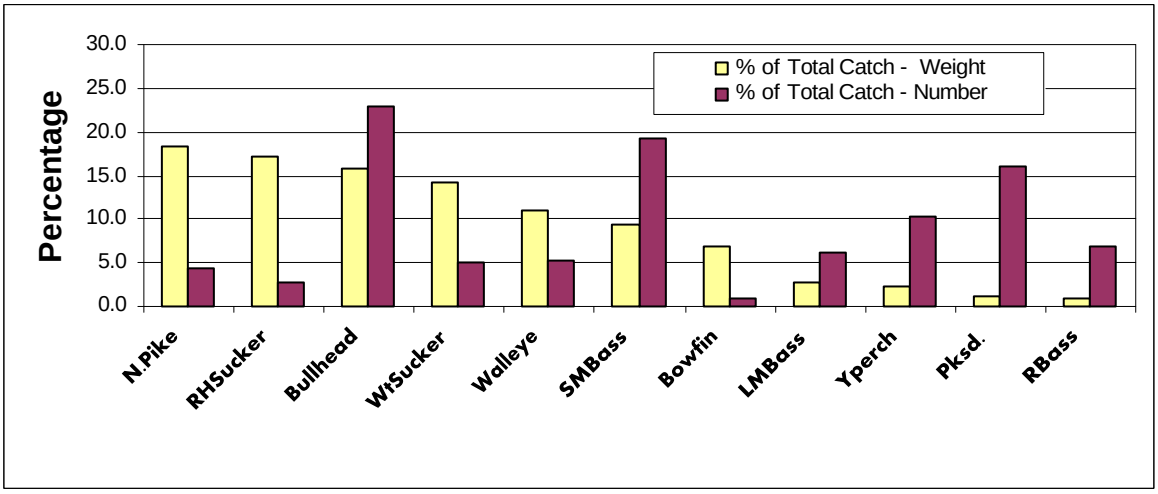
Given our over-all low CPUE-no relative to other NSCIN surveys conducted on Georgian Bay, we conclude that overall fish productivity in the Bayfield and Nares Inlet area of eastern Georgian Bay is below the Georgian Bay average.

3.1. 2 Catch Composition:

We analyzed our catch data according to species, both in terms of number (i.e. number of a particular species caught per unit effort – CPUE-no.) and weight (i.e. weight of a particular species caught per unit effort – CPUE-wt) (Figure 2 and Appendix A).

Figure 2. Species Catch Composition by Percent of Total Catch and Weight.

Total Number Caught: 393; Total Weight Caught: 230.301 kg. (Data from Appendix A)



By weight, northern pike was the highest represented species in the catch (18.3%), followed by redhorse sucker (17.1%), brown bullhead (15.9%), white sucker 14.2%), walleye (11%), smallmouth bass (9.5%), bowfin (6.8%), largemouth bass (2.8%), yellow perch (2.4%), pumpkinseed (1.2%) and rock bass (0.9%) (Figure 2).

By number, brown bullhead was the highest represented (90) followed by smallmouth bass (76), pumpkinseed (63), yellow perch (40), rock bass (27), largemouth bass (24), walleye (21), white sucker (20), northern pike (17), redhorse sucker (11) and bowfin (4) (Figure 2).

By weight, non-game fish species (redhorse sucker, brown bullhead, white sucker, bowfin,) comprised 54.0% of the total catch weight of 230 kilograms. Game fish (walleye, pike, large and smallmouth bass) comprised 41.5% and pan fish (rock bass, pumpkinseed and yellow perch) 4.5% (Appendix A) .

We caution our readers that the foregoing discussion and results may give the impression that our catch is representative of fish community composition. Such is not necessarily the case. Although 6' trap-nets are a broad-spectrum capture gear for near-shore fish, not all species are equally vulnerable to the gear. Also, there is size selectivity associated with the gear. Consequently, very small and abundant fish species such as minnows are absent from the catch as are the early life stage of larger fish species. Consequently, our catch composition should not be considered a direct reflection of fish community composition.

3.1.3 Number of Fish Species Caught:

We captured 11 different fish species in this survey; the same as the 1997 Shebeshekong Delta survey and lowest for the eight NSCIN surveys thus far conducted on Georgian Bay (Appendix B). A high of 17 species were captured in the 1996 Moon River Delta survey, 1998 Shawanaga River Delta survey and 2005 Sturgeon Bay survey.

Species that we perhaps expected to see but didn't include: muskellunge, gar pike and black crappie.

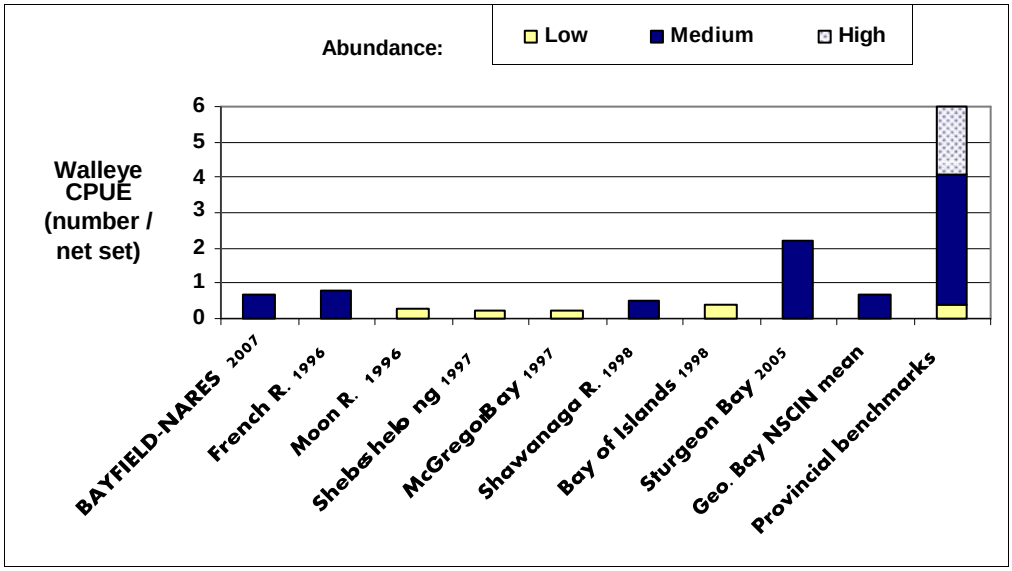
3.2 Species Analysis:

3.2.1 Walleye

From 30 over-night trapnet sets, we captured 21 walleye for a Catch-Per-Unit-Effort **(CPUE-no.) of 0.7 walleye per net set** ± 0.7 ($p<0.05$) (Appendix A). The wide 95% confidence limit for this statistic is attributable to high variation in our walleye catch data. Walleye were only caught in seven sets and numbering 1 – 3 fish each, with the exception of one set that caught 10.

