Proceedings of the Iowa Academy of Science

Volume 89 | Number

Article 5

1982

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Proc. Iowa Acad. Sci. 89(4): 153-154. 1982

Factors Influencing Catches of Drifted Trammel Nets in a Pool of the Upper Mississippi River[1]

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Catch per unit of effort in drifted trammel nets fished along the bottom in the main channel of Pool 9 was described. Multiple regression analysis indicated that variations in water temperature, current velocity, turbidity, or sampling periods accounted for significant variations in catch of four of the five most abundant species in the samples (Shovelnose sturgeon, *Scaphirhynchus platorynchus;* Quillback, *Carpiodes cyprinus;* Shorthead redhorse, *Moxostoma macrolepidotum;* Walleye, *Stizostedion vitreum vitreum;* and Freshwater drum, *Aplodinotus grunniens*).

INDEX DESCRIPTORS: Fish, Mississippi River, Pool 9, trammel net, catch.

Few fish sampling gears can be used in the main channel of the Mississippi River because the currents are too strong. The most commonly used devices for entanglement (gill nets, trammel nets) and entrapment (fyke nets, hoop nets) cannot be fished or are extremely difficult to use because of the strong current and turbulence created by irregularities of the bottom or the passage of barges. Drifted trammel nets have been used by commercial fishermen to capture shovelnose sturgeon (*Scaphirhynchus platorynchus*) and other species in channels of the Upper Mississippi River (Helms 1970); however, the utility of this gear as a sampling device for fishery research or monitoring has not been established. Catch per unit of effort (CPUE) with drifted trammel nets is a function of fish abundance (Gulland 1973), as well as of numerous environmental variables that influence the movements and distribution of fish.

Information on catch composition of drifted trammel nets fished along the bottom in the Upper Mississippi River is limited to one previous study (Helms 1974). The purpose of the present study was to gather basic data on CPUE of drifted trammel nets, to evaluate the influence of selected environmental variables on CPUE, and to assess the utility of this gear as a sampling tool. Variables examined were current velocity, turbidity, water temperature, dissolved oxygen and sampling period.

METHODS

Sampling was conducted from July 22 through October 30, 1980. Fish collections were made in the main channel of Pool 9 between Mississippi River Miles 663 and 672. The study was divided into five 3-week sampling periods to enable an assessment of temporal trends. Midchannel current velocity, turbidity, water temperature, and dissolved oxygen were measured by standard methods on each sampling day.

The trammel net was 50m × 2m with a 5cm mesh (bar measure) inner wall and 25cm mesh outer wall. A polycore float line and lead-core lead line were attached. Weighted brails were connected to each end of the net and a hydrofoil float or "mule" was attached to each brail with 20m of rope. The hydrofoils were designed to catch and deflect current in such a way that the net was pulled downstream with the current while being stretched perpendicular to the thread of the current. The lead line of the submerged net moved along the bottom.

The drifted net was given constant attention. A drift was terminated when the net became snagged or approached known obstacles in the main channel. Drifts lasted from 10 to 90 minutes with a mean of 42 minutes. Distance drifted was computed as the product of current velocity and duration of drift. The CPUE was expressed as a number of fish per kilometer drifted (FPKD).

For the five most abundant species caught, analysis of variance was used to evaluate variation in CPUE between sampling periods, and stepwise multiple regression was employed to determine possible associations between measured environmental variables and CPUE. All decisions to reject null hypotheses were at the 0.05 level of sampling probability.

RESULTS

Seventeen fish species were captured in the main channel of Pool 9 (Table 1), of which 5 species comprised about 85% of the total catch: freshwater drum (29% of total catch), shorthead redhorse (21%), quillback (19%), shovelnose sturgeon (10%) and walleye (6%).

A total of 587 fish were captured in 97 drifts (6.1 fish per drift). Mean CPUE was 3.8 and ranged from 0 to 18.2 in individual drifts. The catch rate was highest for freshwater drum (1.09 FPKD), followed by shorthead redhorse (0.78), quillback (0.72), shovelnose sturgeon (0.36), and walleye (0.23).

Analysis of variance showed a statistically significant difference in CPUE of three species—shovelnose sturgeon, quillback, and shorthead redhorse—over the 5 sampling periods (Table 2). The mean CPUE of walleye, freshwater drum, and all fish combined also varied among periods, but not significantly.

The measured environmental characteristics varied significantly among sampling periods. Current velocity ranged from 39 to 106 cm/second at the location of the drifts. Turbidity ranged from 29 to 435 Jackson Turbidity Units during the study. From initiation of sampling in July to termination in October, water temperature gradually declined from 25 to 4 C, and dissolved oxygen increased from 6 to 11 mg/ℓ in the main channel.

Stepwise multiple regression analysis showed environmental variables significantly account for variation in CPUE of some species (Table 3). Water temperature accounted for a substantial amount of variation in CPUE of quillback ($r^2 = 0.39$) and shorthead redhorse ($r^2 = 0.61$). Other variables that significantly accounted for variation in CPUE of at least one species were turbidity, current velocity, and sampling period, but variance accounted for was less than 15%.

[1]Journal Paper No. J-10220 of the Iowa Agriculture and Home Economics Experiment Station, Ames, IA. Project No. 2458. Financed by a grant from the Upper Mississippi River Basin Commission and made available through the U. S. Fish and Wildlife Service to the Iowa Cooperative Fishery Research Unit. The Unit is jointly supported by Iowa State University, the Iowa State Conservation Commission, and the U. S. Fish and Wildlife Service.

