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Connecticut Fisheries Division

Northern Pike Management

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Cover photo: Fisheries Biologist Chris McDowell holding a large female Northern Pike prior to releasing into the Haddam pike spawning marsh.

Summary

The Connecticut DEEP Fisheries Division (FD) has created a number of successful Northern Pike fisheries as evidenced by angler survey results and numerous trophy fish awards. However, variable production of pike fingerlings in managed marshes remains a challenge to effective management of Connecticut pike fisheries. In 2016, fingerlings were stocked into four Pike Management Lakes (PMLs) and the lower Connecticut River. In addition, the FD completed the final year of the pike enhancement study that involved: 1) stocking yearling pike obtained from a private hatchery into Mansfield Hollow Reservoir (MHR) and, 2) rearing pike fry acquired from the Hacketstown Fish Hatchery in New Jersey in a managed nursery marsh. Also in 2016, the FD began a third pike enhancement study at Punch Brook Pond, Burlington State Fish Hatchery where fry, also obtained from the Hacketstown Fish Hatchery, were raised to an advanced (>8 inches) fingerling stage. An ice angler survey was conducted at MHR during winter 2016-17. Safe fishable ice was intermittent throughout the season due to erratic swings in temperature through the season. Most ice fishing effort was directed towards pike and 80% of the anglers were in favor of the pike program.

Background

The Northern Pike is one of Connecticut's largest freshwater gamefish. Angler surveys conducted on Pike Management Lakes (PMLs) have documented that pike attract angling effort year-round, especially during the ice fishing season, and that a majority of anglers fishing these waters are in favor of Connecticut's Pike Management Program (Machowski et al. 2011). The pike's large size and predatory nature also makes it an effective consumer of a variety of forage fish. Predation by pike helps thin out smaller fish species, which prevents them from becoming "stockpiled" (overabundant and therefore slower growing), thereby improving the overall quality of angling in a waterbody.

Maintenance and enhancement of pike fisheries is an important component of Connecticut's overall Inland Fisheries management program. Pike populations in the PMLs are supplemented or completely supported by annual stockings of 3-6-inch pike "fingerlings". Currently, the CT DEEP Fisheries Division (FD) stocks four PMLs: Bantam Lake, Mansfield Hollow Reservoir,

Pachaug Pond and Winchester Lake (Figure 1). Stocking in Quaddick Reservoir has been discontinued because the current winter drawdown regime likely results in most of the pike emigrating downstream. A fifth lake that is not a PML, Lake Lillinonah, is not stocked by the FD, but receives annual stockings of yearling pike purchased by the Lake Lillinonah Authority. The FD also stocks pike fingerlings in the Haddam area of the Connecticut River to supplement the self-sustaining population there.

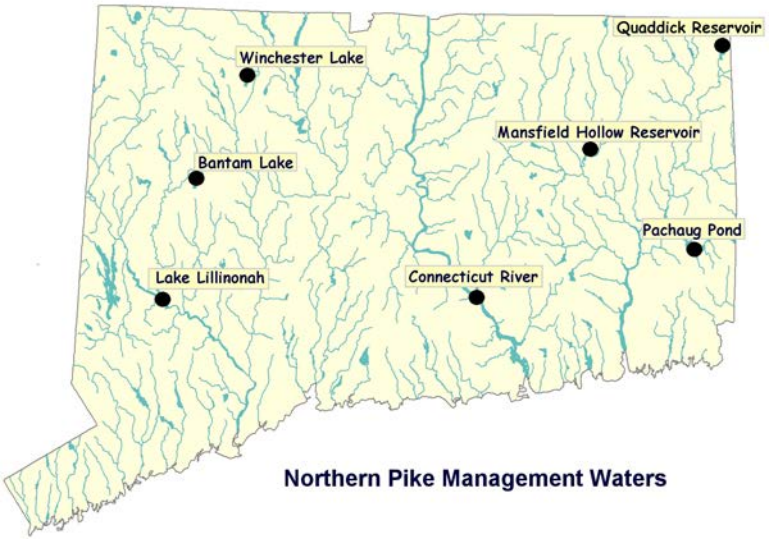

Figure 1. *Connecticut waterbodies stocked and managed for Northern Pike. Note: Quaddick Reservoir is no longer stocked with pike.*

The purpose of Job 5 is to maintain and enhance Northern Pike populations in selected Connecticut waters in order to increase and improve fishing opportunities for Connecticut anglers. This report summarizes pike-related work conducted during 2016-17.