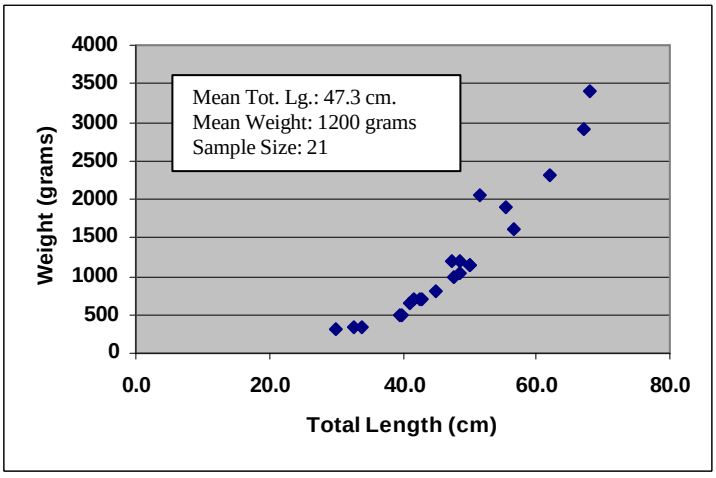
The mean walleye CPUE-no from eight NSCIN surveys conducted on the east and north shores of Georgian Bay is also 0.7 walleye per net set (Figure 3 and Appendix B), indicating that walleye abundance in the Bayfield-Nares area is equivalent to the Georgian Bay NSCIN average. Relative to the Provincial NSCIN dataset, the walleye CUPE-no of 0.7 for our survey, falls within the "medium" category of relative abundance (Figure 3).

Figure 3. Walleye CPUE-no for surveys conducted on the north and east shores of Georgian Bay in relation to Provincial NSCIN benchmarks of abundance. (Data from Appendix B)



The walleye *probability of catch* (PoC) for our survey was 0.23. That is, 23% of net sets caught at least one or more walleye. This suggests that walleye are not particularly abundant or widely distributed throughout the study area. They comprised 11.0% of the over-all catch weight (Appendix A).

Figure 4. Walleye size distribution; Bayfield-Nares NSCIN survey, 2007. (Data from Appendix C)

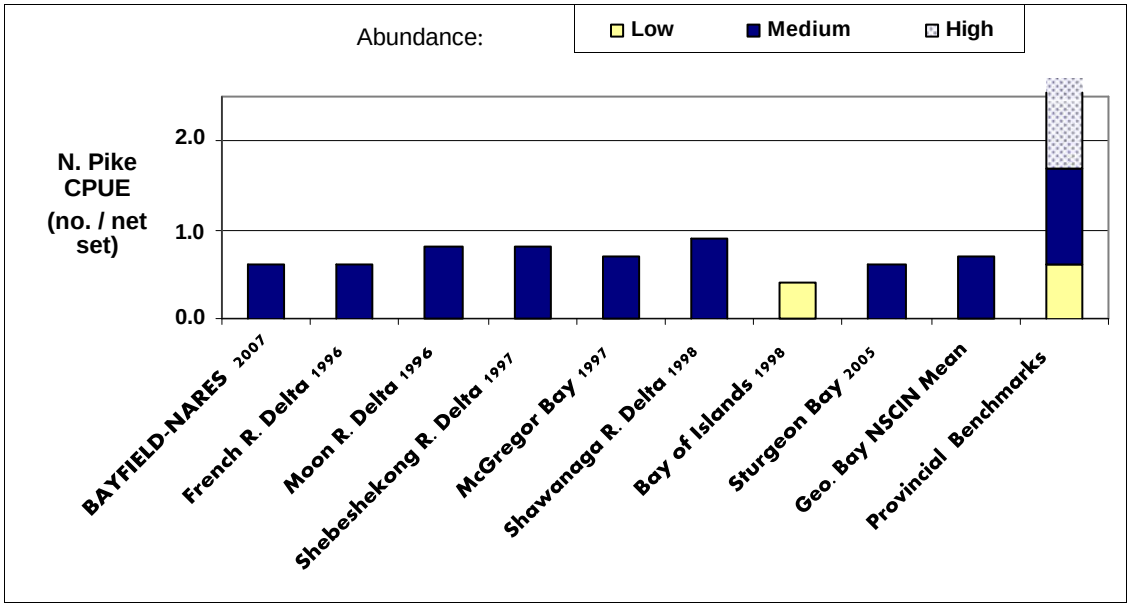


Our sample of walleye showed a wide size distribution (Figure 4). Both large and small size walleye were proportionately well represented in the catch. Successful recruitment is occurring in this population. The size distribution of the population in conjunction with its 'medium' abundance in a Provincial context, suggests recruitment and mortality rates of this population are at sustainable levels.

3.2.2 Northern Pike

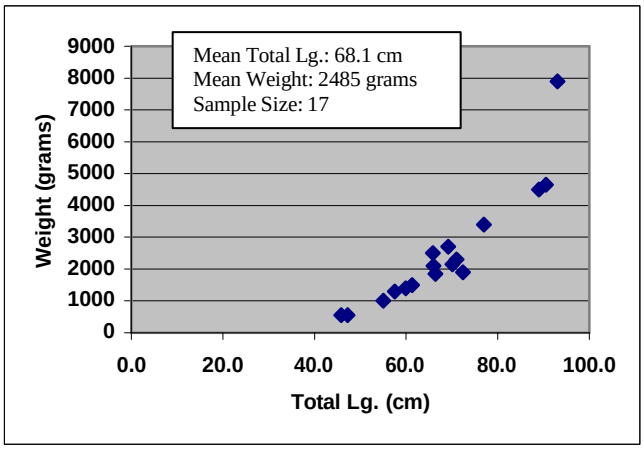
We captured 17 northern pike for a CPUE of 0.6 pike per net set ± 0.3 ($p<0.05$) (Appendix A). This index of abundance is similar to the mean value of 0.7 from eight NSCIN surveys conducted on the north and east shores of Georgian Bay (Appendix B). Within the context of Provincial NSCIN benchmarks, this represents 'medium' abundance.

