Sport Fish Creel Results of 9 Arkansas State-owned Lakes With Some Management Implications

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Abstract: Creel surveys were conducted on 9 state-owned public fishing lakes during 1981 and 1982 to determine harvest, pressure, and angler success rates. Anglers harvested a mean 50.4 kg/ha (SD = 18.0 kg/ha) among all lakes surveyed and had a mean success rate of 0.94 fish/angler-hour and 0.18 kg/angler-hour. Mean pressure among all lakes was 318.2 angler-hours/ha (SD = 145.3 angler-hours/ha). *Lepomis macrochirus* was the most sought after species during the survey, followed by *Pomoxis sp.*, *Micropterus salmoides*, and *Ictalurus punctatus*, respectively. Negative relationships were detected between *Micropterus salmoides* mean sizes and success rates and between *Pomoxis sp.* mean sizes and harvest rates. Anglers tended to spend a greater percentage of their time within lakes seeking species which returned the higher success rate. Management implications derived from the surveys are discussed and include fishery-specific programs and increased emphasis on bluegill and crappie management.

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The Arkansas Game and Fish Commission owns and manages 26 public fishing lakes throughout the state ranging from 7 ha to 2,712 ha. These lakes are generally constructed in areas with few other fishing resources. A statewide questionnaire survey of Arkansas anglers in 1984 ranked state-owned public fishing lakes second only to natural rivers and streams in the number of angler trips (Heller 1985). To meet angler demand fisheries management efforts on all lakes are directed at producing quality stocks of largemouth bass (*Micropterus salmoides*), crappie (*Pomoxis sp.*), bluegill (*Lepomis machrochirus*), and channel catfish (*Ictalurus punctatus*). Fertilization programs, water level manipulations, selective population thinnings, stockings, and highly regulated commercial fishing seasons are employed to sustain fish population structures that are consistent with management goals. Redear (*Lepomis microlophus*), blue catfish (*Ictalurus furcatus*), flathead catfish (*Pylodictus olivaris*), white bass (*Morone chrysops*), and yellow bass (*Morone mississippiensis*) are present in several of the lakes but are not considered principal

sport species and generally do not comprise a significant proportion of the total fish community.

Fishery management agencies have recognized the need to quantify and document fishing pressure, success, and harvest information to monitor resource trends, evaluate management programs, and document fisherman satisfaction (Van Den Avyle 1986). Historical development of creel surveys, types of survey designs, and the applications and limitations of survey data have been reviewed by Van Den Avyle (1986) and Malvestuto (1983). This paper reports the results of a set of creel surveys designed to quantify pressure, harvest, and success of anglers utilizing 9 Arkansas state-owned public fishing lakes during the period 1981–1982. These surveys represent the only effort to quantify angler use of state-owned public fishing lakes in Arkansas to date. The purpose of the surveys was to provide fish managers with information for evaluating alternative management objectives.

Methods

Creel surveys were performed on 9 state-owned public fishing lakes during 1981–1982. Six of the lakes (Bob Kidd, Elmdale, Frierson, Hogue, Mallard, and Poinsett) were surveyed with a roving-clerk type survey. Fishing pressure was estimated by instantaneous counts made by a creel clerk whose path sampled the entire body of water. All 6 lakes were ≤200 ha, allowing the creel clerk to easily traverse the entire body of water during a single sample period. Fishing success was determined by interviews (incomplete trip) carried out by the creel clerk. Total catch was calculated as the product of pressure and success. The 3 largest lakes (Upper White Oak, 321 ha; Lower White Oak, 486 ha; Conway, 2,680 ha) were surveyed using an access point creel survey (complete trip) and conducting aerial counts of anglers. Reported concern over the use of incomplete trips for estimating success is discussed by Van Den Avyle (1986) and Malvestuto (1983). Both authors report that research to date tends to support the use of incomplete trip interviews for estimating success rates, but suggest that more investigation is needed.

Sampling schedules on all lakes were determined using a stratified, randomized sampling design. Survey design and calculation of survey statistics were performed by the North Carolina State University Institute of Statistics under the direction of Dr. Dan Hayne. Information collected by creel clerks during the interview included numbers and weight of each species harvested, species sought, length of fishing trip, and number in party. Sportfishing regulations were uniform across all lakes, and no size-limit regulations were in effect. All lakes are open to year-round fishing with both boat and bank access.

