

Multiple Survey Evaluation of a Kentucky Commercial Trotline Fishery

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Abstract: The commercial trotline fishery on the Kentucky portions of Kentucky Lake and Lake Barkley was evaluated by a telephone survey, an onboard survey, and from market data. Results indicate that the telephone survey was a reliable source of economic information based on high correlations ($r \geq 0.89$) of effort and harvest data among the 3 data sets. Data obtained from the onboard survey overestimated economic impact of the fishery because of bias toward full-time fishermen. However, the onboard survey did yield accurate species composition information. Thirty-five percent of the respondents in the telephone survey were full-time fishermen, 44% were part-time, and 21% fished for non-profit reasons. Although the annual estimated harvest in the trotline fishery (745,500 kg) was valued at \$0.8 million, fishermen reported an income of \$1.5 million, nearly twice the value of their harvest. Ninety-seven percent of total catch (both kept and released) and harvest, by weight, was catfish. Fishermen who sold their catch grossed \$46.23 per trip (\$61 for full-time, \$43 for part-time) and \$4,629 per year (\$8,475 for full-time, \$3,200 for part-time). Operating expenses reduced gross income by 47%. Automobile expenses accounted for 49% of annual expense, followed by 24% for gear and 20% for boat motor fuel.

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Commercial trotline fisheries in the southeastern United States are well established. However, few studies have documented those fisheries and analyses have been limited to fishermen's responses to survey questions. The Tennessee River commercial fishery was examined by creel surveys from 1940 to 1945 (Bryan and Tarzwell 1941, Tarzwell and Bryan 1945) and 1956 (Bryan and White 1958) and was found to have an annual value of \$353,686. The commercial fisheries of the lower Tennessee River were first studied in 1951 by interviews and correspondence (Tompkins et al. 1951), in 1959 by mail survey and personal contact (Carter 1961), and from 1965 to 1966 by mail and telephone surveys (Renaker and Carter 1968). During 1966, the Kentucky Lake trotline fishery was valued at \$166,806 and

comprised 75% of the state's total trotline harvest (Renaker and Carter 1968). Economic value of Kentucky Lake's trotline fishery has not been examined since 1966 and Lake Barkley's fishery has never been examined.

Surveying all fishermen in a fishery eliminates bias that may occur when only a portion of the fishery is sampled. Deuel (1980) states that telephone surveys have the potential of surveying the entire population and the cost per interview is low. However, an incomplete telephone survey may be biased with respect to income because lower income fishermen may not have telephones (Smith 1983). In addition, individual responses (i.e., estimations rather than actual measured data) may be inaccurate. An onboard and/or market survey could yield accurate data on specific individual fishermen and their catch, but may be biased toward more accessible or cooperative fishermen. Malvestuto (1983) and DeMory and Golden (1983) recommended complementing surveys to overcome biases of each individual survey. Combining telephone and onboard surveys allows for a more comprehensive study and a statistical check on the accuracy of the fishermen's responses by comparing responses to actual onboard data.

In 1984 a telephone survey, an onboard observer survey, and market data collection were conducted to study the commercial trotline fisheries on the Kentucky portion of Kentucky Lake and Lake Barkely. Commercial fishermen are those that buy a commercial license. Objectives of the study were to describe: (1) the economics of trotline fishery, (2) relative participation of full-time, part-time, and "recreational" or non-profit fishermen, (3) species composition of the catch and harvest and (4) accuracy of telephone survey responses.

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Methods

Names of fishermen interviewed during the telephone survey were obtained from 1983 commercial license receipts provided by the KDFWR. Fishermen from the 10 counties surrounding both reservoirs were interviewed in December 1984. Other counties were considered too far away for a fisherman to make a profit and were not included. Sampling error was reduced by interviewing all fishermen in the 10 counties. Only results of interviews with trotline fishermen that fished on 1 or both reservoirs in 1984 are included in this report.

Fishermen were selected for the onboard survey from a list of currently active fishermen obtained from fish markets. We attempted to randomly sample these fishermen but found that this was impossible because fishermen were not equally accessible or cooperative in allowing an observer onboard. This survey was conducted between February and December 1984.

