

Recreational Darkhouse Spearing for Northern Pike in Minnesota: Historical Changes in Effort and Harvest and Comparisons with Angling

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Abstract.—A traditional form of harvest for northern pike *Esox lucius* during winter is darkhouse spearing through the ice. Using a comprehensive evaluation of creel surveys and license sales in Minnesota, we document a long-term decline in this unique sport fishery. The decline in recreational spear fishing effort cannot be blamed on catch rates because spearing catch rates have not changed perceptibly with time. Catch rates for spearing (mean = 0.175 fish/h) are similar to harvest rates by anglers that are targeting northern pike. Conflicts between spearers and anglers have led to questions about relative harvests by each group and their effects on northern pike populations. Creel survey data since 1980 show that summer and winter angling account for most of the northern pike harvest. Spearing accounted for 15% of the average yield of northern pike by number, but spearing is selective for the larger fish. In comparison with population estimates, spearing removes a small proportion of the total population and biomass of northern pike but an increasing proportion of fish with increasing size. Recreational angling, by comparison, removes an even greater proportion of all fish sizes in a population. Management designed to improve the size structure of northern pike populations will need to be directed at reducing harvest by all methods.

A traditional form of northern pike *Esox lucius* harvest during Minnesota winters is darkhouse spearing through the ice. A large hole is cut in the ice, and live bait or artificial decoys are suspended in the water to attract fish within spearing distance. Low light levels in a darkhouse allow the spearer to see down into the water column. Minnesota creel limits for spearing and angling are identical (3 fish/day with only one greater than 30 in long allowed), but the darkhouse spearing season is restricted to the first of December through mid-February. Recreational angling for northern pike is allowed year-round except for mid-February

through mid-May. Minnesota is not unique in allowing winter spear fishing for northern pike; Alaska, Michigan, Montana, South Dakota, and Wisconsin offer at least limited winter spearing seasons, although no other state has experienced the amount of effort expended by spearers in Minnesota (Leitch 1992).

The legacy of spearing in Minnesota is long and laced with controversy. Various groups have charged that spearing is incompatible with other uses of the fisheries resources. Meanwhile, darkhouse spearers have fought efforts to curtail their sport with organized political efforts (Pierce 1998). The origins of northern pike spearing in Minnesota can undoubtedly be traced back to American Indian winter fishing techniques, and the tendency of early lawmakers and fishermen to classify northern pike as rough fish. In contrast to some other game fish species, harvests of northern pike were largely unregulated in the late 1800s and early 1900s. After 1919, bag limits and closed seasons were established that progressively became more restrictive. Spearing reached the height of its popularity in the 1950s, and spearing licenses were first issued in 1955.

Conflicts between spearers and anglers, particularly about harvests of large northern pike, have led to questions about relative harvests by each group and their effects on northern pike populations (Latta 1972). Management of esocid fisheries in Minnesota is intended to accommodate both types of harvest. The purposes of this paper are to document historical changes in spearing effort and harvest, to compare spearing and angling harvests, and to estimate the relative effects of spearing and angling on northern pike populations.

Methods

License sales (Cook et al. 1997) were used to contrast numbers of people participating in spear-

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TABLE 1.—Estimated population density of northern pike for three length-classes in 11 northcentral Minnesota lakes.

Lake	Surface acres	Fish length			
		>13.8 in		>19.7 in (fish/acre)	>23.6 in (fish/acre)
		Fish/acre	Lb/acre		
Coon-Sandwick	627	13.1	14.8	1.4	0.5
Forest	38	3.7	12.0	2.6	1.4
Lake-of-Isles	67	14.4	16.2	1.6	0
Medicine	446	14.8	26.4	5.3	
Nord	411	9.6	10.6		
North Twin	315	5.6	12.3	2.9	
Sand	118	10.7	14.6	2.3	0.6
Sissabagamah	365	9.9	12.2	1.6	0.2
Six Mile	1,288	3.5	6.7	1.5	0.4
Wilkins	372	4.8	7.6	1.9	0.6
Willow	238	1.3	3.3	0.9	0.3

ing, angling, and ice fishing in Minnesota. Separate licenses are required for spearing, angling (summer and winter), and for placing portable or permanent houses (shanties) on the ice. Trends in spearing license sales were evaluated by linear regression of numbers of licenses sold during 1955–1996.

