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FISHERIES DIVISION

TECHNICAL REPORT

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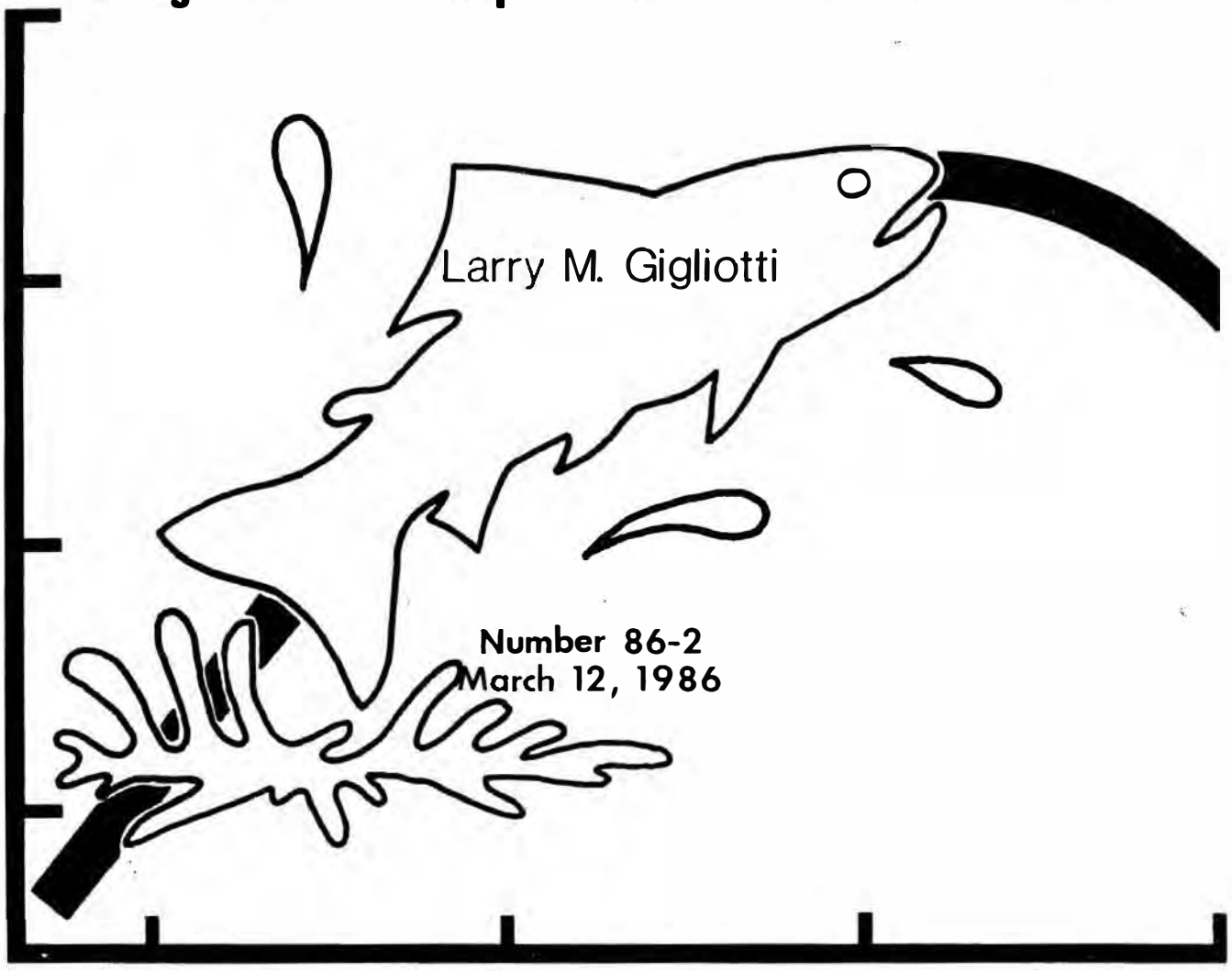

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ILLEGAL HARVEST: IMPACT ON RECREATIONAL FISHERIES

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ABSTRACT

The degree of compliance with a fishing regulation can have a significant impact on its effectiveness. This paper considers the impact that certain illegal harvest has on sport fisheries.

