Thousand Islands Warmwater Fish Stock Assessment

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Warmwater fish stock assessment on the St. Lawrence River began in 1977 as an outgrowth of environmental assessment projects related to proposed Seaway navigation season extension. This program provides standardized indices of abundance for major gamefish and panfish stocks, information on year class strength, and age and growth relationships of these stocks. Information obtained is used to evaluate and, if necessary, modify existing fishing regulations. It also provides baseline information for evaluation of environmental disturbances.

Methods

Warmwater fish stock assessment in New York waters of the Thousand Islands is conducted from the upstream end of Grindstone Island (near Clayton, New York) downstream to the Morristown area (opposite Brockville, Ontario), a water surface area of approximately 43,000 acres (17,400 ha). Sampling was conducted during the last week of July/first week of August period each year from 1977 through 2006. Sampling effort consists of 32 overnight gill net sets (16 sets prior to 1982) at standard sites. Multifilament nylon nets were used from 1977 through 2003; monofilament nets were used beginning in 2004. Based on 24 paired net sets, catch rates of rock bass (*Ambloplites rupestris*) and yellow perch (*Perca flavescens*) in the two net types were significantly different (α = .05). To correct monofilament catches to the multifilament standard, rock bass catches were multiplied by 1.7 and yellow perch catches by 0.74. Both types of net are 200 ft (61 m) long by 8 ft (2.4 m) deep and contain eight 25 ft (7.6 m) panels. Stretch measure mesh sizes range from 1.5 in (38 mm) to 6 in (152 mm). Sampling was confined to the mid-depths of the river, from 10 to 60 ft (3 to 20 m). Nets were set on bottom, half in relatively shallow water, less than 30 ft (9 m) deep, the other half at 33 to 60 ft (10 to 20 m).
Fish were identified, weighed and measured (total length). All game fish and sub-samples (Ketchen 1949) of pan fish were examined for sex and maturity, and scales (cleithra for esocids) were removed for age determination. Ages were determined from projections of scales or from direct observation of cleithra.

Results and Discussion

Environmental conditions
The mid-summer sampling period was chosen to minimize intra- and inter-annual variation in environmental conditions, chiefly water temperature. Surface water temperatures varied from 64EF (18EC) during the 1982 sampling period through 78EF (26EC) in 1979. Bottom temperatures are generally within 2EF (1EC) of surface temperatures. In 2006 mean bottom temperature at 35 to 40 ft (11 to 12 m) was 72EF (22E C). Surface temperatures were in the average range at between 72 and 75EF (Table 1). Prior to colonization by dreissenid mussels, summer water transparency (Secchi depth) ranged down to about 10 ft (3 m, S. LaPan, pers. communication) and was not considered a significant influence on catchability. By 1995 it was apparent that significant increases in transparency had occurred. Transparency data are now collected during fish sampling. Secchi depths during the sampling period have ranged from 55 ft (16.8 m) in 1999 to 14.1 ft (4.3 m) in 1997. In 2006, mean Secchi depth was 29 ft (8.8 m) (Table 1).

Stock composition
A total of 36 species have been represented in Thousand Islands gill net sampling between 1977 and 2006 (Table 2). Annual catch (for 32 net sets) has historically ranged from 880 fish (adjusted to

multifilament nets) of 16 species in 2005 to 2,080 fish of 19 species in 1988. In 2006 catch was in the typical range at 1349 (not adjusted) individuals; diversity was low with only 15 species represented (Table 2). In 2006, as in most years, more than 90 percent of the catch consisted of six species: northern pike (*Esox lucius*), brown bullhead (*Ameiurus nebulosus*), rock bass, pumpkinseed sunfish (*Lepomis gibbosus*), smallmouth bass (*Micropterus dolomieui*) and yellow perch (Table 3). While walleye (*Sander vitreus*) are not usually well represented in this survey, an above average catch was recorded in 2006.

