Current Status of Fish Populations and Fishing in the Upper Tippecanoe River Lake Area

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EXECUTIVE SUMMARY

Various surveys were conducted at six natural lakes in the Tippecanoe River watershed during 2009 to obtain current information on the status of fish populations and fishing, determine which lakes met fish management objectives established by the Upper Tippecanoe River Lake Association (UTRLA), and identify which lakes might benefit from new fish management actions.

Spring electrofishing catch rates of 8-inch and larger largemouth bass ranged from 117/hour at Crooked to 305/hour at Big and averaged 215/hour. All but Crooked exceeded the UTRLA management objective of 80 to 140/hour. Although bass numbers were high, their size structure was dominated by small individuals. Only Crooked contained an adequate proportion (≥25%) of legal-size bass (≥14-in). No lake contained the objective proportion (≥8%) for 18-inch and larger bass.

Bluegill electrofishing catch rates fell within the management objective of 140 to 400/hour at each lake except Goose, ranging from 193/hour at Loon to 539/hour at Goose and averaging 238/hour. All lakes except Crane contained an adequate proportion (≥15%) of 7-inch and larger bluegills, ranging from 12% at Crane to 34% at Old. All lakes met the objective (≥4%) for 8-inch and larger bluegills except Loon.

Bluegills ranked first numerically in each lake but varied from 47% of the catch at Big to 80% at Loon and averaged 59%. Percentages at all lakes except Loon were within the objective range of 40 to 60%. Largemouth bass ranked second numerically in each lake except Goose, but the relative species composition of largemouth bass in Crooked and Loon (8%) fell below the management objective of 10 to 25% and above the objective at Big (28%).

Anglers fished a combined total of 36,055 hours at the six lakes and removed 17,003 fish The overall effort per acre per day (0.48) was close to the management objective (≥0.50) and exceeded the objective at Crane (0.60), Goose (0.72), and Old (0.58) but was below the objective at Big (0.32), Crooked (0.39), and Loon (0.31). Fishing preferences varied among lakes and in most cases met the management objectives. Bluegill preference was above the objective (≥40%) at each lake except Loon. Bass preference exceeded the objective (≥30%) at Big, Crooked, Goose, and Loon. Angler preference for muskies at Loon (6%) also exceeded the management objective (≥5%).

Bluegill fishing failed to meet several objectives. The harvest of 13,395 bluegills was below the objective of 45,600 bluegills (0.5/ac/d) and the harvest rate (0.7/hr) was 30% below the objective. Based on interviews of boat anglers who targeted bluegills, the harvest rate (0.6/hr) was 40% below expectations. Specific bluegill harvest rates by boat anglers were highest at Crane (0.8/hr), Crooked and Goose (0.7/hr), but lowest at Old (0.6/hr), Loon (0.5/hr), and Big (0.4/hr). Although angler catch rates of bluegills were low and bluegill sizes were adequate at all lakes except Loon.

Anglers removed a total of 338 largemouth bass. Seventy-five bass were taken from Crooked Lake and represented 11% of the estimated number of legal-size bass present in the spring. Bass up to 18 inches were taken from Crooked and Goose. At Loon, 22% of the harvested bass were 18-inch and larger, making it the only lake to reach the management objective (≥10%) for that size category.

Angler satisfaction with fishing quality differed by species, by lake, and between residents and lake visitors. Overall, 40% of bluegill anglers described fishing as "good", less than the management objective of 50%. Bass anglers who rated fishing as good accounted for 54%, slightly above the 50% objective. Few bluegill anglers who fished from boats rated fishing good at Big, Crane, and Crooked. Over half rated fishing "good" at Goose, Loon, and Old. Large percentages of bass anglers considered fishing good at Goose, Loon, and Old. Those who rated fishing poor ranged up to 67% at Crane.

Muskie fishing quality at Loon was described as good. The estimated catch rate (harvest plus release) was one muskie per 21 hours of muskie fishing and exceeded the objective of one muskie per 30 hours of fishing.

Water clarity was greatest at Crooked on June 15 (19 ft) and lowest at Crane (<3 ft) on July 9. Clarity decreased from June to July at all lakes except Old. Where measurements were continued, clarity was 6 feet at Big, 10 feet at Crooked, and less than 3 feet at Loon. Ample oxygen (≥5 ppm) was present in June only in the top 6 feet in Crane and Old, 8 feet in Big and Goose, 10 feet in Loon, and down to 26 feet and again below 38 feet in Crooked. By July, ample oxygen was present to 6 feet in Crane, 10 feet in Goose and Old, 12 feet in Big and Loon, and 30 feet in Crooked.

Submersed aquatic plants covered 53% of the littoral zone in Crane to 97% in Crooked and averaged 79%. Coontail was the dominant species, but varied from 30% coverage in Loon to 87% in Old and averaged 57%. Coverage of floating-leaf emergent plant beds (lilies) ranged from 3 acres in Old to 32 acres in Crooked. Emergent beds covered the least amount of surface area as a fraction of the whole lake in Loon (4%). Mean coverage of emergent beds was 10% of the total lake area.

Overall, the UTRLA lakes met a greater number of bluegill objectives than largemouth bass objectives. Therefore, fish management initiatives should first be directed toward largemouth bass. Big and Crane could serve as candidate sites for testing alternative bass management strategies to improve balance. Because angler opinions of bluegill fishing did not match up with population parameters or fishery characteristics, efforts should also be directed at promoting available bluegill fishing opportunities to increase fishing effort, fishing success, and perceptions of fishing quality.

Although Loon met all four bass fishing objectives, as well as three muskie fishing objectives, it has the least-satisfactory bluegill fishery. More research is needed to better understand how various environmental and biological features influence bluegill fishing at Loon and to identify management actions that will improve bluegill fishing.

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BACKGROUND

In 2008 the Upper Tippecanoe River Lake Association (UTRLA) in partnership with the Division of Fish and Wildlife (DFW) completed a diagnostic plan for seven lakes located within the upper reaches of the Tippecanoe River Watershed (Williams Creek 2008). The process was coordinated through Indiana's Lake and River Enhancement Program (LARE) and the Tippecanoe Watershed Foundation (TWF) for the purpose of improving water quality. Within this context, however, is a goal to develop sustainable fish populations that support the recreational needs of lake users.

To measure success toward achieving the goal, an UTRLA fish committee was formed and held a series of discussions to establish quantifiable fish management objectives that describe the desired number and size of selected sport fish within the lakes and those caught by anglers (UTRLA Fish Management Plan 2010-2019). Once sport fish management objectives were set, various surveys were conducted during 2009 to obtain current information on the status of fish populations and fishing in the UTRLA lakes, determine which lakes met the objectives, and identify which lakes might benefit from new management actions. When conducted according to standard sampling procedures, fishery surveys can help document common problems that affect fish resources on a broad scale that may then be addressed through common approaches. Likewise, standardized sampling (i.e. using similar gear and similar effort at a similar time) can also be used to generate comparable data from various waters to quantify site-specific problems and generate public support for management initiatives where the data demonstrate a greater need.

Results of these surveys at the UTRLA lakes are presented in this report and are being used to describe where and when specific management actions should be conducted. Although past information on file for each lake is also included in the appendices, the main emphasis of this report is to assess whether the current status of each lake is achieving the fish management objectives. Additional information on habitat features, including clarity, temperature/oxygen profile, and aquatic plants, was also obtained and is discussed briefly in relation to their possible impacts on fish.

MANAGEMENT OBJECTIVES

Eighteen measurable objectives with 26 benchmarks were established by the UTRLA committee as criteria for long-term fish population balance and satisfactory fishing opportunities. The objectives were primarily based on established averages for various fish population parameters at Indiana natural lakes, with the exception that committee members wanted a greater proportion of 18-inch and larger bass. Although current habitat conditions vary among the lakes, expectations were that each lake, if properly managed, should contain suitable habitat that is capable of sustaining a typical fish community with a typical level of fishing:

1. *Provide a relative species composition of bluegills at 40 to 60%.*
2. *Provide a relative species composition of largemouth bass at 10 to 25%.*
3. *Provide a relative species composition of crappies or yellow perch at 5 to 10%.*
4. *Provide an electrofishing catch rate of 3-inch and larger bluegills at 160 to 400/hour.*
5. *Provide a relative size distribution of 7-inch and larger bluegills ≥15%.*
6. *Provide a relative size distribution of 8-inch and larger bluegills ≥4%.*
7. *Provide a summer electrofishing catch rate of age-1 and older bass or a spring catch rate of 8-inch and larger bass at 80 to 140/hour.*
8. *Provide a relative size distribution of 14-inch and larger bass ≥25%.*
9. *Provide a relative size distribution of 18-inch and larger bass ≥8%.*
10. *Provide an average summer fishing effort ≥0.5/hour/acre/day.*
11. *Provide an angler preference for bluegill fishing ≥40% and bass fishing ≥30%.*
12. *Provide a harvest rate of bluegill ≥0.5/acre/day and 1/hour of targeted bluegill fishing.*
13. *Provide a catch size distribution of 7-inch and larger bluegills ≥50% and ≥20% for 8-inch and larger bluegills.*
14. *Provide a catch rate of bass ≥1/hour of targeted bass fishing.*
15. *Provide a catch size distribution ≥10% for 18-inch and larger bass.*
16. *Provide ≥50% of bluegill and bass anglers with a "good" satisfaction level.*
17. *Provide a cisco population in Crooked Lake that sustains a gill net catch rate ≥2/lift and annual harvest of 500 ciscoes.*
18. *Provide a muskie population in Loon Lake that sustains a spring trap net catch ≥4/lift of adults (≥30 in), an angler interest of ≥5%, an angler catch rate of 1/30-hours of targeted muskie fishing, and a muskie angler satisfaction level ("fair and good") ≥50%.*

PROJECT AREA

The UTRLA Project Area is located in northeastern Indiana midway between Fort Wayne and South Bend in the southwest corner of Noble County and northwest corner of Whitley County (Figure 1). State Road 109 bisects the eastern part of the watershed. The area encompasses 13,714 acres with an average slope of 3.5% and contains agricultural land (64%), forest (15%), water (11%), residential land (8%), and grassland (2%).

Although 12 named natural lakes are located within the watershed, the primary ones include Big (228 ac), Crane (28 ac), Crooked (206 ac), Goose (84 ac), Loon (222 ac), New (50 ac), and Old (32 ac). Each one except New Lake has a state-owned public access site. Because of limited access, New Lake was not included in the sampling project. Dollar, Green, Haroff, and Winters lakes were also not included in the project because of their small size (<10 ac) and restricted access. Little Crooked Lake, a basin connected to the east end of Crooked Lake, was included with Crooked Lake sampling.

The UTRLA lakes are connected by a series of small ditches created years ago to improve drainage (Figure 2). Crane and Crooked lakes drain through separate ditches into Big, while Goose and Old lakes drain through separate ditches into Loon. New Lake empties into Old. The outlets of Big and Loon merge north of Loon and drain to Smalley Lake, eventually to Webster, James, and Tippecanoe lakes and then into the Tippecanoe River and ultimately the Wabash River. The Loon sub-watershed above the lake outlet covers 7,122 acres and the Big sub-watershed outlet covers 5,733 acres. Hydraulic retention time varies from 79 and 124 days at Crane and Old, 289 and 355 days at Loon and Big to 2.2, 4.6 and 9.2 years at Goose, New, and Crooked, respectively.

Water quality and habitat conditions vary within the UTRLA lakes and have been documented, along with their watershed characteristics, in the UTRLA management plan (Williams Creek 2008). Based on sampling in 2006, mean secchi disk transparency (ft) in July and August was 3.3 at Big and 3.9 at Loon, 4.0 at Goose, 9.7 at Old, and 15 at Crooked. Crane Lake's clarity is also typically poor (Figure 3). Chlorophyll-a (ppb) ranged from 2 at Crooked, 8 at Old, 17 at Big, 25 at Crane, 45 at Goose, and 58 at Loon. Substrates are dominated by sand and marl in Crooked, sand and muck in Big and Loon, and muck in Crane, Goose and Old. Residential shoreline development is more prevalent at Big and Loon, less prevalent at Crooked, Goose and Old, while Crane is undeveloped.

SAMPLING METHODS AND ANALYSES

Fish population and angler data at the UTRLA lakes was obtained in 2009 through several types of standardized surveys used in Indiana. Targeted sampling for largemouth bass was conducted in late April and May, bluegill sampling was conducted in late May and June, fish community surveys were conducted in June, and angler creel surveys were conducted from mid-May through August. Procedures generally followed DFW guidelines for targeted sampling, general surveys, and creel surveys.

Spring bass sampling, using pulsed DC electrofishing (504V) and a two-person crew to retrieve stunned bass, was conducted twice for up to two hours at random sites each night at Big and Loon or for one shoreline lap each night at Crane, Goose, and Old. Sampling was separated by bi-weekly intervals. Each bass was measured (total length) and released after scale samples were taken for age and growth analyses. At Crooked, bass electrofishing was conducted on three occasions at weekly intervals using mark-recapture techniques (right ventral fin-clip) to estimate the number of 8-inch and larger bass. Two crews were used to cover the entire shoreline each night. Bass were grouped into four length categories at each lake (7.8- to 11.7-in, 11.8- to 13.7-in, 13.8- to 17.8-in, ≥17.8-in). The categories were then rounded to the nearest inch for data discussion. Mean nightly catch/hour was calculated for each of the four length categories. Size structure indices were also calculated. Back-calculated growth rates of bass were also determined from scales using a 0.8-inch body-length to scale-length intercept.

Targeted electrofishing for bluegills was conducted on one night in late May using procedures similar to bass sampling but for only two 15-minute stations per lake. On a second night in June, bluegills were electrofished along with all species. Similar stations were sampled on both occasions, but effort was increased to 45 minutes at Goose and 60 minutes at Big, Loon, and Crooked on the second night to conform to standard fish population survey guidelines. Bluegills were also grouped into four length categories (2.8- to 5.7-in, 5.8- to 6.7-in, 6.8- to 7.7-in, ≥7.8-in). These categories were also rounded to the nearest inch for data discussion. As with bass, mean nightly catch/hour and size structure indices were calculated for bluegills and scales were taken for age and growth determinations using the same 0.8-inch intercept.

During the fish community assessments, various numbers of gill nets and trap nets were set in proportion to lake size. Four gill net lifts were made at Crane and Old, six at Goose, and eight at Big, Crooked and Loon. Two trap net lifts were made at Old, three at Goose, and four at Big, Crane, Crooked, and Loon. The nets were checked and moved daily within each lake. All netted fish were measured and released when possible.

Angler surveys were conducted from May 11 through August 31, 2009 using two creel clerks with each covering three lakes. Boat and shore anglers were counted eight times at hourly intervals on each survey day except at Big and Crooked, either during an early (7 am -2 pm) or late (3 pm -10 pm) period on six to eight weekend days and 15 to 18 weekdays. Counts were made during six 1.5-hour intervals at Big and Crooked due to lake shape and boat speed limits. Each clerk spent the entire survey day at only one lake.

The amount of sampling effort per lake was less than standard creel surveys in Indiana (due to the number of lakes involved), so total fishing effort was calculated at each lake over the entire survey period stratified for weekends and weekdays by multiplying the average daily count per strata times 16 hours/day times 34 weekend days or 80 weekdays. Angler catch was determined by interviewing anglers during the survey day. Total catch of each species was estimated by expanding the observed catch times the fraction of total effort attributed to interviewed anglers. Harvested fish were measured to assess size structure. During interviews, a spokesperson for the party was asked if they were a resident at the lake, which species they fished for, whether they released any legal (≥14-in) or sub-legal (<14-in) bass, and how they rated fishing quality ("good, fair, or poor"). Harvest rates and fishing quality perceptions were compiled from anglers who targeted each species, either singly or in combination with other species. Catch rates (i.e. harvest plus release) were also calculated for bass and muskies.