Two types of illegal harvest were considered: (1) harvest of fish below the size limit in a fishery regulated by a typical minimum size limit and (2) harvest of fish of all sizes in a fishery under catch-and-release regulations. The results show that illegal harvest can significantly reduce the legal harvest in fisheries with minimum size limits. In catch-and-release fisheries, illegal harvest reduces the numbers of fish legally caught and released. Most of the benefits of a catch-and-release regulation, in terms of increased numbers and sizes of fish, are lost when 20% of the legal-sized fish caught are illegally harvested.

INTRODUCTION

The primary goal of sport fisheries management is to provide opportunities for quality recreational fishing while preventing unacceptable resource damage (Driver and Cooksey 1977). Regulations are a major tool for accomplishing this goal, e.g., creel limits, size limits, and restrictions on gear, etc. Catch-and-release regulations have been one tool used by fishery managers to provide quality angling with the logic that fish will be available to be caught several times and will reach larger sizes since they are allowed to live longer.

Illegal harvest or noncompliance with regulations is one factor that may block the goal of providing quality recreational experiences. Many fisheries managers feel that compliance with regulations is an important issue for which they do not have sufficient information. Yet, the degree of compliance with a regulation could be consequential to its effectiveness, and this is particularly so with a minimum length limit (Paragamian 1984).

Compliance issues must become an important component of fisheries management plans in both setting of regulations and the evaluation of management objectives. This will require that managers have an understanding of the impact that noncompliance with various regulations can have on the recreational fisheries. For example, enforcement efforts can be directed to areas where noncompliance is having the greatest impact or preventing managers from reaching a management objective. After all, decreasing the illegal harvest represents a valid way to improve the legal harvest.

The purpose of this paper is to show what impact illegal harvest can have on a fishery. First, the impact that keeping sublegal sized sport fish can have on a normal fishery (sport fishery that has size limits) will be explored. Second, a catch-and-release fishery will be explored where any fish kept is considered illegal harvest.

METHODS

The model used in this paper was developed by Richard D. Clark, Jr., of the Michigan Department of Natural Resources. The model is described in detail in Clark (1983). Clark modified the classical yield-per-recruit model developed by Beverton and Holt (1957) to incorporate the important elements of catch and release. Since some fish die after being caught and released the total mortality rate (Z) was partitioned into three components: natural (M), fishing (F), and hooking (H) mortality rates. Another parameter (p), representing the probability a legal fish was released when captured, was used to modify the levels of fishing and hooking mortality. The model allows the identification of legal, sublegal, and trophy fish. The calculations in Clark's model are made on a per-recruit basis, so the model requires the usual assumptions of a typical yield-per-recruit model which are as follows (Clark 1983):

1. The fish population is at equilibrium with its environment.
2. Natural mortality and growth are constant and not affected by fishing.
3. Mortality and growth occur continuously and simultaneously.

Also, this model assumes that the instantaneous catch rate and the probability a fish will die after catch and release are constant for all fish older than Xr (age at first vulnerability to fishing gear).

The same four Michigan sport fisheries used by Clark in his analysis were used in this paper so that the results would be comparable. These four fisheries had contrasting mortality and growth rates (Clark 1983):

a) A brook trout (Salvelinus fontinalis) fishery from Hunt Creek, a small stream (McFadden et al. 1967);
b) a large bass (Micropterus salmonids) fishery from Kent Lake, a 400-ha reservoir (Goudy 1981);
c) a brown trout (Salmo trutta) fishery from the Au Sable River, a 30-m-wide river (Clark et al. 1980); and
d) a northern pike (Esox lucius) fishery for a typical lake (Latta 1972).

The references listed were used to obtain rates of growth, mortality, and fishing for each fishery. The data for these four fisheries used in the model can be found in Clark (1983).

