To the Graduate Council:

I am submitting herewith a thesis written by Rowland Glenn Thomas entitled "Effects of Fish Attractors on Sport Fishing Success on Norris Reservoir, Tennessee." I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Wildlife and Fisheries Science.

J. Larry Wilson

J. Larry Wilson, Major Professor

We have read this thesis
and recommend its acceptance:

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Accepted for the Council:

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Vice Chancellor
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# EFFECTS OF FISH ATTRACTORS ON SPORT FISHING SUCCESS ON NORRIS RESERVOIR, TENNESSEE

A Thesis

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Degree

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Rowland Glenn Thomas

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## ABSTRACT

A creel survey was conducted in 1980 on Norris Reservoir, Tennessee, from March through October to assess the effects of artificial fish attractors (also known as hides, havens, shelters, or reefs) on fisherman success. An average of 9.8 brush-pile attractors were installed in each of 259 coves in the lake by Tennessee Valley Authority (TVA) and Comprehensive Employment Training Act (CETA) personnel between 1978 and 1980. The 7.5-month creel survey yielded 1435 party interviews, separating those fishermen who had fished only attractor areas (115 individuals) from those who had fished other areas exclusively (2582), and those who had fished both attractor and non-attractor sites (358). Ten species of fish were caught by attractor fishermen, whereas non-attractor fishermen caught specimens of 19 species, and those who had fished both area types on the same day accounted for 15 species. Comparisons of attractor and non-attractor creels indicated that percent successful, mean number of fish caught, mean fish per man-hour, and mean kilograms per man-hour were all significantly higher for attractor fisherman (t-test, $\alpha = .05$). Analysis of variance showed that those fishermen angling primarily for crappie (*Pomoxis spp.*) caught significantly more fish per man-hour and kilograms per man-hour ($\alpha = .01$) on attractors, contributing most to the higher overall success rates for attractor fishermen.

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# CHAPTER I

## INTRODUCTION

Fisheries biologists and fishermen have long recognized that underwater structures tend to attract fish. Where natural cover is sparse, the placement of artificial fish attractors (shelters, hides, havens, or artificial reefs) has been used to concentrate desirable species for sport and commercial fishing utilization, while contributing more or less positively to a number of other biotic parameters. Experimentation has been conducted on attractors' effects on primary production, fish production, and fish spawning, survival, and condition. These studies document the reasons that "fish seem to find there (in shelters) something which meets their instinctive environmental needs, and which is probably conducive to their general well-being and growth" (Hubbs and Eshmeyer 1938).

In this country, study of the effects of man-made concentrators has been done largely in the last 50 years (Pierce and Hooper 1979); though in the coastal waters of Japan, artificial reefs were constructed and studied as early as 1800 (Stone 1978). The efficacy of artificial structures in concentrating fish in any structureless water, be it coastal marine areas or clear-cut multipurpose reservoir, has since been well documented (Stroud 1975). This study examines the possible changes in sportfishing success attributable to the placement of brush fish attractors in such a reservoir.

Specific objectives were to evaluate: 1) the amount and nature of attractor use by fishermen, 2) the relative success of fishermen in attractor and non-attractor areas, 3) differences in the composition of the catches made in attractor areas, non-attractor areas, and in both area types, and 4) the condition of the attractors after several cycles of inundation and drying.

## CHAPTER II

## LITERATURE REVIEW

Research on fish habitat improvement in lakes begun in this country about 1930 (Hubbs 1930), the "undersized twin" to stream improvement (Hazzard 1937). Additional shelter was thought to be desirable largely for the protection of young game fish (Hubbs et al. 1933; Eschmeyer 1938). The tendency for larger fish to be attracted was also recorded (Hubbs et al. 1933; Rodeheffer 1939, 1940, 1945).

The study of the effects of man-made attractors has centered largely on simple fish population enumeration. Rodeheffer (1939, 1945) pioneered this work in this country by encircling brush shelters with seines and dragging the lot ashore, or by raising the shelter above the nets with a floating hoist. Attractors have since been monitored by underwater observation (Manges 1959; Pierce 1966; Thomas et al. 1968; Brouha 1974; Majure 1977; Prince 1977; Reeves et al. 1977; Janisch 1978) as well as by fish collection. Gill nets (Manges 1959; Brouha 1974; Prince 1977), traps and hoop nets (Manges 1959; Pierce 1966; Brouha 1974), rotenone (Manges 1959; Chapman 1975; Pierce and Hooper 1979) and electrofishing (Prince 1977; Wilbur 1978) have been used. Most studies have found significantly more fish at attractor sites, regardless of enumeration method.

Evaluation by relative angling success has been made with controlled experimental fishing (Manges 1959; Patriarche 1959; Pierce 1966; Wilbur and Langford 1971, 1972, 1973; Vaughn et al.

1974; Paxton and Stevenson 1979; Hickman (unpublished Tennessee Valley Authority (TVA) report 1980) and by public creel surveys (Sheridan 1957; Manges 1959; May 1968; White 1974; Chapman 1975; Wilbur and Langford 1971, 1972, 1973; Wilbur and Crumpton 1975). Catch rates were generally higher at attractors (Table 1), but some controlled fishing did not result in significantly better catches at attractor sites (Patriarche 1959; Hickman (unpublished TVA report 1980)).

Many effects of man-made attractors other than the general concentration of fish have been described. In support of the beliefs of the earliest researchers, recent studies have shown that added cover probably does increase short-term survival of certain young-of-year fishes (Aggus and Elliot 1975; Strange et al. 1982). Shelters are used by some fish for spawning: spotted bass (Micropterus punctulatus) and largemouth bass (M. salmoides) (Vogele and Rainwater 1975) and white catfish (Ictalurus catus) (Prince 1977). The establishment of awfwuchs communities on the added structure increases primary production (Prince et al. 1976) and in some cases produces increased growth rate and condition factor of centrarchids (Swingle 1968; Pardue 1973; Prince 1977; Wege and Anderson 1979). In fact, periphyton can be the predominant food item of bluegills (Lepomis macrochirus) which inhabit artificial reefs (Prince 1977).

Freshwater fish attractors have been constructed of brush, logs, tires, car bodies, cement blocks, pipes, tiles, stone, rubble, and combinations of these materials. Comparisons have shown that brush is usually as good, or better than, other materials for

Table 1. Fishing success for selected waters of the United States artificial reefs versus nonreef areas[a] (from Prince, Raleigh, and Corning 1975).

| Fish and Lake | Source | State | Reefs: Controls | Reefs: Entire Lake |
|---|---|---|---|---|
| Sunfish | | | | |
| Smith Mountain | Prince (1975) | Va. | 2.18:1 | -- |
| Concord[b] | | N.C. | | 1.98:1 |
| Tohopekaliga | Wilbur and Crumpton (1974) | Fla. | -- | 1.5:1 |
| Sutton | | W.Va. | -- | 2.0:1 |
| Centrarchid basses | | | | |
| Smith Mountain[b] | Brouha (1974) | Va. | 2.60:1 | -- |
| Sutton | Pierce (1966) | W.Va. | -- | 1.90:1 |
| Largemouth bass | | | | |
| Tohopekaliga[b] | Wilbur and Crumpton (1974) | Fla. | -- | 1.67:1 |
| Crappie | | | | |
| Sutton | Pierce (1966) | W.Va. | -- | 4.8:1 |
| Holliday | Sheridan (1957) | Va. | -- | 1.45:1 |
| Kentucky | Petit (1972) | Tenn. | 3.67:1 | -- |
| Tohopekaliga | Wilbur and Crumpton (1974) | Fla. | -- | 2.57:1 |
| All fish | | | | |
| Fort Loudon | Manges (1959) | Tenn. | 4.60:1 | -- |
| Sutton | Pierce (1966) | W.Va. | -- | 3.31:1 |
| Smith Mountain[b] | Brouha (1974) | Va. | 2.91:1 | -- |
| Knox | Moseley (1961) | Ohio | 2.42:1 | 3.01:1 |
| Devoe | Patriarche (1959) | Mich. | 1.31:1 | -- |
| Millerton | Christensen (1960) | Calif. | 1.20:1 | -- |
| Lowery | Wilbur and Crumpton (1974) | Fla. | 1.86:1 | -- |
| Perch | Wilbur and Crumpton (1974) | Fla. | -- | 9.48:1 |
| Magnolia | Wilbur and Crumpton (1974) | Fla. | -- | 19.00:1 |
| Wildcat | Wilbur and Crumpton (1974) | Fla. | -- | 34.33:1 |
| Dias | Wilbur and Crumpton (1974) | Fla. | 13.33:1 | 40.00:1 |

[a]Based on catch per fisherman per hour.

