

Indiana Largemouth Bass Strategic Plan 2018-2023



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Cover photo: Division of Fish and Wildlife Biologist Steven Gratz holds a Largemouth Bass collected from Little Long Lake (Noble Co.) during a 2017 Status and Trends Survey.

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MANAGEMENT HISTORY

The Largemouth Bass (*Micropterus salmoides*) is an ecologically tolerant sportfish that inhabits nearly all waterbody types including swamps, ponds, lakes, reservoirs, streams and rivers. The native range of Largemouth Bass includes the Great Lakes basin, Mississippi River basin from southern Quebec to Minnesota and south to the Gulf of Mexico, Atlantic Slope from North Carolina to Florida and the Gulf Slope from southern Florida into northern Mexico. However, Largemouth Bass have been widely introduced outside of this range as a result of its popularity as a sportfish. In Indiana, Largemouth Bass have been so widely introduced that they are presumed to be present in virtually every glacial lake, reservoir, pond and river in the state. However, this document focuses on Largemouth Bass in glacial lakes and reservoirs.

Adult Largemouth Bass primarily feed on crustaceans and fishes. Individuals inhabiting cold lakes may live to age-16, but generally do not exceed age-10. Indiana Largemouth Bass typically grow 3 to 4-inches per year for the first 3 years, then 1 to 2-inches per year through age-8, and less than 1-inch per year after age-8. Long-term data collected on Largemouth Bass in Indiana indicates that fish from natural lakes attain quality-size (12-inches) by age-4, preferred-size (15-inches) by age-5, and memorable-size (20-inches) by age-9. Largemouth Bass in southern Indiana reservoirs grow quicker, attaining quality-size by age-3, preferred-size by age-5, and, memorable-size by age-7. The state record Largemouth Bass is 14 pounds, 12 ounces and was caught in Seven Spring Lake in Harrison County in 1991.

Largemouth Bass are a critical component of the fish community in waterbodies throughout the state and are a commonly used predatory management tool to provide quality fishing opportunities for panfish. Therefore, Largemouth Bass are regularly stocked in Indiana waterbodies to reestablish or rebalance fish communities. Since 2012, approximately 367,000 Largemouth Bass fingerlings (4.3-inches) have been stocked in 34 waterbodies across 22 counties. In the spring of 2016 Lake Waveland (Montgomery Co.) was stocked with 22,000 Largemouth Bass fingerlings (4.5-inches) as part of a Gizzard Shad management strategy¹. One of the largest stocking efforts in recent years took place at West Boggs Lake (Martin Co.) in 2014 as part of a total fishery renovation of the reservoir². West Boggs Lake was stocked with approximately 104,400 fingerlings (6.4-inches) between October and November of 2014.

Largemouth Bass were initially regulated in Indiana with a daily bag limit of 6 fish (aggregate of Smallmouth Bass, Largemouth Bass, or Silver Bass), a minimum size limit of 10-inches, and a closed season from May 1st through June 15th (1935-1936). From 1961-current there has been no closed season on Largemouth Bass fishing and all bag limits have applied to a single bass species or aggregate of bass species. A bag limit of 6 fish and no minimum size limit was in effect from 1961 through 1990, with the exception of a 14-inch minimum size limit on waterbodies located on state owned property beginning in 1973. The daily bag limit of 6 fish remained from 1991-1998, however size limits varied by waterbody. While size limits for many individual waterbodies began in 1991 the remainder of the state had a 14-inch minimum size limit south of State Road 28 and a 12-inch minimum size limit north of State Road 28. The daily bag limit was reduced to 5 fish with

¹ Long, C. 2007. Lake Waveland 2005 Fish Management Report. Indiana Division of Fish and Wildlife. 11 pp.

² Kittaka, D.S. 2016. West Boggs Creek Lake Daviess and Martin Counties 2014 Lake Renovation Summary. Indiana Division of Fish and Wildlife. 26pp.

a minimum size limit of 14-inches (lakes) and 12-inches (rivers) from 1999-2012. Starting in 2005 a daily bag limit of 3 fish was put in place on black bass in Lake Michigan (2005-2017). The daily bag limit of 5 fish with a minimum size limit of 14-inches (lakes) has remained in effect since 1999. However, the implementation of a 12 to 15-inch slot limit and a daily bag limit of 5 fish (no more than 2 over 15-inches) on all black bass in rivers and streams has been in place since 2013. There are also a select group of special regulations on Largemouth Bass currently in place at waterbodies requiring specialized management strategies. Special minimum size limits (associated bag limit) that have been used include: no minimum size (5), 15-inches (5), 16-inches (5), 18-inches (2), and 20-inches (1). Slot limits have been limited to a 12 to 15-inch protected slot and an experimental 10 to 14-inch harvest slot³, both of which were used to facilitate harvest of small, overabundant bass. The Ohio River has a Largemouth Bass minimum size limit of 12-inches with an aggregate black bass bag limit of 6 (Table 1).

Table 1. Historical statewide Largemouth Bass minimum size limit and bag limit regulations.

