J. Aquat. Plant Manage. 34: 33-38

Relations between Submersed Macrophyte Abundance and Largemouth Bass Tournament Success on Two Tennessee River Impoundments

MICHAEL J. MACEINA[1] AND W. C. REEVES[2]

ABSTRACT

During an eight-year period from 1986 to 1993, submersed macrophyte coverage ranged from 7 to 28% on Lake Guntersville and 2 to 14% on Wheeler Lake. Using black bass (*Micropterus* spp.) fishing tournaments data from these two mainstream impoundments of the Tennessee River, catch rates of primarily largemouth bass (*M. salmoides* Lacepde) were generally greater when macrophyte cover was highest. However, average weight of fish caught was lowest during peak macrophyte coverage, but no differences in weight-per-hour of fish caught were evident. The amount of effort to catch a memorable-size (≥ 2.27 kg) largemouth bass varied inversely with macrophyte abundance. We hypothesized that angling vulnerability of these larger fish likely declined due to the refuge provided by plant cover. With the exception of catch rates of memorable-size fish, fluctuating plant coverage had minimal impact on tournament success as winnings are based on total weight of fish caught rather than the number caught.

Key words: submersed macrophytes, fishing tournaments, catch rates, average weight, fishing success.

INTRODUCTION

Most largemouth bass (*Micropterus salmoides* Lacepede) anglers prefer to fish near or in aquatic vegetation and generally demonstrate the greatest opposition to the control of aquatic macrophytes (Wilde et al. 1992). In particular, a strong majority of the largemouth bass tournament and club member anglers showed greatest disapproval to aquatic plant control in Texas (Wilde et al. 1992). Fishery managers who support maintenance or establishment of aquatic plants for habitat generally believe greater recruitment and subsequent higher densities of catchable-size largemouth bass occur in water bodies colonized by plants (Durocher et al. 1984).

The two primary concerns related to largemouth bass fisheries and aquatic plant management focus on 1) population dynamics and 2) fishing success. At times, these factors may not be dependent on each other. Numerous studies on largemouth bass population dynamics have demonstrated mixed impacts of varying levels of submersed aquatic plants (Bailey 1978, Colle and Shireman 1980, Durocher et al. 1984, Moxely and Langford 1985, Shireman et al. 1985, Canfield and Hoyer 1992, Bettoli et al. 1992, Bettoli et al. 1993, Wrenn et al. 1995). Secondly, some anglers and fishery managers believe largemouth bass are easier to catch in habitats that contain plants. However, a paucity of published information is available that examined the relations between largemouth bass fisheries and aquatic plant abundance and the results were mixed (Colle et al. 1987, Klussmann et al. 1988, Wrenn et al. 1995). Regardless of largemouth bass population characteristics, possibly the most important and visible impact of any aquatic plant management program may be public angling success for these fish.

Tournament angling for largemouth bass has grown in popularity, often stimulating local economies, and these anglers can comprise the majority of largemouth bass anglers on lakes and reservoirs (Schramm et al. 1991, Dolman 1991). Catch rates between tournament and non-tournament anglers were similar or proportional to each other (Dolman et al. 1991, Hendricks 1994). Thus, catch statistics collected from largemouth bass tournaments can provide useful data to assess these fisheries. The objective of this paper was to examine the relations between tournament catch statistics and submersed aquatic plant abundance in two mainstream impoundments of the Tennessee River in Alabama. This information should be useful to both aquatic plant and fishery managers when multiple-use conflicts arise due to excessive levels of aquatic macrophytes.

MATERIALS AND METHODS

This work was conducted on Lakes Guntersville and Wheeler, the two largest impoundments in Alabama on the Tennessee River, and are operated by the Tennessee Valley Authority (TVA). Lakes Guntersville and Wheeler are 28,000 and 27,200 hectares and relatively shallow with mean depths of 4.6 and 4.4 meters, respectively. Eurasian milfoil (*Myriophyllum spicatum* Lacepede) has historically been the dominant submersed plant, but naiads (*Najas* spp.), pondweeds (*Potamogeton* spp.), chara (*Chara* spp.), coontail (*Ceratophyllum demersum* Lacepde), and hydrilla (*Hydrilla verticillata* Royle) also inhabit both reservoirs. Submersed aquatic plant coverage was highest in these two reservoirs during the

[1]Department of Fisheries and Allied Aquacultures, Alabama Agricultural Experiment Station, Auburn University, Alabama 36849

