

PENOBSCOT RIVER SMALLMOUTH BASS MANAGEMENT
SUMMARY REPORT NO. 2
(2006)

Introduction

New England's second largest river system, the Penobscot drains an area of 8,570 square miles. Like all of New England's major rivers, the Penobscot has been grossly polluted with untreated industrial and municipal waste for most of the 20th century. Water quality on the main-stem and lower tributaries has improved markedly since the 1970s. Most of the watershed is forested, intensively harvested for pulp and saw logs and sparsely settled. The only major urban area in the watershed is the riverfront cities of Bangor and Brewer. Paper mills are located on West Branch at Millinocket and East Millinocket, and on the main-stem at Lincoln, Old Town, Brewer and Bucksport. The Penobscot is home to many fish species, including brook trout (*Salvelinus fontinalis*), landlocked salmon (*Salmo salar*), smallmouth bass (*Micropterus dolomieu*), white perch (*Morone americana*) and chain pickerel (*Esox niger*).

A recent illegal introduction of northern pike (*Esox lucius*) in Pushaw Lake, a shallow warmwater lake in the lower part of the Penobscot drainage, has been documented. There are no barriers to pike movements from Pushaw Lake into the outlet, Pushaw Stream (a tributary stream to the Penobscot), and eventually into the Penobscot River. Although presence of pike has not been documented beyond the lake, it is logical to assume that if pike do become established in Pushaw Lake, they will move into the Penobscot River where they would be expected to dramatically change the ecology of the Lower Penobscot River for all resident fish species.

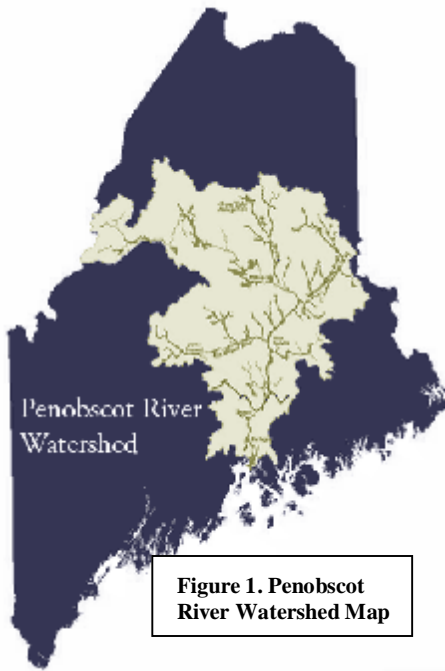


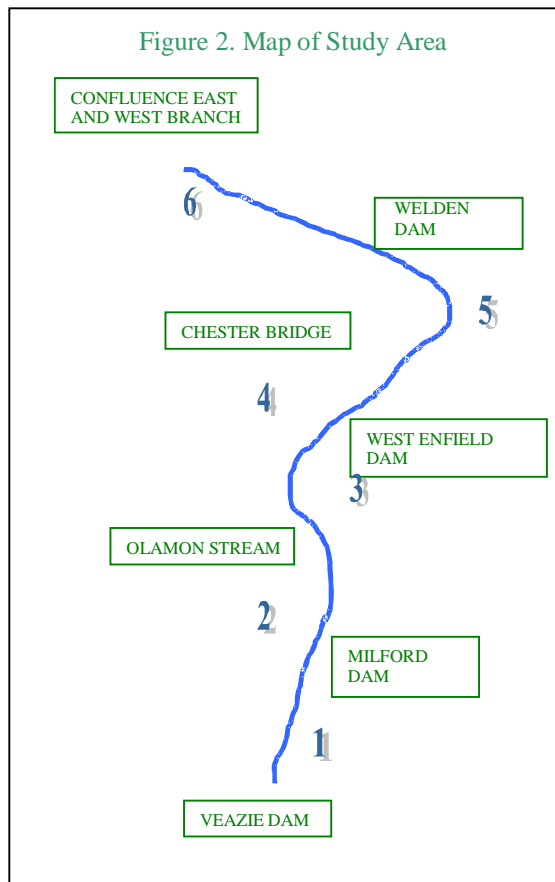
Figure 1. Penobscot River Watershed Map

Comment:

