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Status and Trends of Michigan Inland Lake Resources, 2002–2007

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Table of Contents

Michigan Department of Natural Resources
Fisheries Report 08, 2015

Status and Trends of Michigan Inland Lake Resources, 2002–2007

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Executive Summary

Science-based management of aquatic resources requires high-quality information that is readily available to managers and stakeholders. Collecting and distributing this information is an essential role of the Michigan Department of Natural Resources (DNR) and helps the DNR to fulfill its public trust mission. This report, Status and Trends of Inland Lake Resources, 2002-2007, provides the comprehensive information needed to understand and effectively manage Michigan's inland lakes.

This report represents the first statewide assessment of inland lake resources and is intended for use by scientists, managers, policy makers, and the public. It provides an up-to-date summary of information on lakes and characterizes the broad-scale patterns in lake habitat, fish community structure, and fish population dynamics. The findings presented here document the current status of selected lake resources and establish the baseline conditions against which future monitoring results can be compared.

Michigan's inland lakes are an abundant, diverse, and valuable resource. A growing list of environmental issues result in ever-increasing demands on lake habitats, fishes, and other aquatic life. The findings of this report, and the continued assessment efforts of the DNR will help in the protection and enhancement of lake resources and in the optimum use of lake resources for the benefit of the people of Michigan.

Introduction

Michigan's inland lakes and streams are an abundant, diverse, and valuable resource. Over 10,000 lakes and more than 36,000 miles of streams are distributed across the Michigan landscape. These waters range from small, shallow lakes that support sunfish to large, deep lakes that support diverse fish communities including yellow perch, walleye, and lake trout; and from small, groundwater-driven headwater streams that support trout and other coldwater species to large, runoff-driven rivers that support diverse communities of warmwater fishes. Inland lakes and streams are of great value, providing ample fishing and other recreational opportunities as well as being a source for water, energy, and employment. The long-term quality of these waters and fishery resources and the benefits that they provide are threatened by a variety of factors including pollution, landscape development, invasive species, over exploitation of fish stocks, and climate change. The demands placed on these resources by multiple user groups, together with a growing list of disturbances that threaten inland lakes and streams, necessitate an effective management strategy to protect inland resources for current and future generations.

The mission of the Fisheries Division is "to protect and enhance fish environments, habitat, populations, and other forms of aquatic life, and to promote optimum use of these resources for benefit of the people of Michigan" (Anonymous 1997). Obtaining adequate information to meet this mission is a challenging task given the abundance and diversity of lakes and streams in the state. Recognizing this challenge, Fisheries Division implemented the Status and Trends Program (STP) in 2002 (Hayes et al. 2003). The objective of the STP is to collect and synthesize data needed by fisheries managers, policy-makers, and the public to address inland aquatic resource management needs. The specific goals of the STP are to: 1) collect the information needed to maintain an inventory of inland habitat and fish community characteristics statewide; 2) develop reference points for local, regional, and statewide management needs; and 3) to assess the status of, and detect changes to, aquatic habitats and fish communities across Michigan. To meet these goals, Fisheries Division personnel survey aquatic habitats and fish communities using standardized methods in lakes and streams that are representative of the broad range of waters found in the state.

The purpose of this report is to document the results of the Status and Trends Program's first six years of monitoring (2002-2007). The results of this report are presented in a non-technical manner intended to inform a broad audience of scientists, resource managers, policy makers, and the public. The goals of this report are to document the current status of Michigan's inland fishery resources. In this report, status refers to both the geographic distribution and the ecological condition or "health" of the resource. Fishery resource refers to both habitat and fish species. Documenting current status is necessary to meet today's management needs and to establish baseline conditions against which future monitoring results can be compared. Such comparisons will enable researchers and managers to determine trends, or document how inland fishery resources change through time in response to natural and human-induced sources of variability.

This report focuses on the inland lakes portion of the Status and Trends Program. Results from the streams Status and Trends Program can be found in a companion report (Wills et al. 2015). This report begins by providing a brief background on the sampling design and survey methods used in the inland lakes Status and Trends Program. Next, statewide patterns in the chemical, physical, and biological aspects of lake habitat are presented in the section entitled, "Status of Lake Habitat." Finally, the report concludes by describing statewide patterns of distribution, abundance, and growth of individual fish species in the section entitled, "Status of Lake Fishes." The results presented in this report characterize the broad scale status of lakes. Readers wishing to learn more about the status of individual lakes should contact the DNR full service center in the appropriate fisheries management unit within which the lake is located.

Methods

Sampling Design

The Status and Trends Program used a statistically-based sampling design to determine what lakes to survey. This design ensured that sampling effort was distributed across the state and across a range of lake types. In this design, all public lakes 10 acres and larger were considered for surveying.

Lakes were selected for surveying using a stratified random design. All public lakes 10 acres and larger were stratified by fisheries management unit (Figure 1) and lake size category (small = 10 to 100 acres; medium = 100 to 1,000 acres; large > 1,000 acres). Lakes within these strata were then selected at random. The resulting list was filtered using several criteria. First, if a general survey was completed on a lake in the past 10 years (large and medium lakes) or 15 years (small lakes) then that lake was kept off the list. Lakes having a recent survey were allowed to appear back on the list once the 10 or 15 year time limit was reached. After a lake was surveyed using Status and Trends methods, then it was kept off of the list for the time limit for that lake category. Private lakes were generally not sampled by Fisheries Division. Private lakes were defined as those waters where access to a particular lake was restricted to the landowners living around the lake. If a lake had no public launch ramp but was accessible from a pay ramp or from a connecting waterbody that does have a public launch ramp, then that lake would have been considered for surveying.

Figure 1.–Map of Michigan showing the location of fisheries management units.

Status and Trends surveys consisted of a fish component and a limnological component. Fish surveys were conducted between the end of April and mid-June in the Lower Peninsula and between the end of May and mid-July in the Upper Peninsula. Multiple gear types (trap nets, fyke nets, gill nets, seines, and electrofishing) were used in an effort to collect information from a range of species and size classes. Because the primary goal of Status and Trends fish surveys was to collect an unbiased, representative sample of the entire fish community, nets were set at randomly selected locations to ensure that a range of conditions were sampled in each lake.

Limnological surveys were conducted in August and September when lakes were at their peak stratification. At the deepest basin in each lake, estimates of transparency were made and temperature and dissolved oxygen profiles were measured. Water samples were also collected to determine alkalinity, concentrations of nutrients and chlorophyll a, and to determine the size structure of zooplankton. The littoral zone and lake shore were also visually assessed to determine intensity of residential development and shoreline modifications as well as the quantity of fish habitat in the form of large woody debris. More detailed information on fish and limnological sampling procedures can be found in Wehrly et al. (in press).

Data Summaries

Reference points for habitat and fish variables were computed using 25th and 75th percentiles of the data to score data into low (<25th percentile), medium (25th to 75th percentile) and, high (>75th percentile) categories. Reference points were computed for the entire state by pooling all data. Lakes falling within the "medium" category were considered typical; whereas, lakes falling in the "low" or "high" categories were considered exceptional and may suggest that additional investigation is warranted. Average habitat and fish values were also calculated by lake size, lake depth, and management unit. These averages represent the "typical" condition and were used to characterize broad-scale differences across different lake types and management units.

Tables summarizing these averages were created using the following labels and criteria.