Note: The Connecticut DEEP Inland and Marine Fisheries Divisions were merged into a single Fisheries Division in January of 2017. Although the majority of the work for this report was conducted while we were still Inland Fisheries, the new designation has been incorporated herein.

Approach

Adult pike broodstock are collected in early spring using trap nets at Bantam Lake and a fixed weir trap at the Lower Haddam Marsh on the Connecticut River. Broodstock are then stocked into managed marshes at a targeted ratio of two males to one female. The fingerlings hatched

Figure 2. *FD biologist Chris McDowell with an adult broodstock pike (top left). Adult pike are stocked into managed marshes to spawn each spring (bottom photo is the Upper Haddam Marsh). Juveniles (right) are collected in June of the same year for stocking. Photos by Chris McDowell and Eric Schluntz.*

in the marshes are collected in June by draining or "drawing down" the marshes and then stocking them into the PMLs (rates for most PMLs range from 2 to 5 pike/acre, Figure 1 and 2).

Adult pike abundance is estimated in selected lakes using the Schnabel mark-recapture method (Hayes et al. 2007). Boat electrofishing, trap nets, and gill nets are used to collect pike for abundance estimates. Scale samples are collected from a subsample of adult pike and used to estimate age and growth rates (scales have annual growth rings that can be counted).

Angler surveys are used to assess angler effort, catch and harvest of pike and other species within PMLs during open water and ice fishing seasons. Surveys employ a standardized stratified random roving design (Malvestuto et al. 1978) and are conducted in selected lakes as resources permit (see "Lake and Large River Angler Surveys" report: Study 2, Job 2, for more detailed methods).

Production Experiments

In 2013, two experiments were initiated to investigate alternative methods of pike production. A third experiment began in 2016.

1. In Mansfield Hollow Reservoir (MHR), fingerling pike stocking was discontinued for seven years (2005-11) to assess the level of natural reproduction. Additionally, stocking numbers were reduced between 2002 and 2004. The pike population declined over this time indicating that natural reproduction alone could not support the fishery (McDowell et al. 2014). Lake Lillinonah, a non-PML stocked annually by the Lake Lillinonah Authority with only 200-600 yearling (10-16-inch) pike appeared to have a thriving pike population (McDowell et al. 2013; McDowell et al. 2014). Using the yearling stocking rates from Lake Lillinonah, a study was designed to compare stocking yearlings versus 4-6-inch fingerlings at MHR. The FD purchased yearling pike from Zetts Fish Farm & Hatcheries, Inc. (Zetts Fish Farm), a commercial hatchery in Pennsylvania. Yearlings were marked with year-specific fin clips and stocked at 0.13 pike/acre (60 fish) in 2013 and 0.26 pike/acre (120 fish) in 2014. The relative performance of the two pike age classes were tracked via angler surveys and trap netting (2014-16) to assess their contribution to the fishery.
2. The second experiment compared the cost effectiveness of stocking fry as an alternative to stocking pre-spawn adults in managed marshes. Two marshes in Wyantenock State Forest (Kent, CT) were chosen as the study sites because they are not prone to flooding and have consistently produced fingerlings by the standard practice of stocking pre-spawn adult pike. Known numbers of pike fry provided gratis by the New Jersey Division of Fish and Wildlife were stocked into one of two

Figure 3. *Fry received from the Hackettstown Fish Hatchery in New Jersey that were used in the Wyantenock and Punch Brook experiments.*

Wyantenock marshes from 2013 through 2016. The other marsh was stocked with broodstock adults. Fry stocking densities were calculated to closely match typical densities produced by stocking spawning adults (10 fry/m^2, Bry and Souchon 1982). Fry stocking and stocking spawning adults were alternated between the marshes each year to reduce any within-marsh bias. Production by the two methods was then compared.