[b]Statistically significant data $P > 0.05$.

attracting fish (Wilbur 1974, 1978; Forshage and Moore 1975; Pierce and Hooper 1979).

Since brush can often be cut on-site, it is generally the most inexpensive and convenient attractor material. The longevity of constantly-inundated brush is remarkable. Thomas et al. (1968) found that the brush shelters placed in Douglas Lake, Michigan, by Rodeheffer 30 years earlier were concentrating about the same numbers of fish that they had when new, though they had broken down to some degree. These shelters appeared to have caused increased accumulation of sediment in their immediate vicinity, accompanied by denser stands of aquatic macrophytes.

Shape and interstice size appear to be of primary concern in attractor construction. Large, loosely built structures (Hubbs and Eschmeyer 1938; Rodeheffer 1945; Manges 1959; Chapman 1975) with significant vertical profile (Prince et al. 1975) have been found best for concentrating larger fish.

Depth and season also affect fish use; littoral shelters often hold reduced fish populations during winter (Vaughn et al. 1974; Wilbur 1974; Prince and Maughan 1979a) or in the event of their location in oxygen-deficient strata (Majure 1977).

CHAPTER III

DESCRIPTION OF STUDY AREA

Norris Reservoir (Plate I, In Pocket) is a 13840 hectare storage impoundment located about 42 km northwest of Knoxville, Tennessee. The bifurcate reservoir extends 116 km up the Clinch River basin, and 90 Km up the Powell River basin, as well as backing up many smaller tributaries. It was completed in 1936, the first Tennessee Valley Authority (TVA) dam to be closed. The floodplain was clearcut prior to impoundment, as was standard practice.

Total area of the Norris watershed is 7542 $km^2$, largely woodlands. Normal pool is at 310.9 m, but fluctuations of over 9 m in a year are common. The lake's mean depth is 22.9 m. A relatively clear, mesotrophic impoundment, visibility reaches 3 m at times.

Norris is located in the ridge and valley physiographic province of East Tennessee. Its banks are largely composed of limestone and dolomite bluffs and weathered shale ridges, with some clay/silt residuum banks and flats. Most coves are narrow and deep.

Aquatic macrophytes and emergent vegetation are extremely rare, as is large allocthanous detritus. Combined with the pre-impoundment basin clearing, these factors result in a significant lack of substrate for the attachment of periphyton (Prince et al. 1979).

In 1977 TVA, in cooperation with the Tennessee Wildlife Resources Agency (TWRA), began construction of fish attractors in

Norris. Crews of Comprehensive Employment Training Act (CETA) personnel and Young Adult Conservation Corps (YACC) personnel worked with TVA Water Resources supervision to build and place attractors. Coves were used exclusively; each site received an average of 9.8 weighted brushpiles in a line down the middle of the cove (Figure 1). Brush units were low-profile (generally less than 1 m high) and up to 7 m in diameter. Brush (mostly hardwood) cut on-site supplied almost all the attractor material, with tires used only occasionally. A tree at the head of each attractor cove was painted with a 2 m white stripe to identify the site. By 1980, 259 sites had been completed.

TVA has a schedule of ongoing cove rotenone surveys of Norris Lake. The 1979 inventory, which compared attractor and non-attractor coves, sampled 5.4 hectares and produced an overall average of 288.6 kilograms of fish per hectare (Brown, unpublished TVA report, 1980). About 40% were angler-sought species: bluegill (*Lepomis macrochirus*), white crappie (*Pomoxis annularis*), black crappie (*P. nigromaculatus*), smallmouth bass (*Micropterus dolomieui*), spotted bass (*M. punctulatus*), largemouth bass (*M. salmoides*), rock bass (*Ambloplites rupestris*), white bass (*Morone chrysops*), striped bass (*M. saxatilis*), channel catfish (*Ictalurus punctatus*), flathead catfish (*Pylodictis olivaris*), walleye (*Stizostedion vitreum*), sauger (*S. canadense*), and muskellunge (*Esox masquinongy*).

Gizzard shad (*Dorosoma cepedianum*) were the predominant forage species, but threadfin shad (*D. petenense*) are common when winters are not as severe as was the winter of 1978/1979 (none

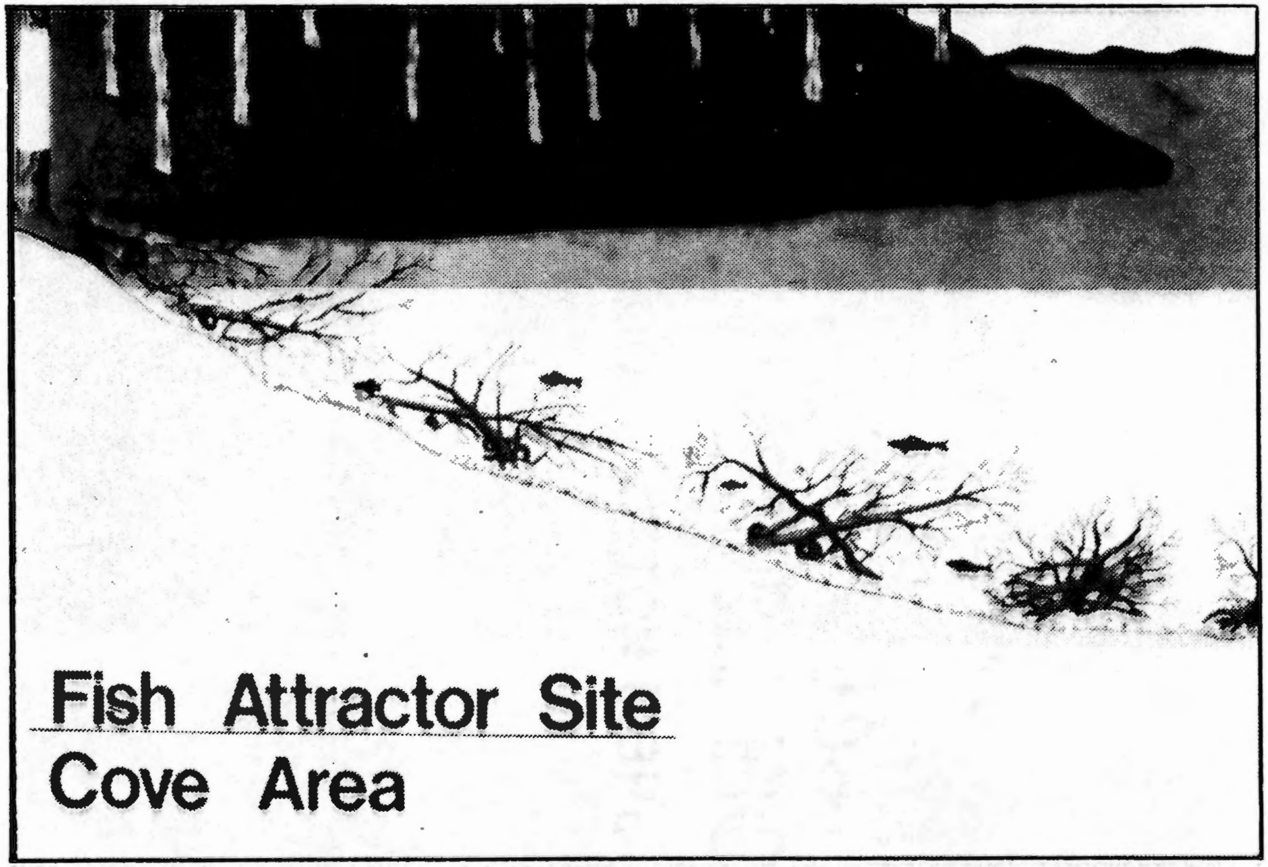


Figure 1. Schematic representation of typical Norris attractor site.

were collected in the 1979 inventory). Bluntnose minnows (*Pimephales notatus*) were abundant (Appendix A).

