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Accidental Mortality of Crappie in Pound Nets Fished for Rough Fish Species

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Accidental Mortality of Crappie in Pound Nets Fished for Rough Fish Species[1]

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Abstract. Crappie contributed a maximum of 28% to the catch of commercially fished pound nets. Mortality of crappie in pound nets was measured concurrently with total catch and temperature. A regression analysis was calculated for net density, in pounds per net lift, and water temperature (°C) against the percentage loss of crappie. Net density was the most relevant factor affecting mortality. Possible removal rates of rough fish at various, arbitrary levels of expected crappie losses were discussed. The second ranked sport fish in the catch was bullhead, but no mortality was observed. Other sport fish contributed less than 2% to the catch.

Fish populations in Iowa's inland streams and flood-control reservoirs are dominated by underharvested, rough fish species (Harrison, 1955; Harrison, 1959; Mayhew, 1964; Helms and Mayhew, 1964 and Mitzner, 1967). These species are undesirable to sport fishermen, but have potential commercial value. In 1966 the Bureau of Commercial Fisheries, United States Fish and Wildlife Service, was granted research funds under Public Law 88: 309 to investigate and develop commercial fisheries on a cost sharing basis with the states. One of the main objectives of the Iowa study under this program was to determine species selectivity of various types of fishing gear.

DESCRIPTION OF THE STUDY AREA

This study was conducted at Coralville Reservoir, Johnson County, Iowa. Operation and maintenance of the reservoir is administered by the Rock Island District, Army Corps of Engineers. Water level is dependent on influx of flood waters and discharge from the dam. At elevation 712 msl the reservoir contains 24,800 surface acres. Minimum conservation pool (elevation 670 msl) has 1,820 surface acres. From 15 June to 1 February the level is maintained near 680 msl, except when flood waters are stored. In anticipation of spring runoff, water is stored at 670 msl from 15 February to 1 June.

METHODS

At the beginning of the study it was evident every type of gear was accidentally lethal to sport fish. Ideally, a maximum number of

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commercially valuable fish could be exploited with a specified type of gear which caused minimum mortality of sport fishes. With this in mind an evaluation was made of the catch and mortality of sport fish in pound nets. Pound nets of 1-inch bar measure web were selected because of their greater efficiency over other gear. Each net consisted of a 50-foot lead, 2½ by 5-foot frames and hoop net 2½ feet in diameter. A wing throat was formed by the frames and the hoop net had two funnel throats. The cod end of the hoop net was 8 feet long.

Crappie were used to determine game fish mortality, because they are the most abundant game species in the sport fishery, and the most abundant game fish species caught in pound nets. White crappie, *Pomoxis annularis,* dominated black crappie, *Pomoxis nigromaculatus,* by more than eight fold. During 1968 the number of dead crappie in nets was recorded concurrently with other catch data.

Results

The ratio of commercial fish exploitation to loss of game fish species in the nets was partially dependent upon the proportion of commercial fish to game fish in the population. Also, this was dependent upon the catch rate of game fish. These factors varied greatly during the fishing season and each bi-weekly period was analyzed independently.

The per cent and catch rate of rough fish in pound nets at bi-weekly intervals was pooled for 1966, 1967 and 1968. Maximum rough fish in the catch was 89.8% for 2-15 July and the minimum was 51.1% for 7-20 May (Table 1). Maximum catch success of 2.8 rough fish per net hour was recorded during 26 March-8 April (Table 2). The lowest success, 0.51 fish per net hour, was recorded 10-23 September.

It was evident crowding in nets was a major cause of accidental mortality. Because of the physiology of fish and from past experience with their transport, it was also conjectured warmer water caused increased mortality.

To test the relationship between crappie mortality, net density and temperature multiple linear regression analysis was made using the model:

$$Y_{ij} = a + b_1X_1 + b_2X_2 + e_{ij}$$

where Y_{ij} = the j^{th} percent crappie mortality of the i^{th} net lift, X_1 = net density in total pounds of fish per net lift and X_2 = temperature in °C (Table 3).