In both surveys, data were collected on effort (mean N of hooks per line, mean N of lines set per day fished, and N of days fished per year for each fisherman); harvest; catch per unit effort (CPUE); expenses; income; whether the fisherman was full-time (≥ 40 hours per week), part-time (< 40 hours per week), or noncommercial (fish were not sold); and daily work hours. The onboard survey also recorded species composition of the catch and portion of the catch that was sold. Effort and harvest data from the telephone and market survey (specified as confidential at the market) and harvest data from telephone and onboard surveys for individual fishermen were correlated with the Pearson product-moment correlation (SAS Inst. Inc. 1982).

Estimated annual harvest for each fisherman was the mean harvest per trip times the number of days fished per year. Total annual harvest for the fishery was calculated by multiplying the estimated number of fishermen fishing the 2 reservoirs by the mean annual harvest of the fishermen surveyed. Ninety-five percent confidence intervals were calculated for the annual harvest.

Each fisherman's CPUE was expressed as the mean catch per trip divided by the mean number of hooks set per trip and these values were averaged to get the fishermen's mean CPUE. The fishery's CPUE was the sum of all the fishermen's annual harvest divided by the sum of all the hooks set and was therefore a weighted estimate. Each CPUE was expressed as either number or kilograms of marketed fish per 100 hooks.

Expenses were recorded in the following categories: boat gasoline, automobile gas and depreciation (estimated at \$0.33 per km), bait, gear, and other. Annual income responses of the fishermen were compared to the value of their estimated annual harvest by testing for significance of the correlation coefficient (SAS Institute Inc. 1982) to check for consistency.

Results

Telephone Survey

In 1984, commercial trotline licenses were purchased by 334 fishermen in the 10 counties surrounding the 2 lakes. Several attempts were made to interview all the fishermen by telephone; however, only 78 were contacted. Sixty-two percent of the interviewees fished 1 or both lakes, and 38% fished somewhere else. An estimated 208 commercial trotline fishermen fished the 2 lakes. Thirty-five percent were full-time trotline fishermen (23% fished seasonally), 44% were part-time (29% fished seasonally), and 21% did not sell their fish. Seasonal trotline fishermen either fished another gear type or did not fish at all for a part of the year.

The telephone survey indicated that 60% of the trotline fishery effort was exerted on Kentucky Lake and 40% on Lake Barkley. Fishermen fished an average of 98 hooks per line, 8.7 lines per trip, and 92 trips per year (includes all fishermen). They harvested a mean of 38.9 kg per trip and 3583 kg per year. Fishermen's CPUE (mean of individual fishermen) and the fishery's CPUE (weighted mean) were 4.6 and 4.7, respectively (Table 1).

Total annual harvest for the trotline fishery was estimated to be 745, 478 \pm

Table 1. Effort, harvest, and catch per unit effort (CPUE) of Kentucky Lake and Lake Barkley trotline fishermen surveyed by telephone in 1984.

	Full-time	Part-time	Non-profit	Mean
Effort				
Lines per trip	10.9	8.2	6.2	8.7
Trips per year	128	68	37	92
Harvest (kg)				
Per trip	51.2	36.2	23.2	38.9
Per year	6,561	2,477	850	3,585
CPUE (kg per 100 hooks fished)				
Fishermen's ^a	5.1	4.5	3.9	4.6
Fishery's ^b	5.1	4.5	3.9	4.7

^aAverage of all fishermen's CPUEs.

^bTotal harvest of all fishermen divided by total effort.

202,176 kg (432,951 kg on Kentucky Lake and 312,527 kg on Lake Barkley) with 65% harvested by full-time fishermen, 30% by part-time fishermen, and 5% by non-profit fishermen. Annual harvest of marketed species, calculated from data obtained during the onboard survey indicated that blue catfish (*Ictalurus furcatus*) comprised 72.3% of the total annual harvest by weight, followed by channel catfish (*I. punctatus*) (24.9%) (Table 2). Blue catfish was the dominant species on both lakes.

Commercial trotline fishermen expended, on the average, \$28.28 per trip and \$2,163 per year (Table 3). Automotive travel expenses accounted for 49% of the total annual expense. Fishermen's gross income was \$46.23 per trip (\$61 for full-time, \$43 for part-time) and \$4,629 per year (\$8,475 for full-time, \$3,200 for part-time) based on harvest and mean market values of the fishes. Fishermen reported a mean annual gross income (non-profit fishermen not included) of \$3,847, 17% less than the calculated value of their annual harvest. The correlation coefficient was statistically significant ($r = 0.77$, $P < 0.05$), indicating that fishermen's responses

Table 2. Annual harvest of marketed species, calculated from the percent frequency by weight and the total annual harvest estimates.

