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 period from the third week of July through first week of August each year. 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 nets, catch rates of rock bass (*Ambloplites rupestris*) and yellow perch (*Perca flavescens*) in the two net types were significantly different ($\propto$ = .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).

All 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 had scales (and cleithra for esocids) 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 64°F (18°C) during the 1982 sampling period through 78°F (26°C) in 1979. Bottom temperatures are generally within 2°F (1°C) of surface temperatures. In 2007 mean bottom temperature at 35 to 40 ft (11 to 12 m) was 70°F (21° C). Surface temperature was in the average range at 69-72°F (21-22°C). 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, and 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 2007, mean Secchi depth was 25.5 ft (7.8 m) (Table 1).

Stock composition

A total of 37 species have been represented in Thousand Islands gill net sampling between 1977 and 2007 (Table 2). Annual catch (for 32 net sets) has historically ranged from 932 fish of 17 species in 2002 to 2,080 fish of 19 species in 1988. In 2007 catch was in the typical range at 1,293 individuals (adjusted to multifilament standard); diversity was relatively high with 18 species represented (Table 2). Although they had been

detected in predator stomachs for several years, round goby (*Neogobius melanostomus*) were captured in assessment nets for the first time in 2007. 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*) were not well represented in this survey, substantial increases in catch have been recorded since 2004.

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. Since 1988 bass abundance generally declined and was low from 1996 through 2004 (Figure 1). The 2005 catch increased and the 2006 catch reached its highest level since the 1988 peak. Catch declined somewhat from that very high level in 2007; but abundance still appears to be trending upward. 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 and 2007 age 2-4 bass were caught at a rate higher than usual (Figure 2). This may indicate a change in catchability of young bass probably due to increased growth.

Smallmouth bass growth changed little between 1977 and 1998. Growth rate increased beginning in 1999. Bass are now generally reaching legal size, 12" (305 mm), before age-5. In 2007 age-5 averaged a record 13.7 in (348 mm) (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).

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 (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 generally declined. Catch increased substantially in 2006 then dropped back in 2007 but remained slightly above 2004-5 levels. Age-4 and younger fish have been less abundant recently than in earlier years. 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 ages-3 and 4, in 2003 through 2007 suggesting continuing recruitment problems. Older fish have thus far shown no decline, and in some cases have increased in abundance, suggesting that survival of recruited fish has improved relative to earlier years (Figure 5).

Pike recruited to the fishery (22 in or 558 mm) at age- 3 during the 1977-86 period. In recent years pike had taken a year longer 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. Growth in 2001-2006 was faster than the 1987-96 average. Growth measured in 2003-05 sampling had returned to higher 1977-86 levels. Total length of age-4 pike in 2006 and 2007 suggests that growth may be declining again (Table 6).

Yellow Perch

Yellow perch abundance peaked in the late 1970's, then went into an irregular decline through 1992. From 1992 through 1999, yellow perch abundance tended to increase. Since 1999, yellow perch catch generally declined, falling to its lowest recorded (adjusted) level in 2005. Catches increased dramatically in 2006 and remained relatively high in 2007 (Figure 7). The general decline through the early 1990's may have been connected with relatively high alewife populations at that time, which have been linked to high yellow perch larval mortality (Abraham 1994). Age -2, 3 and 4 perch were abundant in 2006 and age-3 and 4 perch were above average abundance in 2007 (Figure 8). The 2002 year class was well represented at ages-3 and 4 in 2005 and 2006, respectively, but was at average levels at age-5 in

2007. Relatively poor representation of older perch in recent years suggests that mortality rates may have increased (Figure 8). There are indications that growth rate may have generally increased since 1994 (Figure 9).