# CHAPTER IV

## METHODS

In January and February 1980, attractor coves were examined and marked at the position of the deepest attractor unit. With winter drawdown, most of the attractors in each cove were exposed; submerged units were located with a flasher-type depthfinder. A shoreline tree adjacent to the deepest unit was flagged with surveying tape to delineate the extent of each attractor area.

From 1 March through 15 October a survey of fishermen was taken by boat. The lake was divided into six areas of approximately 2307 full-pool hectares, each about as large as could be covered in 6 hours. Morning surveys were for the 6 hours after dawn and afternoon surveys included the 6 hours before sunset. Days worked (5 of 7), sample time (morning or afternoon), and area of the lake were selected at random by computer.

The following information was recorded for each interview (Appendix B):

1. Area (Plate I, In Pocket)
    a. The Cove Creek embayment (Cove Creek Kilometer (CC Km) 0, at the dam (CC Km 23), the Big Creek embayment (BC Km 0-25), and the Clinch/Powell embayment to their confluence (CR Km 128.7-143.2) (Area 1)
    b. The Powell River embayment, from its mouth to Brassfield Bend (PR Km 0-35.4) (Area 2)

c. The Powell embayment above Brassfield Bend (PR Km 35.4-75.7) (Area 3)

d. The Clinch/Powell confluence ("Forks of the River") up the Clinch through Lost and Mill Creeks ("Loyston Sea") (CR Km 143.2-167.3) (Area 4)

e. The Clinch embayment from Poor Land Creek to Highway 33 bridge (CR Km 167.3-193.9) (Area 5)

f. The Clinch embayment above Highway 33 (CR Km 193.9-241.7) (Area 6)

2. Sub-area:

   a. Having fished attractor area(s) exclusively

   b. Having fished non-attractor area(s) exclusively

   c. Having fished both attractor and non-attractor areas

3. Time of interview

4. Number of hours fished

5. Boat or bank fishing

6. Number of fishermen in the party

7. Number successful: Where success was defined as the taking of at least one fish deemed worth keeping by the fisherman

8. Primary species (or groups; as "crappie," "walleye/sauger," "catfish") sought

9. Number and aggregate weight of each species in a party's creel

10. Knowledge and usage of attractor sites by the fishermen

The data were transcribed, keypunched, recorded on disc, and analyzed using the Statistical Analysis System (SAS).

Four values were obtained for the comparison testing of the catches made in attractor and non-attractor areas. The percentage successful was defined as the number of successful fishermen in a party divided by the total number in the party (x 100%). Mean fish per man at the time of interview was the total number of fish in a party's creel divided by the number in the party. Mean fish per man-hour was the total number of fish caught divided by the number of man-hours fished by that party. Kilograms per man-hour was the sum of weights of all fish caught divided by the total number of man-hours fished by that party.

The comparison of the catches of attractor and non-attractor fishermen was first made by computing the means for the four terms just described for both groups, and testing by t-test (at least 95% probability level). Grouping fishermen according to species group sought results in a more precise analysis of catch rates (Davis and Hughes 1965; Lambou 1966). The catch rates (in fish per man-hour and kilograms per man-hour) of these sub-groups were compared by two-way analysis of variance, and tested at 99% probability levels. The mean weights of each species taken in attractor areas and elsewhere were compared at the 95% level (t-test).

# CHAPTER V

# RESULTS AND DISCUSSION

## Fisherman Use of Attractors

During the study period, 1435 fishermen interviews were taken from parties totalling 3055 fishermen. Fifty-eight party interviews were taken from 115 attractor fishermen. Eighty-four percent of the interviews taken (1201 parties, 2582 fishermen) were from people who had fished areas other than attractor sites. A total of 176 parties (358 fishermen) had fished both attractor sites and non-attractor areas.

The low number of parties found to have fished only attractor sites may be attributed to several factors, including: 1) the necessity of excluding from this category any fishermen who may have fished outside the attractor area(s). The both-area fisherman group by design included most highly mobile anglers, such as trollers and shoreline casters, whereas the attractor group was composed largely of stationary bait fishermen; 2) the fisherman's frequent lack of knowledge of the attractors. Although 43.3% of the interviewees reported that they had made use of the attractors, many of these added that they fished them only in the spring for crappie. Experienced fishermen often had good fishing spots selected long before the attractors were installed, as was found by Crumpton (1972) and Wilbur (1978). In fact, some Norris fishermen had placed their own unmarked fish attractors and spurned public sites.

Inexperienced fishermen often thought that the shallowest attractor units (the only ones easily located at the high water levels common to late spring and summer) were the only brushpiles in the coves; and 3) tradition and location. Many fishermen had found the best fishing to be on the points and banks near the channel, and rarely fished in coves. Some fishermen also fished only in the headwater sections of the reservoir, where coves (and attractor sites) were rare.

Boat/bank fishing. The highest percentage of bank fisherman parties in the three area types was in the non-attractor group (20.5%).

| Percent of Each Group (Number of Parties) | Attractor | Non-Attractor | Both |
|---|---|---|---|
| Boat | 84.5 (49) | 79.5 (599) | 98.3 (173) |
| Bank | 15.5 ( 9) | 20.5 (246) | 1.7 ( 3) |

This would be expected, since attractor coves constitute only a small fraction of total bank area, and most are inaccessible from the bank. The bank fishermen who did fish attractor sites did so more because the area was easily accessible than because it contained brushpiles. Few bank fishermen (3 parties) were mobile enough to fish both attractor and non-attractor areas. The percentages of fishermen who fished from boats were similar enough in attractor (84.5) and non-attractor (79.5) areas to preclude the possibility that this was an important bias favoring one group over the other.

## Relative Fisherman Success

Overall success. Four measures of relative success for attractor and non-attractor fishermen are compared in Table 2.

Table 2. Overall success, including all fishermen in the two discrete-area groups.

| Evaluation | Attractor Fisherman (N=115) | Non-Attractor Fishermen (N=2582) |
|---|---|---|
| Percent successful | 56.75[a] | 33.69 |
| Mean fish per man | 3.07[a] | 1.32 |
| Mean fish per man-hour | 1.96[a] | 0.63 |
| Mean kilograms per man-hour | 0.44[b] | 0.16 |

[a]Significantly higher, $\alpha = .01$.

[b]Significantly higher, $\alpha = .05$.

Attractor fishermen were significantly more successful (t-test, $\alpha = .05$) than were non-attractor fishermen, by each evaluation: 1) percent successful, 2) mean fish per man, 3) mean fish per man-hour, and 4) mean kilograms per man-hour. Indications are that: 1) greater mean catch rates on attractors were not the result of a few inordinately successful fishermen, 2) attractor fishermen had more fish in their creels, 3) those fish were taken at a faster rate than were the fish taken in non-attractor areas, and 4) the greater catch on attractors was not comprised of higher numbers of much smaller fish.

Catch rates of species-sought groups. The results of testing the primary-species-sought success rates of attractor and non-attractor fishermen are presented in Table 3. Analysis of variance indicated that the catch rates for attractor-area crappie fishermen were principally responsible for the overall higher catch rates of attractor fishermen. The only catch rates that differed significantly between the two types were for the crappie fishermen (2.64 fish per man-hour versus 1.01 fish per man-hour; 0.45 kilograms per man-hour versus 0.19 kilograms per man-hour), and catfish, which showed 4.1 kilograms per man-hour on attractors, due to a single exceptional catch. Sample size was too low to effectively evaluate significance between catch rates for catfish fishermen, as well as for sunfish fishermen. Fishermen seeking fish of any species outside attractor areas caught fish (and tallied kilograms) slightly more often than did that group of fishermen in attractor coves. Bass fishermen may have been slightly more successful on attractors.