- Lakes were classified into small, medium, and large size strata based on the surface area criteria used for lake selection described above.
- Depth strata were based on maximum depth and varied by lake size. Lakes were considered "shallow", and therefore less likely to stratify, when maximum depths were less than 15 for small lakes, less than 25 feet for medium lakes, and less than 35 feet large lakes. Lakes were considered "deep" when maximum depth equaled or exceeded these thresholds. Lakes where depth measurements were unavailable were grouped into an "unknown" depth strata.
- Fisheries management units were abbreviated as follows: LMS = Southern Lake Michigan, LMC = Central Lake Michigan, LMN = Northern Lake Michigan, LSW = Western Lake Superior, LSE = Eastern Lake Superior, LHN = Northern Lake Huron, LHS = Southern Lake Huron, LE = Lake Erie.

Results

Waters Surveyed

A total of 233 inland lakes were sampled from 2002 to 2007 as part of the Status and Trends Program. Status and Trends lakes were fairly well distributed across the state and tended to cluster in regions where the concentration of lakes was naturally high (Figure 2). These regions, such as the area where the Lake Erie, Southern Lake Michigan, and Southern Lake Huron management units meet, contain many lakes that were formed by the same geologic events. In terms of numbers, the majority of surveys were focused on medium lakes (127) followed by small lakes (79) and large lakes (27)

(Table 1). However, when we consider the total population of lakes in the state, there are many more small lakes than large lakes. Consequently, when we account for the total number of lakes in each size strata, a much larger proportion of large lakes (25%) were sampled than medium (12%) and small lakes (1%). The total number of Status and Trends lakes (233) sampled from 2002 to 2007 represented a mere 3.5% of all lakes 10 acres and larger.

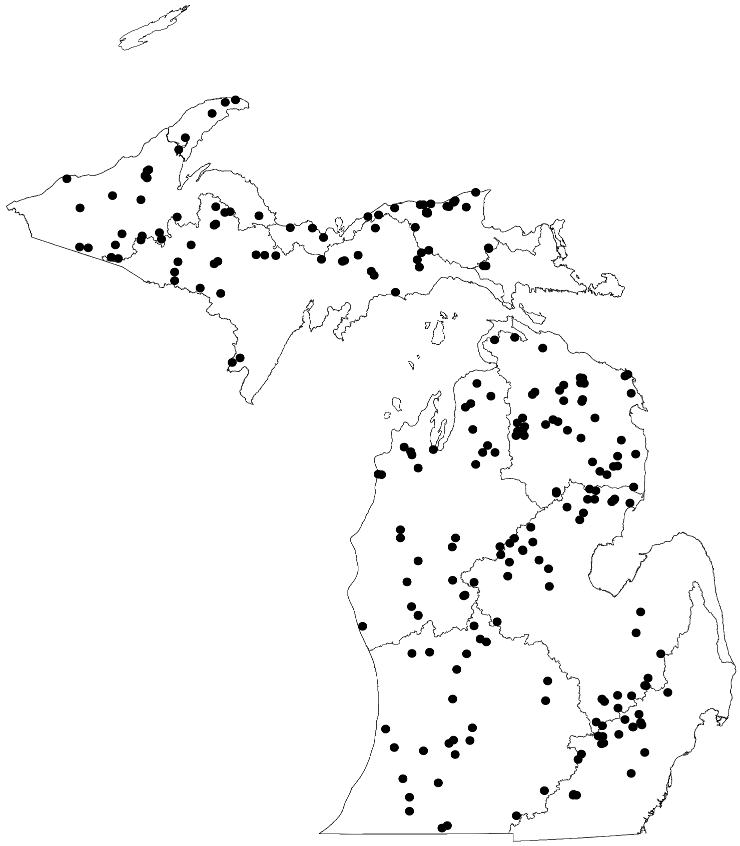


Figure 2.–Location of inland lakes sampled in the Status and Trends program from 2002 through 2007.

Table 1.–Number of inland lake Status and Trends surveys completed from 2002 to 2007 stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		3	2	4		1	1	1	12
	Shallow	1		3	3		5	3		15
Medium	Deep	14	11	5	8	5	14	14	9	80
	Shallow		4	5	6	2	3	4	1	25
	Unknown	3	3	4	1	2	5	4		22
Small	Deep	6	7	9	2	6	8	8	5	51
	Shallow			1		2			1	4
	Unknown	2	2			8	8	2	2	24
All		26	30	29	24	25	44	36	19	233

Status of Lake Habitat

Habitat conditions determine rates of fish reproduction, mortality, and growth, and consequently the number and types of fish that can live in a lake. In addition to determining fishery potential, habitat conditions also influence other biota such as aquatic plants, invertebrates, reptiles, and amphibians. Habitat conditions, because they influence water quality and general appearance, can also determine the suitability of a lake for being a source for drinking water, swimming, and boating as well as overall lake aesthetics. Habitat indicators sampled through the Status and Trends Program are used to assess the chemical, physical, and biological conditions in inland lakes.

Chemical Indicators

Total Alkalinity

Total alkalinity is a measure of the buffering capacity of lake waters and plays an important role in determining lake pH and, consequently, overall lake productivity. Lakes having relatively low alkalinity tend to be more acidic (pH < 6) and tend to support fewer individuals and species. Low alkalinity lakes are particularly susceptible to the impacts of acid rain. In contrast, lakes having relatively higher alkalinity typically exhibit higher pH values (~7–8) and tend to be more productive. An exception to this pattern is found in high alkalinity lakes having relatively high pH (~8.5). In these lakes, calcium carbonate ($CaCO_3$) precipitates out of solution forming crusty white mineral deposits (marl) on all surfaces including aquatic plants. Nutrients such as phosphorus bind with marl and are unavailable for use by phytoplankton. As a result, marl lakes tend to be very clear because of limited primary production and tend to support fewer fish and other biota compared with other lakes having relatively high alkalinity.

Based on Status and Trends sampling, alkalinity values in Michigan inland lakes were classified into low (<49.5 mg/L as $CaCO_3$), medium (49.5–141.5), and high categories (>141.5). Statewide, alkalinity values in lakes showed a strong north-to-south trend (Figure 3). The high proportion of low alkalinity lakes in the Upper Peninsula resulted from igneous and sandstone bedrock that dominate the region. These bedrock types are relatively carbonate poor and therefore do not provide much buffering capacity. Low alkalinity in some lakes may have also resulted from acidic conditions created by Sphagnum moss, as is the case in bog lakes which are more common in the Upper Peninsula. The high proportion of medium to high alkalinity lakes in the southern portion of the state resulted from limestone bedrock and thick glacial deposits that dominate the Lower Peninsula. Limestone and overlying glacial deposits are rich in carbonate, and groundwater and surface waters interacting with these formations provide much greater buffering capacity to lakes. Variation in alkalinity within a region resulted from more localized differences in geology and, to a greater extent, lake connectivity. On average, disconnected lakes (no inlet or outlet) had lower alkalinity, headwater lakes (having only an outlet) had intermediate alkalinity, and in-line lakes (having an inlet and an outlet) had higher alkalinity.

Lakes in the Western Lake Superior Management Unit had the lowest alkalinity followed by lakes in the Eastern Lake Superior and Northern Lake Michigan (Table 2) management units. In contrast, lakes in the Lake Erie Management Unit had the highest alkalinity followed by lakes in the Southern Lake Michigan and Southern Lake Huron management units. Average alkalinity values for lakes in the Central Lake Michigan and Northern Lake Huron management units were intermediate to these two extremes. There were no consistent differences in alkalinity across lake size and depth strata. This result is not surprising given the importance of geology and lake connectivity in determining alkalinity.