3. In 2016, the FD Fish Management and hatchery personnel began a pike culture experiment in Punch Brook Pond #6 on the Burlington State Fish Hatchery property (Figure 4). Twenty-one thousand fry obtained gratis from the State of New Jersey Hackettstown Fish Hatchery were stocked into the 0.16 acre pond during March 2016. The pond was fertilized with alfalfa meal to promote zooplankton growth prior to stocking fry and for the first four weeks following stocking. Plankton tows were conducted five days after, then again 10 days after fry stocking to determine the abundance and type of zooplankton. Pike fry grow rapidly and switch to a fish diet when approximately two inches long. To accommodate this diet change and help prevent cannibalism, the pond was stocked with forage fish (Fathead Minnows and Golden Shiners) in early May and through the summer. Further details of this experiment can be found in McDowell et al. (2016).

Figure 4. *Punch Brook Pond #6 following dredging and before it was filled with water for the pike rearing experiment during spring 2016.*

Key Findings

Fingerling Production at Pike Spawning Marshes

Statewide production during 2016 (Appendix 1, Table 1) was 7,338 fingerling pike, which was lower than both the project production goal and the 2002-15 average annual production of 10,829 and 12,555 fish. The majority (51%) of fingerlings produced in 2016 came from the Mansfield Marsh. Table 1 displays stocking statistics for the PMLs stocked in 2016.

Table 1. Stocking statistics for fingerling pike stocked into the Connecticut PMLs and the Connecticut River in 2016.

Lake	Acres	Number Stocked	Avg. Length (inches)	No./Acre	Target No./Acre[1]
Bantam	947	513[2]	5.1	0.5	2.0[3]
Mansfield Hollow	460	2,395[4]	4.5	5.2	5.0
Pachaug	841	1,710[5]	3.6	2.0	5.0
Quaddick[6]	408	0	0	0	0
Winchester	246	1,303[7]	4.5[8]/10.0[9]	1.4	5.0
Connecticut River		1,417[10]	4.5[11]/3.6[12]		
Total		**7,338**			

[1] These are "maintenance" stocking rates. Introduction rate is 10/acre.

[2] Fingerlings raised in Wyantenock #3 from Bantam Lake adult broodstock.

[3]Maintenance stocking rate for Bantam is lower than other lakes due to the occurrence of some natural reproduction.

[4]Fingerlings from Mansfield Hollow Marsh.

[5]Fingerlings from Lower Haddam Marsh.

[6]Stocking discontinued until winter drawdowns can be regulated on this lake.

[7]Fingerlings raised from New Jersey fry in Wyantenock #4 (1,185) and New Jersey fry raised to 'advanced' fingerling stage in Punch Brook Pond #6 (118) located at Burlington Hatchery.

[8]New Jersey fingerlings from Wyantenock Marsh #4.

[9]New Jersey fingerlings raised to 'advanced' fingerling stage in Punch Brook Pond #6 at Burlington Hatchery.

[10]Fingerlings from the Mansfield and Lower Haddam marshes.

[11]Fingerlings from Mansfield Hollow Marsh.

[12]Fingerlings from Lower Haddam Marsh.

Yearling vs. Fingerling Stocking Experiment at Mansfield Hollow Reservoir

The results to date of the yearling versus fingerling stocking experiment conducted from 2013 through 2016 at MHR are inconclusive. Trap netting during March and April of 2014-16 captured lower numbers of adult pike compared to historical trap net records (see Table 2 "# Caught" column). The identifying clips given to the pike purchased from Zetts were easily recognizable; however, relatively few were caught over the three netting periods (1 in 2014, 6 in 2015 and 2 in 2016). The total contribution of Zetts pike to the adult pike population at MHR will be assessed once all of the pike scales collected are aged.

Table 2. Population estimates of Northern Pike in Mansfield Hollow Reservoir 1997 through 2016. Population estimates were conducted using trap nets, and during some years a combination of trap nets, gill nets, and night boat electrofishing.