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Other common species

Rock bass abundance declined considerably during the late 1970's and early 1980's. It has fluctuated without trend since 1989 (Figure 10). Brown bullhead abundance declined dramatically between 1992 and 93, and increased through 2003. Abundance declined in 2004 and remains relatively low (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 °C (°F)		Sample Year	Water Temperature Range °C (°F)	Secchi Depth m (ft)
1977	22-23 (72-73)		1993	21-24 (70-75)	
1978	21-22 (70-72)		1994	21-24 (70-75)	
1979	25-26 (77-79)		1995	22-24 (72-75)	10.7 (35)
1980	20-22 (68-72)		1996	21-21 (70-70)	8.8 (29)
1981	20-22 (68-72)		1997	20-22 (68-72)	4.3 (14)
1982	18-19 (64-66)		1998	22-24 (72-75)	8.0 (27)
1983	22-23 (72-73)		1999	23-24 (74-76)	16.8 (55)
1984	19-21 (66-70)		2000	21-22 (70-71)	13.4 (44)
1985	20-21 (68-70)		2001	20-24 (68-75)	6.2 (20)
1986	19-21 (66-70)		2002	21-23 (70-73)	7.3 (24)
1987	19-21 (66-70)		2003	21-24 (69-76)	6.5 (21)
1988	22-24 (72-75)		2004	21-22 (69-71)	8.1 (26.5)
1989	19-22 (66-72)		2005	22-24 (72-75)	11 (36)
1990	22-24 (72-75)		2006	22-24 (72-75)	8.8 (29)
1991	23-23 (73-73)		2007	21-22 (69-72)	7.8 (22.5)
1992	18-19 (64-66)				

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	1993	38.6	15	1,235
1978	59.7	16	955	1994	35.1	16	1,123
1979	57.7	12	923	1995	37.4	13	1,197
1980	47.5	13	760	1996	36.7	17	1,174
1981	38.1	14	610	1997	36.4	17	1,165
1982	41.5	17	1,328	1998	32.6	17	1,044
1983	39.0	16	1,249	1999	44.9	19	1,437
1984	39.7	18	1,271	2000	30.0	18	959
1985	40.4	17	1,292	2001	29.1	17	932
1986	50.7	12	1,622	2002	34.9	16	1,077
1987	51.9	17	1,661	2003	35.5	18	1,137
1988	65.0	19	2,080	2004	30.3a	15	970a
1989	45.3	19	1,450	2005	27.5a	16	880a
1990	49.2	19	1,574	2006	41.9a	15	1,352a
1991	41.5	18	1,328	2007	40.4a	18	1293a
1992	31.7	19	1,014				

* 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
lake sturgeon	0	0	.06	.06	0	0	0	0	0	0	0	0	0	0
bowfin	0	0	0	0	0	.06	0	0	.03	0	0	.03	0	.09
alewife	1.5	1.1	2.3	2.6	5.0	0	2.0	1.5	1.0	6.5	2.2	1.5	.30	.28
gizzard shad	0	6	0	.06	0	0	0	0	0	0	0	0	0	0
coho salmon	0	0	0	0	0	0	0	.03	0	0	0	0	0	0
brown trout	0	0	0	0	0	.06	0	0	0	0	0	0	0	0
lake trout	0	0	0	0	0	0	0	0	0	0	0	0	.16	0
rainbow smelt	0	.18	0	0	0	0	0	0	0	0	0	0	0	0
northern pike	3.20	2.30	2.50	4.10	7.30	4.90	4.50	3.90	4.80	3.70	3.63	4.03	5.31	4.38
muskellunge	0	0	0	0	0	0	0	0	0	0	.03	0	.03	0
carp	0	0	0	0	0	.20	.10	.10	.03	0	.19	.09	.16	.31
golden shiner	0	0	0	0	0	0	0	0	0	0	0	.03	.03	0
fallfish	0	0	0	0	.12	0	0	0	0	0	0	0	0	.03
longnose sucker	0	0	0	0	0	.39	0	.13	0	0	0	0	0	0
white sucker	2.40	3.60	2.40	2.00	1.80	.80	1.40	1.30	2.10	1.70	1.81	2.50	3.03	3.06
silver redhorse	.10	.10	.20	0	.20	.10	.10	.10	.30	0	.16	1. 0	.09	.16
shorthead redhorse	*	*	*	*	*	*	*	*	*	*	0	.03	0	0
greater redhorse	*	*	*	*	*	*	*	*	*	*	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
yellow bullhead	0	0	0	0	0	0	0	0	0	0	0	0	0	0
channel catfish	.10	1.00	0	.20	0	.20	.40	.80	4.80	1.40	.41	1.31	.16	.97
stonecat	0	0	0	0	0	0	0	.13	0	0	0	0	0	0
burbot	0	0	0	0	0	0	.0 3	0	0	0	0	0	0	0
white perch	.10	.80	.10	0	.10	.10	.10	0	.10	0	.03	.13	.16	.03
white bass	0	0	0	0	0	0	0	0	.06	0	0	0	0	.09
rock bass	6.00	10.1	9.00	7.40	6.10	6.20	5.50	5.50	5.60	6.50	6.88	11.3	5.59	4.78
pumpkinseed	6.30	5.20	8.30	4.50	11.5	9.30	12.3	7.80	5.70	6.40	10.3	10.2	9.66	11.8
bluegill	.90	1.10	0	.60	2.80	.30	1.30	.60	.60	.60	.59	.09	.59	.78
smallmouth. bass	6.20	7.40	6.60	5.10	2.90	3.50	5.20	4.60	5.90	5.90	7.66	9.84	5.69	6.66
largemouth. bass	0	.10	0	0	.10	0	.50	.10	0	.10	.28	.22	.09	.09
black crappie	.40	.20	.10	.10	.20	.10	0	0	.10	0	.13	.09	.06	.03
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
walleye	0	0	0	0	0	.10	.10	.10	.10	.30	.03	.31	.09	.34
freshwater drum	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 3. Abundance index (catch/net night) by species (continued).