Regression coefficients to satisfy the normal equations were $b_1 = 0.0037$, $b_2 = 0.0067$ and $a = -0.097$. Y values in per cent crappie mortality were transformed into angular sine values before com-

Table 1

Per cent Composition of Pound Net Catch for Rough Fish, Crappie, Bullhead, Walleye and Northern Pike at Bi-weekly Intervals

Period	% Rough Fish	% Crappie	% Bullhead	% Walleye	% N. Pike	% Other
3/26-4/8	60.0	14.5	20.0	1.4	3.4	0.7
4/9-4/22	68.3	20.2	3.4	0.6	4.0	3.5
4/23-5/6	64.1	26.6	3.8	1.5	3.1	0.9
5/7-5/20	51.1	27.9	14.8	2.7	2.2	1.3
5/21-6/3	56.6	27.1	11.1	1.7	1.7	1.8
6/4-6/17	70.7	10.9	14.5	1.4	0.4	2.1
6/18-7/1	81.2	7.6	6.1	1.0	0.5	3.6
7/2-7/15	89.8	3.8	2.6	1.2	1.0	1.6
7/16-7/29	84.7	8.3	2.5	0.8	1.6	2.1
7/30-8/12	76.4	11.6	7.1	0.7	1.2	3.0
8/13-8/26	71.1	21.0	2.2	2.3	1.6	1.8
8/27-9/9	77.0	16.5	3.4	1.7	0.9	0.5
9/10-9/23	67.5	22.5	2.5	0.0	7.5	0.0
9/24-10/7	78.9	15.5	1.8	1.9	1.3	0.6

putation. Steel and Torrie (1960) suggest arcsin transormation in a binomial distribution when per cent values include a wide range.

Table 2

Catch Per Unit Effort of Rough Fish and Crappie and Expected Crappie Mortality at Bi-weekly Intervals

Period	Rough Fish Per Net Day	Crappie Per Net Day	% Crappie Mortality	Crappie Loss per 10 Net Days	Crappie Loss per 1,000 Rough Fish Caught
3/26-4/8	67.2	16.3	19.0	31.0	46
4/9-4/22	47.0	15.6	12.5	19.5	42
4/23-5/6	42.5	17.5	6.2	10.9	26
5/7-5/20	28.1	15.4	5.5	8.5	30
5/21-6/3	22.3	10.7	15.3	16.4	74
6/4-6/17	45.4	7.0	7.9	5.5	12
6/18-7/1	42.2	4.1	15.2	6.2	15
7/2-7/15	18.7	0.8	2.9	0.2	1
7/16-7/29	27.4	2.7	5.5	1.5	5
7/30-8/12	23.8	3.6	4.1	1.5	6
8/13-8/26	21.6	6.3	3.2	2.0	9
8/27-9/9	23.5	5.0	4.1	2.1	9
9/10-9/23	13.4	4.5	1.9	0.9	7
9/24-10/7	45.8	9.0	17.7	15.9	35

An anlysis of variance (Table 4) rejected the null statement of no linear relationship between all variables. Extension of the analysis of variance showed significant linear relationship between net density and mortality, but no relationship between temperature and mortality. The coefficient of determination (r^2) for mortality on net density revealed 24.6% of the variation in Y was attributed to

Table 3

Pounds Per Net Lift X_1, Temperature (°C) X_2, and Observed Percentage Loss of Crappie Y

X_1	X_2	Y	X_1	X_2	Y
173	12.0	14.3	20	16.5	0.0
130	12.2	31.6	38	16.6	0.0
146	12.4	27.5	24	16.9	1.5
56	12.5	2.1	21	17.3	0.0
49	12.8	0.0	22	17.4	0.0
54	13.5	9.1	40	24.4	0.9
63	14.0	0.0	56	24.2	0.0
114	14.5	8.4	39	24.4	16.7
124	15.5	13.8	37	24.0	17.5
61	12.6	26.0	51	24.0	9.1
23	9.5	4.0	100	24.1	31.6
60	9.5	3.1	72	23.0	9.6
42	14.0	0.0	76	23.6	5.2
41	16.5	13.3	78	23.6	8.9
43	18.5	27.1	117	23.0	6.9
32	19.2	0.0	80	23.3	2.0
44	21.5	7.0	268	23.0	91.5
30	16.8	15.7			

variability in X_1. Only 1% of the variability in Y could be accounted for in the regression of X_2. Much of this can be explained by the fact, when water temperatures are high, net density is low. The R^2 value for the mutiple linear regression was 0.46.