The implementation of the Federal Clean Water Act of 1972 resulted in many positive changes in the ecological health of the river. A highly attractive fishery for smallmouth bass has developed over the years in the Penobscot River as a result

of those changes. Regional interest among anglers and fisheries personnel in the smallmouth bass fishery was instrumental in the Department's decision to initiate an investigation of the smallmouth bass fishery in the Penobscot River. The purpose of the study was to document the status of the smallmouth bass fishery and attempt to track changes over time. The study began in 1990 and the initial results are reported in Penobscot River Bass Management, Fishery Interim Summary Report Series No. 98-1, 1998. The current report describes the smallmouth bass fishery in the Penobscot River in 2002/2003 and compares it to the 1990 fishery.

Study Area



The study area consists of approximately 74 linear miles (10,496 acres) of river, from just above the head of tide at Veazie Dam in the towns of Veazie and Eddington, to the confluence of the East and West Branches of the Penobscot River in Medway. As in the 1990 study, the river was divided into six sections (Figure 2) based on area, angler use, angler access and broad habitat types. Other regional responsibilities determined that only half of the project sections could be accomplished per year. The three northern sections from Howland/West Enfield to Medway were sampled in 2002, and the lower three sections from Howland/West Enfield south to Bangor were sampled in 2003.

Table 1. Penobscot River by sample section.

Section No.	Section Description	Section Length (miles)
1	Veazie Dam to Milford Dam including the Stillwater River to Gillman Falls	9.8
2	Milford Dam/Gilman Falls to Olamon Stream	14.0
3	Olamon Stream to West Enfield Dam	11.6
4	West Enfield Dam to Chester Bridge	17.2
5	Chester Bridge to Welden Dam	13.8
6	Welden Dam to Confluence of East and West Branches of the Penobscot	7.3
	Total Length =	73.7

The Penobscot River smallmouth bass fishery was managed under General Law Regulations until 1992. When the initial samples were taken in 1990 the minimum length limit was 12 inches. From January 1 to March 31 there was a five bass bag limit in effect, and from April 1 to June 20 the daily bag limit dropped to three bass with a artificial lures only terminal tackle restriction as well. From June 21 to October 31 the daily bag limit on bass was five fish. Regulation of the Penobscot bass fishery became increasingly restrictive beginning with changes in the general law regulations in 1992 (Table 2). Further restrictions were applied in 1995 with strong support from a number of guides and experienced bass anglers.

TABLE 2. BLACK BASS REGULATION HISTORY, PENOBSCOT RIVER

TIME FRAME	LENGTH LIMITS	BAG LIMITS
Until 1992	12 Inches	<u>From 1/1 to 3/31:</u> 5 Bass bag limit. <u>From 4/1 to 6/20:</u> 3 Bass bag limit and ALO. <u>From 6/21 to 9/30:</u> 5 Bass bag limit.
1992 to 1995	12 Inches	<u>From 1/1 to 3/31:</u> 1 Bass bag limit. <u>From 4/1 to 6/20:</u> 1 Bass bag limit and ALO. <u>From 6/21 to 8/15:</u> 3 Bass bag limit. <u>From 8/16 to 9/30:</u> 1 Bass bag limit and ALO. <u>From 10/1 to 10/31:</u> No Kill and ALO
1996 to the present	12 Inches	<u>From 1/1 to 9/30:</u> 1 Bass between 12 and 15 inches and ALO. <u>From 10/1 to 11/30:</u> No kill and ALO.