Various habitat assessments were conducted at each lake using current survey guidelines. Clarity (secchi) and temperature/oxygen profiles (2- and 5-ft intervals) were measured on the first day of each fish survey in June and again at all lakes on July 9. Three additional secchi readings were taken in July at Big, Crooked, and Loon. Submersed plants were sampled at various littoral sites from July 27-30 using a standard double-headed rake. Emergent beds were mapped with GPS and range-finder equipment during August and characterized by their species composition along visual transects.

RESULTS

Largemouth bass sampling

Spring electrofishing catch rates of 8-inch and larger bass ranged from 117/hour at Crooked to 305/hour at Big and averaged 215/hour (Table 1). All lakes but Crooked exceeded the management objective of 80 to 140/hour established by the UTRLA committee. Catch rates of 8- to 12-inch bass ranged from 49/hour at Crooked to 213/hour at Big and averaged 139/hour, while catch rates of 12- to14-inch bass ranged from 25/hour at Old to 86/hour at Big and averaged 58/hour. Although Big had the greatest number of sub-legal bass (<14-in), it provided the lowest catch rate of 14- to 18-inch bass (5/hr). Crooked had the lowest overall catch rate but the highest catch rate of 14- to 18-inch bass (26/hr). The average catch rate of 14- to 18-inch bass was 15/hour. Goose Lake not only had a high catch rate of 14- to 18-inch bass (22/hr) but also the highest catch rate of 18-inch and larger bass (7/hr). In contrast, Big and Loon each produced catch rates of less than 2/hour for 18-inch and larger bass. The average catch rate of 18-inch and larger bass was 3/hour. Although spring electrofishing indicated 8-inch and larger bass are abundant in the UTRLA lakes, catch rates of age-1 and older bass during the June surveys were close to or within the management objectives of 80 to 140/hour at Crooked (79/hr), Loon (86/hr), and Old (126/hr). Catch rates of age-1 and older bass remained above the objective at Big (314/hr), Crane (168/hr), and Goose (203/hr).

Bass numbers were high and overall bass populations in the UTRLA lakes are dominated by sub-legal fish. The percentage of 14-inch and larger bass in the spring samples averaged only 11% and ranged from 2% at Big to 25% at Crooked (Table 2). The UTRLA management objective is 25% or more. Likewise, no lake reached the objective of 8% or more for 18-inch and larger bass. Goose had the largest percentage of 18-inch and larger bass (4%) but the other lakes had 2% or less. The average percentage of 18-inch and larger was only 2%.

Based on the mark-recapture sampling at Crooked Lake, it contained 2,888 (SE=301) 8-inch and larger bass (14/ac). Of these, 1,201 were 8- to 12-inch (42%), 977 were 12- to 14-inch (34%), 656 were 14- to 18-inch (23%), and 54 were 18-inch and bigger (2%). At the completion of sampling, 820 marked bass were placed in the population (28%). A similar percentage of marked bass (21%) were captured in the June sample.

Bass growth rates in the UTRLA lakes were typical of rates in other northern Indiana lakes but varied among the lakes (Figure 4). Bass lengths, based on back-calculations of size at their current age, averaged 4.1, 7.1, 9.5, 11.5, 13.4, and 15.1 inches at age-1 through age-6, respectively. By age-6, however, bass were much larger in Crooked (15.3 in) and Loon (15.9 in) than they were in Big (13.9 in), Crane (14.3 in), Goose (14.0 in), and Old (14.1 in). Although less incremental growth occurred during the fourth year at each lake, bass continued to grow during their fifth and sixth years. Loon and Old had the largest sixth-year increments.

Bluegill sampling

With the exception of Goose (539/hr), electrofishing catch rates of 3-inch and larger bluegills were similar among the lakes and fell within the management objective of 140 to 400/hour, ranging from 193/hour at Loon to 297/hour at Big (Table 3). Including Goose, the overall mean catch rate was 288/hour. Catch rates of 3- to 6-inch bluegills varied from 95/hour at Loon to 332/hour at Goose and averaged 178/hour. Catch rates of 6- to 7-inch bluegills varied from 30/hour at Crooked to 101/hour at Goose and averaged 51/hour. Goose had the highest catch rate of 7-inch and larger bluegills (56/hr) and Crane had the lowest (14/hr). The average among all six lakes was 35/hour. Catch rates of 8-inch and larger bluegills were more variable than catch rates of other size groups, ranging from 0/hour at Loon to 50/hour at Goose and averaging 24/hour.

Proportions of various bluegill size groups also differed among lakes (Table 4). Loon (49%) and Old (48%) had the lowest percentages of 3- to 6-inch bluegills, while percentages at the other lakes varied from 62% at Goose to 73% at Crooked. Loon also had the largest percentage of 6- to 7-inch bluegills (29%) and 7- to 8-inch bluegills (22%) but had the lowest percent of 8-inch and larger bluegills (0%). All lakes except Crane (12%) exceeded the combined management objective of 15% for 7-inch and larger bluegills and all lakes except Loon exceeded the management objective of 4% for 8-inch and larger bluegills. Old had the second greatest percentage of 7- to 8-inch bluegills (16%) and the greatest percentage of 8-inch and larger bluegills (18%).

Bluegill growth rates were also typical of bluegills in other northern Indiana natural lakes. Overall, bluegills in the UTRLA lakes averaged 1.4, 2.8, 4.6, 6.4, 7.4, and 8.2

inches at age-1 through age-6, respectively. Bluegills were larger in Big, Crane, Goose, and Old than they did in Crooked and Loon (Figure 4). Although first-year increments were similar, differences became apparent in the second year with larger increments at Crane and Old and smaller increments at Crooked and Loon. By age-4 bluegills were larger than 6 inches in each lake except Crooked and Loon. For example, age-4 bluegills in Goose were 2.1 inches larger than age-4 bluegills in Crooked and 1.6 inches larger than age-4 bluegills at Loon. Growth slowed considerably during the fifth year at Goose but increased in the sixth year. No age-6 bluegills were collected at Loon.

Fish community sampling

The fish community surveys provided a combined catch of 5,409 fish representing 28 species (Table 5). Catches varied from 437 fish at Old and 450 at Crane to over 1,000 fish at Big, Crooked, and Loon and was 1,316 fish at Goose. The number of species varied from 13 at Crane and Goose to 19 at Big and averaged 16. With the exception of Loon (0.35), native species diversity indices ranged from 0.61 at Crane to 0.69 at Big. Sport fish accounted for 94% of the total catch by number, 90% to 98% at each lake, while non-game fish accounted for 6%.

Although relative species compositions were similar among lakes, there were a few notable differences (Table 6). Bluegills ranked first numerically in each lake but varied from 47% of the catch at Big to 80% at Loon and averaged 59%. Percentages at all lakes except Loon were within the range of 40 to 60% established as the UTRLA management objective. Largemouth bass ranked second numerically in each lake except Goose where redear sunfish were more abundant. Nevertheless, the relative species composition of largemouth bass in Crooked and Loon (8%) fell below the management objective of 10 to 25%, but was within the objective range at Crane (19%), Goose (12%), and Old (14%), and above the objective at Big (28%). Several other species comprised 5% or more of the catch at individual lakes, including redear sunfish in all lakes, spotted gar at Big, yellow perch at Crooked, and black crappie and yellow perch at Goose. Goose was the only lake to meet the management objective of 5 to 10% for black crappies and/or yellow perch, while Crooked was the only lake to meet the objective of 5 to 10% for perch.

Of 28 species caught in the surveys, three were considered non-endemic. Carp were found at Big, Goose, Loon and Old with the highest catches at Big (6) and Old (7). Two northern pike were caught in Loon and one white bass was caught in Big. Twenty-three ciscoes, a species considered native to Crooked, were caught in five gill nets in deepwater habitat (4.6/lift). Other catches included a logperch in Big, as well as bluntnose minnows, redfin pickerel, longnose gar, and rock bass in Crooked and a spotted sucker in Old. White suckers were found only in Big and Crane. No gizzard shad were collected at any lake even though shad are present in other parts of the Tippecanoe watershed.

Four species previously found in UTRLA lakes were not observed in the 2009 surveys, including black bullhead, black-chin shiner, channel catfish, and tadpole madtom. Although a few muskies were observed during spring electrofishing, none were caught, despite stocking 1,200 per year in Loon since 1978. Other species previously stocked and captured on occasion in past surveys but not caught in 2009 were rainbow trout and smallmouth bass. Seven species (bluegills, largemouth bass, pumpkinseeds, redear sunfish, warmouth, yellow bullhead, and yellow perch) were present in all six lakes. Hybrid sunfish were collected at Old Lake.

Angler creel surveys

Anglers fished a combined total of 36,055 hours at the six UTRLA lakes, of which 89% were logged by boat anglers and 11% by shore anglers (Table 7). Weekend anglers accounted for 44% of the total effort and weekday anglers accounted for 56%. Among boat anglers, their effort accounted for 43% of the pressure on weekends and 57% on weekdays. Total fishing effort varied per lake in large part due to lake size, ranging from 1,909 hours at Crane to 9,071 hours at Crooked. Angler effort on an acreage basis was lowest at Loon (35 hr/ac), Big (37 hr/ac), and Crooked (44 hr/ac), moderate at Old (66 hr/ac) and Crane (68 hr/ac), and highest at Goose (82/ac). Likewise, boat angler effort was lowest at Big (30 hr/ac), Loon (31 hr/ac) and Crooked (40 hr/ac), moderate at Old (59 hr/ac) and Crane (68 hr/ac), and highest at Goose (76 hr/ac). The overall effort per acre per day (0.48) was close to the management objective ($\geq$0.50) and exceeded the objective at Crane (0.60), Goose (0.72), and Old (0.58) but was below the objective at Big (0.32), Crooked (0.39), and Loon (0.31).

Anglers fished for a variety of species (Table 8). Of 636 interviewed angler-parties, 44% fished solely for bluegills and 32% for bass. Those who fished for both represented 8%. Crappie anglers (4%) and crappie anglers who also fished for bluegills (4%) ranked third. Those who expressed no preference accounted for 3%, while muskie anglers accounted for 1%. Very few anglers fished for perch singly (<1%) or in combination with other species. One party fished for carp and another for gar, while sunfish were mentioned by four parties (<1%). Based on the number of times a species was mentioned, anglers fished mainly for bluegills (50%) and bass (36%), followed by crappies (8%), muskies (1%), perch (1%), sunfish (<1%) and miscellaneous species (3%).

Fishing preferences, based on the number of times a species was mentioned by interviewed anglers, varied considerably among lakes and in most cases met the management objectives (Table 9). Bluegill preference met the 40% objective at each lake except Loon (36%) and was highest at Old (68%). Bluegill preference at the other lakes ranged from 49-54%. Bass preference met the 30% objective at Big, Crooked, and Goose and was highest at Loon (51%), but below the objective at Crane (21%) and slightly below at Old (29%). Angler preference for muskies at Loon (6%) also met the management objective (≥5%).

Anglers removed a total of 17,003 fish from the six lakes, including 13,395 bluegills, 1,469 redear sunfish, 1,023 crappies, 671 perch, 338 bass, 77 other sunfish, 18 catfish from Goose Lake, and 11 muskies from Loon Lake (Table 10). Anglers took the most bluegills out of Crooked Lake (4,229), followed by Goose (3,650), Big (1,791), Loon (1,599), Crane (1,204) and Old (921). Big Lake provided the most crappies (579) with Goose second (273). Goose (743) and Crooked (491) provided the most redear sunfish. Crooked (362) and Loon (242) gave up the most perch. Of the 338 total bass taken by anglers, 116 came from Goose, 94 from Loon, 75 from Crooked, 43 from Big, and 11 from Crane. The 75 bass taken from Crooked represented 11% of the estimated number of 14-inch and larger bass present in the spring (75/710). No bass were reportedly removed from Old Lake.

Bluegill fishing failed to meet several UTRLA management objectives (Table 11). The total harvest of 13,395 bluegills (0.15/ac/d) was below the objective of 45,600 (0.50/ac/d). Crane (0.38/ac/d) and Goose (0.38/ac/d) came closest to the objective. Old

(0.25/ac/d), Crooked (0.18/ac/d), Big (0.07/ac/d), and Loon (0.06/ac/d) were well below. The overall bluegill harvest rate, i.e. harvest/(total effort x preference), was 0.7/hour and was 30% below the objective (1.0/hr). The harvest rate exceeded the objective at Crane (1.2/hr), met the objective at Goose (1.0/hr), and was slightly under the objective at Crooked (0.9/hr). Harvest rates were low at Old (0.6/hr), Loon (0.6/hr), and Big (0.4/hr). Based solely on interviews of boat anglers who specifically targeted bluegills, the overall harvest rate of 0.6/hour was 40% below expectations. Specific bluegill harvest rates by interviewed boat anglers were higher at Crane (0.8/hr), Crooked and Goose (0.7/hr), but lower at Old (0.6/hr), Loon (0.5/hr), and Big (0.4/hr).

Although few bass were taken by anglers, many were caught and released (Tables 10 and 11). Anglers released 15,677 bass, 89% of which were smaller than the size limit (<14 in) and 11% were larger than the limit. Big (5,352) and Loon (5,315) accounted for 68% of the released bass, followed by Crooked (2,350), Goose (1,712), Old (669), and Crane (279). Per acre, bass catches were similar at Crane and Crooked (10-12/ac) but twice as great at the other lakes (20-24/ac). The overall bass catch per acre per day was 0.18, while the total catch of 16,015 bass provided a catch rate of 1.2/hour and was above the management objective of 1.0/hour. Boat anglers who specifically targeted bass caught them at a rate of 1.0/hour. The rate was highest at Big (1.4/hr) and Loon (1.0/hr), followed by Goose (0.9/hr), Old (0.8/hr), Crooked (0.7/hr), and lowest at Crane (0.4/hr).

Although catch rates of bluegills were low, bluegill sizes met the objectives at all lakes except Loon (Table 12). The proportion of 7-inch and larger bluegills (CSD7) was 38% at Loon and below the objective (≥50%), compared to 77% at Big and Old, 81% at Crooked, 87% at Goose, and 89% at Crane. The proportion of 8-inch and larger bluegills (CSD8) also met the objective (≥20%) at Crooked (48%), Crane (44%), Goose (39%), and Old (30%), slightly below the objective at Big (18%), but well below the objective at Loon (3%). Crooked provided the most 8-inch and larger bluegills (2,023), followed by Goose (1,409), Crane (535), Big (323), Old (279), and Loon (39). The largest bluegills were 9.5 inches long and caught at Crane, Goose, and Old. In contrast, the size of harvested bass did not meet the UTRLA objective (Table 12). Harvested bass were less than 15 inches at Big and only 14 inches at Crane. Loon was the only lake where 18-inch and larger bass (22%) met the objective (≥10%).

Angler satisfaction with fishing quality differed by species, by lake, and between lake residents and lake visitors (Table 13). Overall, 39% of bluegill anglers who fished from boats described fishing as "good". This percentage was less than the management objective of 50%. Another 32% described fishing as "fair" and 29% described fishing as "poor". Bass anglers who fished from boats who rated fishing as good accounted for 53%, slightly above the 50% objective, while 28% rating fishing as fair and 18% rating fishing as poor. Although fewer residents fished than visitors, resident bluegill anglers had a more positive perception of fishing quality (40% good, 36% fair) compared to visitors (39% good, 30% fair). Resident bass anglers also had a more positive perception of fishing quality (58% good) than visiting anglers (51% good).

Additional differences were noted between residents and visitors. No lake resident anglers described bluegill fishing as good at Big or Crooked, compared to 60% or more at Goose, Loon, and Old. A larger percentage of visiting anglers rated fishing as good at Big (18%) and Crooked (32%), but Crane had the lowest percentage (14%). More than half of the visiting bluegill anglers at Goose, Loon, and Old, however, rated fishing good. Likewise, larger percentages of bass anglers who fished from boats considered fishing good at Goose (72%), Loon (75%), and Old (64%) than Big (21%), Crane (22%), or Crooked (31%). Those who rated bass fishing poor ranged from 3% at Loon and 4% at Goose to 67% at Crane. No lake resident bass anglers at Big or Old rated fishing good, but 28% of visiting bass anglers at Big and 88% at Old rated fishing good. Few lake residents also considered bass fishing good at Crooked (11%), as did visiting anglers (36%). Most lake residents rated bass fishing as good at Goose (77%) and Loon (85%), as did visitors (55% and 73%, respectively).