Figure 5. Northern Pike CPUE-no for surveys conducted on the north and east shores of Georgian Bay in relation to Provincial NSCIN benchmarks of abundance.



We captured one or more pike in 12 of our 30 trap-net sets (Appendix A), for a *probability of capture* (PoC) of 0.43. This suggests pike are fairly well dispersed throughout the study area. They comprised a survey high – 18.3% of the over-all catch weight, indicating a dominant position in the fish community.

Figure 6. Northern Pike size distribution; Bayfield-Nares NSCIN survey, 2007.



(Data from Appendix D)

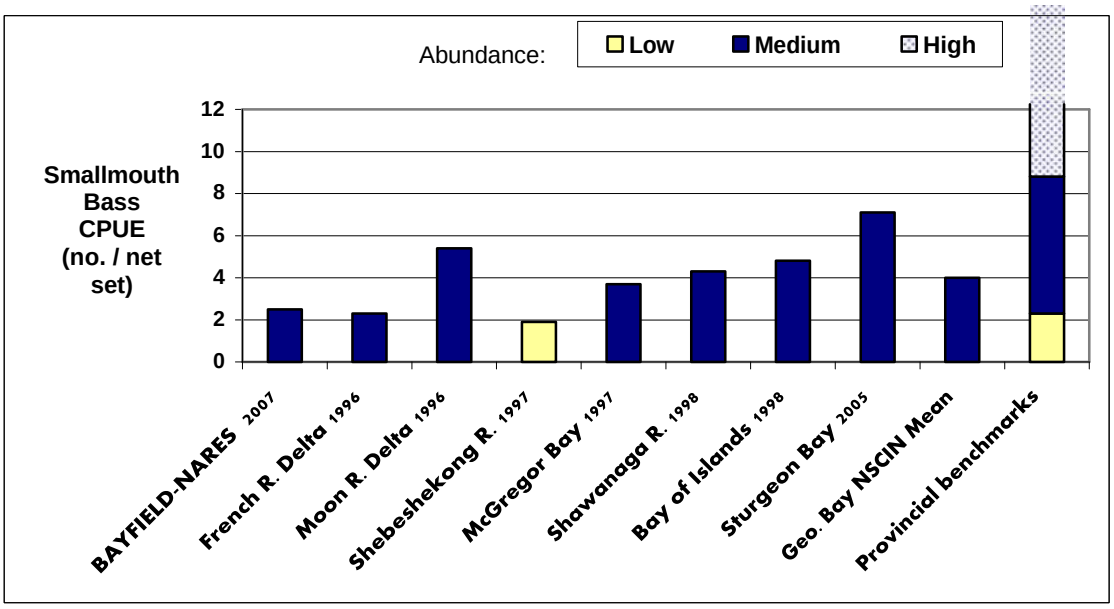
We size-sampled all 17 pike captured in this survey (Figure 6). Notwithstanding our small sample size; size distribution appeared reasonably good with all size classes represented in the catch. Successful recruitment to the population is occurring and the fair number of large fish suggests mortality is not excessive.

Indices of abundance and size distribution of the pike population suggest it is reasonably healthy and certainly self-sustaining.

3.2.3 Smallmouth Bass

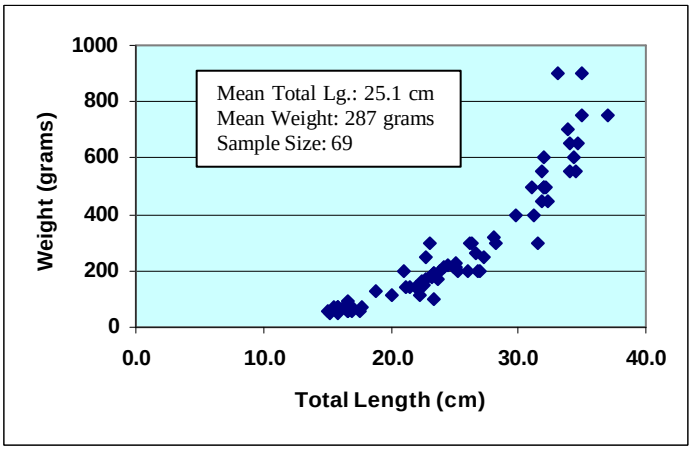
We captured 76 smallmouth bass for a CPUE of 2.5 smallmouth per net set ± 1.5 ($p<0.05$) (Appendix A). Although below the mean of 3.8 for eight NSCIN surveys conducted on the north and east shore of Georgian Bay, within the context of provincial NSCIN benchmarks, smallmouth abundance is 'medium' (Figure 7).

Figure 7. Smallmouth bass CPUE-no for surveys conducted on the north and east shore of Georgian Bay in relation to Provincial NSCIN benchmarks of abundance.



We captured one or more smallmouth bass in 21 of 30 net sets (Appendix A), for a survey high *probability of capture* (PoC) of 0.70. Smallmouth bass and brown bullhead had the two highest CPUE-no and PoC for the survey, indicating these were the most widely dispersed species caught throughout the study area. Smallmouth comprised 9.5% of the over-all catch weight.