Simple least-squares linear regressions were used to determine any relationships between total pressure, total harvest, and success rates among lakes, and to determine relationships between mean weights of bass and crappie creeled and their respective success and harvest rates. Correlation and regression coefficients were tested for significance at the 0.05 level.

Results

Pressure across the 9 lakes (Table 1) ranged from 130.5 angler-hours/ha to 618.5 angler-hours/ha. Mean pressure of all lakes over the survey period was 318.2 angler-hours/ha. Total harvest ranged from 24.5 kg/ha to 85.3 kg/ha, with a mean harvest of 50.4 kg/ha. There was not a significant correlation ($P \leq 0.05$, df = 7) for either harvest rates or success rates when correlated with pressure. Fishing success for all species combined ranged from 0.57 to 1.26 fish/hour with a mean success of 0.94 fish/hour, and 0.09–0.25 kg/angler-hour with a mean of 0.18 kg/angler-hour.

Bluegill was the most-sought-after species (Table 2), comprising 34.4% of the angling effort among all lakes, followed by crappie (27.3%), largemouth bass (20.3%), and channel catfish (5.9%). In 7 of the 9 surveys, the most sought after species was also that which yielded the highest success rate. Bluegill was the most sought after species in 7 lakes, crappie in 4 lakes, and largemouth bass was the most sought after species in only 1 lake.

Largemouth Bass

Largemouth bass harvest ranged from 4.7 kg/ha to 20.1 kg/ha, with a mean harvest of 11.5 kg/ha (Table 2). Success rates ranged from 0.10–0.80 fish/angler-hour with a mean of 0.49 fish/angler-hour. Correlation and regression coefficients were negative and significant when mean weights of bass creeled are correlated with success rates among all lakes ($P \leq 0.05$, df = 7, $r = -0.83$, $t = 2.929$), indicating that among lakes where fishermen were most successful in catching bass, the average size of the bass creeled tended to be small.

Largemouth bass was the third most sought after species by fishermen, comprising 20.3% of the mean effort among all lakes. Lakes Elmdale and Bob Kidd, which had relatively high harvest and success rates, also experienced relatively high

Table 1. Creel results of Arkansas state-lakes creel survey 1981–1982.

Lakes	Total pressure (hrs/ha)	Total harvested (kg/ha)	Success (*N*/hr)	Success (kg/hr)	Size (ha)
Elmdale[a]	410.1	74.1	0.81	0.17	56
Bob Kidd[a]	359.3	85.3	1.04	0.24	80
Frierson	416.3	43.8	0.57	0.10	134
L. White Oak[b]	130.5	24.5	0.75	0.19	486
U. White Oak[b]	163.8	41.0	1.19	0.25	321
Conway[a]	194.3	39.7	1.08	0.21	2,680
Mallard	618.5	54.0	0.7	0.09	120
Poinsett	250.3	38.4	1.1	0.15	200
Hogue	315.0	55.9	1.26	0.22	94
Mean	318.2	50.4	0.94	0.18	
SD	1,453.0	18.0	0.23	0.05	

[a]Values presented are an average of a 2-year creel survey period.
[b]Values presented from a 10-month creel survey period.

Table 2. Annual harvest, success, mean size, and percent effort of largemouth bass, crappie, and bluegill estimated from creel surveys conducted on 9 state-owned fishing in Arkansas, 1981–1982.

	Largemouth bass				Crappie				Bluegill			
Lakes	kg/ha	*N*/hr	Mean size (kg)	% Effort	kg/ha	*N*/hr	Mean size (kg)	% Effort	kg/ha	*N*/hr	Mean size (kg)	% Effort
Elmdale[a]	20.1	0.8	0.37	15.7	4.1	0.75	0.29	6.1	37.5	1.54	0.16	37.8
Bobb Kidd[a]	19.8	0.56	0.42	24.4	17.6	1.31	0.24	17.8	43.6	2.04	0.20	31.9
Frierson	13.6	0.66	0.29	17.8	7.9	0.41	0.15	31.5	16.6	0.90	0.14	37.0
L. White Oak[b]	9.7	0.50	0.31	48.7	1.1	0.20	0.38	10.8	12.3	1.25	0.22	35.2
U. White Oak[b]	13.2	0.69	0.39	30.2	7.8	0.94	0.23	22.2	19.4	1.77	0.16	42.9
Conway[a]	7.3	0.29	0.47	9.9	13.0	0.39	0.23	61.9	16.4	0.80	0.14	27.3
Mallard	4.7	0.10	0.83	9.3	31.1	1.00	0.10	52.4	11.3	0.40	0.15	28.6
Poinsett	7.7	0.3	0.62	15.3	17.8	1.20	0.12	5.1	9.6	1.5	0.1	26.5
Hogue	7.4	0.49	0.51	11.4	7.9	0.74	0.22	38.1	25.9	2.20	0.11	42.0
Mean	11.5	0.49	0.47	20.3	12.0	0.77	0.22	27.3	21.4	1.38	0.15	34.4
SD	5.3	0.21	0.16	11.9	8.6	0.35	0.08	19.1	11.3	0.56	0.04	5.8