Species	91	92	93	94	95	96	97	98	99	00	01	02	03	04
lake sturgeon	0	0	0	0	0	0	0	0	.03	.03	.06	0	0	0
longnose gar	0	0	0	0	0	0	0	0	0	0	0	0	.03	0
bowfin	.03	0	.03	.03	0	.03	0	.03	0	0	.03	0	0	0
alewife	.91	.19	.07	.38	0	.63	.22	0	.09	.03	.18	.09	0	.03
gizzard shad	.06	.03	0	0	0	0	0	0	.03	0	0	0	0	0
coho salmon	0	0	0	0	0	0	0	0	0	0	0	0	0	0
brown trout	0	.03	0	0	0	0	0	0	0	0	0	0	0	0
lake trout	0	.06	0	0	0	0	0	0	0	0	0	0	0	0
rainbow smelt	0	0	0	0	0	0	0	0	0	0	0	0	0	0
northern pike	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
muskellunge	0	0	0	0	.03	.03	3	0	.03	0	0	0	.06	.03
carp	0	.06	.20	.09	.06	.16	.06	.06	.03	.03	.03	.03	.06	.03
rudd	0	0	0	0	0	0	0	0	0	.03	0	0	0	0
golden shiner	0	0	0	0	0	0	0	0	0	0	0	0	0	0
fallfish	0	0	0	0	0	0	0	0	0	0	.03	0	0	0
longnose sucker	0	0	0	0	0	0	0	0	0	0	0	0	0	0
white sucker	1. 16	2. 06	1. 07	1. 28	1. 50	. 81	1. 30	1. 28	1.0	.97	1.34	1.13	1.41	1.03
silver redhorse	.09	.03	.03	0	.06	.13	0	.03	.03	.03	0	0	.06	0
shorthead redhorse	0	0	0	0	0	0	.06	.03	0	0	0	0	0	0
greater redhorse	.03	.03	0	.03	0	0	0	.03	0	.03	0	.06	0	0
brown bullhead	3.09	3.97	1.43	1.06	1.00	.44	.69	1.47	2.50	1.59	2.84	2.53	4.66	1.22
yellow bullhead	0	0	0	.03	0	0	0	0	0	0	0	0	0	0
channel catfish	.19	.13	.63	.22	.30	.13	.19	.31	.13	.06	.06	.03	.22	.22
stonecat	0	0	0	0	0	0	0	0	0	.03	0	0	0	0
burbot	0	0	0	0	0	0	0	0	0	0	0	0	0	0
white perch	.09	.03	0	0	0	0	0	0	0	.03	0	.03	.03	0
white bass	0	0	0	0	0	0	0	.03	.03	0	0	0	0	0
rock bass	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*
pumpkinseed	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
bluegill	.72	1. 03	.20	.34	.50	.16	.06	.12	0.30	0	.06	.09	.03	0
smallmouth bass	6. 91	2. 47	5. 33	4. 53	5. 50	2. 94	2. 34	2. 91	3.30	1.84	3.06	2.16	2.78	3.13
largemouth bass	.16	.09	.10	.09	0	.03	.03	.06	.06	.03	.15	.06	.03	.06
black crappie	.09	0	0	0	0	.03	.03	0	.03	0	.06	0	.03	0
yellow perch	10.4	8. 16	14.8	10.4	12.8	15.7	17.2	14.4	20.7	12.2	9.81	14.4	14.0	10.6*
walleye	.25	.09	.23	.13	.30	.25	.09	.06	.13	.19	.31	.5	.34	.28
freshwater drum	0	0	0	0	0	.03	0	0	0	0	0	0	.03	.06

