

# **Current status of the fish community and quality of fishing at Lake Webster, Indiana**

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## EXECUTIVE SUMMARY

To address a variety of needs and issues, the Indiana Division of Fish and Wildlife conducted a study at 774-acre Lake Webster during 2005. The purpose was to estimate density and size structure of the muskie and bass populations, examine fishing activity and the quality of fishing, assess possible impacts of muskie stockings and weed control efforts on the fish community, and determine whether changes in fish or lake management strategies are needed. Muskie fingerlings are annually stocked at the rate of 5/acre. A 14-inch size limit on bass went into effect in 1999 and more aggressive measures have been taken recently to control non-native invasive aquatic plants.

Based on spring trapping for muskies and electrofishing for bass, Lake Webster contained 5,363 muskies, 23.5-50.5 inches long, and 3,850 bass ( $\geq$  8-in). Average muskie length was 33 inches. Mean muskie lengths from age-3 through age-8 were 26, 29, 33, 36, 40, and 45 inches, while estimated numbers of age-3 through age-8 muskies were 416, 2127, 1279, 938, 408, and 183, respectively. Anglers fished 70,829 hours during April through November and effort was primarily directed at muskies and bass. They made 6,399 trips to fish specifically for muskies and 2,342 trips to fish specifically for bass. Anglers removed 11,203 fish, but kept only 14 muskies and 210 bass. They also caught and released 2,201 muskies and 8,275 bass. Bluegills dominated the July fish population survey catch but nearly all were less than 7 inches. Submersed aquatic plants covered 90% of the littoral zone in May and 84% in July and were dominated by curly-leaf pondweed in May and coontail in July. Forty-one beds of emergent plants were mapped, covering 34 acres.

Lake Webster continues to support a high-quality muskie fishery that provides high-quality muskie fishing experiences. Muskie density, fishing effort, and catches have increased substantially over the years with no apparent or significant adverse effects on the native fish community or angler satisfaction for other species, although bluegill and bass catches were lower in 2005. Bass density was 50% lower in 2005 compared to 1998 but more larger bass were present and the angler catch rate doubled from 0.3/hour to 0.6/hour. No changes in current fish management strategies are needed or recommended.

*Cover photo: Fisheries biologist Jed Pearson (right), assisted by Manchester University student Jared Mobley (left), displays a 49½-inch muskellunge captured in a trap at Lake Webster in April 2005.*

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## INTRODUCTION

Lake Webster is currently Indiana's premier lake for muskie fishing. Muskies were first introduced into the lake in 1978 when 48,000 fry were stocked into the adjacent Backwater Area (Table 1). In 1981 the Michiana Chapter of Muskies, Inc., purchased fingerlings from a Wisconsin source and stocked additional fish in 1982-1985. The Division of Fish and Wildlife (DFW) added muskie fingerlings produced in state rearing ponds from 1982-1988. Beginning in 1989 and since then, only fingerlings produced at the Fawn River State Fish Hatchery and reared on live forage fish have been stocked. Since 1981 a total of 56,059 muskie fingerlings have been released. Assuming a commercial price of \$8 each, the program costs to date are valued at \$448,472.

Various surveys have been conducted by the DFW at Lake Webster to monitor success of the stocking program and assess its effects on the fish community. Standard fish population surveys were conducted in July 1976, 1985, 1988, 1990 and 1995. Angler surveys were conducted in 1987 and 1990. Largemouth bass density, size structure, and exploitation were examined in 1990 at a time when no minimum size limit was in effect. In 1998, the DFW conducted a more-extensive study of the muskie population. Purposes at that time were to estimate muskie density and size structure, examine angler interest and catch, monitor impacts on the fish community, and track radio-tagged muskies to better understand their behavior and locate possible spawning concentrations for broodstock collections. No surveys were conducted after 1998 but sexually-ripe muskies have been trapped each spring for hatchery broodstock.

Since 1998 two other issues have come to the forefront of fish management at Lake Webster. Local lake residents are now more active in controlling Eurasian water milfoil and plans are to increase control of curly-leaf pondweed. Unusually dense growths of milfoil reached nuisance levels in 1999 and 2002, prompting lake-wide applications of fluridone (Sonar®). Although the 1999 treatment was considered successful, water clarity and overall plant abundance declined sharply following the 2002 treatment. By 2004 some plants had recovered, although anglers expressed concerns over possible long-term adverse effects of the fluridone treatments on fish and fishing. Throughout the same period, some anglers also complained about poor bass fishing and attributed it to muskie predation.

Based on a variety of needs and issues, the DFW conducted a follow-up study at Lake Webster in 2005. Purposes of the study were to again estimate density and size structure of the muskie and bass populations in the lake, examine fishing activity and the quality of fishing, continue to assess any possible impacts of the muskie stockings on native fish, monitor the effects of weed control efforts on the fish community, and determine whether any changes in fish or lake management strategies are needed. The results of this work are presented in this report.

### STUDY SITE

Lake Webster, including the Backwater Area, is a 774-acre lake located at North Webster, Indiana, about equal distance from Fort Wayne and South Bend. The lake formerly consisted of five small natural lake basins that were impounded in the 1800s. Public access is available at a state-owned site along CR 550N. The lake lies within the Tippecanoe River watershed and drains 31,488 acres, 92% of which enters the Backwater Area. The outlet leaves the west side of Webster Lake over a concrete structure and flows to James Lake. Maximum depth is 52 feet and average depth is 12 feet. A large percentage of the lake, including the Backwater Area, is less than 6 feet deep and estimates of hydraulic retention time range from 49-82 days.

Lake Webster is a mesotrophic lake. During summer however, enough oxygen is present for fish (> 3 ppm) only in the top 10-15 feet of water (Table 2). From 1976 through 1998, water clarity varied from 3.3-5.0 feet but increased to 8.5 feet in 2005. The bottom materials are mostly muck and sand. Curly-leaf pondweed, coontail, and Eurasian water milfoil are the most common submersed plants, although herbicides are used annually to control curly-leaf pondweed and milfoil. Duckweed is also abundant in the Backwater Area and floats down into the main area of the lake. Some floating-leaf emergent plant beds are scattered throughout the lake. Most of the lake is residentially developed but significant wetlands and natural shoreline sections are still present in the northeast corner of the main lake and at the south end of the Backwater Area.



## METHODS

An attempt was made to estimate the number of adult muskies in Lake Webster during spring 2005 using large commercial trap nets set at 12 locations (Figure 1) from March 29 through April 14. The number of traps fished per day ranged from two to six. The traps, as well as their leads, were checked daily except on April 2 and 10 and moved when catches were low. The number of sets at each site varied from one to 13 during the period. Water temperature varied from 41-57 degrees and averaged 50 degrees. Each trapped muskie was measured, marked with a left-pectoral fin ray clip (also used for age determinations), tagged with a uniquely-coded PIT tag near the base of the dorsal fin, and sexed. The dates and capture locations of each muskie and each recaptured muskie were recorded. If sexually-ripe, females, along with a number of males, were trucked to the Fawn River State Fish Hatchery for egg-taking and fertilization. Otherwise, each muskie was taken by boat to sites in the general center of the lake. Fish taken for spawning were also hauled back to the lake and released at offshore locations away from the traps. A Schnabel estimate of the muskie population over the entire size range of captured fish was then generated ( $N = (\sum C_t M_t) / \sum R + 1$ ) based on the daily ( $t$ ) catch ( $C$ ), number of marked muskies at large ( $M$ ), and recaptures ( $R$ ).

Largemouth bass density, size and growth were determined at Lake Webster and the Backwater Area from mark-recapture electrofishing over a four-week period from April 25 through May 16. Water temperatures varied from 48-58 degrees. Three crews, each sampling approximately two hours per night, covered the entire shoreline of Lake Webster and the northern half of the Backwater Area each night. Stunned bass were retrieved by two dip-netters in each boat, measured, and marked with a right ventral fin-clip before release. A Schnabel estimate of 8-inch and larger bass was then generated from the four nightly mark-recapture sessions. Mean nightly estimates of catch per effort for four size categories of bass (8-11½ in, 12-13½ in, 14-17½ in, ≥18 in) were calculated. Numbers of bass in each size category were then determined by multiplying the mean nightly proportions of each group times the population estimate. Scale samples for growth analyses were also obtained from bass collected at this time. A separate estimate of the bass population over the entire length range was made and partitioned into various age groups based on age proportions per half-inch to examine annual survival.

To estimate fishing effort and catch, a creel survey was conducted from April 1 to November 30. During the survey, boat and shore anglers were counted at regular intervals on four occasions daily (three occasions daily in November), throughout an early period (morning to mid-afternoon) or late period (mid-afternoon to dark) on seven randomly selected weekdays and three weekend days every two weeks. Fishing effort was calculated for boat and shore anglers each month for weekends and weekdays by multiplying the average daily count of anglers times the number of hours available per day (12 hrs in April, October and November, 14 hrs in May and September, 16 hrs in June, July and August) times the number of weekend and weekdays per month. Angler catch was determined by interviewing as many anglers as possible during each sampling day. Total catch of each species was then calculated by multiplying the observed catch times the fraction of the total effort for each month. Harvested fish were also measured to determine size structure and each harvested muskie or bass was inspected for PIT tags or fin-clips. Estimates of percentages of legal-size muskies ( $\geq 36$  in) and bass ( $\geq 14$  in) removed by anglers from the population were calculated by dividing the harvest estimates by the spring population estimates. During each interview, a spokesperson for the party was asked which species they were fishing for, whether they released any legal or sub-legal muskies or bass, how they rated fishing quality, and their county of residence.

A standard fish population survey was conducted at Lake Webster on July 18-21. Surface water temperature was 82 degrees and water clarity was 8½ feet. No sampling was done in the Backwater Area. To ensure comparability with previous surveys, effort included 60 minutes of pulsed DC electrofishing (504V) at night with two dip-netters and three gill nets set for three days, but one net was damaged by a large boat (8 lifts). Two trap nets were also set for two days at four sites (4 lifts). All captured fish were measured to the nearest tenth-inch and released when possible. Weights were estimated from standard length-weight formulas generated from data on file from natural lake fish population surveys in the area. Fish scales were taken from dominant game fish for age and growth analyses using standard body-length:scale-length relationships.

Submersed aquatic plants were sampled at 132 random littoral sites in Lake Webster and the Backwater Area on May 31 and at 134 sites on July 29 using a doubled-head rake according to Division of Fish and Wildlife sampling guidelines. Site locations

on the first occasion were recorded with a GPS unit and then approximately relocated on the second occasion. Sample sites were located within the littoral zone and varied up to 14 feet deep in May and up to 15 feet deep in August. Channel areas were not included. Plant abundance, including algae, was quantified at each site by stacking the plants evenly across one side of the rake tines. Scores (0-5) were assigned to the amount of plants based on increments marked evenly on the tines. Species were then separated and scored individually at each site. The sampling was closely patterned after similar sampling on two occasions in 2003 and 2004.

Emergent plant beds were mapped on August 9 by boating along the lakeward perimeters of all beds and recording GPS coordinates of their edges. Width of the bed at each GPS point, oriented perpendicularly to shore (i.e. visual transect), was measured with a laser rangefinder. Bed size was calculated by summing areas of each polygon created by the linear distance between two consecutive GPS points and their mean width. The presence of various species along each visual transect was recorded, as was the presence of various nearshore wetland plants associated with each transect. Beds were generally defined as areas where emergent plants covered more than 625 square feet and spaces between plants were more than 25 feet. Small emergent stands, defined as isolated patches (<625 sq ft), were also mapped and characterized by species.

## RESULTS

### *Muskie population parameters*

A total of 971 muskies, including 72 recaptures, were trapped in spring 2005 at an average rate of 15 per lift (Table 3). At the end of trapping, 844 muskies had been PIT-tagged and released. The peak catch occurred on March 30-31 and accounted for 33% of the total when water temperature increased from 41 to 47. Two sites (#1 and #4) in the northeast and northwest corners of the lake (Figure 1) provided 52% of the total catch. Traditional broodstock collection sites (#5, #9, #10) provided 29% of the total catch. The largest single daily catch was 72 muskies and occurred at site #1 on March 31. Based on the mark-recapture sampling (Table 4), Lake Webster and the Backwater Area contained 5,363 (SE = 628) muskies in spring 2005. The estimate represented a population density of seven muskies per acre and tagged muskies comprised 16% of the population.

Individual muskies captured in trap nets (895) ranged from 23.5-50.5 inches long and averaged 33 inches (Figure 2). Those less than 30 inches long made up 25% of the catch, while those that were 36-inch or larger accounted for 24%. Based on these percentages, Lake Webster contained 1,300 legal-size muskies, 2,720 that were 30-35.5 inches, and 1,342 that were less than 30 inches, although those less than 30 inches were probably not as vulnerable to the traps and were therefore likely underestimated. Muskies that were 40-inch or larger accounted for 7% of the overall catch and represented 30% of the legal-size muskies in the lake (389). Recaptured muskies, including a 30-inch fish that was recaptured twice, ranged from 25.5-41.0 inches long and averaged 31.5 inches. Of these, 31% were less than 30 inches and 11% were 36-inch or larger.

Muskies caught in spring 2005 ranged in age from age-3 to age-10 (Table 5), although no age-9 muskies were presumed present since no fingerlings were stocked in 1996. Mean lengths at capture for each age from age-3 to age-8 increased from 26 inches to 29, 33, 36, 40, and 45 inches, respectively. The two largest muskies appeared to be 10 years old and averaged 50 inches. Based on age key analysis of scales samples taken per half-inch over the entire length range, the estimated numbers of age-3 to age-8 muskies in the lake were 416, 2127, 1279, 938, 408, and 183, respectively, while the number of age-10 muskies was estimated to be 12. Assuming this age composition is typical of the muskie population at Lake Webster each year, annual survival of age-4 muskies is 57% and annual survival of age-5 muskies is 55%. Survival decreases to 39% for age-6 muskies, 32% for age-7 muskies, and 6% for age-8 and older muskies.