RESULTS

Two types of regulations were picked for each of the four species. A normal fishery is where all fish below a certain minimum size limit (brook trout, 178 mm; brown trout, 203 mm; largemouth bass, 305 mm; northern pike, 508 mm) are illegal for harvest and catch-and-release fishery is where any size fish is considered illegal for harvest. For each of these cases I varied the rate of illegal fishing to determine its effect on the legal harvest. Results of the analysis were based on 1,000 recruits starting at age of first vulnerability to fishing gear (Clark 1983).

The normal fishery.—The effect of varying the percentage of illegal fish harvested on the total legal harvest is shown in Table 1. These results show that illegal harvest of sublegal-sized fish can very quickly have a significant impact on some fisheries. The brook trout, brown trout, and northern pike fisheries show a strong decrease in legal harvest as the percent of illegal harvest increases. For example, at 30% illegal harvest the legal harvest was reduced by 32% for brook trout, 22% for brown trout, and 27% for northern pike. The impact on the largemouth bass fishery was not nearly as great, due largely to the relatively low catch rate used in the model ($Q = 0.22$). A 30% illegal harvest of largemouth bass reduced the legal harvest by only 7%.

The catch-and-release fishery.—In a catch-and-release fishery, illegal harvest is likely to be variable depending on the size of the fish, i.e., anglers may be more likely to keep the larger fish. Paragamian (1982) reported that many of the sublegal largemouth bass recorded in a creel survey were within 0.5 inches of the legal length. Therefore, this analysis considered two types of illegal harvest: (1) illegal harvest of legal-sized fish only, i.e., fish that would meet the minimum size limit in a normal fishery; and (2) illegal harvest of all catchable sizes.

The effect of varying the percentage of the illegal catch on the total number of fish caught and released was similar for each species (Figs. 1–4). In catch-and-release fisheries, illegal harvest (both types) can have a dramatic impact on the numbers of legal-sized fish caught-and-released by the public (lines A and D in Figs. 1–4). The impact on the total number of fish caught is much less because it includes the illegal catch. The difference between the total number of fish caught under 0% illegal harvest and the total number of fish caught under 100% illegal harvest represents the difference between a catch-and-release fishery and a normal fishery when the illegal harvest of sublegal fish is zero. In other words, it represents how many more fish can be caught when changing from a normal fishery to a catch-and-release fishery.

DISCUSSION

Clark (1983) has shown that releasing legal-sized fish can have a significant impact on the fishery by increasing the total numbers caught. And indeed, catch-and-release fishing has been one tool used by fishery managers to produce quality angling. However, this research shows that the benefits of a catch-and-release fishery are quickly reduced by illegal harvest. Thus, when catch-and-release management areas are established some type of plan should be included to ensure compliance with the regulations.

If it can be assumed that most of the illegal harvest is of fish over the legal minimum size, then most of the benefits of the catch-and-release regulation are lost if about 20% of the legal-sized fish caught are illegally harvested. With about 20% illegal harvest, the total numbers caught nearly equal what the legal harvest would be in a normal fishery. More specifically, the illegal harvest rate which reduced all benefits of catch and release to that of a normal fishery was about 22% for brook trout, 24% for brown trout, 26% for largemouth bass, and 28% for northern pike.

If on the other hand, the illegal harvest includes all catchable fish, then the impact on the catch-and-release fishery is even more significant. As an example, for northern pike, 28% illegal harvest of only legal-sized fish eliminates all benefits of the catch-and-release regulation, but if illegal harvest includes all catchable fish, then about 15% illegal harvest reduces all benefits of the catch-and-release regulation. Therefore, in addition to knowing the

amount of illegal harvest, managers need to estimate the nature of illegal harvest with respect to the size of fish removed.

Illegal harvest of sublegal-sized fish can also have a significant impact on a normal fishery. The extent of illegal harvest on a recreational fishery may very well be the fishery manager's greatest unknown. Yet, it could easily be the one factor blocking the manager's objectives of supplying quality angling. Attention needs to be directed towards this problem, since at present it represents a significant but difficult problem for managers. Too often, fishery managers have implemented their programs with little or no special consideration of the problem of illegal harvest.