Mean trip length at time of interview. Since significant variation in mean trip length between attractor, non-attractor, and both-area fishermen could contribute bias in catch-rate determination, a Duncan's multiple range test was computed for those means. Mean trip length was 2.09 hours for attractor fishermen, 2.39 hours for non-attractor fishermen, and 3.77 hours for those fishermen who had fished both area types. There was no significant difference ($\alpha = .05$) between the means for attractor and non-attractor parties,

Table 3. Catch rates for primary-species-sought fisherman groups.

| Primary Species Group Sought | Variable[a] | Attractor Catch Rate | N | Non-Attractor Catch Rate | N |
|---|---|---|---|---|---|
| Any fish | FMH | 0.35 | 26 | 0.51 | 833 |
| | KMH | 0.03 | 26 | 0.08 | 833 |
| Crappie | FMH | 2.64[b] | 74 | 1.01 | 539 |
| | KMH | 0.45[b] | 74 | 0.19 | 539 |
| Bass | FMH | 0.22 | 10 | 0.15 | 403 |
| | KMH | 0.15 | 10 | 0.09 | 403 |
| Sunfish | FMH | 0.50 | 2 | 2.60 | 202 |
| | KMH | 0.04 | 2 | 0.27 | 202 |
| Catfish | FMH | 0.80 | 1 | 0.56 | 35 |
| | KMH | 4.11[b] | 1 | 0.29 | 35 |

[a]FMH = mean fish per man-hour.
KMH = mean kilograms per man-hour.

[b]Significantly greater, $\alpha = .01$, where ANOVA shows a probability of greater F = .0001.

but both-area fishermen averaged significantly longer times on the water at the time of interview. It would be expected that, on the average, it would take somewhat longer to fish both area types. Since catch rate testing was conducted only on the two non-overlapping groups of fishermen, the significant difference for the mean trip length of both-area fishermen was not considered relevant to the analysis.

## Catch Composition

Overall species diversity. Attractor fishermen took 310 fish of 10 species, while non-attractor fishermen took 3400 fish of 19 species (Appendix C). Both-area fishermen caught 543 fish of 15 species.

The large species diversity in the creel from non-attractor areas was likely a result of both heavier pressure in these areas and the use of more varied fishing techniques there. These variables would explain the intermediate range species diversity (16) in the creel of both-area fishermen, the group which accounted for the intermediate amount and variability (in type) of effort. Rotenone sampling (Chapman 1975; Brown (unpublished TVA report, 1980)) has indicated about the same number of species in attractor and non-attractor areas. Prince (1977) found that "the frequency of sport fishes on the reefs generally coincided with their overall abundance in the impoundment."

In this study, as in others (Manges 1959; Pierce 1967; White 1974), crappie comprised by far the largest part of the catch on attractors (Table 4). Seventy-four percent of the catch from attractors was crappie, of which 14% were black crappie. Only 8% of the crappie taken elsewhere were black crappie.

Table 4. Catch composition of each area type expressed as the percentage of the total number of fish caught in that area type.

| | Percent of Catch | | |
|---|---|---|---|
| | Attractor Area(s) | Non-Attractor Area(s) | Both Area(s) |
| Crappie | 74.2 | 39.0 | 48.6 |
| Bluegill | 17.7 | 44.8 | 25.6 |
| Largemouth Bass | 1.3 | 1.4 | 2.0 |
| Smallmouth Bass | 1.0 | 3.2 | 3.5 |
| Spotted Bass | 0.6 | 0.8 | 1.7 |
| Walleye & Sauger | 0.3 | 1.4 | 7.2 |
| Flathead Catfish | 3.6 | 1.1 | 0.4 |
| Channel Catfish | 0.6 | 3.0 | 7.2 |
| White Bass | 0.0 | 2.2 | 1.3 |
| Striped Bass | 0.0 | 0.7 | 0.0 |
| Other[a] | 0.7 | 2.4 | 2.9 |
| | 100.0 | 100.0 | 100.0 |

[a]Longnose gar, carp, redhorse, drum, other sunfishes, rock bass, turtles.

Bluegills made up the largest part of the non-attractor catch, at almost 45%, and the second largest part of the attractor catch (17.7%), even though only one party was angling on attractors primarily for sunfish. As with crappie, the bluegill catch of both-area fishermen was intermediate to the other groups.

Here again, effort toward crappie in attractor coves (mainly with minnows for bait) contributed to the higher crappie and lower bluegill catches there. The more frequent use of worms and crickets for non-attractor fishing, as well as the habit of Norris bluegill fishermen to concentrate their efforts on sandy bends and rocky ledges near the channel helped account for the greater bluegill catches in non-attractor areas.

The centrarchid basses comprised a larger percentage of the catch of both-area fishermen than of the other two groups; most successful bass fishermen moved along more or less constantly. Smallmouth bass were the principal bass taken by non-attractor and both-area fishermen, and largemouth bass were taken more often than other basses on attractor sites. Spotted bass appeared least frequently in the creel from all three area types. These results are in line with the reported tendencies for largemouth bass to orient to underwater structures (Prince and Maughan 1979b), for smallmouth bass to stay near rocky substrates and open water, and for spotted bass to be distributed over various types of habitat (Eschmeyer 1944).

Walleye were seen nine times more often than sauger in the overall creel. Walleye and sauger were an important part (7.2%) of the catch of both-area fishermen, as were channel catfish (7.2%). Many walleye fishermen were quite successful trolling in and out of deep attractor coves, which amounted to almost all of the fisherman usage of the deeper attractor units. Walleye/sauger fishermen also took many of the both-area channel catfish with this trolling pattern, especially when the "junebug spinner and nightcrawler" rig was used.

A few excellent catches of large flathead catfish (mean weight 3.6 Kg) were made in attractor areas, which accounted for 3.6% of the total number of fish caught there, and 45.0% of the total weight. It might be expected that attractor areas would provide excellent forage for the large, piscivorous flatheads, since attractor areas held many times the number of small, non-pelagic fishes (up to 2540 bluegills under 125 mm per hectare (Brown, unpublished TVA report 1980)) that non-attractor coves held (Appendix A).

White bass, often considered an open-water fish, indeed appeared most often in the catch from non-attractor areas. They were not sought as the species of primary intent by any attractor fishermen (see page 26).

Comparison to rotenone inventory. The 1979 Norris rotenone study was conducted by TVA in August and September. Ten cove sites were sampled, including five adjacent pairs of attractor and non-attractor coves (Brown, unpublished TVA report, 1980). Approximately 5.4 total hectares were blocked off and treated. Attractor coves yielded 337.9 kilograms per hectare (all fish), whereas those without attractors produced 232.4 kilograms per hectare. Attractor sites held over four times the "harvestable" fish that the non-attractor coves yielded (see Appendix D for sizes).

The species composition of the primary fishes found in the creel compared to the harvestable-sized fish of those species found in the rotenone study is presented in Table 5. Species composition

Table 5. Species composition of anglers' creel compared to composition of 1979 rotenone survey expressed as the percent of the total number of fish caught in that area type.[a]

| Species | Attractor Coves Creel | Attractor Coves Rotenone | Rest of Lake Creel | Non-Attractor Coves Rotenone |
|---|---|---|---|---|
| White Crappie | 63.5 | 11.2 | 35.8 | 6.1 |
| Black Crappie | 10.7 | 5.4 | 3.2 | 1.0 |
| Bluegill | 17.7 | 73.7 | 44.8 | 79.3 |
| Largemouth Bass | 1.3 | 0.7 | 1.4 | 0.7 |
| Smallmouth Bass | 1.0 | 0.7 | 3.2 | 2.5 |
| Spotted Bass | 0.6 | 0.5 | 0.8 | 2.5 |
| Walleye | 0.3 | 2.2 | 1.2 | 0.8 |
| Sauger | -- | 0.02 | 0.2 | 0.2 |
| Flathead Catfish | 3.6 | 0.9 | 1.1 | 0.3 |
| Channel Catfish | 0.6 | 1.2 | 3.0 | 1.4 |
| White Bass | -- | 2.6 | 2.2 | 2.7 |
| Striped Bass | -- | -- | 0.7 | 0.1 |
| | 99.3 | 99.3 | 97.6 | 97.6 |
| | 0.7 | 0.7 | 2.4 | 2.4 |
| | 100.0 | 100.0 | 100.0 | 100.0 |

[a]Percentage of harvestable-sized rotenoned fish species calculated to equal total of important species in creel.

of the rotenone sample was calculated to match the percentage total of the more important species in the creel; 0.7% (attractor) and 2.4% (non-attractor) of less frequently caught fish were not included in the comparison.

The selectivity of fishing pressure for crappie was evident. Attractor fishermen's creel contained 74.2% crappie out of a total fish population which could have been nearer 16.6% harvestable crappie.

Bluegills comprised by far the largest part of the harvestable rotenoned fish in all areas. They were found in attractor coves 4.2 times as often in the rotenone inventory as in the attractor creel, and 1.8 times as often in the rotenone take from non-attractor coves as from the non-attractor creel.