#### *Largemouth bass population parameters*

A total of 1,138 largemouth bass ( $\geq 8$  in), including 118 recaptures, were caught, marked, and released during the four nights of spring electrofishing (Figure 3). Based on these results (Tables 6 and 7), the population estimate of 8-inch and larger bass was 3,850 (SE = 353) and represented five per acre. Excluding recaptures, the number of individual 8-inch and larger bass captured during sampling was 1,020 and represented 27% of the estimate. By the end of sampling, 258 legal-size bass ( $\geq 14$  in) had been marked and released. An additional 487 small bass ( $< 8$  in) were also captured and marked, of which 29 were later recaptured. Although these fish were likely under-represented, including

them in the overall population estimate increased the total number to 6,541 (SE = 538), or eight bass per acre.

The average nightly catch rate of 8-inch and larger bass was 44/hour of electrofishing, including average nightly catch rates of 28/hour of 8- to 11.5-inch bass, 5/hour of 12- to 13.5-inch bass, 8/hour of 14- to 17.5-inch bass, and 3/hour of 18-inch and larger bass. Mean nightly estimates of the proportional size distribution of these four size groups were 64%, 11%, 19% and 6%, respectively. Based on these percentages, the estimated numbers of bass in each size group were 2456, 433, 731 and 230.

Largemouth bass up to 8 years old were aged from scale samples. Mean back-calculated lengths at each current age from age-1 through age-8 were 5, 8, 10, 12, 14, 16, 18 and 19 inches, respectively. Based on the age composition of scale samples taken within each half-inch group over the entire length range and the overall population estimate (6,541), Lake Webster contained 747, 2299, 926, 1287, 480, 455, 282 and 65 bass that were age-1 through age-8, respectively. Using these figures, annual survival of bass, age-2 through age-7, was 60%, 74%, 50%, 63%, 43%, and 19%, respectively.

#### *Angler creel survey*

Anglers fished 70,829 hours at Lake Webster (92 hrs/ac) during April through November (Table 8). Anglers fishing from boats accounted for 65,559 hours (93%) and anglers fishing from shore or piers accounted for 5,270 hours (7%). Peak effort occurred in May (16%), June (15%), and October (15%), although the single maximum monthly amount of fishing effort from boats occurred in October (10,489 hrs). April (11%) and November (8%) experienced the least effort. Shore anglers fished more in June (1,286 hrs) and July (1,237 hrs). Total fishing pressure on weekends (35,780 hrs) was nearly identical to effort on weekdays (35,049 hrs). Boat anglers on weekends accounted for 47% of the total effort and 51% of the boat angling effort, while boat anglers on weekdays accounted for 45% of the total effort and 49% of the boat angling effort.

Fishing effort was primarily directed at muskies and largemouth bass (Table 9). Of 2,215 angler parties interviewed during the survey, 1,205 (54%) fished solely for muskies, 128 (6%) fished for muskies in combination with other species, and 380 fished solely for bass (17%). Bluegills were sought by less than 4% of the parties, followed by

perch (2%) and crappies (2%). Anglers who expressed no species preferences accounted for 10% of the total, while anglers who fished for various combinations of fish accounted for 6%. Overall, individual species were mentioned alone or in different combinations 2,446 times. Muskies were named 1,333 times (55%), followed by bass (21%), anything (9%), bluegills (8%), perch (5%), crappies (3%), sunfish or others (<1%).

As might be expected, boat anglers in general fished for different species than shore anglers, but differences among weekend and weekday anglers were minor. Boat anglers were more likely to fish specifically for muskies (61%) than shore anglers (5%), although shore anglers fished for bass (16%) about as much as boat anglers (17%). Shore anglers were more likely to fish for “anything” (48%) compared to boat anglers (5%). Bluegills were also specifically sought more by shore anglers (15%) than boat anglers (2%). Preferences for crappies, perch or other fish were similar between both groups. Muskies were targeted by 53% of anglers on weekends and 56% of anglers on weekdays. Bass were slightly more popular among weekend anglers (21%) than weekday anglers (15%). Differences between preferences for the other species were less than 3%.

Fishing preferences and effort directed at each species varied by month. The percentages of anglers who fished solely for muskies were greater during April (63%), May (65%), October (77%) and November (95%) than the other months. Fewer than 30% of anglers sought muskies in July or August. In contrast, largemouth bass were sought more in July (30%) and August (37%) than during other months (<21%). The percentage of anglers seeking bluegills was greatest in June and July (6%), while the percentage seeking crappies was greatest in April (13%). Anglers seeking perch peaked in July (5%). Of the 70,829 total hours fished, anglers who fished specifically for muskies accounted for 38,532 (54%). Muskie fishing effort was greatest in October (8,250 hrs) and May (7,214 hrs), followed by November (5,547 hrs), April (4,719 hrs), June (4,421 hrs) and September (4,204 hrs), then August (2,257 hrs) and July (2,095 hrs). Bass effort was greatest in August (2,942 hrs) and July (2,693 hrs), then June (2,191 hrs) and September (1,462 hrs), and less than 1,000 hours in April, May, October, with zero hours in November. Bluegill effort peaked in June (704 hrs), crappie effort peaked in April (978 hrs), and perch effort peaked in August (400 hrs).

Anglers caught and removed 11,203 fish during the creel survey, including 5,203 yellow perch, 4,801 bluegills, 414 crappies, and 534 miscellaneous sunfish (Table 10). They caught and kept only 210 largemouth bass, including 32 (15%) that had been marked in the spring. They kept only fourteen muskies. Fishermen also removed 26 other fish, mainly bullheads. However, anglers also caught and released 8,275 bass, including 2,555 (31%) that were reportedly 14-inch or larger. They also caught and released 2,201 muskies, of which 1,385 (63%) were reportedly less than 36 inches and 816 muskies (37%) that were 36-inch or larger. Of the 2,215 total muskies caught by anglers (including those taken home), 24% were caught in May and 20% were caught in October. Catches in April and May each contributed 13% to the total. Another 10% were caught in November. Of the 8,485 largemouth bass caught during the survey (including those taken home), 28% were caught in July, 28% in August, 21% in June, 10% in September, 7% in October, 4% in May, 3% in April, and fewer than 1% in November. Perch catches were greatest in July, September, and October. Bluegill catches were greatest in June and July, while crappie catches were greatest in April. Anglers who fished solely for muskies fished 22.8 hours on the average to catch one but catch rates varied considerably per month, ranging from 17.6 hours in May to 41.5 hours in September. Anglers who targeted bass caught them at an average rate of one per 1.7 hours of fishing. Monthly bass catch rates varied from one bass per 1.3 hours in July to 4.1 hours in May. Catch rates by anglers targeting only bluegills, crappies, or perch were one fish per 1.2, 1.6, and 0.5 hours, respectively.

Harvested bass ranged from 14-20 inches long while harvested muskies were 36-48 inches (Table 11). Most panfish taken by anglers were small. Bluegills were 5-11.5 inches and averaged 6.5 inches. Crappies were 6-12.5 inches and averaged 8 inches. Perch were 5-11.5 inches and averaged 7 inches. Only 8% of bluegills taken by anglers were 8-inch or larger and only 8% of crappies were 10-inch or larger. While 25% of perch were 8-inch or larger, less than 2% were 10-inch or larger. In contrast, mean length of harvested bass was 16 inches and mean length of harvested muskies was 39.5 inches. Of the 210 bass kept by anglers, 43 (20%) were 18-inch and larger. The 210 bass represented 22% of the number of legal bass ( $\geq 14$  in) present at the start of the survey, slightly higher than the 15% estimate based on the expanded harvest of marked bass. The

14 legal muskies kept by anglers represented 1% of the estimated number of legal fish present in April (1300).

Muskie anglers came from a wider geographic area and had a more favorable opinion of fishing quality than other anglers. Anglers who fished solely for muskies came from 53 Indiana counties (Figure 4) and nine other states. Those who fished only for bass came from 29 Indiana counties and four other states. In contrast, bluegill anglers came from 16 Indiana counties and two other states, crappie anglers came from 11 counties and one other state, and perch anglers came from seven counties and one other state. When asked to rate fishing quality, 80% of muskie-only anglers described it as good, 15% said it was fair, and 5% said it was poor (Table 12). In contrast, 57% of bass-only anglers rated fishing as good, 32% said it was fair, and 11% said it was poor. Among bluegill anglers, 66% considered fishing good, 28% said it was fair, and 6% said it was poor. The responses from perch anglers were similar (75% good, 22% fair, 8% poor) to bluegill anglers but crappie fishermen were less satisfied (46% good, 24% fair, 29% poor). Among all anglers, 70% rated fishing good, 22% rated fishing fair, and 8% rated fishing poor. Anglers who said they were lake residents were also generally satisfied, rating fishing as either good (72%) or fair (21%).

Contrary to what may have been expected, more lake residents specifically fished for muskies (28%) than bass (19%), bluegills (9%), perch (6%), or crappies (3%), although 21% had no preference. Meanwhile, 77% of out-of-state anglers fished for muskies, of which 70% came from Illinois and 15% came from Ohio, and 10% came from Michigan. Only 10% of out-of-state anglers came specifically to Lake Webster to fish for bass. Bass fishing, however, was more popular (31%) among local Kosciusko county residents (excluding lake residents) than were muskies (26%). Among anglers who came from the six neighboring counties (Elkhart, Fulton, Marshall, Noble, Wabash, Whitley), 50% fished solely for muskies and 28% fished solely for bass. Likewise, anglers who came from all other Indiana counties fished mostly for muskies 68%, while 13% fished for bass.

Muskie anglers generally fished longer than other anglers. Among all anglers who fished solely for muskies and had completed fishing at the time of the interview, average trip length was 6.2 hours. Mean complete fishing trip length for bass-only anglers was 5.2



hours. Anglers who fished for muskies in combination with bass fished an average of 4.9 hours. Average trip lengths for bluegill, crappie, and perch anglers were 4.2, 3.3, and 4.5 hours, respectively. Based on these figures, anglers who fished solely for muskies made 6,399 trips to Lake Webster. Bass-only anglers made 2,342 trips, while anglers who fished for muskies in combination with bass made 683 trips. The numbers of fishing trips made by bluegill, crappie, or perch anglers were 637, 398, and 345, respectively.

### *Fish population survey*

During the July fish population survey 2,205 fish, representing 19 species and weighing 383 pounds, were collected (see appendices). Bluegills dominated the catch by number (63%) and accounted for the largest share of the weight (29%). Perch ranked second, comprising 10% of the number and 10% of the weight. Gizzard shad were third in number (7%) and second by weight (13%), while largemouth bass were fourth in number (6%) and weight (12%). Only five muskies were captured. They accounted for 10% of the survey weight. Altogether game fish comprised 91% of the catch by number and 80% of the weight.

Bluegills ranged from 1-7 inches long, but only three were 7 inches. Most were 5.5 inches (246) or 6 inches (249) and ages 3-5. Of all 3-inch and larger bluegills (997), 36% were 6-inch or larger. Electrofishing provided 510 (128/15-min) and traps provided 857 (214/lift). Bluegill growth was slow, especially after age-4 and averaged less than 6 inches long by age-4.

Yellow perch ranged in length from 5-9 inches but most were 6.5-8 inches. Only 37 of the 218 perch caught during the survey were 8-inch or larger. Sixty-eight were caught in gill nets at a rate of 9/lift and 64 were captured during electrofishing, while 86 were caught in traps. Older perch were mostly age-4 and also grew slowly, averaging 6½ inches long in spring 2005.

A total of 123 largemouth bass were collected in the July survey. They measured 1.5-20 inches long, although only seven bass were 14-inch or larger. Peaks in the size distribution were at 2.5, 6.5, and 9.0 inches and corresponded to age-0, age-1, and age-2 fish, based on scales taken from bass captured during the spring sampling. All but eight bass were captured by electrofishing (29/15-min), including 53 bass that were 8-inch or

larger (13/15-min) and at a catch rate similar to spring (11/15-min). The catch rate of legal-size bass ( $\geq 14$  in), however, was about half (1.5/15-min) the catch rate in spring (2.8/15-min).

Other gamefish in the survey catch included 72 pumpkinseeds, 65 black crappies up to 10 inches long, 46 redear, 40 yellow bullheads and 37 brown bullheads, 16 longear, 12 warmouth, and the five muskies. The muskies were 29.5-35.5 inches. The smallest was caught during electrofishing and the two largest were caught in gill nets. A 31-inch and a 33.5-inch muskie were caught in traps.

Of the 154 gizzard shad collected during the survey, most were 8-12 inches long. Four were age-0 and were 2-2.5 inches. Only four shad were larger than 12 inches with the largest measuring 15.5 inches. Nearly all shad (91%) were captured during electrofishing and only eleven were caught in gill nets. In addition to shad, other non-game fish included 19 golden shiners, six spotted gar, six brook silversides, two lake chubsuckers, a 28-inch carp, a 26.5-inch bowfin, and one bluntnose minnow.

#### *Aquatic plant surveys*

Submersed aquatic plants were found to a depth of 14 feet at 90% of the sample sites in late May and to a depth of 15 feet at 84% of the sample sites in late July. The percentages of sites with native plant species on both occasions were 76% and 82%, respectively. Water clarity was 18 feet in May but declined to 8.5 feet in July. During May, 48% of the sites were within the 5-foot contour, 50% were within the 5.5- to 10-foot contour, and 2% were with the 10.5- to 14-foot contour. In July, 50% were within the 5-foot contour, 43% were within the 5.5- to 10-foot contour, and 10 sites were within the 10.5- to 15-foot contour. Ten species, including Eurasian water milfoil and curly-leaf pondweed, were found in May and 13 species, including both non-native plants, were found in July. The maximum number of species per site was six on both occasions, while the mean number per site dropped from 2.2 in May to 1.6 in July. Species diversity indices were similar on both dates (0.77-0.78) and average rake scores were also similar: 3.9 in May and 3.3 in July.

Curly-leaf pondweed and coontail were the two most dominant species. Curly-leaf pondweed was the dominant species in May and occurred at 81% of the littoral sites

with a mean rake score of 2.9 (Figure 5). After herbicide treatment and mid-summer senescence, curly-leaf pondweed was found at 14% of the littoral sites with a mean rake score of 1.1. During May sampling, it provided rake scores of 5 at 34% of the sites where present but only provided rakes scores of 1 or 2 in July. Coontail ranked second in dominance (i.e. percent of maximum potential abundance) in May (19) but ranked first in July (30). It occurred at 48% of the sample sites in May and 64% in July with mean rakes scores of 2.0 and 2.4, respectively. Eight (13%) of the sites where it was detected in May produced a rake score of 5, whereas 19 (22%) of the sites where it was detected in July produced a rake score of 5.