Table 3. Abundance index (catch/net night) by species (continued).

Species	05	06	07	08	09	10	12	13	14	15	16	17	18	19
lake sturgeon	.03	0	0											
longnose gar	0	0	0											
bowfin	.03	0	0											
alewife	.09	.03	2.25											
gizzard shad	0	0	0											
coho salmon	0	0	0											
brown trout	0	0	0											
lake trout	0	0	0											
rainbow smelt	0	0	.06											
northern pike	1.63	1.84	2.06											
muskellunge	0	0	0											
carp	.12	.19	.16											
rudd	0	0	0											
golden shiner	0	0	.03											
fallfish	0	0	0											
longnose sucker	0	0	0											
white sucker	1.10	1.16	.88											
silver redhorse	.03	.06	.03											
shorthead redhorse	0	0	0											
greater redhorse	0	0	0											
brown bullhead	1.53	2.47	1.22											
yellow bullhead	0	0	0											
channel catfish	.38	.44	.25											
stonecat	0	0	0											
burbot	0	0	0											
white perch	0	.03	0											
white bass	0	.03	0											
rock bass	8.23*[*]	11.3*	9.03*											
pumpkinseed	1.88	2.41	.97											
bluegill	.06	.03	.13											
smallmouth bass	4.75	7.84	5.13											
largemouth bass	0	0	.19											
black crappie	0	0	0											
yellow perch	6.82*[*]	12.95*	16.44*											
walleye	.75	.81	1.34											
freshwater drum	.06	0	.13											
round goby	0	0	.09											

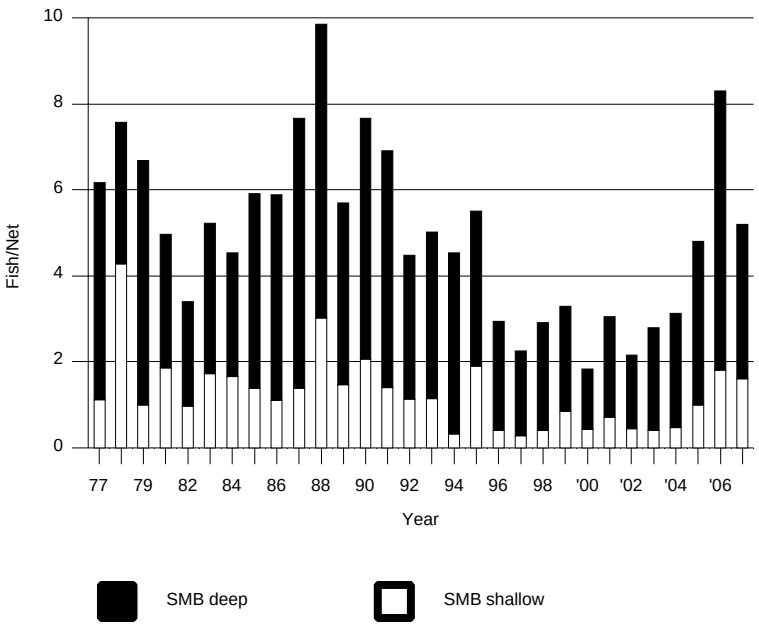

Figure1. Smallmouth bass abundance index by depth stratum in the St. Lawrence River Thousand Islands area.