Year	Minimum Size Limit	Bag Limit
1935-1936	10-inches	6
1961-1990	None	6
1991-1998	12-inches N of SR 28 14-inches S of SR 28	6
1999-2012	12-inches (Rivers)	5
2013-Current	12 to 15-inch slot(Rivers/Streams)*	5 (no more than 2 over 15-inches)
1999-Current	14-inches (Lakes)	5

*Refers to Black Bass

POPULATION STATUS

Ninety-three glacial lakes have been surveyed from 2010-2017 by biologists as part of the Status and Trends project designed to describe landscape-level variation in fish communities and aquatic habitats. The Status and Trends probability of detection rate for Largemouth Bass is 99%, demonstrating that the species is ubiquitous in northern Indiana glacial lakes⁴. A total of 4,946 Largemouth Bass have been collected across these 93 glacial lakes since 2010, resulting in an average (interquartile range) catch rate of 46-112 Largemouth Bass ($\geq$ stock; 8+ inches) per hour of nighttime electrofishing (Table 2). On average (interquartile range) Largemouth Bass represent 10-21% of the fish community by number in glacial lakes. Twenty-one percent of Largemouth Bass are less than stock size (8-inches), while 48%, 24%, 6%, and 1% are stock (8-12 inches), quality (12-15 inches), preferred (15-20 inches), and memorable (20-25 inches) sizes, respectively. Fourteen percent of captured Largemouth Bass ($\geq$ stock size) are $\geq$ 14-inches in total length.

³ Pearson, J. 2016. Impacts of a temporary harvest slot limit on Largemouth Bass in Indiana natural Lakes. Indiana Division of Fish and Wildlife. 4 pp.

⁴ Donabauer, S. 2014. Status and trends of Indiana glacial lake fish communities 1986-2014 spatial and temporal variation of species specific detection probabilities. Indiana Division of Fish and Wildlife. 142pp.

Standardized sampling among 32 reservoirs began in 2016 where biologists have collected over 1,900 Largemouth Bass. The average (interquartile range) catch rate is 53-106 Largemouth Bass ($\geq$ stock) per hour of nighttime electrofishing (Table 2). During these surveys less than stock, stock, quality, preferred, and memorable size Largemouth Bass have represented 31%, 43%, 17%, 9%, and 1% of reservoir populations, respectively. Twenty-one percent of captured Largemouth Bass ($\geq$ stock size) are $\geq$ 14-inches in total length.

Table 2. Catch-per-unit-effort (N/hr) of Largemouth Bass by proportional size distribution group at glacial lakes during June 2010-2017 surveys and May 2016-2017 reservoir surveys. Proportional size distribution groups include stock (8-12 inches), quality (12-15 inches), preferred (15-20 inches), and memorable (20-25 inches).

Resource Type	Quartiles	Total CPUE $\geq$ Stock	N/hr					
			<Stock	Stock	Quality	Preferred	Memorable	$\geq$ 14.0"
Glacial Lakes	1 st Quartile	46	6	24	10	0	0	2
	Median	68	20	42	20	2	0	6
	3 rd Quartile	112	34	73	32	8	0	16
Reservoirs	1st Quartile	53	8	18	9	2	0	6
	Median	80	20	39	18	6	0	10
	3rd Quartile	106	48	65	32	14	2	24

ANGLER STATUS

Largemouth Bass have consistently ranked in the top 5 sportfish sought by Indiana anglers. Anglers participating in the 2017 statewide licensed angler survey ranked Largemouth Bass as one of their top three fished for species in 51% of responses⁵. As one of the most popular sportfish in the state, Largemouth Bass fishing in Indiana generates an estimated \$147 million of annual economic activity (Appendix A). Largemouth Bass provide approximately 105,000 anglers with 4,591,000 angler-days. While Largemouth Bass are highly sought after throughout the state there are areas of greater angler preference for the species where unique angling opportunities exist⁶.

Property rules (e.g., permits, bonding, reporting) to manage Largemouth Bass tournaments on large reservoirs were put in place in the 1970s due to the rise in tournament popularity, access-user conflicts, and mortality concerns. In 1999, summer tournaments were banned at all reservoirs except Monroe, which shifted more events to already over-crowded and unregulated glacial lakes. At that time no statutory authority existed to manage tournaments on lakes. In response to recommendations by a DFW Tournament Advisory Committee and the Indiana Lakes Management Work Group, reservoir limits were relaxed and changes were made to allow local communities to petition the Natural Resources Commission (NRC) to set lake-specific rules on tournament and group activities at glacial lakes (312 IAC 5-3.5). Since then only Wawasee, Syracuse, and Sylvan have gone through the NRC public hearing process for approval. Therefore,

⁵ Responsive Management. 2017. Indiana anglers' fishing participation and their opinions on fishing management issues. Responsive Management National Office. 228 pp.

⁶ Pearson, J., R. Edgell, N. Thomas. 2009. Current status of fish populations and Fishing in the Upper Tippecanoe Lake Area. Division of Fish and Wildlife. 61pp.