Methods

Region F fisheries personnel, with the assistance of volunteers and Region B and G fisheries personnel, captured bass by angling with artificial lures. Bass were played and landed expeditiously to avoid injury. Biological fish data was recorded as well as habitat information from the sample areas. Length and weight measurements and a scale sample were taken from each fish as they were captured. Fish were marked with an upper caudal clip to eliminate duplication of the sample and were released as close as possible to the capture site. All smallmouth bass scales were cleaned and pressed on acetate slides in the lab for later analysis. Scales were aged using a Bausch and Lomb microprojector. As each scale impression was read, measurements were made to each annulus, permitting back-calculation to bass lengths at each age.

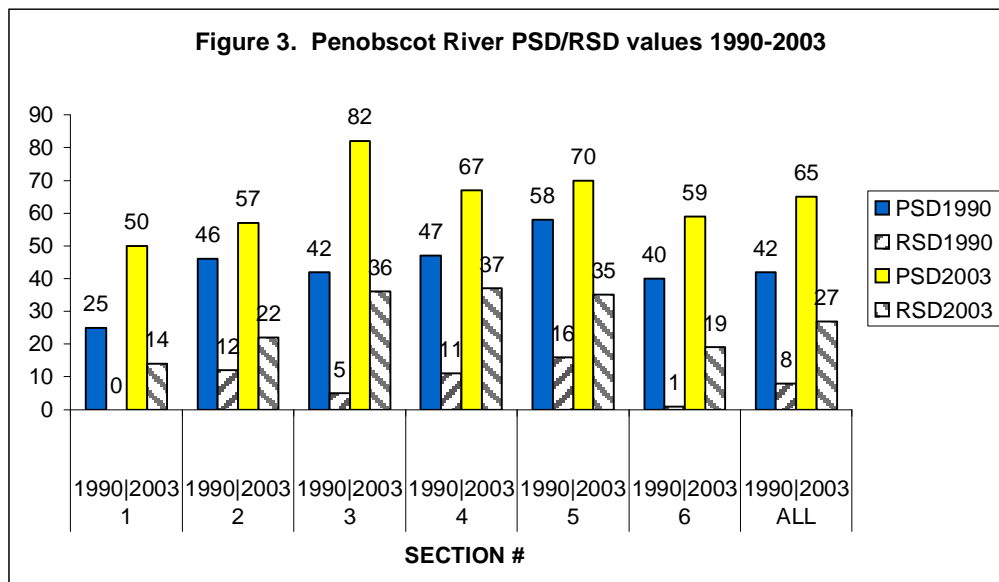
Results

Mean length and weight of all smallmouth bass handled in 1990 and 2002/2003 is shown on Table 3. There was general improvement among years in both length and weight of bass in every section, however, increases in size quality came at different rates among sections, with Section 2 (Milford to Greenbush) showing only 1% over all increase in length, while Section 1 (Veazie Impoundment to Milford Dam) showed the largest increase (17%). The increase in length between samples for all sections combined was 11% (272±3mm to 305±3mm).

Table 3. Mean lengths and weights of smallmouth bass by section and year.

Section #	Sample Year	Sample size (n=)	Mean length ±SE (mm)	Mean weight ±SE (g)
Section 1	1990	100	241±5	195±9
	2003	101	290±5	318±15
Section 2	1990	100	282±8	318±23
	2003	105	284±8	392±29
Section 3	1990	100	272±5	290±18
	2003	100	329±6	525±25
Section 4	1990	100	282±8	322±23
	2003	119	320±6	463±22
Section 5	1990	100	302±8	413±27
	2003	141	319±6	469±21
Section 6	1990	100	251±5	235±14
	2003	125	287±6	344±19
AllSections	1990	600	272±3	295±4
	2003	690	305±3	420±9

Proportional Stock Density (PSD_{11}) and Relative Stock Density (RSD_{15}) are represented graphically by section in Figure 2. The mean PSD_{11} and RSD_{15} for all sections combined was $PSD_{11}=65$ and $RSD_{15}=27$, respectively. This represents a rather dramatic increase from values obtained in 1990, which were $PSD_{11}=42$ and $RSD_{15}=8$, respectively. In every distinct section of the river in 2003, PSD_{11} and RSD_{15} were higher than observed in 1990. RSD_{15} values showed the most change over time in a couple of sections, most notably section 1 ($RSD_{15}=0$ in 1990 to $RSD_{15}=14$ in 2002/3), and section 3 ($RSD_{15}=5$ in 1990 to $RSD_{15}=36$ in 2002/3).