Nutrients

Phosphorus and nitrogen are two important nutrients influencing production, biomass, and species composition of plants in lake ecosystems. Concentrations of phosphorus and nitrogen vary naturally among lakes depending on geology, the lake's position in a stream network, and water

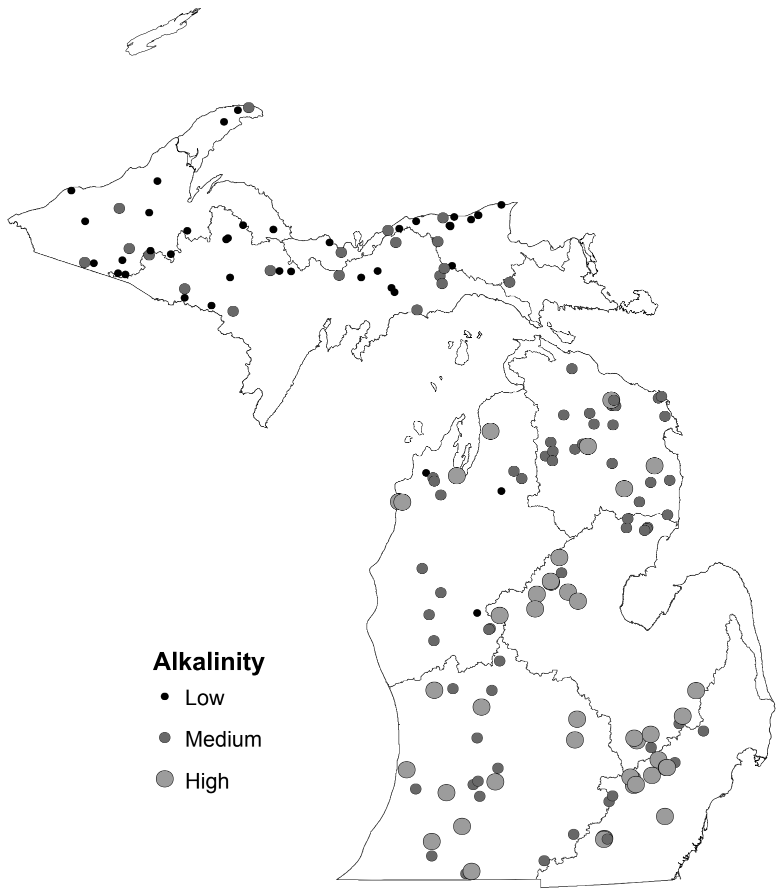


Figure 3.–Total alkalinity in Status and Trends lakes classified into low (<49.5 mg/L as CaCO3), medium (49.5 to 141.5 mg/L as CaCO3) and high (>141.5 mg/L as CaCO3) categories.

Table 2.–Mean total alkalinity (mg/L as $CaCO_3$) in Status and Trends lakes stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		126	48	36		152	151	161	88
	Shallow	131		78	30		119	164		95
Medium	Deep	143	132	86	18	57	112	118	151	111
	Shallow		80	26	22	31	96	122	93	56
	Unknown	128	108	62	67	74	77	152		96
Small	Deep	145	67	34		46	119	129	179	108
	Shallow			133					114	124
	Unknown	126	83			14	70	184	156	73
All		139	107	57	27	40	105	132	155	97

residence time. Nutrient concentrations in many lakes are also elevated because of human activities at local and watershed scales. Human-derived inputs of nutrients can lead to eutrophication which is characterized by an increased production of phytoplankton and aquatic macrophytes, often to nuisance levels. Decomposition of dead plants consumes oxygen from the water column and can reduce oxygen concentrations to the point that suitable fish habitat becomes severely limited. At the other extreme, lakes having low nutrient concentrations typically exhibit lower primary production and fish populations with slower growth rates and lower biomass.

- Total Phosphorus

Phosphorus naturally occurs in relatively low concentrations in aquatic environments and therefore tends to be the primary limiting nutrient for primary producers (phytoplankton, periphyton, and aquatic macrophytes). The majority of Michigan lakes are phosphorus limited because nitrogen to phosphorus ratios are above favorable levels (approximately 16-20) for most plants. Consequently, overall productivity in lakes across the state tends to be more controlled by phosphorus than nitrogen concentrations. Relatively high phosphorus concentrations are typically indicative of lakes that receive elevated loadings of phosphorus from human-derived sources including agricultural and urban land use, municipal and industrial point sources, and lawn fertilizers and leaching septic tanks from riparian residences.

Summer phosphorus concentrations varied considerably across the state with lakes having low (<0.009 mg/L), medium (0.009 to 0.020 mg/L), and high (>0.020) concentrations occurring in each management unit (Figure 4). However, a greater proportion of lakes with high phosphorus concentrations occurred in three main areas: the region where the Lake Erie and the Southern Lake Huron management units adjoin, a band that covers the southern portion of the Central Lake Michigan and the northern portion of the Southern Lake Huron management units, and the western third of the Upper Peninsula. On average, lakes in the Southern Lake Huron Management Unit had the highest phosphorus concentrations followed by lakes in the Lake Erie, Western Lake Superior, and Southern and Central Lake Michigan management units (Table 3). Lakes having the lowest concentrations of phosphorus occurred in the Eastern Lake Superior and Northern Lake Michigan management units. There were no consistent differences in phosphorus across lake size and depth strata.

Table 3.–Mean total phosphorus concentration (mg/L) in Status and Trends lakes stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.025	0.012	0.015		0.010	0.014	0.067	0.021
	Shallow	0.009		0.011	0.015		0.008	0.028		0.014
Medium	Deep	0.015	0.015	0.014	0.009	0.013	0.012	0.019	0.025	0.015
	Shallow		0.012	0.019	0.040	0.012	0.008	0.025	0.009	0.022
	Unknown	0.039	0.014	0.005	0.017	0	0.010	0.045		0.020
Small	Deep	0.018	0.016	0.012	0.014	0.012	0.008	0.019	0.010	0.014
	Shallow			0.006					0.018	0.012
	Unknown	0.011	0.012			0.010	0.013	0.025	0.025	0.014
All		0.018	0.016	0.013	0.019	0.011	0.010	0.024	0.022	0.016

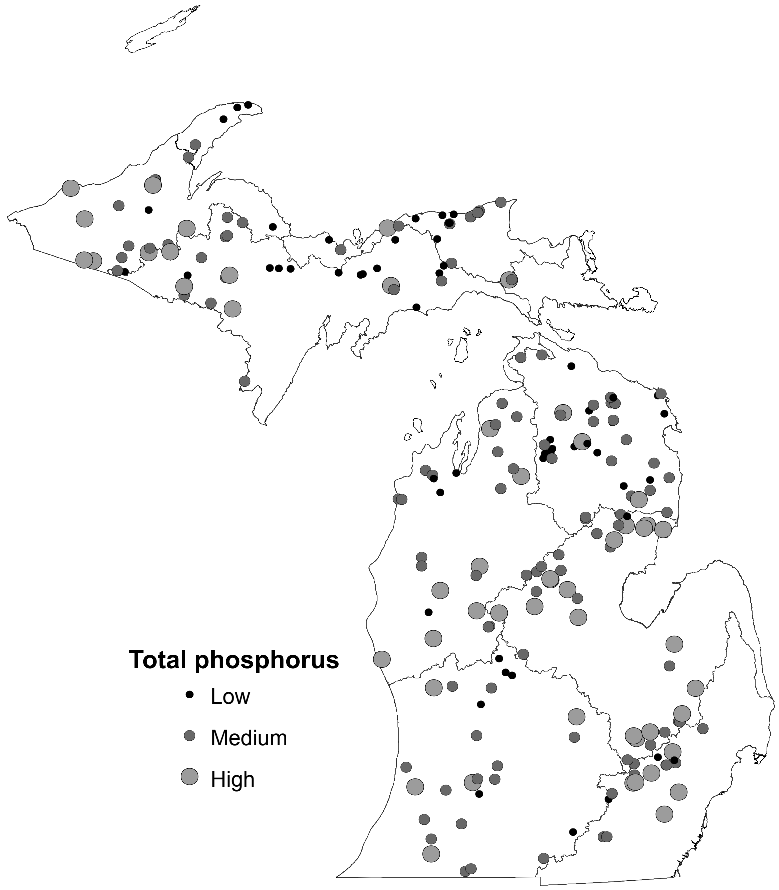


Figure 4.–Total phosphorus in Status and Trends lakes classified into low (<0.009 mg/L), medium (0.009 to 0.020 mg/L) and high (>0.020 mg/L) categories.