Largemouth Bass fishing tournaments with fifteen (15) or more participants on Indiana public waters (Brookville, Hardy, Cagles Mill, Mississinewa, Monroe, Patoka, Raccoon, Salamonie, Sylvan, Syracuse, or Wawasee) are required to apply for fishing tournament permits⁷. Monitoring of permitted Largemouth Bass fishing tournaments demonstrates the continued popularity of Largemouth Bass with 39,697 anglers participating in 778 tournaments from 2011-2015⁸. Furthermore, Largemouth Bass tournaments not requiring permits are also rather popular among anglers⁹.

Similarly, creel surveys at 24 glacial lakes and 19 reservoirs demonstrate that Largemouth Bass are a highly sought after sportfish in Indiana with an average (interquartile range) angler preference of 26-47% among glacial lakes and 27-44% among reservoirs (Table 3 and 4, respectively). The average (interquartile range) catch rate for anglers targeting Largemouth Bass at glacial lakes is 0.7-1.5 Largemouth Bass per angler hour and 0.4-1.5 Largemouth Bass per angler hour at reservoirs (Table 3 and 4, respectively). Approximately 20% of the Largemouth Bass caught by anglers from waterbodies under the current statewide regulation are ≥ 14.0 -inches. Despite the statewide 14.0-inch minimum size limit on Largemouth Bass, 2% of harvested Largemouth Bass are < 14.0 -inches. Sixty percent of surveyed licensed anglers targeting Largemouth Bass rated fishing as “good”, while 29%, 8%, and 2% rated fishing as “fair”, “poor”, and “don’t know”, respectively. Twelve percent of surveyed licensed anglers targeting Largemouth Bass also indicated that fishing had “improved”, while 50%, 25%, and 13%, indicated that fishing had “declined”, “stayed the same”, and “did not know”, respectively¹⁰.

Table 3. Largemouth Bass angler preference, pressure, and catch rates based on 24 glacial lake creel surveys conducted from 2015-2017.¹¹

	Preference (%) ^{1,2}	Hours/100acres/day ^{1,3}	LMB/angler hour ^{1,4}
1 st Quartile	26	3.1	0.7
Median	40	8.6	1.1
3 rd Quartile	47	23.5	1.5
	¹ Boat anglers only ² Largemouth Bass mentioned alone or in combination of all respondents and not individuals. ³ Multiplying the estimated angler hours for the entire creel survey by the species preference divided by the total number of days covered in the creel survey divided by the acreage and multiplied by 100. ⁴ Total catch (harvest and release) divided by estimated Largemouth Bass hours		

⁷ Changes in largemouth bass populations associated with minimum size limits at Indiana natural lakes. Indiana Division of Fish and Wildlife. 96pp.

⁸ Munter, R. 2017. Statewide black bass tournament monitoring 2015. Indiana Division of Fish and Wildlife. 15pp.

⁹ Pearson, J. 2012. Largemouth bass tournament monitoring at Indiana natural lakes. Indiana Division of Fish and Wildlife. 16pp.

¹⁰ Responsive Management. 2017. Indiana anglers' fishing participation and their opinions on fishing management issues. Responsive Management National Office. 228 pp

¹¹ Linn, M. 2017. 2017 Status and Trends Creel Summary. Indiana Division of Fish and Wildlife. 3pp.

Table 4. Largemouth Bass angler preference, pressure, and catch rates based on 19 reservoir creel surveys conducted from 2008-2017.

	Preference (%) ^{1,2}	Hours/100acres/day ^{1,3}	LMB/angler hour ^{1,4}
1 st Quartile	27	2.0	0.4
Median	33	7.0	1.0
3 rd Quartile	44	11.1	1.5
	¹ Two-stage non-uniform probability or roving access study designs ² Largemouth Bass mentioned alone or in combination of all respondents and not individuals. ³ Expansion factors were applied to the daily observations totals for each observed category to provide projections of monthly lake-wide fishing pressure and harvest. The total estimated angler effort was divided by the acreage, multiplied by 100, divided by the number of days in the creel survey. ⁴ Total catch (harvest and release) divided by estimated Largemouth Bass hours		

An analysis of Largemouth Bass entries for Fish of the Year and Record Fish programs further demonstrates the popularity of the species among anglers. Since 1963 there have been 104 Largemouth Bass entered into the Fish of the Year program and five for the Record Fish program. The majority of Largemouth Bass entries were caught from ponds (65%), followed by reservoirs (17%), glacial lakes (15%), and rivers (3%). Sixty-three percent of entries were memorable (20-25 inches) size followed by trophy (>25-inches, 29%) and preferred (15-20 inches, 9%) size. The popularity of the Fish of the Year and Record Fish programs among Largemouth Bass anglers has steadily increased. From 1963 through 1999 there was an average of 1 entries per year (N=42), compared to 3 per year (N=34) from 2000 through 2009 and 5 per year (N=33) from 2010 through 2016.