Other species were distributed less widely and most were present at lower levels of abundance. Eurasian water milfoil occurred at 39% of the sites in May and 12% in July and yielded mean rake scores of 2.4 and 1.1. Chara ranked fourth in dominance in May and third in July, occurring at 12% and 10% of the sample sites. Dominance scores for all other species were less than 5 on each occasion and included elodea, common naiad, sago pondweed, flat-stem pondweed, eel grass, and Illinois pondweed in May. Water stargrass, leafy pondweed, spiny naiad, variable-pondweed and large-leaf pondweed were found in July, but not common naiad, eel grass, or Illinois pondweed. These species were typically found at less than 10% of the sample sites.

Forty-one beds of floating-leaf emergents were mapped in Lake Webster and the northern end of the Backwater Area. They covered 34 acres, or 4% of the surface, and had a lakeward perimeter of 2.2 miles, or 28% of the shoreline length. Mean bed width was 71 feet. Most beds (63%) covered less than half an acre and only six beds were larger than an acre. The largest bed was 13 acres and present in a bay along the north shore. Few beds were present in the western half of the lake. Spatterdock occurred in each of the 41 beds and was noted along 30-100% of the visual transects in each bed, although 36 beds contained spatterdock throughout. Water lilies were present in six beds and were noted at 22-100% of transects in beds where they occurred. Other species associated with the 41 beds included cattails, arrow arum, purple loosestrife, swamp loosestrife, pickerelweed, arrowhead, and phragmites. Twenty-nine isolated patches of emergents were also noted, of which 55% contained water lilies and 48% contained spatterdock.

## DISCUSSION

The current estimate of adult muskie population density (6.9/ac) at Lake Webster was much higher than the previous estimate (1.5/ac) obtained in 1998 (Pearson 1999), greater than a recent estimate (1.3/ac) at nearby Loon Lake (Pearson 2005a), far exceeded the initial management goal of establishing a density of one 30-inch or larger muskie per acre, and was considerably greater than muskie population densities reported at other lakes in the nation. For example, most Wisconsin muskie lakes contain less than one adult per acre (Simonson 2003). Margenau (1999) described a Wisconsin population consisting of one adult muskie ( $\geq 30$  in) as a high-density population. The number of adult muskies in 5,650-acre Spirit Lake, Iowa declined from only 711 to 156 in the 1980s (Larscheid et. al 1999) and the current goal is to maintain a density of only one adult muskie per 7-10 acres.

Although the estimate of muskie population size was fairly precise (SE = 12%), its accuracy may be questioned. After high catches the first three days, they declined throughout the rest of the sampling. The number of recaptured muskies also decreased and the percentage of recaptured muskies stayed relatively constant, varying from 12-20% over the second half of the period except on the last day (30%). These factors could indicate that once captured, tagged muskies were less likely to be recaptured. If the percentage of tagged muskies captured during 2006 brood stock operations is greater than 16%, the 2005 population was probably overestimated and could be adjusted accordingly. Regardless of the true size of the population, the fact that 899 individual muskies were captured indicated Lake Webster contains many more muskies than a typical population.

Despite their high density, muskies continue to grow throughout their life and growth is comparable to rates reported from other waters. Although muskies in Missouri and Kentucky reach 30 inches by age-3 (Neuswanger et. al. 1994), they do not reach 30 inches until age-5 in Wisconsin (Simonson 2003). Muskies at Lake Webster were nearly 30 inches long by age-4. In Wisconsin, muskies reach 36 inches during age-7 and 40 inches after age-9, but reach 36 inches at Lake Webster by age-6 and 40 inches by age-7. Apparently enough forage is available to support the current number of muskies despite concerns that high densities can lead to excessive predatory demand (Wahl 1999) or population imbalances (Margenau 1999).

As a result of the high density and quality size of muskies in Lake Webster, muskie fishing interest has increased substantially over the years (Pearson 1987, 1991, 1999). Overall angler effort from April through November increased from 53,051 hours in 1990 and 43,929 hours in 1998 to 70,829 hours in 2005, mainly due to increased muskie fishing in spring and fall months. Excluding effort directed at muskies, anglers fished 32,297 hours in 2005 for other species and their effort was similar to 1998 (29,432 hrs). Fishing effort during June through August varied from 19,952 to 31,651 hours between 1987 and 1998 and was similar (27,816 hrs) in 2005. The percentage of boat anglers who targeted muskies increased from 7% in 1987 and 6% in 1990 to 24% in 1998 and 60% in 2005. Like 1998, muskie interest accounted for most of the activity in the fall months and was lowest in July and August. However, interest in spring muskie fishing was greater in 2005 (63% of April effort) compared to 1998 (15%). As noted in 1998, a high percentage of muskie anglers have been satisfied with fishing quality but satisfaction may have decreased slightly. As many as 89% of muskie anglers rated fishing good and 10% rated fishing fair in 1998, compared to 80% and 15%, respectively, in 2005.

Apparently muskies and increased muskie fishing activity have not reduced the satisfaction of other anglers who continue to fish at the lake. More bass anglers rated fishing good in 2005 (57%) than 1998 (37%). Another 57% rated bass fishing fair in 1998 compared to 32% in 2005, so the combined total of satisfied bass anglers was similar between years (89-94%). Only 6% of bluegill anglers rated fishing poor in 2005 compared to 30% in 1998. A much larger percentage of bluegill anglers considered fishing good in 2005 (66%) than they did in 1998 (10%). The percentage of crappie anglers who consider fishing good increased from 18% to 46%.

Although perceptions among anglers were that fishing quality was better in 2005 compared to 1998, anglers may have fished slightly fewer hours in 2005 for fish other than muskies than they did in 1998 or 1990. However, differences in the way angler preferences were calculated in 1998 may explain some of the decreases. Nevertheless, bass accounted for 40% of all fish listed in the responses of anglers in 1998 and 21% of the responses in 2005. Multiplying these figures by the overall effort each year yielded an estimate of 17,572 hours of bass fishing in 1998 and 14,874 hours in 2005, a decrease of 15%. Likewise, bluegill effort decreased from 10,982 to 5,666 hours but crappie effort

was similar, 2,196 and 2,125 hours. However, more hours were directed at perch in 2005 (3,541) compared to 1998 (878). In 1990, estimates were that bass anglers fished 23,342 hours, bluegill anglers fished 18,037 hours, crappie anglers fished 4,244 hours, and perch anglers fished 530 hours.

As expected with a build-up of the muskie population and with more anglers targeting muskies, muskie catches are now greater than ever. Only 268 muskies were harvested (67) or released (201) by anglers in 1987. Only four were taken in 1990 and only 86 were caught and released. In 1998 anglers removed only 27 muskies but the number caught and released (501) increased six-fold over 1990. By 2005, the number of muskies removed by anglers still remained low (14) but the number caught and released (2,201) was another four-fold greater. Although many more muskies were caught in 2005, the catch rate (1/23 hrs) of anglers who specifically targeted only muskies was similar to the catch rate in 1998 (1/25 hrs). These catch rates were also similar to, if not slightly better than, a 12-year average of one muskie per 27 hours of fishing in Wisconsin (Simonson 2003). The low harvest figure of 1.8 muskies per 100 acres at Lake Webster was also nearly identical to a 2001 average of 1.7 muskies per 100 acres in Wisconsin and probably reflects the impacts of high minimum size limits and a strong catch-and-release philosophy among muskie anglers.

As muskie catches have increased, harvest of most other species have generally decreased (Table 15). Largemouth bass harvest decreased from 2,924 fish in 1990 to 210 in 2005, although there was no minimum size limit on bass and a daily creel limit of six bass was in effect in 1990 compared to a 14-inch size limit and five-bass limit in 2005. Although fewer bass were harvested, the combined total of bass removed or released in 2005 was 8,485 and approached the combined total of 10,373 in 1990. It exceeded the combined total of 5,843 in 1998 when a 12-inch limit was in effect. The estimate that 2,555 legal-size bass ( $\geq 14$ -in) were released in 2005 may also indicate increased interest in catch-and-release fishing among bass anglers and could explain some of the decline in bass harvest, although overall bass catches also declined. Bluegills and sunfish showed the largest harvest declines in 2005. Although fewer crappies were taken in 2005 compared to 1990 and 1998, even fewer were taken in 1987. In contrast, perch harvest was greatest in 2005.

The economic value of muskie fishing at Lake Webster exceeded the value of other fishing activity at the lake and the cost of the stocking program. Assuming each fishing trip was valued at \$53 (Fish and Wildlife Service 2002), muskie trips by anglers who targeted only muskies were worth \$339,147, representing 76% of the entire program cost since its inception and worth more than 10 times the annual cost of stocking (\$30,960). This annual benefit:cost ratio was higher than the 4:1 ratio reported at nearby Loon Lake in 2004 (Pearson 2005a). The additional 683 trips by Lake Webster anglers who fished for muskies and bass added \$36,199 of economic worth. Bass fishing trips by anglers fishing only for bass were valued at \$124,126. Bluegill, crappie, and perch fishing trips accounted for a total value of \$73,140. Since many anglers who fished for muskies were drawn from a wide geographic area, including out-of-state, the difference in value of muskie fishing versus fishing for other species may have been even greater.

Although muskies have been stocked in Lake Webster for more than two decades, there is little evidence to suggest they have altered the fish community at the lake. Based on standard surveys conducted since 1976, bluegills have consistently ranked first by number (Table 13). Despite a low catch by anglers, more bluegills were captured in the 2005 fish population survey than any previous survey. Average bluegill weights varied from 0.06-0.11 pounds with no apparent trend. Although few 7-inch and larger bluegills were present (Table 14), more 5- to 6½-inch bluegills were captured. More 2- to 3½-inch bluegills were also collected, indicating muskie stockings, bass regulation changes, and weed control efforts have probably not affected bluegill reproduction and recruitment. Crappies have not been abundant at Lake Webster over the years and varied from 3-10% of the catch by number and averaged 6%. Yellow perch, a preferred prey item for muskies in Wisconsin (Bozek and Burri 1999), were more abundant prior to the start of muskie stockings and were at low levels from 1985 through 1995, but have apparently rebounded in recent years. Gizzard shad, the lake's dominant non-game prey fish and routinely found in the stomachs of Lake Webster muskies (personal communication with local taxidermists), remain the most abundant forage fish by number and weight. Consequently, the maintenance of an abundant gizzard shad forage base and the increase in yellow perch numbers offer further evidence that muskie density has not exceeded the lake's carrying capacity.

The number and weight of bass collected in fish surveys have also been fairly stable, although spring sampling indicated fewer, but more larger, bass were present in 2005. Bass catches in standard surveys varied from 47-143 and averaged 101 (Table 14). The number caught in 2005 matched the catch in 1988 and was exceeded only by the catch of 143 bass in 1995. The weight of bass varied from 40-73 pounds and averaged 56 pounds with no apparent trend over time. In contrast (Figure 5), density of 8-inch and larger bass in 2005 based on spring electrofishing was half (5/ac) of what was present in 1990 (10/ac). Catch rates of 8-inch and larger bass also decreased from 92 to 44 per hour. Density and catch rate of 8- to 11½-inch bass dropped 61%, while density and catch rate of 12- to 13½-inch bass declined by over 50%. Among larger size groups however, density and electrofishing catch rates increased but remained low. Density increased 9% and catch rate increased 7% among 14- to 17½-inch bass and 67% and 64%, respectively, among 18-inch and larger bass. The combined number of bass less than 14 inches decreased from 7,219 in 1990 to 2,889 in 2005, while the number of 14-inch and larger bass increased from 808 to 961. Although these figures represented only two years of more than two decades of muskie management at Lake Webster, lower overall bass densities but better size structure and greater densities of large bass were noted recently at other Indiana lakes where muskies (Pearson 2005a) and walleyes (Pearson 2005b) were stocked. Furthermore, despite the buildup of the muskie population at Lake Webster and potential risk to fishing for native species, the angler catch rate of bass doubled from 0.3/hour in 1998 to 0.6/hour in 2005 and should alleviate some concerns that muskie predation has reduced bass survival or adversely affected bass fishing.

## SUMMARY AND RECOMMENDATIONS

To reiterate the summary from the 1998 study (Pearson 1999) in light on new information obtained in 2005, Lake Webster continues to support a high-quality muskie fishery that not only draws a substantial number of muskie anglers from a wide area but also provides high-quality muskie fishing experiences. The stocking program, coupled with more restrictive largemouth bass fishing regulations and changes in aquatic plant management, has had no significant adverse effects on the native fish community. No changes in current management strategies are needed or recommended.



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Table 1. Number, size and source of muskellunge stocked at Lake Webster from 1978 through 2005.

Year	Number	Inches	Source
1978	48,483	fry	Pennsylvania
1981	350	10-12	Muskies, Inc
1982	1,622	8-17	mixed sources
1983	300	10-12	Muskies, Inc
1984	3,240	6-11	DFW ponds
1985	350	10-12	Muskies, Inc
1986	860	7-13	DFW ponds
1987	0	---	---
1988	3,294	5-8	DFW mixed
1989	1,760	7-9	Fawn River
1990	1,702	9-12	Fawn River
1991	3,144	8.5-11.5	Fawn River
1992	1,386	8-11	Fawn River
1993	1,009	7.5-9.5	Fawn River
1994	836	6.5-11	Fawn River
1995	2,370	7.5-9.5	Fawn River
1996	0	---	---
1997	2,746	7-10	Fawn River
1998	3,870	8.5-11.5	Fawn River
1999	3,870	9.5-12	Fawn River
2000	3,870	9.5-13	Fawn River
2001	3,870	7.5-13	Fawn River
2002	3,870	8-12	Fawn River
2003	3,870	7-10.5	Fawn River
2004	3,994	8-11.5	Fawn River
2005	3,876	7.5-12	Fawn River

Table 2. Oxygen levels (ppm) and water clarity (secchi depth in ft) at Lake Webster from 1976 through 2005 (source - Division of Fish and Wildlife files).