Illegal harvest can be substantial in some areas. Gabelhouse (1980) found sublegal largemouth bass comprised from 0 to 90% of the harvest in seven Kansas reservoirs. The harvest of sublegal largemouth bass recorded in a creel survey at Big Creek Lake, Iowa, ranged from 28 to 39% of the total catch (Paragamian 1982).

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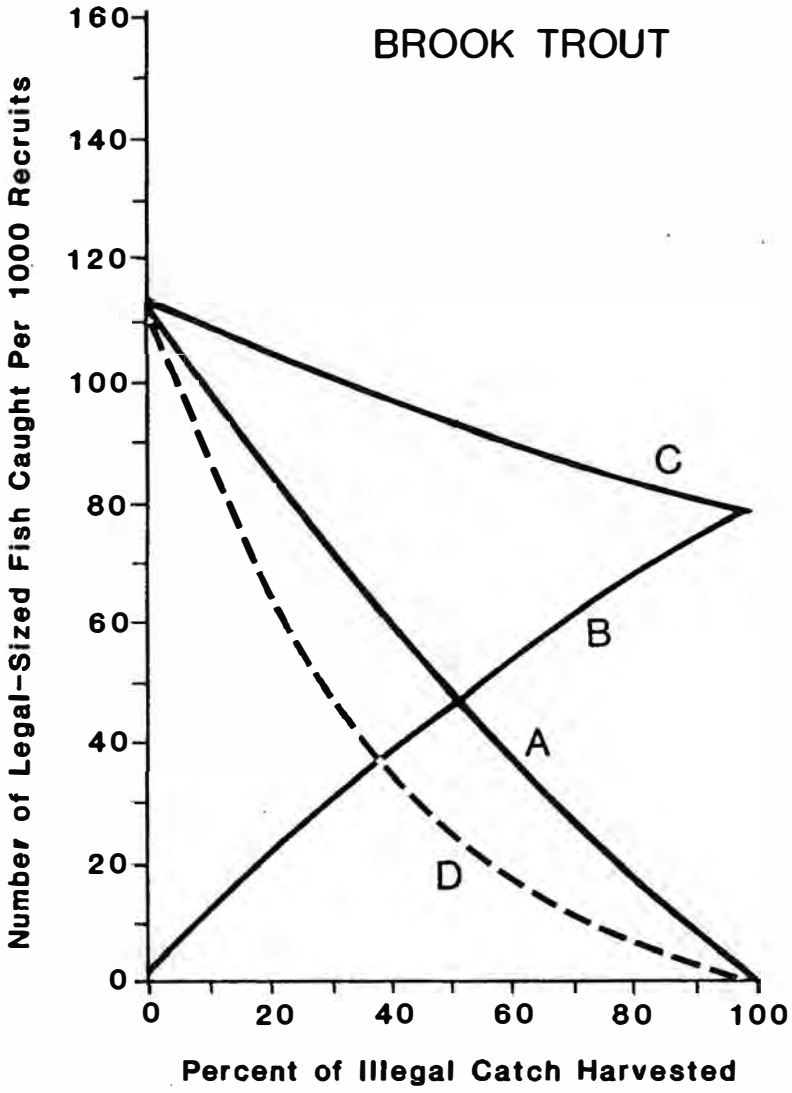

Figure 1. The effect of varying the percentage of legal-sized brook trout (178 mm+) illegally harvested from a catch-and-release fishery on the number of legal-sized brook trout (178 mm+) caught and released (A), the illegal harvest (B), and the total harvest (C). Line D represents the effect of varying the percentage of all sizes of fish illegally harvested from a catch-and-release brook trout fishery on the number of legal-sized fish caught and released.