Smallmouth bass

Smallmouth bass are the most sought-after sport fish in the New York Thousand Islands fishery (McCullough 1987). Abundance of smallmouth bass was relatively high in the late 1970's, declined through 1982, then increased to its highest recorded level in 1988 (Figure 1). Since 1988 bass abundance generally declined and was low from 1996 through 2004 (Figure 1). Catch increased in 2005 and in 2006, reaching its highest level since 1988. Smallmouth bass have been distributed primarily in the deeper stratum in nearly all years (Figure 1). An expanding cormorant (*Phalacrocorax auritus*) population in the nearby Eastern Basin of Lake Ontario was implicated in suppression of smallmouth bass recruitment (Lantry et al. 1999). Cormorants may also have affected Thousand Islands bass. Younger bass, ages 3-6, have been less abundant recently relative to earlier years; however, in 2006 age 2-5 bass were caught at a rate much higher than usual. Since there was little suggestion of increased year class strength in earlier sampling, this may indicate a temporary change in catchability of young bass. Over the last four years the1999 year class (age-7 in 2006) has been very well represented (Figure 2).

Smallmouth bass growth changed little between 1977 and 1998. Growth rate was above the previous range in 1999 and 2001-2006. Bass are now generally reaching legal size, 2 in; (305 mm), by age-5 (Figure 3). Smallmouth bass growth has also increased recently in Lake Ontario's Eastern Basin (Eckert 2004) in Lake St. Lawrence (Klindt 2006) and in Lake Erie (Einhouse et al. 2005).

Round gobies are now a probable factor in smallmouth bass growth. In 2006 sampling, 11 of 17 bass stomachs with identifiable contents contained gobies (132 of 149 examined were empty or contained unidentified fish remains).

Northern pike

Northern pike are an important part of the New York fishery and are the most highly sought-after fish in the Province of Ontario Thousand Islands fishery (Bendig 1995). Northern pike have always been a predominantly shallow water fish, however in 2006, most fish were caught in the deep stratum (Figure 4). Their abundance peaked during the 1989-91 period, generally declined through 1996, and varied without trend through 2001 (Figure 4). From 2001 through 2005 abundance declined, however, catch increased substantially in 2006. In recent years age-4 and younger pike were less abundant. Evidence suggests that spawning habitat changes resulting from reduced water level fluctuation may be impairing recruitment (S. LaPan, pers. communication.). Pike were less abundant, particularly at ages3 and 4, in 2003 through 2006 suggesting continuing recruitment problems Age-5 and older fish have thus far shown little change in abundance, suggesting lower mortality on younger fish relative to earlier years (Figure 5).

Pike recruited to the fishery (22 in or 558 mm) at age- 3 during the 1977-86 period. From 1988-2001 it took a year longer for pike to recruit to the fishery (Figure 6). Changes in the prey community, particularly reduced alewife abundance, may have caused a reduction in northern pike growth. More recently, growth in 2002-2006 was faster than the 1987-96 average. Growth measured in 2003-05 sampling had returned to approximately 1977-86 levels. This increased growth may be a density dependent effect or may indicate another environmental or prey community change.

Yellow Perch

Yellow perch abundance peaked in the late 1970's, then went into an irregular decline through 1992 (Figure 7). From 1992 through 1999 yellow perch abundance tended to increase and has been moderately low since the mid 1990s. Yellow perch catch declined to its lowest recorded (adjusted) level in 2005 but increased dramatically in 2006 (Figure 7). The general decline through the early 1990's may be due to relatively abundant alewife populations at that time, which have been

linked to high yellow perch larval mortality (Abraham 1994). Ages 2through 4 were abundant in 2006. The 2002 year class was well represented at age 3 in 2005 and again at age 4 in 2006. Relatively poor representation of older perch in recent years suggests that mortality rates may have increased (Figure 8). Data indicate that growth rate may have improved since 1994 (Figure 9).

Other common species

Rock bass abundance declined considerably during the late 1970's and early 1980's and has fluctuated without trend since 1989 (Figure 10). Brown bullhead abundance declined dramatically between 1992 and 1996, and increased through 2003. Abundance declined in 2004 and appears to be increasing again (Figure 11). Abundance of pumpkinseed sunfish has generally declined since 1990 and has been very low since 2003 (Figure 12).

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Table 1. Water temperature and secchi depth.