Depth (ft)	7/1976	7/1985	7/1988	7/1990	7/1995	7/1998	7/2005
0	8.0	7.0	8.0	9.0	9.0	8.0	7.4
5	8.2	7.0	8.0	9.0	9.0	8.0	7.2
10	8.0	7.0	8.0	8.0	2.5	8.0	7.1
15	5.6	5.0	5.0	8.0	4.0	6.0	2.2
20	0.4	1.5	1.0	4.0	0.8	0.4	0.5
25	0.0	trace	0.6	2.0	1.2	0.4	0.4
30	0.0	trace	0.6	0.0	0.0	1.0	0.3
35	0.0	0.0	0.0	0.0	0.0	trace	0.3
Clarity (ft)	5.0	4.5	5.0	3.3	4.0	3.5	8.5

Table 3. Daily water temperature (F) and the number of muskies captured per day at various trapping sites (#1-#12) at Lake Webster, spring 2005.

Date	F	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
Mar 29	--	18	0	8	31	24	-	-	-	-	-	-	-	81
Mar 30	41	46	-	10	35	40	16	18	-	-	-	-	-	165
Mar 31	47	72	-	15	20	18	8	26	-	-	-	-	-	159
Apr 1	44	28	-	-	28	9	-	6	-	-	-	-	-	71
Apr 3	45	37	-	-	57	-	-	-	-	-	-	-	-	94
Apr 4	47	9	-	-	19	-	-	-	-	-	-	-	-	28
Apr 5	50	-	-	-	21	-	-	-	8	15	-	-	-	44
Apr 6	53	-	-	-	38	-	-	-	25	21	15	-	-	99
Apr 7	54	-	-	-	24	-	6	-	7	18	8	-	-	63
Apr 8	56	-	-	-	10	-	0	-	-	20	6	6	-	42
Apr 9	55	-	-	-	8	-	2	-	-	12	7	1	-	30
Apr 11	57	-	-	-	4	13	2	-	-	17	9	-	-	45
Apr 12	53	-	-	-	4	4	2	-	-	10	7	-	-	27
Apr 13	49	-	-	-	-	-	3	-	-	1	0	-	6	10
Apr 14	51	-	-	-	-	-	-	-	-	7	4	-	2	15
<b>TOTAL</b>		<b>210</b>	<b>0</b>	<b>33</b>	<b>299</b>	<b>108</b>	<b>39</b>	<b>50</b>	<b>40</b>	<b>121</b>	<b>56</b>	<b>7</b>	<b>8</b>	<b>971</b>

Table 4. Daily water temperature (F), number of muskies caught (C), muskie deaths (D), marked muskies at large (M), recaptured muskies (R), muskies transported to Fawn River (T), muskies shipped back for release (S), untagged muskies released (U), Schnabel population estimate (N), and standard error (SE) at Lake Webster, spring 2005.

Date	F	C	D	M	R	T	S	U	C*M	N	SE
Mar 29	---	81	0	0	0	0	0	0	0	---	---
Mar 30	41	165	6	81	1	0	0	0	13365	6683	4725
Mar 31	47	159	5	239	1	0	0	0	38001	17122	9885
Apr 1	44	71	0	392	2	0	0	0	27832	15840	7084
Apr 2	<i>traps not checked</i>										
Apr 3*	45	94	3	461	9	0	0	0	43334	8752	2339
Apr 4	47	28	0	543	2	0	0	0	15204	8609	2152
Apr 5	50	44	2	569	3	0	0	0	25036	8567	1965
Apr 6	53	99	7	608	12	19	0	6	60192	7192	1292
Apr 7	54	63	2	663	10	22	15	0	41769	6457	1008
Apr 8	56	42	3	707	8	20	19	0	29694	6009	858
Apr 9	55	30	1	737	5	15	20	0	22110	5862	798
Apr 10	<i>traps not checked</i>										
Apr 11*	57	45	4	766	9	21	17	0	34470	5572	702
Apr 12	53	27	5	794	4	14	18	0	21438	5559	679
Apr 13	49	10	0	816	2	8	20	0	8160	5516	664
Apr 14	51	13	2	836	4	0	1	0	10868	5363	628
Apr 15	---	---	---	---	---	---	8	---	---	---	---
<b>TOTAL</b>		971	40	844	72	119	118	6		5363	628

\*numbers represent a two-day catch.

Table 5. Age frequency distribution of muskies per half-inch and the estimated number of muskies present in Lake Webster per age per half-inch in spring 2005.

Inch	Age										Rays	Estimate number/age										Sum
	3	4	5	6	7	8	9	10	3	4		5	6	7	8	9	10					
23.5	2										2	12	0	0	0	0	0	0	0	0	0	12
24.0	4	1									5	19	5	0	0	0	0	0	0	0	0	24
24.5	3	2									5	18	12	0	0	0	0	0	0	0	0	30
25.0	7	2									9	51	15	0	0	0	0	0	0	0	0	66
25.5	5	2									7	43	17	0	0	0	0	0	0	0	0	60
26.0	7	1	1								9	47	7	7	0	0	0	0	0	0	0	60
26.5	1	7	1								9	13	89	13	0	0	0	0	0	0	0	114
27.0	5	4									9	67	53	0	0	0	0	0	0	0	0	120
27.5	6	2	2								10	58	19	19	0	0	0	0	0	0	0	96
28.0	4	5	1								10	62	78	16	0	0	0	0	0	0	0	156
28.5		6	3								9	0	92	46	0	0	0	0	0	0	0	138
29.0	1	5	2	1							9	27	133	53	27	0	0	0	0	0	0	240
29.5		10									10	0	228	0	0	0	0	0	0	0	0	228
30.0		11									11	0	348	0	0	0	0	0	0	0	0	348
30.5		10	2								12	0	195	39	0	0	0	0	0	0	0	234
31.0		10									10	0	306	0	0	0	0	0	0	0	0	306
31.5		8	2								10	0	197	49	0	0	0	0	0	0	0	246
32.0		5	5								10	0	93	93	0	0	0	0	0	0	0	186
32.5		4	5	1							10	0	93	117	23	0	0	0	0	0	0	234
33.0		2	4	2							8	0	55	111	55	0	0	0	0	0	0	222
33.5		2	4	3							9	0	51	101	76	0	0	0	0	0	0	228
34.0		1	7	2							10	0	23	164	47	0	0	0	0	0	0	234
34.5		1	5	4							10	0	20	102	81	0	0	0	0	0	0	204
35.0			7	4							11	0	0	99	57	0	0	0	0	0	0	156
35.5			7	3	1						11	0	0	80	34	11	0	0	0	0	0	126
36.0			1	7							8	0	0	25	173	0	0	0	0	0	0	198
36.5			3	4	1						8	0	0	49	66	16	0	0	0	0	0	132
37.0			4	4	1						9	0	0	56	56	14	0	0	0	0	0	126
37.5			1	4	3						8	0	0	16	63	47	0	0	0	0	0	126
38.0			2	5	1						8	0	0	25	64	13	0	0	0	0	0	102
38.5				3	5						8	0	0	0	31	52	0	0	0	0	0	84
39.0				3	6						9	0	0	0	30	60	0	0	0	0	0	90
39.5				5	4						9	0	0	0	30	24	0	0	0	0	0	54
40.0				2	9						11	0	0	0	13	59	0	0	0	0	0	72
40.5				1	1						2	0	0	0	6	6	0	0	0	0	0	12
41.0					4	1					5	0	0	0	0	24	6	0	0	0	0	30
41.5				1	2						3	0	0	0	6	12	0	0	0	0	0	18
42.0					5						5	0	0	0	0	36	0	0	0	0	0	36
42.5				1	1						2	0	0	0	0	15	15	0	0	0	0	30
43.0					2	2					4	0	0	0	0	6	6	0	0	0	0	12
43.5					1	1					2	0	0	0	0	6	6	0	0	0	0	12
44.0					1	3					4	0	0	0	0	6	18	0	0	0	0	24
44.5						2					2	0	0	0	0	0	24	0	0	0	0	24
45.0						1					1	0	0	0	0	0	18	0	0	0	0	18
45.5						1					1	0	0	0	0	0	6	0	0	0	0	6
46.0						5					5	0	0	0	0	0	60	0	0	0	0	60
46.5						1					1	0	0	0	0	0	12	0	0	0	0	12
47.0						1					1	0	0	0	0	0	6	0	0	0	0	6
47.5						1					1	0	0	0	0	0	6	0	0	0	0	6
49.0									1		1	0	0	0	0	0	0	0	0	0	6	6
50.5									1		1	0	0	0	0	0	0	0	0	0	6	6
	45	101	69	59	48	20	0	2	344	416	2127	1279	938	408	183	0	12	5363				

Table 6. Length distribution of largemouth bass captured (Catch) and recaptured (Recaps) at Lake Webster in spring 2005 (catch does not include recaptured fish).

Inches	04/25/05		05/02/05		05/09/05		05/16/05		Total		Total	
	Catch	Recap	Catch	Recap	Catch	Recap	Catch	Recap	Catch	Percent	Recaps	Percent
<=3	0	0	1	0	0	0	0	0	1	0.07	0	0.00
3.5	0	0	0	0	1	0	1	0	2	0.13	0	0.00
4.0	0	0	5	0	8	0	12	0	25	1.66	0	0.00
4.5	4	0	5	0	7	0	28	1	44	2.92	1	0.68
5.0	4	0	9	0	10	1	31	1	54	3.58	2	1.36
5.5	4	0	11	0	4	0	19	0	38	2.52	0	0.00
6.0	4	0	2	0	5	0	3	0	14	0.93	0	0.00
6.5	4	0	2	0	1	0	6	1	13	0.86	1	0.68
7.0	25	0	27	0	16	1	31	5	99	6.57	6	4.08
7.5	49	0	40	1	31	5	77	13	197	13.07	19	12.93
8.0	33	0	32	1	32	3	29	5	126	8.36	9	6.12
8.5	16	0	26	1	14	3	31	5	87	5.77	9	6.12
9.0	33	0	18	5	19	2	19	7	89	5.91	14	9.52
9.5	17	0	15	0	19	4	36	8	87	5.77	12	8.16
10.0	20	0	19	1	22	6	19	6	80	5.31	13	8.84
10.5	21	0	10	4	22	3	16	2	69	4.58	9	6.12
11.0	19	0	15	2	17	3	15	0	66	4.38	5	3.40
11.5	6	0	11	1	17	2	10	4	44	2.92	7	4.76
12.0	10	0	6	1	10	2	12	3	38	2.52	6	4.08
12.5	8	0	12	0	5	2	7	1	32	2.12	3	2.04
13.0	6	0	5	0	6	1	4	0	21	1.39	1	0.68
13.5	7	0	8	0	5	2	3	1	23	1.53	3	2.04
14.0	6	0	6	1	8	1	2	2	22	1.46	4	2.72
14.5	8	0	8	0	4	1	7	0	27	1.79	1	0.68
15.0	7	0	2	0	9	1	9	0	27	1.79	1	0.68
15.5	3	0	9	0	9	2	6	0	27	1.79	2	1.36
16.0	3	0	9	1	10	3	5	2	27	1.79	6	4.08
16.5	4	0	4	0	9	0	6	2	23	1.53	2	1.36
17.0	7	0	3	0	7	1	3	1	20	1.33	2	1.36
17.5	7	0	4	0	10	2	4	0	25	1.66	2	1.36
18.0	4	0	6	1	3	0	1	0	14	0.93	1	0.68
18.5	6	0	7	0	5	2	3	1	21	1.39	3	2.04
19.0	5	0	3	0	5	1	3	2	16	1.06	3	2.04
19.5	0	0	1	0	1	0	1	0	3	0.20	0	0.00
20.0	1	0	1	0	1	0	0	0	3	0.20	0	0.00
20.5	0	0	0	0	1	0	0	0	1	0.07	0	0.00
21.0	1	0	0	0	0	0	0	0	1	0.07	0	0.00
21.5	0	0	0	0	0	0	0	0	0	0.00	0	0.00
>=22	0	0	0	0	1	0	0	0	1	0.07	0	0.00
Total	352	0	342	20	354	54	459	73	1507		147	
Seconds	22927		22236		24217		23620		93000			
<8	94	0	102	1	83	7	208	21	487		29	
8-11.5	165	0	146	15	162	26	175	37	648		78	
12-13.5	31	0	31	1	26	7	26	5	114		13	
14-17.5	45	0	45	2	66	11	42	7	198		20	
>=18	17	0	18	1	17	3	8	3	60		7	

Table 7. Nightly electrofishing effort in hours (H), catches (C), marked bass at large (M), recaptures (R), Schnabel population estimate (N), and standard error (SE) of 8-inch and larger largemouth bass in Lake Webster and the Backwater Area during April-May 2005.

Date	H	C	M	R	N	SE
4/25/05	6.37	258	0	0	0	0
5/02/05	6.18	259	258	19	3,341	747
5/09/05	6.73	318	498	47	3,361	411
5/16/05	6.56	303	769	52	3,850	353



Table 8. Mean daily counts of boat anglers (meanB), shore anglers (meanS), length of a fishing day (Hrs/day), fishing days per month (Day/m), estimated hours fished by boat anglers (BoatHrs) and shore anglers (ShoreHrs), and total angling effort (TotalHrs) on weekend (we) and weekdays (wd) per month at Lake Webster, April through November 2005.