Analyses of spear fishing and angling catches of northern pike were drawn from a comprehensive evaluation of creel surveys in Minnesota that was recently described in detail by Cook and Younk (1998). They compiled a database consisting of all available creel survey information from Minnesota lakes during 1935–1996. The database included recreational fishing estimates from 924 lakes surveyed across 2,167 fishing seasons. Although the Minnesota Department of Natural Resources has completed a large number of creel surveys, far fewer creel surveys have been conducted in winter than summer, and few lakes have had both winter and summer creels conducted in the same year. Therefore, comparisons of summer angling estimates with winter estimates (either spearing or angling) do not have comparable sample sizes or numbers of lakes. In the case of lakes with more than one survey, each survey was treated as an independent sample because catches were often highly variable from year to year and fisheries management activities have also varied through time (Cook and Younk 1998).

An intensive series of creel surveys that were conducted in the 1950s provide a useful benchmark for measuring changes that have occurred in darkhouse spear fishing. Therefore, we compared creel statistics for the periods 1949–1959 and 1980–1996 to evaluate changes that have occurred in spear fishing. The analysis was restricted to

lakes less than 60,000 acres in size to exclude very large lakes managed for walleyes *Stizostedion vitreum*, such as Leech, Mille Lacs, and Lake of the Woods.

To compare recent spear fishing with recent angling activity in Minnesota, harvest and catch rate statistics were derived using only surveys conducted during 1980–1996. Population size and biomass estimates for northern pike were obtained during 1993–1998 in 11 northcentral Minnesota lakes using methods validated by Pierce (1997). Fish were trapped and tagged during early spring, then recaptured during the next few weeks after trapping by using randomly placed multimesh gill nets. Petersen population estimates were calculated for as many subset length-classes as possible, then summed to obtain an overall estimate for each lake. Confidence intervals for some of the length-class estimates are provided in Pierce (1997). The 11 lakes ranged in size from 38 to 1,288 acres (Table 1). We assumed that an average of population estimates in these lakes was representative for northern pike populations in small to moderate-sized Minnesota lakes. The proportion of the population harvested by spearers was calculated by dividing average yields since 1980 by average population and biomass estimates from the 11 lakes.

Results and Discussion

License and Creel Statistics

In contrast to increases observed in sales of angling and ice house licenses, darkhouse spearing license sales have progressively decreased from 64,835 licenses sold during 1955 to 15,729 licenses sold in 1996 (Figure 1). A regression equa-

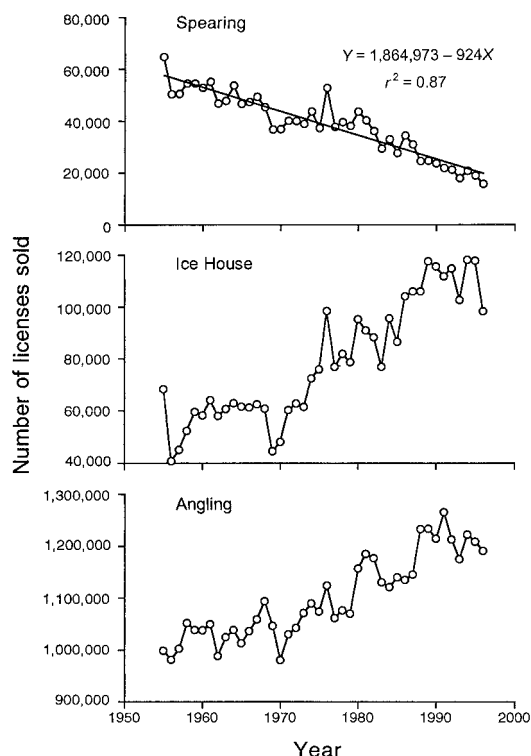


FIGURE 1.—Numbers of darkhouse spearing, ice house, and angling licenses sold in Minnesota, 1955–1996.

tion fit to the trend in license sales for 1955–1996 indicated an average decline of 924 licenses sold per year ($r^2 = 0.87$; number of licenses sold = $1,864,973 - 924 \times \text{year}$). Meanwhile, ice house license sales have more than doubled from an average of 50,526/year during 1949–1959 to an average of 102,801/year during 1980–1996. Therefore, interest in ice fishing has increased at the same time as the number of spearers has declined.