Sample Year	Water Temperature Range EC (EF)		Sample Year	Water Temperature Range EC (EF)	Secchi Depth m (ft)
1977	22-23 (72-73)		1992	18-19 (64-66)	
1978	21-22 (70-72)		1993	21-24 (70-75)	
1979	25-26 (77-79)		1994	21-24 (70-75)	
1980	20-22 (68-72)		1995	22-24 (72-75)	10.7 (35)
1981	20-22 (68-72)		1996	21-21 (70-70)	8.8 (29)
1982	18-19 (64-66)		1997	20-22 (68-72)	4.3 (14)
1983	22-23 (72-73)		1998	22-24 (72-75)	8.0 (27)
1984	19-21 (66-70)		1999	23-24 (74-76)	16.8 (55)
1985	20-21 (68-70)		2000	21-22 (70-71)	13.4 (44)
1986	19-21 (66-70)		2001	20-24 (68-75)	6.2 (20)
1987	19-21 (66-70)		2002	21-23 (70-73)	7.3 (24)
1988	22-24 (72-75)		2003	21-24 (69-76)	6.5 (21)
1989	19-22 (66-72)		2004	21-22 (69-71)	8.1 (26.5)
1990	22-24 (72-75)		2005	22-24 (72-75)	11 (36)
1991	23-23 (73-73)		2006	22-24 (72-75)	8.8 (29)

Table 2. Total annual abundance index (catch/net-night), number of species sampled and number of individuals caught.

Year	Index*	Species**	Individuals	Year	Index*	Species**	Individuals
1977	44.3	13	709	1992	31.7	19	1,014
1978	59.7	16	955	1993	38.6	15	1,235
1979	57.7	12	923	1994	35.1	16	1,123
1980	47.5	13	760	1995	37.4	13	1,197
1981	38.1	14	610	1996	36.7	17	1,174
1982	41.5	17	1,328	1997	36.4	17	1,165
1983	39.0	16	1,249	1998	32.6	17	1,044
1984	39.7	18	1,271	1999	44.9	19	1,437
1985	40.4	17	1,292	2000	30.0	18	959
1986	50.7	12	1,622	2001	29.1	17	932
1987	51.9	17	1,661	2002	34.9	16	1,077
1988	65.0	19	2,080	2003	35.5	18	1,137
1989	45.3	19	1,450	2004	30.3a	15	970a
1990	49.2	19	1,574	2005	27.5a	16	880a
1991	41.5	18	1,328	2006	41.9a	15	1,352a

* 16 net-nights 1977-81, 32 net-nights thereafter. Change to monofilament nets in 2004.
** Prior to 1987 redhorse suckers were not identified to species.
a - adjusted to multifilament standard

Table 3. Abundance index (catch/net night) by species (* net type correction applied).