Comparison of these figures should be made with caution, however. Habit and tradition are important factors in the fisherman catch. A predominance of attractor fishing hours were logged in spring crappie fishing, when these fish congregated in protected coves to spawn (Pflieger 1975) and perhaps to also exploit high densities (1565 per hectare, Appendix A) of bluntnose minnows in Norris attractor coves. Many fishermen rarely fished in coves during the rest of the year. The rotenone study, made in early fall, by necessity included only cove locations.

Fisherman selectivity was another factor separating the creel composition from the make-up of the total fish population. Though many fishermen would not consider 126 mm bluegills harvestable

(Appendix D), bluegill (and walleye) were probably underexploited species in attractor cove populations. White bass, found in significant numbers in the rotenone kill of attractor areas, were completely unexploited by fishermen there.

Catch composition by primary species sought. Subdividing fisherman effort into species-sought groups (and a group of those fishermen seeking any species (Table 6) provided detail in success analysis (Lambou 1966). The large numbers of harvestable bluegills found in attractor areas by rotenone inventory were not equally represented in the overall attractor creel (Table 5). However, they did appear among the fish caught by fishermen seeking any species of fish near attractors (85.7% bluegills).

Crappie anglers in all areas averaged about nine crappie for every 10 fish kept. The methods employed by crappie fishermen were demonstrably ineffective for other species.

Bass fishermen who had not ventured from attractor areas took largemouths exclusively. Smallmouths were especially prevalent (49.6%) in the creel of bass fishermen who had not fished attractor sites, and were somewhat less common (30.4%) in the creel of fishermen who had fished both attractor and non-attractor areas.

Walleye and sauger, and white bass were not sought by any attractor fishermen. Walleye did appear as a small fraction of the total catch of attractor fishermen (Table 5) as incidental catch in a crappie angler's creel (Appendix E).

Table 6. Primary species groups sought expressed as percentage of all parties for each area type and principle species caught (percentage of total number caught by each species-sought sub-group in each area type).

| Primary Species Group Sought | Attractor Areas | Species Caught/% | Non-Attractor Areas | Species Caught/% | Both Areas | Species Caught/% |
|---|---|---|---|---|---|---|
| Any fish | 17.3 | Bluegill 85.7 | 27.7 | Bluegill 75.0 | 13.8 | Bluegill 43.0 |
| Crappie | 67.3 | Crappie 90.2 | 20.8 | Crappie 90.2 | 28.7 | Crappie 90.0 |
| Bass | 10.3 | Largemouth 100 | 17.9 | Smallmouth 49.6 | 32.8 | Smallmouth 30.4 |
| Sunfish | 1.7 | Bluegill 100 | 7.7 | Bluegill 96.5 | 3.5 | Bluegill 100 |
| Catfish | 1.7 | Flathead 100 | 1.4 | Channel 72.0 | 1.7 | Channel 87.5 |
| Walleye/Sauger | -- | -- | 11.4 | Walleye 25.7<br>Crappie 25.7<br>Channel 22.1 | 19.5 | Walleye 44.7<br>Channel 23.7 |
| White Bass | -- | -- | 1.1 | White Bass 71.1 | -- | -- |
| Miscellaneous | 1.7 | Channel 100 | 0.2 | Turtles 50.0 | -- | -- |
| | 100.0 | | 100.0 | | 100.0 | |

Crappie were represented in the creel of walleye/sauger fishermen in non-attractor areas as often as were walleye/sauger. This was due in large part to the fishing method of some very successful trollers, who fished deep mainstream flats in the upper Powell embayment. These fishermen trolled (with lead-core line) small minnow-imitating plugs, which were more effective on crappie than was the "junebug spinner and nightcrawler" rig commonly fished by walleye fishermen on other parts of the reservoir.

Mean weights. Average weights were computed for each species adequately represented in the creels from attractor and non-attractor areas (Table 7). Slight differences were seen between the groups, but none were significant (t-test, $\alpha$ = .05). Fisherman selectivity would be expected to negate any differences which may have existed in the populations. Significant size differences for attractor and non-attractor fishes were seldom seen in fishermen's creels (Pierce 1966), but may be demonstrated by less biased sampling methods (Prince 1977).

Table 7. Mean weights of species adequately represented in both attractor and non-attractor creels.

| Species | Area: Number of Samples Containing This Species | | Mean Weight (Kg) | Probability of > $\|t\|$ |
|---|---|---|---|---|
| White Crappie | Attractor: | 27 | 0.19 | 0.80 |
| | Non-Attractor: | 163 | 0.18 | |
| Black Crappie | Attractor: | 10 | 0.15 | 0.68 |
| | Non-Attractor: | 42 | 0.16 | |
| Bluegill | Attractor: | 10 | 0.13 | 0.48 |
| | Non-Attractor: | 220 | 0.11 | |

Condition of Attractors

Three of the 259 attractor cove sites were found, during the winter drawdown, to contain few brushpiles or none at all. Two of these sites were in large, open coves, and were likely destroyed by wave action and sedimentation. Evidence of vandalism by burning was found at another site. The painted tree at the head of each attractor cove was often found to have been cut down, as was the surveying tape used to mark the location of the deepest attractor at each site. The loss of attractor markers has been a common problem (Manges 1959; Petit 1973; White 1974).

Most attractors, which had been inundated and dried for several seasonal cycles, were in good condition. Hardwoods and softwoods commonly held twigs as small as 5 mm in diameter, but softwoods showed a tendency to flatten in profile.

As the water level dropped in the fall, it could be seen that much of the brush held growths of algae and colonial bryozoans, both of which can contribute to the diet of grazing centrarchids (Prince 1977). Encrustations were sloughed upon drying, and the attractors showed little change from the previous winter.

# CHAPTER VI

## SUMMARY

1. During the study period, 1435 party interviews were taken. Of these, 84% (1201) parties had fished only non-attractor areas at the time of interview. The greater total amount and variability (in type) of effort expended by these fishermen probably explained the larger species diversity (19 species) taken from non-attractor areas. Attractor-only fishermen (58 parties) took specimens of 10 species, and those fishermen who had fished both attractor and non-attractor areas (176 parties) expended the intermediate total amount of effort and collected the intermediate number of species (15).

2. Comparisons of attractor and non-attractor creels indicated that percentage successful, mean number of fish caught, mean fish per man-hour, and mean kilograms per man-hour were all significantly higher for attractor fishermen. Crappie anglers' catch contributed most to the higher overall success rates for attractor fishermen.

3. Public fishing pressure on the attractors was low due to ignorance of their installation, loss of attractor markers, and traditional use of non-cove fishing sites. Deep attractor units were almost completely unutilized.

4. The littoral brush attractors held up well for the first several inundation cycles, except in a few large coves subject to severe wind and wave action.

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# APPENDICES

# APPENDIX A

## SIZE DISTRIBUTION AND SPECIES DENSITIES; NORRIS ROTENONE SURVEY, 1979

**Table 8. Size distribution per hectare by species, cove rotenone survey Norris Reservoir, 1979 (Brown, unpublished TVA report, 1980).**