Month	Wky	MeanB	MeanS	Hrs/d	Day/m	BoatHrs	ShoreHrs	TotalHrs
Apr	we	41.42	4.00	12	8	3976	384	4360
Apr	wd	12.36	0.88	12	20	2967	211	3179
May	we	38.15	2.82	14	10	5340	395	5736
May	wd	16.89	1.42	14	21	4965	417	5381
Jun	we	29.89	4.00	16	8	3826	512	4338
Jun	wd	16.27	2.20	16	22	5726	774	6500
Jul	we	22.31	2.82	16	11	3926	497	4423
Jul	wd	12.01	2.32	16	20	3844	741	4585
Aug	we	28.92	2.33	16	8	3701	299	4000
Aug	wd	9.58	1.21	16	23	3527	444	3970
Sep	we	27.21	1.96	14	9	3428	247	3675
Sep	wd	13.76	0.37	14	21	4044	109	4154
Oct	we	51.89	0.64	12	10	6227	77	6304
Oct	wd	16.91	0.36	12	21	4262	92	4353
Nov	we	30.29	0.38	12	8	2907	37	2944
Nov	wd	10.96	0.13	12	22	2892	35	2927
<b>Sum</b>						<b>65559</b>	<b>5270</b>	<b>70829</b>
<b>Apr</b>						<b>6943</b>	<b>595</b>	<b>7539</b>
<b>May</b>						<b>10305</b>	<b>812</b>	<b>11117</b>
<b>Jun</b>						<b>9552</b>	<b>1286</b>	<b>10838</b>
<b>Jul</b>						<b>7770</b>	<b>1238</b>	<b>9008</b>
<b>Aug</b>						<b>7228</b>	<b>742</b>	<b>7970</b>
<b>Sep</b>						<b>7472</b>	<b>356</b>	<b>7829</b>
<b>Oct</b>						<b>10489</b>	<b>169</b>	<b>10657</b>
<b>Nov</b>						<b>5800</b>	<b>72</b>	<b>5871</b>
<b>Sum</b>						<b>65559</b>	<b>5270</b>	<b>70829</b>
<b>Weekends</b>						<b>33333</b>	<b>2447</b>	<b>35780</b>
<b>Weekdays</b>						<b>32226</b>	<b>2824</b>	<b>35049</b>

Table 9. Number of interviewed angler parties who fished for various species or combinations of various species at Lake Webster per month from April through November 2005.

<b>Species</b>	<b>Apr</b>	<b>May</b>	<b>Jun</b>	<b>Jul</b>	<b>Aug</b>	<b>Sep</b>	<b>Oct</b>	<b>Nov</b>	<b>Total</b>
Anything	12	40	47	48	42	26	11	3	229
Bass	27	30	56	90	103	48	26		380
Bass-muskie	10	20	16	21	10	12	12	4	105
Bass-perch			2						2
Bluegill	4	20	18	20	13	6	2		83
Bluegill-bass			1	10	1	3			15
Bluegill-bass-muskie			1						1
Bluegill-crappie	1	4	2	4	1				12
Bluegill-crappie-perch					6				6
Bluegill-muskie	1		2	3	1	4			11
Bluegill-perch	1	1	13	21	4	7	2		49
Bluegill-sunfish			5	3					8
Crappie	34	1	1	2	2	1			41
Crappie-bass	1								1
Crappie-muskie		2		2					4
Crappie-perch						1			1
Muskie	164	220	113	70	79	138	233	188	1205
Muskie-perch					2	1	2	1	6
Muskie-sunfish							1		1
Others	1			1	1				3
Perch	6	1		5	14	10	9	3	48
Sunfish							2		2
Sunfish-perch				1			1		2
<b>Total</b>	<b>262</b>	<b>339</b>	<b>277</b>	<b>301</b>	<b>279</b>	<b>257</b>	<b>301</b>	<b>199</b>	<b>2215</b>

Table 10. Observed harvest of bluegills (BG), crappies (CR), sunfish (SF), perch (YP), other fish (OT), muskies (M), unmarked largemouth bass (UNMK) and marked largemouth bass (MRKD), number of sub-legal bass (<14 in) released (R<14), number of legal-size bass (R>14) released, number of sub-legal muskies (R<36) released, number of legal muskies (R>36) released, accumulated interview hours (Int hrs), estimated fishing hours (Fish Hrs), and expansion factors (ExpF) used to estimate total harvest and releases by boat and shore anglers (B/S), fishing on weekends (we) or weekdays (wd), for the creel survey at Lake Webster from April through November 2005.

Month	Wkdy	B/S	BG	CR	SF	YP	OT	MUS	UNMK	MRKD	R<14	R>14	R<36	R>36	Int Hrs	Fish Hrs	ExpF
Apr	we	b	0	0	0	18	0	0	0	0	8	7	6	15	631.63	3976.00	6.29
Apr	we	s	0	0	0	13	0	0	0	0	2	0	2	0	60.63	384.00	6.33
Apr	wd	B	4	126	0	21	0	2	5	0	27	17	37	17	1153.80	2967.14	2.57
Apr	wd	s	3	15	0	0	0	0	0	0	0	5	0	0	45.63	211.43	4.63
May	we	b	63	0	0	25	0	0	0	0	9	13	37	21	1329.03	5340.42	4.02
May	we	s	12	0	0	5	0	0	0	0	2	1	0	1	70.33	395.21	5.62
May	wd	b	88	0	5	5	0	0	2	0	55	18	62	27	1634.73	4964.75	3.04
May	wd	s	60	0	0	8	0	0	0	0	1	1	2	1	112.10	416.50	3.72
Jun	we	b	95	0	3	33	0	0	5	0	145	68	8	3	753.98	3825.78	5.07
Jun	we	s	21	0	2	5	0	0	0	0	2	0	0	0	82.88	512.00	6.18
Jun	wd	b	164	1	0	60	0	0	5	2	46	44	35	12	1157.42	5725.87	4.95
Jun	wd	s	33	0	1	2	0	0	0	0	6	13	1	0	104.15	774.40	7.44
Jul	we	b	20	0	3	34	0	0	6	0	151	88	20	1	661.98	3926.48	5.93
Jul	we	s	27	0	4	9	0	0	0	1	3	2	0	0	47.65	496.57	10.42
Jul	wd	b	190	1	25	165	0	1	6	2	132	66	9	5	948.98	3843.56	4.05
Jul	wd	s	60	0	0	9	0	0	0	0	5	3	0	0	107.02	741.33	6.93
Aug	we	b	10	1	20	59	1	0	0	0	272	100	4	3	764.58	3701.33	4.84
Aug	we	s	4	0	0	18	0	0	0	0	0	0	0	0	71.35	298.67	4.19
Aug	wd	b	29	2	4	87	0	0	5	0	104	34	22	7	1047.67	3526.67	3.37
Aug	wd	s	22	0	0	19	0	0	0	0	9	4	0	0	78.27	443.76	5.67
Sep	we	b	22	0	0	107	0	0	2	1	121	21	4	2	915.80	3428.25	3.74
Sep	we	s	7	0	0	0	0	0	0	0	2	0	0	0	43.55	246.75	5.67
Sep	wd	b	66	0	7	211	0	0	4	0	60	15	28	7	1284.98	4044.13	3.15
Sep	wd	s	1	0	0	1	0	0	0	0	0	0	0	0	4.27	109.43	25.65
Oct	we	b	2	0	31	87	4	1	0	0	57	8	26	26	1184.97	6227.14	5.26
Oct	we	s	0	0	0	0	0	0	0	0	0	0	0	0	4.33	77.14	17.80
Oct	wd	b	19	0	9	177	0	0	2	0	23	6	27	23	1362.92	4261.50	3.13
Oct	wd	s	0	0	0	0	0	0	0	0	8	2	0	0	6.70	91.50	13.66
Nov	we	b	0	0	0	0	0	0	0	0	0	0	6	14	962.47	2907.43	3.02
Nov	we	s	0	0	0	8	0	0	0	0	0	0	0	0	0.77	36.57	47.70
Nov	wd	b	0	0	0	0	0	0	2	0	1	0	30	30	1048.58	2892.27	2.76
Nov	wd	s	0	0	0	0	0	0	0	0	0	0	0	0	2.22	35.20	15.88

Table 11. Size distribution of fish taken by anglers each month at Lake Webster from April through November 2005.

Inches	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total	Percent	Harvest
<b>Bluegill</b>											
5.0	0	9	3	1	0	17	1	0	31	3.3	157
5.5	0	14	13	2	2	13	3	0	47	5.0	238
6.0	2	37	73	59	15	16	5	0	207	21.8	1047
6.5	2	40	87	92	20	11	9	0	261	27.5	1320
7.0	1	32	64	74	5	11	2	0	189	19.9	956
7.5	2	29	47	58	0	5	0	0	141	14.9	713
8.0	0	23	17	14	0	4	0	0	58	6.1	293
8.5	0	13	1	0	0	0	0	0	14	1.5	71
9.0	0	0	1	0	0	0	0	0	1	0.1	5
											4801
<b>Crappie</b>											
6.0	7	0	0	0	0	0	0	0	7	6.3	26
6.5	8	0	0	1	0	0	0	0	9	8.0	33
7.0	28	0	0	0	0	0	0	0	28	25.0	104
7.5	23	0	0	0	0	0	0	0	23	20.5	85
8.0	12	0	0	0	0	0	0	0	12	10.7	44
8.5	10	0	0	0	0	0	0	0	10	8.9	37
9.0	5	0	1	0	0	0	0	0	6	5.4	22
9.5	7	0	0	0	0	0	0	0	7	6.3	26
10.0	8	0	0	0	1	0	0	0	9	8.0	33
10.5	0	0	0	0	0	0	0	0	0	0.0	0
11.0	0	0	0	0	0	0	0	0	0	0.0	0
11.5	0	0	0	0	0	0	0	0	0	0.0	0
12.0	0	0	0	0	0	0	0	0	0	0.0	0
12.5	0	0	0	0	1	0	0	0	1	0.9	4
											414
<b>Sunfish</b>											
5.0	0	1	0	0	0	0	0	0	1	1.4	8
5.5	0	0	0	1	1	0	1	0	3	4.3	23
6.0	0	1	2	9	5	0	5	0	22	31.4	168
6.5	0	0	0	19	3	3	3	0	28	40.0	214
7.0	0	3	1	3	2	2	0	0	11	15.7	84
7.5	0	0	1	0	1	2	0	0	4	5.7	31
8.0	0	0	1	0	0	0	0	0	1	1.4	8

Table 11. *Continued.*

Inches	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total	Percent	Harvest
<b>Unmarked Bass</b>											
14.0	1	1	2	0	1	1	0	0	6	19.4	34
14.5	0	1	2	0	0	1	0	0	4	12.9	23
15.0	0	0	2	2	0	0	1	1	6	19.4	34
15.5	0	0	0	0	1	0	0	0	1	3.2	6
16.0	0	0	0	1	0	0	1	0	2	6.5	11
16.5	0	0	0	0	0	0	0	1	1	3.2	6
17.0	1	0	1	2	1	0	0	0	5	16.1	29
17.5	0	0	0	1	0	0	0	0	1	3.2	6
18.0	0	0	1	0	0	0	0	0	1	3.2	6
18.5	0	0	0	1	0	1	0	0	2	6.5	11
19.0	0	0	1	0	0	0	0	0	1	3.2	6
19.5	0	0	0	0	0	0	0	0	0	0.0	0
20.0	0	0	1	0	0	0	0	0	1	3.2	6
											178
<b>Marked Bass</b>											
14.0	0	0	1	0	0	1	0	0	2	28.6	9
14.5	0	0	0	0	0	0	0	0	0	0.0	0
15.0	0	0	0	0	0	0	0	0	0	0.0	0
15.5	0	0	0	1	0	0	0	0	1	14.3	5
16.0	0	0	0	0	0	0	0	0	0	0.0	0
16.5	0	0	0	0	0	0	0	0	0	0.0	0
17.0	0	0	0	0	0	0	0	0	0	0.0	0
18.0	0	0	1	0	0	0	0	0	1	14.3	5
18.5	0	1	0	1	0	0	0	0	2	28.6	9
19.0	0	0	0	1	0	0	0	0	1	14.3	5
											32
<b>Perch</b>											
5.0	0	14	0	0	6	11	6	0	37	3.0	154
5.5	0	3	0	0	5	14	9	0	31	2.5	129
6.0	8	3	19	1	7	21	33	0	92	7.4	383
6.5	9	5	27	26	31	39	106	0	243	19.4	1011
7.0	15	6	28	42	37	96	52	2	278	22.2	1156
7.5	13	5	12	70	31	75	46	3	255	20.4	1061
8.0	2	2	8	43	20	33	41	8	157	12.5	653
8.5	0	3	2	13	6	17	24	8	73	5.8	304
9.0	0	0	2	6	4	1	22	6	41	3.3	171
9.5	0	1	0	0	1	2	15	2	21	1.7	87
10.0	1	0	0	2	4	6	3	0	16	1.3	67
10.5	1	1	0	0	2	1	0	0	5	0.4	21
11.0	0	0	0	0	1	0	0	0	1	0.1	4
11.5	0	0	0	0	0	1	0	0	1	0.1	4
											5203
<b>Muskie</b>											
36.0	1	0	0	1	0	0	0	0	2	50.0	7
38.0	1	0	0	0	0	0	0	0	1	25.0	4
48.0	0	0	0	0	0	0	1	0	1	25.0	4
											14

Table 12. Number of interviewed anglers parties who rated fishing as fair, good or poor based on their species preference at Lake Webster from April through November 2005.

<b>Species</b>	<b>Good</b>	<b>Fair</b>	<b>Poor</b>	<b>Total</b>
Anything	122	88	19	229
Bass	218	120	42	380
Bass-muskie	66	26	13	105
Bass-perch	1		1	2
Bluegill	55	23	5	83
Bluegill-bass	8	6	1	15
Bluegill-bass-muskie	1			1
Bluegill-crappie	5	4	3	12
Bluegill-crappie-perch	3	3		6
Bluegill-muskie	5	4	2	11
Bluegill-perch	32	15	2	49
Bluegill-sunfish	2	4	2	8
Crappie	19	10	12	41
Crappie-bass	1			1
Crappie-muskie	1	2	1	4
Crappie-perch			1	1
Muskie	966	177	60	1203
Muskie-perch	5	1		6
Muskie-sunfish	1			1
Others	2	1		3
Perch	36	10	2	48
Sunfish	1	1		2
Sunfish-perch	2			2
<b>Total</b>	<b>1551</b>	<b>494</b>	<b>165</b>	<b>2213</b>

Table 13. Number and weight of fish collected during standard fish population surveys at Lake Webster from 1976 through 2005.