Muskie fishing quality at Loon was described as good. Of seven interviewed muskie angler-parties, four considered fishing good and three considered fishing fair, thereby exceeding the combined management objective of 50%. The estimate of 11 muskies taken from the lake was based on observation of a single 37-inch observed fish. The party that took the fish also released another muskie the same day (July 8). No other anglers reported releasing any muskies. Muskie anglers fished 466 hours (6% of 7,770 hrs). Therefore, the estimated catch rate (harvest plus release) was one muskie per 21 hours of muskie fishing and exceeded the objective of one muskie per 30 hours of fishing.

Habitat assessments

Water clarity varied within and among the lakes (Table 14). Clarity was greatest at Crooked on June 15 (18.5 ft) and lowest (2.5 ft) at Crane on July 9 and Loon on July 24 and July 30. Clarity decreased from the first measurement in June to the second measurement on July 9 at all lakes except Old. At Big, Crooked, and Loon where measurements were continued through July, clarity subsequently declined, decreasing to 5.3, 9.5, and 2.5 feet, respectively. Clarity decreased 75% at Loon through the monitoring period and about 50% at Big and Crooked.

Although surface temperatures varied during each survey in June due to different sampling dates (Table 15), they were similar by July 9 and ranged from 73 to 75°F. Temperatures 5 feet below the surface on July 9 differed by only 1° (73 to 74°F). Thermoclines were established by June but at various depths and moved downward by early July in Big (12 ft), Crooked (16 ft), Goose and Loon (10 ft), and Old (6 ft), but remained the same in Crane (6 ft). Thermocline thickness was generally 8 to 10 feet.

Dissolved oxygen profiles also differed at each lake (Table 16). Ample amounts of oxygen for fish (≥5 ppm) were present in June only in the top 6 feet at Crane and Old, 8 feet in Big and Goose, 10 feet in Loon, and down to 26 feet and again below 38 feet down to 94 feet in Crooked. By July, ample oxygen was present to 6 feet in Crane, 10 feet in Goose and Old, 12 feet in Big and Loon, and 30 feet in Crooked. Oxygen amounts were also inadequate for fish (<3 ppm) below these depths in Crane, Big, Goose and Loon, but not until 14 feet in Old and 86 feet in Crooked.

Submersed aquatic plant communities were also different in each lake (Table 17). Coverage within the littoral zones varied from 53% in Crane to 97% in Crooked. Mean coverage was 79%. The number of species ranged from four at Crane to 14 at Crooked and averaged nine. Native species diversity was lowest at Crane (0.23) and Old (0.24) and highest at Loon (0.83) and Crooked (0.87). Crane Lake also had the lowest number of species per site and lowest number of native species per site.

Coontail was the most dominant species and was the only species found in all six lakes. It varied from 30% coverage in Loon to 87% in Old and averaged 57%. Coontail dominance, i.e. a measure of its coverage and density, was nearly five times greater in Old (52%) than Loon (11%). Coontail dominance was also low at Crane (14%) and

moderate in Big (25%), Crooked (22%), and Goose (33%). Dominance of other major native plants, those that were 10% or more, included eel grass in Big and Loon along with chara and northern water milfoil in Crooked. Filamentous algae was present in all lakes, varying from 2% of the sites in Crooked to 30% in Big and Crane, 35% in Loon, 70% in Goose, and 80% in Old.

Two non-native plant species were found in the UTRLA lakes. Eurasian water milfoil was found in each lake except Big, although a state-funded herbicide program has been in place to reduce its abundance. Its coverage was greater in Goose (63%) and Crane (43%), but less than 20% in Crooked, Loon and Old. Curly-leaf pondweed was found in four lakes and varied from 2% at Crooked to 10% at Crane. It was not detected in Big or Loon, although curly-leaf pondweed usually goes into scenescense by early-July.

Floating-leaf emergent plant bed coverage (primarily water lily and spatterdock) varied within the UTRLA lakes (Table 18). Total bed coverage ranged from 3.2 acres in Old to 31.6 acres in Crooked. Emergent beds covered the least amount of surface area as a fraction of the whole lake in Loon (4%), Big (7%), and Old (10%), while greatest in Crooked (15%), Goose (16%), and Crane (17%). As a measure of edge cover for fish, the distances along the lakeward edge of emergent beds ranged from 3,768 feet at Old to 18,067 feet at Crooked and totaled 92,136 feet. Emergent beds covered more of the shoreline at Crooked and Goose (81%), less at Crane (75%) and Old (69%), and the least amount at Big (49%) and Loon (32%).

DISCUSSION

Standardized sampling conducted in 2009 provided a tool to compare the current status of fish populations and fishing within the UTRLA lakes and assess whether management objectives are being met. Overall, the lakes met a greater number of bluegill objectives than largemouth bass objectives (Figure 5). Of the 24 bluegill population objectives (4 objectives at 6 lakes), 83% were met. In contrast, only 21% of the bass population objectives were met. Likewise, 53% of the bluegill fishing objectives and 28% of the bass fishing objectives were met. Based on these results, a new fish management initiative at the UTRLA lakes should first be directed toward improving largemouth bass size structure and fishing opportunities where needed.

Bass populations in the UTRLA lakes are generally characterized by high densities of sub-legal fish, a condition more common now at other northern Indiana lakes following imposition of a 14-inch minimum size limit in 1998 and greater voluntary release of legal bass by anglers (Pearson 2008). Compared to other northern Indiana lakes, electrofishing catch rates of 8-inch and larger bass were above the normal range at each lake except Crooked, while proportions of 14-inch and larger bass were low. The proportions of 18-inch and larger bass were also below the northern Indiana average of 4% at all lakes except Goose. High catch rates of sub-legal bass and low proportions of legal bass are more pronounced at Big and Crane.

High numbers and high proportions of sub-legal bass can develop where recruitment and survival of young bass is excessive, resulting in slow growth. Low numbers and low proportions of legal bass can also develop where fishing mortality or natural mortality of old bass is high. Because few bass were taken by anglers at the UTRLA lakes, including only 11% at Crooked, the current scarcity of 14-inch and larger bass is probably not due to fishing mortality. Instead, growth of age-6 and older bass may not be sufficient to produce bigger bass, especially at Big and Crane. As a result, any new regulation designed to reduce exploitation of 14-inch and larger bass would not address an over-abundance of smaller bass. Likewise, any new regulation designed to reduce bass less than 14 inches may have little effect on size structure if anglers are reluctant or unable to remove sufficient numbers. If sufficient numbers are removed, fishing mortality of 14-inch and larger bass might also increase and negate any improvement in size structure.

What may be needed, therefore, is a management approach that can ensure sufficient removal of bass less than 14 inches while providing more protection of bass larger than 14 inches. As a result, Big and Crane could serve as candidate sites for testing alternative regulations to improve bass population balance. How changes in bass regulations might affect bluegill abundance and size in these lakes could also be examined.

Even with new bass regulations, UTRLA lakes may not be capable of producing proportions of 18-inch and larger bass to achieve the objective (8%) for a variety of reasons (e.g. habitat, productivity, forage). Only seven lakes in northern Indiana, based on standardized sampling since the early 1980s, are known to have developed populations where proportions of 18-inches and larger bass were 8% or higher but none were sustained (DFW largemouth bass dataset). Ironically, these populations developed under a variety of size limits, including no limit (Beaver Dam, Sacarider), 12-inch (Hartz, Robinson), 14-inch (Barrel&1/2, Lake-of-the-Woods), and 18-inch limits (Barrel&1/2, Shock). In addition, all produced electrofishing catch rates of 8-inch and larger bass less than 80/hour. A more reasonable objective at the UTRLA lakes, in light of the high catch rates, may be 4%. For example, 24 northern Indiana lakes on 52 sampling occasions have produced bass populations where proportions of 18-inch and larger bass reached 4%. Goose currently meets that standard, while Crane did in 1981 and Old did in 1991. Although the 8% objective may be unrealistic, achieving 4% or higher would be preferable over the current low proportions $\leq$2%. Achieving 4% or more, however, may require a trade-off in over bass numbers. Lakes where 18-inch and larger bass make up 4% or more of the population have typically had electrofishing catch rates of 8-inch and larger bass below the UTRLA objective (73/hr) and densities averaging 17.5/acre.

Because Loon met all four bass fishing objectives, there is little evidence to suggest stocking muskies adversely affects bass fishing. Overall fishing effort at Loon was nearly identical to fishing effort at Big and not much lower than Crooked, yet angler interest as measured in preference for bass fishing was about 50% greater at Loon than Big or Crooked. Greater interest in bass fishing may be due to better bass size structure. Loon was the only lake where anglers took 18-inch and larger bass and had the most satisfied bass anglers (75%). However, Loon met the fewest number of bluegill objectives and has apparently not benefited from additional predation on bluegills by muskies.

While Loon could benefit from additional bluegill management, there is little need for any new bluegill initiatives at Big, Crooked, and Old lakes, given the adequate number and size of bluegills already present. Likewise, there is little need for additional bluegill management at Crane or Goose. The proportion of 7-inch and larger bluegills in Crane was slightly below the objective, but an adequate percentage of 8-inch and larger bluegills was present. Goose contains also ample numbers of 7-inch and larger bluegills, so there is little reason to suspect it may contain too many small bluegills.

Angler opinions of bluegill fishing quality at the UTRLA lakes did not match up with bluegill population parameters or fishery characteristics. Although all population objectives were met at Big and Crooked, and most bluegill fishery objectives were met at Crane, angler satisfaction with bluegill fishing quality was low at these three lakes. In contrast, anglers at Goose and Old had a more favorable opinion of bluegill fishing quality even though population and fishery parameters were similar to Big, Crane, and Crooked. Even at Loon, where bluegill population parameters were the least desirable, bluegill anglers had a good opinion of fishing. Electrofishing and trap nets generally provide reliable data on the status of bluegill populations, so the discrepancy between fishery characteristics and angler opinions may reflect bias in assessing quality based on interviewing anglers during creel surveys. In doing so, anglers who have a negative perception of quality are less likely to fish and less likely to be encountered. Anglers who fish where they think fishing is poor may have low expectations or derive satisfaction from factors other than catch. Likewise, anglers dissatisfied with fishing where good fisheries exist may have unreasonably high expectations or poor personal experience. Nevertheless, effort should be directed at promoting available bluegill fishing opportunities to increase effort and improve angler perceptions of quality.

Why Loon, compared to other UTRLA lakes, met the fewest bluegill objectives is not known. However, angler dissatisfaction with bluegill fishing, despite the positive responses reflected in the 2009 survey, has persisted since the 1970s when Loon residents complained of small bluegill size and asked that pike be stocked to increase predation on bluegills. In 2004, 47% of bluegill anglers considered fishing poor at Loon and only 11% considered it good (Pearson 2005). Although muskies were stocked in lieu of pike, they have not improved bluegill population characteristics or fishing success. Instead, the

relative species composition on bluegills increased from 55% in 1988 to 61% in 2000, 77% in 2004, and 80% in 2009. Until 2009, proportions of 7-inch and larger bluegills never exceeded 5% and were less than 2% twice. Electrofishing catches of 3-inch and larger bluegills were also consistently high, ranging from 808/hour in 1988 to 451/hour in 2000 and 1,999/hour in 2004. These previous surveys, however, were conducted in July. In contrast, the June 2009 proportion of 7-inch and larger bluegills was much higher (22%) and the catch rate of 3-inch and larger bluegills (193/hr) was much lower. Because the changes in 2009 may simply reflect sampling variability, additional sampling in July could help verify whether the increase in size and decrease in numbers observed in June represented a real shift in the population.

As the percentage of bluegills increased at Loon, the percentage of perch decreased from 11% in 1988 to 4% in 2000, 2% in 2004, and 1% in 2009. More importantly, the actual number of perch captured during the surveys decreased from 134 in 1988 to 82 in 2000, 53 in 2004, and only 11 in 2009. Lake chubsuckers, similar in shape and size to perch, also declined. Both may be more vulnerable to muskie predation because of their shape. Meanwhile, the number of black crappies and redear sunfish, two species similar in shape to bluegills, increased from 1988 to 2004 before decreasing in 2009, although two other sunfish species, pumpkinseeds and warmouth, did not. How these changes may or may not be related to muskie stockings is not known, but perch are a preferred prey item for muskies in Wisconsin (Bozek and Burri 1999). Perch, as well as chubsuckers, also declined at Lake Webster downstream of Loon after muskies were stocked but perch eventually returned to previous levels (Pearson 2005). At Webster, however, gizzard shad are also present. They provide additional muskie forage which, unlike at Loon and other sunfish-dominated lakes, could temper predation on perch. White suckers, another species typically eaten by muskies (Bozek and Burri 1999), are also absent from Loon.

Once perch declined at Loon, muskies should have fed on bluegills, thus reducing bluegill density and improving growth. That apparently did not happen, as has been reported elsewhere (Graff 1986, Wahl and Stein 1988). Instead, bluegills and crappies increased. Perch declined and bluegills increased after pike were stocked in a Minnesota lake (Anderson and Schupp 1986). In contrast, after removing large pike from a Nebraska lake, more large perch and bluegills were present (Jolley et. al 2008). Although perch

prey on small bluegills, especially in winter (Fullhart et. al. 2002), and can influence bluegill size (Anderson and Schupp 1986, Reed and Parsons 1996, Tomcko and Pierce 2005), large bluegills were not abundant in Loon when more perch were present. Whether perch ever played a significant role in limiting bluegill density is not known. Therefore, to more fully understand the impacts of muskie stockings within fish communities, it may be in the long-term interest of managers and anglers to evaluate how Loon Lake's fish community responds if muskie stockings are stopped. Anglers would still have ample muskie fishing opportunities in lakes downstream in the watershed, including Webster, Tippecanoe, and Barbee chain.

Bluegill size at Loon has also remained apparently independent of changes that may have occurred in the bass population following imposition of a 12-inch size limit in 1990 and 14-inch limit in 1998. Bass electrofishing catch rates during summer surveys declined at Loon over the last decade from a mean of 144/hour in 1988 and 52/hour in 2004 and 65/hour in 2009 (see Appendix 5). Catch rates in spring, however, increased from 113/hour in 2004 to 192/hour in 2009. Most of the increase was among 8- to 12-inch bass. Given the uncertainty over the actual long-term trend in bass abundance and size, it is not possible to adequately assess their impacts on bluegill numbers and size.

No single factor likely explains why Loon does not produce better bluegill fishing. From a habitat perspective, its turbidity ranks second to Crane, although Loon has the highest chlorophyll-a value. Not unlike the other UTRLA lakes except Crooked, Loon contains sufficient oxygen for fish only in the top 10 to 12 feet during summer stratification. Loon has the largest watershed (7,140 ac) and presumably more sediment and nutrient inputs, but it ranks third in the ratio of watershed size to lake size (32:1) and third in retention time. It also has the largest percentage of residential shoreline development with numerous sand and gravel beaches that may provide more spawning areas and contains several native plant species with plant coverage is typical (75%), although coontail coverage is the lowest. Emergent beds also cover the least amount of surface area compared to other UTRLA lakes, so it is not likely that vegetation provides too much cover for bluegills to escape predators. Whether these factors influence bluegill population characteristics at Loon and at other natural lakes is not known.

Until more is known how habitat features affect bluegill, it is not possible to identify strategies to address habitat limitations at Loon. This is not to say, however, that general habitat improvements are unwarranted. Efforts to reduce nutrient and sediment inputs through wetland restoration, best-management farming practices, along with efforts to prevent in-lake recycling of nutrients, can be expected to improve water clarity over time. As water clarity improves, oxygen concentrations could increase in deeper water and provide additional fish habitat. Control of non-native aquatic plants and other aquatic vegetation restoration actions could expand coverage of native submersed and emergent plants. Steps to limit future shoreline development and alterations, as well as potential adverse impacts from boating or other human activities, could help protect nearshore habitat. These various habitat strategies, while not necessarily directed at individual species, can be expected to benefit most sport fish populations and anglers as well as enhance lake quality and maintain their economic value.