[2]Alabama Department of Conservation and Natural Resources, 64 North Union Street, Montgomery, Alabama 36130. Received for publication October 3, 1994 and in revised form on June 13, 1995.

drought in the mid and late 1980's and covered 7,800 and 3,700 hectares of the surface area of Lakes Guntersville and Wheeler, respectively (Webb et al. 1994). Submersed aquatic plants fluctuate widely in these two impoundments and in other reservoirs on the Tennessee River primarily due to climatic conditions (Webb et al. 1994). The TVA is responsible for aquatic plant management, and in both reservoirs, chemical herbicides were used to control plants in designated areas along developed shorelines. Rarely more than 70 hectares per year were controlled with herbicides on Lake Wheeler, and a maximum of about 750 hectares were controlled on Lake Guntersville during the peak of submersed plant colonization (D. Webb, TVA, personal communication). About 100,000 triploid grass carp (*Ctenopharyngodon idella* Val.) were stocked by TVA at a rate of 17 fish/vegetated hectare (based on 1989 areal coverage) in Lake Guntersville primarily to control expanding hydrilla colonies.

Tournament data were first collected by the Alabama Department of Conservation and Natural Resources in 1986 through a volunteer reporting program named the Bass Angler Information Team (BAIT). These data could be used until October 1993 when a 381 mm minimum length limit was placed on all black bass. Thus, more recent catch statistics were not comparable to data collected before October 1993. Other black bass species including spotted bass (*M. punctulatus* Rafinesque) and smallmouth bass (*M. dolomieui* Lacepede) also occur in these two reservoirs, but largemouth bass were likely the dominant black bass species caught by anglers. Historic cove-rotenone data indicated that 78% and 95% of the black bass biomass in Lakes Wheeler and Guntersville, respectively, were comprised of largemouth bass (D. Lowery, TVA, unpublished data). Participating BAIT clubs report number of anglers, hours fished, total catch, total weight, number of anglers weighing in at least one fish, and the number of memorable-size (≥ 2.27 kg) fish caught. From these data, five fishing quality indicators were computed including catch-per-effort (N/hour), average weight, the effort to catch a memorable-size fish, weight-per-hour, and percent success of weighing in at least one fish. In all tournaments, a 304 mm total length (TL) size limit was enforced. In an effort to reduce fishing mortality, daily bag limit was voluntarily reduced from 1986 to 1993 in both reservoirs and this factor was considered in the analysis.

Aquatic plant coverage was determined annually by TVA personnel using color photography obtained in September or October as described by Webb et al. (1994). Emergent and floating-leaved plants were minor components of the flora, were usually found in shallow and remote back-water areas, and were not included in these analyses.

For tournaments conducted between July and November (the peak of plant abundance), catch statistics of individual tournaments with 100 hours or more of angling effort were compared to plant coverage values using correlation analysis. Data from 56 and 40 tournaments were available from Lakes Guntersville and Wheeler, respectively. The influence of different bag limits which could influence catch-per-effort and average weight of fish caught (Hendricks 1994) was tested for statistical significance ($P < 0.10$) with plant cover as an additional independent variable in multiple regression. In addition to these analyses, individual tournament data displayed a great deal of variability and all tournament data ($N = 78$ Guntersville, $N = 57$ Wheeler) were summed from July to November for each year (1986 to 1993) and averages were computed ($N = 8$ for each reservoir) and compared to plant coverage using correlation analysis. This resulted in loss of sample size, but tended to stabilize the high variability associated with individual tournaments. Catch rates of memorable-size fish were computed only for yearly data as 59% of the tournaments did not catch any fish greater than 2.27 kg and catch rates of these fish were proportional to angling effort. Finally, weighted catch-per-effort and average weight were computed for each three-month season and included winter (January to March), spring (April to June), summer (July to September), and fall (October to December). These values were plotted over time with plant coverage to visualize changes in these catch statistics. The entire data base included 165 and 116 tournaments from Lakes Guntersville and Wheeler with 34,813 and 23,945 hours of angling effort, respectively.

RESULTS

In Lake Guntersville, submersed macrophyte coverage increased from 23 to 28% between 1986 and 1988, declined to 7% by 1991, but increased to 11% by 1993 (Figure 1). Similar trends were observed in Wheeler Lake as submersed coverage peaked at 14% in 1987, declined to 2% by 1990, then increased to 8% by 1993 (Figure 1). High rainfall and inflow in 1989, 1990, and 1991 were the primary factors associated with the decline in plant coverages (Webb et al. 1994). In Lake Guntersville, grass carp herbivory also contributed to the decline in hydrilla and possibly other submersed macrophytes (Webb et al. 1994).