- Total Nitrogen

Unlike phosphorus, nitrogen naturally occurs in relatively high concentrations in aquatic environments and therefore rarely limits primary production in lakes. However, nitrogen can become limiting in some eutrophic lakes where relatively high concentrations of phosphorus reduce N:P below favorable levels (approximately 16-20) for most plants.

Summer nitrogen concentrations varied considerably across the state with lakes having low (<0.403 mg/L), medium (0.403 to 0.750 mg/L), and high (>0.750 mg/L) concentrations occurring in each management unit (Figure 5). However, a greater proportion of lakes with medium to high nitrogen concentrations occurred in the southern portion of the state. Average nitrogen concentrations within management units increased from north to south with the highest concentrations in the Southern Lake Huron, Southern Lake Michigan and Lake Erie, intermediate concentrations in the Central Lake Michigan and Northern Lake Huron, and the lowest concentrations in the Northern Lake Michigan, Eastern Lake Superior, and Western Lake Superior management units (Table 4). Nitrogen concentration tended to be highest in medium-sized lakes and lowest in large lakes.

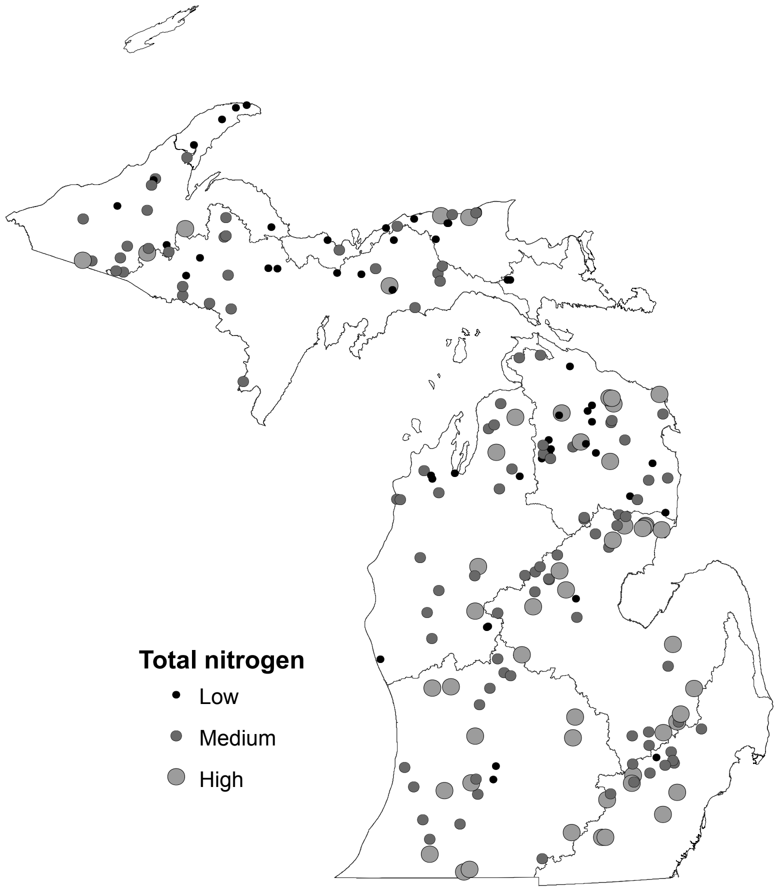


Figure 5.–Total nitrogen in Status and Trends lakes classified into low (<0.430 mg/L), medium (0.403 to 0.750 mg/L) and high (>0.750 mg/L) categories.

Table 4.–Mean total nitrogen concentration (mg/L) in Status and Trends lakes stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.440	0.453	0.375		0.315	0.345	0.683	0.422
	Shallow	0.591		0.583	0.345		0.437	0.647		0.500
Medium	Deep	0.798	0.493	0.411	0.402	0.430	0.533	0.819	0.738	0.616
	Shallow		0.794	0.642	0.783	0.544	0.729	1.141	0.768	0.814
	Unknown	1.094	0.605	0.371	0.266	0.910	0.498	1.249		0.743
Small	Deep	0.810	0.618	0.550	0.380	0.372	0.428	0.702	0.615	0.587
	Shallow			0.337					0.698	0.518
	Unknown	0.435	0.424			0.546	0.638	0.626	1.100	0.596
All		0.799	0.553	0.495	0.469	0.481	0.523	0.843	0.726	0.620

Dissolved Oxygen

Dissolved oxygen (DO) is a critical habitat component in aquatic systems. Dissolved oxygen in lakes derives from the atmosphere and from plants during photosynthesis. The concentration of oxygen in lakes varies within and among lakes depending on stratification patterns, light levels, and water temperature. Concentration of DO is relatively uniform throughout the water column in shallow well-mixed lakes that do not stratify. In deeper, stratified lakes, wind-induced mixing is restricted to warmer, less dense waters of the epilimnion where DO levels remain similar throughout. Shortly after stratification in early summer, DO concentrations in deeper, colder waters of the hypolimnion can be higher because gas solubility is greater at colder temperatures. However, as stratification persists through the summer, DO levels in the hypolimnion may become reduced by the decomposition of dead plant matter. If deeper waters do not have enough light to support photosynthesis, then bottom waters will remain low in oxygen until stratification breaks down in the fall allowing for mixing top to bottom. Lakes that have a longer period of stratification may be more susceptible to oxygen deficits. Low DO concentrations can affect the distribution and growth of fishes and the size composition and biomass of zooplankton. Dissolved oxygen becomes limiting to fish at concentrations <4 mg/L (hypoxia) and can become lethal for all animals at concentrations <0.5 mg/L (anoxia). Low DO concentrations can also lead to the release of nutrients and toxins from the lake bottom. At low DO levels, solubility of nutrients and toxins that are bound up in lake sediments increases resulting in an increase in nutrients and toxins in the water column.

- Hypoxia

  Summer hypoxia (<4 mg/L dissolved oxygen) was evident in lakes throughout the state (Figure 6). Lakes having low (<1%), medium (1 to 45%), and high (>45%) proportions of the water column in which conditions were hypoxic occurred in each management unit. The greatest proportion of lakes with high hypoxia was found in the southern half of the Lower Peninsula and in the western portion of the Upper Peninsula. Deeper lakes had a greater percentage of the water column exhibiting hypoxic conditions than shallower lakes (Table 5). This trend is to be expected because the probability of stratification is higher in deeper lakes. Mean percentage of the water column with hypoxic conditions was highest in the Southern Lake Michigan management unit followed by the Central Lake Michigan, Southern Lake Huron, and Lake Erie management units. Mean percentage of the water column with hypoxic conditions in the Northern Lake Huron, Northern Lake Michigan, and Western Lake Superior management units were similar and noticeably lower than levels in the southern portion of the state. Lakes in the Eastern Lake Superior Management Unit had the lowest percentage of the water column with hypoxic conditions.