An analysis of age class composition by section also shows some rather remarkable shifts (Fig 3a, 3b). In the 2002/2003 samples, the most abundant age class was age 5 fish at 22.7% followed by the 4-year-old cohort at 18.4% of all fish sampled. In 1990, the 5-year-old bass made up only 14.7% and the 3 year old bass were by far the most numerous age class at 47.5%. The strong 3-year-old cohort in 1990 was the result of a cool, wet summer in 1986 that prevented YOY smallmouth bass from reaching the critical size necessary for over winter survival. First year survival of smallmouth bass is dependant on size at the end of the first growing season (Shuter et al. 1980.) This greatly reduced the level of intraspecific competition that the 1987 cohort faced which, coupled with the very hot summer of 1988, yielded a significant growth advantage to the 1988 cohort.

Although only bass through age 5 were used in the backcalculated length analysis, I have included bass through age 7 in Figures 3a and 3b. Bass scales from fish older than age are notoriously difficult to read. Consequently, those assigned ages should be regarded as minimum ages for these fish.

Figure 3a. Age-class composition of smallmouth bass for all sections, Penobscot River, 1990 and 2002/2003.

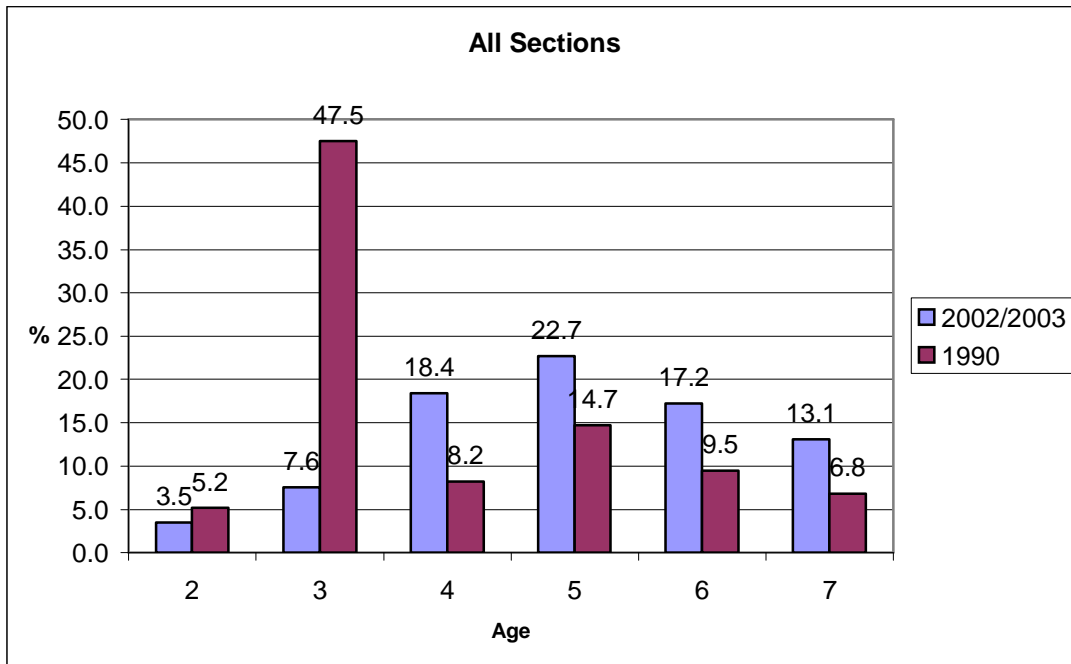
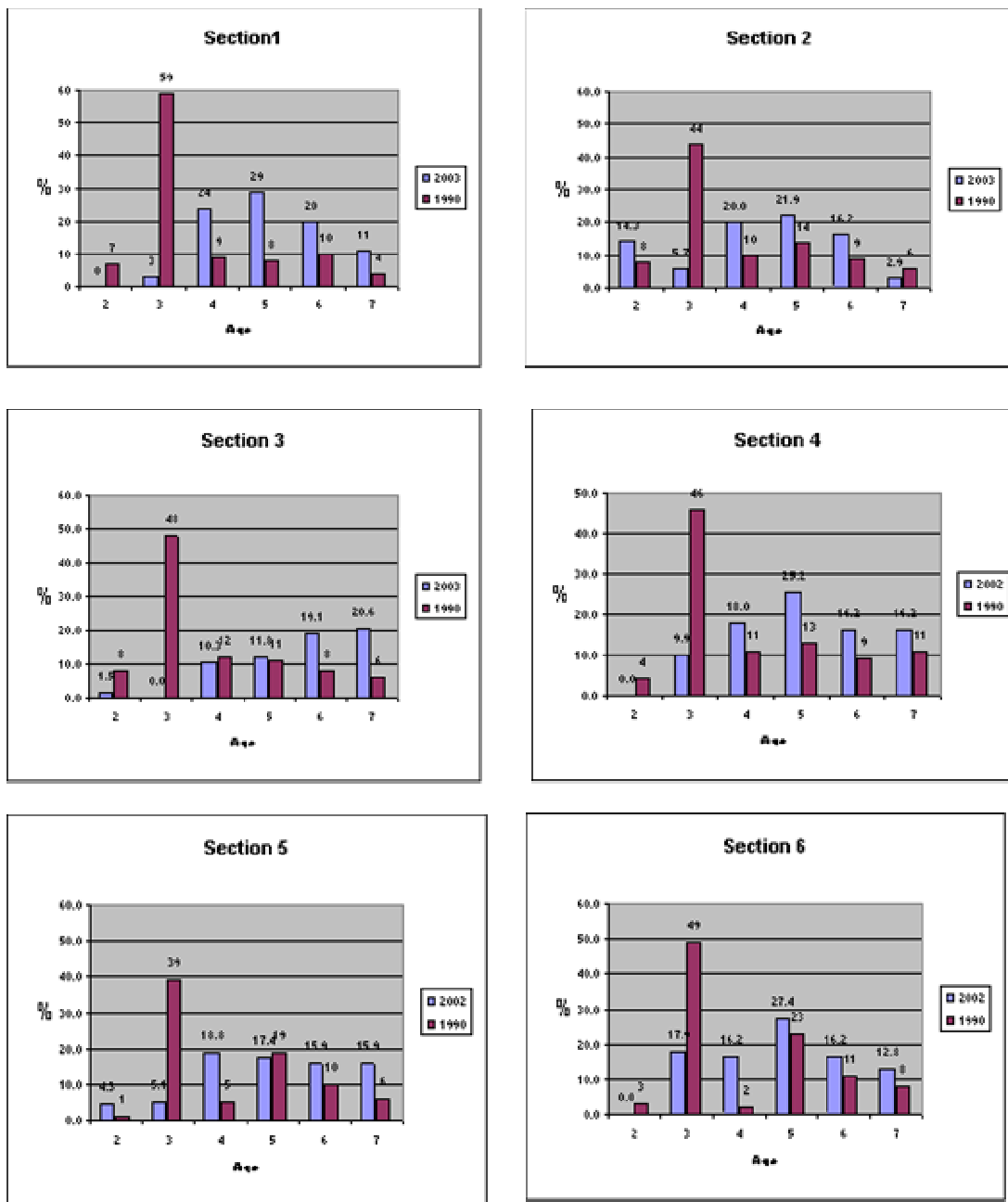
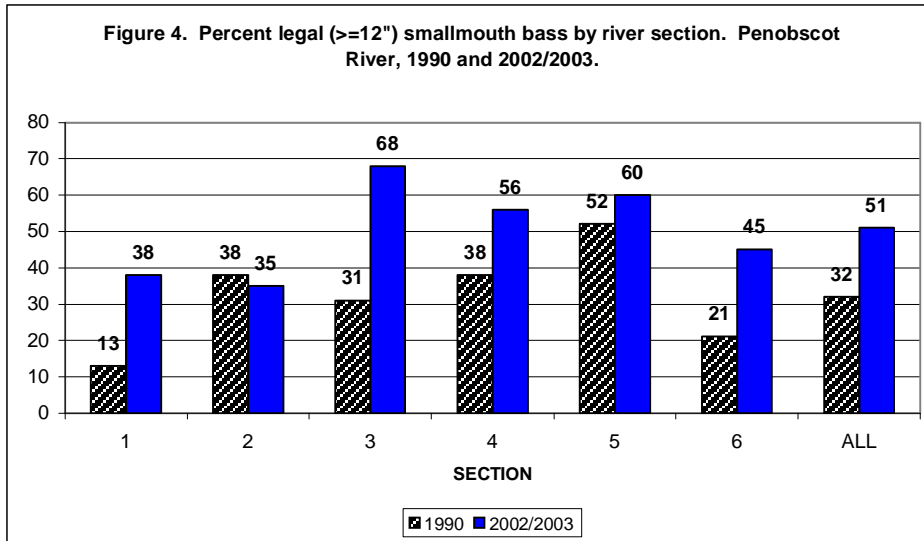