| | With Attractors (2.93 Hectares) | | | | | | | | Without Attractors (2.45 Hectares) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Young | | Intermediate | | Harvestable | | Total | | Young | | Intermediate | | Harvestable | | Total | |
| | No. | Kg. | No. | Kg. | No. | Kg. | No. | Kg. | No. | Kg. | No. | Kg. | No. | Kg. | No. | Kg. |
| Gizzard shad | 155.6 | 0.7 | - | - | 1,438 | 116.4 | 1,593.6 | 117.1 | 16.7 | 0.1 | - | - | 4,213.1 | 178.7 | 4,229.8 | 178.8 |
| Freshwater drum | 9.6 | 0.1 | 71.7 | 2.2 | 85.7 | 11.9 | 167 | 14.5 | 2.8 | T | 24.1 | 0.7 | 36.7 | 5.1 | 63.6 | 5.8 |
| Channel catfish | 39.8 | 0.1 | 4.4 | 0.1 | 17.7 | 5.9 | 61.9 | 6.0 | 22.1 | 0.1 | 3.7 | T | 4.9 | 2.2 | 30.7 | 2.3 |
| Flathead catfish | 49.5 | 0.2 | 4.1 | 0.1 | 4.8 | 12.6 | 50.4 | 12.9 | 16.7 | T | 0.8 | T | 1.2 | 2.1 | 18.7 | 2.2 |
| Carp | - | - | 1.7 | 0.5 | 24.9 | 59.4 | 26.6 | 59.9 | - | - | 3.7 | 1.0 | 9.0 | 11.0 | 12.7 | 12.0 |
| Mooneye | - | - | 2.0 | 0.3 | 7.2 | 1.8 | 9.2 | 2.1 | - | - | 1.6 | 0.2 | 3.3 | 1.1 | 4.9 | 1.3 |
| Longnose gar | - | - | 1.7 | 0.2 | 3.8 | 2.6 | 5.5 | 2.8 | - | - | - | - | 1.2 | 0.6 | 1.2 | 0.6 |
| Golden redhorse | - | - | - | - | 4.4 | 3.1 | 4.4 | 3.1 | - | - | - | - | 0.8 | 0.8 | 0.8 | 0.8 |
| Black redhorse | - | - | - | - | 0.3 | 0.4 | 0.3 | 0.4 | - | - | - | - | 0.4 | 0.2 | 0.4 | 0.2 |
| Shorthead redhorse | - | - | - | - | 0.3 | 0.2 | 0.3 | 0.2 | - | - | - | - | 0.8 | 0.5 | 0.8 | .0.5 |
| Northern hogsucker | - | - | - | - | 0.3 | T | 0.3 | T | - | - | - | - | 0.4 | 0.3 | 0.4 | 0.3 |
| White bass | 5.8 | T | 73.4 | 1.0 | 10.9 | 2.9 | 133.4 | 4.1 | 13.9 | 0.1 | 66.1 | 0.9 | 8.6 | 2.7 | 88.6 | 3.7 |
| Largemouth bass | 4.8 | T | 22.2 | 0.4 | 10.6 | 4.0 | 37.6 | 4.4 | 15.9 | T | 16.7 | 0.2 | 2.4 | 0.2 | 35.0 | 0.4 |
| Spotted bass | 14.3 | .1 | 68.3 | 1.2 | 7.8 | 1.1 | 90.4 | 2.4 | 13.5 | T | 37.1 | 0.7 | 8.6 | 1.1 | 59.2 | 1.8 |
| Walleye | 4.1 | T | 10.2 | 0.5 | 31.7 | 13.8 | 46.0 | 14.4 | 1.6 | 0.1 | - | - | 2.9 | 1.2 | 4.5 | 1.3 |
| White crappie | 10.6 | T | 56.3 | 1.4 | 160.8 | 17.4 | 227.7 | 18.8 | 3.6 | T | 5.3 | 0.1 | 21.2 | 2.1 | 30.1 | 2.2 |
| Black crappie | 0.7 | T | 15.4 | 0.4 | 77.5 | 8.8 | 93.6 | 9.2 | - | - | 0.4 | T | 3.3 | 0.3 | 3.7 | 0.3 |
| Bluegill | 487.7 | 0.6 | 2,053.2 | 18.5 | 1,060.1 | 32.5 | 3,601.0 | 51.6 | 211.4 | 0.2 | 429.4 | 4.1 | 275.1 | 9.0 | 915.9 | 13.3 |
| Rock bass | 39.5 | T | 16.0 | 0.1 | 13.0 | 0.5 | 68.5 | .6 | 37.1 | T | 12.2 | T | 3.3 | 0.1 | 52.6 | .3 |
| White sucker | - | - | - | - | - | - | - | - | - | - | - | - | 0.4 | T | 0.4 | T |
| Longear sunfish | - | - | - | - | - | - | - | - | - | - | 2.9 | T | 0.4 | T | 3.3 | T |
| Striped bass | - | - | - | - | - | - | - | - | 0.4 | T | - | - | 0.4 | 0.8 | 0.4 | 0.8 |
| Muskellunge | - | - | - | - | - | - | - | - | - | - | 0.4 | 0.1 | - | - | 0.4 | 0.1 |
| Sauger | - | - | - | - | 0.3 | 0.2 | 0.3 | 0.2 | - | - | - | - | 0.8 | T | 0.8 | T |
| Mimic shiner | 0.3 | T | - | - | - | - | 0.3 | T | 40.0 | T | - | - | - | - | 40.0 | T |
| Bluntnose minnow | 1,565.2 | 1.8 | - | - | - | - | 1,565.2 | 1.8 | 659.6 | 0.7 | - | - | - | - | 659.6 | 0.7 |
| Spofein shiner | 18.1 | T | - | - | - | - | 18.1 | T | 31.0 | 1.0 | - | - | - | - | 31.0 | 1.0 |
| Log perch | 55.3 | 0.4 | - | - | - | - | 55.3 | 0.4 | 44.1 | T | - | - | - | - | 44.1 | T |
| Brook silverside | 32.1 | T | - | - | - | - | 32.1 | T | 73.9 | 0.1 | - | - | - | - | 73.9 | 0.1 |
| Emerald shiner | - | - | - | - | - | - | - | - | 2.4 | T | - | - | - | - | 2.4 | T |
| Stoneroller | - | - | - | - | - | - | - | - | 0.5 | T | - | - | - | - | 0.5 | T |
| Bullhead minnow | - | - | - | - | - | - | - | - | 13.5 | T | - | - | - | - | 13.5 | T |

# APPENDIX B

## TVA FISHING CENSUS

TVA FISHING CENSUS

BB No. 74-R0071
Approval Expires 12-31-83

**General Information**

Date: ☐☐ ☐☐ ☐☐

Body of Water: ☐☐ Area ☐ Sub-area ☐

Type of Fishing: (1) boat, (2) bank, (3) special ☐

Time Checked ☐☐☐☐

Period of day (1) a.m., (2) p.m., (3) night ☐

Hours Fished (Hours, Tenths) ☐☐☐

Trip Completed: (1) yes, (2) no ☐

Boat (if boat fisherman) ☐

No. in party ☐ No. successful ☐

**Primary Species Information**

Primary Species Fished For ☐ 24

PRIMARY SPECIES CODE

(1) Any species
(2) Crappie
(3) Black bass
(4) Sunfish
(5) Catfish
(6) Walleye or sauger
(7) Trout
(8) Rough fish
(9) White bass
(0) Other

Number of fish of the primary species caught by a max. of 6 successful fishermen in party. Skip if party not fishing for primary species; i.e., Code (1) in Block 24.

1- ☐☐ 25 26
2- ☐☐ 27 28
3- ☐☐ 29 30
4- ☐☐ 31 32
5- ☐☐ 33 34
6- ☐☐ 35 36

**Creel Information**

| | Code | No. | Lbs., Tenths |
|---|---|---|---|
| White crappie | 8 8 | ☐☐ | ☐☐☐ |
| Black crappie | 8 9 | ☐☐ | ☐☐☐ |
| L. M. bass | 8 1 | ☐☐ | ☐☐☐ |
| Spotted bass | 8 3 | ☐☐ | ☐☐☐ |
| S. M. bass | 8 2 | ☐☐ | ☐☐☐ |
| White bass | 6 8 | ☐☐ | ☐☐☐ |
| Yellow bass | 6 9 | ☐☐ | ☐☐☐ |
| Bluegill | 9 5 | ☐☐ | ☐☐☐ |
| Redear sunfish | 9 6 | ☐☐ | ☐☐☐ |
| Rock bass | 9 9 | ☐☐ | ☐☐☐ |
| Other sunfish | 9 0 | ☐☐ | ☐☐☐ |
| Sauger | 7 1 | ☐☐ | ☐☐☐ |
| Walleye | 7 0 | ☐☐ | ☐☐☐ |
| Channel catfish | 4 3 | ☐☐ | ☐☐☐ |
| Flathead catfish | 4 1 | ☐☐ | ☐☐☐ |
| Blue catfish | 4 2 | ☐☐ | ☐☐☐ |
| Bullheads | 4 4 | ☐☐ | ☐☐☐ |
| Drum | 5 2 | ☐☐ | ☐☐☐ |
| Carp | 3 0 | ☐☐ | ☐☐☐ |
| ________ | __ | ☐☐ | ☐☐☐ |
| ________ | __ | ☐☐ | ☐☐☐ |
| ________ | __ | ☐☐ | ☐☐☐ |

