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IMPACT OF UNDERWATER SPEARFISHING ON A MIXED WARMWATER FISH POPULATION

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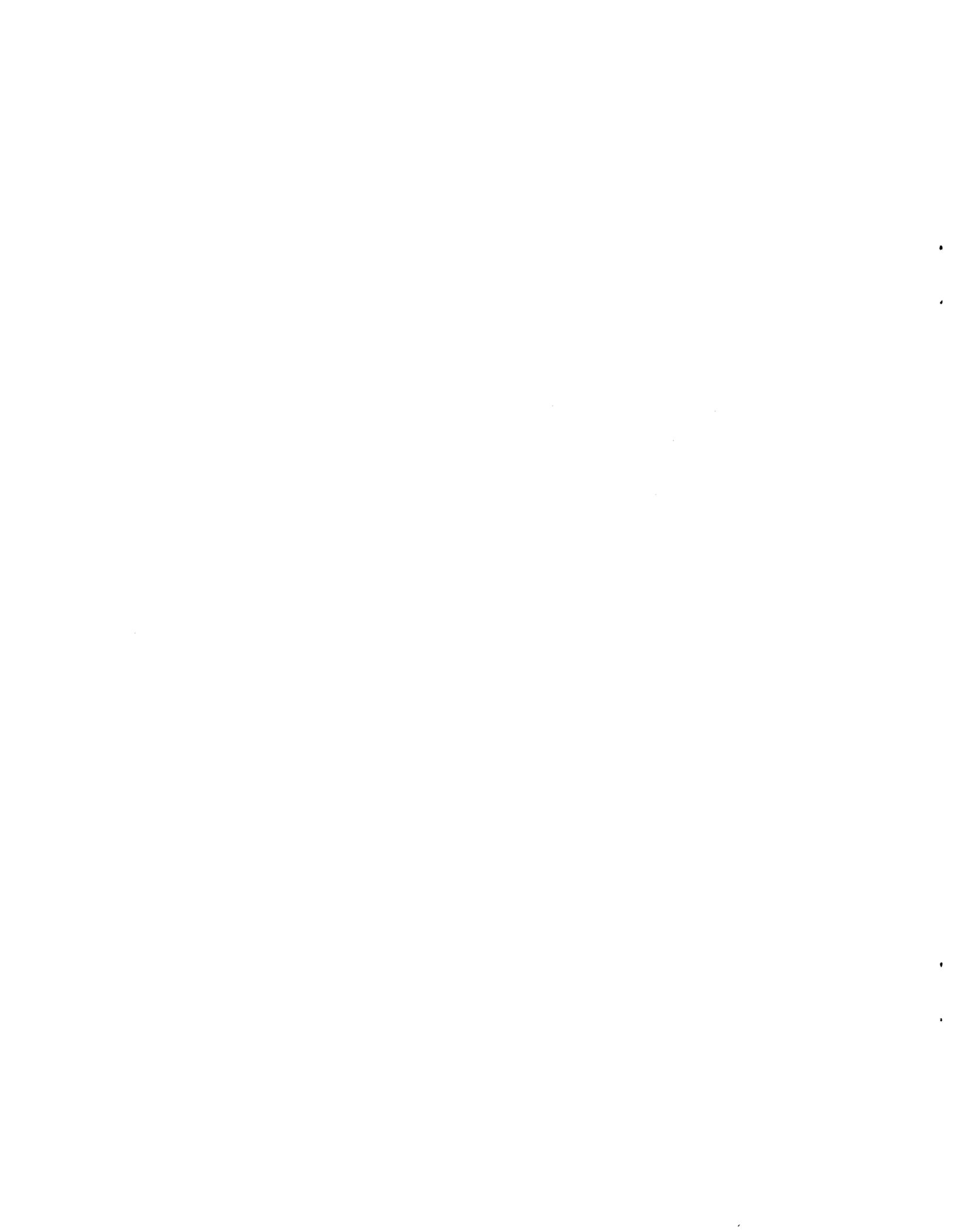
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INTRODUCTION

Skin diving and the use of spears to capture fish is a relatively new sport in Wisconsin. With greater use of skin diving apparatus, however, there is increasing interest in spearing in more lakes.