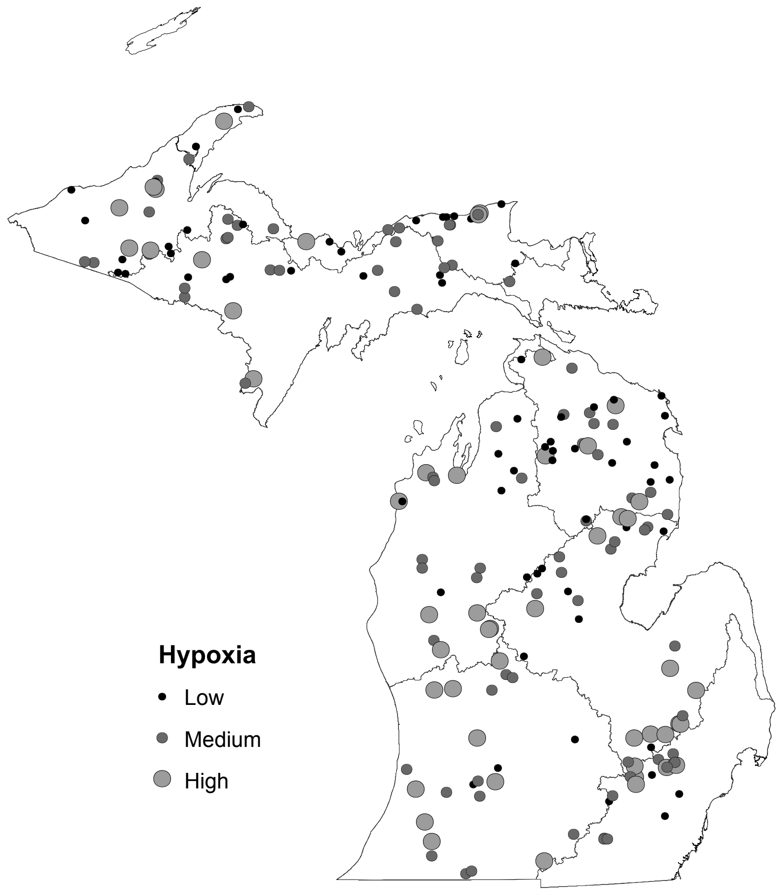


Figure 6.–Hypoxic conditions in Status and Trends lakes classified into low (<1%), medium (1–45%), and high (>45%) categories.

Table 5.–Mean percentage of the water column with hypoxic conditions (<4.0 mg/L dissolved oxygen) in Status and Trends lakes stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep			19.5	35.5		0.0	31.6	0.0	23.6
	Shallow	39.2		0.0	5.9		5.8	0.0		6.7
Medium	Deep	37.6	39.3	12.1	17.9	6.2	28.5	35.4	36.8	30.0
	Shallow		0.0	9.5	8.1	10.5	0.0	3.6	0.0	5.7
	Unknown	0.0	8.6	20.6	45.8	0.0	25.4	41.4		23.4
Small	Deep	37.8	35.7	35.9	36.2	42.1	6.5	42.4	31.1	32.9
	Shallow					0.0			18.8	9.4
	Unknown	28.6	37.0			14.5	30.2	0.0	20.2	23.1
All		35.3	29.9	19.3	19.6	16.1	19.7	29.7	28.3	24.6

- Anoxia

Summer anoxia (<0.5 mg/L dissolved oxygen) was evident in lakes throughout the state (Figure 7). Lakes having low (<1%), medium (1 to 15%), and high (>15%) amounts of the water column with anoxic conditions occurred in each management unit. Deeper lakes had a greater percentage of the water column in anoxic conditions than shallower lakes (Table 6). This trend was to be expected because the probability of stratification is higher in deeper lakes. Mean percentage of the water column with anoxic conditions was highest in the Lake Erie Management Unit followed by the Central Lake Michigan, and Southern Lake Michigan management units. Mean percentage of the water column with anoxic conditions in the Northern Lake Huron, Southern Lake Huron, Northern Lake Michigan, and Eastern Lake Superior management units were similar and noticeably lower than levels in the remainder of the Lower Peninsula. Lakes in the Western Lake Superior Management Unit had the lowest percentage of the water column with anoxic conditions.

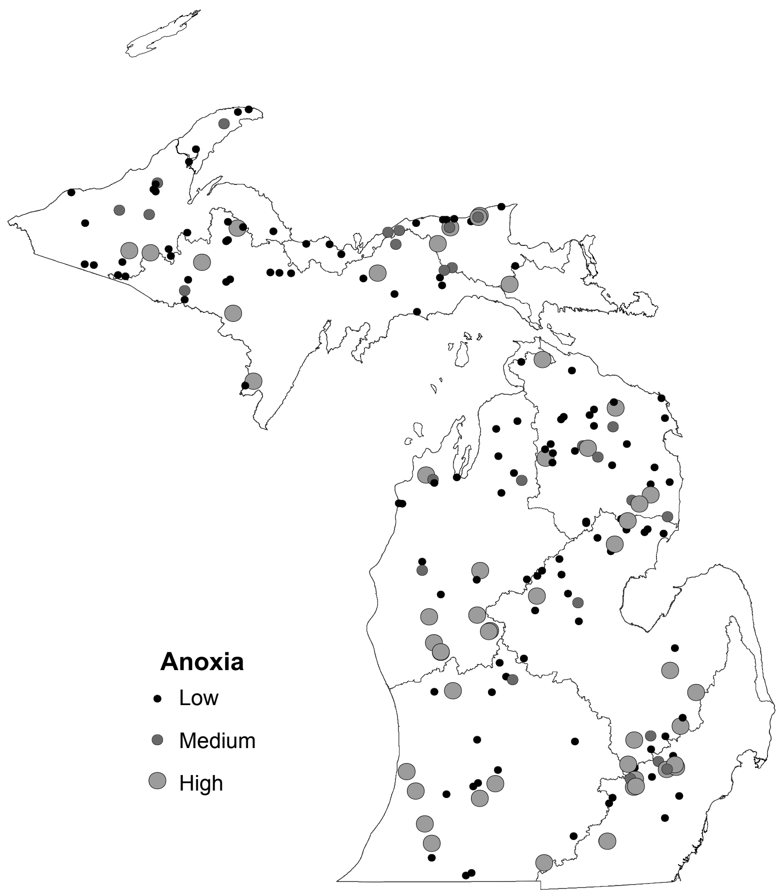


Figure 7.–Anoxic conditions in Status and Trends lakes classified into low (<1%), medium (1 to 15%) and high (>15%) categories where percentages reflect proportions of the water column having <0.5 mg/L dissolved oxygen.