PROGRAM ANALYSIS

Largemouth Bass are common and distributed throughout Indiana with ample angling opportunities statewide. Since 2010, the DFW has detected Largemouth Bass in 99% of northern glacial lake surveys, totaling approximately 40,000 acres. Angling opportunities for Largemouth Bass also exist at 142 reservoirs and 179 strip pits totaling approximately 45,000 acres. There are also 67 rivers scattered throughout the state where Largemouth Bass are commonly found. In 2016, the DFW spent \$655,323 to supply fishable Largemouth Bass waters throughout the state. Largemouth Bass anglers account for 23% of all anglers, which generates \$1,146,831 of the annual revenue to the DFW. Therefore, the current Largemouth Bass supply:demand ratio is 0.57:1, which is near the 0.50:1 target established by the DFW to sustain native sport fishing opportunities. Thus, the statewide supply of Largemouth Bass is meeting angler demand. Nevertheless, local improvements to catch rates and size distribution among Largemouth Bass populations are desirable.

The implementation of 14-inch minimum size limits is believed to have successfully increased the number of sublegal-size (8-14 inches) Largemouth Bass in Indiana lakes¹². However, general and targeted surveys continually exhibit a high degree of variability in catch rate and size distribution among Indiana Largemouth Bass populations. Since 2010, eleven percent of the glacial lakes surveyed had below average catch rates of Largemouth Bass $\geq$ stock size (<46 per hour) and $\geq$ quality size (<16 per hour). However, fifteen percent of the glacial lakes surveyed had above average catch rates of Largemouth Bass $\geq$ stock size (>112 per hour) and $\geq$ quality size (>40 per hour). Nineteen percent of reservoirs surveyed had below average catch rates of Largemouth Bass $\geq$ stock size (<53 per hour) and $\geq$ quality size (<15 per hour). Lastly, six percent of reservoirs surveyed had above average catch rates of Largemouth Bass $\geq$ stock size (>106 per hour) and $\geq$ quality size (>42 per hour) (Tables 5 and 6). Thus, quality Largemouth Bass angling opportunities are certainly available; however, there are also considerable opportunities to improve Largemouth Bass populations.

Table 5. Percentage of glacial lakes and reservoirs from May and June Status and Trends surveys that have catch rates of Largemouth Bass $\geq$ stock size and $\geq$ quality size that are below average or catch rates of Largemouth Bass $\geq$ stock size and $\geq$ quality size that are above average.

Resource Type	Below Average	Above Average
Glacial Lakes	11%	15%
Reservoirs	19%	6%

Table 6. Catch rate standards for above and below average catch rates for glacial lakes and reservoirs from May and June Status and Trends surveys.

		Glacial Lakes	Reservoirs
Above Average	Total catch ($\geq$ Stock)	>112 /hour	>106 /hour
	Catch of $\geq$ Quality	>40 /hour	>42 /hour
Below Average	Total catch ($\geq$ Stock)	<46 /hour	<53 /hour
	Catch of $\geq$ Quality	<16 /hour	<15 /hour

While considerable opportunities to make improvements to catch rates and size distributions exist, the underlying problems producing undesirable population demographics are highly variable at the statewide scale. The primary factors typically limiting Largemouth Bass populations at the statewide scale include habitat, angling pressure, and/or water quality. While water quality is certainly essential, the majority of glacial lakes and reservoirs contain water quality sufficient for Largemouth Bass. There is however, a far greater degree of variability in both habitat and angling pressure among resources influencing Largemouth Bass population demographics.

Emergent and submerged vegetation is the primary form of habitat in glacial lakes and reservoirs. Vegetation surveys at 91 glacial lakes since 2010 and 27 reservoirs since 2016 indicate that median littoral zone submerged vegetation coverages are 78% and 54%, respectively. Emergent vegetation surveys have only been completed on a handful glacial lakes since 2004 and therefore, far less is

12 Pearson, J. 2008. Changes in largemouth bass populations associated with minimum size limits at Indiana natural lakes. Indiana Division of Fish and Wildlife. 96pp.

known about emergent vegetation communities of glacial lakes and reservoirs. For the majority of glacial lakes submerged vegetation provides adequate structural habitat for Largemouth Bass and other fishes. Therefore, glacial lake habitat efforts should focus on an improved understanding of emergent vegetation communities and continued preservation of diverse native submerged vegetation communities. While reservoir vegetation communities certainly provide habitat, littoral coverages are typically lower than glacial lakes. In 2016, the DFW initiated the Reservoir Habitat Enhancement Program to enhance habitat in reservoirs with limited vegetated habitat through the addition of artificial structures. The DFW should continue to use this program to work in partnership with stakeholders to address in-lake habitat, shoreline habitat, and shoreline erosion concerns in reservoirs.

Angling pressure and harvest of Largemouth Bass can also have a considerable influence on population demographics. However, the response of Largemouth Bass population demographics to angling pressure and harvest is highly variable. Therefore, locally and regionally prescribed regulation changes are most likely to achieve their intended objectives. Before individual resource regulation changes deviating from the statewide regulation are considered sufficient justification should be provided, describing how the proposed regulation change aides in the successful completion of statewide Largemouth Bass goals and objectives. Potential regulation change options should also be thoroughly reviewed, taking into consideration the risk of unintended sportfish population responses, regulation simplicity, angler support, and enforcement capability.