Concurrent with changes in macrophyte coverage, average bag limits declined from 8.7 to 5.0 fish/angler and 8.4 to 5.7 fish/angler between 1986 and 1993 on Lakes Guntersville and Wheeler, respectively. Although plant coverage and bag limit covaried over time, correlation and multiple regression analyses of individual and annual data indicated this variable was a non-significant ($P > 0.10$) factor influencing catch-per-effort and average weight over time.

On Lake Guntersville, for individual tournaments conducted between July and November, weak, but positive correlations were computed between macrophyte coverage and catch-per-effort ($r = 0.39$, $N = 56$, $P < 0.01$) and success rate of catching at least one fish for weigh-in ($r = 0.37$, $N = 56$, $P < 0.01$), respectively. Conversely, plant coverage was negatively correlated ($r = -0.44$, $N = 56$, $P < 0.01$) to average weight of tournament caught fish. No relationship ($P > 0.10$) was evident between weight-per-hour and plant coverage between 1986 and 1993.

Similar, but stronger relationships were computed between macrophyte coverage and annual catch statistics from Lake Guntersville (Figure 2). At coverage greater than 20%, annual catch rates were generally greater than 0.20 fish/hour, but average weights were less 0.7 kg. Average annual weight ranged from 0.72 to 0.89 when coverage was 7 to 11%. The amount of fishing effort to catch a memorable-size largemouth increased at higher plant coverage (Figure 2). Average annual percent success was also strongly correlated ($r = 0.82$, $N = 8$, $P < 0.01$) to macrophyte coverage. No