[a]Values presented are an average of a 2-year creel survey period.
[b]Values presented from a 10-month creel survey period.

bass-angling efforts and yielded smaller than average size bass. Mallard Lake experienced low bass-angling effort and yielded low harvest and success rates, but yielded larger fish, as did Lake Conway and Lake Hogue. Lower White Oak Lake, the only lake where largemouth bass was the most sought after species, ranked fifth among lakes in bass harvest and sixth in success.

Crappie

Creel clerks did not always differentiate black crappie (*Pomoxis nigromaculatus*) from white crappie (*Pomoxis annularis*) while collecting survey data, and the species are combined in this paper. Crappie harvest ranged from 1.1 kg/ha to 31.1 kg/ha, with a mean of 12.0 kg/ha among all lakes (Table 2). The mean size of crappie creeled by anglers ranged 0.1–0.4 kg/fish. There was a negative and significant relationship correlation between mean weights of crappie and harvest rates ($P \leq 0.05$, df = 7, $r = -0.76$, $t = 3.1003$), indicating that lakes which yielded high crappie harvest rates did so by producing large numbers of small crappie.

Crappie-angling success rates ranged 0.20–1.31 crappie/angler-hour with a mean of 0.77 crappie/angler-hour. Lakes which yielded larger-than-average crappie also received the lightest crappie-angling effort. Lakes Lower White Oak, Elmdale, and Bob Kidd all yielded mean-sized crappie larger than the survey average, but anglers on these lakes spent less of their effort angling for crappie than the survey average. Lakes Conway, Mallard, and Hogue experienced relatively high crappie-angling effort, but these lakes yielded smaller crappie.

Bluegill

Bluegill harvest ranged from 9.6 kg/ha to 43.6 kg/ha. Mean bluegill harvest among all lakes was 21.4 kg/ha. Regression coefficient of bluegill mean sizes on harvest rates was not significant ($P > 0.05$, df = 7), indicating that the average size of harvested bluegills did not vary significantly with harvest rates among the 9 surveyed lakes. Bluegill-angling success rates ranged from 0.40 to 2.20 bluegill/angler-hour. Mean success rate was 1.38 bluegills/angler-hour among all lakes. Bluegill was the most sought after species among the surveys, comprising 34.4% of the total effort.

Channel Catfish

Channel catfish harvest ranged from 0.6 kg/ha to 8.6 kg/ha, with a mean of 2.8 kg/ha among all lakes (Table 3). Channel catfish were the least sought after species identified during the creel surveys, comprising only 5.9% of the total effort. Table 3 includes the total number of "catchable-sized" ($x = 0.2$–0.3 kg/fish) av channel catfish stocked into each lake by the Arkansas Game and Fish Commission during the creel surveys. The number of catfish harvested from surveyed lakes ranged from 7% to 108% of the total number stocked.

Table 3. Catfish creel survey results from 9 Arkansas state-owned public fishing lakes, 1981–1982.

Lake	kg/ha	*N*/hr	Mean size (kg)	% Effort	Total *N* harvested	*N* stocked
Elmdale[a]	8.6	0.19	0.72	10.5	1,143	3,490
Bob Kidd[a]	3.1	0.08	1.42	9.5	456	2,700
Frierson	2.6	0.12	0.52	9.8	641	1,500
L. White Oak[b]	1.1	N/A	0.29	0.1	1,972	1,800
U. White Oak[b]	0.6	N/A	0.45	N/A	402	1,800
Conway[a]	0.9	0.12	0.71	1.1	6,971	N/A
Mallard	3.6	0.20	0.45	5.6	946	880
Poinsett	1.3	0.3	0.42	3.9	642	1,836
Hogue	3.7	0.43	0.47	7.0	886	2,502
Mean	2.8	0.20	0.61	5.9		
SD	2.5	0.12		3.9		

[a]Values presented are an average of a 2-year creel survey period.
[b]Values presented from a 10-month creel survey period.