Species	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06
lake sturgeon	0	0	0.06	0.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.03	0.03	0.06	0	0	0	0.03	0
longnose gar															0	0	0	0	0	0	0	0	0.03	0.03	0.06	0	0	0	0.03	0
bowfin	0	0	0	0	0	0.06	0	0	0.03	0	0	0.03	0	0.09	0.03	0	0.03	0.03	0	0.03	0	0.03	0	0	0.03	0	0	0	0.03	0
alewife	1.5	1.1	2.3	2.6	5	0	2	1.5	1	6.5	2.2	1.5	0.3	0.28	0.91	0.19	0.07	0.38	0	0.63	0.22	0	0.09	0.03	0.18	0.09	0	0.03	0.09	0.03
gizzard shad	0	6	0	0.06	0	0	0	0	0	0	0	0	0	0	0.06	0.03	0	0	0	0	0	0	0.03	0	0	0	0	0	0	0
coho salmon	0	0	0	0	0	0	0	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brown trout	0	0	0	0	0	0.06	0	0	0	0	0	0	0	0	0	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0
lake trout	0	0	0	0	0	0	0	0	0	0	0	0	0.16	0	0	0.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0
rainbow smelt	0	0.18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
northern pike	3.2	2.3	2.5	4.1	7.3	4.9	4.5	3.9	4.8	3.7	3.63	4.03	5.31	4.38	5. 28	3. 84	3. 87	3. 22	2. 90	2. 00	2. 53	2. 28	2. 50	2. 21	2.78	3.22	1.94	1.69	1.63	1.84
muskellunge	0	0	0	0	0	0	0	0	0	0	0.03	0	0.03	0	0	0	0	0	0.03	0.03	3	0	0.03	0	0	0	0.06	0.03	0	0
carp	0	0	0	0	0	0.2	0.1	0.1	0.03	0	0.19	0.09	0.16	0.31	0	0.06	0.2	0.09	0.06	0.16	0.06	0.06	0.03	0.03	0.03	0.03	0.06	0.03	0.12	0.19
golden shiner	0	0	0	0	0	0	0	0	0	0	0	0.03	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
fallfish	0	0	0	0	0.12	0	0	0	0	0	0	0	0	0.03	0	0	0	0	0	0	0	0	0	0	0.03	0	0	0	0	0
longnose sucker	0	0	0	0	0	0.39	0	0.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
white sucker	2.4	3.6	2.4	2	1.8	0.8	1.4	1.3	2.1	1.7	1.81	2.5	3.03	3.06	1.16	2.06	1.07	1.28	1.5	. 81	1.3	1.28	1	0.97	1.34	1.13	1.41	1.03	1.1	1.16
silver redhorse	0.1	0.1	0.2	0	0.2	0.1	0.1	0.1	0.3	0	0.16	1. 0	0.09	0.16	0.09	0.03	0.03	0	0.06	0.13	0	0.03	0.03	0.03	0	0	0.06	0	0.03	0.06
shorthead redhorse	*	*	*	*	*	*	*	*	*	*	0	0.03	0	0	0	0	0	0	0	0	0.06	0.03	0	0	0	0	0	0	0	0
greater redhorse	*	*	*	*	*	*	*	*	*	*	0	0	0	0	0.03	0.03	0	0.03	0	0	0	0.03	0	0.03	0	0.06	0	0	0	0
brown bullhead	2.4	3	1.4	6.7	1.6	2.1	2.7	3.4	2.6	2.6	4.25	5.69	3	3.69	3.09	3.97	1.43	1.06	1	0.44	0.69	1.47	2.5	1.59	2.84	2.53	4.66	1.22	1.53	2.47
yellow bullhead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.03	0	0	0	0	0	0	0	0	0	0	0	0
channel catfish	0.1	1	0	0.2	0	0.2	0.4	0.8	4.8	1.4	0.41	1.31	0.16	0.97	0.19	0.13	0.63	0.22	0.3	0.13	0.19	0.31	0.13	0.06	0.06	0.03	0.22	0.22	0.38	0.44
stonecat	0	0	0	0	0	0	0	0.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.03	0	0	0	0	0	0
burbot	0	0	0	0	0	0	.0 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
white perch	0.1	0.8	0.1	0	0.1	0.1	0.1	0	0.1	0	0.03	0.13	0.16	0.03	0.09	0.03	0	0	0	0	0	0	0	0.03	0	0.03	0.03	0	0	0.03
white bass	0	0	0	0	0	0	0	0	0.06	0	0	0	0	0.09	0	0	0	0	0	0	0	0.03	0.03	0	0	0	0	0	0	0.03
rock bass	6	10.1	9	7.4	6.1	6.2	5.5	5.5	5.6	6.5	6.88	11.3	5.59	4.78	5.06	3. 13	5. 17	7. 44	6. 40	9. 00	6. 31	5. 38	7. 80	8. 38	5.69	5.53	7.84	11.3*	8.23**	11.3*
pumpkinseed	6.3	5.2	8.3	4.5	11.5	9.3	12.3	7.8	5.7	6.4	10.3	10.2	9.66	11.8	6. 94	6. 28	5. 43	5. 81	6. 20	4. 10	4. 65	4. 13	6. 80	2. 19	2.59	4.13	1.91	1.72	1.88	2.41
bluegill	0.9	1.1	0	0.6	2.8	0.3	1.3	0.6	0.6	0.6	0.59	0.09	0.59	0.78	0.72	1. 03	0.2	0.34	0.5	0.16	0.06	0.12	0.3	0	0.06	0.09	0.03	0	0.06	0.03
smallmouth. bass	6.2	7.4	6.6	5.1	2.9	3.5	5.2	4.6	5.9	5.9	7.66	9.84	5.69	6.66	6. 91	2. 47	5. 33	4. 53	5. 50	2. 94	2. 34	2. 91	3.3	1.84	3.06	2.16	2.78	3.13	4.75	7.84
largemouth. bass	0	0.1	0	0	0.1	0	0.5	0.1	0	0.1	0.28	0.22	0.09	0.09	0.16	0.09	0.1	0.09	0	0.03	0.03	0.06	0.06	0.03	0.15	0.06	0.03	0.06	0	0
black crappie	0.4	0.2	0.1	0.1	0.2	0.1	0	0	0.1	0	0.13	0.09	0.06	0.03	0.09	0	0	0	0	0.03	0.03	0	0.03	0	0.06	0	0.03	0	0	0
yellow perch	21.9	30.8	32.2	22.9	12.8	19.6	10.9	19.7	14.8	26.9	15.3	16.9	11.4	11.6	10.4	8. 16	14.8	10.4	12.8	15.7	17.2	14.4	20.7	12.2	9.81	14.4	14	10.6*	6.82**	12.95*
walleye	0	0	0	0	0	0.1	0.1	0.1	0.1	0.3	0.03	0.31	0.09	0.34	0.25	0.09	0.23	0.13	0.3	0.25	0.09	0.06	0.13	0.19	0.31	0.5	0.34	0.28	0.75	0.81
freshwater drum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.03	0	0	0	0	0	0	0.03	0.06	0.06	0