Figure 8. Smallmouth bass size distribution; Bayfield Nares NSCIN survey, 2007 (Data from Appendix E)



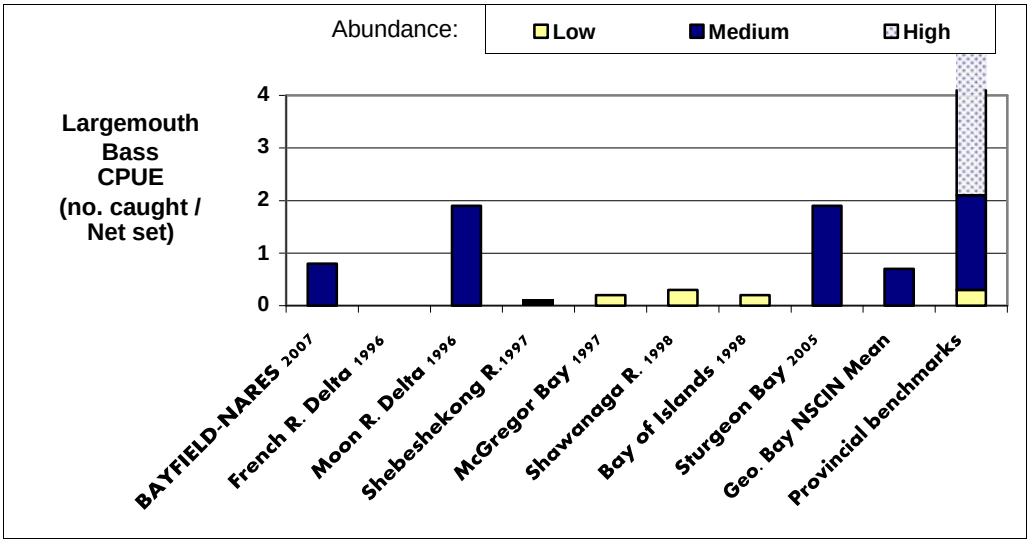
We size-sampled 69 of the 76 smallmouth bass captured. All size classes were well represented suggesting good levels of recruitment and modest mortality of adult fish.

Indices of abundance as well as size distribution of the catch, suggest the smallmouth bass population is healthy and self-sustaining.

3.2.4 Largemouth Bass

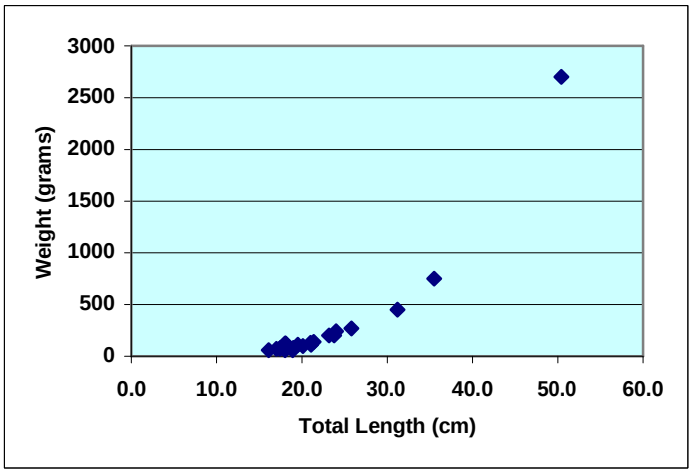
We captured 24 largemouth bass for a CPUE of 0.8 largemouth per net set ± 0.7 ($p<0.05$) (Appendix A). This is essentially the same as the mean of 0.7 from Georgian Bay NSCIN surveys previously conducted (Figure 9). Within the context of Provincial NSCIN benchmarks, this index of relative abundance is considered 'medium.'

Figure 9. Largemouth bass CPUE-no for surveys conducted on the north and east shore of Georgian Bay in relation to Provincial NSCIN benchmarks of abundance.



Eight trap-net sets caught one or more largemouth bass for a Probability of Capture (PoC) of 0.27 (Appendix A). This rather low index of abundance and distribution is typical of largemouth bass which has habitat requirements that are generally not abundant throughout eastern Georgian Bay. Largemouth bass only comprised 2.8% of the over-all catch weight.

Figure 10. Largemouth bass size distribution; Bayfield-Nares NSCIN survey, 2007



(Data from Appendix F)

We size-sampled all 24 largemouth bass captured (Figure 10). The abundance of small fish indicates successful reproduction as well as good recruitment. However, the paucity of larger size fish suggests high mortality amongst adults.

3.2.5 Other Non-game Species

White Sucker:

We captured 20 common white sucker for a CPUE of 0.7 sucker per net set ± 0.4 ($p<0.05$) (Appendix A). This was very similar to the Georgian Bay NSCIN mean of 0.8. Within the context of the Provincial NSCIN benchmarks, this index of abundance is considered 'medium.'

White sucker comprised 14.2% of the over-all catch weight, ranking them 4th in this category.

We randomly size-sample 15 white sucker; mean total length was 48.3 cm and mean weight was 1633 grams (Appendix G).

Redhorse Sucker (*Moxostoma sp*.)

We captured 11 redhorse sucker for a CPUE of 0.4 sucker per net set ± 0.3 ($p<0.05$) (Appendix A). We have no data available in either the Georgian Bay NSCIN database or the Provincial NSCIN database with which to provide a context of relative abundance.

Redhorse sucker comprised 17.1% of the over-all catch weight, ranking them second in this category (Appendix A).

We randomly size-sampled 12 redhorse sucker and determined a mean total length of 60.4 cm and mean weight of 3283 grams (Appendix G). In terms of mean size (weight), redhorse sucker were the second largest fish caught in this survey. Bowfin was the largest.

Brown Bullhead:

We captured 90 brown bullhead for a CPUE of 3.0 bullhead per net set ± 1.5 ($p<0.05$) (Appendix A). In terms of CPUE by number, bullhead were the most abundantly caught species in this survey. Nonetheless, this index is abundance is below the mean of 5.7 for the Georgian Bay NSCIN reference dataset. Relative to the Provincial NSCIN benchmarks, our CPUE for bullhead places it in the 'medium' abundance category.

Bullhead *probability of capture* (PoC) was 0.7, tying it with smallmouth bass for the highest in this survey. Consequently, brown bullhead was the most abundant and widely distributed species captured in this survey.

Bullhead comprised 15.9% of the over-all catch weight, ranking them third in this category behind northern pike and redhorse sucker (Appendix A).

We randomly size-sampled 36 brown bullhead and determined a mean total length of 27.1 cm and mean weight of 406 grams. (Appendix H).

Bowfin

We captured four bowfin for a CPUE survey low of 0.1 bowfin per net set ± 0.2 ($p<0.05$) (Appendix A). We have no reference dataset with which to compare this index of abundance, but considering the low catch rate, this is somewhat superfluous. Bowfin abundance was low and with a PoC of 0.1 was also the lowest in this category for the survey.