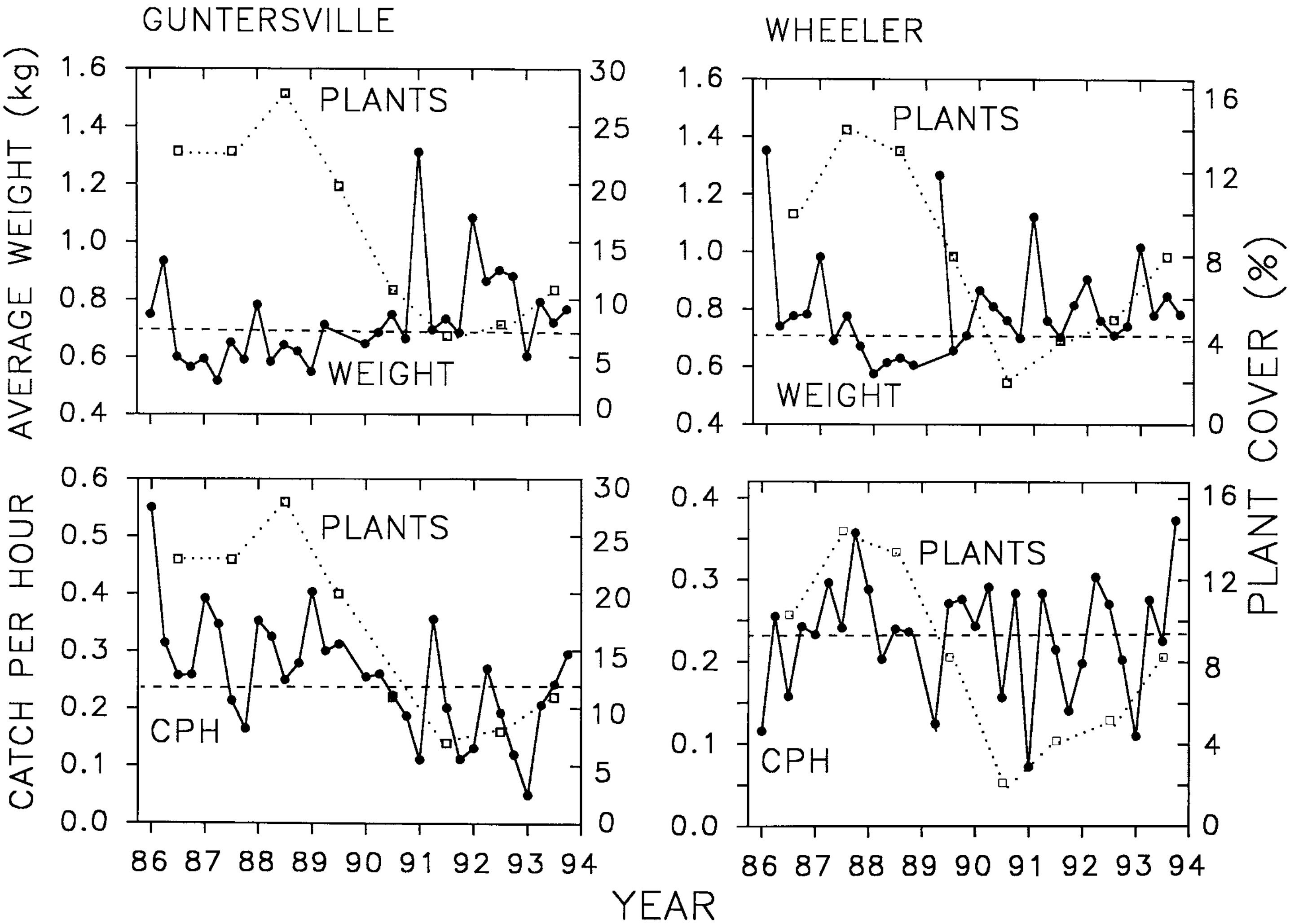

Figure 1. Seasonal plots of average weight and catch-per-hour, and annual submersed macrophyte coverage in Lakes Guntersville and Wheeler from 1986 to 1993. Dashed lines for catch-per-hour and average weight represent Alabama state-wide averages (from Hendricks 1994).

relationship was evident between annual weight-per-hour and coverage (Figure 2). Seasonal data generally showed higher catch rates and greater average weight in the winter and spring consonant with state-wide Alabama data (Hendricks 1994), but consistently higher catch rates and lower weights were evident in the late 1980's during peak macrophyte coverage compared to the early 1990's (Figure 1).

During peak macrophyte coverage, catch-per-hour in Lake Guntersville was generally higher (Figure 1) than the state-wide average of 0.23 fish/hour (Hendricks 1994). However, average weights tended to be lower during highest coverage (Figure 1) than the state-wide average of 0.71 kg (Hendricks 1994). When macrophyte coverage was less than 12%, the amount of fishing effort to catch a memorable-size fish in Lake Guntersville (Figure 2) was less than the state-wide average of 365 hours (Hendricks 1994).

On Wheeler Lake, for individual tournaments conducted between July and August, a weak, but positive relationship was computed between macrophyte coverage and catch-per-effort ($r = 0.28$, $N = 40$, $P < 0.10$). No relationships ($P > 0.10$) were evident between macrophyte coverage and average weight, percent success of catching one fish, or weight-per-hour.

For annual data summed between July and November in Wheeler Lake, the correlation coefficient between macrophyte coverage and catch-per-effort was higher ($r = 0.48$, $N = 8$) than that computed for individual tournament data, but was not significant ($P = 0.22$) due to reduction in sample size (Figure 3). Annual average weight and weight-per-hour were also not related to macrophyte coverage (Figure 3). The effort to catch a memorable-size largemouth bass was much greater at higher plant coverages in Wheeler Lake (Figure 3), consonant with our findings from Lake Guntersville.

Similar to Lake Guntersville, seasonal data indicated that lowest average weights of fish were caught in 1987 and 1988 when macrophyte coverage was greatest in Wheeler Lake (Figure 1). However, correlation coefficients between coverage and average weight for individual and annual data collected during summer and fall were not significant ($P > 0.10$). Higher catch rates were associated with peak or