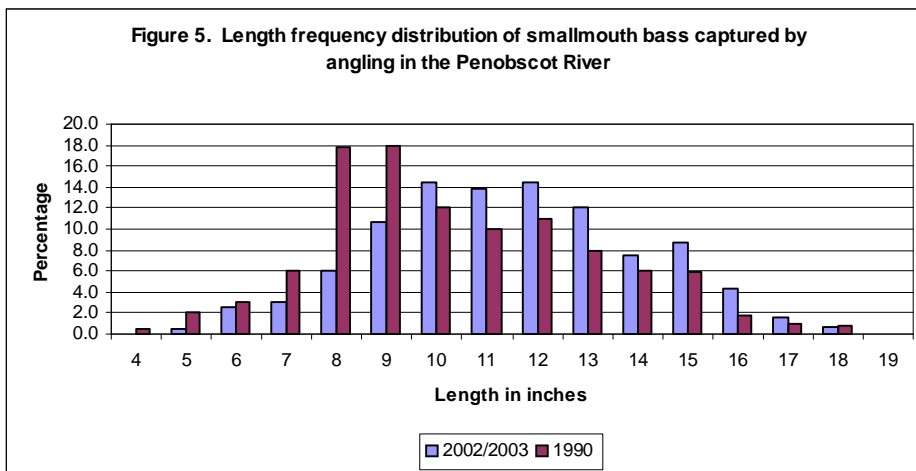
Figure 3b. Age-class composition of smallmouth bass by section, Penobscot River, 2002/2003.