We size-sampled all bowfin captured and determined a mean total length of 68.9 cm and mean weight of 3925 grams (Appendix I). This mean size, both in terms of total length and weight was the largest in the survey. Notwithstanding being the lowest species caught in terms of number (4), due to their large size bowfin comprised 6.8% of the overall catch weight (Appendix A) .

Panfish – Pumpkinseed, Rock Bass and Yellow Perch

As is typical of these species, they are caught in relatively large number, but due to their small size comprise a small component of the over-all catch weight. Such was the case in our survey. We captured 63 pumpkinseed, 27 rock bass and 40 yellow perch (Appendix A). Respective CPUEs for this survey are given below with comparable Georgian Bay NSCIN mean values and provincial benchmark abundance categories.

Species	Bayfield-Nares CUPE (no. / net set)	Geo. Bay NSIN Mean CPUE (no. / net set)	Prov. Benchmark abundance category
Pumpkinseed	2.1 ± 1.7 ($p<0.05$)	2.4	Medium
Rock Bass	0.9 ± 0.5 ($p<0.05$)	1.7	Medium
Yellow Perch	1.3 ± 1.3 ($p<0.05$)	0.6	Medium

We conclude that the abundance of panfish species captured in this survey are approximately equivalent to the mean from other Georgian Bay NSCIN surveys and have 'medium' abundance within the context of Provincial benchmarks.

Collectively panfish comprised 4.5% of the total catch weight (Appendix A).

4.0 Report Card and Discussion

We prepared a hypothetical 'report card' in which we accord the Bayfield-Nares area of Georgian Bay an over-all grade of C-.

	Diagnostic Indicator	Bayfield Nares NSCIN Value	Reference Value Geo. Bay NSCIN mean	Grade	Comment
Over-all Fish Community	Over-all productivity CPUE no (all species)	13.1 fish / net set	21.5 fish / net set	F	Low over-all CPUE-no and CPUE-wt. (* *Note - From Parry Sound Area NSCIN reference dataset*)
	CPUE-wt (all species)	7.677 kg. / net set	*13.088 kg / net set**	F	
	% of total catch weight	game fish - 41.5% non-game fish 58.5%	*game fish - 50.5% non-game fish 49.5%*	C-	
	# fish species caught	11	14.4	C	
Walleye	CPUE-no	0.7 +/- 0.7 (p<0.05)	0.7	C	Average' abundance; Provincial benchmark accords 'medium' abundance
	Probability of Catch	0.23			
	% of total catch weight	11.0%			
	Size distribution	Good		B	
Northern Pike	CPUE-no	0.6 +/- 0.3 (p<0.05)	0.7	C	Average' abundance; Provincial benchmark accords 'medium' abundance
	Probability of Catch	0.43			
	% of total catch weight	18.3% - *highest in survey*		B	
	Size distribution	Good		B	
Smallmouth Bass	CPUE-no	2.5 +/- 1.5 (p<0.05)	3.8	C-	Average' abundance; Prov. Benchmark accords 'medium' abundance
	Probability of Catch	0.7 - *highest in survey*		B	
	% of total catch weight	9.50%			
	Size distribution	Excellent		A	
Largemouth Bass	CPUE-no	0.8 +/- 0.7	0.7	C	Average' abundance; 'medium' by Prov. benchmark. Small component within fish community.
	Probability of Catch	0.27			
	% of total catch weight	2.8%			
	Size distribution	large fish scarce		D	
Non-game fish	White Sucker CPUE	0.7 +/- 0.4 (p<0.05)	0.8	C	Approximately 'average' abundance for Geo. Bay NSCIN surveys; slighly high dominance in catch weight
	Redhorse Sucker CPUE	0.4 +/- 0.3 (p<0.05)			
	Brown Bullhead CPUE	3.0 +/- 1.5 (p<0.05)	5.7	C	
	Bowfin CPUE	0.1 +/- 0.2 (p<0.05)			
	% total catch weight	54.0%		C-	
	Pumpkinseed CPUE	2.1 +/- 1.7 (p<0.05)	2.4	C	Approximately 'average' abundance for Geo. Bay NSCIN surveys
	Rock Bass CPUE	0.9 +/- 0.5 (p<0.05)	1.7	C	
	Yellow Perch CPUE	1.3 +/- 1.3 (p<0.05)	0.6	C+	
	% total catch weight	4.5%		C	

Overall grade: C-. Most indices of species abundance are approximately equivalent to the Georgian Bay NSCIN reference values. According to Provincial benchmarks, abundance is invariably 'medium.' Most disconcerting however are low indices of overall fish productivity.

This assessment is largely based on ranking various diagnostic indicators collected in this survey, relative to values from other NSCIN surveys previously conducted on the north and east shores of Georgian Bay. We occasionally supplemented this reference dataset with benchmarks from

the Provincial NSCIN dataset and the Parry Sound Area synoptic trapnet dataset when appropriate. Consequently, our grade of a C- for this survey is based on a "relative assessment."

Such an assessment methodology has the potential of providing a biased perspective depending on the surveys within the reference datasets. For instance, if individual or over-all near-shore fish populations are depressed for all surveys within our reference dataset, then indices of abundance are approximately equivalent and fish population seem 'normal' or 'average.' In fact they are 'normal' – but uniformly depressed. We fear this may be the case with the Georgian Bay NSCIN dataset.

Total dissolved solids (TDS), mean depth and waterbody morphology are primary determinants of fish productivity. Georgian Bay waters are known to have considerably higher TDS levels than inland lakes within the adjacent Parry Sound Area. Also, littoral areas in the Bayfield and Nares Inlet area of eastern Georgian Bay have relatively shallow waters with exceptional high complexity of shoreline associated with numerous islands, bays and inlets. Consequently, one would expect that over-all fish productivity should be considerably higher in the Bayfield and Nares Inlet area than adjacent inland lakes. However, when we compare the overall CPUE by weight from our survey – 7.677 kg / net set (Appendix A); it is considerably lower than that observed from nearby inland waters – 13.088 kg / net set (unpublished Parry Sound synoptic 6'-trapnet data). The inference here is that fish productivity on Georgian Bay is under producing relative to its potential. It appears that the fish community in the Bayfield and Nares Inlet area of Georgian Bay may indeed be 'average' relative to the Georgian Bay NSCIN reference dataset. However, this reference dataset – including the Bayfield and Nares Inlet area, appears to represent poor productivity and presumably depressed fisheries producing well below potential.