More research is needed to better understand why Loon, similar in size and depth to Big and Crooked, has such different environmental and biological characteristics. Research could eventually help identify feasible lake management and fish management actions that will overcome fish habitat limitations and improve fishing. Initial study into various lake features and how they may relate to fishing quality got underway by Purdue University researchers in cooperation with the Division of Fish and Wildlife at Crooked and at several other Indiana lakes in 2009. The opportunity to expand this research to include Big and Loon should be considered.

RECOMMENDATIONS

During the UTRLA fish management planning process, 41 strategies were suggested as action items that could protect and enhance fish populations and fishing opportunities (Appendix - UTRLA Fish Management Plan 2010-2019). These strategies were assigned to seven broad categories: fishing regulations, information, surveys, habitat, invasive species, stockings, and funding. Based on results of sampling in 2009, the Division of Fish and Wildlife recommends that priority emphasis be placed on the following actions:

Action #1: To reduce an over-abundance of sub-legal bass in Big and Crane and improve size structure (UTRLA Strategy #2), it is recommended that a "reverse size-limit" be established to allow removal of bass less than 14 inches. Anglers should be

encouraged to remove small bass through various media (UTRLA Strategy #10), fishing seminars (UTRLA Strategy #8), fishing derbies and the annual Free-Fishing Weekend in June (UTRLA Strategy #9), coupled with monitoring to re-impose the 14-inch minimum limit once harvest reaches a pre-determined level (UTRLA Strategy #16). A second alternative, with the best means of control but more controversial, could be to simulate the effects of a reverse slot limit by removing a pre-determined number of sub-14 inch bass by electrofishing. Concerns over transferring potential diseased fish to other waters might preclude stocking them elsewhere but they could be donated to food programs.

Action #2: To address the poor size structure of bluegills at Loon, two approaches are needed. To better understand possible habitat limitations on the bluegill population at (UTRLA Strategy #18), it is recommended that a research study be designed and funded (UTRLA Strategy #37, 38, 40) to compare various habitat features of Big, Crooked, and Loon. The focus of the research should be to identify significant factors that likely explain poor bluegill fishing quality at Loon and better bluegill fishing at Big and Crooked. Until more is learned about how and why various features affect bluegill populations, it is not possible to identify specific strategies to address bluegill habitat limitations (UTRLA Strategy #19). At the same time, action could be taken again to alter predator-prey relationships within the lake even though bass size limits and muskie stockings have failed to improve bluegill fishing. Muskie stockings could be discontinued to evaluate whether perch numbers rebound and bluegill size increases. Muskies scheduled to be stocked in Loon could be released in other Indiana lakes with more suitable forage (i.e. shad and suckers).

Action #3: To promote existing fishing opportunities at the UTRLA lakes where sampling indicated population characteristics are meeting the objectives, results of the surveys and other on-going management efforts should be published on various websites (e.g. Tippecanoe Watershed Foundation, Division of Fish and Wildlife), in newsletters, and through press releases (UTRLA Strategy #10), as well as other electronic media (UTRLA Strategy #11).

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Table 1. Electrofishing catch per hour of various size groups of largemouth bass during spring sampling and electrofishing catch per hour of age-1 and older largemouth bass during June surveys at six UTRLA lakes in 2009.

SPRING SURVEYS	Big	Crane	Crooked	Goose	Loon	Old	Average
8-12 in	213	203	49	65	116	188	139
12-14 in	86	76	40	62	59	25	58
14-18 in	5	12	26	22	15	7	15
>=18 in	2	2	2	7	2	4	3
Total	305	294	117	156	192	223	215
JUNE SURVEYS							
Age-1	314	168	79	203	86	126	163

Table 2. Proportions (percentages) of various size groups of largemouth bass captured by electrofishing during spring sampling at six UTRLA in 2009.

SPRING SURVEYS	Big	Crane	Crooked	Goose	Loon	Old	Average
8-12 in	70	69	41	41	61	84	61
12-14 in	28	26	34	40	31	11	28
14-18 in	2	4	23	14	8	3	9
>=18 in	0	1	2	4	1	2	2
Total	100	100	100	100	100	100	100

Table 3. Electrofishing catch per hour of various size groups of bluegills at six UTRLA lakes in 2009.

Size category	Big	Crane	Crooked	Goose	Loon	Old	Average
3-6 in	197	136	200	332	95	106	178
6-7 in	39	45	30	101	55	38	51
7-8 in	33	14	31	56	43	35	35
>=8 in	27	10	14	50	0	40	24
Total	297	205	275	539	193	219	288

Table 4. Proportions (percentages) of various size groups of bluegills captured by electrofishing at six UTRLA lakes in 2009.

Size category	Big	Crane	Crooked	Goose	Loon	Old	Average
3-6 in	66	66	73	62	49	48	61
6-7 in	13	22	11	19	29	17	18
7-8 in	11	7	11	10	22	16	13
>=8 in	9	5	5	9	0	18	8
Total	100	100	100	100	100	100	100

Table 5. Number of fish collected during fish population surveys at six UTRLA lakes during 2009.

Species	Big	Crane	Crooked	Goose	Loon	Old	Total
Bluegill	531	264	610	711	836	236	3188
Largemouth bass	314	84	79	152	86	63	778
Redear	55	31	77	194	20	59	436
Yellow perch	46	1	57	93	11	7	215
Yellow bullhead	31	3	36	37	9	15	131
Black crappie	6	14		89	16	5	130
Spotted gar	61	18	13		18	18	128
Warmouth	28	6	13	13	6	9	75
Brook silverside	6		40	3	18		67
Lake chubsucker	7	8	34		1	1	51
Golden shiner	1	15		17	5	2	40
Pumpkinseed	10	1	12	3	1	2	29
Brown bullhead	3	3	8	2	5	6	27
Cisco			23				23
Carp	6			1	3	7	17
Rock bass			16				16
Bluntnose minnow			11				11
Bowfin	5		1	1	2	2	11
Grass pickerel			9				9
White sucker	7	2					9
Fathead minnow	1				3		4
Green sunfish			4				4
Spotted sucker						3	3
Hybrid sunfish						2	2
Northern pike					2		2
Logperch	1						1
Longnose gar			1				1
White bass	1						1
Total	1120	450	1044	1316	1042	437	5409
Species count	19	13	18	13	17	16	16
Native species	17	13	18	12	15	14	15
Sport fish	1025	407	935	1294	992	404	843
Native diversity	0.69	0.61	0.64	0.66	0.35	0.67	0.60
Electrofishing hours	1.00	0.50	1.00	0.75	1.00	0.50	
Gill net lifts	8	4	8	6	8	4	
Trap net lifts	4	4	4	3	4	2	

Table 6. Percentage of fish collected during fish population surveys at six UTRLA lakes during 2009.

Species	Big	Crane	Crooked	Goose	Loon	Old	Average
Bluegill	47.4	58.7	58.4	54.0	80.2	54.0	58.8
Largemouth bass	28.0	18.7	7.6	11.6	8.3	14.4	14.7
Redear	4.9	6.9	7.4	14.7	1.9	13.5	8.2
Spotted gar	5.4	4.0	1.2		1.7	4.1	3.3
Yellow perch	4.1	0.2	5.5	7.1	1.1	1.6	3.3
Black crappie	0.5	3.1		6.8	1.5	1.1	2.6
Yellow bullhead	2.8	0.7	3.4	2.8	0.9	3.4	2.3
Cisco			2.2				2.2
Brook silverside	0.5		3.8	0.2	1.7		1.6
Rock bass			1.5				1.5
Warmouth	2.5	1.3	1.2	1.0	0.6	2.1	1.5
Lake chubsucker	0.6	1.8	3.3		0.1	0.2	1.2
Golden shiner	0.1	3.3		1.3	0.5	0.5	1.1
Bluntnose minnow			1.1				1.1
Grass pickerel			0.9				0.9
Spotted sucker						0.7	0.7
Carp	0.5			0.1	0.3	1.6	0.6
Brown bullhead	0.3	0.7	0.8	0.2	0.5	1.4	0.6
White sucker	0.6	0.4					0.5
Pumpkinseed	0.9	0.2	1.1	0.2	0.1	0.5	0.5
Hybrid sunfish						0.5	0.5
Green sunfish			0.4				0.4
Bowfin	0.4		0.1	0.1	0.2	0.5	0.3
Northern pike					0.2		0.2
Fathead minnow	0.1				0.3		0.2
Longnose gar			0.1				0.1
Logperch	0.1						0.1
White bass	0.1						0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	
Sport fish	91.5	90.4	89.6	98.3	95.2	92.4	92.9
Electrofishing hours	1	1	1	1	1	1	
Gill net lifts	8	4	8	6	8	4	
Trap net lifts	4	4	4	3	4	2	

Table 7. Estimated number of fishing hours by boat and shore anglers on weekends and weekdays and fishing hours per acre at six UTRLA lakes in 2009. MeanB represents the average number of boat anglers per count per day and MeanS represents the average number of shore anglers per count per day.

Lake	Day	MeanB	MeanS	Boat Hours	Shore Hours	Total Hours
Big	Weekend	4.89	1.75	2660	952	3612
Big	Weekday	3.21	0.48	4110	612	4722
Big	Total			6770	1564	8333
	Hours/acre			30	7	37
Crane	Weekend	1.83	0.00	997	0	997
Crane	Weekday	0.71	0.00	911	0	911
Crane	Total			1909	0	1909
	Hours/acre			68	0	68
Crooked	Weekend	7.22	0.69	3929	378	4307
Crooked	Weekday	3.41	0.31	4366	398	4764
Crooked	Total			8295	776	9071
	Hours/acre			40	4	44
Goose	Weekend	4.78	0.61	2601	332	2933
Goose	Weekday	2.93	0.14	3756	178	3933
Goose	Total			6357	509	6866
	Hours/acre			76	6	82
Loon	Weekend	5.07	0.64	2759	350	3109
Loon	Weekday	3.15	0.49	4032	629	4661
Loon	Total			6791	979	7770
	Hours/acre			31	4	35
Old	Weekend	1.45	0.11	787	58	845
Old	Weekday	0.85	0.13	1092	169	1261
Old	Total			1879	228	2106
	Hours/acre			59	7	66
			All lakes sum	31999	4056	36055
			Weekend sum	13732	2069	15802
			Weekday sum	18267	1986	20253

Table 8. Various fish species and combinations of species sought by anglers at six UTRLA lakes in 2009. Numbers represent interviewed angler-parties with each response.

Species	Big	Crane	Crooked	Goose	Loon	Old	Total	Percent
bluegill	56	13	53	87	36	35	280	44.0
bass	36	4	39	47	65	11	202	31.8
bluegill/bass	5	4	11	7	18	7	52	8.2
crappie	2	1		16	6	2	27	4.2
bluegill/crappie	3	5	4	6	5		23	3.6
anything	10		8				18	2.8
muskie					7		7	1.1
crappie/bass		1		4			5	0.8
perch			5				5	0.8
bluegill/perch			3				3	0.5
bluegill/sunfish	2		1				3	0.5
catfish	1	2					3	0.5
bass/muskie					1		1	0.2
bass/perch			1				1	0.2
bluegill/bass/muskie					1		1	0.2
bluegill/crappie/catfish			1				1	0.2
carp					1		1	0.2
crappie/muskie					1		1	0.2
gar		1					1	0.2
sunfish		1					1	0.2
Total	115	32	126	167	141	55	636	

Table 9. Combined preferences for various fish species sought by anglers at six UTRLA lakes in 2009. Values represent the number and percentage of responses that each species was mentioned by interviewed angler-parties.

Number	Big	Crane	Crooked	Goose	Loon	Old	Total
Bluegill	66	22	72	100	59	42	361
Bass	41	9	51	58	84	18	261
Crappie	5	7	4	26	12	2	56
Perch	0	0	9	0	0	0	9
Muskie	0	0	0	0	10	0	10
Sunfish	2	1	1	0	0	0	4
Miscellaneous	11	3	9	0	1	0	24
Total	125	42	146	184	166	62	725

Percent	Big	Crane	Crooked	Goose	Loon	Old	Total
Bluegill	52.8	52.4	49.3	54.3	35.5	67.7	49.8
Bass	32.8	21.4	34.9	31.5	50.6	29.0	36.0
Crappie	4.0	16.7	2.7	14.1	7.2	3.2	7.7
Perch	0.0	0.0	6.2	0.0	0.0	0.0	1.2
Muskie	0.0	0.0	0.0	0.0	6.0	0.0	1.4
Sunfish	1.6	2.4	0.7	0.0	0.0	0.0	0.6
Miscellaneous	8.8	7.1	6.2	0.0	0.6	0.0	3.3

Table 10. Estimated number of fish removed and the number of bass caught and released by anglers at six UTRLA lakes in 2009.

Species	Big	Crane	Crooked	Goose	Loon	Old	Total
Bluegill	1791	1204	4229	3650	1599	921	13395
Redear	65	34	491	743	55	82	1469
Crappie	579	13	0	273	103	55	1023
Perch	0	13	362	53	242	0	671
Bass	43	11	75	116	94	0	338
Sunfish	12	0	65	0	0	0	77
Bullhead	0	0	0	18	0	0	18
Muskie	0	0	0	0	11	0	11
Total	2490	1277	5222	4854	2104	1057	17003
Bass caught and released							
<14 inch	5076	268	1755	1507	4776	623	14006
>14 inch	275	11	595	204	539	45	1671
Total	5352	279	2350	1712	5315	669	15677
All bass	5394	291	2425	1827	5409	669	16015

Table 11. Angler harvest rates of bluegill and angler catch rates of bass (harvest and releases) at six UTRLA lakes in 2009.

Total	Big	Crane	Crooked	Goose	Loon	Old	Overall
Bluegill harvest	1791	1204	4229	3650	1599	921	13395
Bluegill harvest/acre	7.9	43.0	20.5	43.5	7.2	28.8	16.7
Bluegill harvest/acre/day	0.07	0.38	0.18	0.38	0.06	0.25	0.15
Total fishing hours	8333	1909	9071	6866	7770	2106	36055
Bluegill preference	0.53	0.52	0.50	0.54	0.36	0.68	0.50
Bluegill harvest/hour	0.4	1.2	0.9	1.0	0.6	0.6	0.7
Bass harvest	43	11	75	116	94	0	338
Bass harvest/acre	0.2	0.4	0.4	1.4	0.4	0.0	0.4
Bass catches	5394	291	2425	1827	5409	669	16015
Bass caught/acre	23.7	10.4	11.8	21.8	24.4	20.9	20.0
Bass caught/acre/day	0.21	0.09	0.10	0.19	0.21	0.18	0.18
Total fishing hours	8333	1909	9071	6866	7770	2106	36055
Bass preference	0.33	0.21	0.35	0.32	0.51	0.29	0.36
Bass caught/hour	2.0	0.7	0.8	0.8	1.4	1.1	1.2

Table 12. Length distributions of bluegills and largemouth bass harvested by anglers at six UTRLA lakes in 2009.