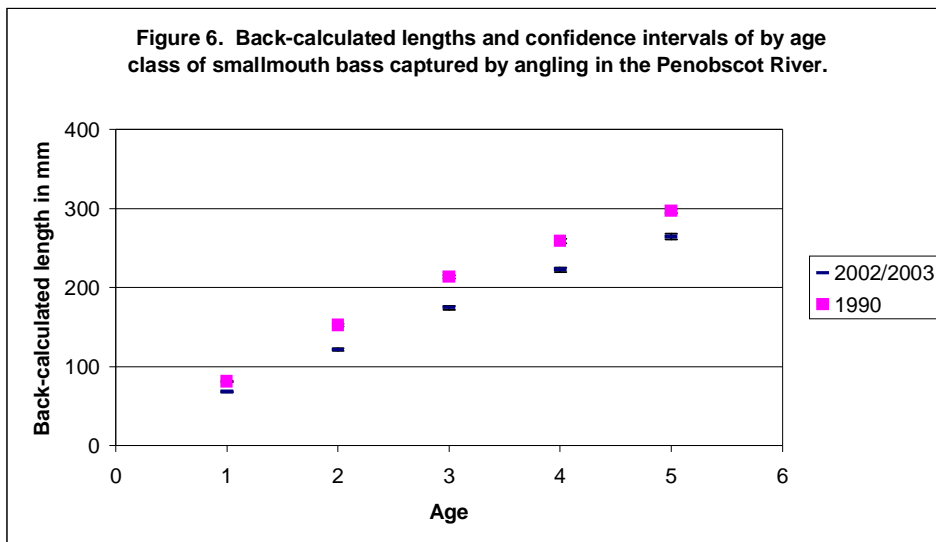
The percent of the sample that was legal at the time of capture is shown in Figure 4. In 2002/2003, in every section except section 2, the percent of legal fish was greater than observed in the 1990 sample. In section 3 the percent legal jumped from 31 % in 1990 to 68 % in 2002/2003. All sections combined show an increase of 19% through the study period.



A notable upward shift between sample years is apparent in the length frequency of bass (Figure 5). In the 1990 sample the 8" and 9" size class is dominant because they are the age 3 bass from the abundant '87 cohort, while the 10" to 12" size class is most abundant in the 2002/2003 sample. Although there may be some angling bias toward larger bass, the focus of our sampling is to obtain a representative cross-section of all sizes in the population.



The mean back-calculated growth relationship is displayed in Figure 6 (see also Table 4, Appendix I). In 1990, back-calculated lengths were somewhat larger at each age. This could be attributed to a number of factors, including an actual shift in growth rate of juvenile bass from 1990 to 2002/2003, reader error in either 1990 or 2002/2003, or other unknown factors. In 1990 the back-calculated length of age I bass was 81.3 ± 0.1 mm, and in 2002/2003 the calculated size at age I was 68.2mm. This differential in calculated values continues up to age V.



We speculate that increased protection from the special regulation in effect on the River since 1995, increases in water quality, and a change in angler attitudes may have contributed to this apparent shift in the bass population.

While catch rate data from anglers is limited, catch rates for our staff (Table 4) is available. Catch and effort information kept during our sampling does not suggest a large change in population abundance.

Section Number	1990 SMB/hour	2002/2003 SMB/hour
1	3.7	7.5
2	1.8	1.9
3	1.7	1.5
4	1.3	1.4
5	3.1	2.8
6	2.0	1.8
ALL	1.9	1.8

Discussion

With the advent of the new special bass regulations on the Penobscot River, we expected a general improvement in size quality. Comparison of our survey work in 2002/2003 to 1990 samples showed that the overall size quality has improved. However, the growth rate of bass appears to have slowed in all sections, and at all age-classes as well.

Our purpose in adjusting the regulations on the Penobscot River was to enhance size quality, but since the new regulations were directed towards harvest, and most bass anglers don't harvest any bass, the regulation changes may not have played a significant role in the observed enhancement of size quality. Although a portion of the river's anglers do harvest bass, we believe that harvest of bass occurs only at a low rate, as we have observed very few anglers harvesting bass in the river over the last 20+ years. Additionally, while we sampled a rather large number of bass during this project, the samples took place over just a few sample years, making it difficult to determine the population status of a long-lived species such as the smallmouth bass let alone identifying the cause or causes of any particular changes in that population.