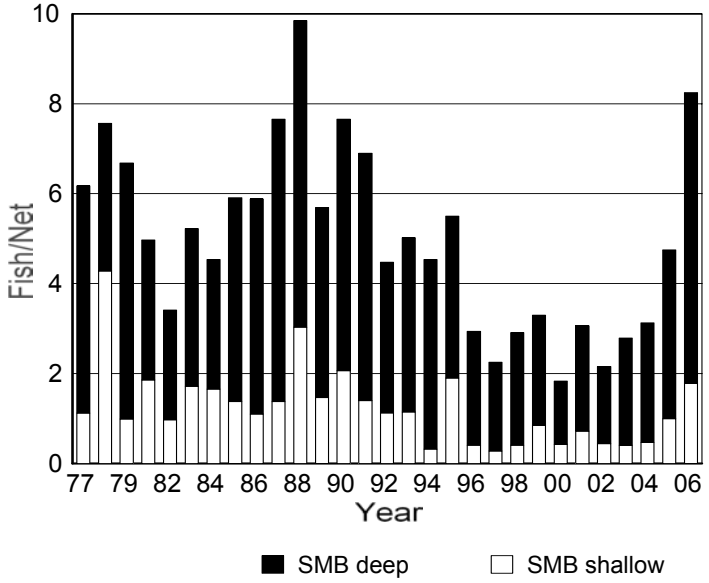

Figure1. Smallmouth bass abundance index by depth stratum in the St. Lawrence River Thousand Islands area.

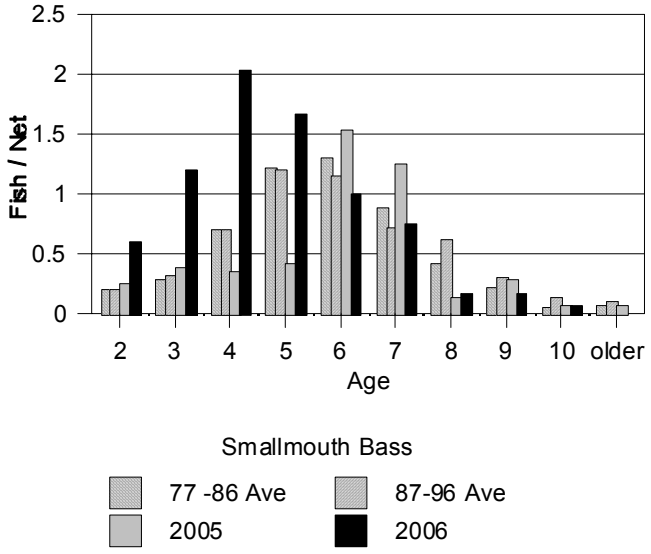

Figure 2. Smallmouth bass age distribution.

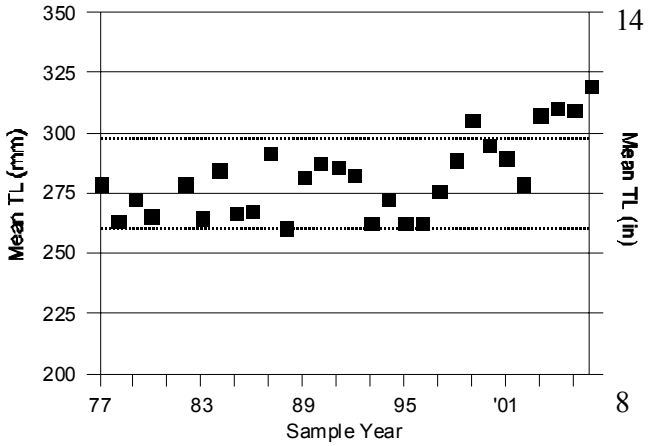

Figure 3. Smallmouth bass growth (mean total length at age 5) in the St. Lawrence River Thousand Islands area