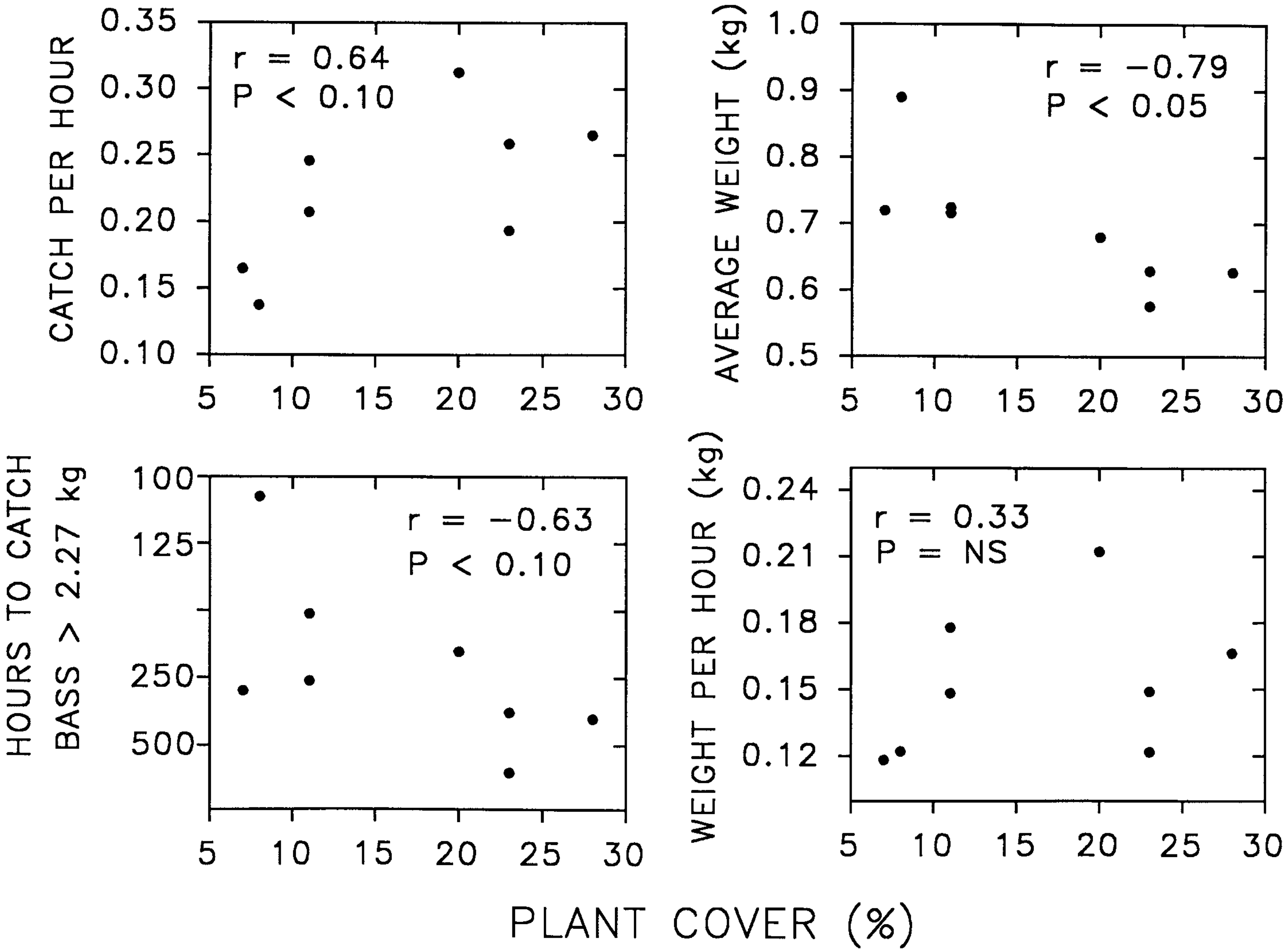

Figure 2. Catch-per-hour, average weight, effort to catch a largemouth bass greater than 2.27 kg, and weight-per-hour for annual BAIT data collected between July and November plotted against annual submersed macrophyte coverage in Lake Guntersville.

increasing plant coverage. Inspection of seasonal data demonstrated less fluctuation in catch rates when macrophyte coverage was highest (Figure 1). Compared to state-wide values presented earlier, Wheeler Lake displayed the same comparable trends evident in Lake Guntersville. At macrophyte coverages greater than 12%, the amount of fishing effort to catch a memorable-size fish in Wheeler Lake was about twice as great as the state-wide average.

DISCUSSION

Our results were generally similar to those reported for largemouth bass tournaments from Lake Conroe, Texas, as a positive correlation was computed between macrophyte coverage and catch rates and a negative correlation was observed between coverage and average weight of fish caught, respectively (Klussmann et al. 1988). However, weight-per-hour declined with macrophyte removal in Lake Conroe and tournament success was negatively impacted. Similarly, a creel survey of all anglers fishing for largemouth bass on Lake Conroe paralleled the tournament results (Klussmann et al. 1988). Colle et al. (1987) reported catch rates of largemouth bass were highest in a Florida lake that was nearly covered with hydrilla compared to when coverage was lower, but angler effort was extremely low when hydrilla covered the lake due to difficult access. In Lake Guntersville, a creel survey of non-tournament anglers conducted between 1990 and 1994 found that catch rates of largemouth bass were similar between vegetated and unvegetated regions (Wrenn et al. 1995).