Expected mortality of crappie due to gear was back calculated for 1966, 1967 and 1968 from temperature records and catch statistics by applying the multiple regression equation. After pooling the results for the 3 years, highest rate of 19% crappie mortality occurred in the 16 March-8 April interval. Lowest loss was recorded from 10-23 September (Table 2).

The maximum number of game species which succumb as a result of gear mortality is related to ratios of game species to rough

Table 4

Analysis of Variance With Crappie Mortality the Dependent Variable

Source of variation	Degrees of freedom	Sums of squares	Mean squares	F
Total	35	4.99		
Regression on X_1	2	2.31	1.15	14.37**
Deviations	33	2.68	0.08	
X_1 alone	1	1.23	1.23	38.44**
X_2 after X_1	1	0.04	0.04	1.25 ns
X_2 alone	1	0.05	0.05	1.56 ns
X_1 after X_2	1	1.22	1.22	38.13**
Residuals	32	1.05	0.032	

** = significant at 0.01 probability
ns = not significant

species and catch per effort of game species for each sampling period. Greatest percentage of crappie in the catch was during the period 7-20 May and lowest was 2-15 July. Catch rate for this species was also very high during spawning and lowest in mid-summer.

Absolute numbers of crappie lost for each net day was computed by multiplying the number of crappie caught per net day by the predicted gear mortality for each corresponding time period (Table 2). This revealed mortality was about 155 times greater in 26 March-8 April compared to 2-15 July. Much of this difference was the result of net density of all fish being greater in the early part of the season, and crappie catch was highest during the early part of the season. An increase in mortality also occurred after 23 September when crappie catches increased again. Crappie mortality was computed at about 74 fish per 1,000 rough fish caught in the 21 May-3 June interval.

Bullhead are abundant in Coralville Reservoir and are prevalent in angler catches. Mortality due to gear was negligable and contributed no threat to the bullhead population. Walleye and northern pike catches rarely exceed 5% in pound nets and are of minor importance to the angler. Other species, such as white bass, largemouth bass, bluegill, green sunfish, pumpkinseed, northern redhorse, channel catfish, flathead catfish and stonecat contributed to less than 1.8% of the catch.

Discussion

It was evident high crappie mortality was associated with high rough fish catches only when the catch of crappie was high. During crappie spawning this situation is particularily pronounced. At present it is not known whether a slight decrease in brood stock will affect the year class strength and the sport fishery. Due to high fecundity of crappie and their year class strength being determined by factors more important than stock density, it is doubtful decreased brood stock would affect the sport fishery.

Preliminary investigations (unpublished) on the crappie population in Coralville Reservoir indicate a density of 87.3 fish per acre at elevation 670 msl. Harvest of crappie in the sport fishery is approximately 2.4 per surface acre. Investigators working on similar reservoir populations (Patriarche, 1952; Eschmeyer, 1947) found harvests <10 per acre were below optimum.

If an arbitrary limit of 10% of the population density could be lost by gear mortality without altering the sport fishery, 335 rough fish per acre could be exploited from March 26 to October 7, without exceeding this limit. Further, if rough fish removal were initiated after crappie spawning, 638 rough fish per acre could be removed. This would probably be well above the standing crop of rough fish. If an arbitrary limit of 5% of the crappie population could be safely sacrificed to accidental gear mortality, 167 rough fish per acre could be exploited for the entire season and 338 fish per acre could be removed following crappie spawning.

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