Expanded bluegill harvest by size

Inches	Big	Crane	Crooked	Goose	Loon	Old	TOTAL
5.0	13	0	18	0	0	0	32
5.5	0	0	18	0	0	0	18
6.0	135	0	313	36	343	19	846
6.5	283	134	496	379	647	192	2132
7.0	566	161	680	813	451	221	2891
7.5	471	375	680	1012	118	211	2867
8.0	256	294	1085	777	29	86	2528
8.5	54	134	846	506	10	86	1636
9.0	13	94	92	99	0	86	385
9.5	0	13	0	27	0	19	60
Sum	1791	1204	4229	3650	1599	921	13394
CSD7	77	89	81	89	38	77	78
CSD8	18	44	48	39	2	30	35

Expanded bass harvest by size

Inches	Big	Crane	Crooked	Goose	Loon	Old	TOTAL
14.0	14	11	38	0	10	0	73
14.5	29	0	13	0	0	0	41
15.0	0	0	0	0	10	0	10
15.5	0	0	0	39	31	0	70
16.0	0	0	0	39	0	0	39
16.5	0	0	0	0	21	0	21
17.0	0	0	13	0	0	0	13
17.5	0	0	13	39	0	0	51
18.0	0	0	0	0	0	0	0
18.5	0	0	0	0	21	0	21
Sum	43	11	75	116	94	0	339
CSD18	0	0	0	0	22	0	6

Table 13. Number and percentages of responses of boat anglers who fished for bluegills and largemouth bass who rated fishing as "good, fair, or poor" at six UTRLA lakes in 2009.

BOAT ANGLERS ONLY - Bluegill anglers

NUMBER	Residents				Non-residents				Grand total			
Lake	Good	Fair	Poor	Total	Good	Fair	Poor	Total	Good	Fair	Poor	Total
Big	0	9	7	16	7	8	24	39	7	17	31	55
Crane	0	0	0	0	3	6	13	22	3	6	13	22
Crooked	0	6	3	9	17	18	19	54	17	24	22	63
Goose	14	4	2	20	34	22	8	64	48	26	10	84
Loon	6	2	2	10	12	8	2	22	18	10	4	32
Old	5	1	1	7	15	7	4	26	20	8	5	33
Sum	25	22	15	62	88	69	70	227	113	91	85	289

PERCENT	Residents			Non-residents			Grand total		
Lake	Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor
Big	0.0	56.3	43.8	17.9	20.5	61.5	12.7	30.9	56.4
Crane	0.0	0.0	0.0	13.6	27.3	59.1	13.6	27.3	59.1
Crooked	0.0	66.7	33.3	31.5	33.3	35.2	27.0	38.1	34.9
Goose	70.0	20.0	10.0	53.1	34.4	12.5	57.1	31.0	11.9
Loon	60.0	20.0	20.0	54.5	36.4	9.1	56.3	31.3	12.5
Old	71.4	14.3	14.3	57.7	26.9	15.4	60.6	24.2	15.2
Sum	40.3	35.5	24.2	38.8	30.4	30.8	39.1	31.5	29.4

BOAT ANGLERS ONLY - Bass anglers

NUMBER	Residents				Non-residents				Grand total			
Lake	Good	Fair	Poor	Total	Good	Fair	Poor	Total	Good	Fair	Poor	Total
Big	0	4	5	9	8	10	11	29	8	14	16	38
Crane	0	0	0	0	2	1	6	9	2	1	6	9
Crooked	1	4	4	9	13	16	7	36	14	20	11	45
Goose	30	9	0	39	6	3	2	11	36	12	2	50
Loon	12	2	0	14	37	12	2	51	49	14	2	65
Old	0	0	3	3	7	1	0	8	7	1	3	11
Sum	43	19	12	74	73	43	28	144	116	62	40	218

PERCENT									
Lake	Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor
Big	0.0	44.4	55.6	27.6	34.5	37.9	21.1	36.8	42.1
Crane	0.0	0.0	0.0	22.2	11.1	66.7	22.2	11.1	66.7
Crooked	11.1	44.4	44.4	36.1	44.4	19.4	31.1	44.4	24.4
Goose	76.9	23.1	0.0	54.5	27.3	18.2	72.0	24.0	4.0
Loon	85.7	14.3	0.0	72.5	23.5	3.9	75.4	21.5	3.1
Old	0.0	0.0	100.0	87.5	12.5	0.0	63.6	9.1	27.3

Table 14. Water clarity (secchi depth) on various occasions at six UTRLA lakes in 2009.

Lake	Date	Depth (ft)
Big	6/9/09	11.0
Big	7/9/09	9.0
Big	7/13/09	5.5
Big	7/24/09	6.0
Big	7/28/09	5.3
Crane	6/1/09	3.0
Crane	7/9/09	2.5
Crooked	6/15/09	18.5
Crooked	7/9/09	15.0
Crooked	7/13/09	13
Crooked	7/24/09	9.8
Crooked	7/27/09	9.5
Goose	6/1/09	4.0
Goose	7/9/09	3.5
Loon	6/23/09	10.0
Loon	7/9/09	6.0
Loon	7/13/09	4.5
Loon	7/24/09	2.5
Loon	7/30/09	2.5
Old	6/8/09	5.5
Old	7/9/09	6.5

Table 15. Water temperatures (F) at various depths within six UTRLA lakes on two occasions in 2009. Shaded areas represent the top of the thermocline.

Temp	Big	Big	Crane	Crane	Crooked	Crooked	Goose	Goose	Loon	Loon	Old	Old
Depth (ft)	6/9/2009	7/9/2009	6/1/2009	7/9/2009	6/15/2009	7/9/2009	6/1/2009	7/9/2009	6/23/2009	7/9/2009	6/8/2009	7/9/2009
0	70.7	73.6	66.9	73.4	71.1	73.2	69.1	74.8	79.3	73.9	72.3	74.3
2	70.7	73.6	67.7	73.4	71.1	73.2	69.2	74.5	79.0	73.9	72.2	74.3
4	70.7	73.6	67.3	73.2	71.1	73.2	69.2	73.6	79.0	73.9	70.6	73.9
5	70.7	73.6	66.6	72.9	71.1	73.2		73.4	79.0	73.9		73.9
6	70.7	73.6	64.4	70.9	71.1	73.2	69.2	73.0	78.1	73.9	66.8	73.4
8	69.1	73.4	59.7	66.7	70.9	73.2	68.3	72.3	75.6	73.8	62.1	70.9
10	65.5	73.4	55.0	59.9	70.3	73.2	63.2	70.7	71.2	73.6	57.3	66.6
12	62.4	73.4	52.5	54.5	69.8	73.2	59.1	67.3	67.6	70.3	55.0	59.5
14	59.7	67.6	50.2	50.9	68.7	73.2	56.9	60.4	62.8	66.0	52.0	54.0
15	59.0	65.7	48.4	49.5	67.3	73.0		57.6	62.4	63.1		51.3
16	58.5	63.5	47.3	48.2	64.8	72.3	54.3	55.6	59.2	60.3	49.5	50.2
18	56.8	58.1	45.1	46.2	61.0	65.1	50.1	52.0	55.6	55.8	46.8	48.0
20	55.9	55.0	43.7	44.8	55.6	60.8	47.8	49.5	53.1	52.7	45.7	46.4
22	52.0	52.3	42.6	43.7	53.1	57.2	46.6	47.8	50.7	50.2		45.3
24	49.5	49.8	42.1	43.2	50.5	53.6	46.0	46.6	49.5	48.7		44.6
25	48.4	48.9	41.9	42.8	49.6	51.6		46.2	48.4	48.4		44.2
26	47.7	48.0	41.7	42.6	48.4	50.5	45.7	45.9	47.5	47.8		44.2
28	46.8	46.9	41.5	42.4	46.9	48.7	45.5	45.5	47.1	47.5		44.1
30	46.0	46.6	41.4	42.4	45.7	47.5	45.4	45.5	46.8	46.9		43.9
32	45.7	46.2	41.4	42.3	45.0	46.8		45.3	46.2	46.6		43.9
34	45.3	45.9			44.4	44.8		45.3	46.2	46.4		43.7
35	45.3	45.7			44.2	44.6		45.1	46.2	46.2		43.5
36	45.1	45.7			44.1	44.6		45.1	46.2	46.2		43.5
38	45.0	45.5			43.7	44.1		45.1	46.2	45.9	43.6	43.5
40	44.8	45.5			43.3	43.7		45.0	46.2	45.5		43.3
42												
44												
45	44.4	45.0			43.0	43.3		44.8		45.1		
46												
48												
50	44.1	44.6			42.6	43.0		44.8	46.2	44.6		
52												
54												
55		44.4			42.4	42.6		44.8		44.2		
56												
58												
60	43.9	44.2			42.3	42.4		44.4	46.0	43.7		
62												
64												
65		44.1			42.1	42.4				42.8		
66												
68												
70	43.9	43.9			42.1	42.3			46.0	42.3		
72												
74												
75					41.9	42.3				41.7		
76												
78												
80					41.9	42.1			46.0	41.4		
82												
84												
85					41.9	42.1				41.2		
86												
88												
90					41.9	41.9				41.0		
92												
94												
95					41.7	41.9						

Table 16. Dissolved oxygen concentrations (ppm) at various depths within six UTRLA lakes on two occasions in 2009. Dark shaded areas represent depths with ample oxygen (≥5 ppm). Light shaded areas represent depths with low oxygen levels (<5≥3 ppm). Non shaded area represent depths where insufficient oxygen is present for fish (<3 ppm).

Oxygen	Big	Big	Crane	Crane	Crooked	Crooked	Goose	Goose	Loon	Loon	Old	Old
Depth (ft)	6/9/2009	7/9/2009	6/1/2009	7/9/2009	6/15/2009	7/9/2009	6/1/2009	7/9/2009	6/23/2009	7/9/2009	6/8/2009	7/9/2009
0	5.7	9.6	10.8	9.5	9.8	9.8	8.8	10.3	7.3	10.6	8.1	10.0
2	5.6	9.5	13.0	16.4	9.8	9.8	9.6	10.2	7.3	10.6	9.3	10.0
4	6.4	9.6	11.6	16.2	9.8	9.8	9.8	10.2	7.3	10.6	9.6	10.0
5	6.4	9.5	10.5	13.1	9.8	9.8	9.8	10.3	7.3	10.5	9.8	10.0
6	6.3	9.4	9.7	10.6	9.8	9.8	9.8	10.0	7.1	10.5	9.8	9.9
8	5.6	9.4	0.5	0.9	9.8	9.7	5.6	9.7	6.8	10.4	2.0	9.3
10	4.1	0.5	0.3	0.7	9.5	9.7	4.6	6.8	6.3	10.0	1.6	8.5
12	3.7	0.3	0.2	0.5	8.2	9.6	2.0	0.7	6.5	5.6	0.8	2.8
14	3.6	1.6	0.2	0.3	6.3	9.6	1.1	0.4	1.1	0.8	0.1	0.7
15	3.4	0.6	0.1	0.4	6.5	9.5		0.3	0.6	0.6		0.4
16	3.4	0.4	0.1	0.6	6.6	9.1	0.8	0.3	0.6	0.6	0.0	0.3
18	2.4	0.3	0.1	0.2	6.6	11.6	1.0	0.2	0.2	0.5	0.0	0.3
20	2.5	0.3	0.1	0.1	7.1	12.4	1.3	0.2	0.3	0.4	0.0	0.3
22		0.2	0.1	0.2	7.0	11.2	1.2	0.2	0.5	0.4		0.3
24		0.1	0.0	0.1	6.7	10.2	1.2	0.1	0.4	0.4		0.2
25	3.2	0.2	0.0	0.1	6.3	8.7		0.1	0.3	0.3		0.2
26		0.1	0.0	0.0	5.7	6.9	1.0	0.1	0.2	0.3		0.2
28		0.1	0.0	0.0	4.9	5.1	0.8	0.1	0.3	0.3		0.2
30	3.0	0.1	0.0	0.0	4.5	5.4	0.4	0.1	0.3	0.3		0.1
32		0.0	0.0		4.2	4.8		0.1	0.8	0.3		0.1
34		0.1			4.5	4.6		0.0	0.8	0.8		0.2
35	2.8	0.1			4.6	4.6		0.0	0.8	0.4		0.2
36		0.1			4.7	4.6		0.0	0.3	0.5		0.1
38		0.1			4.9	5.1		0.0	0.3	0.5		0.1
40	2.5	0.0			5.1	5.3			0.0	0.2		0.0
42												
44												
45	1.1	0.0			5.1	5.4				0.2		
46												
48												
50	0.1	0.1			5.1	5.6			0.0	0.1		
52												
54												
56		0.0			5.2	5.6				0.1		
58												
60												
62	0.1	0.0			5.1	5.4			0.0	0.2		
64												
66												
68		0.0			4.8	5.1				0.1		
70												
72												
74	0.0				4.7	4.7			0.0	0.1		
76												
78												
80					4.2	3.9				0.1		
82												
84												
86					3.6	2.0			0.0	0.3		
88												
90												
92					3.0	0.8				0.2		
94												
					2.0	0.2				0.1		
					0.6	0.1						

Table 17. Submersed aquatic plant community parameters, species frequency of occurrence at sample sites, and species dominance at six UTRLA lakes in 2009.

Parameter	Big	Crane	Crooked	Goose	Loon	Old	Mean
Date:	7/28/09	7/28/09	7/27/09	7/28/09	7/30/09	7/28/09	
Number of sites:	60	30	60	40	60	30	
Sites with plants:	44	16	58	32	45	28	
Sites with native plants:	44	13	57	28	44	26	
Vegetated sites (%)	73.3	53.3	96.7	80.0	75.0	93.3	78.6
Number of species:	7	4	16	10	10	6	8.8
Number of native species:	7	2	14	8	9	4	7.3
Maximum species/site:	4	4	7	5	4	4	4.7
Mean species/site:	1.65	1.03	2.60	1.63	2.43	1.23	1.8
Standard error (ms/s):	0.18	0.23	0.20	0.20	0.17	0.14	0.2
Mean native species/site:	1.65	0.50	2.38	0.95	2.23	1.10	1.5
Standard error (mns/s):	0.18	0.12	0.19	0.15	0.15	0.13	0.2
Species diversity:	0.74	0.63	0.88	0.66	0.85	0.47	0.7
Native species diversity:	0.74	0.23	0.87	0.44	0.83	0.24	0.6

Occurrence	Big	Crane	Crooked	Goose	Loon	Old	Mean
Bladderwort			1.7				1.7
Brittle naiad					5.0		5.0
Chara	3.3		38.3		21.7		21.1
Common naiad	11.7		8.3	2.5	13.3		9.0
Coontail	55.0	43.3	55.0	70.0	30.0	86.7	56.7
Curly-leaf pondweed		10.0	1.7	5.0		3.3	5.0
Eel grass	46.7		28.3	2.5	50.0		26.9
Elodea	6.7		5.0	7.5		3.3	5.6
Eurasian water milfoil		43.3	20.0	62.5	16.7	20.0	32.5
Flat-stem pondweed		6.7	8.3	2.5	13.3		7.7
Illinois pondweed			3.3				3.3
Large-leaf pondweed	11.7		5.0		5.0		7.2
Leafy pondweed	20.0					3.3	11.7
Long-leaf pondweed			1.7	2.5			2.1
Northern water milfoil			31.7				31.7
Sago pondweed			10.0	2.5	18.3	6.7	9.4
Variable pondweed			20.0		6.7		13.3
Water stargrass			21.7	5.0			13.3
Filamentous algae	30.0	30.0	1.7	70.0	35.0	80.0	41.1

Dominance	Big	Crane	Crooked	Goose	Loon	Old	Mean
Bladderwort	0.0	0.0	1.0	0.0	0.0	0.0	0.2
Brittle naiad	0.0	0.0	0.0	0.0	1.0	0.0	0.2
Chara	2.0	0.0	27.0	0.0	5.7	0.0	5.8
Common naiad	3.0	0.0	2.3	0.5	5.3	0.0	1.9
Coontail	25.7	14.0	22.3	33.0	11.3	52.0	26.4
Curly-leaf pondweed	0.0	2.0	0.3	1.0	0.0	0.7	0.7
Eel grass	19.3	0.0	7.0	0.5	17.3	0.0	7.4
Elodea	2.0	0.0	1.7	1.5	0.0	0.7	1.0
Eurasian water milfoil	0.0	10.0	5.3	28.5	3.3	4.0	8.5
Flat-stem pondweed	0.0	1.3	2.3	0.5	2.7	0.0	1.1
Illinois pondweed	0.0	0.0	0.7	0.0	0.0	0.0	0.1
Large-leaf pondweed	3.0	0.0	1.7	0.0	1.0	0.0	0.9
Leafy pondweed	4.0	0.0	0.0	0.0	0.0	0.7	0.8
Long-leaf pondweed	0.0	0.0	0.3	0.5	0.0	0.0	0.1
Northern water milfoil	0.0	0.0	10.3	0.0	0.0	0.0	1.7
Sago pondweed	0.0	0.0	2.0	0.5	3.7	1.3	1.3
Variable pondweed	0.0	0.0	4.7	0.0	2.0	0.0	1.1
Water stargrass	0.0	0.0	5.0	1.0	0.0	0.0	1.0

Table 18. Coverage and extent of floating-leaf emergent plant beds at six UTRLA lakes in 2009.