Catch rates of largemouth bass by tournament anglers tended to be greater when macrophyte coverage was higher on Lakes Guntersville and Wheeler. Conversely, average weight of fish caught was lower in Lake Guntersville and smaller fish were caught in Wheeler Lake during peak coverage. With the trade-off of catching fewer, but larger fish at lower macrophyte coverage, variable levels of macrophyte coverage (maximum 28%) did not influence overall weight-

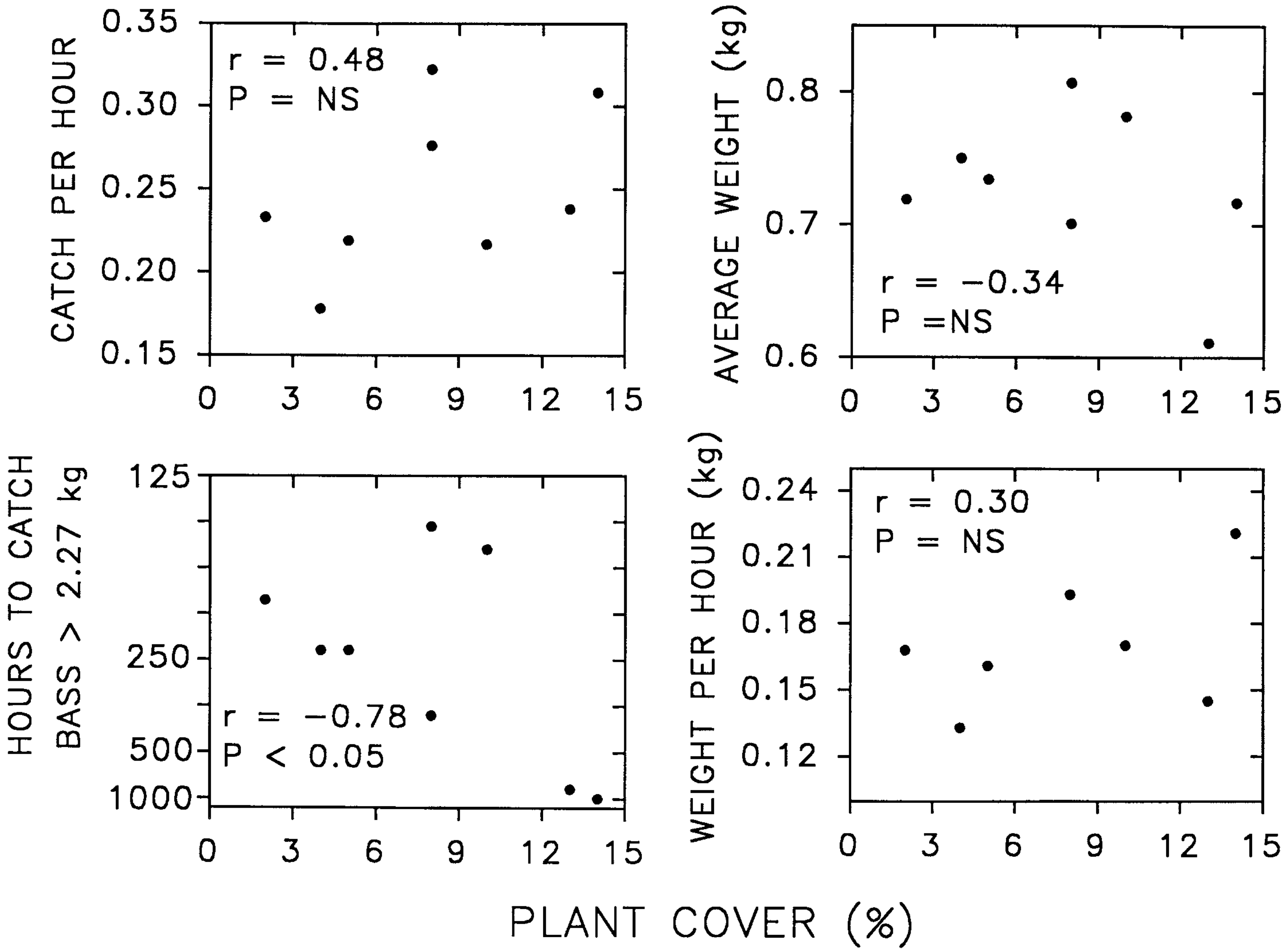

Figure 3. Catch-per-hour, average weight, effort to catch a largemouth bass greater than 2.27 kg, and weight-per-hour for annual BAIT data collected between July and November plotted against annual submersed macrophyte coverage in Wheeler Lake.