However, staff at the UGLMU postulate an alternate explanation for the low catches observed in the Georgian Bay NSCIN reference dataset, which also includes this survey. The NSCIN survey protocol was developed from research work conducted on inland lakes and findings may not be applicable to surveys conducted on Great Lakes waters (Arunas Liskauskas; pers. comm.). The effectiveness of passive trapnet gear may be reduced in the late summer when fish tend to be more sedentary. Catch data from ESTN surveys conducted on Georgian Bay waters, essentially the same as NSCIN in protocol except they are conducted in the late spring; clearly show a much higher catch rate for all species. This hypothesis suggests that low catch rates in the Georgian Bay NSCIN dataset is perhaps more attributable to the timing of the survey as opposed to uniformly depressed fish populations.

5.0 Literature Cited

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6.0 Acknowledgements

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Appendix A. 2007 Bayfield and Nares Inlet Area NSCIN Catch Summary, with CPUE-no comparison to Georgian Bay NSCIN reference dataset.

Net Set	Wall-eye	Small M. Bass	Large M. Bass	Northern Pike	White Sucker	Red H. Sucker	Brown Bullhead	Pump-kinseed	Rock Bass	Yellow Perch	Bow- fin	
1	0	9	0	2	1	0	1	0	0	0	0	
2	2	19	0	0	2	0	3	0	0	0	0	
3	0	1	0	1	1	0	0	2	0	0	0	
4	0	0	0	0	0	0	1	0	0	0	0	
5	2	0	1	2	0	0	0	0	1	0	0	
6	0	1	0	1	0	1	1	1	0	2	0	
7	3	1	1	1	2	0	2	2	1	0	1	
8	0	0	0	0	0	0	0	0	1	3	0	
9	0	1	0	1	1	0	9	3	1	2	0	
10	1	3	0	1	1	1	1	0	3	0	0	
11	0	0	1	0	0	1	1	0	0	1	1	
12	0	2	0	1	1	0	5	10	4	2	0	
13	0	1	0	1	0	0	0	0	1	9	0	
14	0	0	0	1	0	0	0	1	0	1	0	
15	0	4	0	0	0	0	1	0	2	0	0	
16	0	5	0	0	0	1	0	0	4	0	0	
17	2	12	0	0	0	0	1	0	0	0	0	
18	1	2	3	1	0	0	7	0	1	0	0	
19	0	1	3	0	1	4	6	0	0	0	2	
20	0	2	0	1	1	0	2	0	4	0	0	
21	0	0	0	0	1	0	0	0	0	17	0	
22	0	2	0	0	0	1	2	0	0	0	0	
23	0	0	0	0	0	0	0	16	1	1	0	
24	0	1	0	0	5	1	10	0	0	0	0	
25	0	2	6	3	0	0	16	14	0	2	0	
26	0	4	0	0	0	0	0	0	3	0	0	
27	0	0	0	0	0	0	2	0	0	0	0	
28	0	0	1	0	0	0	1	2	0	0	0	
29	0	1	8	0	3	0	9	12	0	0	0	
30	10	2	0	0	0	1	9	0	0	0	0	Grand Total
Total	21	76	24	17	20	11	90	63	27	40	4	393
CPUE (no. / set)	0.7	2.5	0.8	0.6	0.7	0.4	3.0	2.1	0.9	1.3	0.1	13.1
Standard Error	0.353	0.752	0.344	0.141	0.205	0.148	0.737	0.821	0.246	0.629	0.079	
95% Confidence Level	0.722	1.537	0.703	0.289	0.420	0.302	1.506	1.680	0.503	1.287	0.162	
Standard Deviation	1.932	4.117	1.883	0.774	1.124	0.809	4.034	4.498	1.348	3.447	0.434	
Sample Size	30	30	30	30	30	30	30	30	30	30	30	
Probability of Capture	0.23	0.70	0.27	0.43	0.40	0.27	0.70	0.33	0.43	0.33	0.10	
% of over-all catch Number	5.3	19.3	6.1	4.3	5.1	2.8	22.9	16.0	6.9	10.2	1.0	99.9
Mean Weight (grams)	1200.0	286.7	264.6	2485.3	1633.3	3283.3	406.1	43.8	75.4	138.8	3925.0	
Total Species Weight Caught	25250	21789	6350	42250	32666	39400	36549	2759	2036	5552	15700	230301
% of over-all catch Weight	11.0	9.5	2.8	18.3	14.2	17.1	15.9	1.2	0.9	2.4	6.8	100.1
CPUE (gr. / set)	841.7	726.3	211.7	1408.3	1088.9	1313.3	1218.3	92	67.9	185.1	523.3	7676.8
Geo. Bay NSCIN Reference dataset (N=8) :												
Mean CPUE	0.7	4.0	0.7	0.7	0.8		5.7	2.4	1.7	0.6		

Appendix B. Georgian Bay NSCIN dataset of species specific CPUE-no values.

NSCIN Survey Area & Yr	Wal-eye	SM bass	LM Bass	N Pike	Black Crappy	White Suckr	Brown Bllhd	Pksk.	R. Bass	Y. Perch	Other	All Species	# Sp. Caught
French R. 1996	0.8	2.3	0.0	0.6	0.1	1.2	4.2	2.0	1.5	1.9	1.5	16.1	14
Moon R. 1996	0.3	5.4	1.9	0.8	3.9	0.0	10.8	2.2	1.9	0.3	0.5	28.0	17
Shebeshekong 1997	0.7	1.9	0.1	0.5	0.2	3.0	5.4	0.6	3.3		2.0	17.7	11
McGregor Bay 1997	0.2	3.7	0.2	0.7	0.4	0.1	1.2	0.5	0.6	0.1	1.2	8.9	15
Shawanaga R. 1998	0.5	4.3	0.3	0.9	0.7	0.8	1.2	3.2	1.3	0.3	0.9	14.4	17
Bay of Islands 1998	0.4	4.8	0.2	0.4	0.1	0.2	0.3	0.1	0.6	0.2	0.3	7.6	13
Sturgeon Bay 2005	2.2	5.2	1.9	0.8	13.8	0.9	19.3	8.6	3.1	0.3	1.1	57.2	17
Bayfield-Nares 2007	**0.7**	**2.5**	**0.8**	**0.6**		**0.7**	**3.0**	**2.1**	**0.9**	**1.3**	**0.5**	**13.1**	11
Geo. Bay NSCIN mean	**0.7**	**3.8**	**0.7**	**0.7**	**2.7**	**0.9**	**5.7**	**2.4**	**1.7**	**0.6**	**1.1**	**20.9**	14.4
Median	0.6	4.0	0.3	0.7	0.4	0.8	3.6	2.1	1.4	0.3	1.1		
Provincial NSCIN mean	1.2	4.6	0.9	0.8	1.1	2.0	2.7	6.3	2.8	0.6	0.7	23.7	

Note: Data for surveys from 1996 to 1998 obtained from Brereton, 2000. FAU Network Report 2000-1

Appendix C. Walleye size-sampling data – 2007 Bayfield and Nares Inlet Area NSCIN survey.