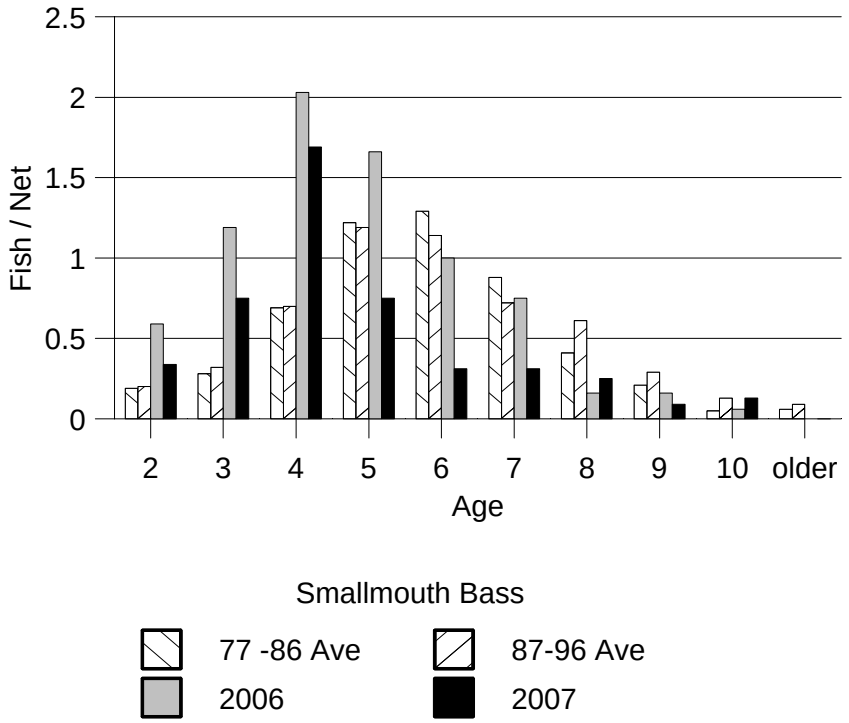

Figure 2. Smallmouth bass age distribution

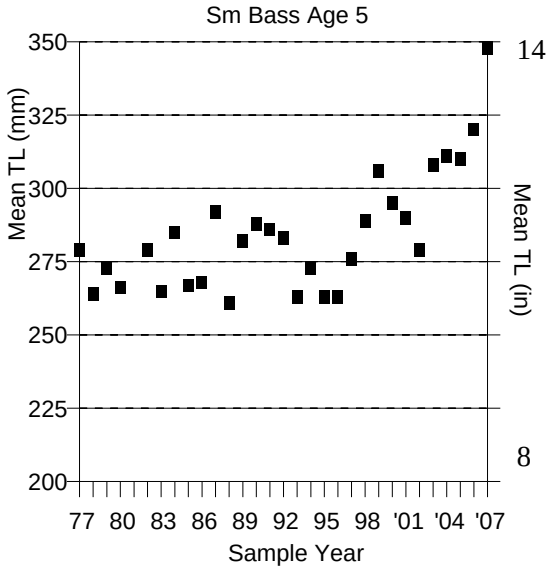

Figure 3. Smallmouth bass growth (mean total length at age 5) in the St. Lawrence River Thousand Islands area

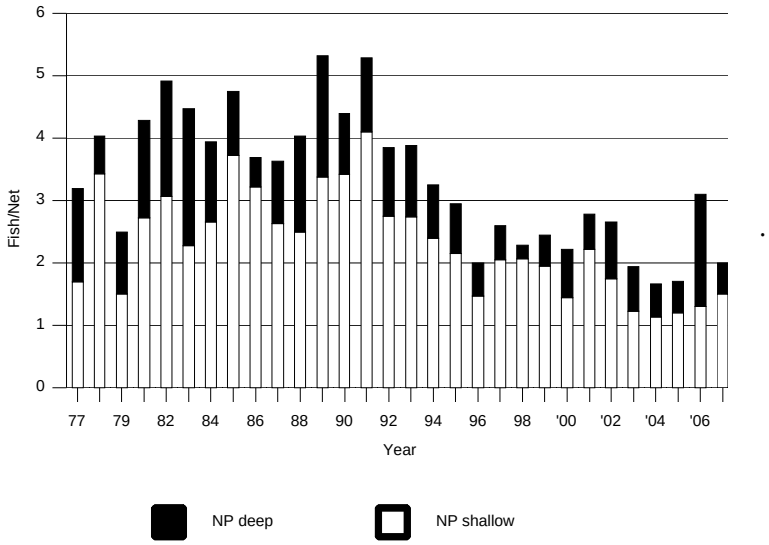

Figure 4. Northern pike abundance index by depth stratum in the St. Lawrence River Thousand Islands area.