Year	# Caught (Recaptured)	All Sizes		Stock Size (>35cm)		Quality Size (>53 cm)		Preferred Size (>71cm)	
		N	95% CI	N	95% CI	N	95% CI	N	95% CI
1997	151 (21)	443	363-566						
1998	81 (14)	179	141-245						
1999	125 (8)	471	348-729						
2000	79 (3)	379	240-897						
2002	103 (6)	523	371-884						
2013	33 (6)	95	44-259	95	44-259	90	41-246	45	15-227
2015	39 (2)	282	78-2,820	224	62-2,240	138	38-1,380	48	13-485
2016	32 (3)	133	45-667	124	42-618	75	25-373	22	6-220

Fry Versus Broodstock Experiment at Wyantenock Marshes

Wyantenock #3 was stocked with fry in 2013 and 2015, and Wyantenock #4 was stocked with fry in 2014 and 2016 (Table 3). Using two-way ANOVA, the individual marsh had a significant effect on fingerlings produced per acre ($F = 38.88$; $df = 1$; $P = <0.0016$). After controlling for the marsh effect, the stocking "treatment" (fry vs. adult stocked) had no significant effect on production ($F = 0.09$; $df = 1$; $P = <0.7720$).

Cost per fingerling for fish produced by fry stocking was slightly less than that of stocking adults ($4.60/fingerling vs. $5.46/fingerling). However, cost per fingerling for both methods was slightly more expensive than the state average for all marshes combined using broodstock adults ($4.44) (McDowell et al. 2016).

Table 3. Pike fry vs. broodstock adult stocking statistics and fingerling production from the two marshes in Wyantenock State Forest, 2013-16.

	Wyantenock #3 (6 Acres)				Wyantenock #4 (2 Acres)		
Year	**# Fry Stocked**	**# Adults Stocked**	**# Fingerlings Produced/acre**		**# Fry Stocked**	**# Adults Stocked**	**# Fingerlings Produced/acre**
2013	135,000		91.2			8 female/5 male	461.0
2014		12 Female/9 male	211.0		50,000		474.5
2015	101,000		233.3			8 female/16 male	589.5
2016		14 female/28 male	91.3		45,000		629.0

Punch Brook Fry Rearing Experiment

A total of 21,000 fry were stocked into Punch Brook Pond #6 at the Burlington State Fish Hatchery on March 30, 2016. The first plankton tow revealed that only Chironomid larvae were present in the pond. Whereas, five days later (the second sample) zooplankton (Copepods and Cladocerans) were both present and abundant. At that time, fry swimming near shore appeared to have full abdomens indicating utilization of the zooplankton forage.

The pond was first seined on May 20 to determine growth and survival from fry to small fingerling. A total of 1,845 (avg. length = 2.8 inches) fingerlings (Table 4; Figure 5) was captured equating to a 9% survival rate from stocked fry to fingerling. Cost (including staff time, screening, valves, fertilizer and live forage) was calculated at $2.68/fingerling.

All fingerlings were restocked into the pond and allowed to grow to advanced fingerling size. The pond was seined again on September 9 when 118 advanced-size (avg. length = 10 inches) fingerlings were captured, equating to a 6% survival from small to advanced fingerling. Due to the increased staff time, high cost of live forage and increased mortality, the cost to produce a

10-inch fingerling was much higher ($65.16/fish) than to produce a 3-inch fingerling. The advanced fingerlings were given a fin clip and stocked into Winchester Lake.

Table 4. Calculated costs of both small (2.8 inches) and advanced (10 inches) fingerling pike raised at the Burlington State Fish Hatchery, 2016.

Punch Brook Pond #6 Pike Culture Experiment 2016			
Personnel cost and expenses to produce small fingerling pike: (*Cost calculated through May 20 – first harvest date*)	**Expenses**	**Personnel**	**Production**
Total single use item annual expenses (e.g. fertilizer):	$835.00	$3,831.50	1,845
Annual prorated expenses (e.g. durable equipment):	$288.20		
Total Annual cost including both one time and prorated expenses:	$1,123.20		**$4,954.70 total cost to produce 1,854, 3-inch fingerlings = $2.68/fingerling**
Personnel cost and expenses to produce large fingerling pike: (*Cost calculated through September 9 – second harvest date*)	**Expenses**	**Personnel**	**Production**
Total one time annual expenses:	$2,510.00	$4,891.25	118
Annual prorated expenses:	$288.20		
Total Annual cost including both one time and prorated expenses:	$2,798.20		**$7,689.45 total cost to produce 118, 10-inch fingerlings = $65.16/fingerling**