Since it has been a common opinion of anglers that fish are easy prey for skin divers, there is need for biological information to determine the impact of underwater spearfishing on a fish population and to determine vulnerability of various fish species. The extent to which a group of skin divers might "take over" a lake and conflict with anglers was also not understood.

Nebish Lake, a clear, landlocked lake in northeastern Wisconsin was opened to spearfishing from 1964-66. All major fish species found in this area of the state inhabited the lake, with the exception of muskellunge. The lake was most desirable for a spearfishing experiment because complete biological and sociological data could be collected through the compulsory fishing permit system. This system assured control as well as a means of gathering accurate and complete data. There were no size or bag limits and all fish species were legal to spear throughout the year.

DESCRIPTION OF NEBISH LAKE

Nebish Lake, Vilas County, is one of five lakes in the Northern Highland Fishery Research Area (Fig. 1). There is a public boat landing on the lake and adequate parking facilities. The lake has 3.2 miles of irregular shoreline that is state-owned land. The size of the lake is 91 acres and the maximum depth is 45 feet. The bottom contour is irregular with a sudden "dropoff" from shore, which creates a small littoral area for growth of rooted aquatics. There are no fish cribs which reportedly concentrate fish and make them more available to spearfishermen.

The water is of seepage origin and is infertile, having a total alkalinity of 17 parts per million. Water clarity is good for diving. In 1964, Secchi disc readings taken May through September were 28, 22, 18, 12 and 14 feet. Average Secchi disc readings taken on Lake Mendota, Dane County, open to spearfishing for panfish, was 17.5, 14.5, 9.5, 8.0, and 9.0 feet for the same months (Stewart, 1965).

Although Nebish Lake was regarded as a smallmouth bass lake, at the time of the spearfishing experiment, 14 fish species inhabited the lake: common white sucker, Catostomus commersonnii; northern pike, Esox lucius; perch, Perca flavescens; walleye, Stizostedium vitreum; smallmouth bass, Micropterus dolomieu; largemouth bass, Micropterus salmoides; green sunfish, Lepomis cyanellus; pumpkinseed, Lepomis gibbosus; bluegill, Lepomis macrochirus; rock bass, Ambloplites rupestris; black bullhead, Ictalurus melas; black crappie, Pomoxis nigromaculatus; and two species of minnows that were too small to enter the spearfishermen's catch.

HISTORY OF LAKE

Nebish Lake has a history of fishery studies that date back to the early 1930's (Couey, 1935; Schneberger, 1935; Hile, 1941). It is one of several lakes in Wisconsin where fish populations have been intensively studied and the findings documented over many years.

Walleyes were first introduced in the spring of 1937 when 95,000 were stocked. However, the first known successful stocking of walleyes was in 1957 when fingerlings were stocked to study the effect of fin removal on survival and growth (Churchill, 1963). Northern pike were first introduced in the spring of 1939 and this species has entered the angler's catch since the creel census began in 1946. Green sunfish, pumpkinseed, bluegill, black crappie and bullhead have probably also been introduced, but there are no stocking records.

Nebish Lake is one of five lakes chosen in 1946 to determine the effects of liberalized fishing regulations. An extensive creel census has been maintained for 21 years. In 1964, the lake was opened to spearfishing for skin divers. In the fall of 1966 Nebish Lake was chemically treated with emulsifiable rotenone to remove the entire fish population.

METHODS

All persons participating in the spearfishing sport were required to possess a fishing license, and obtain a free fishing permit at the Escanaba Lake Checking Station. Spearfishing was allowed from sunrise to sunset. Skin divers were urged to keep all fish speared, regardless of size or species. Upon completion of the spearing trip, the daily permit was returned and speared fish were inspected by Division of Conservation personnel. Fish taken and hours spent spearing were recorded to determine catch per hour. Skin diving apparatus and type of spear used was recorded and success of each method employed was determined. Data on spearfishermen included sex of angler, age group and distance traveled to take part in this sport. Rates of spearing exploitation were determined for the major fish species during the 1966 season. Spearing success was compared to hook and line angler success for the same years.