EMERGENTS

Parameter	Big	Crane	Crooked	Goose	Loon	Old	Total
Coverage (acres)	16.25	4.67	31.62	13.09	8.95	3.21	77.79
Percent coverage	7.1	16.7	15.3	15.6	4.0	10.0	9.7
Plant edge (ft)	12251	4621	18067	7143	7637	3768	53487
Percent shoreline	48.7	74.8	80.5	80.5	31.8	68.6	58.1

Figure 1. The UTRLA lakes.

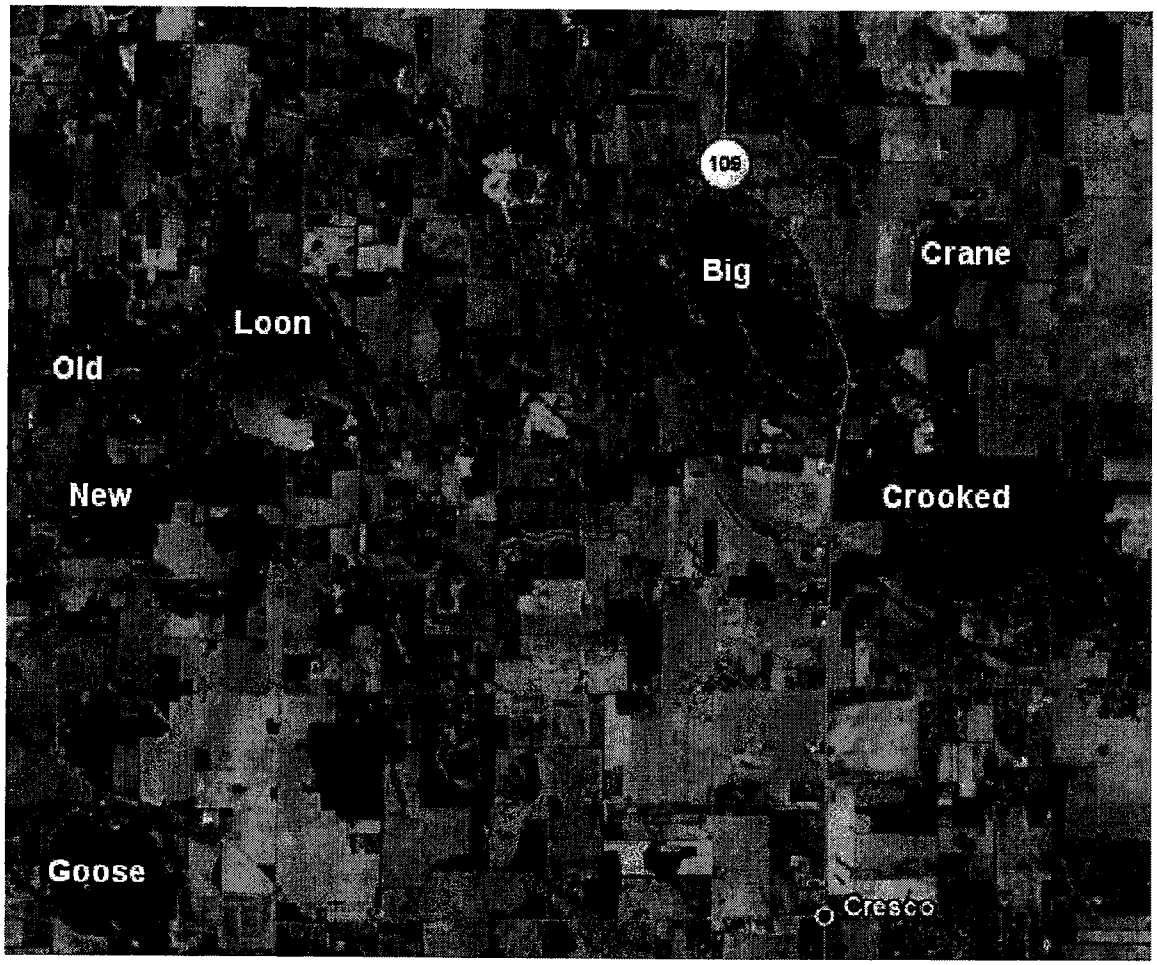


Figure 2. The UTRLA watershed (shaded area).

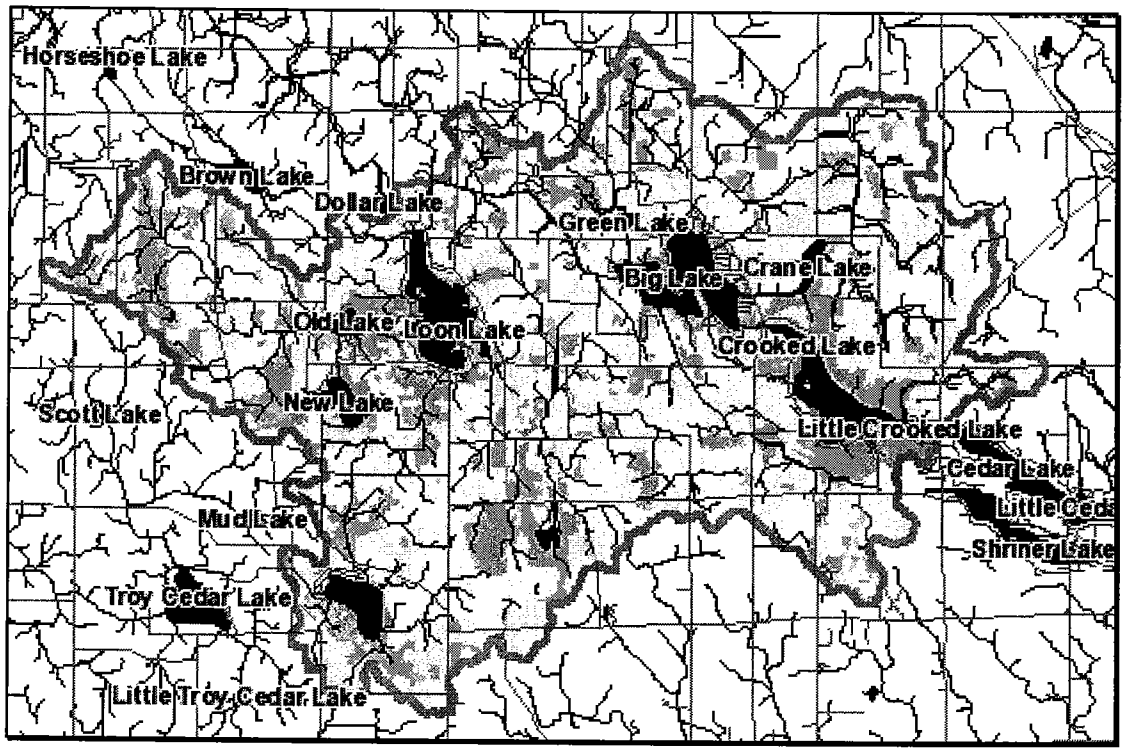
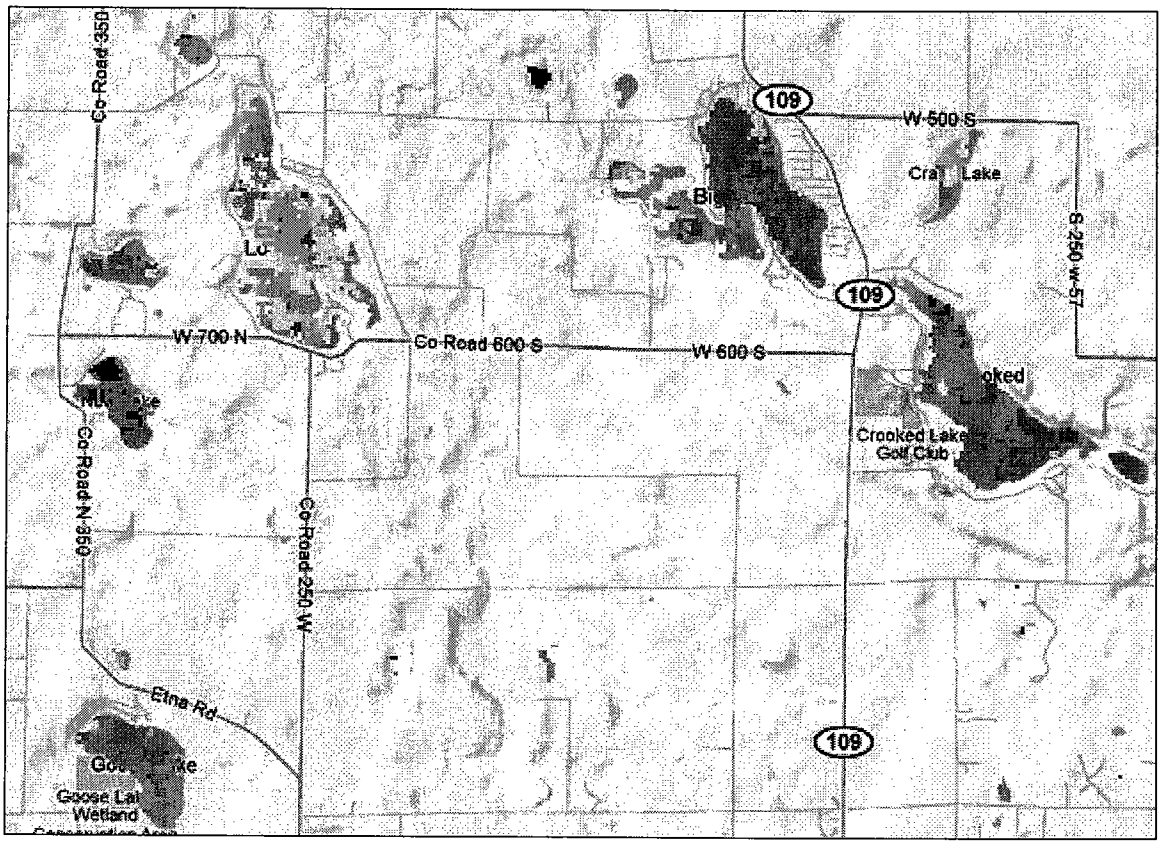


Figure 3. Water clarity in the UTRLA lakes.



Color scale – data from September 24, 2004 satellite (http://water.umn.edu/nalms/)

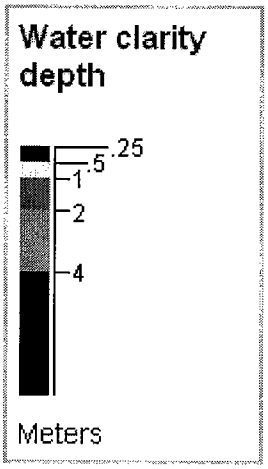
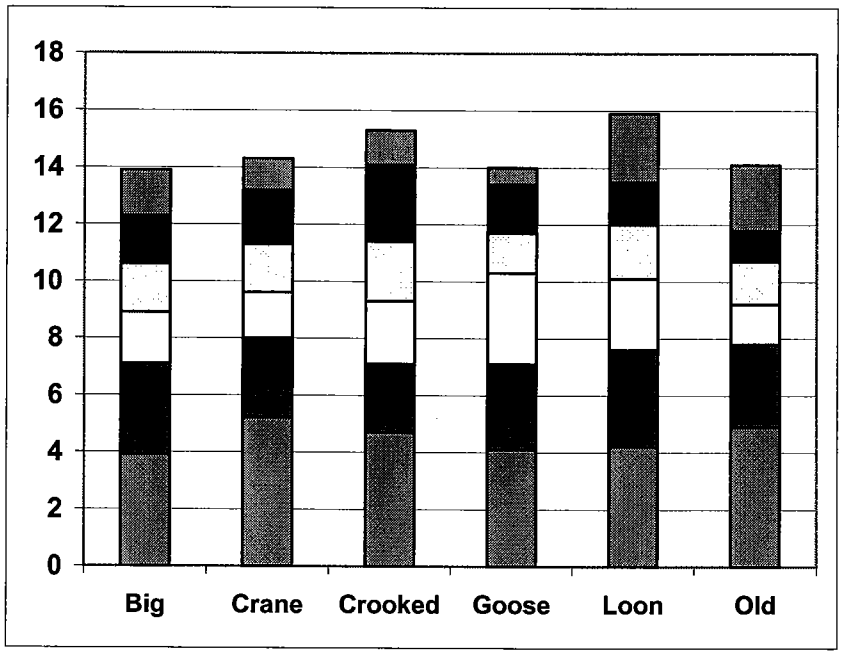


Figure 4. Back-calculated growth rates of largemouth bass and bluegills at six UTRLA lakes, based on scale samples taken in 2009. Shaded bars represented incremental growth increase in inches per year for age-1 through age-6.

Largemouth bass



Bluegills

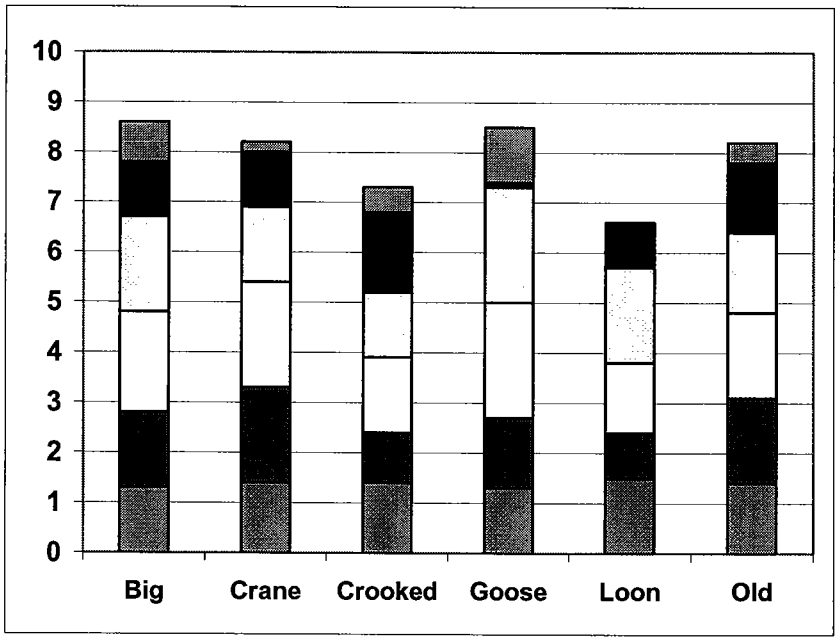


Figure 5. Summary of fish population and fishing quality parameters at six UTRLA lakes in 2009. Values in clear cells met the UTRLA management objectives, values in light gray cells exceeded the management objectives, and values in dark gray cells were below the management objectives.