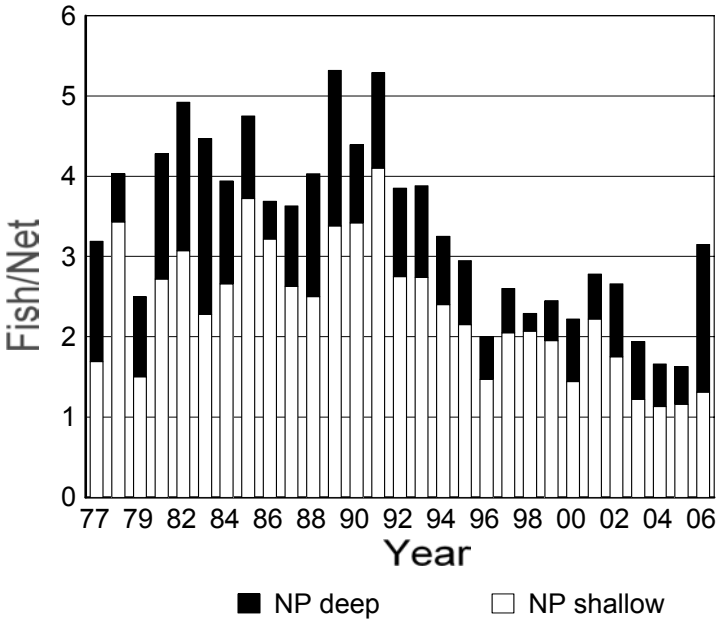

Figure 4. Northern pike abundance index by depth stratum in the St. Lawrence River Thousand Islands area.

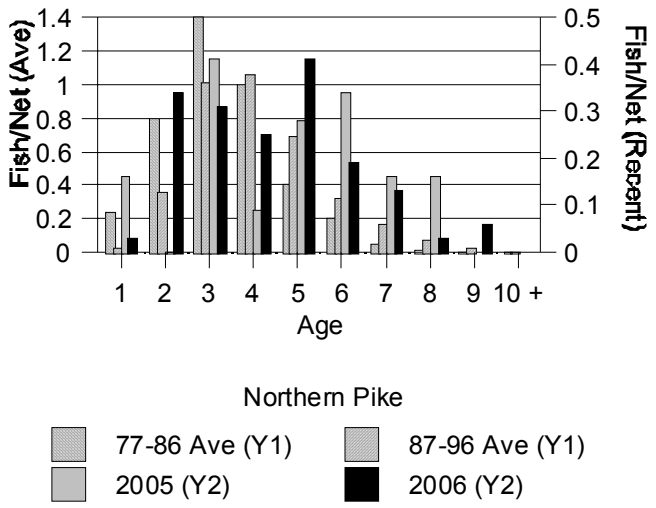

Figure 5. Northern pike age distribution in the St. Lawrence River Thousand Islands area.

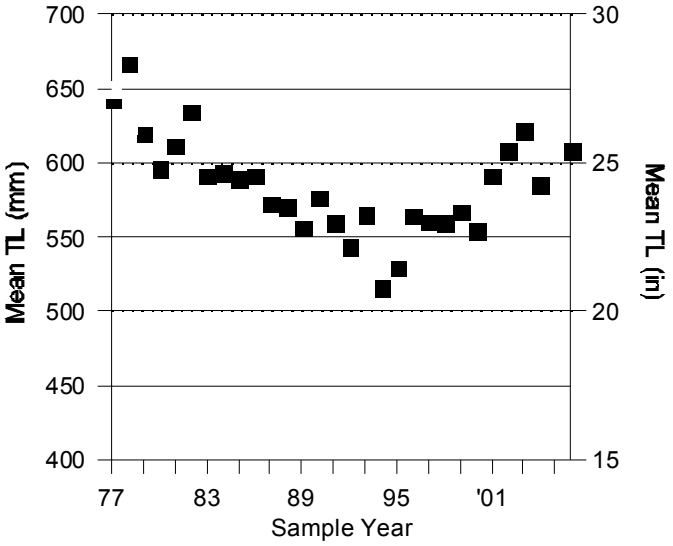

Figure 6. Northern pike growth (mean total length at age 4) in the St. Lawrence River Thousand Islands area.