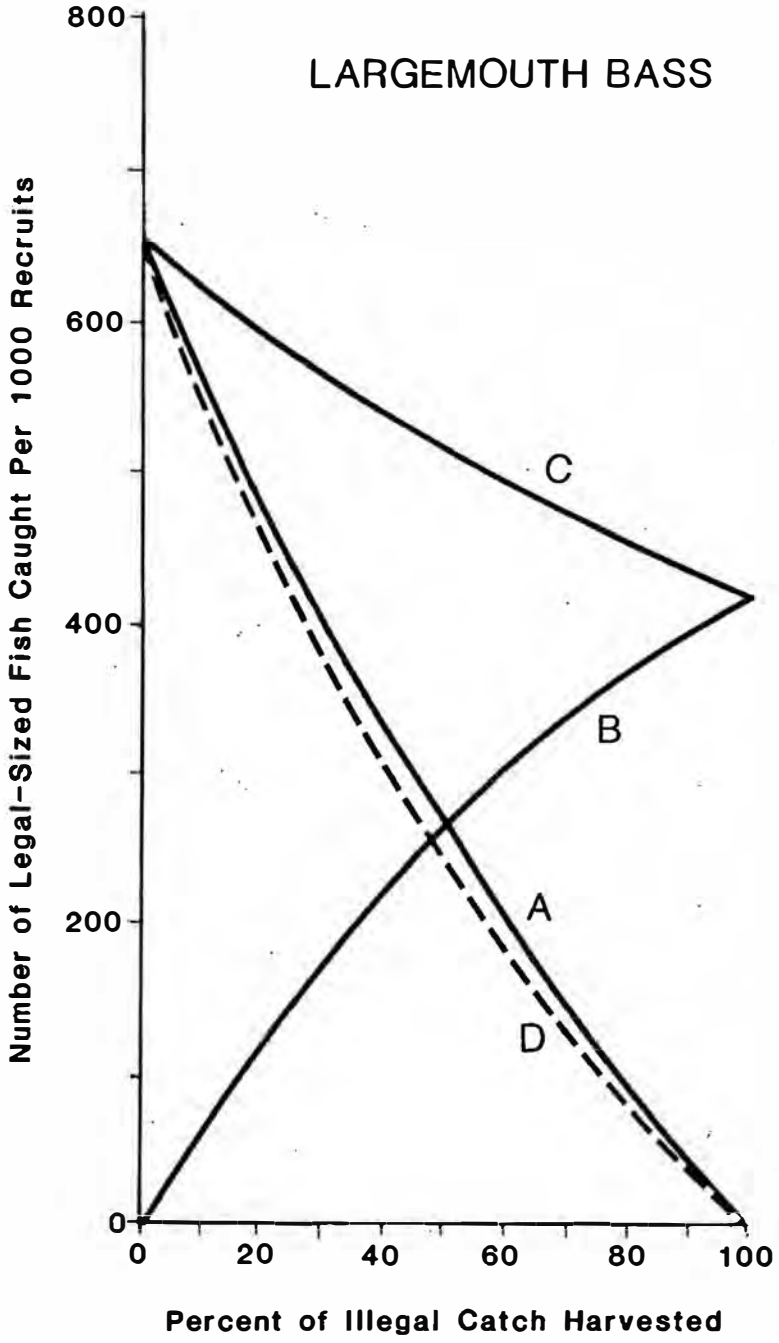

Figure 2. The effect of varying the percentage of legal-sized largemouth bass (305 mm+) illegally harvested from a catch-and-release fishery on the number of legal-sized largemouth bass (305 mm+) caught and released (A), the illegal harvest (B), and the total harvest (C). Line D represents the effect of varying the percentage of all sizes of fish illegally harvested from a catch-and-release largemouth bass fishery on the number of legal-sized fish caught and released.