Discussion

Fishing pressure exerted on Arkansas state-owned public fishing lakes, while substantial, does not appear excessive. Jarmen et al. (1968) reported fishing pressure on 12 unmanaged state-owned public fishing lakes (11.4–72.0 ha) in Oklahoma ranging from 345 angler-hours/ha to 1,555 angler-hours/ha, with a mean of 950 angler-hours/ha. Rasmussen and Michelson (1974) reported small north-central Missouri impoundments typically receive an average of 741 to 1,235 angler-hours/ha. State-owned public fishing lakes in Alabama received an average of 1,167 angler-hours/ha (assuming a 3.5-hour average per angling trip) during a 14-year period (Byrd and Crance 1965), with some lakes receiving as much as 2,636 angler-hours/ha (Powell 1975). In comparison, the lakes in this survey received a mean pressure of 318.2 angler-hours/ha. The 2 most heavily fished lakes in the survey, Mallard Lake and Lake Frierson, are both located in heavily agriculturalized northeast Arkansas where alternative fishing resources are few.

Comparing the mean yields of this survey with those reported in national reservoir surveys illustrates the benefits of small, intensively managed public fishing lakes. Mean harvest, pressure, and success for 103 reservoirs >200 ha was 16.6 kg/ha, 76 angler-hours/ha, and 0.85 fish/hour, respectively (Jenkins and Morias 1971). Simple mean yields for 294 reservoirs over 200 ha, mostly located in the south, were 5.0 kg/ha black bass, 6.6 kg/ha crappie, and 4.6 kg/ha sunfishes (Jenkins 1982). Yields of these sportfish were substantially higher in this study (Table 2).

Significant negative relationships emerged between mean weights of fish creeled and their success rates (bass) and harvest rates (crappie), suggesting the existence of a quality-size versus numbers trade-off. In lakes where anglers enjoyed relatively high success and harvest rates, the mean size of the fish creeled tended to

be small. Within lakes, anglers tended to allocate fishing effort towards those species that yielded the higher success rate. Intuitively this trade-off should exist since the basic capacity of a specific lake to produce bass and crappie is generally limited by environmental parameters (Jenkins 1982, Hill 1984) and population structure can vary between large numbers of small, often slow-growing fish, or fewer numbers of larger fish (Hackney 1975). Traditional management of small impoundments in Arkansas has centered on maintaining population structures that optimize the number of "harvestable-sized" fish based on the stock-structure models developed by Swingle (1950).

Angler preference for bluegill and crappie indicated by these surveys contrasts with the results of a 1984 questionnaire survey of Arkansas anglers (Heller 1985). Anglers responding statewide and fishing all types of waters identified largemouth bass as the most sought after species. Bluegill, or bream, was ranked fifth, behind crappie, catfish, and trout. The creel surveys indicate that state-owned fishing lakes are drawing a specific clientele of bluegill and crappie anglers, and management efforts should be directed toward producing quality stocks of these fish. Novinger and Legler (1978) and Gabelhouse (1984) present functional management strategies for obtaining desired bluegill and crappie Proportional Stock Densities (Anderson and Gutreuter 1983) by emphasizing the predation of Age I bluegills and crappie by bass under restrictive length or slot limits. Ellison (1984) keyed maximizing the production of harvestable crappie to prey management. Obviously, quality as well as quantity is most desired. But more importantly, management goals should be fishery-specific and realistic within environmental constraints. The 9 surveys in this study illustrated broad differences existing between the angler use and yield of Arkansas state-owned lakes. To what extent inherent differences in each lake's capacity to produce fish-dictated angler use is unknown. However, management efforts designed to increase the satisfaction of anglers on Mallard Lake may be of little benefit for anglers using Lower and Upper White Oak Lake.

The relatively low angling effort directed at channel catfish is surprising. Heller's (1985) angler survey identified catfish as the third most sought after species among anglers statewide. The low efforts expended by angler identified in the creel surveys can be justified to Heller's results by assuming either the majority of catfish angling effort on state-owned lakes is expended at night, which the creel surveys did not measure, or catfish anglers are seeking the species in waters other than state-owned fishing lakes. Even at relatively low angling effort, the creel surveys indicate that catfish harvest ranged from 7% to 108% of the total number of catchable-sized channel catfish stocked in each lake during the survey period (Table 3). The Arkansas Game and Fish Commission engages in an extensive channel catfish grow-out program that allows the creation of an "instant fishery" of a species that typically experiences very poor recruitment in state-owned fishing lakes (Broach 1967). Supplemental stocking may be the sole influence sustaining the catfish fishery in these lakes.