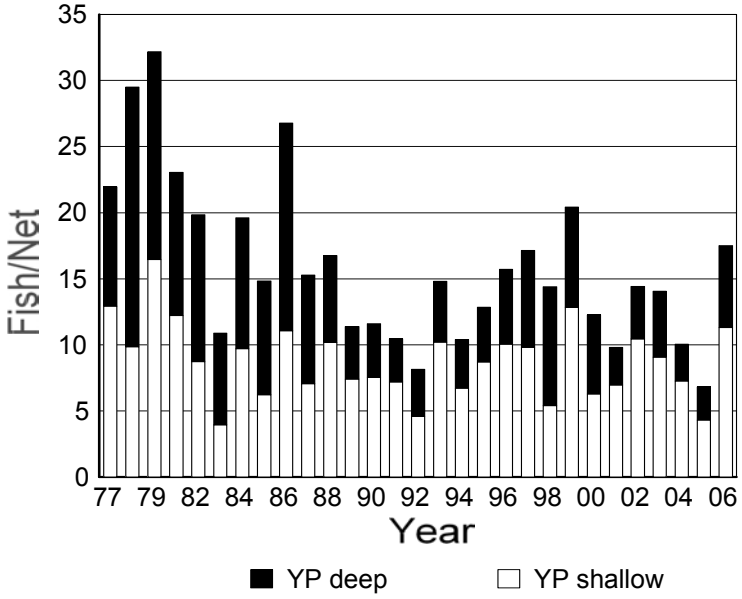

Figure 7. Yellow perch abundance index by depth stratum in the St. Lawrence River Thousand Islands area.

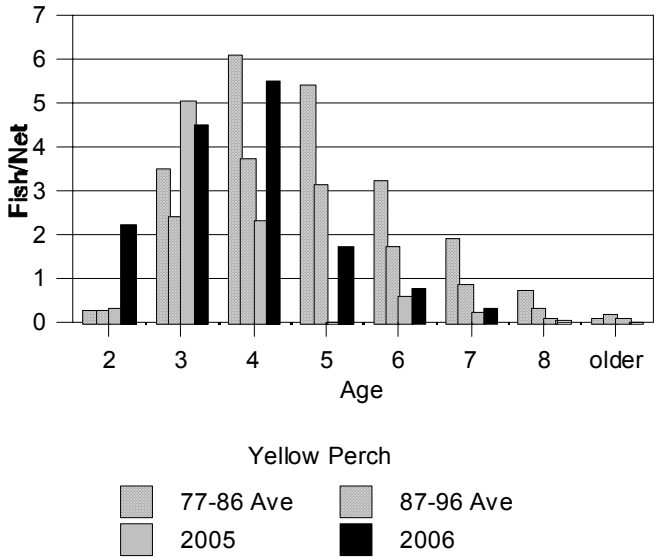

Figure 8. Yellow perch age distribution in the St. Lawrence River Thousand Islands area.

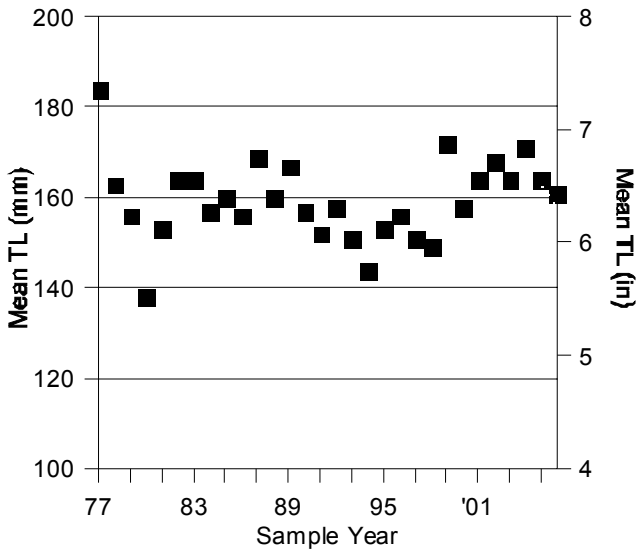

Figure 9. Yellow perch growth (mean total length at age 4) in the St. Lawrence River Thousand Islands area.