Table 6.–Mean percentage of the water column with anoxic conditions (<0.5 mg/L dissolved oxygen) in Status and Trends lakes stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep			4.3	11.2		0.0	10.5	0.0	7.1
	Shallow	16.6		0.0	0.0		1.9	0.0		2.0
Medium	Deep	18.6	21.2	0.5	5.3	2.9	10.2	15.1	23.3	13.9
	Shallow		0.0	3.3	0.1	5.3	0.0	0.0	0.0	1.2
	Unknown	0.0	0.0	11.2	12.5	0.0	12.8	2.6		6.6
Small	Deep	5.7	21.0	14.8	0.0	24.7	2.0	14.6	13.7	12.6
	Shallow					0.0			0.0	0.0
	Unknown	0.0	4.9			3.5	17.5	0.0	5.4	8.0
All		12.8	14.7	7.1	4.2	7.4	8.7	9.6	14.8	9.7

Physical Indicators

Stratification

Lakes that are deep enough will stratify into distinct layers during summer. Stratification occurs when a density gradient, created by warming of upper waters by solar radiation, becomes large enough to prevent wind currents from mixing waters from top to bottom. The warmer upper layer, known as the epilimnion, has adequate light levels to support photosynthesis and much of the primary production occurs in this layer. Dissolved oxygen concentrations in the epilimnion are rarely limiting because of oxygen contributions from photosynthesis and from gas exchange with the atmosphere. The colder bottom layer, known as the hypolimnion, is often too dark to support photosynthesis and can become oxygen limiting if decomposition of organic material is excessive and the period of stratification is relatively long. The transition zone between the epilimnion and hypolimnion is know as the metalimion and is characterized by relatively rapid changes in temperature with depth. The point in the metalimnion where the rate of temperature change with depth is highest is known as the thermocline. Stratification not only affects temperature and oxygen dynamics in lakes, but also influences nutrient availability by preventing nutrient-rich waters of the hypolimnion from mixing with upper layers. Depending on depth and oxygen conditions, lakes that stratify can support cool and cold water biota in the hypolimnion. Stratification can also influence zooplankton composition and size structure by creating a refuge in deeper, colder water where large zooplankton can reside during the day to escape predation by warm- and coolwater fishes. Stratification, therefore, is an important determinant of thermal habitat, chemical characteristics, the distribution and composition of biota, and overall lake productivity.

The majority of lakes sampled across the state stratified during summer (Figure 8). A greater proportion of deeper lakes were stratified than shallower lakes across all size categories (Table 7). The shallow lakes that were stratified tended to have a larger surface area. A lower proportion of lakes in the Northern Lake Michigan, Western Lake Superior, and Eastern Lake Superior management units were stratified compared with management units in the Lower Peninsula.

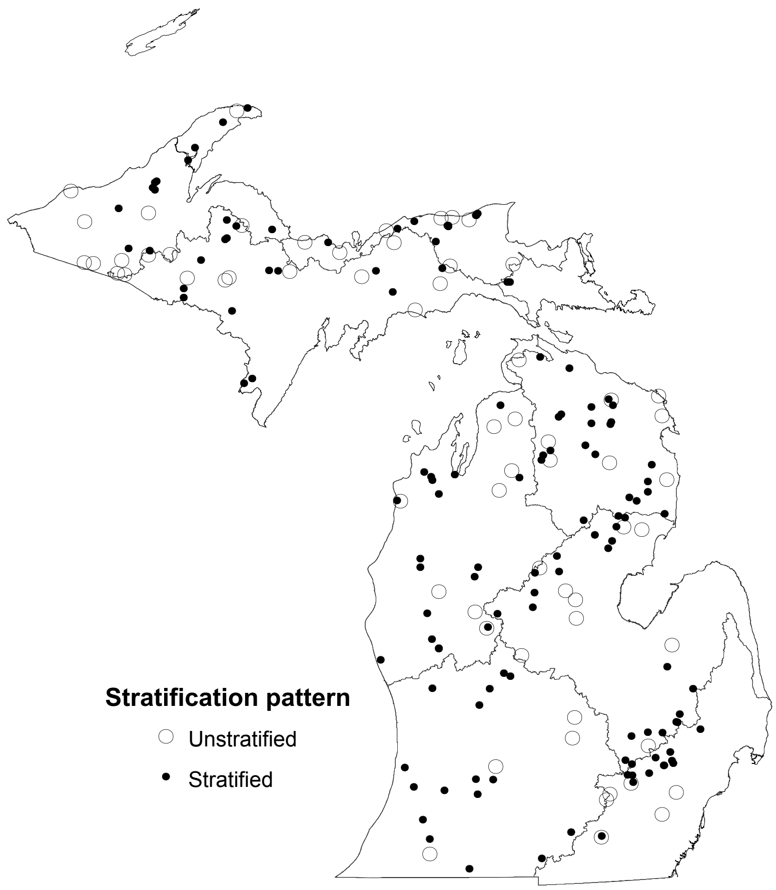


Figure 8.–Status and Trends lakes classified by whether or not they stratify during summer.

Table 7.–Frequency of summer stratification in Status and Trends lakes stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.00	1.00	0.75		1.00	0	1.00	0.83
	Shallow	1.00		0	0.67		0.50	0.50		0.55
Medium	Deep	0.92	0.82	0.40	0.63	0.60	0.92	0.85	0.75	0.78
	Shallow		0	0.20	0	0	0.50	0	0	0.10
	Unknown	0	0	0.50	1.00	0	0.80	0.75		0.56
Small	Deep	0.80	0.67	1.00	1.00	1.00	0.50	1.00	0.80	0.84
	Shallow					0			0	0
	Unknown	0	1.00			0.60	0.71	0	0.50	0.61
All		0.80	0.69	0.58	0.55	0.56	0.76	0.70	0.67	0.67

Transparency

Secchi disc depth is a measure of water transparency. Lakes having relatively shallow Secchi depths have lower transparency than lakes having higher Secchi depths. Secchi depth is often used to index the level of phytoplankton production and overall lake productivity. However, some caution must be used when interpreting Secchi depth readings because low transparency also can be found in lakes with high turbidity from suspended inorganic particles such as clay and in lakes that are colored or stained by humic acid derived from dissolved organic compounds from plants.

Summer Secchi depths varied considerably across the state with lakes having low (<2.3 m), medium (2.3 to 4.1 m) and high (>4.1 m) transparency occurring in each management unit (Figure 9). Average Secchi depth within management units varied by over a meter and was highest in the Northern Lake Huron and lowest in the Southern Lake Michigan and Western Lake Superior management units (Table 8). Average Secchi depths within the Lake Erie, Southern Lake Huron, Central Lake Michigan, Northern Lake Michigan, and Eastern Lake Superior management units were relatively similar to one another and to the statewide average. Secchi depth tended to be higher in deeper lakes.

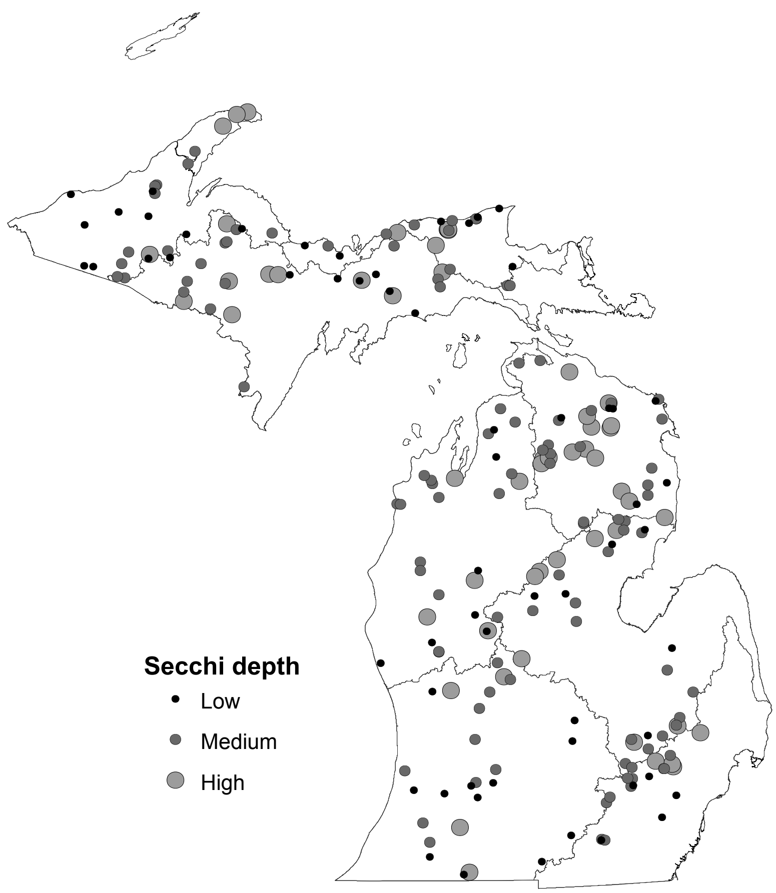


Figure 9.–Secchi depth in Status and Trends lakes classified into low (<2.3 m), medium (2.3 to 4.1 m) and high (>4.1 m) categories.