Trends in spearing effort measured by creel surveys followed the declining trend in spearing license sales. Spearing license sales averaged 54,961/year during 1955–1959 and 27,328/year during 1980–1996, a reduction of 50%. Darkhouse spearers averaged 2.3 h/acre (SE = 0.2; $N = 130$ surveys) of effort during 1949–1959 but only 1.1 h/acre (SE = 0.1; $N = 97$) during 1980–1996. Spearing catch rates, on the other hand, have not changed perceptibly between the two time periods. During 1949–1959 spearers harvested an average of 0.17 fish/h (SE = 0.01; $N = 96$ surveys) whereas during 1980–1996 they took an average of 0.19 fish/h (SE = 0.02; $N = 62$).

Because spearing effort since 1980 has been

lower than effort during the 1950s, recent spearing yields are also significantly lower than in the 1950s. During 1949–1959, the average yield of northern pike from spearing was 0.46 fish/acre (SE = 0.05; $N = 92$ surveys) and 1.34 lb/acre (SE = 0.13; $N = 96$). Since 1980, spearers harvested an average of 0.27 fish/acre (SE = 0.04; $N = 70$) and 0.97 lb/acre (SE = 0.17; $N = 50$). Therefore, the yield in weight harvested has not changed as much as the yield in number.

Spearing harvests have clearly accounted for fewer fish than recreational angling during recent years. Average northern pike yields from all methods (1980–1996) were 1.77 fish/acre and 4.47 lb/acre. Darkhouse spearing accounted for 15% of the northern pike yield in number (0.27 fish/acre; SE = 0.04; $N = 70$ surveys) and 22% of the yield in weight (0.97 lb/acre; SE = 0.17; $N = 50$). Angling accounted for the majority of the yield (78%; 3.50 lb/acre) with summer angling averaging 2.33 lb/acre (SE = 0.20; $N = 213$) and winter angling taking 1.17 lb/acre (SE = 0.18; $N = 71$).

Long-term harvest rate averages (number of fish kept per angler-hour) indicate that anglers that are targeting northern pike are at least as efficient as spearers. The creel surveys show that spearers harvested northern pike at an average rate of 0.175 fish/angler-h (SE = 0.008; $N = 180$ surveys), whereas anglers targeting northern pike had a summer harvest rate of 0.185 (SE = 0.002; $N = 117$) and a winter harvest rate of 0.193 (SE = 0.003; $N = 28$) northern pike per angler-h. Angling harvest rates are much lower when all anglers are considered (including those not targeting northern pike), averaging 0.045 fish/angler-h (SE = 0.002; $N = 446$) during summer and 0.055 fish/angler-h (SE = 0.007; $N = 167$) during winter. Angling harvest rates, however, do not include released fish, and catch-and-release fishing can be an important component of recreational northern pike fisheries (Pierce et al. 1995). Most released northern pike tend to be the smaller sizes and there is a tendency for the percentage harvested to increase with increasing northern pike size (Pierce et al. 1995; Cook and Younk 1998).

Johnson et al. (1957), Schupp (1981), and Diedrich (1992) have previously described how spearers take larger fish than anglers. In an individual lake, this was illustrated during a 3-year period in which both summer and winter creel surveys were obtained. The average weight of northern pike speared in Ball Club Lake, a 3,936 acre Minnesota lake, was consistently greater during the 3-year period than the average weight caught by anglers