Table 1. Species composition of 587 fish taken in 97 drifts of a trammel net in Pool 9, Upper Mississippi River, July-October, 1980.

Species	Number Caught	Percent of Total Catch
Lake sturgeon, *Acipenser fulvescens*	1	0.2
Shovelnose sturgeon, *Scaphirhynchus platorynchus*	56	9.5
Mooneye, *Hiodon tergisus*	6	1.0
Common carp, *Cyprinus carpio*	6	1.0
Quillback, *Carpiodes cyprinus*	111	18.9
White sucker, *Catostomus commersoni*	3	0.5
Smallmouth buffalo, *Ictiobus bubalus*	9	1.5
Silver redhorse, *Moxostoma anisurum*	22	3.7
Golden redhorse, *Moxostoma erythrurum*	13	2.2
Shorthead redhorse, *Moxostoma macrolepidotum*	121	20.6
Channel catfish, *Ictalurus punctatus*	6	1.0
Flathead catfish, *Pylodictis olivaris*	1	0.2
Largemouth bass, *Micropterus salmoides*	1	0.2
Black crappie, *Pomoxis nigromaculatus*	1	0.2
Sauger, *Stizostedion canadense*	27	4.6
Walleye, *Stizostedion vetreum vitreum*	35	6.0
Freshwater drum, *Aplodinotus grunniens*	168	28.6

DISCUSSION

Helms (1974) captured 670 fish in 166 drifts in channel habitats of Pool 9. Drifts were conducted in the main channel,main channel border, side channels, and tailwaters. The most abundant fish in Helms' samples were channel catfish (22% of total catch), freshwater drum (17%), and shovelnose sturgeon, walleye, and mooneye (14% each). Helms' results were substantially different from ours, probably because our sampling was limited to the main channel.

The mean CPUE in the trammel nets was 3.8 FPKD (or 5.8 fish per hour of drifting). If this value were converted to fish per hectare of bottom swept by the net, the CPUE would be 0.85 fish per hectare. This low value indicated either the drifted trammel nets were not highly efficient or there were few fish in the main channel. Inasmuch as sand waves and other irregularities occur in the bottom of the main channel of Pool 9, it is likely that the drifted nets are relatively inefficient and skip from the crest of one sand wave to the crest of the next. Consequently, they fail to entangle bottom-dwelling fish in the trough of the wave, or fish escape over the top of the net.

Despite the relatively low efficiency of the gear, CPUE with drifted trammel nets was sufficiently consistent to indicate that they could be used as an indicator of fish abundance, especially if further work improves understanding of the relations between CPUE and measurable environmental variables. The CPUE of two species was strongly related to variation in water temperature, indicating such predictability should be attainable for some species.

Drifted trammel nets are more desirable for sampling the main channel than entrapment devices such as hoop nets because the trammel nets are fished actively over short periods. Problems of gear destruction from turbulence generated by passing barges, vandalism, and rapid rises in water level are not encountered as they could be with entrapment devices. A disadvantage of the drifted nets is the requirement for long reaches of obstacle-free bottom over which the net can be drifted. Snag-free areas were difficult to locate in the main channel and were generally unavailable in other channel habitats of Pool 9.

Table 2. Mean number of fish caught per kilometer in drifting trammel nets in the main channel of Pool 9, Upper Mississippi River, over five sampling periods, 1980 (± standard error of the mean.)

Species	SAMPLING PERIOD				
	July 22-Aug. 7	Aug. 11-Aug. 26	Sept. 2-Sept. 18	Sept. 22-Oct. 9	Oct. 13-Oct. 30
Shovelnose sturgeon	0.98±0.75	1.38±0.42	0.20±0.10	0.61±0.14	0.18±0.07
Quillback	4.36±2.19	4.06±0.88	0.99±0.34	0.51±0.18	0.09±0.04
Shorthead redhorse	0.65±0.41	0.11±0.11	0.10±0.06	0.55±0.14	2.73±0.63
Walleye	0.21±0.21	0.11±0.11	0.37±0.16	0.14±0.08	0.41±0.20
Freshwater drum	0.85±0.85	1.56±0.50	1.63±0.34	1.96±0.49	0.85±0.27
All species	7.27±3.31	7.41±1.42	3.71±0.69	4.61±0.77	5.30±0.82

Table 3. Stepwise multiple regression of fish per kilometer drifted (FPKD) relative to sampling period (P), water temperature (T), current velocity (V), and turbidity (S) for 97 individual trammel net drifts. Regression equations showing maximum accounted for variance ($P \leq 0.05$ for variables inclusion) are presented for the five most abundant species and all fish combined.

Species	Regression Equation	Variance explained (r^2)
Shovelnose sturgeon	$FPKD = 1.36 - 0.23\ P$	0.09
Quillback	$FPKD = 1.34 - 0.34\ T + 0.020\ T^2$	0.39
Shorthead redhorse	$FPKD = 16.6 + 0.53\ T - 20.8 \log T$	0.61
Walleye	No significant variables	
Freshwater drum	$FPKD = -14.8 + 7.29 \log V - 27.0 \log S$	0.15
Combined	$FPKD = 12.5 - 4.32 \log S$	0.06

ACKNOWLEDGMENTS

We thank John Verdon and William Noonan for their assistance in the field, the Iowa State Conservation Commission—in particular John Spinner—for the use of facilities, equipment, and general guidance; and Jim Mayhew, Kenneth Carlander, and John Nickum for reading the manuscript and making suggestions.

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