Further enhancement of size quality will require regulations designed to improve growth rate by increasing the number of smaller bass harvested while protecting the older larger fish. Since most anglers are reluctant to harvest any bass, they need to be convinced of the benefits of harvesting smaller bass to increase growth rates.

Recommendations

- Submit a proposal for a general law regulation for the Penobscot River from Veazie Dam to Medway Dam and confluence with East Branch: Winter- 1 bass, 12 inch length limit, ALO. Summer- April 1 to June 20 -1 bass, 12-inch length limit, ALO. June 21 to September 30 –3 bass, 12-inch length limit, only 1 may exceed 14 inches.
- Collect angler use information with fixed wing aircraft counts.
- Collect age and growth information from study sections 4, 5 and 6 in 2008, and study sections 1, 2 and 3 in 2009.
- Mount an aggressive public outreach effort educating anglers regarding the desirability of encouraging some increase in the smallmouth bass harvest.

Acknowledgements

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Appendix I

Table 4. Back-calculated length at age of smallmouth bass in the Penobscot River, 1990 and 2002/2003.

AGE	SECTION #	1990		2002/2003	
		n	Mean length \pm SE	n	Mean length \pm SE
I	1	100	81.3 \pm 1.8	97	74.1 \pm 1.2
	2	100	83.8 \pm 1.8	105	71.2 \pm 1.1
	3	100	83.8 \pm 1.8	68	67.3 \pm 1.1
	4	100	81.3 \pm 1.5	111	65.8 \pm 1.1
	5	99	81.3 \pm 1.5	138	68.5 \pm 1.3
	6	100	78.7 \pm 1.5	117	62.9 \pm 0.7
	ALL	599	81.3 \pm 0.7	636	68.2 \pm 0.5
II	1	100	152.4 \pm 3.0	97	129.4 \pm 1.9
	2	100	157.5 \pm 3.8	105	127.6 \pm 2.0
	3	100	160.0 \pm 4.1	68	110.4 \pm 2.3
	4	100	157.5 \pm 3.8	111	123.3 \pm 2.5
	5	99	157.5 \pm 3.3	138	121.8 \pm 2.3
	6	100	139.2 \pm 3.0	117	113.1 \pm 1.5
	ALL	599	152.4 \pm 1.5	636	121.4 \pm 0.9
III	1	93	208.3 \pm 3.8	97	181.8 \pm 2.7
	2	92	221.0 \pm 4.3	90	175.7 \pm 2.5
	3	92	223.5 \pm 5.1	67	154.8 \pm 2.4
	4	96	218.4 \pm 3.3	111	186.3 \pm 3.6
	5	98	221.0 \pm 4.3	132	176.7 \pm 3.0
	6	97	190.5 \pm 4.3	117	165.7 \pm 2.5
	ALL	568	213.4 \pm 1.8	614	174.6 \pm 1.3
IV	1	34	243.8 \pm 6.6	94	225.4 \pm 2.7
	2	48	269.2 \pm 5.6	84	219.7 \pm 3.2
	3	44	265.2 \pm 7.1	67	201.9 \pm 3.6
	4	50	265.2 \pm 4.6	100	237.2 \pm 4.0
	5	59	269.2 \pm 5.8	125	229.1 \pm 3.0
	6	48	233.7 \pm 6.4	96	214.6 \pm 3.0
	ALL	283	259.1 \pm 2.8	566	222.8 \pm 1.4
V	1	25	271.2 \pm 7.4	70	261.7 \pm 3.3
	2	38	304.8 \pm 6.6	63	254.4 \pm 3.8
	3	32	304.8 \pm 6.9	60	238.5 \pm 4.2
	4	39	304.8 \pm 4.8	88	284.1 \pm 4.9
	5	54	307.3 \pm 5.6	99	270.9 \pm 3.6
	6	46	276.9 \pm 5.6	92	264.6 \pm 3.9
	ALL	234	297.2 \pm 2.8	449	264.1 \pm 1.8