Species	<i>Number</i>						
	1976	1985	1988	1990	1995	1998	2005
Bass	72	115	123	47	143	86	123
Bluegills	667	755	847	611	882	1,148	1,381
Bullheads	103	117	45	72	42	52	77
Crappies	69	131	49	130	63	101	65
Muskies	0	3	1	0	6	0	5
Perch	183	20	36	43	10	108	218
Pike	0	0	0	0	0	0	0
Redear	117	32	18	30	26	54	46
Other sunfish	66	63	48	34	47	39	100
Carp	18	18	3	1	4	2	1
Chubsuckers	15	4	2	7	0	0	2
Gar	15	12	9	13	8	6	6
Shad	273	182	65	310	119	174	154
Shiners	18	11	0	2	0	3	19
Others	22	11	15	10	35	10	8
Total	1,638	1,474	1,261	1,310	1,385	1,783	2,205

Species	<i>Pounds</i>						
	1976	1985	1988	1990	1995	1998	2005
Bass	39.5	62.5	72.9	41.8	64.4	64.0	45.8
Bluegills	55.5	72.6	54.4	64.5	71.5	116.7	113.0
Bullheads	67.8	66.3	33.2	46.6	19.9	31.9	40.9
Crappies	13.7	25.5	5.4	31.3	19.6	29.3	13.2
Muskies	0.0	7.0	3.8	0.0	27.0	0.0	38.7
Perch	7.0	1.8	3.8	7.0	1.7	16.8	37.2
Pike	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Redear	23.1	5.1	2.8	5.6	4.1	8.9	8.9
Other sunfish	5.9	4.2	4.2	4.2	2.4	4.9	10.5
Carp	127.9	94.2	24.5	5.0	39.4	18.5	10.1
Chubsuckers	2.0	0.7	0.8	2.2	0.0	0.0	0.2
Gar	35.9	21.6	17.2	57.7	26.3	16.9	9.1
Shad	183.7	73.7	41.2	77.2	49.9	60.9	48.0
Shiners	1.6	1.1	0.0	0.2	0.0	0.4	1.6
Others	33.3	20.4	1.5	29.1	15.5	1.6	6.7
Total	596.9	456.7	265.7	372.4	341.7	370.8	383.8

*Sampling gear and effort*

Electro-hours (ac)	3.00*	1.00	---	---	---	---	---
Electro-hours (dc)	---	1.25	1.00**	0.50	0.75	1.00	1.00
Gill net lifts	12	12	8	6	6	6	8
Trap net lifts	0	11	8	8	7	6	4

\*includes 90 minutes of electrofishing during the day and 90 minutes at night.

\*\*includes 15 minutes when only bass were captured.

Table 14. Number of bluegills collected per size interval during standard fish population surveys at Lake Webster from 1976 through 2005.

Inches	1976	1985	1988	1990	1995	1998	2005
1-1.5	3	0	0	2	0	2	11
2-2.5	50	9	17	3	68	245	373
3-3.5	80	25	127	40	166	172	225
4-4.5	115	200	296	83	196	61	87
5-5.5	201	356	266	305	289	198	328
6-6.5	192	146	138	169	150	404	354
7-7.5	26	19	3	9	13	64	3
8-8.5	0	0	0	0	0	1	0
Total	667	755	847	611	882	1,147	1,381
Mean (in)	4.7	4.9	4.5	5.0	4.4	4.5	4.0



Table 15. Estimated number of fish of various species taken by anglers during surveys conducted at Lake Webster in 1987 (summer only), 1990, 1998 and 2005.

<u>Species</u>	<u>1987</u>	<u>1990</u>	<u>1998</u>	<u>2005</u>
Bass	616	2,924	600	210
Bluegills	11,313	37,566	13,859	4,801
Crappies	287	4,223	2,506	414
Muskies	67	4	27	14
Perch	1,125	2,865	1,946	5,203
Sunfish	1,308	4,010	1,174	534
Others	0	234	188	26
<u>TOTAL</u>	<u>14,716</u>	<u>51,816</u>	<u>20,300</u>	<u>11,202</u>
Hours fished	19,952	53,051	43,929	70,829
Bass released	na	7,449	5,243	2,555
Muskies released	201	86	501	2,201

Figure 1. Locations and trap number of muskellunge trapping sites at Lake Webster during spring 2005.



Figure 2. Number of muskies captured (gray columns) and recaptured (dark columns) per size interval (inches) at Lake Webster, spring 2005.

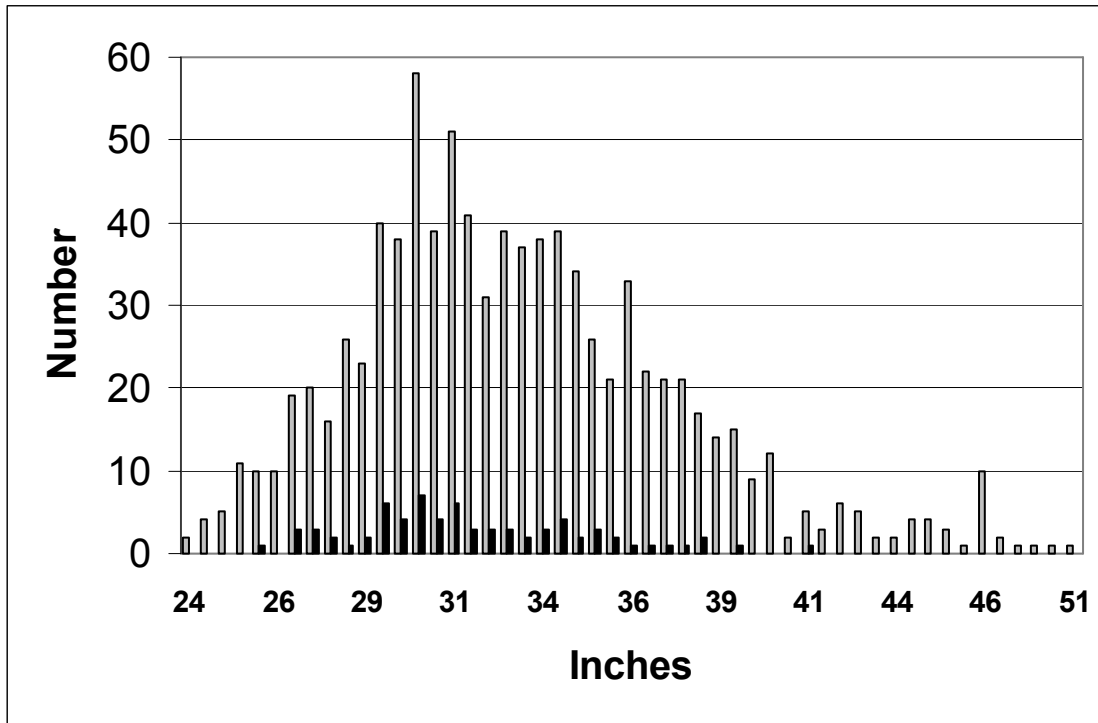


Figure 3. Number of largemouth bass captured (gray columns) and recaptured (dark columns) per size interval (inches) at Lake Webster, spring 2005.

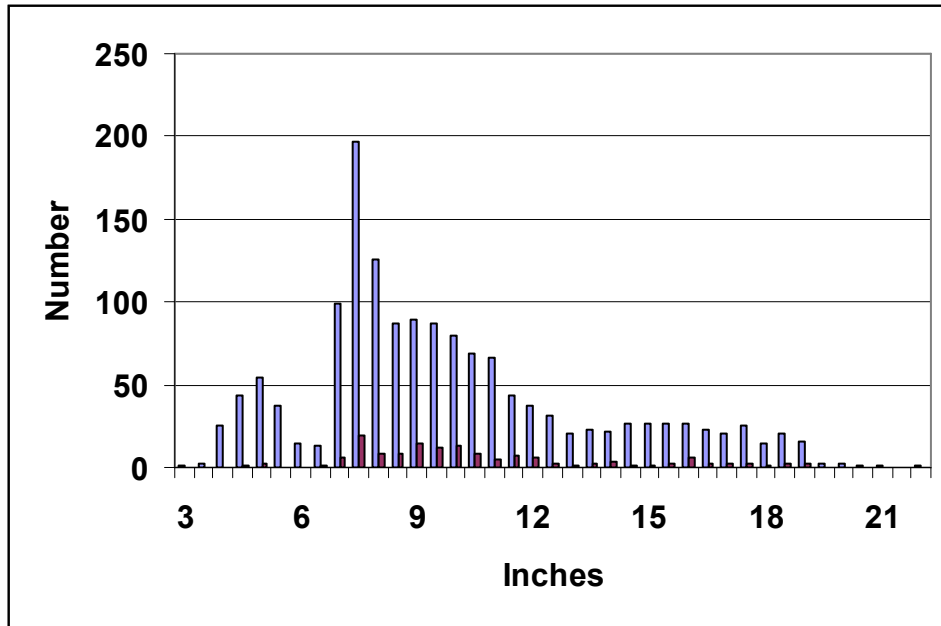


Figure 4. Indiana counties of origin of muskie anglers who fished at Lake Webster in 2005. Numbers represent the number of angler parties.

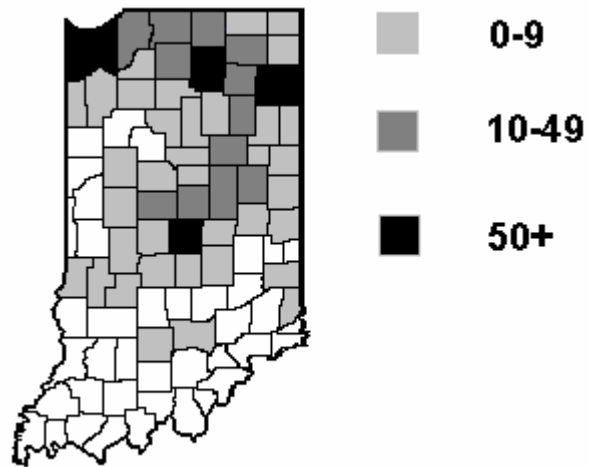


Figure 5. Locations (large circles) and rake scores (1-5) where curly-leaf pondweed was detected at Lake Webster in May and July 2005 and where coontail and Eurasian water milfoil were detected in July 2005. Small circles represent other sample sites.

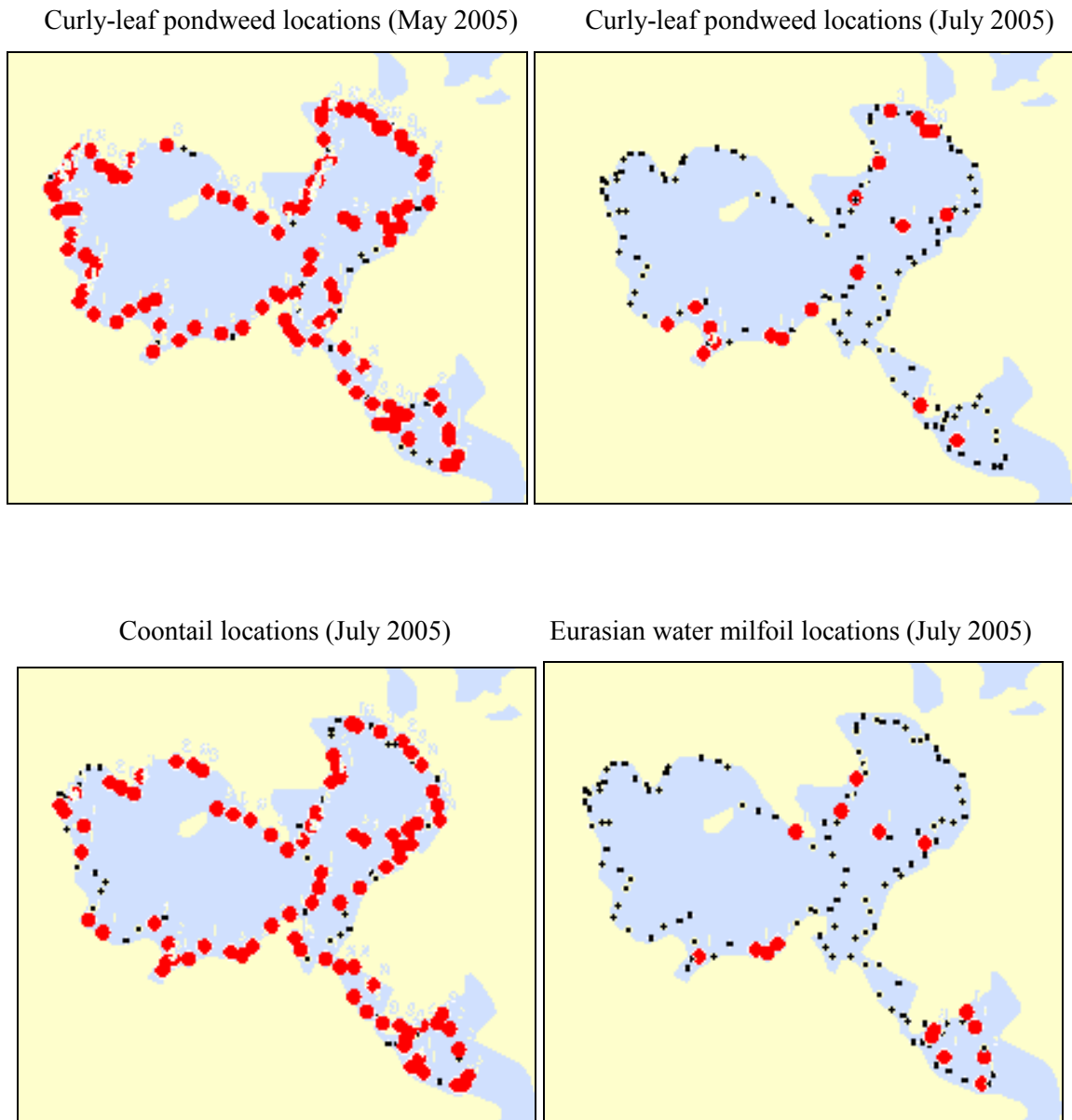
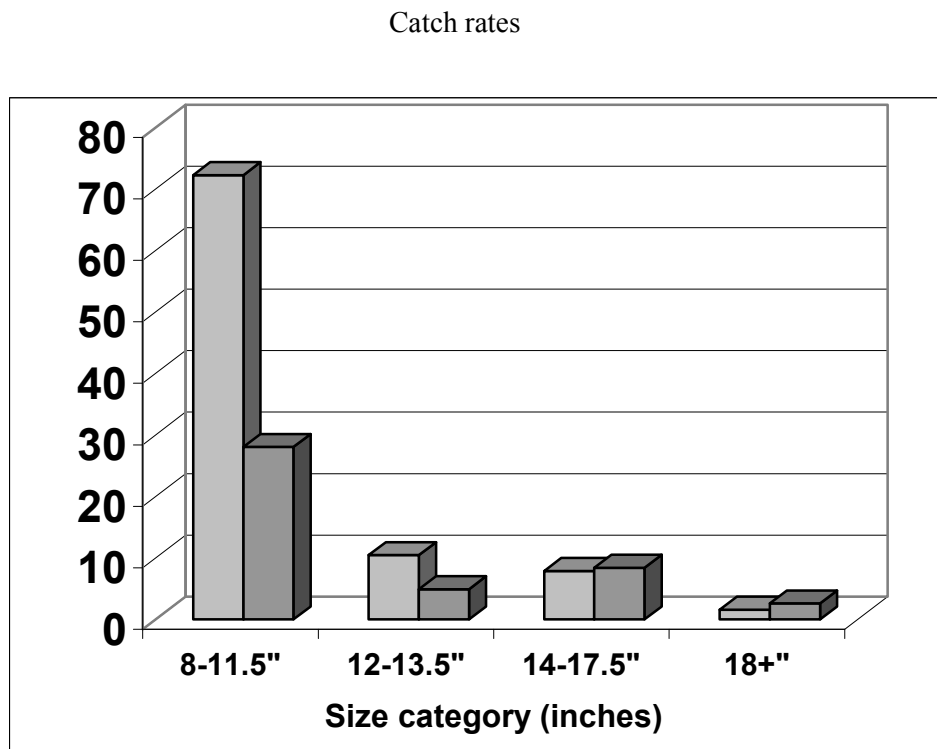
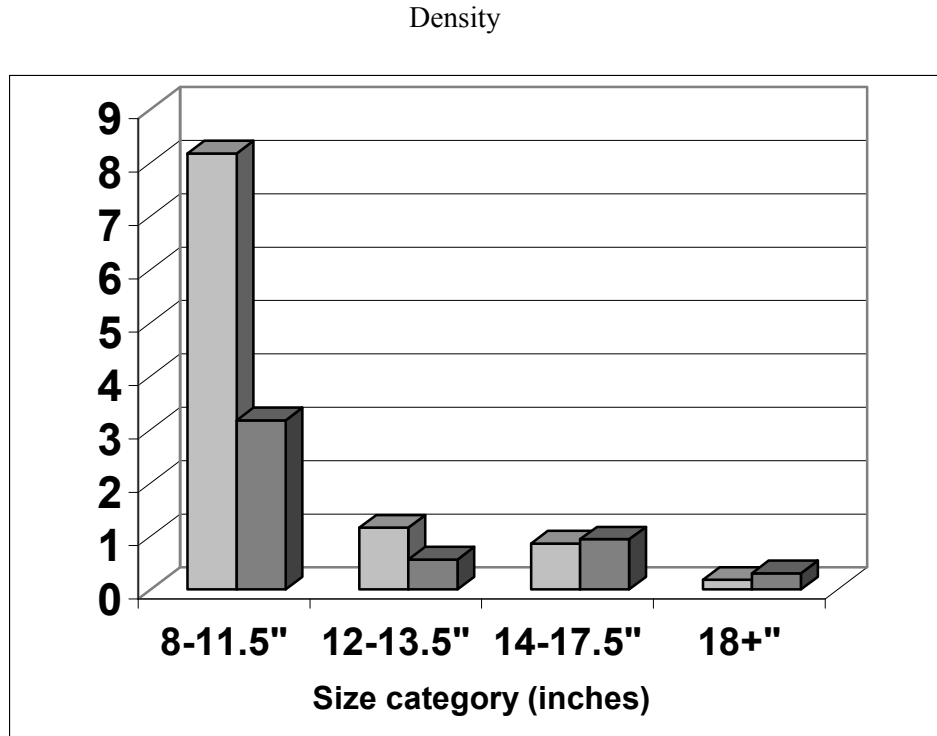