per-hour. Tournament winnings are based on total weight of fish caught, not numbers, thus we considered that fluctuating submersed macrophyte cover did not affect tournament success.

In both reservoirs, catch rates of memorable-size largemouth bass greater than 2.27 kg was much higher when submersed macrophyte coverage was low. Previous age, growth, and condition analyses on largemouth bass in Lake Guntersville and other water bodies consistently showed reduced growth and condition of these fish when macrophyte abundance was high (Colle and Shireman 1980, Klussmann et al. 1988, Wrenn et al. 1995). Thus, higher catch rates of large, faster growing fish might be expected when plant abundance is low. However, catch rates of memorable-size fish increased immediately when macrophytes declined. It takes about 7 years for a largemouth bass to obtain 2.27 kg in both reservoirs (M. J. Maceina unpublished data). We hypothesized that larger fish become more vulnerable to angling when macrophytes decline. This occurred in both reservoirs as strong negative relationships were evident between the effort to catch a memorable-size fish and macrophyte coverage. This appeared as the most apparent impact of fluctuating plant abundance in these two reservoirs. Similarly, the negative relationship between average weight of fish caught and macrophyte coverage may have been due to slower growth rates and lower condition, but reduced angling vulnerability of larger fish may have also caused a reduction in average size when plants were abundant.

Some of the differences between reservoirs and the computation of weaker or non-existent correlations in Wheeler Lake may be due to lower macrophyte coverage and macrophyte distribution in Wheeler Lake. Effects of macrophytes on largemouth bass fishing success may be easier to detect when macrophyte coverage exceeds a certain level, such as that observed in Lake Guntersville. In addition, during peak macrophyte coverage in the late 1980's in Lake Guntersville, aquatic plant communities inhabited areas throughout the entire reservoir. In Wheeler Lake, macrophytes have been confined to the mid-reservoir shallow overbank areas adjacent to the river channel, and anglers fishing tournaments originating from a downstream origin may have to travel 40-60 km to fish submersed macrophytes. Thus, tournament anglers fishing macrophyte habitats may have been lower in Wheeler Lake.

Tournament catch statistics in these two reservoirs may have been influenced by the formation of weak and strong year-classes of fish which occurred on both reservoirs (Wrenn et al. 1995, M. J. Maceina, unpublished data). However in both reservoirs, hydrologic conditions were more an important variable related to year class production than aquatic plant coverage (Wrenn et al. 1995, M. J. Maceina, unpublished data).

Aquatic plant managers are faced with the dilemma of providing multiple uses when excessive levels of macrophytes occur. Largemouth bass anglers prefer to fish aquatic macrophytes, particularly in southeastern and mid-western reservoirs that are generally devoid of any other cover. With the exception of catch rates of memorable-size largemouth bass, the impact of fluctuating macrophyte abundance appeared minimal in these two Tennessee River impoundments if anglers accept the trade-off between lower catch rates, but larger fish. Management to maintain some aquatic plants in largemouth bass fisheries is usually desirable. Population studies generally suggest that coverage in excess of 30% does not provide for any additional benefits to the fishery (Colle and Shireman 1980, Durocher et al. 1984, Wiley et al. 1984, Canfield and Hoyer 1992). However, a lack of quantitative data on the relation between largemouth bass fishing success and submersed macrophytes exists. The use of tournament records can provide aquatic plant and fishery managers with inexpensive data to examine this relationship in other water bodies. Managers could possibly determine an optimal level of plants that is acceptable to a majority of users.

ACKNOWLEDGMENTS

Funding for this project was provided through Federal Aid in Sport Fish Restoration Project F-40. We especially thank David Webb with TVA for providing macrophyte data. We also thank all the bass anglers who participated in the BAIT program. D. Bayne, W. Davies, V. DiCenzo, J. Estes, M. Hoyer, J. Jensen, S. Rider, D. Webb, and W. Wrenn provided comments to improve this paper. This paper represents Journal Number 8-944905 of the Alabama Agricultural Experiment Station.