Only by viewing Largemouth Bass populations at the appropriate spatial and temporal scale can the variability among Indiana's populations be fully understood. An improved understanding of the variability among Indiana's Largemouth Bass populations at the appropriate scale is a necessary prerequisite for developing applied management strategies that can aid in the statewide enhancement of Largemouth Bass populations. To address statewide Largemouth Bass population deficiencies the DFW should continue to assess glacial lakes, reservoirs, and other waterbodies using standardized surveys designed to describe long-term regional trends in Largemouth Bass populations. Standardized annual surveys will provide the DFW the ability to detect changes to Largemouth Bass populations at a scale appropriate for guiding statewide management strategies, while also providing the context needed to select local resources in need of supplementary management.

STRATEGIC PLAN

Population Goal: Supply quality Largemouth Bass populations statewide.

Objective: Among glacial lakes maintain a median Largemouth Bass CPUE $\geq$ stock size (hour/June nighttime electrofishing) of no less than 68, including a median CPUE (hour/June nighttime electrofishing) of no less than 26 Largemouth Bass $\geq$ quality size, and a median CPUE of no less than 4 $\geq$ preferred size by 2028.

Among reservoirs maintain a median Largemouth Bass CPUE $\geq$ stock size (hour/May-June nighttime electrofishing) of no less than 80, including a median CPUE (hour/May-June nighttime electrofishing) of no less than 24 Largemouth Bass $\geq$ quality size and no less than 6 $\geq$ preferred size by 2028.

- **Problem:** Resource characteristics may limit our ability to make improvements to Largemouth Bass populations.
- **Strategies:**
 1. Develop criteria for the selection of resources likely to respond positively to Largemouth Bass management techniques.
 2. Modify existing angling regulations, vegetation management, habitat management, and stockings where possible to maintain balanced Largemouth Bass populations.

Objective: By 2028, decrease the proportion of glacial lakes and reservoirs that are below average for total CPUE $\geq$ stock size (glacial lakes <46 ; reservoirs <53) and also below average for CPUE of $\geq$ quality size (glacial lakes <16 ; reservoirs <15) Largemouth Bass to 6% and 14%, respectively.

By 2028, increase the proportion of glacial lakes and reservoirs that are above average for total CPUE $\geq$ stock size (glacial lakes >112 ; reservoirs >106) and also above average for CPUE of $\geq$ preferred size (glacial lakes >8 ; reservoirs >18) to 10%.

- **Problem:** Biological and jurisdictional barriers may limit the DFW's ability to apply desired management techniques.
- **Strategies:**
 3. Work in partnership with resource stakeholders to develop solutions to historical barriers to successful Largemouth Bass management.
- **Problem:** No criteria exists to identify resources with exceptional Largemouth Bass fishing potential.
- **Strategies:**
 4. Use available fish community, habitat, and creel surveys to identify resource characteristics that have the potential to produce exceptional Largemouth Bass populations.

Human Dimensions Goal: Provide Largemouth Bass populations that produce quality fishing opportunities.

Objective: Ensure that at least 60%, 29%, and no more than 8% of Largemouth Bass anglers consider fishing "good", "fair", and "poor", respectively.

- **Problem:** The frequency of licensed angler surveys limits the ability to accurately measure Largemouth Bass angler satisfaction in the desired timeframe.
- **Strategies:**
 - 5. Increase the frequency at which targeted licensed angler surveys are conducted to align with strategic planning objectives.
- **Problem:** The licensed angler survey question pertaining to species preferences introduces uncertainty.
- **Strategies:**
 - 6. Modify licensed angler survey questions pertaining to species preference to more accurately quantify species preference.

Objective: Maintain a median Largemouth Bass catch rate among Largemouth Bass anglers of no less than 1.0/angler hour, with at least 22% of Largemouth Bass being ≥ 14.0 -inches and at least 2% being ≥ 18.0 -inches.

- **Problem:** There is currently no statewide creel survey program in place capable of providing unbiased evaluations of angler metrics for naturally reproducing sportfish at the statewide scale.
- **Strategies:**
 - 7. Develop and implement a statewide creel survey program and lake sampling schedule designed to evaluate naturally reproducing sportfish angler metrics.

Objective: Attain a median tournament angler catch rate of ≥ 18.0 -inch Largemouth Bass equal to or greater than 0.021 Largemouth Bass per angler hour.

- **Problem:** Tournament data does not currently provide sufficient information to accurately track the desired tournament angler the catch rate metrics.
- **Strategies:**
 - 8. Encourage tournaments to collect data required to track the angler catch rates.
 - 9. Implement internal monitoring at tournaments where data gaps exist.

Objective: Recruit, retain, or reactivate a sufficient number of licensed Largemouth Bass anglers to maintain a Largemouth Bass supply:demand ratio between 0.4-6:1.