Species	Lake Barkley		Kentucky Lake		Lakes combined	
	% Frequency	Harvest (kg)	% Frequency	Harvest (kg)	% Frequency	Harvest (kg)
Blue catfish	52.1	162,827	85.5	370,173	72.3	538,981
Channel catfish	44.6	139,387	12.0	51,954	24.9	185,624
Paddlefish	1.3	4,063	0.8	3,464	1.0	7,455
Common carp	1.4	4,375	0.3	1,299	0.7	5,218
Buffalofish	0.3	1,563	1.3	5,628	1.0	7,455
Flathead catfish	0.1	313	0.1	433	0.1	745
Total		312,528		432,951		745,478

Table 3. Expenses of Lake Barkley and Kentucky Lake trotline fishermen.

	Full-time (N = 17)	Part-time (N = 21)	Nonprofit (N = 10)	Overall (N = 48)
Per trip				
Boat gas ^a	5.67	4.15	4.55	4.77
Automotive ^b	12.73	13.36	11.41	12.73
Bait	1.30	0.47	0.37	0.74
Gear ^c	6.80	8.18	6.41	7.31
Other ^d	1.02	4.06	2.84	2.73
Total	27.52	30.18	25.58	28.28
Per year				
Boat gas ^a	722	233	200	399
Automotive ^b	1,726	804	443	1,055
Bait	186	33	7	82
Gear ^c	841	437	245	540
Other ^d	89	86	34	87
Total	3,564	1,593	979	2,163

^aEstimated at \$1.22 per gallon (includes motor oil).

^bEstimated at \$0.205 per mile.

^cIncludes boat, boat trailer, and motor depreciation [(purchase price—resale value)/years used], and expenses for trotline equipment.

^dIncludes hired help, fixed costs of boat registration (\$10/year), commercial license (\$72, 6 tags included), extra tags (\$6 per tag), and miscellaneous items.

in the telephone survey were consistent. Expenses accounted for 53% of gross income.

Total annual gross income of the fishermen was estimated to be \$1,499,656 (90% full-time and 10% part-time). Their total annual harvest (non-profit fishermen included), valued at approximately \$1.08 per kg, was estimated at \$804,497.

Mean annual prices per kg of fish (whole) sold to the market were \$1.10 for catfish, \$0.44 for buffalofish (*Ictiobus* spp.), \$0.37 for paddlefish (*Polyodon spathula*), and \$0.11 for common carp (*Cyprinus carpio*). Paddlefish roe was worth up to \$77 per kg; however, the amount of roe sold was not monitored. Eight different fish markets were identified in the area. All full-time fishermen sold fish at their own fish market or to other fish markets. Seventy-one percent of the part-time fishermen sold all their fish to a market or friends and 29% sold \leq 75% of their harvest to a market, friends, and/or pay lakes. The remaining fishermen used their fish for personal consumption.

Average work hours per trip from telephone survey response was 7.8 hours for noncommercial fishermen, 8.0 hours for part-time fishermen, 10.9 hours for full-time fishermen; the overall weighted average was 8.0 hours. Work hours included traveling, obtaining bait, baiting hooks, setting lines, pulling lines, and preparing gear to reset.

Onboard and Market Surveys

A total of 81 onboard and market surveys was conducted: 67 onboard surveys of 14 different trotline fishermen (71% full-time and 29% part-time) and 14 surveys

at 3 different fish markets. Full-time fishermen were more cooperative in allowing an observer aboard their boat. Onboard survey data over-estimated the fishery because of insufficient representation of part-time fishermen; therefore, effort, CPUE, and expenses and income data are not included in the results.

A total of 7,154 fish and turtles were recorded during onboard and market surveys (5,766 onboard and 1,388 at the market.) Twenty-five species were caught on trotlines fished in both lakes (Table 4). However, marketed species accounted for 80.3% and 91.6% of the number and weight, respectively, of fishes observed during the onboard survey. Catfish, the major target species, comprised 93.7% of the catch by number (79.6% harvested, 14.1% released) and 90.1% by weight.