LITERATURE CITED

Bailey, W. M. 1978. A comparison of fish populations before and after stocking extensive grass carp stocking. Trans. Am. Fish. Soc. 107: 181-206.

Betolli, P. W., M. J. Maceina, R. L. Noble, and R. K. Betsill. 1992. Piscivory in largemouth bass as a function of aquatic vegetation abundance. North Am. J. Fish. Manage. 12: 509-516.

Bettoli, P. W., M. J. Maceina, R. L. Noble, and R. K. Betsill. 1993. Response of a reservoir fish community to aquatic vegetation removal. North Am. J. Fish. Manage. 13: 110-124.

Canfield, D. E., Jr. and M. V. Hoyer. 1992. Aquatic macrophytes and their relation to the limnology of Florida lakes. Final rep. submitted to Fl. Dept. Nat. Res., Tallahassee, FL.

Colle, D. E. and J. V. Shireman. 1980. Coefficients of condition for largemouth bass, bluegill, and redear sunfish in hydrilla-infested lakes. Trans. Am. Fish. Soc. 109: 521-531.

Colle, D. E., J. V. Shireman, W. T. Haller, J. C. Joyce, and D. E. Canfield, Jr. 1987. Influence of hydrilla on harvestable sport-fish populations, angler use, and angler expenditures at Orange Lake, Florida. North. Am. J. Fish. Manage. 7: 410-417.

Dolman, W. B. 1991. Comparison of bass-club tournaments reports and creel survey data from Texas reservoirs. North Am. J. Fish. Manage. 11: 177-184.

Durocher, P. P., W. C. Provine, and J. E. Kraai. 1984. Relationship between abundance of largemouth bass and submerged vegetation in Texas reservoirs. North Am. J. Fish. Manage. 4: 84-88.

Hendricks, A. S. 1994. Analysis of black bass tournament catch data from Alabama public reservoirs. MS thesis, Auburn University, Alabama.

Klussmann, W. G., R. L. Noble, R. D. Martyn, W. J. Clark, R. K. Betsill, P. W. Betolli, M. F. Cichra, and J. M. Campbell. 1988. Control of aquatic macrophytes by grass carp in Lake Conroe, Texas, and the effects on the reservoir ecosystem. Publ. MP-1663, Texas Agricul. Exper. Station, Texas A&M University.

Moxely, D. J. and F. H. Langford. 1985. Beneficial effects of hydrilla on two eutrophic lakes in central Florida. Proc. Southeast. Assoc. Fish Wildl. Agenc. 36: 280-286.

Schramm, H. L., M. L. Armstrong, N. A. Funicelli, D. M. Green, D. E. Lee, R. E. Manns, Jr., B. D. Taubert, and S. J. Waters. 1991. The status of competitive sport fishing in North America. Fisheries 16(3): 4-12.

Shireman, J. V., M. V. Hoyer, M. J. Maceina, and D. E. Canfield, Jr. 1985. The water quality and fishery of Lake Baldwin, Florida 4 years after macrophyte removal by grass carp. Lake and Reservoir Management 1: 201-206.

Webb, D. H., L. N. Mangum, A. L. Bates, and H. D. Murphy. 1994. Aquatic vegetation in Guntersville Reservoir following grass carp stocking. pages 199-209 *in* Proc. Grass Carp Conference, 1994. U.S. Army Corps of Engineer Waterways Exper. Sta., Vicksburg, MS.

Wilde, G. R., R. K. Riechers, and J. Johnson. 1992. Angler attitudes toward control of freshwater vegetation. J. Aq. Plant. Manage. 30: 77-79.

Wrenn, W. B., D. R. Lowery, M. J. Maceina, and W. C. Reeves. 1995. Largemouth bass and aquatic plant abundance in Guntersville Reservoir, Alabama. *in* L. E. Miranda and D. R. DeVries, *eds.* Multidimensional approaches to reservoir fisheries management. Am. Fish. Soc. Sympos. 17: *In press.*

Wiley, M. J., R. W. Gorden, S. W. Waite, and T. Powless. 1984. The relationship between aquatic macrophytes and sport fish production in Illinois ponds: a simple model. North Am. J. Fish. Manage. 4: 111-119.