Figure 5. *Punch Brook pike fingerlings (small May fingerlings seen on left and large advanced September fingerling seen on right).*

Angler Survey

An angler survey was conducted at MHR during the ice fishing season from December 15, 2016 to March 18, 2017 (see Lake and Large River Angler Survey report: Study 2, Job 2 for details on other species caught). Safe fishable ice was intermittent throughout the season (total days of safe ice = 63) due to erratic swings in temperature. Estimated directed effort for pike was 2,674

angler-hrs (AH) making up 92% of total angler effort for the season. Anglers caught 194 (80% CI) pike and harvested none.

Catch effort of pike by anglers targeting them was 0.06/hr in 2017 (Figure 6). After pike fingerling stocking was suspended in MHR, the mean directed catch effort decreased by 73% (0.11/hr in 2001-02 vs. 0.03/hr in 2010-15 (Figure 6). There was a moderate increase in directed catch per effort in 2017, which hopefully indicates the population density began to increase.

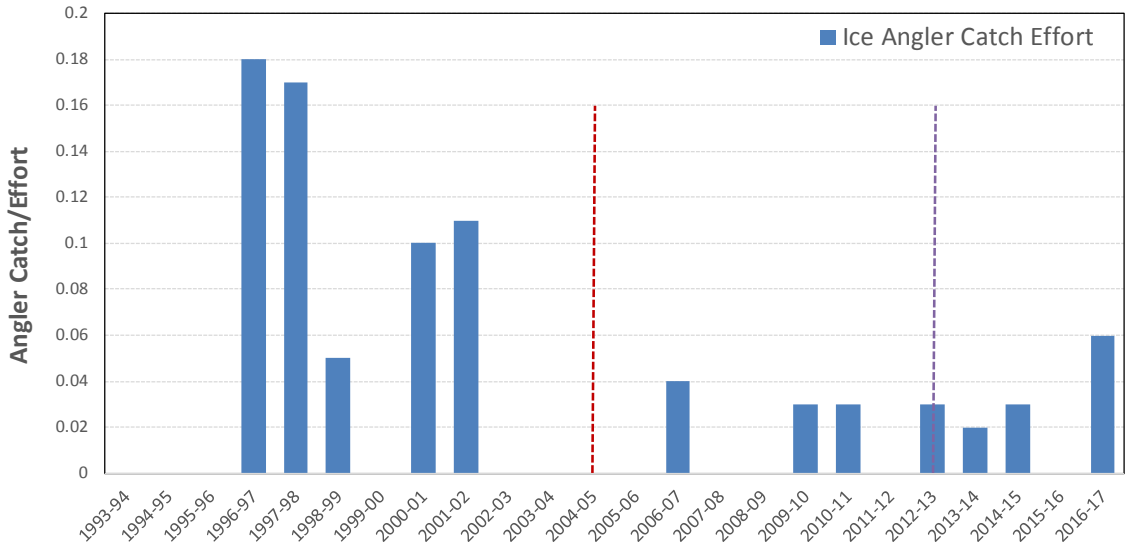

Figure 6. *Catch per effort of pike by ice anglers targeting pike in Mansfield Hollow Reservoir 1994-2017. No surveys were conducted during years with missing data. The* ***red dashed line*** *marks when fingerling stocking was suspended and the* ***purple dashed line*** *when fingerling stocking resumed.*

The length-frequency of the 2016-17 pike catch was relatively narrow (24-36 inches) compared to the length-frequency of catch prior to the cessation of stocking (Figure 7). Age-classes can be inferred by interpreting modes in length-frequencies. The 2016-17 pike length-frequency appears to include only two overlapping age-classes; whereas, length-frequencies from prior ice fishing angler surveys at MHR contain multiple age classes (Figure 7). There should have been at least four age-classes present in the 2016-17 population because restocking started at MHR in 2013. It is unclear whether this is an indication of variable survival of stocked year-classes or if

the other age-classes were somehow underrepresented due to the short safe ice fishing season of 2016-17.