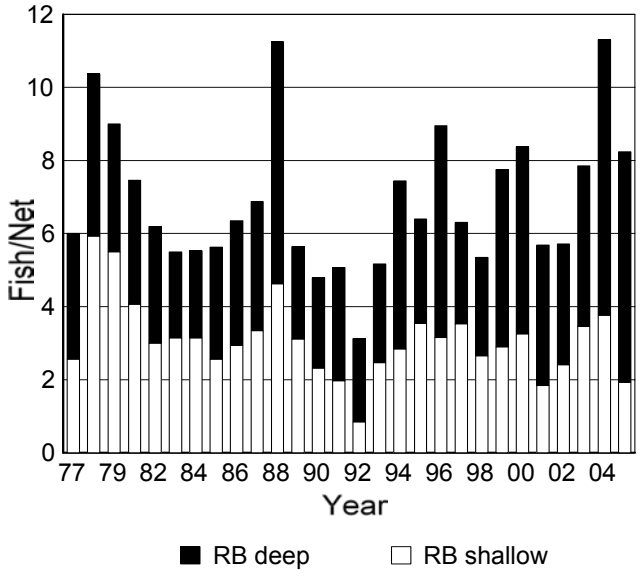

Figure 10. Rock bass abundance index by depth stratum in the St. Lawrence River Thousand Islands area.

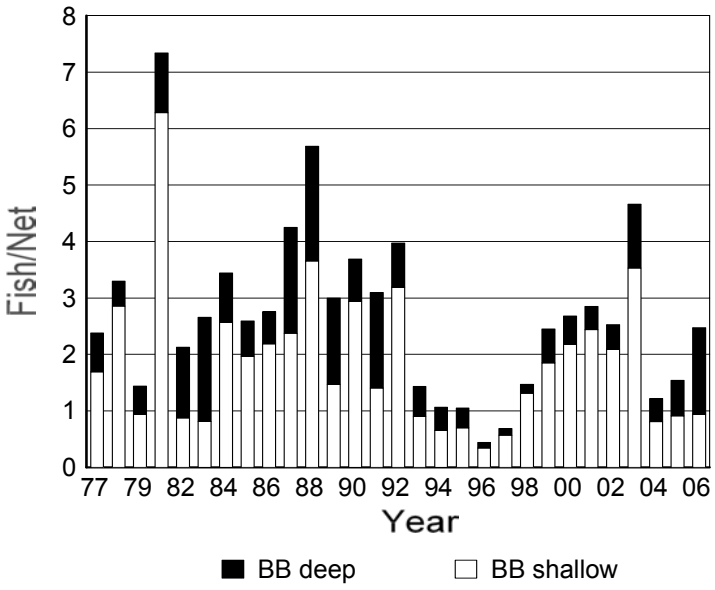

Figure 11. Brown bullhead abundance index by depth stratum in the St. Lawrence River Thousand Islands area.

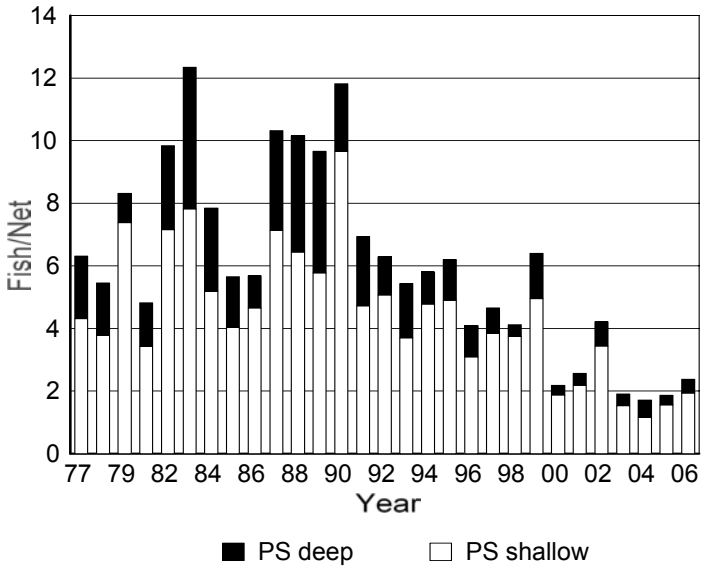

Figure 12. Pumpkinseed abundance index by depth stratum in the St. Lawrence River Thousand Islands area.