During the three years of the spearfishing experiment, adult walleye, perch and northern pike populations were estimated in conjunction with other fish population studies. Fish were captured and marked in spring with the use of fyke nets. Returns of tagged fish in the creel census provided the source of the population estimate. All fish populations were estimated when the lake was chemically treated.

ANGLER HARVEST AND POPULATION ESTIMATES

From 1946 through 1966, a total of 32,374 fish were caught by anglers from Nebish Lake. Perch, smallmouth bass and rock bass comprised 90 percent of the total catch (Table 1).

TABLE 1

Total Fish Caught and Percent of Total Harvest, 1946-66,
from Nebish Lake

Species	No. Caught	Percent of Total Harvest
Perch	18,526	57
Smallmouth bass	5,731	18
Rock bass	4,800	15
Largemouth bass	1,014	3
Walleye	889	3
Bluegill	737	2
Northern pike	418	1
Miscellaneous species*	259	1
Total	32,374	

* Includes black bullhead, black crappie, pumpkinseed and green sunfish.

The perch population, dominated by one year class, was estimated at 855 in 1964. In 1965 and 1966, the numbers of perch marked were too few to permit estimation of the population. The age II and older walleye population during 1964 and 1965 was estimated at 585 and 750, and in 1966, age III and older walleyes were estimated at 384. The populations of northern pike 17 inches and longer for the same years were 153, 110 and 141 (Table 2).

TABLE 2

Population Estimates Determined by Mark and Recapture by Anglers

Species	Age	Length Range*	Population Estimates		
			1964	1965	1966
Walleye	II>	11.9-21.0	585	750	-
	III>	14.3-21.0	-	-	384
Northern Pike	-	17.0-29.2	153	110	141
Perch	III>	7.4-12.6	855	-	-

* Length ranges are from the 1966 data from chemical treatment and are representative for the two other years.

After chemical treatment on October 3, 1966, the age III and older walleye population was estimated at 521. The northern pike population 17 inches and larger was estimated at 156 fish. The population estimates of ten fish species at time of chemical treatment in the fall of 1966 are shown in Table 3.

TABLE 3
Population Estimates Determined by Mark and Recapture During Chemical Treatment, 1966

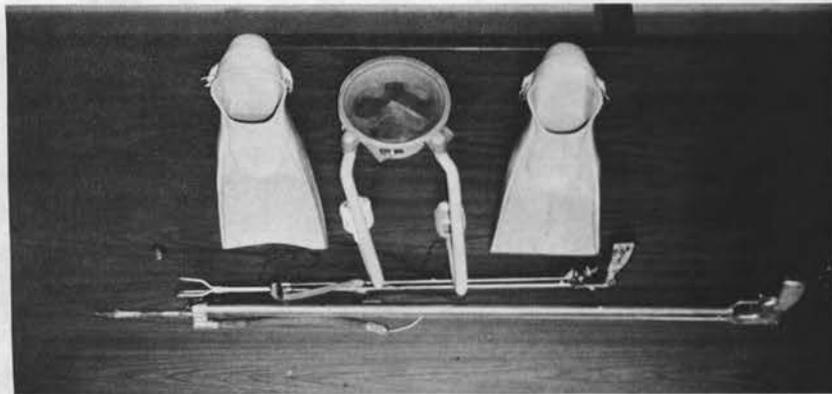
Species	Age	Length Range	Number
Walleye	0	5.1- 8.2	} 1,013
	I	7.7-13.1	
	II	11.9-15.5	
	III	14.3-17.8	} 521
	IV	15.6-20.5	
	IX	17.0-21.0	
Smallmouth bass	I	4.3- 6.9	1,095
	II >	7.0 >	432
Northern pike	-	7.3-16.9	465
	-	17.0-29.2	156
Perch	I >	4.4- 8.8	8,521
Rock bass	I >	2.1- 9.6	2,341
Bluegill	I >	2.3- 8.8	2,907
Pumpkinseed	I >	2.8- 6.3	747
Green sunfish	I >	3.1- 6.3	1,094
Largemouth bass	I >	6.7-19.3	28
Common suckers	-	-	426
Total population			19,746