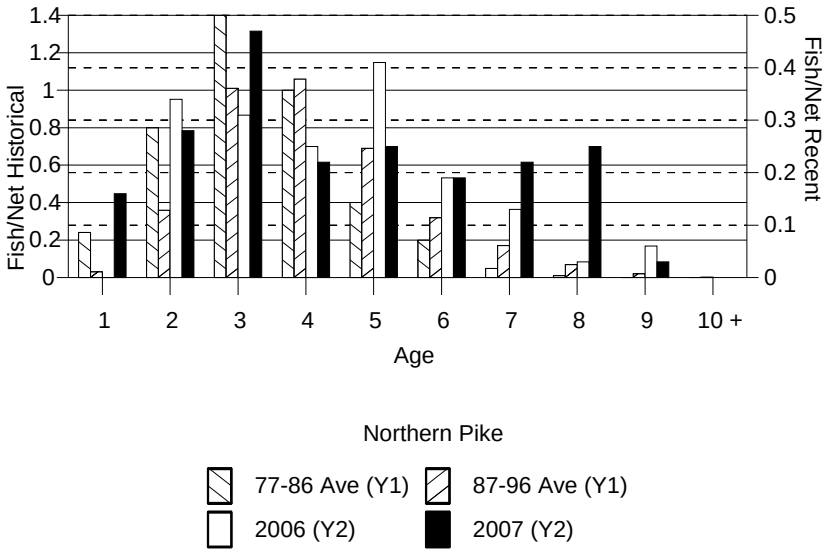

Figure 5. Northern pike age distribution in the St. Lawrence River Thousand Islands area.

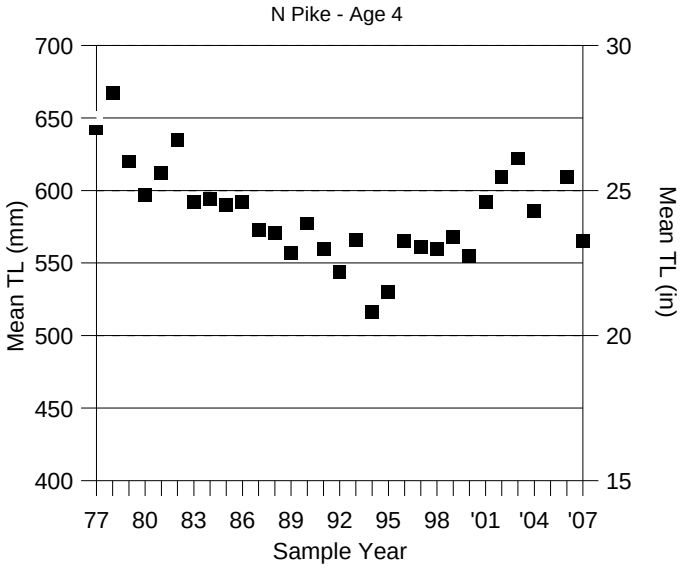

Figure 6. Northern pike growth (mean total length at age 4) in the St. Lawrence River Thousand Islands area.

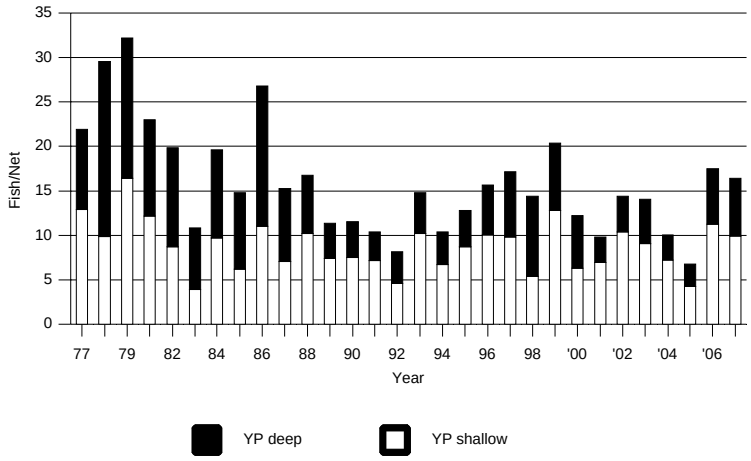

Figure 7. Yellow perch abundance index by depth stratum in the St. Lawrence River Thousand Islands area.