**Boat Code**

(1) rented
(2) TVA access
(3) G & F access
(4) commercial dock
(5) other public access
(6) private access
(7) COE access
(8) Special (specify)

TVA 5587 (ONR-7-80)

**Economic Information**

State ☐☐ Distance from home ☐

Main reason for trip ________ ☐
(If other, specify)

Boat Length ☐ Motor Size ☐

**Cost for the Day's Trip**

| | |
|---|---|
| Gas and oil | ☐☐☐☐ |
| Boat rental | ☐☐☐☐ |
| Motor rental | ☐☐☐☐ |
| Launching fee | ☐☐☐ |
| Food: meals, refreshments, ice, etc. | ☐☐☐☐ |
| Lodging: motel, resort, camping fee, etc. | ☐☐☐☐ |
| Bait: minnows, crickets, worms, corn, etc. | ☐☐☐☐ |
| Tackle: rods, reels, lures, hooks, sinkers, etc. | ☐☐☐☐ |
| Other expense: for example, guide service | ☐☐☐☐☐ |
| Miles traveled today | ☐☐☐ |
| License cost | ☐☐☐☐ |

**Codes**

**Distance**

(1) 0-25 miles
(2) 26-100 miles
(3) 101-250 miles
(4) over 250 miles

**Reason**

(1) fishing
(2) vacation
(3) business
(4) other (specify)

**Boat Length**

(1) Under 10'
(2) 10'0" to 10'11"
(3) 11'0" to 11'11"
(4) 12'0" to 12'11"
(5) 13'0" to 13'11"
(6) 14'0" to 14'11"
(7) 15'0" to 15'11"
(8) 16'0" to 16'11"
(9) 17'0" to 17'11"
(0) 20 ft. and up

**Motor Size**

(1) 0 to 9.9 hp
(2) 10.0 to 19.9 hp
(3) 20 to 29 hp
(4) 30 to 50 hp
(5) 51 to 100 hp
(6) 100 hp and up

## APPENDIX C

## OVERALL CATCH COMPOSITION

Table 9. Species composition of catch from each area type, by number and weight, and percent of total for each area type.

| Area Type | Total Number of Fish and Percent | | Total Weight of Fish (Kg) and Percent | |
|---|---|---|---|---|
| Attractors | | | | |
| Flathead catfish | 11 | 3.55 | 42.82 | 44.93 |
| Channel catfish | 2 | 0.65 | 1.45 | 1.52 |
| Freshwater drum | 2 | 0.65 | 1.09 | 1.14 |
| Walleye | 1 | 0.32 | 0.09 | 0.10 |
| Largemouth bass | 4 | 1.29 | 2.81 | 2.95 |
| Smallmouth bass | 3 | 0.97 | 0.82 | 0.86 |
| Spotted bass | 2 | 0.65 | 0.36 | 0.38 |
| White crappie | 197 | 63.55 | 35.65 | 37.41 |
| Black crappie | 33 | 10.65 | 5.31 | 5.57 |
| Bluegill | 55 | 17.74 | 4.90 | 5.14 |
| Non-Attractors | | | | |
| Flathead catfish | 36 | 1.05 | 26.63 | 3.53 |
| Channel catfish | 102 | 2.97 | 52.66 | 6.98 |
| Golden redhorse | 1 | 0.03 | 1.00 | 0.13 |
| Freshwater drum | 31 | 0.90 | 10.52 | 1.40 |
| Striped bass | 24 | 0.70 | 172.50 | 22.87 |
| White bass | 77 | 2.25 | 28.12 | 3.73 |
| Walleye | 42 | 1.22 | 29.21 | 3.87 |
| Sauger | 5 | 0.15 | 1.18 | 0.16 |
| Largemouth bass | 49 | 1.43 | 22.63 | 3.00 |
| Smallmouth bass | 109 | 3.18 | 45.27 | 6.00 |
| Spotted bass | 26 | 0.76 | 4.54 | 0.60 |
| White crappie | 1228 | 35.81 | 187.38 | 24.84 |
| Black crappie | 110 | 3.21 | 17.10 | 2.27 |
| Bluegill | 1536 | 44.79 | 144.97 | 19.22 |
| Rock bass | 16 | 0.47 | 0.45 | 0.26 |
| Other sunfish | 4 | 0.12 | 0.95 | 0.13 |
| Longnose gar | 1 | 0.03 | 0.82 | 0.11 |
| Carp | 3 | 0.09 | 5.44 | 0.72 |
| Turtles | 2 | 0.06 | 1.36 | 0.18 |
| Both-Areas | | | | |
| Flathead catfish | 2 | 0.37 | 6.85 | 4.80 |
| Channel catfish | 39 | 7.18 | 17.96 | 12.60 |

Table 9 (Continued)

| Area Type | Total Number of Fish and Percent | | Total Weight of Fish (Kg) and Percent | |
|---|---|---|---|---|
| Freshwater drum | 8 | 1.47 | 2.86 | 2.00 |
| White bass | 7 | 1.29 | 1.95 | 1.37 |
| Walleye | 36 | 6.63 | 21.50 | 15.08 |
| Sauger | 3 | 0.55 | 1.18 | 0.83 |
| Largemouth bass | 11 | 2.03 | 5.85 | 4.10 |
| Smallmouth bass | 19 | 3.50 | 11.88 | 8.34 |
| Spotted bass | 9 | 1.66 | 2.18 | 1.53 |
| White crappie | 243 | 44.75 | 49.94 | 34.03 |
| Black crappie | 21 | 3.87 | 4.08 | 2.86 |
| Bluegill | 139 | 25.60 | 12.07 | 8.46 |
| Rock bass | 3 | 0.55 | 0.32 | 0.22 |
| Mooneye | 2 | 0.37 | 0.82 | 0.57 |
| Carp | 1 | 0.18 | 3.13 | 2.20 |

# APPENDIX D

## ROTENONE SIZE CLASS DIVISIONS

Table 10. Size classes* used for cove rotenone survey, Norris Reservoir, 1979 (Brown, unpublished TVA report, 1980).

| Species | Young-of-Year Millimeters (Inches) | Intermediate Millimeters (Inches) | Harvestable Millimeters (Inches) |
|---|---|---|---|
| White bass | Less than 150 ( 5.9) | 151-200 ( 5.9- 7.9) | 201 ( 7.9) and over |
| Striped bass | Less than 175 ( 6.9) | 176-375 ( 6.9-14.8) | 376 (14.8) and over |
| Rock bass | Less than 75 ( 3.0) | 76-125 ( 3.0- 4.9) | 126 ( 5.0) and over |
| Bluegill | Less than 75 ( 3.0) | 76-125 ( 3.0- 4.9) | 126 ( 5.0) and over |
| Smallmouth bass | Less than 100 ( 3.9) | 101-200 ( 4.0- 7.9) | 201 ( 7.9) and over |
| Spotted bass | Less than 100 ( 3.9) | 101-200 ( 4.0- 7.9) | 201 ( 7.9) and over |
| Largemouth bass | Less than 100 ( 3.9) | 101-225 ( 4.0- 8.9) | 226 ( 8.9) and over |
| Crappie | Less than 75 ( 3.0) | 76-175 ( 3.0- 6.9) | 176 ( 6.9) and over |
| Sauger | Less than 200 ( 7.9) | 201-275 ( 7.9-10.8) | 276 (10.9) and over |
| Walleye | Less than 200 ( 7.9) | 201-275 ( 7.9-10.8) | 276 (10.9) and over |
| Channel catfish | Less than 125 ( 4.9) | 126-225 ( 5.0- 8.9) | 226 ( 8.9) and over |
| Flathead catfish | Less than 125 ( 4.9) | 126-275 ( 5.0-10.8) | 276 (10.9) and over |
| Gizzard shad** | Less than 125 ( 4.9) | -- | 126 ( 5.0) and over |
| Threadfin shad** | Less than 125 ( 4.9) | -- | 126 ( 5.0) and over |
| Miscellaneous forage fish | All sizes | -- | -- |

*The size class divisions are arbitrary but are based on knowledge of growth rates and information from creel census and commercial harvest records.