Table 8.–Mean secchi depth (m) in Status and Trends lakes stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		3.1	3.7	3.3		3.7	3.2	1.5	3.2
	Shallow	2.1		2.5	2.7		4.2	2.5		3.0
Medium	Deep	2.8	3.6	3.5	3.9	3.2	3.8	3.5	3.7	3.5
	Shallow		2.4	2.5	1.5	3.2	2.9	2.6	4.0	2.4
	Unknown	2.4	2.4	4.3	2.3	1.8	4.5	2.2		3.2
Small	Deep	2.6	2.8	4.0	2.9	3.7	4.5	3.7	3.4	3.5
	Shallow			0.8		1.5			2.9	1.7
	Unknown	3.4	3.5			3.7	3.0	5.2	2.7	3.4
All		2.7	3.1	3.4	2.9	3.3	3.9	3.2	3.4	3.3

Residential development

Residential development, measured as dwelling density (number of dwellings per kilometer of shoreline), provides an index of the potential influence of human activities on lake resources. Activities such as manipulating vegetation in lakes and along lakeshores, removing large woody debris in nearshore areas, armoring shorelines, constructing docks, contributing nutrients from lawn fertilizer and septic tanks, boating, and fishing are some of the ways that humans influence lake ecosystems.

- Dwelling density

  Dwelling density varied considerably across the state with lakes having low (<3.0 dwellings/km) and medium (3.0 to 18.9 dwellings/km) dwelling densities occurring in each management unit (Figure 10). With one exception, lakes having high dwelling densities (>18.9 dwellings/km) were restricted to the Lower Peninsula. Average dwelling density was highest in the Southern Lake Michigan Management Unit followed by the Southern Lake Huron, Central Lake Michigan, Lake Erie, and Northern Lake Huron management units (Table 9). Dwelling density was markedly lower in the Upper Peninsula and was lowest in the Eastern Lake Superior Management Unit. There were no consistent trends in dwelling density across lake size and depth categories.

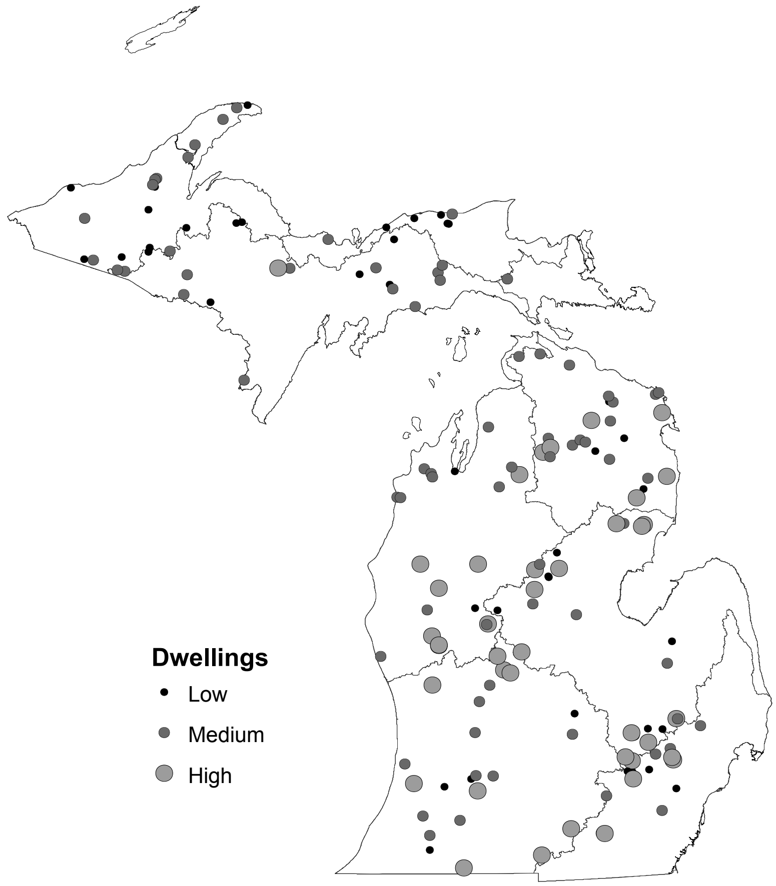


Figure 10.–Dwelling density (dwellings/km) around Status and Trends lakes classified into low (<3.0), medium (3.0 to 18.9) and high (>18.9) categories.

Table 9.–Mean dwelling density (dwellings/km) around Status and Trends lakes stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		14.9	15.2	6.4				0	9.2
	Shallow	29.2		8.9	7.5		12.1	9.6		11.5
Medium	Deep	20.3	16.3	9.4	7.4	1.4	15.6	25.3	19	16.7
	Shallow		17.5	3.7	1.4	5	7.9	8.7	12.7	5.7
	Unknown	4.6	26	12.7		0	10.7	2.4		8
Small	Deep	12.2	13.3	4.5	0.5	0.5	9	12.6	11.7	9.5
	Shallow									
	Unknown	29.5	3.9				13.5	17.5	0.4	12.4
All		16.9	15.3	8.1	5.1	1.5	12.7	16.1	13.7	12.3

- Boat docks

Density of boat docks, measured as the number of docks per kilometer of shoreline, provides an index of near shore disturbance and potential boat activity level. Construction of docks and boat traffic in near shore areas can impact large woody debris, aquatic vegetation, and bottom sediments.

Statewide patterns of boat dock density were similar to dwelling density. Dock density varied considerably across the state with lakes having low (<1.2 docks/km) and medium (1.2 to 13.6 docks/km) dock densities occurring in each management unit (Figure 11). With one exception, lakes having high dock densities (>13.6 docks/km) were restricted to the Lower Peninsula. Average dock density within management units was highest in the Southern Lake Michigan Management Unit followed by the Southern Lake Huron, Central Lake Michigan, and Lake Erie management units (Table 10). Dock density in the Northern Lake Huron and Northern Lake Michigan units was about half of that observed in the southern portion of the state. Lowest dock densities were found in the Eastern and Western Lake Superior management units. There were no consistent trends in dock density across lake size and depth categories.