Set No.	Total Lg. (cm)	Fork Lg. (cm)	Weight (grams)
2	39.5	37.3	500
2	50.1	47.4	1150
5	67.0	62.6	2900
5	68.0	64.9	3400
7	50.0	46.8	1150
7	48.6	45.8	1200
7	55.5	52.1	1900
10	51.4	48.5	2050
17	30.1	28.0	300
17	39.9	37.1	500
18	47.5	44.8	1000
30	33.9	32.0	350
30	41.5	38.9	700
30	48.5	45.8	1050
30	56.5	53.1	1600
30	32.7	30.8	350
30	42.6	39.7	700
30	62.1	58.5	2300
30	44.8	42.2	800
30	41.1	38.6	650
30	42.9	40.1	700
Mean	47.3	44.5	1200
Standard Error	2.261	2.150	187.892
Confidence Level (95.0%)	4.716	4.485	391.935
Standard Deviation	10.360	9.852	861.028
Sum			25250
Count	21	21	21

Appendix D. Northern Pike size-sampling data – 2007 Bayfield and Nares Inlet Area NSCIN survey.

Total Lg. (cm)	Fork Lg. (cm)	Weight (grams)	Total Lg. (cm)	Fork Lg. (cm)	Weight (grams)
89.0	84.0	4500	72.4	68.2	1900
70.1	66.0	2150	90.5	86.0	4650
57.5	53.6	1300	59.9	56.5	1400
66.0	62.6	2100	61.3	57.8	1500
55.0	51.5	1000	71.0	68.2	2300
69.2	65.0	2700	77.0	73.8	3400
66.4	62.6	1850	45.8	43.9	550
93.0	87.6	7900	47.2	44.5	550
65.8	62.7	2500			
		Mean	68.1	64.4	2485.3
		Standard Error	3.329	3.164	442.415
		Confidence Level(95.0%)	7.057	6.708	937.878
		Standard Deviation	13.725	13.047	1824.123
		Sum			42250
		Count	17	17	17

Appendix E. Smallmouth bass size-sampling data – 2007 Bayfield and Nares Inlet Area NSCIN survey.

Total Lg. (cm)	Fork Lg. (cm)	Weight (grams)	Total Lg. (cm)	Fork Lg. (cm)	Weight (grams)	Total Lg. (cm)	Fork Lg. (cm)	Weight (grams)
34.7	33.0	650	23.9	22.1	200	26.7	25.5	265
32.0	30.2	500	21.0	19.8	200	16.7	15.8	60
24.2	22.8	210	25.3	23.9	200	16.9	16.0	60
32.0	30.2	500	26.0	24.6	200	22.7	21.5	170
35.0	33.0	750	34.1	32.2	550	17.5	16.5	60
21.2	20.0	140	22.8	21.5	250	16.7	15.7	60
29.8	28.2	400	32.3	30.7	450	33.9	32.0	700
23.7	22.4	170	22.6	21.3	150	26.2	25.0	300
23.2	22.0	180	34.4	32.5	600	15.2	14.6	50
21.9	20.5	140	31.8	30.0	450	15.8	15.0	50
32.0	30.0	600	28.2	26.7	300	17.0	16.1	70
22.4	21.1	160	26.4	25.1	300	15.6	14.8	70
21.5	20.0	140	34.5	32.7	550	15.1	14.2	60
37.0	34.8	750	31.6	30.0	300	35.0	33.1	900
34.0	32.2	650	27.0	25.6	200	33.1	31.1	900
28.1	26.9	320	31.8	29.9	550	23.0	21.8	300
31.0	29.2	500	31.2	29.4	400	25.1	23.8	210
25.1	23.8	230	27.3	25.6	250	15.8	15.1	70
23.3	22.2	190	22.3	21.1	110	16.8	16.0	70
20.1	19.1	110	23.3	21.9	190	15.9	14.9	70
16.6	16.1	90	18.8	17.8	125	17.7	16.7	70
16.4	15.5	80	26.9	25.5	200	32.1	30.7	500
24.4	23.4	220	23.4	22.2	100	24.9	23.7	210
				Mean		25.1	23.7	286.7
				Standard Error		0.764	0.721	26.798
				Confidence Level(95.0%)		1.524	1.438	53.475
				Standard Deviation		6.344	5.986	222.601
				Sum				19780
				Count		69	69	69

Appendix F. **Largemouth bass size-sampling data – 2007 Bayfield and Nares Inlet Area NSCIN survey.**

Total Lg. (cm)	Fork Lg. (cm)	Weight (grams)	Total Lg. (cm)	Fork Lg. (cm)	Weight (grams)
24.0	23.0	240	18.1	17.3	70
18.9	18.8	60	17.4	16.6	70
18.0	17.1	60	17.0	16.2	70
20.1	19.2	100	17.9	17.0	70
17.5	16.7	80	25.8	25.0	270
18.0	17.1	80	21.4	20.6	140
50.4	48.7	2700	23.2	24.3	200
18.1	17.2	125	19.5	18.6	110
18.0	17.2	125	35.5	34.3	750
16.1	15.5	60	23.8	22.8	200
21.0	20.1	130	31.2	30.1	450
19.0	18.1	80	21.1	20.3	110
	Mean		22.1	21.3	264.6
	Standard Error		1.548	1.512	110.474
	Confidence Level(95.0%)		3.203	3.128	228.534
	Standard Deviation		7.585	7.409	541.212
	Sum				6350
	Count		24	24	24