Figure 5. Density (N/ac) and mean nightly electrofishing catch rates (N/hr) of four size categories of largemouth bass at Lake Webster in spring 1990 (light columns) and 2005 (dark columns).



# FISH SURVEY REPORT

Indiana Division of Fish and Wildlife

Type of survey
Initial:      Re-survey: <input checked="" type="checkbox"/>

Lake name	County	Date of survey (Month, day, year)
Lake Webster	Kosciusko	7/18 - 7/21/05
Biologist's name	Date of approval (Month, day, year)	
Jed Pearson		

LOCATION		
Quadrangle name	Range	Section
North Webster	7E	1,2,10-15,24
Township	Nearest town	
33N	North Webster	

### ACCESSIBILITY

State owned public access site	Privately owned public access site	Other access site			
On Backwater Lake	Marina on east shore				
Surface acres	Maximum depth (ft)	Average depth (ft)	Acre feet	Water level (msl)	Extreme fluctuations (ft)
774	52	12.3	7,165	840.7	

INLETS		
Name	Location	Origin
Tippecanoe River	Backwater Lake - east side	Crooked Lake
Gaff Ditch	Backwater Lake - south end	Runoff
Two unnamed ditches	Northeast corner	Tri-County FWA, runoff

OUTLET			
Name	Location		
Tippecanoe River	Southeast corner - flows to James Lake (Little Tippecanoe)		
Water level control			
Concrete dam			
<b>POOL</b>	<b>ELEVATION (Feet MSL)</b>	<b>ACRES</b>	Bottom type
TOP OF DAM			
TOP OF FLOOD CONTROL POOL			
TOP OF CONSERVATION POOL			
TOP OF MINIMUM POOL			
STREAMBED			
Boulder <input type="checkbox"/> Gravel <input type="checkbox"/> Sand <input checked="" type="checkbox"/> Muck <input checked="" type="checkbox"/> Clay <input type="checkbox"/> Marl <input type="checkbox"/>			

Watershed use
General farming, woodlots and wetlands, residential
Development of shoreline
Nearly all of the shoreline is developed. Less development has occurred in Backwater Area.
Previous surveys and investigations
Fish surveys, DNR, 1976, 1985, 1988, 1990, 1995, 1998; Angler surveys, DNR, 1987, 1990, 1998; Muskie surveys, DNR, 1982-84, 1998; Bass sampling, DNR, 1990; Plant sampling, DNR, 2003, 2004.



SAMPLING EFFORT			
ELECTROFISHING	Day hours	Night hours	Total hours
		1	1
TRAPS	Number of traps	Days	Total lifts
	3	3	8 (ninth net damaged by boater)
GILL NETS	Number of nets	Days	Total lifts
	2	2	4

PHYSICAL AND CHEMICAL CHARACTERISTICS	
Color	Turbidity
Blue-green	8 Feet 6 Inches (Secchi disk)

TEMPERATURE, DISSOLVED OXYGEN (ppm), TOTAL ALKALINITY (ppm), pH							
Depth (ft)	Degrees F	Oxygen*			Depth (ft)	Degrees F	Oxygen*
Surface	82.2	7.4					
2	82.2	7.3					
4	82.4	7.3					
5	82.4	7.2					
6	82.4	7.2					
8	82.4	7.1					
10	82.4	7.1					
12	81.5	6.1					
14	79.5	3.8					
15	78.3	2.2					
16	76.6	1.4					
18	72.7	0.7					
20	66.7	0.5					
22	61.3	0.5					
24	58.3	0.4					
25	57.0	0.4					
26	56.1	0.4					
28	54.5	0.3					
30	53.6	0.3					
32	52.9	0.3					
34	51.8	0.3					
35	51.6	0.3					
36	51.4	0.3					
38	51.3	0.3					
40	50.9	0.3					
42	50.5	0.3					
44	50.5	0.3					
45	50.4	0.3					

\*ppm = parts per million

Relative Abundance, Size and Estimated Weight of Fish Collected at Lake Webster						
			Minimum	Maximum		
Common Name*	Number	Percent	Length (in)	Length (in)	Weight (lb)**	Percent
Bluegill	1381	62.6	0.9	7.0	113.03	29.4
Yellow perch	218	9.9	3.9	9.0	37.21	9.7
Gizzard shad	154	7.0	1.9	15.7	47.98	12.5
Largemouth bass	123	5.6	1.4	20.2	45.79	11.9
Pumpkinseed	72	3.3	2.8	6.8	7.96	2.1
Black crappie	65	2.9	3.7	10.0	13.16	3.4
Redear	46	2.1	2.8	4.8	8.88	2.3
Yellow bullhead	40	1.8	1.9	11.7	19.10	5.0
Brown bullhead	37	1.7	1.3	13.1	21.82	5.7
Golden shiner	19	0.9	1.8	7.9	1.59	0.4
Longear	16	0.7	2.7	5.1	0.77	0.2
Warmouth	12	0.5	3.6	7.1	1.78	0.5
Spotted gar	6	0.3	15.2	28.8	9.05	2.4
Brook silverside	6	0.3	1.9	3.9	0.02	0.0
Muskellunge	5	0.2	29.7	35.3	38.70	10.1
Lake chubsucker	2	0.1	5.6	6.2	0.22	0.1
Carp	1	0.0	28.2		10.11	2.6
Bowfin	1	0.0	26.6		6.66	1.7
Bluntnose minnow	1	0.0	2.9		0.01	0.0
	2205				383.84	
*Common names of fishes recognized by the American Fisheries Society.						
**Weights estimated from standard length-weight regression models.						

Number, catch by gear, percentage, estimated weight and age of bluegills															
Length (in)	Catch by gear			Total Number	Percent	Estimated Weight (lb)	Age	Length (in)	Catch by gear			Total Number	Percent	Estimated Weight (lb)	Age
	EF	GN	TN						EF	GN	TN				
1.0	10			10	0.7	0.00		14.5							
1.5	1			1	0.1	0.00		15.0							
2.0	32		158	190	13.8	0.01	1	15.5							
2.5	34		149	183	13.3	0.01	1	16.0							
3.0	27		130	157	11.4	0.02	1	16.5							
3.5	14		54	68	4.9	0.03	1,2	17.0							
4.0	14		9	23	1.7	0.05	1,2	17.5							
4.5	28		36	64	4.6	0.07	2,3	18.0							
5.0	50	1	31	82	5.9	0.09	3,4	18.5							
5.5	132	7	107	246	17.8	0.12	3,4,5	19.0							
6.0	133	3	113	249	18.0	0.16	3,4	19.5							
6.5	34	3	68	105	7.6	0.20	4,5	20.0							
7.0	1		2	3	0.2	0.26	5	20.5							
7.5								21.0							
8.0								21.5							
8.5								22.0							
9.0								22.5							
9.5								23.0							
10.0								23.5							
10.5								24.0							
11.0								24.5							
11.5								25.0							
12.0															
12.5															
13.0															
13.5															
14.0								Total				1381		113.03	
Electrofishing catch:			510			Gill net catch:		14			Trap net catch:		857		

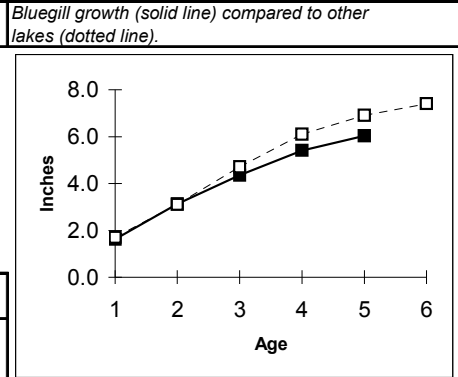
Number, catch by gear, percentage, estimated weight and age of gizzard shad																
Length (in)	Catch by gear			Total Number	Percent	Estimated Weight (lb)	Age	Length (in)	Catch by gear			Total Number	Percent	Estimated Weight (lb)	Age	
	EF	GN	TN						EF	GN	TN					
1.0								14.5	1			1	0.6	1.04		
1.5								15.0								
2.0	2			2	1.3	0.00		15.5	1			1	0.6	1.26		
2.5	2			2	1.3	0.01		16.0								
3.0								16.5								
3.5								17.0								
4.0								17.5								
4.5								18.0								
5.0								18.5								
5.5								19.0								
6.0								19.5								
6.5	2			2	1.3	0.10		20.0								
7.0	1			1	0.6	0.13		20.5								
7.5								21.0								
8.0	10	3	1	14	9.1	0.19		21.5								
8.5	29	2	1	32	20.8	0.22		22.0								
9.0	25	3		28	18.2	0.26		22.5								
9.5	18	1		19	12.3	0.31		23.0								
10.0	19	1	1	21	13.6	0.36		23.5								
10.5	15			15	9.7	0.41		24.0								
11.0	9			9	5.8	0.47		24.5								
11.5	3			3	1.9	0.53		25.0								
12.0	2			2	1.3	0.60										
12.5																
13.0	1	1		2	1.3	0.76										
13.5																
14.0								Total				154		47.98		
Electrofishing catch:				140			Gill net catch:				11		Trap net catch:			3

Number, catch by gear, percentage, and estimated weight of largemouth bass (July sample)																
Length	Catch by gear			Total	Percent	Estimated	Age	Length	Catch by gear			Total	Percent	Estimated	Age	
(in)	EF	GN	TN	Number		Weight (lb)		(in)	EF	GN	TN	Number		Weight (lb)		
1.0								14.5		1		1	0.8	1.53		
1.5	7			7	5.7	0.00		15.0								
2.0	9			9	7.3	0.00		15.5	2			2	1.6	1.88		
2.5	12			12	9.8	0.01		16.0								
3.0								16.5								
3.5								17.0								
4.0								17.5								
4.5								18.0								
5.0	1	1		2	1.6	0.06		18.5	1			1	0.8	3.24		
5.5	4			4	3.3	0.08		19.0								
6.0	4	2		6	4.9	0.10		19.5								
6.5	16	1		17	13.8	0.13		20.0	2			2	1.6	4.11		
7.0	8			8	6.5	0.16		20.5								
7.5	1			1	0.8	0.20		21.0								
8.0	1	1		2	1.6	0.25		21.5								
8.5	6	1		7	5.7	0.30		22.0								
9.0	11			11	8.9	0.35		22.5								
9.5	10			10	8.1	0.42		23.0								
10.0	5			5	4.1	0.49		23.5								
10.5	7			7	5.7	0.57		24.0								
11.0	3	1		4	3.3	0.65		24.5								
11.5	3			3	2.4	0.75		25.0								
12.0																
12.5	1			1	0.8	0.97										
13.0																
13.5																
14.0	1			1	0.8	1.37		Total				123		45.79		
Electrofishing catch:			115				Gill net catch:			8			Trap net catch:			0