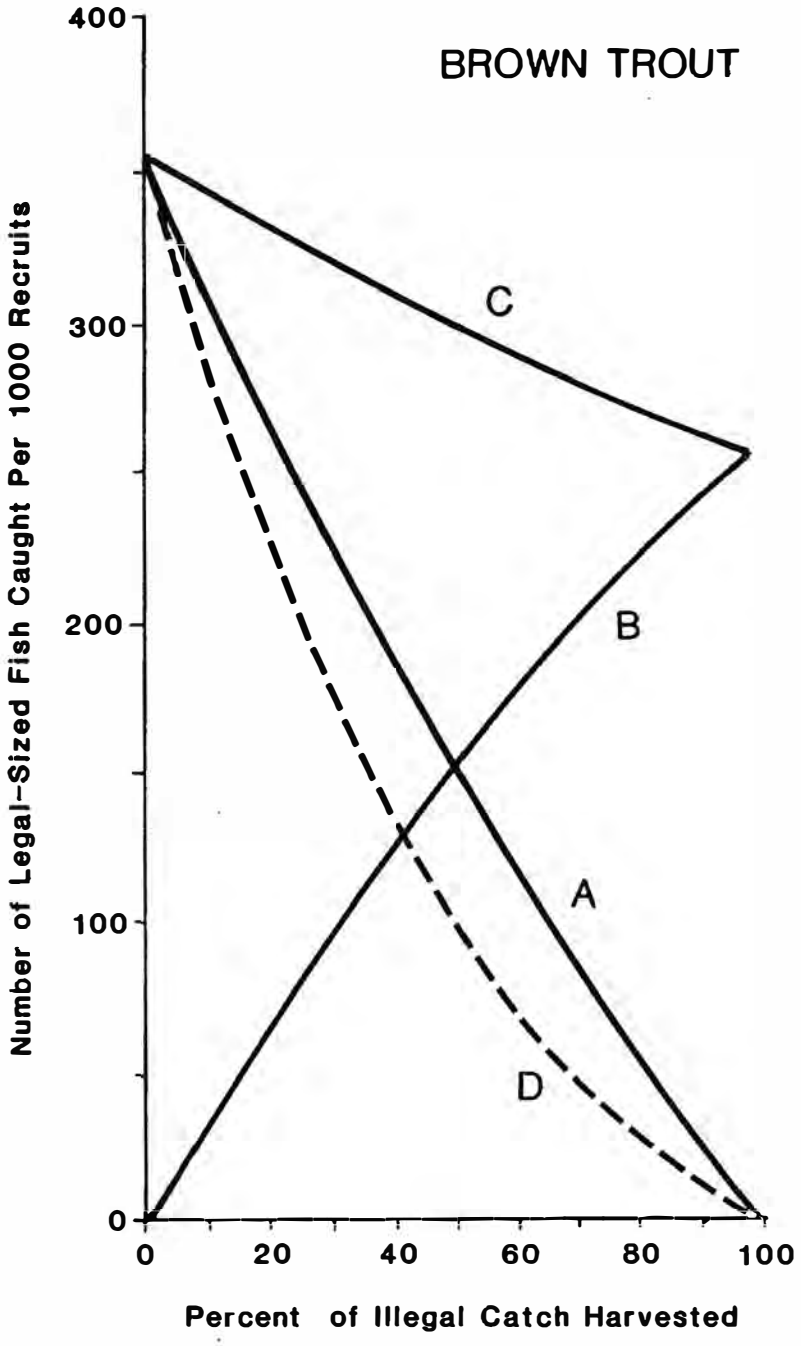

Figure 3. The effect of varying the percentage of legal-sized brown trout (203 mm+) illegally harvested from a catch-and-release fishery on the number of legal-sized brown trout (203 mm+) caught and released (A), the illegal harvest (B), and the total harvest (C). Line D represents the effect of varying the percentage of all sizes of fish illegally harvested from a catch-and-release brown trout fishery on the number of legal-sized fish caught and released.