Bluegill Population Objective	**Big**	**Crane**	**Crooked**	**Goose**	**Loon**	**Old**
Bluegill % (40-60)	47	59	58	54	80	54
Bluegill >=3-inch (160-400/hr)	297	205	275	539	193	219
Bluegill RSD7 (>=15%)	20	12	16	20	22	34
Bluegill RSD8 (>=4%)	9	5	5	9	10	18
Bluegill Fishing Objective						
Bluegill preference (>=40%)	53	52	50	54	36	68
Bluegill harvest (>=0.5/h/a/d)	0.07	0.38	0.18	0.38	0.06	0.25
Bluegill harvest (>=1/hr)	0.4	1.2	0.9	1.0	0.6	0.7
Bluegill CSD7 (>=50%)	77	89	81	89	38	77
Bluegill CSD8 (>=20%)	8	44	48	39	3	30
Bluegill rating (good>=50%)	13	14	27	57	56	61
Bass Population Objective						
Bass % (10-25)	28	19	8	12	8	14
Bass >=8-inch (80-140/hr)	305	294	117	156	192	223
Bass RSD14 (>=25%)	2	5	25	19	9	5
Bass RSD18 (>=8%)	1	1	2	4	1	2
Bass Fishing Objective						
Bass preference (>=30%)	33	21	35	32	51	29
Bass catch (>=1/hr)	1.4	0.4	0.7	0.9	1.0	0.8
Bass CSD18 (>=10%)	0	0	0	0	22	10
Bass rating (good>=50%)	21	22	31	72	75	64
Other Objective						
Fishing Effort (>=0.5/hr/ac/d)	0.32	0.60	0.39	0.72	0.61	0.58
Perch/crappie % (5-10)	4	3	6	7	2	2
Cisco netting (>=2/lift)			4.6			
Cisco harvest (>=500)			NA			
Muskie trapping (>=4/lift)						
Muskie preference (>=5%)					6	
Muskie catch (>=1/30 hrs)					1/21	
Muskie rating (fair/good>=50%)					100	

APPENDIX

1. Upper Tippecanoe River Lake Association Fish Management Plan Strategies

Fishing regulations and enforcement

Fish management began with enactment of laws in the 1880s to limit over-harvest. Since then regulations have evolved to maximize public benefits without unduly restricting public rights. Regulating actions of individual anglers to ensure the rights of all anglers is the fundamental role of conservation officers. No special fishing regulations are currently in effect at UTRLA lakes.

Strategies:

1. Support changes in bluegill fishing regulations to reduce over-harvest where necessary.

2. Support changes in largemouth bass regulations to improve size structure as needed.

3. Support a larger minimum size limit on muskies to increase quality if appropriate.

4.Evaluate the need to adopt rules to manage fishing tournaments to reduce bass mortality.

Information and education:

Without informed anglers, UTRLA and the DFW cannot expect to obtain compliance with fishing regulations, other rules, or gain public understanding of management actions and priorities. Marketing local fishing opportunities also help to garner public backing needed to overcome problems and provides local economic and social benefits.

Strategies:

5. Encourage tournament organizers to use immediate release practices or weigh-in sites where habitat conditions are favorable.

6. Emphasize through media the limited role stockings play in managing native fish species and the importance of fishing rules.

7. Involve residents in muskie stocking activities to increase knowledge of the program.

8. Host fishing demonstrations to encourage fishing and improve success.

9. Coordinate a "youth fishing day" with other organizations and the Go-Fishin' program.

10. Publish survey results on the Tippecanoe Watershed Foundation and DFW websites, in newsletters, and press releases.

11. Create and distribute a CD of fish and fish management activities.

12. Post highly-visible boating speed limit signs at Big, Crooked and Loon access sites.

13. Install no-wake buoys near the boat ramp at Loon Lake.

Surveys, data needs, and evaluations:

Misguided fishing regulations and other ineffective programs have been undertaken in the past due to gaps in scientific knowledge and lack of data to make sound decisions. Tracking trends in fish populations allows UTRLA and the DFW to address problems on a local level and examine criteria by which management success is measured. Gaining understanding of the dynamics of fish populations through application of new technology and testing new theories can also improve management programs and fishing. Current data for most UTRLA lakes is not available, nor is information on the potential differences in perceptions of fishing quality between lake residents and lake visitors.

Strategies:

14. Conduct targeted sampling for bass and bluegills, standard fish population surveys, and angler creel surveys in 2009 for baseline comparisons (note- New Lake excluded due to limited public access).

15. Monitor the cisco population each fall at Crooked Lake.

16. Conduct studies to determine the need for and benefits of alternative bluegill, bass, and muskie size and/or daily catch limits.

17. Determine the diet composition of muskies and bass to define their predatory role.

18. *Investigate and address habitat limitations on fish populations.*

19.Explore innovative and experimental management approaches to achieve objectives.

Habitat protection and enhancement:

Good habitat is a basic requirement to support the life functions of reproduction, survival, and growth of fish. Threats to habitat must be regulated to ensure the production and maintenance of balanced fish populations. Preservation of existing high-quality habitat and restoration of damaged habitat provides the necessary setting for fish to flourish. Because the primary mission of ULTRA is to protect water quality, overall strategies that address water quality are likely to benefit fish, fish habitat, and fishing. More effort is needed to link habitat management with fish and fishing.

Strategies:

20. *Create a weed management program that balances needs of multiple lakes users with emphasis on reducing non-native species.*

21. *Promote practices to reduce nutrient loading from all watershed residents.*

22. *Promote the development of regulations to control funneling and lakeshore development.*

23. *Protect natural shorelines, inlets and outlets, and other areas from erosion.*

24. Seek compliance to all existing rules on lakeshore and lakebed habitat alterations.

25. Host an "inspection/compliance field day" to identify and address issues involving outstanding permit violations.

26. Support a DFW policy of no new habitat alterations, except for special circumstances, to protect cisco habitat at Crooked Lake.

27. Restore native emergent plant beds to increase the amount and diversity of habitat.

28. Experimentally plant low-height emergent and wetland plants along residential shorelines.

29. Install a rock fish attractor between the islands at Loon Lake.

30. Establish targets for habitat features (clarity, oxygen, plants) with emphasis on clarity at Crane and Loon lakes.

31. Provide fish samples to the Indiana Department of Environmental Management for testing of contaminant levels.

Invasive fish species and fish population control:

Fishermen and other lake users can alter the distribution and abundance of fish, as well as contribute to the spread of fish diseases and parasites. Habitat alterations and activities associated with fishing (boating, bait use) create opportunities for expansion of non-native species which further degrade habitat and disrupt fish balance. Unbalanced populations of native species can also reduce fishing quality and block achievement of

management objectives. Carp, gizzard shad, and northern pike post the most immediate threat to UTRLA lakes. Spawning carp concentrations have been observed in tributary ditches. Shad are present in downstream lakes in the Tippecanoe watershed. Pike were netted at Crooked Lake in 2008 and may feed on ciscoes.

Strategies:

32. Locate and reduce potential areas of carp concentration and reproduction.
33. Support efforts to prevent the introduction of gizzard shad.
34. Restore balance to fish populations with fish toxicants if appropriate.

Stocking:

Stocking native fish in lakes where they currently reproduce is seldom justified. However, where suitable niches are available, stocking non-native fish can enhance fishing opportunities. To be successful, stockings must be purposeful, popular, economical, and not adversely affect native species. In rare cases, stocking non-native predator fish may improve fishing quality for native fish, although stocking muskies failed to improve bluegill fishing at Loon Lake. Whether stocking other predators can improve fishing in some UTRLA lakes is unknown. Although the committee expressed support to stock walleyes, most members did not favor stocking trout, pike, sauger, or smallmouth bass. If stocked into Crooked Lake each could have possible adverse effects on ciscoes. Trout cannot survive in any other UTRLA lake. Pike are similar to muskies but do not get as large or interest many anglers. Smallmouth bass are generally unavailable from public and private hatcheries and would likely compete with largemouth bass.

Strategies:

35. *Continue to stock 1,110 muskie annually in Loon Lake that are available from state fish hatcheries to enhance fishing diversity.*
36. Support local efforts to stock walleyes in selected lakes that are purchased from private sources to enhance fishing diversity.

Grant application, funding, and administration:

Because fish are public resources held in trust for all citizens, public funds from the sale of fishing licenses and excise taxes on fishing equipment are needed to manage them. These funds are administered through various grant programs within DNR. Fishing groups and individuals can also provide direct financial support. All citizens benefit indirectly from good natural resource stewardship and should also be expected to share in the cost of management efforts.

Strategies:

37. Primarily rely on DFW funds to manage UTRLA fish populations.
38. When budget shortfalls arise, supplement DFW funding of fish management programs with local funds and volunteer support.
39. Promote the sale of fishing licenses to non-anglers to recover more federal dollars for lake and fish management programs.
40. Seek grants from other public and private sources, including the Lake and River enhancement Program, to manage fish habitat.
41. Periodically review progress toward achieving objectives and make appropriate adjustments in objectives and strategies as warranted through public consensus.

2. Historical number of fish collected at fish population surveys at UTRLA lakes.

NUMBER SPECIES	Big 1987	Big 2000	Big 2009	Crane 1990	Crane 1998	Crane 2008	Crane 2009	Crooked 1987	Crooked 2000	Crooked 2009	Goose 2001	Goose 2009	Loon 1988	Loon 2000	Loon 2004	Loon 2009	New 1995	Old 1988	Old 2002	Old 2009	Grand Total
Black bullhead																	1				1
Black crappie	1	8	6	11	35	11	14				12	89	31	154	203	16	23		3	5	622
Blackchin shiner											1										1
Bluegill	196	534	531	61	253	22	264	239	347	610	878	711	694	1243	1819	836	706	189	305	236	10674
Bluntnose minnow								2	19	11			2	4							38
Bowfin	6	9	5	4	4			5	2	1	7	1	2	8	3	2		1	3	2	65
Brook silverside		13	6					7	1	40		3	3	1	2	18	2				96
Brown bullhead	24	4	3	9	7	3	3	3	10	8	5	2	2	22	8	5	58	8	3	6	193
Carp		1	6		1	2					2	1	2	11	9	3		1	2	7	48
Channel catfish	1			27	10										3						41
Cisco									3	23											26
Fathead minnow			1													3					4
Golden shiner	2	3	1	35	22	15	15	1	2		28	17	6	9	1	5	6	7	8	2	185
Grass pickerel	2				1			13		9	1		1				48	3			78
Green sunfish				1				2	1	4							2				10
Hybrid sunfish				1	2			1			1			5					11	2	23
Lake chubsucker	9	4	7	14	14		8	18	13	34	38		37	5	4	1	7	13		1	227
Largemouth bass	135	359	314	108	103	44	84	143	130	79	178	152	154	288	77	86	154	93	44	63	2788
Logperch			1																		1
Longnose gar								3	3	1											7
Muskellunge													9	2	2			2			15
Northern pike		1														2					3
Pumpkinseed	12	7	10	8	8		1	14	13	12	8	3	58	41	3	1		6	3	2	210
Rainbow trout								5													5
Redear	20	29	55	6	31	69	31	79	76	77	209	194	40	109	119	20	277	43	91	59	1634
Rock bass								13	21	16											50
Smallmouth bass													1								1
Spotted gar	18	32	61		5	1	18	5	12	13	36		8	20	21	18	3	5	4	18	298
Spotted sucker		4			2									3	1				1	3	14
Tadpole madtom																	1				1
Warmouth	9	15	28	17	17	7	6	32	8	13	15	13	23	10	5	6	53	15		9	301
White bass			1																		1
White sucker	13	9	7	1	6		2										1		2		41
Yellow bullhead	20	4	31	8	12	14	3	3	4	36	18	37	44	23	25	9	26	9	8	15	349
Yellow perch	49	51	46	48	7	3	1	32	30	57	313	93	134	82	53	11	83	3	7	7	1110
GRAND TOTAL	517	1087	1120	359	540	191	450	620	695	1044	1750	1316	1251	2040	2358	1042	1451	398	495	437	19161
Species	16	18	19	16	19	11	13	20	18	18	17	13	19	19	18	17	17	15	15	16	35
Native species	15	16	17	14	16	10	13	18	18	18	15	12	16	16	15	15	17	13	13	14	27
Sport fish	467	1012	1025	305	485	173	407	566	643	935	1637	1294	1190	1979	2317	992	1383	368	475	404	18057
SAMPLING EFFORT																					
Electrofishing hrs	1	1	1	0.67	0.5	0.5	0.5	1	1	1	0.75	0.75	0.75	1	0.75	1	1	0.7	0.5	0.5	15.87
Gill net lifts	6	8	8	6	4	4	4	6	8	8	4	6	8	8	8	8	6	5	4	4	123
Trap net lifts	8	4	4	4	4	4	4	8	4	4	6	3	8	4	4	4	6	8	3	2	96

3. Historical relative fish species composition by percentage at UTRLA lakes.

PERCENT SPECIES	Big 1987	Big 2000	Big 2009	Crane 1990	Crane 1998	Crane 2008	Crane 2009	Crooked 1987	Crooked 2000	Crooked 2009	Goose 2001	Goose 2009	Loon 1988	Loon 2000	Loon 2004	Loon 2009	New 1995	Old 1988	Old 2002	Old 2009	Mean
Black bullhead																	0.1				0.0
Black crappie	0.2	0.7	0.5	3.1	6.5	5.8	3.1				0.7	6.8	2.5	7.5	8.6	1.5	1.6		0.6	1.1	3.2
Blackchin shiner											0.1										0.0
Bluegill	37.9	49.1	47.4	17.0	46.9	11.5	58.7	38.5	49.9	58.4	50.2	54.0	55.5	60.9	77.1	80.2	48.7	47.5	61.6	54.0	55.7
Bluntnose minnow								0.3	2.7	1.1			0.2	0.2							0.2
Bowfin	1.2	0.8	0.4	1.1	0.7			0.8	0.3	0.1	0.4	0.1	0.2	0.4	0.1	0.2		0.3	0.6	0.5	0.3
Brook silverside		1.2	0.5					1.1	0.1	3.8		0.2	0.2		0.1	1.7	0.1				0.5
Brown bullhead	4.6	0.4	0.3	2.5	1.3	1.6	0.7	0.5	1.4	0.8	0.3	0.2	0.2	1.1	0.3	0.5	4.0	2.0	0.6	1.4	1.0
Carp		0.1	0.5		0.2	1.0					0.1	0.1	0.2	0.5	0.4	0.3		0.3	0.4	1.6	0.3
Channel catfish	0.2			7.5	1.9										0.1						0.2
Cisco									0.4	2.2											0.1
Fathead minnow			0.1													0.3					0.0
Golden shiner	0.4	0.3	0.1	9.7	4.1	7.9	3.3	0.2	0.3		1.6	1.3	0.5	0.4		0.5	0.4	1.8	1.6	0.5	1.0
Grass pickerel	0.4				0.2			2.1		0.9	0.1		0.1				3.3	0.8			0.4
Green sunfish				0.3	0.0			0.3	0.1	0.4							0.1				0.1
Hybrid sunfish				0.3	0.4			0.2			0.1			0.2					2.2	0.5	0.1
Lake chubsucker	1.7	0.4	0.6	3.9	2.6		1.8	2.9	1.9	3.3	2.2		3.0	0.2	0.2	0.1	0.5	3.3		0.2	1.2
Largemouth bass	26.1	33.0	28.0	30.1	19.1	23.0	18.7	23.1	18.7	7.6	10.2	11.6	12.3	14.1	3.3	8.3	10.6	23.4	8.9	14.4	14.6
Logperch			0.1																		0.0
Longnose gar								0.5	0.4	0.1											0.0
Muskellunge													0.7	0.1	0.1			0.5			0.1
Northern pike		0.1														0.2					0.0
Pumpkinseed	2.3	0.6	0.9	2.2	1.5		0.2	2.3	1.9	1.1	0.5	0.2	4.6	2.0	0.1	0.1		1.5	0.6	0.5	1.1
Rainbow trout								0.8													0.0
Redear	3.9	2.7	4.9	1.7	5.7	36.1	6.9	12.7	10.9	7.4	11.9	14.7	3.2	5.3	5.0	1.9	19.1	10.8	18.4	13.5	8.5
Rock bass								2.1	3.0	1.5											0.3
Smallmouth bass													0.1								0.0
Spotted gar	3.5	2.9	5.4		0.9	0.5	4.0	0.8	1.7	1.2	2.1		0.6	1.0	0.9	1.7	0.2	1.3	0.8	4.1	1.6
Spotted sucker		0.4			0.4									0.1					0.2	0.7	0.1
Tadpole madtom																	0.1				0.0
Warmouth	1.7	1.4	2.5	4.7	3.1	3.7	1.3	5.2	1.2	1.2	0.9	1.0	1.8	0.5	0.2	0.6	3.7	3.8		2.1	1.6
White bass			0.1																		0.0
White sucker	2.5	0.8	0.6	0.3	1.1		0.4										0.1		0.4		0.2
Yellow bullhead	3.9	0.4	2.8	2.2	2.2	7.3	0.7	0.5	0.6	3.4	1.0	2.8	3.5	1.1	1.1	0.9	1.8	2.3	1.6	3.4	1.8
Yellow perch	9.5	4.7	4.1	13.4	1.3	1.6	0.2	5.2	4.3	5.5	17.9	7.1	10.7	4.0	2.2	1.1	5.7	0.8	1.4	1.6	5.8
Sport fish percent	90.3	93.1	91.5	85.0	89.8	90.6	90.4	91.3	92.5	89.6	93.5	98.3	95.1	97.0	98.3	95.2	95.3	92.5	96.0	92.4	94.2
SAMPLING EFFORT																					
Electrofishing hrs	1.0	1.0	1.0	0.7	0.5	0.5	0.5	1.0	1.0	1.0	0.8	0.8	0.8	1.0	0.8	1.0	1.0	0.7	0.5	0.5	15.9
Gill net lifts	6.0	8.0	8.0	6.0	4.0	4.0	4.0	6.0	8.0	8.0	4.0	6.0	8.0	8.0	8.0	8.0	6.0	5.0	4.0	4.0	123.0
Trap net lifts	8.0	4.0	4.0	4.0	4.0	4.0	4.0	8.0	4.0	4.0	6.0	3.0	8.0	4.0	4.0	4.0	6.0	8.0	3.0	2.0	96.0