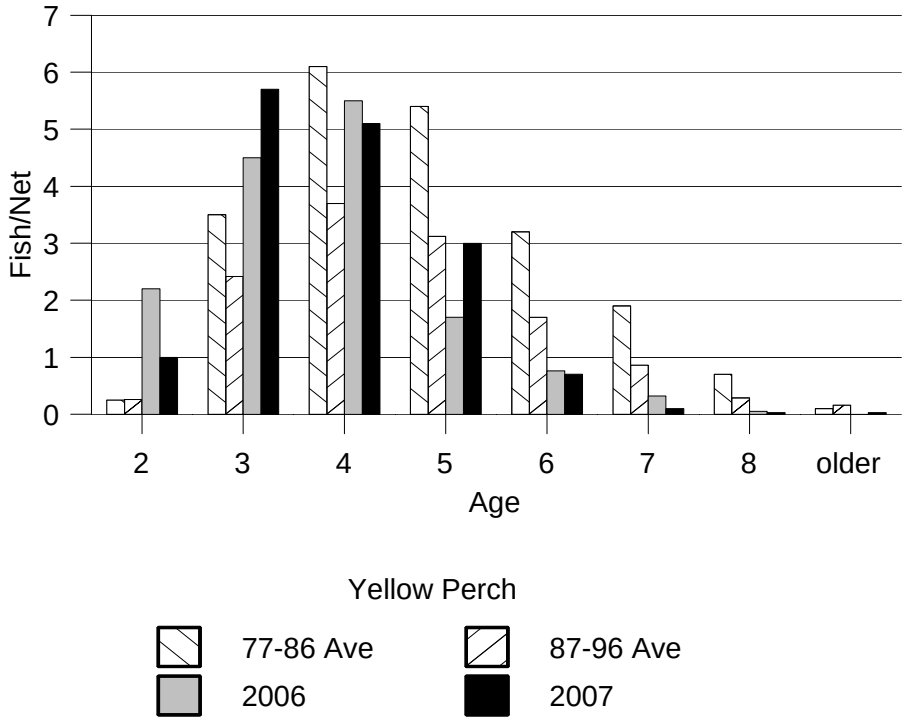

Figure 8. Yellow perch age distribution in the St. Lawrence River Thousand Islands area.

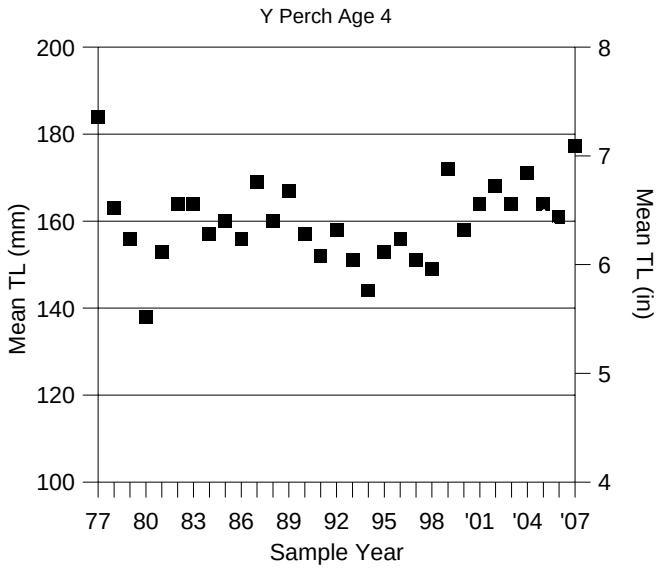

Figure 9. Yellow perch growth (mean total length at age 4) in the St. Lawrence River Thousand Islands area.