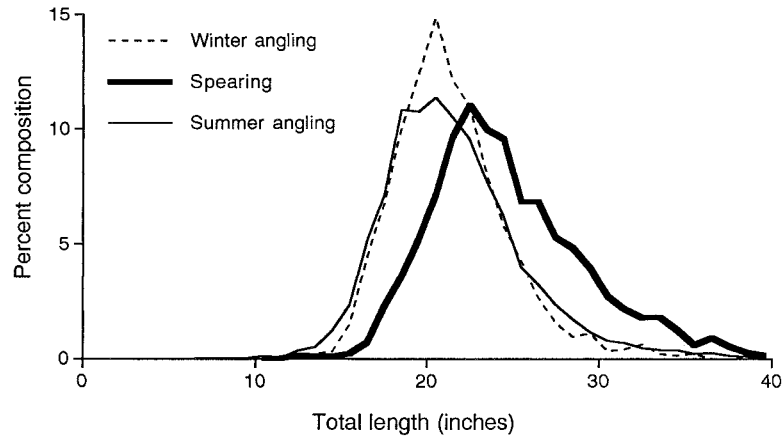


FIGURE 2.—Percent composition by length of northern pike harvested by spearing and by summer and winter angling in Minnesota lakes as determined from creel surveys (spearing, $N = 3,492$ fish from 40 surveys in 33 lakes; winter angling, $N = 1,455$ fish from 36 surveys in 31 lakes; summer angling, $N = 18,262$ fish from 193 surveys in 111 lakes).

(Johnson and Peterson 1955). In our study, length-frequencies from the creel survey database confirm that the spearing harvest contains a greater proportion of larger-sized fish than summer and winter angling harvests (Figure 2). Age frequencies illustrate that spearing harvests peak for age-3 northern pike (Figure 3). Fish aged 2–5 years composed more than 84% of the harvest in the nine surveys in which ages of speared pike were determined.

Relative Effects of Spearing and Angling on Population Numbers

The impact of spearing on northern pike populations can be evaluated, in part, by comparing

average spearing yields with recent population estimates for northern pike. Population estimates for northern pike longer than 13.8 in averaged 8.3 fish/acre (range of 1.3–14.8 fish/acre; Table 1). Biomass estimates averaged 12.4 lb/acre (range of 3.3–26.4 lb/acre). If we can correctly assume that these estimates are representative for northern pike populations, then spearing harvests are typically about 3% of the number and 8% of the biomass of northern pike in a lake.

The effect of spearing on population numbers becomes increasingly important with fish size. Because 87% of the spearing harvest is fish larger than 20 in and 50% of the spearing harvest is larger than 24 in, a more relevant number is the propor-

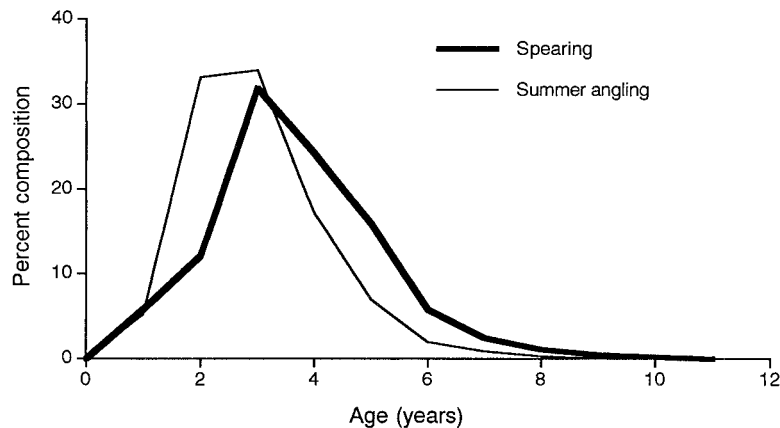


FIGURE 3.—Percent composition by age of northern pike harvested by darkhouse spearing ($N = 1,246$ fish from 9 creel surveys in 5 lakes) and summer angling ($N = 4,927$ fish from 71 creel surveys in 27 lakes). Similar data were not available for winter angling.

tion of large fish that are harvested. Population estimates averaged 2.2 fish/acre for fish larger than 20 in (10 of the lakes listed in Table 1) and 0.5 fish/acre for northern pike larger than 23.6 in (eight lakes listed in Table 1). Spearing harvests, then, were estimated to be roughly 11% of the number of northern pike larger than 20 in and 27% of the fish 24 in and longer. A caveat attached to these percentages is that they are only averages and spearing effort and northern pike densities can vary widely among individual lakes. Nonetheless, these results illustrate that few larger-sized northern pike are typically in a population and that spearing harvests a relatively large proportion of them.

Summer angling, when compared with spearing, harvests even more of the larger-sized northern pike. Summer anglers were estimated to take 30% the average population estimate of fish greater than 20 in and 47% of the average population estimate of fish greater than 24 in. A limitation for this analysis was the low number of lakes with adequate population estimates for large northern pike. The exploitation rates we estimated would be biased high if the lakes with population estimates had low northern pike densities compared with lakes where creel surveys have been conducted. Pierce et al. (1995) reported exploitation rates from tagging studies of northern pike that were lower than those calculated here. Yet, even if the average population estimate is low by 25%, it is still evident that large (>24 in) northern pike are heavily exploited and that both angling and spearing are culpable.