**Shad were recorded as young-of-year or harvestable; sizes of other forage fish were not differentiated.

## APPENDIX E

## CATCH COMPOSITION OF SPECIES-SOUGHT GROUPS

Table 11. Species composition of catch, by primary species-group sought (number and percent of catch for each group in each area type).

| Species Group Sought | Number of Parties | Species | Number and Percent | |
|---|---|---|---|---|
| Attractors | | | | |
| Any fish | 10 | Flathead catfish | 2 | 4.76 |
| | | Freshwater drum | 1 | 2.38 |
| | | Largemouth bass | 1 | 2.38 |
| | | Smallmouth bass | 1 | 2.38 |
| | | Spotted bass | 1 | 2.38 |
| | | Bluegill | 36 | 85.71 |
| Crappie | 39 | Flathead catfish | 1 | 0.39 |
| | | Channel catfish | 1 | 0.39 |
| | | Freshwater drum | 1 | 0.39 |
| | | Walleye | 1 | 0.39 |
| | | Largemouth bass | 1 | 0.39 |
| | | Smallmouth bass | 2 | 0.78 |
| | | Spotted bass | 1 | 0.39 |
| | | White crappie | 197 | 77.25 |
| | | Black crappie | 33 | 12.94 |
| | | Bluegill | 17 | 6.67 |
| Bass | 6 | Largemouth bass | 2 | 100 |
| Sunfish | 1 | Bluegill | 2 | 100 |
| Catfish | 1 | Flathead catfish | 8 | 100 |
| Miscellaneous | 1 | Channel catfish | 1 | 100 |
| Non-Attractors | | | | |
| Any fish | 332 | Flathead catfish | 25 | 3.03 |
| | | Channel catfish | 32 | 3.88 |
| | | Golden redhorse | 1 | 0.12 |

Table 11 (Continued)

| Species Group Sought | Number of Parties | Species | Number | Percent |
|---|---|---|---|---|
| | | Freshwater drum | 16 | 1.94 |
| | | White bass | 18 | 2.18 |
| | | Walleye | 5 | 0.61 |
| | | Sauger | 1 | 0.12 |
| | | Largemouth bass | 15 | 1.82 |
| | | Smallmouth | 11 | 1.33 |
| | | Spotted bass | 14 | 1.70 |
| | | White crappie | 45 | 5.46 |
| | | Black crappie | 13 | 1.58 |
| | | Bluegill | 618 | 75.00 |
| | | Rock bass | 7 | 0.85 |
| | | Longnose gar | 1 | 0.12 |
| | | Carp | 2 | 0.24 |
| Crappie | 249 | Flathead catfish | 5 | 0.36 |
| | | Channel catfish | 13 | 0.95 |
| | | Freshwater drum | 4 | 0.29 |
| | | White bass | 14 | 1.02 |
| | | Walleye | 1 | 0.07 |
| | | Sauger | 1 | 0.07 |
| | | Largemouth bass | 7 | 0.51 |
| | | Smallmouth bass | 26 | 1.90 |
| | | Spotted bass | 3 | 0.22 |
| | | White crappie | 1141 | 83.22 |
| | | Black crappie | 95 | 6.93 |
| | | Bluegill | 51 | 3.71 |
| | | Rock bass | 6 | 0.44 |
| | | Other sunfish | 3 | 0.22 |
| | | Carp | 1 | 0.07 |
| Bass | 215 | Channel catfish | 2 | 1.55 |
| | | Striped bass | 2 | 1.55 |
| | | White bass | 3 | 2.33 |
| | | Walleye | 7 | 5.43 |
| | | Largemouth bass | 26 | 20.16 |
| | | Smallmouth bass | 64 | 49.61 |
| | | Spotted bass | 7 | 5.43 |
| | | White crappie | 5 | 3.88 |
| | | Bluegill | 11 | 8.53 |
| | | Rock bass | 2 | 1.55 |

Table 11 (Continued)

| Species Group Sought | Number of Parties | Species | Number and Percent | |
|---|---|---|---|---|
| Sunfish | 92 | Channel catfish | 9 | 1.05 |
| | | White bass | 4 | 0.47 |
| | | Smallmouth | 7 | 0.81 |
| | | Spotted bass | 1 | 0.12 |
| | | White crappie | 7 | 0.81 |
| | | Bluegill | 429 | 96.51 |
| | | Rock bass | 1 | 0.12 |
| | | Other sunfish | 1 | 0.12 |
| Walleye, Sauger | 137 | Channel catfish | | |
| | | Freshwater drum | | |
| | | White bass | | |
| | | Walleye | | |
| | | Sauger | | |
| Striped bass | 142 | Striped bass | 21 | 70.00 |
| | | Channel catfish | 2 | 6.67 |
| | | White bass | 4 | 13.33 |
| | | White crappie | 3 | 10.00 |
| White bass | 13 | Striped bass | 1 | 2.63 |
| | | White bass | 27 | 71.05 |
| | | Bluegill | 10 | 26.32 |
| Striped bass | 142 | Striped bass | 21 | 70.00 |
| | | Channel catfish | 2 | 6.67 |
| | | White bass | 4 | 13.33 |
| | | White crappie | 3 | 10.00 |
| White bass | 13 | Striped bass | 1 | 2.63 |
| | | White bass | 27 | 71.05 |
| | | Bluegill | 10 | 26.32 |
| Catfish | 17 | Flathead catfish | 6 | 24.00 |
| | | Channel catfish | 18 | 72.00 |
| | | Bluegill | 1 | 4.00 |
| Miscellaneous | 3 | Channel catfish | 1 | 25.00 |
| | | White bass | 1 | 25.00 |
| | | Turtles | 2 | 50.00 |

Table 11 (Continued)

| Species Group Sought | Number of Parties | Species | Number | Percent |
|---|---|---|---|---|
| Both-Areas | | | | |
| Any fish | 24 | Channel catfish | 10 | 27.03 |
| | | Freshwater drum | 5 | 13.51 |
| | | Walleye | 1 | 2.70 |
| | | White crappie | 1 | 2.70 |
| | | Bluegill | 16 | 43.24 |
| | | Rock bass | 1 | 2.70 |
| | | Mooneye | 2 | 5.41 |
| | | Carp | 1 | 2.70 |
| Crappie | 50 | Flathead catfish | 1 | 0.36 |
| | | Channel catfish | 3 | 1.09 |
| | | Freshwater | 2 | 0.72 |
| | | White bass | 2 | 0.72 |
| | | Largemouth bass | 1 | 0.36 |
| | | Smallmouth bass | 2 | 0.72 |
| | | Spotted bass | 2 | 0.72 |
| | | White crappie | 230 | 83.33 |
| | | Black crappie | 21 | 7.61 |
| | | Bluegill | 10 | 3.62 |
| | | Rock bass | 2 | 0.72 |
| Bass | 57 | Channel catfish | 1 | 2.17 |
| | | White bass | 1 | 2.17 |
| | | Walleye | 1 | 2.17 |
| | | Sauger | 1 | 2.17 |
| | | Largemouth bass | 9 | 19.57 |
| | | Smallmouth bass | 14 | 30.44 |
| | | Spotted bass | 6 | 13.04 |
| | | Bluegill | 13 | 28.26 |
| Sunfish | 6 | Bluegill | 100 | 100.00 |
| Walleye, Sauger | 34 | Channel catfish | 18 | 23.68 |
| | | Freshwater drum | 1 | 1.32 |
| | | White bass | 4 | 5.26 |
| | | Walleye | 34 | 44.74 |
| | | Sauger | 2 | 2.63 |
| | | Largemouth bass | 1 | 1.32 |
| | | Smallmouth bass | 3 | 3.95 |

Table 11 (Continued)

| Species Group Sought | Number of Parties | Species | Number and Percent | |
|---|---|---|---|---|
| | | Spotted bass | 1 | 1.32 |
| | | White crappie | 12 | 15.79 |
| Catfish | 3 | Flathead catfish | 1 | 12.50 |
| | | Channel catfish | 7 | 87.50 |

# VITA

Rowland Glenn Thomas was born in Kinston, North Carolina on July 3, 1954. He has since resided in six eastern states. He received a Bachelor of Science degree in Biology from Augusta College, Georgia, in 1979. In June of 1983, he was awarded the Master of Science degree in Wildlife and Fisheries Science from The University of Tennessee, Knoxville, Department of Forestry, Wildlife and Fisheries.

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