- **Problem:** The current marketing strategy (social media, website content, R3 events) does not recruit, retain, or reactivate an adequate number of anglers.
- **Strategies:**
 - 10. Create Largemouth Bass fishing materials that promote Largemouth Bass management and explain how anglers are part of management (Largemouth Bass fishing hot spot maps, articles in fishing magazines, and Facebook posts promoting Largemouth Bass fishing and management).
 - 11. Work with partners to engage new anglers in Largemouth Bass fishing through R3 programing.
 - 12. Develop and implement a long-term adaptive marketing strategy that effectively promotes Indiana Largemouth Bass angling opportunities.
 - 13. Fully implement strategies described in the DFW R3 Strategic Plan.

Habitat Goal: Protect, restore, and enhance habitat that promotes quality Largemouth Bass populations.

Objective: Ensure that the median littoral zone submergent vegetation coverage for glacial lakes is no less than 78% and reservoirs is no less than 54%.

- **Problem:** Submergent vegetation coverage estimates are often calculated using different methods.
- **Strategies:**
 - 14. Standardize methods for calculating submerged vegetation coverage estimates derived from Tier II Aquatic Vegetation Surveys and regularly provide staff training for field survey methods.

Objective: Determine the relative influence of emergent vegetation, submersed vegetation and woody material abundance on Indiana Largemouth Bass population demographics.

- **Problem:** Information on the amount of emergent vegetation among Indiana glacial lakes and reservoirs is currently lacking.
- **Strategies:**
 - 15. Utilize existing standard survey protocols to quantify emergent vegetation in glacial lakes and reservoirs¹³.
- **Problem:** Indiana lacks data to show the level of aquatic habitat needed to achieve Largemouth Bass population objectives.
- **Strategies:**
 - 16. Determine the minimum and maximum structural habitat requirements (vegetation, woody material, and artificial structure) necessary to maintain resource stability and achieve sportfish population objectives.

Objective: Protect and enhance Largemouth Bass habitat including in-lake, shoreline, and watershed level.

- **Problem:** Various watershed management practices can lead to excessive nutrient, sediment, and contaminant runoff that damages water quality and threatens existing warmwater habitat.
 - 17. Work with partners to promote best management practices through the Lake and River Enhancement Program, soil and water conservation agencies, watershed groups, and other non-governmental organizations.
 - 18. Work with partners to ensure compliance with permit requirements to protect warmwater habitat.

¹³ IDNR. 2015. Emergent Vegetation Survey Protocol. Indiana Division of Fish and Wildlife. 18pp.

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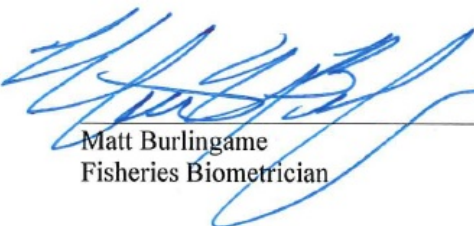
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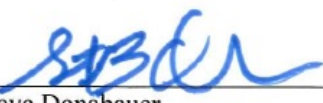
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PRIORITIZED STRATEGIES

Priority Ranking	Strategy #	Strategy
1	6	Modify licensed angler survey questions pertaining to species preference to more accurately quantify species preference.
2	14	Standardize methods for calculating submerged vegetation coverage estimates derived from Tier II Aquatic Vegetation Surveys and regularly provide staff training for field survey methods.
3	5	Increase the frequency at which targeted licensed angler surveys are conducted to align with strategic planning objectives.
4	10	Create Largemouth Bass fishing materials that promote Largemouth Bass management and explain how anglers are part of management (Largemouth Bass fishing hot spot maps, articles in fishing magazines, and Facebook posts promoting Largemouth Bass fishing and management).
5	4	Use available fish community, habitat, and creel surveys to identify resource characteristics that have the potential to produce exceptional Largemouth Bass populations.
6	8	Encourage tournaments to collect data required to track the angler catch rates.
7	15	Utilize existing standard survey protocols to quantify emergent vegetation in glacial lakes and reservoirs.
8	7	Develop and implement a statewide creel survey program and lake sampling schedule designed to evaluate naturally reproducing sportfish angler metrics.
9	2	Modify existing angling regulations, vegetation management, habitat management, and stockings where possible to maintain balanced Largemouth Bass populations.
10	13	Fully implement strategies described in the DFW R3 Strategic Plan.
11	1	Develop criteria for the selection of resources likely to respond positively to Largemouth Bass management techniques.
12	9	Implement internal monitoring at tournaments where data gaps exist.
13	11	Work with partners to engage new anglers in Largemouth Bass fishing through R3 programing.
14	3	Work in partnership with resource stakeholders to develop solutions to historical barriers to successful Largemouth Bass management.
15	17	Work with partners to promote best management practices through the Lake and River Enhancement Program, soil and water conservation agencies, watershed groups, and other non-governmental organizations.
16	12	Develop and implement a long-term adaptive marketing strategy that effectively promotes Indiana Largemouth Bass angling opportunities.
17	18	Work with partners to ensure compliance with permit requirements to protect warmwater habitat.

Priority Ranking	Strategy #	Strategy
18	16	Determine the minimum and maximum structural habitat requirements (vegetation, woody material, and artificial structure) necessary to maintain resource stability and achieve sportfish population objectives.