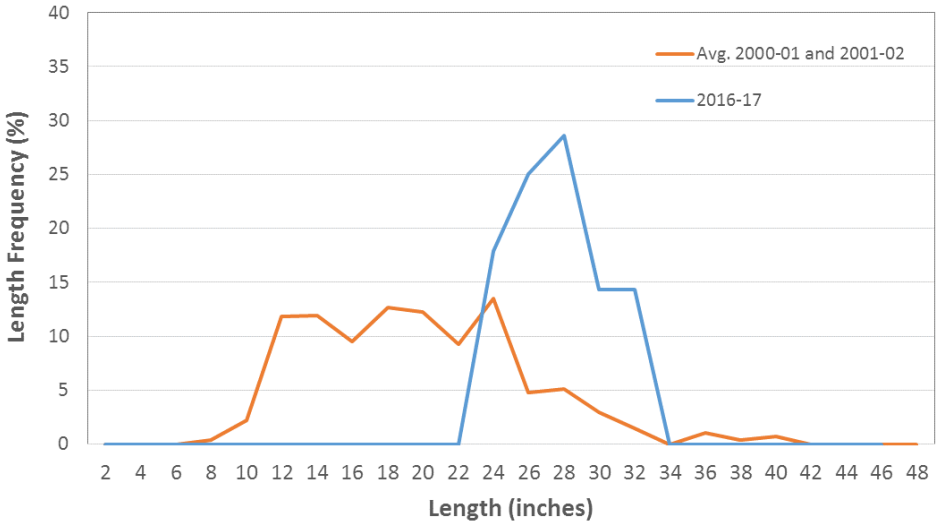

Figure 7. *Length-frequencies of Northern Pike caught during the ice fishing season at Mansfield Hollow Reservoir in 2016-17 compared to the average of ice seasons 2000-01 and 2001-02 before fingerling stocking was suspended.*

During the 2016-17 ice angler survey at MHR, angler opinion regarding the pike program remained high with 80% "In Favor" or "Highly in Favor" (1993-2015 average = 81%). Only 5% of the anglers interviewed were either "Opposed" or "Highly Opposed" (1993-2015 average = 10%). Fifteen percent of anglers said they had "No Opinion" (1993-2015 average = 9%).

Two questions were asked during the 2016-17 ice angler survey to determine angler attitudes toward harvesting pike: "How often are you likely to keep pike that you catch in this lake?" and for those who never keep pike, "Why wouldn't you keep pike?". The majority of respondents (70%) stated they "Never" kept pike. Of the remaining anglers, 12% stated they "Rarely (<10% of the time)" kept pike, 9% said "Occasionally (10-50% of the time)", 6% stated "Most of the time (>50% of the time)", and 3% stated they "Always" kept pike. Of the 55 anglers who said they rarely or never keep pike, 84% said they are catch-and-release anglers. Other less common responses were they did not like the taste (7%), the fish were too bony (5%), and they only keep trophy size fish (4%).

Discussion

Reliable production of pike fingerlings at FD managed marshes remains elusive, likely due to factors outside of staff control. This fact continues to prevent us from stocking PMLs with adequate and consistent numbers of fingerlings as had been done historically. In Connecticut, natural reproduction of pike, though present in many of the PMLs, appears inadequate to maintain long-term fishable populations (McDowell et al. 2013). Therefore, successful management hinges on the ability to consistently stock PMLs with juveniles. Alternative methods of production and sources of juvenile pike require further investigation.

The resumption of stocking pike fingerlings into MHR appears to have improved the fishery based on the increase in pike directed catch effort during the 2016-17 ice season compared to previous (2012-15) surveys. Population estimates using trap net and electrofishing, however; do not indicate an increase in numbers of adult pike between 2013 and 2016. Additionally, the number of the Zetts yearlings in the trap net catches was unexpectedly low compared to results of yearling stocking in Lake Lillinonah (McDowell et al. 2013). It is unclear whether mortality and/or emigration rates are relatively higher at MHR. MHR is a flood control impoundment and fish can easily escape through the dam. Despite these uncertainties, most anglers were in favor of the pike program at MHR such that continued stocking and monitoring of pike are warranted.

32-inch Northern Pike caught by Mike Kelley while ice fishing at Mansfield Hollow Reservoir 2017.