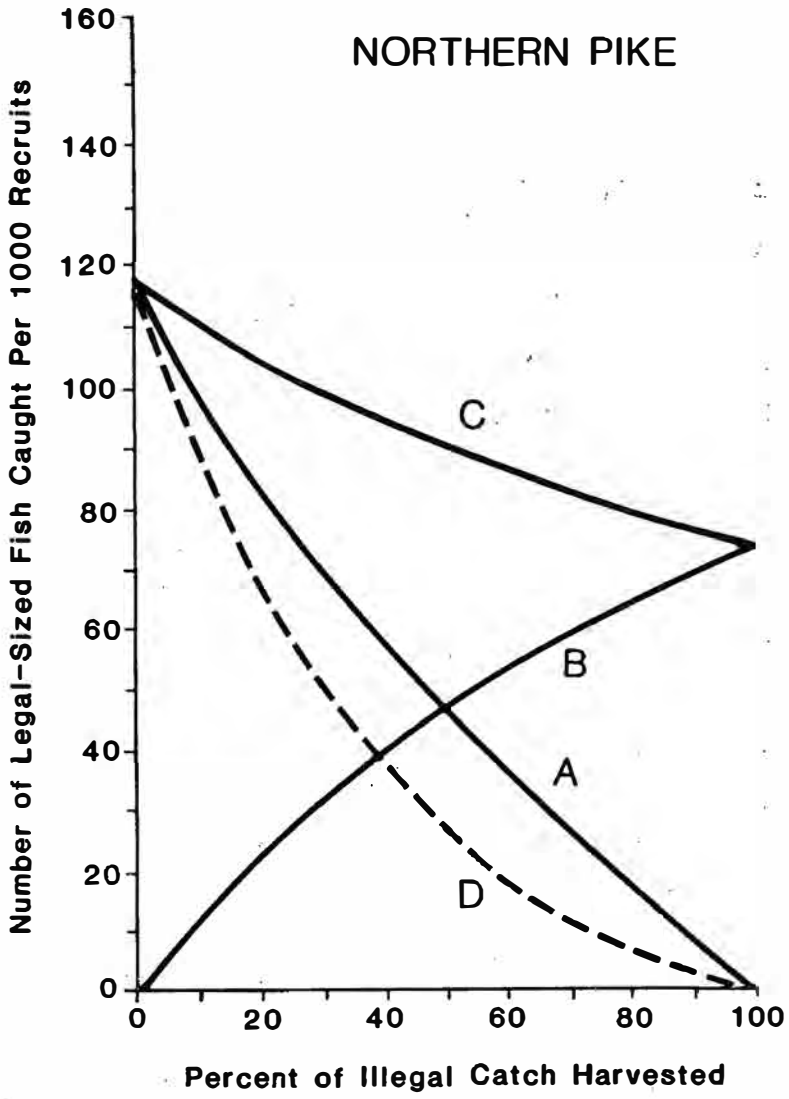

Figure 4. The effect of varying the percentage of legal-sized northern pike (508 mm+) illegally harvested from a catch-and-release fishery on the number of legal-sized northern pike (508 mm+) caught and released (A), the illegal harvest (B), and the total harvest (C). Line D represents the effect of varying the percentage of all sizes of fish illegally harvested from a catch-and-release northern pike fishery on the number of legal-sized fish caught and released.

Table 1. The effect of varying the percentage of sublegal fish illegally harvested on the number of legal fish harvested for brook trout, brown trout, largemouth bass, and northern pike.[1]

Percent illegal catch	Number of legal-sized fish caught per 1,000 recruits							
	Brook trout	Percent reduced	Brown trout	Percent reduced	Large-mouth bass	Percent reduced	Northern pike	Percent reduced
0	79	—	256	—	415	—	73	—
10	70	11	235	8	405	2	66	10
20	61	23	216	16	396	5	59	19
30	54	32	199	22	386	7	53	27
40	47	41	183	29	377	9	48	34
50	42	47	168	34	368	11	43	41
60	36	54	155	39	359	13	39	47
70	32	59	143	44	350	16	35	52
80	28	65	131	59	342	18	31	58
90	24	70	121	53	334	20	28	62
100	22	72	111	57	325	22	25	66

[1] Minimum size limits: brook trout, 178 mm; brown trout, 203 mm; largemouth bass, 305 mm; and northern pike, 508 mm.

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