Validation of the Telephone Survey

Data from 6 of the fishermen obtained during the telephone survey were compared to data recorded by a fish market owner for the same fishermen. The 2 data sets were highly correlated with coefficients of $r = 0.89$ ($P = 0.0177$) for effort and 0.99 ($P = 0.0002$) for harvest. Estimates of harvest per trip obtained from telephone and onboard survey responses were also correlated ($r = 0.95$, $P = 0.0001$). These correlations were statistically significant ($P < 0.05$) supporting the accuracy of the telephone survey, assuming those fishermen that were compared were representative of all fishermen in the telephone survey.

Discussion

Multiple Survey Use

The use of multiple survey technique has been recommended to ensure a valid comprehensive study (DeMory and Golden 1983, Malvestuto 1983). In particular, data obtained during the onboard survey indicated that data received during the telephone survey was both representative and accurate.

Results of the telephone survey appeared to provide unbiased estimates of the economic value of the commercial trotline fishery on Kentucky Lake and Lake Barkley. Non-random sampling during the onboard survey placed a bias toward full-time fishermen, invalidating the effort, harvest, CPUE, and monetary values as representative of the fishery as a whole. However, onboard and market surveys did provide accurate data for comparison with the telephone survey responses and also provided the best estimates of the species composition of the catch. Responses on effort and harvest of individual fishermen in the telephone survey were statistically accurate (all P values < 0.05) based on the correlation analysis.

These surveys yielded the most comprehensive trotline fishery study to date on Kentucky Lake and the first study on Lake Barkley. The results of the surveys provide valuable base-line data for future studies.

Species Composition and CPUE

Trotlines were highly selective for catfish, which accounted for 93.6% of the catch by number (onboard survey). This proportion is consistent with the results of

Table 4. Number, weight (kg), and percent frequencies of each species caught on trotlines on Lake Barkley and Kentucky Lake combined (onboard observations only).

Species	Total N	% by N	Total Weight ^a	% by Weight
Marketed fish				
Blue catfish	2,706	46.9	1737.3	49.8
Channel catfish	1,867	32.4	1278.9	36.7
Common carp	22.00	0.4	43.2	1.2
Flathead catfish	15.00	0.3	5.9	0.2
Paddlefish	12.00	0.2	75.9	2.2
Buffalofish	8.00	0.1	52.2	1.5
Subtotal	4,630	80.30	3,193	91.6
Nonmarketed fish				
Sport fish				
Yellow bass	36.00	0.6	6.0	0.2
Bluegill	17.00	0.3	2.5	0.1
White crappie	16.00	0.3	3.0	0.1
Largemouth bass	7.00	0.1	4.0	0.1
Black crappie	6.00	0.1	1.2	<0.1
Longear sunfish	5.00	0.1	0.7 ^b	<0.1
Sauger	2.00	<0.1	0.2	<0.1
Green sunfish	1.00	<0.1	0.1 ^b	<0.1
White bass	1.00	<0.1	0.7	<0.1
Smallmouth bass	1.00	<0.1	0.4	<0.1
Subtotal	92.00	1.60	18.80	0.5
Nonsport fish				
Blue catfish (small, <200g)	635.00	11.0	99.1	2.8
Channel catfish (small, <170g)	173.00	3.0	22.3	0.6
Freshwater drum	118.00	2.1	74.0	2.1
Yellow bullhead	55.00	1.0	14.5	0.4
American eel	21.00	0.4	18.9 ^b	0.5
Turtle	20.00	0.4	40.0 ^b	1.1
Flathead catfish (small, <160g)	5.00	0.1	0.5	<0.1
Gizzard shad	5.00	0.1	0.8 ^b	<0.1
Skipjack herring	4.00	0.1	0.9	<0.1
Threadfin shad	3.00	0.1	0.1 ^b	<0.1
Gar	2.00	<0.1	1.4 ^b	<0.1
Mooneye	2.00	<0.1	0.6	<0.1
Sucker unidentified	1.00	<0.1	0.5	<0.1
Subtotal	1,044	18.10	273.60	7.9
Total	5,766		3,485	

^aIn kg.^bApproximate weight.

previous studies on the Potomac River (95.5%, Sanderson 1961) and Kentucky Lake (93.8%, Matthai 1972). The species composition of marketed fish was consistent with the results of a creel survey (Bull 1985) and Matthai's (1972) study. Sport fish constituted a minor portion of the trotline catch (1.6%), and most of those were released alive. Matthai found 3.2% of the catch and Sanderson found 1.1% were sport fish. Direct impact on the sport fishery was considered minor.