4. Historical electrofishing catches and size structure of bluegills at the UTRLA lakes.

SIZE STRUCTURE	Big	Big	Big	Big	Crane	Crane	Crane	Crane	Crooked	Crooked	Crooked	Goose	Goose	Loon	Loon	Loon	Loon	New	Old	Old	Old	Old	Grand
Bluegill (EF only)	1987	1990	2000	2009	1990	1998	2008	2009	1987	2000	2009	2001	2009	1988	2000	2004	2009	1995	1988	1995	2002	2009	Mean
<2.8 inch	6	28	44	94	5	21	0	44	26	56	80	29	78	57	302	26	43	752	30	1014	39	19	
2.8-5.7 inch	75	581	252	295	34	40	11	136	65	105	300	292	420	344	368	1402	143	749	44	176	32	106	
5.8-6.7 inch	24	157	50	59	7	13	3	45	5	11	45	31	127	53	61	89	83	78	38	24	14	38	
6.8-7.7 inch	32	13	27	50	3	47	4	14	3	4	46	19	71	7	20	8	64	26	8	32	30	35	
>=7.8 inch	3	1	13	41	1	16	4	10	1	2	21	4	63	0	2	0	0	0	3	20	35	40	
RSD6	44.0	22.7	26.3	33.7	24.4	65.5	50.0	33.7	12.2	13.9	27.2	15.6	38.3	14.9	18.4	6.5	50.7	12.2	52.7	30.2	71.2	51.6	31.6
RSD7	26.1	1.9	11.7	20.4	8.9	54.3	36.4	11.7	5.4	4.9	16.3	6.6	19.7	1.7	4.9	0.5	22.1	3.0	11.8	20.6	58.6	34.2	16.6
RSD8	2.2	0.1	3.8	9.2	2.2	13.8	18.2	4.9	1.4	1.6	5.1	1.2	9.3	0.0	0.4	0.0	0.0	0.0	3.2	7.9	31.5	18.3	5.5
EF seconds	3600	1800	3600	5400	2400	1800	1800	3600	2700	3600	5400	2700	4549	1800	3600	2700	5400	6076	2520	4974	1800	3600	3428
Catch/15-min																							
2.8-5.7 inch	18.8	290.5	63.0	49.2	12.8	20.0	5.5	34.0	21.7	26.3	50.0	97.3	83.1	172.0	92.0	467.3	23.8	110.9	15.7	31.8	16.0	26.5	81.0
5.8-6.7 inch	6.0	78.5	12.5	9.8	2.6	6.5	1.5	11.3	1.7	2.8	7.5	10.3	25.1	26.5	15.3	29.7	13.8	11.6	13.6	4.3	7.0	9.5	14.2
6.8-7.7 inch	8.0	6.5	6.8	8.3	1.1	23.5	2.0	3.5	1.0	1.0	7.7	6.3	14.0	3.5	5.0	2.7	10.7	3.9	2.9	5.8	15.0	8.8	6.6
>=7.8 inch	0.8	0.5	3.3	6.8	0.4	8.0	2.0	2.5	0.3	0.5	3.5	1.3	12.5	0.0	0.5	0.0	0.0	0.0	1.1	3.6	17.5	10.0	3.1
Total/15-min	33.5	376.0	85.5	74.2	16.9	58.0	11.0	51.3	24.7	30.5	68.7	115.3	134.7	202.0	112.8	499.7	48.3	126.3	33.2	45.6	55.5	54.8	104.9

5. Historical electrofishing catches and size structure of largemouth bass at UTRLA lakes.

SIZE STRUCTURE	Big	Big	Big	Big	Crane	Crane	Crane	Crane	Crooked	Crooked	Crooked	Goose	Goose	Loon	Loon	Loon	Loon	New	Old	Old	Old	Old	Grand
Bass	1987	1990	2000	2009	1990	1998	2008	2009	1987	2000	2009	2001	2009	1988	2000	2004	2009	1995	1988	1995	2002	2009	Mean
<7.8 inch	38		67	64	22	16	9	7	97	17	12	73	42	46	108	38	18	68	11	30	5	16	
7.7-11.7 inch	84		181	189	70	59	29	48	33	89	30	79	37	97	107	23	38	57	58	35	16	36	
11.8-13.7 inch	6		93	45	8	23	6	21	8	19	22	13	49	5	41	6	20	23	12	3	13	5	
13.8-17.7 inch	3		8	2	7	4	3	3	5	4	10	13	14	5	27	10	5	5	10	2	8	2	
>=17.8 inch	1		0	3	1	1	0	2	0	1	1	0	4	1	5	0	2	1	2	2	3	0	
RSD14	4.3		2.8	2.1	9.3	5.7	7.9	6.8	10.9	4.4	17.5	12.4	17.3	5.6	17.8	25.6	10.8	7.0	14.6	9.5	27.5	4.7	11.0
RSD18	1.1		0.0	1.3	1.2	1.1	0.0	2.7	0.0	0.9	1.6	0.0	3.8	0.9	2.8	0.0	3.1	1.2	2.4	4.8	7.5	0.0	1.8
EF seconds	3600		3600	3600	2400	1800	1800	1800	3600	3600	3600	2700	4549	2700	3600	2700	3600	3600	2520	2520	1800	1800	
Catch/15-min																							
7.7-11.7 inch	21.0		45.3	47.3	26.3	29.5	14.5	24.0	8.3	22.3	7.5	26.3	7.3	32.3	26.8	7.7	9.5	14.3	20.7	12.5	8.0	18.0	20.6
11.8-13.7 inch	1.5		23.3	11.3	3.0	11.5	3.0	10.5	2.0	4.8	5.5	4.3	9.7	1.7	10.3	2.0	5.0	5.8	4.3	1.1	6.5	2.5	6.3
13.8-17.7 inch	0.8		2.0	0.5	2.6	2.0	1.5	1.5	1.3	1.0	2.5	4.3	2.8	1.7	6.8	3.3	1.3	1.3	3.6	0.7	4.0	1.0	2.3
>=17.8 inch	0.3		0.0	0.8	0.4	0.5	0.0	1.0	0.0	0.3	0.3	0.0	0.8	0.3	1.3	0.0	0.5	0.3	0.7	0.7	1.5	0.0	0.5
Total/15-min	23.5		70.5	59.8	32.3	43.5	19.0	37.0	11.5	28.3	15.8	35.0	20.6	36.0	45.0	13.0	16.3	21.5	29.3	15.0	20.0	21.5	29.6
Catch/hour																							
7.7-11.7 inch	84.0	0.0	181.0	189.0	105.0	118.0	58.0	96.0	33.0	89.0	30.0	105.3	29.3	129.3	107.0	30.7	38.0	57.0	82.9	50.0	32.0	72.0	78.3
11.8-13.7 inch	6.0	0.0	93.0	45.0	12.0	46.0	12.0	42.0	8.0	19.0	22.0	17.3	38.8	6.7	41.0	8.0	20.0	23.0	17.1	4.3	26.0	10.0	24.2
13.8-17.7 inch	3.0	0.0	8.0	2.0	10.5	8.0	6.0	6.0	5.0	4.0	10.0	17.3	11.1	6.7	27.0	13.3	5.0	5.0	14.3	2.9	16.0	4.0	8.6
>=17.8 inch	1.0	0.0	0.0	3.0	1.5	2.0	0.0	4.0	0.0	1.0	1.0	0.0	3.2	1.3	5.0	0.0	2.0	1.0	2.9	2.9	6.0	0.0	1.8
Total/hour	94	0	282	239	129	174	76	148	46	113	63	140	82.3	144	180	52	65	86	117	60	80	86	112.9
All bass	135		359	314	108	103	44	84	143	130	79	178	152	154	288	77	86	154	93		44	63	143.4
Total/hour	135		359	314	161.2	206	88	168	143	130	79	237.3	202.7	205.3	288	102.7	86	154	133		88	126	172.6

SPRING

ELECTROFISHING	Big	Big	Big	Big	Crane	Crane	Crane	Crane	Crooked	Crooked	Crooked	Goose	Goose	Loon	Loon	Loon	Loon	New	Old	Old	Old	Old	
Catch/hour	1987	1990	1996	2009	1981	1990	1998	2009	1987	2000	2009	2001	2009	1988	2000	2004	2009	1995	1991	1995	2002	2009	Mean
7.7-11.7 inch		50.3	123.3	213.0	38.0	148.6	120.3	202.8			48.5		64.7			50.0	116.5	75.1	93.1	115.6	92.2	188.4	108.8
11.8-13.7 inch		29.9	30.9	86.0	8.7	25.2	51.1	76.5			40.0		62.5			20.6	58.9	33.7	4.2	33.8	54.6	24.5	40.1
13.8-17.7 inch		37.9	14.8	4.8	3.7	33.2	10.8	12.0			26.4		22.3			39.3	15.2	15.8	4.6	11.7	31.6	6.7	18.2
>=17.8 inch		2.8	3.0	1.5	3.8	1.3	2.3	2.3			2.3		6.6			3.5	1.7	7.6	5.5	5.3	3.0	3.7	3.5
Total		120.9	172.0	305.3	54.2	208.3	184.5	293.5			117.2		156.0			113.4	192.3	132.2	107.4	166.4	181.4	223.2	167.0
	Big				Crane				Crooked			Goose		Loon				New	Old					
Catch/15-min																							
7.7-11.7 inch		12.6	30.8	53.3	9.5	37.2	30.1	50.7			12.1		16.2			12.5	29.1	18.8	23.3	28.9	23.1	47.1	27.2
11.8-13.7 inch		7.5	7.7	21.5	2.2	6.3	12.8	19.1			10.0		15.6			5.2	14.7	8.4	1.1	8.5	13.7	6.1	10.0
13.8-17.7 inch		9.5	3.7	1.2	0.9	8.3	2.7	3.0			6.6		5.6			9.8	3.8	4.0	1.2	2.9	7.9	1.7	4.5
>=17.8 inch		0.7	0.8	0.4	1.0	0.3	0.6	0.6			0.6		1.6			0.9	0.4	1.9	1.4	1.3	0.8	0.9	0.9
Total/15-min		30.2	43.0	76.3	13.6	52.1	46.1	73.4			29.3		39.0			28.4	48.1	33.1	26.9	41.6	45.4	55.8	41.7
Number/acre																							
7.7-11.7 inch					11.8	35.7	11.9				5.8					5.9		11.9	14.6	16.6	10.9	10.9	13.9
11.8-13.7 inch					2.8	5.8	5.0				4.7					2.4		5.5	0.7	4.8	6.5	6.5	4.2
13.8-17.7 inch					1.4	8.0	1.1				3.2					4.5		2.4	0.8	1.7	3.7	3.7	3.0
>=17.8 inch					1.1	0.5	0.3				0.3					0.4		1.2	0.9	0.8	0.3	0.3	0.6
Total/acre					17.1	50.0	18.3				14.0					13.2		21.0	17.0	23.9	21.4	21.4	21.8
RSD14		33.7	10.3	2.0	13.8	16.6	7.1	4.9			24.5		18.5			37.7	8.8	17.7	9.4	10.2	19.1	4.6	15.6
RSD18		2.3	1.7	0.5	7.0	0.6	1.2	0.8			2.0		4.2			3.1	0.9	5.7	5.1	3.2	1.7	1.7	2.7

6. Historical angler creel surveys results at UTRLA lakes.

CREEL SURVEYS	Big	Crane	Crane	Crooked	Crooked	Goose	Loon	Loon	Loon	Old	Old
PRESSURE	2009	1990	2009	1980	2009	2009	1983	2004	2009	2002	2009
Acres	228	28	28	206	206	84	222	222	222	32	32
Fishing hours	8331	4604	1909	15726	9071	6866	17566	14476	7770	2302	2106
Days surveyed	114	86	114	155	114	114	139	206	114	108	114
Fishing hrs/d	73.08	53.53	16.75	101.46	79.57	60.23	126.37	70.27	68.16	21.31	18.47
Fishing hrs/ac	36.54	164.43	68.18	76.30	44.03	81.74	79.10	65.20	35.00	71.90	65.81
Fishing hrs/ac/d	0.32	1.91	0.60	0.49	0.39	0.72	0.57	0.32	0.31	0.67	0.58
Bluegill preference	52.8	47.0	52.4	56.0	49.7	54.3	57.0	26.0	35.7	44.0	67.7
Bass preference	32.8	28.0	21.4	15.0	34.7	31.5	17.0	36.0	50.6	22.0	29.0
Crappie preferece	4.0	2.0	16.7		3.4	14.1		13.0	7.1	6.0	3.2
Muskie preference								12.0	6.0		
Trout preference				17.0							
FISH HARVEST											
Bluegill harvest	1791	969	1204	4346	4229	3650	14856	2573	1599	1538	921
Bass harvest	43	58	11	407	75	116	682	264	94	14	0
Bass releases	5351	842	279	na	2350	1711	326	4864	5315	307	668
Bass catch	5394	900	290		2425	1827	1008	5128	5409	321	668
Crappie harvest	579	7	13	50	0	273	282	1686	103	100	55
Perch harvest	0	0	13		362	53	28	140	242	6	0
Muskie harvest		0		0			0	9	11	0	0
FISH SIZE											
Bluegill size	2009	1990	2009	1980	2009	2009	2000	2004	2009	2002	2009
2.8-5.7 inch	13	17	0	936	36	0	1827	522	0	145	0
5.8-6.7 inch	418	241	134	1293	809	415	3703	1360	990	301	211
6.8-7.7 inch	1037	571	536	1361	1360	1825	5270	640	569	501	432
>=7.8 inch	323	140	535	756	2023	1409	4056	51	39	591	277
BGharvestRSD7	76.5	74.7	88.9	62.1	80.7	88.6	71.6	33.7	38.0	78.4	77.1
BGharvestRSD8	18.2	14.7	44.4	22.2	48.3	38.6	31.1	2.5	2.4	42.4	30.1
Bass size											
<7.8 inch	0	0	0	0	0	0	12	0	0	0	0
7.7-11.7 inch	0	0	0	311	0	0	280	0	0	0	0
11.8-13.7 inch	0	10	0	80	0	0	316	0	0	5	0
13.8-17.7 inch	43	48	11	16	75	116	74	256	73	9	0
>=17.8 inch	0	0	0	0	0	0	0	8	21	0	0
LMBharvestRSD18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	22.3	0.0	0.0