PROGRAM ACTIONS (2015-present)

2015

- **Priority 5 - Strategy 4:** Fish community surveys were completed for status and trends on 17 glacial lakes, totaling 2,105 acres; spring targeted Largemouth Bass surveys were completed on 8 glacial lakes, totaling 2,175 acres.
- **Priority 8 - Strategy 7:** Creel surveys were completed on 8 glacial lakes and 2 reservoirs, totaling 21,238 acres.
- **Priority 18 - Strategy 16:** Tier II vegetation and hydroacoustics surveys were completed for status and trends on 17 glacial lakes, totaling 2,105 acres.

2016

- **Priority 5 - Strategy 4:** Fish community surveys were completed for status and trends on 17 glacial lakes and 17 reservoirs, totaling 8,866 acres; spring targeted Largemouth Bass surveys were completed on 8 glacial lakes, totaling 1,920 acres.
- **Priority 8 - Strategy 7:** Creel surveys were completed on 8 glacial lakes and 2 reservoirs, totaling 1,948 acres.
- **Priority 18 - Strategy 16:** Tier II vegetation and hydroacoustics surveys were completed for status and trends on 17 glacial lakes, totaling 2,342 acres; Tier II vegetation and hydroacoustics surveys were completed for status and trends on 17 reservoirs, totaling 6,524 acres. Hydroacoustics surveys were completed on 14 reservoirs, totaling 956 acres; the DFW introduced the Reservoir Habitat Enhancement Program. In 2016, 135 artificial structures (Georgia cubes, porcupine cribs, porcupine crib juniors, and black bass nesting structures) were placed in Sullivan Lake (Sullivan Co.).

2017

- **Priority 5 - Strategy 4:** Fish community surveys were completed for status and trends on 16 glacial lakes and 16 reservoirs, totaling 8,927 acres; spring targeted Largemouth Bass surveys were completed on 8 glacial lakes, totaling 3,231 acres.
- **Priority 8 - Strategy 7:** Creel surveys were completed for on 8 glacial lakes and 3 reservoirs, totaling 5,259 acres.
- **Priority 18 - Strategy 16:** Tier II vegetation and hydroacoustics surveys were completed for status and trends on 16 glacial lakes and 16 reservoirs, totaling 8,927 acres; 300 artificial structures (rock piles, porcupine cribs, porcupine crib juniors, and Moss Back structures) were placed in Cecil M. Harden Lake (Parke Co.).

2018

- **Priority 4 - Strategy 10:** Release of a Wild Bulletin article in May promoting Largemouth Bass angling.
- **Priority 5 - Strategy 4:** Fish community surveys were completed for status and trends on 17 glacial lakes and 16 reservoirs, totaling 7,226 acres; spring targeted Largemouth Bass surveys were completed on 8 glacial lakes, totaling 3,203 acres.
- **Priority 8 - Strategy 7:** Creel surveys were completed on 8 glacial lakes and 2 reservoirs, totaling 3,671 acres.
- **Priority 18 - Strategy 16:** Tier II vegetation and hydroacoustics surveys were completed for status and trends on 17 glacial lakes, totaling 3,535 acres; Tier II vegetation surveys were completed for status and trends on 16 reservoirs, totaling 3,691 acres. Hydroacoustics surveys were completed on 14 reservoirs, totaling 1,050 acres; 240 artificial structures (crib structures, porcupine crib juniors and Hoosier cubes) were placed in Monroe Reservoir (Monroe Co.).

SUMMARY REPORTS (2015-present)

Donabauer, S. 2015. Status of Catch and Harvest among Largemouth Bass Anglers from Small Indiana Glacial Lakes. Indiana Division of Fish and Wildlife. 7pp.

Donabauer, S. 2015. Status of Catch and Harvest among Largemouth Bass Anglers from Indiana's 200+ Acre Glacial Lakes. Indiana Division of Fish and Wildlife. 7pp.

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Donabauer, S. 2016. Catch Rate and Size Structure of Largemouth Bass. Indiana Division of Fish and Wildlife. 7pp.

Donabauer, S. 2016. Catch Rate and Size Structure of Largemouth Bass: May versus June Surveys. Indiana Division of Fish and Wildlife. 6pp.

Linn, M. (*in review*). 2016 Status and Trends Creel Summary. Indiana Division of Fish and Wildlife. 3pp.

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Linn, M. (*in review*). 2017. Status and Trends Largemouth Bass Summary. Indiana Division of Fish and Wildlife. 7pp.

Linn, M. (*in review*). 2017 Glacial Lake Water Quality Summary. Indiana Division of Fish and Wildlife. 8pp.

Munter, R. 2017. Statewide Black Bass Tournament Monitoring 2015. Indiana Division of Fish and Wildlife. 15pp.

Clark-Kolaks, S. and Bueltmann A. 2018. 2017 Reservoir Status and Trends Annual Report. Indiana Division of Fish and Wildlife. 11pp.

Ham, T. 2018. Statewide Black Bass Tournament Monitoring 2016. Indiana Division of Fish and Wildlife. 13pp.