SPEARFISHING SUCCESS

In 1964, the first year of spearfishing, 88 skin divers participated, and 28 spearfished in both 1965 and 1966. The 144 spearfishermen took 94 fish at the rate of 0.28 fish per hour. During the same three-year period, 1,071 hook and line anglers also caught 0.28 fish per hour (Table 4).



TYPES OF
SPEARFISHING GEAR



Mask, snorkel, flippers and speargun.



SCUBA gear: wet suit, lead belt, mask, flippers, mouthpiece and regulator, spearguns, depth indicator and compass, and red and white flag which is used to indicate the presence of a diver.

TABLE 4

Comparison Between Spearfishing and Angling Success,
May-September, 1964-66

	<u>Spearfishermen</u>	<u>Anglers</u>
No. of participants	144	1,071
Hours fished	331	4,082
Hours/trip	2.3	4.0
No. fish taken	94	1,143
Fish/hour	0.28	0.28

Spearing success using three types of underwater apparatus is shown in Table 5. The most popular gear was SCUBA gear, used by 108 or 75 percent of the participants. SCUBA divers speared 57 fish, or 60 percent of the total catch. Success rate by this method was poorest of the three underwater apparatus used, with only 0.21 fish speared per hour. The reason given for SCUBA gear preference was that it involved more sport, permitting the diver to remain underwater at greater depths for a longer time. Twenty-seven snorkel participants caught 0.48 fish per hour. The nine participants using face mask only were the most successful, catching 0.87 fish per hour.

The type of spearing device used and success rate are shown in Table 6. Only four skin divers used explosive propellant (CO_2) spears and they speared no fish. The most popular spear used was spring operated. A total of 102 or 71 percent used this method and speared 0.29 fish per hour. Hand spear users were equally effective spearing 0.32 fish per hour.

The fish species speared in greatest abundance was rock bass, comprising 55 percent of the total fish speared. During the 1966 season, skin divers speared 9 rock bass. Exploitation rate of rock bass age I and older was 0.4 percent of the 2,341 fish estimated at the time of chemical treatment.

The species seemingly most vulnerable to the spear was largemouth bass. Three largemouth bass were speared in 1964-66 from a population estimated at 28 at time of chemical treatment. Walleye and northern pike comprised the largest fish in the lake. From 1964-66, 8 walleyes were speared the first year, and one each of the following years. Exploitation rate of walleyes age II and older in 1964 and 1965 and age III and older in 1966 by spearfishermen was 1.4, 0.1 and 0.3 percent of the estimated population for the three years (based on data in Table 2). Exploitation rate of northern pike for the same years was 0.7, 5.4 and 0.7 percent. Angler exploitation rates for walleye and northern pike during the 1966 fishing season were 15 and 19 percent, respectively, of the estimated populations.

TABLE 5

Skin Diving Apparatus Related to Spearing Success, 1964-66

	SCUBA	Snorkel	Face Mask Only	Total
No. participants	108	27	9	144
Percent successful	28	26	44	28
No. hours spent	266	50	15	331
Fish/hour	0.21	0.48	0.87	0.28
No. fish speared:				
Northern pike	8	0	0	8
Walleye	8	1	1	10
Perch	4	2	2	8
Smallmouth bass	7	1	0	8
Largemouth bass	3	0	0	3
Rock bass	26	19	7	52
Bluegill	1	0	2	3
Pumpkinseed	0	1	1	2
Total	<u>57</u>	<u>24</u>	<u>13</u>	<u>94</u>