Appendix G. **Common White Sucker and Redhorse Sucker size-sampling data – 2007 Bayfield and Nares Inlet Area NSCIN survey.**

Common White Sucker				Redhorse Sucker		
Total Lg. (cm)	Fork Lg. (cm)	Weight (grams)		Total Lg. (cm)	Fork Lg. (cm)	Weight (grams)
53.9	50.7	2000		61.2	54.1	3000
44.9	41.4	1150		61.9	54.9	3450
53.4	49.6	1900		60.2	53.7	3350
40.0	37.1	1300		41.7	37	1300
43.3	40.2	1300		61.7	55.5	3300
44.8	42.1	1000		61.4	55.9	3400
51.6	48.2	1700		61.4	54.9	3000
47.3	45.1	1400		70.1	62.5	5400
32.7	30.7	400		66.4	59.4	3700
54.5	50.9	2500		69.4	62.3	4400
52.3	49.7	2000		40.9	36.6	800
54.8	51.5	2150		69.0	61.2	4300
56.0	52.6	2500				
47.1	44.8	1550				
48.3	45.6	1650				
48.3	45.3	1633.3	Mean	60.4	54.0	3283.3
1.673	1.590	147.250	Standard Error	2.782	2.495	361.412
3.588	3.410	315.820	Confidence Level(95.0%)	6.123	5.491	795.463
6.479	6.157	570.296	Standard Deviation	9.637	8.642	1251.968
		24500	Sum			39400
15	15	15	Count	12	12	12

Appendix H. Brown Bullhead size-sampling data – 2007 Bayfield and Nares Inlet Area NSCIN survey.

Total Lg. (cm)	Weight (grams)	Total Lg. (cm)	Weight (grams)	Total Lg. (cm)	Weight (grams)
31.0	500	33.1	750	24.9	550
25.6	300	27.9	300	33.0	900
26.2	260	30.8	400	25.0	600
26.9	300	25.3	200	25.0	600
28.5	400	28.7	350	26.3	700
22.0	150	28.1	400	24.3	500
21.6	150	12.0	50	30.3	340
28.5	360	16.4	40	28.7	300
30.3	440	33.9	500	20.5	150
25.5	260	36.8	650	31.7	400
27.0	700	27.3	200	35.2	700
26.2	700	26.3	200	26.1	320
		Mean		27.1	406.1
		Standard Error		0.813	35.419
		Confidence Level(95.0%)		1.651	71.904
		Standard Deviation		4.881	212.513
		Sum			14620
		Count		36	36

Appendix I. 'Other species' (Pumpkinseed, Rock Bass, Yellow Perch and Bowfind) size-sampling data – 2007 Bayfield and Nares Inlet Area NSCIN survey.

	Pumpkinseed		Rock Bass		Yellow Perch		Bowfin	
	Total Lg.	Weight	Total Lg.	Weight	Total Lg.	Weight	Total Lg.	Weight
	10.2	30	14.0	70	18.0	80		4500
	9.7	30	12.5	50	20.5	100	76.7	5000
	9.6	20	15.3	80	21.6	120	71.2	4100
	12.6	50	20.1	200	19.3	100	58.7	2100
	11.2	40	14.6	50	18.1	75		
	12.3	30	14.3	40	26.0	240		
	12.2	30	19.0	130	18.3	70		
	12.0	30	15.0	75	20.1	80		
	11.7	50	12.6	50	29.3	350		
	18.5	160	14.0	50	21.6	200		
	12.4	25	15.6	70	24.3	200		
	13.2	30	13.3	40	20.7	150		
					24.3	200		
					21.7	175		
					20.6	175		
					19.0	150		
					18.2	125		
					17.3	100		
					19.5	125		
					18.0	100		
					27.3	210		
					18.1	70		
					18.1	125		
					18.6	70		
					19.0	80		
Mean	12.1	43.8	15.0	75.4	20.7	138.8	68.9	3925.0
Standard Error	0.669	10.891	0.674	13.392	0.641	13.516	5.326	635.577
Confidence Level(95.0%)	1.473	23.970	1.484	29.475	1.323	27.896	22.914	2022.690
Standard Deviation	2.319	37.727	2.336	46.391	3.205	67.581	9.224	1271.154
Sum	145.6	525	180.3	905	517.5	3470	206.6	15700
Count	12	12	12	12	25	25	3	4

Appendix J. UTM Coordinates (NAD-83) for trapnet sets; 2007 Bayfield and Nares Inlet NSCIN survey.

Set No.	UTM Coordinates	Vicinity
1	017-538455-5047906	Cratloe Is. - Nares Inlet
2	017-539631-5049323	Nares Inlet - S. Shore
3	017-534053-5053300	S. shore Alexander Passage
4	017-532870-5053307	Black Is.
5	017539973-5050157	Nares Inlet Island
6	017-538772-5049179	Nares Inlet - N. Shore
7	017-534931-5053512	N. Shore - Alexander Passage
8	017-533618-5053206	E. of Risley Is.
9	017-539433-5048791	Nares Inlet- S. Shore
10	017-534661-5052390	SE of Meneily Is.
11	017-535265-5053278	N. Shore - Alexander Passage
12	017-538768-5048820	Gooch Is. - Nares Inlet
13	017-537686-5048334	Nares Inlet - N. Shore
14	017-535150-5052688	S. of Jean Is.
15	017-535125-5051766	Is. W. of Isabel Is.
16	017-538452-5048295	Nares Inlet Island
17	017-538628-5047194	Nares Inlet - S. Shore
18	017-536866-5051164	SW Gibralter Is.
19	017-535952-5053620	Pickerel Pot
20	017-537615-5048554	E. of Hangdog Pt.
21	017-536819-5049309	Hangdog Channel Is.
22	017-536729-5051861	W. of Gibralter Is.
23	017-536463-5052983	Is. at mouth of Pickerel Pot
24	017-537207-5049532	SE of Isle of Pine
25	017-536765-5050272	N. of Bon Ami Is.
26	017-535567-5051170	Is. E. of Cow Is.
27	017-537240-5052631	N. of Lisnacoon Is.
28	017-538761-5051789	S. Bayfield Harbour
29	017-537750-5051620	E. of Gibralter Is.
30	017-537617-5051944	E. of Gibralter Pt.