Number, catch by gear, percentage, estimated weight and age of yellow perch																																						
Length (in)	Catch by gear			Total Number	Percent	Estimated Weight (lb)	Age	Length (in)	Catch by gear			Total Number	Percent	Estimated Weight (lb)	Age																							
	EF	GN	TN						EF	GN	TN																											
1.0								14.5																														
1.5								15.0																														
2.0								15.5																														
2.5								16.0																														
3.0								16.5																														
3.5								17.0																														
4.0	1			1	0.5	0.03	1	17.5																														
4.5			1	1	0.5	0.04	1	18.0																														
5.0	5		3	8	3.7	0.06	1	18.5																														
5.5	2	5	2	9	4.1	0.08	1	19.0																														
6.0	2	10	4	16	7.3	0.10	2,4	19.5																														
6.5	3	21	21	45	20.6	0.13	2,4	20.0																														
7.0	14	14	31	59	27.1	0.17	4	20.5																														
7.5	18	13	11	42	19.3	0.21	4	21.0																														
8.0	14	4	10	28	12.8	0.25	4	21.5																														
8.5	3	1	2	6	2.8	0.31	4	22.0																														
9.0	2		1	3	1.4	0.37	4	22.5																														
9.5								23.0																														
10.0								23.5																														
10.5								24.0																														
11.0								24.5																														
11.5								25.0																														
12.0																																						
12.5																																						
13.0																																						
13.5																																						
14.0								Total				218		37.21																								
Electrofishing catch:												64	Gill net catch:												68	Trap net catch:												86

Bluegill  
Intercept: 0.8 inch

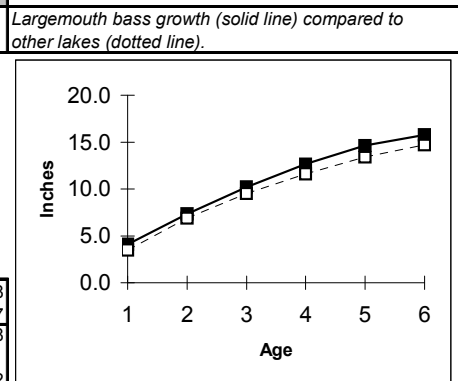
BACK-CALCULATED LENGTH (inches) AT EACH AGE							
Year Class	Count	I	II	III	IV	V	VI
2004	20	1.5					
	stdev	0.31					
2003	8	1.5	3.0				
	stdev	0.18	0.23				
2002	5	1.8	3.0	4.3			
	stdev	0.21	0.26	0.51			
2001	14	1.7	3.2	4.4	5.3		
	stdev	0.23	0.32	0.42	0.62		
2000	4	1.6	3.2	4.3	5.5	6.0	
	stdev	0.16	0.30	0.42	0.75	0.64	
1999	0						
	stdev						
Mean*		1.6	3.1	4.3	5.4	6.0	
SD		0.11	0.11	0.02	0.18		
Count		51	31	23	18	4	



\* Age groups with less than three samples not included in year class averages

Largemouth bass  
Intercept: 0.8 inch

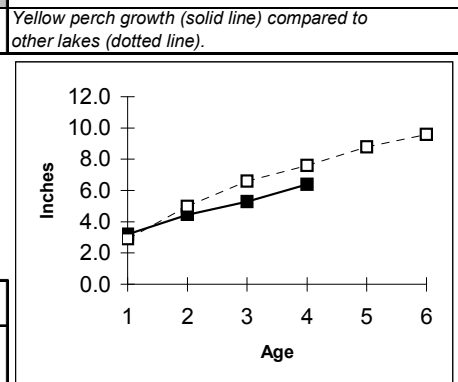
BACK-CALCULATED LENGTH (inches) AT EACH AGE							
Year Class	Count	I	II	III	IV	V	VI
2004	18	4.9					
	stdev	0.55					
2003	38	4.1	7.6				
	stdev	0.65	0.86				
2002	29	4.2	7.3	9.7			
	stdev	0.66	0.91	0.84			
2001	59	3.5	7.0	9.6	11.7		
	stdev	0.79	1.20	1.41	1.29		
2000	39	3.9	7.3	10.7	12.7	14.0	
	stdev	0.86	1.31	1.36	1.24	1.32	
1999	38	3.8	7.6	10.9	13.6	15.3	15.8
	stdev	0.79	1.20	1.20	1.05	1.02	0.67
Mean*		4.1	7.4	10.2	12.7	14.6	15.8
SD		0.46	0.26	0.67	0.98	0.88	
Count		193	175	137	108	49	12



\* Age groups with less than three samples not included in year class averages

Yellow perch  
Intercept: 1.2 inch

BACK-CALCULATED LENGTH (inches) AT EACH AGE							
Year Class	Count	I	II	III	IV	V	VI
2004	9	3.5					
	stdev	0.35					
2003	3	3.4	4.9				
	stdev	0.23	0.37				
2002	0						
	stdev						
2001	24	2.7	4.0	5.3	6.4		
	stdev	0.38	0.35	0.54	0.79		
2000	0						
	stdev						
1999	0						
	stdev						
Mean*		3.2	4.5	5.3	6.4		
SD		0.43	0.68				
Count		36	27	24	24		



\* Age groups with less than three samples not included in year class averages

### Occurrence and abundance of submersed aquatic plants in Lake Webster

Date: 5/31/05	Littoral sites with plants: 119	Mean species/site: 2.24
Littoral depth (ft): 14.0	Littoral sites with native plants: 100	Mean native species/site: 1.04
Littoral sites: 132	Number of species: 10	Species diversity: 0.78
Total sites: 136	Number of native species: 8	Native diversity: 0.73
Secchi (ft): 18.0	Maximum species/site: 6	Average rake score: 3.94

Common Name	Site Frequency	Relative Density	Rake score frequencies					Mean Density	Plant Dominance
			1	2	3	4	5		
Curly-leaf pondweed	81.1	2.33	37	18	9	7	36	2.88	46.7
Coontail	47.7	0.96	31	17	6	1	8	2.02	19.2
Eurasian water milfoil	39.4	0.95	25	9	2	4	12	2.40	18.9
Chara	12.1	0.33	7	2	1	1	5	2.69	6.5
Elodea	11.4	0.22	6	6	2	0	1	1.93	4.4
Common naiad	7.6	0.21	2	3	1	3	1	2.80	4.2
Sago pondweed	10.6	0.14	9	5	0	0	0	1.36	2.9
Flat-stem pondweed	11.4	0.12	14	1	0	0	0	1.07	2.4
Eel grass	0.8	0.01	1	0	0	0	0	1.00	2.0
Illinois pondweed	2.3	0.02	3	0	0	0	0	1.00	0.5
Filamentous algae	63.6								



## Occurrence and abundance of submersed aquatic plants in Lake Webster

Date: 7/29/05	Littoral sites with plants: 113	Mean species/site: 1.58
Littoral depth (ft): 15.0	Littoral sites with native plants: 110	Mean native species/site: 1.32
Littoral sites: 134	Number of species: 13	Species diversity: 0.77
Total sites: 136	Number of native species: 11	Native diversity: 0.70
Secchi (ft): 8.5	Maximum species/site: 6	Average rake score: 3.28

Common Name	Site Frequency	Relative Density	Rake score frequencies					Mean Density	Plant Dominance
			1	2	3	4	5		
Coontail	64.2	1.52	38	20	5	4	19	2.37	30.4
Common naiad	30.6	0.78	19	5	4	1	12	2.56	15.7
Chara	9.7	0.26	6	1	1	1	4	2.69	5.2
Flat-stem pondweed	9.7	0.22	5	4	2	0	2	2.23	4.3
Curly-leaf pondweed	14.2	0.16	17	2	0	0	0	1.11	3.1
Water stargrass	6.7	0.14	5	2	0	0	2	2.11	2.8
Eurasian water milfol	11.9	0.13	15	1	0	0	0	1.06	2.5
Leafy pondweed	3.7	0.07	4	0	0	0	1	1.80	1.3
Spiny naiad	0.7	0.04	0	0	0	0	1	5.00	0.7
Sago pondweed	2.2	0.03	2	1	0	0	0	1.33	0.6
Elodea	2.2	0.02	3	0	0	0	0	1.00	0.4
Variable pondweed	1.5	0.02	1	0	0	0	0	1.50	0.4
Large-leaf pondweed	0.7	0.01	1	0	0	0	0	1.00	0.1
Filamentous algae	64.9								

**Webster Lake Emergent Plant Beds**

8/9/05

Bed	Sites	Mean		Mean Width	Species Frequency of Occurrence								Species		Calculated values			
		Latitude	Longitude		SPA	WAL	ARA	SWL	CAT	PIK	PRL	ARH	PHR	N	N/site	Acres	Length	
1	4	41.31663	-85.67090	40.5	100.0			25.0	75.0						3	2.00	0.11	103
2	7	41.31803	-85.67077	79.0	100.0										1	1.00	0.46	437
3	7	41.31843	-85.67143	60.0	100.0										1	1.00	0.30	323
4	3	41.31834	-85.67035	28.0	100.0	66.7									2	1.67	0.05	75
5	2	41.31940	-85.67020	24.0	100.0		100.0						50.0		3	2.50	0.03	55
6	4	41.31899	-85.67062	30.8	100.0										1	1.00	0.22	246
7	2	41.31942	-85.67043	27.0	100.0										1	1.00	0.02	32
8	8	41.31979	-85.67188	43.9	100.0		75.0						12.5		3	1.88	0.45	425
9	6	41.32026	-85.67301	97.5	100.0										1	1.00	0.74	320
10	4	41.32722	-85.66846	41.3	100.0			25.0	25.0			50.0			4	2.00	0.13	133
11	9	41.32757	-85.66782	77.3	100.0	22.2		33.3		33.3	22.2				5	2.11	1.41	725
12	8	41.33357	-85.67011	68.6	100.0					12.5					2	1.13	0.54	364
13	4	41.33430	-85.67512	83.3	75.0	100.0	25.0		50.0	25.0					5	2.75	0.30	126
14	9	41.33367	-85.67515	224.0	100.0				11.1		77.8				3	1.89	2.27	429
15	10	41.33271	-85.67520	60.6	30.0	100.0	20.0	20.0	10.0		60.0				6	2.40	0.75	706
16	13	41.32832	-85.67212	51.2	100.0						7.7				2	1.08	0.85	519
17	10	41.32902	-85.67695	414.9	90.0	30.0				10.0	20.0				4	1.50	13.01	1317
18	7	41.32862	-85.67785	202.7	85.7	28.6		28.6		28.6					4	1.71	3.58	564
19	4	41.33003	-85.69468	49.5	100.0										1	1.00	0.10	88
20	5	41.32737	-85.69343	93.6	100.0		60.0				40.0				3	2.00	0.64	250
21	5	41.32344	-85.69345	89.4	80.0										1	0.80	0.52	209
22	3	41.32252	-85.69320	42.0	100.0										1	1.00	0.11	105
23	3	41.32219	-85.69279	89.0	100.0										1	1.00	0.29	139
24	3	41.32134	-85.69217	41.0	100.0		33.3								2	1.33	0.09	96
25	3	41.32138	-85.68949	31.0	100.0										1	1.00	0.10	129
26	11	41.32144	-85.67668	93.5	100.0						63.6		9.09		3	1.64	1.62	742
27	3	41.32187	-85.67740	54.0	100.0										1	1.00	0.14	110
28	2	41.32030	-85.67692	33.0	100.0										1	1.00	0.02	31
29	2	41.31986	-85.67675	27.0	100.0										1	1.00	0.04	65
30	6	41.31992	-85.67656	66.5	100.0										1	1.00	0.68	332
31	5	41.32027	-85.67607	54.0	100.0								20.0		2	1.20	0.40	279
32	3	41.31848	-85.67318	43.0	100.0			33.3	33.3						3	1.67	0.13	127
33	2	41.31818	-85.67285	90.0	100.0										1	1.00	0.12	59
34	3	41.31743	-85.67157	32.0	100.0										1	1.00	0.07	95
35	2	41.31732	-85.67133	24.0	100.0										1	1.00	0.01	15
36	2	41.31658	-85.67121	10.5	100.0										1	1.00	0.01	42
37	3	41.31628	-85.67053	57.0	100.0										1	1.00	0.07	49
38	9	41.31535	-85.66929	51.7	100.0										1	1.00	0.69	437
39	3	41.31815	-85.66633	19.0	100.0		100.0	33.3	66.7						4	3.00	0.03	83
40	6	41.31736	-85.66664	54.5	100.0			66.7	33.3						3	2.00	0.66	492
41	8	41.31669	-85.66893	103.5	100.0			87.5	75.0		12.5				4	2.75	2.23	805
<b>Sum</b>	<b>213</b>			<b>Mean</b>	<b>96.6</b>	<b>57.9</b>	<b>63.1</b>	<b>28.4</b>	<b>39.2</b>	<b>24.2</b>	<b>39.3</b>	<b>27.5</b>	<b>9.1</b>	<b>2.2</b>				
				<b>Count</b>	<b>41</b>	<b>6</b>	<b>9</b>	<b>7</b>	<b>10</b>	<b>4</b>	<b>9</b>	<b>3</b>			<b>Sum</b>	<b>34.00</b>	<b>11676</b>	

**Isolated patches**

Sum	29			<b>Mean</b>	<b>48.3</b>	<b>55.2</b>	<b>0.0</b>	<b>3.4</b>	<b>3.4</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>4</b>	<b>1.10</b>		
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**Species present**

- ARA Arrow arum
- ARH Arrowhead
- CAT Cattail
- PHR Phragmites
- PIK Pickerelweed
- PRL Purple loosestrife
- SPA Spatterdock
- SWL Swamp loosestrife
- WAL Water lily

- Lake surface acreage:** 774
- Percent surface coverage:** 4.4
- Contour acreage within 10-ft depth:**
- Percent 10-ft contour area coverage:**
- Lake shoreline perimeter in miles:** 7.9
- Estimated emergent bed miles:** 2.2
- Bed edge:shoreline ratio (%):** 27.9

The map at the right depicts lakeward locations of emergent plant beds (small black dots), lakeward centers of each bed (large dots), and patches (stars) of emergent plants in Lake Webster. Data summary prepared by Jed Pearson - 11/1/05  
Indiana Division of Fish and Wildlife