The fishery's CPUE was slightly higher than what Matthai (1972) reported based on 200 trips with 6 different fishermen on Kentucky Lake in 1970–1972. His results revealed a mean of 3.6 kg of marketed fish per line compared to our estimate of 4.7 kg per 100 hooks (telephone survey).

Economics

The trotline fishery on the Kentucky portion of Kentucky Lake and Lake Barkley involves a substantial number of people but is not of high economic value in the region as indicated by the observer and telephone surveys conducted in 1984. The dollar value of the commercial trotline fishery on Kentucky Lake has increased greatly since the mid-1960s; however, the relative economic value has decreased based on the increased cost of living (Standard and Poors Corp. 1989). Annual harvest and its value were estimated at 61,735 kg (\$32,740) in 1965, 260,955 kg (\$166,806) in 1966 (Renaker and Carter 1968), and 432,951 kg (\$448,717) in 1984. The difference between 1965 and 1966 suggests that annual harvest was highly variable. There is not comparable economic data for Lake Barkley, but in 1984, the value of trotline fishery in Lake Barkley was about 70% of that in Kentucky Lake.

Value of the total annual harvest was a more accurate estimate of the value of the fishery than the total of the fishermen's annual gross incomes. Surveyed fishermen frequently did not separate Kentucky Lake and Lake Barkley trotline income from other income even though they were asked to do so.

The weighted mean value (sum of the value of each species/sum of the weights of each species) of marketed fish per kg in Kentucky has declined relative to values of previous years adjusted for increased cost of living (Standard and Poors Corp. 1989) (Table 5). The greatest declines occurred for marketed paddlefish flesh and carp. Freshwater drum (*Aplodinotus grunniens*) are no longer marketed.

Although there are no previous data on the expenses and income of trotline fishermen in Kentucky, Tarzwell and Bryan (1945) found annual expenses of trotline fishermen averaged \$65.65 in 1945 on the Tennessee River. Adjusted for inflation (Standard and Poors Corp. 1989) \$65.65 would be comparable to approximately \$379 in 1984. Expenses on Kentucky Lake and Lake Barkley in 1984, however, averaged \$2,103 annually. Full-time trotline fishermen in 1941 on Wheeler Reservoir, Alabama, earned a gross of \$665 annually (Bryan and Tarzwell 1941), comparable to an inflation adjusted figure of \$4,688 in 1984. In the present study, the full-time fishermen earned a gross of \$4,629 in 1984 on both lakes. Many of the fishermen (21%) stated that they fish because they enjoy the recreation, not because they need the money. As a result, the average fishermen's net wage was very low: \$2.01 per hour.

Table 5. Actual value and the adjusted value relative to 1984 cost of living (in parenthesis) in cents per kg in southeastern United States trotline fisheries from 1941 to 1984.

Species	TVA Lakes	State-wide	TVA Lakes	State-wide	Kentucky Lake
	Alabama 1941 ^a	Kentucky 1951 ^b	Alabama 1958 ^c	Kentucky 1965 ^d 1966 ^d	Kentucky 1984
Catfish	22 (155)	55-77 (220-308)	60 (215)	55 (181) 66 (211)	110
Paddlefish			60 (215)	55 (181) 55 (176)	37
Carp	4-22 (28-155)	11-33 (44-132)	15 (54)	22 (72) 22 (70)	11
Buffalofish	7-22 (49-155)	(44-132)	37 (132)	26 (86) 31 (99)	44
Drum	22 (155)	22-55 (88-220)		11 (36) 11 (35)	
Weighted mean	22 (155)	64 (256)	64 (211)	53 (174) 64 (205)	108

^aTarzwel and Bryan 1941.^bTompkins et al. 1951.^cBryan and White 1958.^dRenaker and Carter 1968.

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