Arkansas state-owned fishing lakes serve a large number of anglers. Identifi-

cation of angler preference and utilization of these moderate-sized impoundments should aid managers in planning future management programs. This study indicates that angling efforts in state-owned lakes vary, but are most often directed towards bluegill and crappie. Fishery-specific management programs should be tailored towards individual lakes when possible, as opposed to statewide applications, to obtain management goals and increase angler satisfaction.

Literature Cited

Anderson, R. O. and S. J. Gutreuter. 1983. Length, weight, and associated structural indices. Pages 283–300 *in* L. A. Nielson and D. L. Johnson, eds. Fisheries techniques. Am. Fish. Soc., Bethesda, Md.

Broach, R. W. 1967. Arkansas' catchable catfish program. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 21:445–451.

Byrd, I. B. and J. H. Crance. 1965. Fourteen years of management of fishing success in Alabama's state-owned public fishing lakes. Trans. Am. Fish. Soc. 94:129–134.

Ellison, D. G. 1984. Trophic dynamics of a Nebraska black crappie and white crappie population. North Am. J. Fish. Manage. 4:355–364.

Gabelhouse, D. W., Jr. 1984. An assessment of crappie stocks in small midwestern private impoundments. North Am. J. Fish. Manage. 4:371–384.

Hackney, P. A. 1975. Bass populations in ponds and community lakes. Pages 131–139 *in* R. H. Stroud and H. Clepper, eds. Black bass biology and management. Sport Fishing Inst., Washington, D.C.

Heller, K. L. 1985. Arkansas fishing survey 1984. Ark. Game and Fish Comm., Little Rock. 30pp.

Hill, K. R. 1984. Correlation of total and "angler-acceptable" crappie standing stocks with lake basin slopes and siltation indexes. North Am. J. Fish. Manage. 4:350–354.

Jarman, R., C. Bennett, C. Collins, and B. E. Brown. 1968. Angling success and recreational use of twelve state-owned lakes in Oklahoma. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 21:484–495.

Jenkins, R. M. 1982. The morphoedaphic index and reservoir fish production. Trans. Am. Fish. Soc. 111:133–140.

Jenkins, R. M. and D. I. Morias. 1971. Reservoir sport fishery effort and harvest in relation to environmental variables. Pages 381–384 *in* G. E. Hall, ed., Reservoir fisheries and limnology. Am. Fish. Soc. Spec. Publ. 8, Bethesda, Md.

Malvestuto, S. P. 1983. Sampling the recreational fishery. Pages 397–419 *in* L. A. Nielson and D. L. Johnson, eds. Fisheries techniques. Am. Fish. Soc., Bethesda, Md.

Novinger, G. D. and R. E. Legler. 1978. Bluegill population structure and dynamics. Pages 37–49 *in* G. D. Novinger and J. B. Dillard, eds. New approaches to the management of small impoundments. Am. Fish. Soc. Spec. Publ. 5, Bethesda, Md.

Powell, D. H. 1975. Management of largemouth bass in Alabama's state-owned public fishing lakes. Pages 386–390 *in* R. H. Stroud and H. Clepper, eds. Black bass biology and management. Sport Fishing Inst., Washington, D.C.

Rasmussen, J. L. and S. M. Michaelson. 1974. Attempts to prevent largemouth bass overharvest in three northwest Missouri impoundments. Pages 69–83 *in* J. Funk, ed. Symposium on overharvest and management of largemouth bass in small impoundments. Am. Fish. Soc. Spec. Publ. 5, Bethesda, Md.

Swingle, H. S. 1950. Relationships and dynamics of balanced and unbalanced fish populations. Auburn Univ. Agric. Exp. Sta. Bul. 274, Auburn. 74pp.

Van Den Avyle, M. J. 1986. Measuring angler effort, success, harvest. Pages 57–64 *in* G. E. Hall and M. J. Van Den Ayle, eds. Reservoir fisheries management: strategies for the 80's. Am. Fish. Soc., Bethesda, Md.