TABLE 6

Spearing Device Related to Spearing Success, 1964-66

	Hand	Spring	Explosive Propulsion	Total
No. participants	38	102	4	144
Percent successful	32	29	0	29
No. hours spent	81	232	18	331
Fish/hour	0.32	.29	-	0.28
No. fish speared:				
Northern pike	1	7	0	8
Walleye	4	6	0	10
Perch	1	7	0	8
Smallmouth bass	3	5	0	8
Largemouth bass	2	1	0	3
Rock bass	15	37	0	52
Bluegill	0	3	0	3
Pumpkinseed	0	2	0	2
Total	<u>26</u>	<u>68</u>	<u>0</u>	<u>94</u>

There were no indications of smallmouth bass being more vulnerable during the spawning season. Only 8 smallmouth bass were speared during the entire experiment, 4 of them in the summer of 1966. The population of smallmouth bass age II and older was estimated at 432 at the time of chemical treatment in 1966.

Comparative data on harvest by spearfishermen during the three-year period and anglers during 1966 are presented in Table 7.

Information on the spearfishermen is shown in Table 8. Ninety-seven percent of the 144 spearfishing enthusiasts were men, mostly over 16 years of age. There were 28 nonresident spearers, 27 of whom were from Illinois. Thirty-three percent of the skin divers were from the Milwaukee area and only 11 percent lived within a 25-mile radius of the spearfishing lake. July was the most popular month for skin diving. Participation, by number, May through September for the entire three-year period was 9, 21, 68, 27 and 19, respectively.

TABLE 7
Comparison of Spearfishing Harvest
(1964-66) with Angling Harvest (1966)

Species	Spearfishermen		Anglers	
	No. Taken	Length Range (Avg.)	No. Taken	Length Range (Avg.)
Perch	8	6.3-12.8 (9.5)	48	5.3-12.6 (6.9)
Largemouth bass	3	12.2-19.0 (16.2)	1	19.4
Rock bass	52	5.6- 9.8 (7.5)	8	5.4- 8.2 (6.7)
Pumpkinseed	2	4.8- 6.0 (5.4)	1	7.4
Bluegill	3	5.3- 5.6 (5.4)	3	4.8- 7.3 (5.9)
Smallmouth bass	8	7.2-14.4 (10.0)	168	5.4-17.0 (8.5)
Northern pike	8	15.9-28.4 (21.1)	12	18.7-37.5 (28.3)
Walleye	10	9.0-25.0 (14.2)	107	13.5-20.4 (16.9)

TABLE 8

Data on Spearfishermen, 1964-66

Year	1964	1965	1966	Total
No. participants				
Male	87	28	25	140
Female	1	0	3	4
Age group				
1-16	1	0	5	6
16-65	87	28	23	138
65	0	0	0	0
Day of week				
Sunday	33	22	6	59
Monday	2	0	2	4
Tuesday	9	1	3	13
Wednesday	4	0	2	6
Thursday	4	0	8	12
Friday	12	3	0	15
Saturday	24	2	7	35
Total	88	28	28	144
Residence				
State				
Wisconsin	65	28	23	116
Illinois	22	0	5	27
Other	1	0	0	1
Distance (miles)				
0-10	6	4	3	13
10-25	0	2	1	3
25-50	11	0	0	11
50-100	17	16	6	39
100-200	2	1	0	3
200-300	29	5	13	47
300-400	22	0	5	27
400 >	1	0	0	1
Total	88	28	28	144

SUMMARY AND CONCLUSIONS

During the three-year study, underwater spearfishermen captured fish at the same rate as hook and line fishermen. Vulnerability of the walleye, northern pike, and smallmouth bass to spearfishing was very low. Impact of spearfishing on the Nebish Lake warmwater fish population was negligible. Rock bass were speared in greatest abundance, but during the 1966 season, only 0.4 percent of the age I and older rock bass population was exploited. Snorkel and face mask users were approximately two and four times more effective, respectively, capturing fish than participants using SCUBA gear. Hand and spring-operated spears were equally effective. No confliction arose between spearfishermen and anglers during the study period.

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