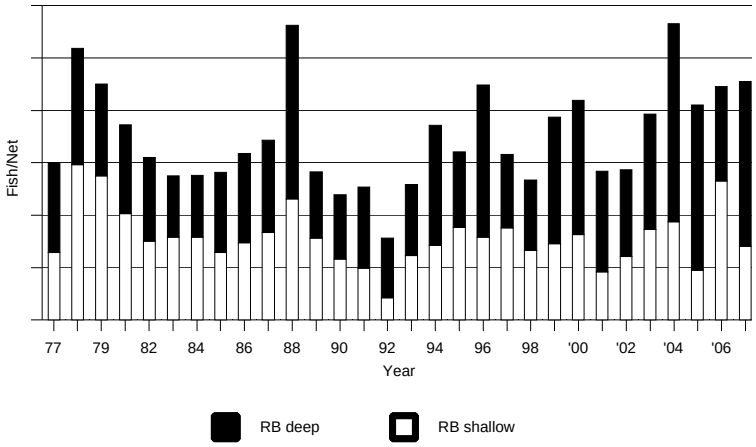

Figure 10. Rock bass abundance index by depth stratum in the St. Lawrence River Thousand Islands area.

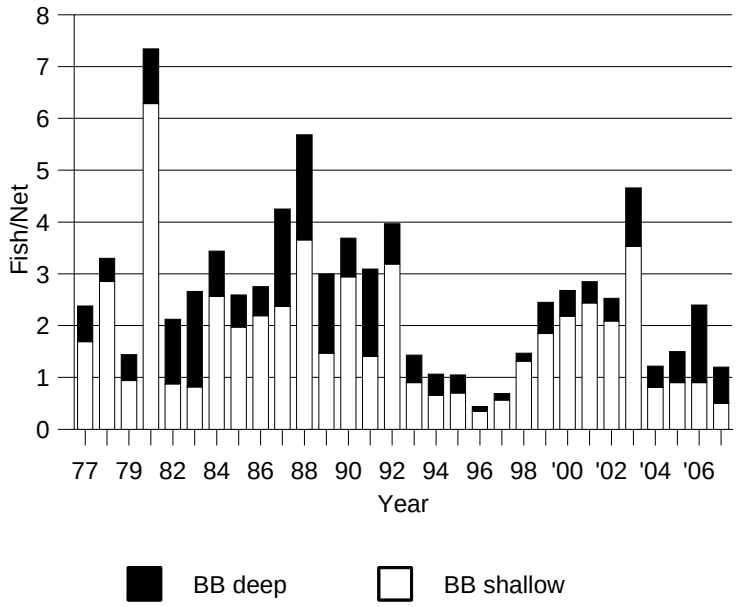

Figure 11. Brown bullhead abundance index by depth stratum in the St. Lawrence River Thousand Islands area.

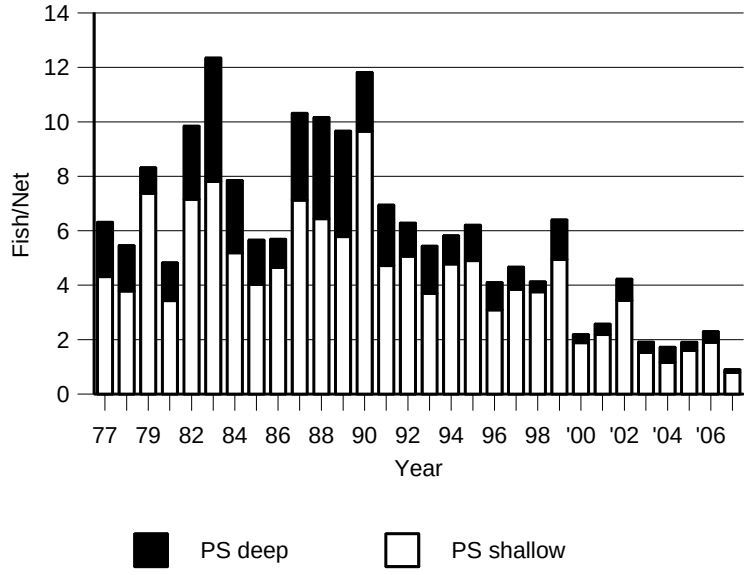

Figure 12. Pumpkinseed abundance index by depth stratum in the St. Lawrence River Thousand Islands area.