We anticipated that fry stocking in two of our easily controlled spawning marshes would result in better fingerling production than the standard method of stocking spawning adults because some of the early season variables that are typically out of our control can be mitigated (e.g., freezing temperatures, fertilization success and egg-to-fry survival). There was a slight cost-benefit to fry stocking; however, our sample size was very small (n = 2 for each marsh/treatment combination) so results should be interpreted with caution. Another issue that "muddies" interpretation is that the stocking density of broodstock females/acre differed between marshes, meaning there were likely more eggs/acre produced in the smaller marsh (Wyantenock #4) than the larger one (Wyantenock #3). This disparity in broodstock stocking rates occurred because of a miscalculation and miscommunication among staff. Although some variables were eliminated by fry stocking, uncontrollable environmental variables still likely play a substantial role in fry survival using either production method. Results of our hatchery rearing experiment conducted at the Burlington Fish Hatchery may shed some light on procedures which could help increase production in our marshes (e.g., fertilization, feeding, etc.) in the future.

Results of the experimental pike culture at Punch Brook Pond #6 were encouraging because we were successful in raising both small and advanced fingerlings in one of our culture ponds, which is a first for a Connecticut State hatchery. This experiment was initiated not only to assess whether pike could be raised within our hatchery system, but also to determine whether it was cost effective compared to our spawning marshes. Based on the results from this experiment, the cost of producing a 3-4-inch fingerling pike is considerably less than that for our managed spawning marshes ($2.68 vs. $4.44 respectively).

In our hatchery ponds, cost per fingerling could be reduced if survival of stocked fry could be improved. While the same argument could be made for our managed marshes, the hatchery pond is a more controlled environment, thus enhancing survival should be more attainable. One factor which may have accounted for the poor fry-to-small-fingerling survival was a lack of zooplankton forage in the pond during the first week of stocking. Zooplankton (Copepods and Cladocerans) did not become abundant until 10 days after fry stocking. Although the pond was fertilized with alfalfa meal six days prior to fry stocking, this period was rainy with persistent

cloud cover likely causing poor zooplankton production. Thus we conclude that mortality of newly-stocked fry may have been high due to lack of food during their first week in the pond.

The reason for poor survival (6%) from small to advanced fingerling is uncertain. Ample forage existed in the pond (live Golden Shiners and Fathead Minnows), but perhaps forage size was not appropriate. The Golden Shiners were smaller than the Fatheads. When the larger Fatheads were stocked we observed that fingerling pike fed heavily on them, but they did not appear to feed on the smaller Golden Shiner. Regrettably, the availability of size-appropriate forage is dependent on our vendor who is located in Arkansas. Because they are well ahead of us in growing season, we could only get what is available.

It is also possible that high cannibalism and/or predation affected fingerling survival. This set of ponds is known for their chronically high predation rates (especially by Great Blue Heron, Mink and Otter) when used to grow trout. Perhaps the pike also became an attractive meal once they began to grow larger.

Recommendations

- Evaluate fingerling production within our hatchery system for a second year and increase the number of ponds used from one to two. Allow the fingerlings to grow to 4-5 inches before being harvested and stocked into PMLs (probably early to mid-June).
- Research availability and cost of pike fingerlings and yearlings from out-of-state sources.
- Stock a suitable PML (other than MHR) or new lake to continue assessing the performance of yearling pike if Zett's Fish Farm has enough yearlings available in 2017.
- Continue to stock fingerlings and/or yearlings at MHR. Monitor periodically using angler surveys and trap nets as resources permit to determine if the pike fishery can be rebuilt.

Expenditures

Total Cost:	79,977
Federal Share:	59,983
State Share:	19,994

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Appendix

Appendix 1. Northern Pike fingerling production from the FD managed marshes and Punch Brook Pond #6 at Burlington State Fish Hatchery, 1987 to present. Each year's production was stocked into the PMLs and the Connecticut River. Note: Punch Brook Pond #6 initially produced 1,845 small (~2.8 inches) fingerlings in 2016. These were stocked back into the pond, whereupon in September the pond was drained again and the 118 advanced (~10 inches) fingerlings that were produced were stocked into a PML.