APPENDIX A

Preference Calculation

The preference was calculated by using the top 3 fish species selected during 2016 Indiana Licensed Angler Survey (LAS).

$$\% \text{ Preference} = \text{species LAS Top 3} / \text{total of all LAS top 3} \% * 100$$

$$\% \text{ Largemouth Bass preference} = 50.9 / 230.47 * 100 = 22.1\%.$$

From 2011 National Survey of Fishing, Hunting, and Wildlife Recreation- Indiana:

Anglers (inland) = 745,290

Days of fishing (inland) = 20,719,290

Total expenditures (all waters) = \$671,840,000

Total expenditures (inland) = \$665,138,060 [(427,310,000+244,530,000)-6,701,940]

Trip related (all waters) = \$427,310,000

Equipment and other (all waters) = \$244,530,000

Lake Michigan Expenditures= \$6,701,940

Average total (inland) expenditures per angler day = \$32.10 (\$665,138,060/20,719,000 angler days). (*Dollar value to be used for our creel analyses)

Economic value:

Total Fishing Trip Expenditures (inland) = \$665,138,060

Species trip expenditures = % Species preference*\$665,138,060 (total expenditures)

Largemouth Bass trip expenditures = 0.221*665,138,060 = \$146,995,511

APPENDIX B

Preference Calculation

See Appendix A.

From 2016 National Survey of Fishing, Hunting, and Wildlife Recreation- Indiana:

Anglers = 477,680

Revenue:

Largemouth Bass licenses = Largemouth Bass preference*certified angler licenses

Largemouth Bass licenses = $0.221 * 477,680 = 105,567$

State-wide License value = \$4.6M Sport Fish Restoration grant +

\$1.53M DFW matching funds = \$6.13M

Individual license value (DFW) = $477,680 \text{ licensed anglers} / \$6.13\text{M} = \$12.835$

Indiana Largemouth Bass license revenue (DFW) = $105,567 * \$12.835 = \$1,354,952$

Division of Law Enforcement receives roughly half of license revenue:

*Net Bluegill license revenue = $DLE + DFW = 1,354,952 * 2 = \$2,709,905$*

APPENDIX C

Strategy rankings

Strategies were ranked using Qualtrics survey where biologists were asked to rank each strategy based on three metrics: feasibility, time frame, and importance. A rankings system of 1 thru 5 was used with a rating of “1” corresponds to a strategy that is very feasible, can be done quickly, and is very important. A rating of “5” corresponds to a strategy that would be unfeasible, take a long time, and not be important.

Strategy	Feasibility	Time Frame	Importance
Develop criteria for the selection of resources likely to respond positively to Largemouth Bass management techniques.	2.32	2.68	2.35
Modify existing angling regulations, vegetation management, habitat management, and stockings where possible to maintain balanced Largemouth Bass populations.	2.27	2.82	2.00
Work in partnership with resource stakeholders to develop solutions to historical barriers to successful Largemouth Bass management.	2.62	2.86	2.48
Use available fish community, habitat, and creel surveys to identify resource characteristics that have the potential to produce exceptional Largemouth Bass populations.	1.86	2.32	2.10
Increase the frequency at which targeted licensed angler surveys are conducted to align with strategic planning objectives.	1.90	1.95	2.10
Modify licensed angler survey questions pertaining to species preference to more accurately quantify species preference.	1.57	1.90	2.14
Develop and implement a statewide creel survey program and lake sampling schedule designed to evaluate naturally reproducing sportfish angler metrics.	2.33	2.62	1.80
Encourage tournaments to collect data required to track the angler catch rates.	2.05	1.95	2.52
Implement internal monitoring at tournaments where data gaps exist.	2.59	2.45	2.77
Create Largemouth Bass fishing materials that promote Largemouth Bass management and explain how anglers are part of management (Largemouth Bass fishing hot spot maps, articles in fishing magazines, and Facebook posts promoting Largemouth Bass fishing and management).	1.81	2.00	2.14
Work with partners to engage new anglers in Largemouth Bass fishing through R3 programming.	2.50	2.64	2.82

Strategy	Feasibility	Time Frame	Importance
Develop and implement a long-term adaptive marketing strategy that effectively promotes Indiana Largemouth Bass angling opportunities.	2.77	3.41	2.14
Fully implement strategies described in the DFW R3 Strategic Plan.	2.45	2.73	2.05
Standardize methods for calculating submerged vegetation coverage estimates derived from Tier II Aquatic Vegetation Surveys and regularly provide staff training for field survey methods.	1.82	1.95	1.86
Utilize existing standard survey protocols to quantify emergent vegetation in glacial lakes and reservoirs.	2.23	2.45	2.09
Determine the minimum and maximum structural habitat requirements (vegetation, woody material, and artificial structure) necessary to maintain resource stability and achieve sportfish population objectives.	3.18	3.14	2.05
Work with partners to promote best management practices through the Lake and River Enhancement Program, soil and water conservation agencies, watershed groups, and other non-governmental organizations.	2.77	3.14	2.38
Work with partners to ensure compliance with permit requirements to protect warmwater habitat.	3.05	2.76	2.52