Management Implications

This work documents the decline of a unique sport fishery for northern pike. As evidenced from license sales, the heyday of spearing in Minnesota was in the 1950s. Since then, there has been a long and relatively consistent decline in darkhouse spearing for northern pike. Reductions in effort and harvests by darkhouse spearers have mirrored declines in license sales. The decline in recreational spear fishing activity cannot be blamed on catch rates because spearing catch rates have not changed. Rather, the tradition of spearing is not being adopted by current generations of sport fishers. Most spearers indicate that spearing is a tradition learned as a youngster from their fathers or grandfathers (Borge and Leitch 1988). Although numbers of spearers have been greatly reduced, the remaining core group of spearers is active and some members belong to the Minnesota Darkhouse

Association, an organization created to preserve their sport. In view of the comparatively low numbers of licensed spearers in recent years, and their devotion to their sport, it seems likely that the decline in spear fishing activity will slow and not continue at its previous rate.

Spearing is selective for the largest northern pike in a population. It removes (on average) a small proportion of the total population and biomass of northern pike but an increasing proportion of fish with increasing size. Recreational angling, by comparison, removes an even greater proportion of the larger-sized fish in a population. In recent years, greater emphasis has been placed on managing recreational fisheries for larger-sized northern pike. Our estimates of the effects of both angling and spearing indicate alarmingly high fishing mortality for large northern pike. Additionally, conflicts between groups have led to the contention that both anglers and spearers should follow the same set of harvest regulations. Therefore, management actions designed to improve the size structure of northern pike populations will need to be directed at all methods of harvest.

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References

- Borge, L. J., and J. A. Leitch. 1988. Winter darkhouse spearing in Minnesota: characteristics of participants. North Dakota State University, Tri-College University Center for Environmental Studies, Miscellaneous Publication 2, Fargo.
- Cook, M. F., and J. A. Younk. 1998. A historical examination of creel surveys from Minnesota's lakes and streams. Minnesota Department of Natural Resources Section of Fisheries Investigational Report 464.
- Cook, M. F., J. A. Younk, and D. H. Schupp. 1997. An indexed bibliography of creel surveys, fishing licenses sales, and recreational surface use of lakes and rivers in Minnesota. Minnesota Department of Natural Resources Section of Fisheries Investigational Report 455.
- Diedrich, P. 1992. An analysis of the winter northern pike fisheries of 10 south central Minnesota lakes. Minnesota Department of Natural Resources, Section of Fisheries, Study Completion Report F-29-R(P)-11, St. Paul.
- Johnson, F. H., and A. R. Peterson. 1955. Comparative harvest of northern pike by summer angling and winter darkhouse spearing from Ball Club Lake,

- Itasca County, Minnesota. Minnesota Department of Conservation Bureau of Fisheries Investigational Report 164.
- Johnson, M. W., W. J. Scidmore, J. H. Kuehn, and C. R. Burrows. 1957. Status of the northern pike fishery in Minnesota. Minnesota Department of Conservation, Bureau of Research and Planning, Investigational Report 178, St. Paul.
- Latta, W. C. 1972. To spear or not to spear—the northern pike in Michigan: a simulation of regulations for fishing. *Michigan Academician* 5:153–170.
- Leitch, J. A. 1992. Darkhouse spearfishing across North America. North Dakota State University, Tri-College University Center for Environmental Studies, Fargo.
- Pierce, R. B. 1997. Variable catchability and bias in population estimates for northern pike. *Transactions of the American Fisheries Society* 126:658–664.
- Pierce, R. B. 1998. Northern pike spearing—a staff update. Minnesota Department of Natural Resources, Section of Fisheries, Staff Report 55, St. Paul.
- Pierce, R. B., C. M. Tomcko, and D. H. Schupp. 1995. Exploitation of northern pike in seven small north-central Minnesota lakes. *North American Journal of Fisheries Management* 15:601–609.
- Schupp, D. H. 1981. A review of the status of northern pike in Minnesota. Minnesota Department of Natural Resources, Section of Fisheries, Staff Report, St. Paul.