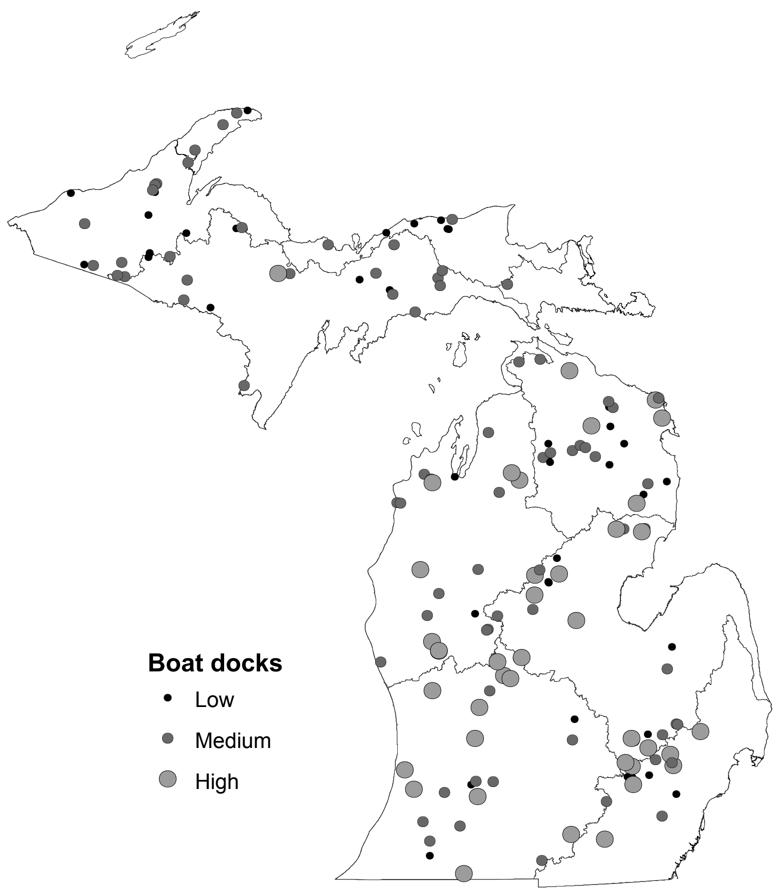


Figure 11.–Boat dock density in Status and Trends lakes classified into low (<1.2 docks/km), medium (1.2 to 13.6 docks/km) and high (>13.6 docks/km) categories.

Table 10.–Mean density of boat docks (docks/km) in Status and Trends lakes stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		10.4	2.4	4.8				0.4	4.3
	Shallow	21.1		5.3	5		10.3	10.1		8.9
Medium	Deep	18.9	10.5	7	5.5	0.8	7.9	21.1	14.2	12.7
	Shallow		15.3	2.1	1.2	3	1.1	4.9	1.3	2.9
	Unknown	4.6	12.9	9.1		0	6.8	0.8		5.2
Small	Deep	7.1	12.7	3.3	0.2	0	1.2	2.8	4.9	5.3
	Shallow									
	Unknown	25.2	1.7				1.5	15.6	0.8	6.1
All		14.3	11	4.8	3.8	0.8	5.4	12	9.1	8.4

- Shoreline armoring

Shoreline armoring, measured as the average amount of shoreline armored across all transects, provides an index of the extent that natural shorelines have been modified. Shorelines obviously hardened were considered armored, regardless of materials (e.g., wood, rock, concrete, etc.) used. Shoreline armoring can affect plants and animals that inhabit nearshore areas by reducing habitat heterogeneity along the lakeshore, by increasing wave energy and turbulence in shallow water, and by altering bottom sediments and reducing the availability of shallow water habitats.

The extent of shoreline armoring varied considerably across the state with lakes having low (<0.6%) medium (0.6 to 30.1%) and high (>30.1%) armoring occurring everywhere except in the Eastern Lake Superior Management Unit (Figure 12). Overall, the proportion of lakes with high levels of shoreline armoring increased from south to north. The percent of shoreline armoring was highest in the Lake Erie, Southern Lake Michigan, and Southern Lake Huron management units, intermediate in the Central Lake Michigan, Northern Lake Michigan, and Northern Lake Huron management units, and lowest in the Eastern and Western Lake Superior management units (Table 11). The extent of shoreline armoring tended to be higher in large lakes and in medium lakes that were deeper.

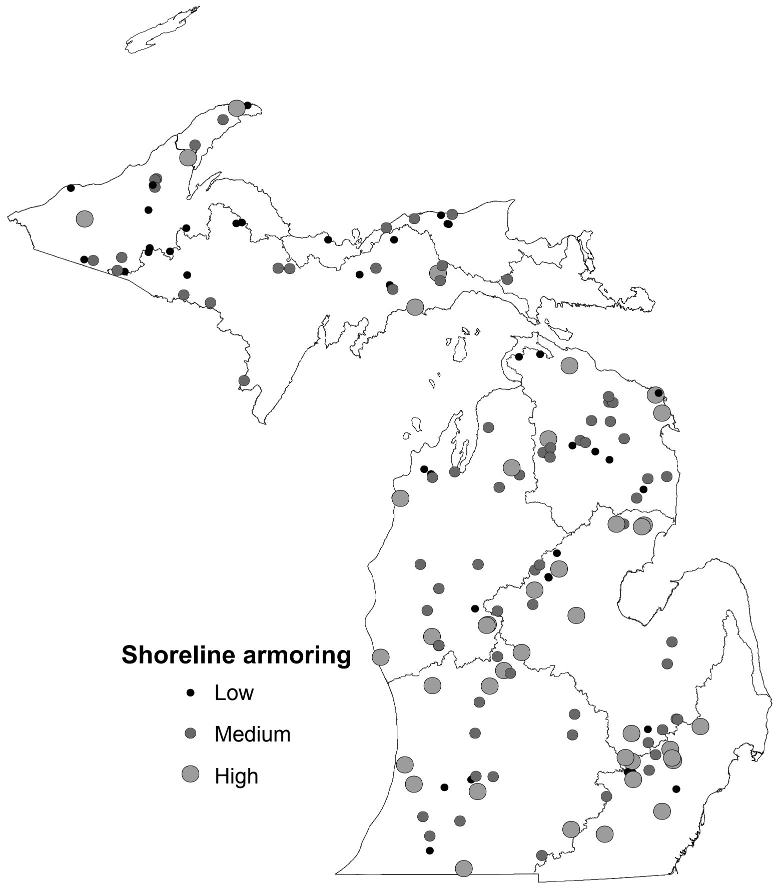


Figure 12.–Shoreline armoring in Status and Trends lakes classified into low (<0.6 %), medium (0.6 to 30.1 %) and high (>30.1 %) categories.

Table 11.–Mean shoreline armoring (percent) in Status and Trends lakes stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		43.7	15	27.6				13.3	24.2
	Shallow	52		26.5	13.4		32.9	27.6		28.4
Medium	Deep	37	19.2	16.9	7.1	4.3	9.1	38.4	45.2	25.3
	Shallow		53.5	0.7	2.3	3	5.8	19.3	9.1	8.9
	Unknown	9.5	5.6	10.1		0	12.3	4.8		8
Small	Deep	10.5	3.3	5.1	1.4	0	9.3	13.3	8.3	7.2
	Shallow									
	Unknown	20.9	0				3.6	21.7	0	7.5
All		26.4	15.9	11.1	9.1	2.3	10.9	25	28.4	17.3

- Large woody debris

Large woody debris is an important habitat component of lakes providing structure for fishes and stabilizing lake sediments. Trees growing along the shoreline that fall into the water are the primary source of large woody debris in most lakes. Humans can have a dramatic impact on habitat conditions in lakes by removing large woody debris in nearshore areas. In addition, humans often limit the recruitment of new large woody debris into lakes because trees are removed from the lakeshore for landscaping purposes.

Amounts of large woody debris showed a distinct north-south trend with lakes having high (>14.1 trees/km) densities of woody debris more common in the north and lakes having low (<0.7 trees/km) densities of woody debris in the south (Figure 13). Lakes having intermediate (0.7 to 14.1 trees/km) densities of woody debris were common throughout the state. Mean density of large woody debris was highest in the Northern Lake Michigan Management Unit, followed by the Eastern and Western Lake Superior management units (Table 12). The amount of woody debris in the Central Lake Michigan Management Unit was higher than anywhere else in the Lower Peninsula. Densities of large woody debris in the Northern Lake Huron and Southern Lake Huron management units were similar and slightly lower. Lowest densities of large woody debris were found in the Lake Erie and Southern Lake Michigan management unit lakes. The density of large woody debris tended to be higher in shallower lakes.

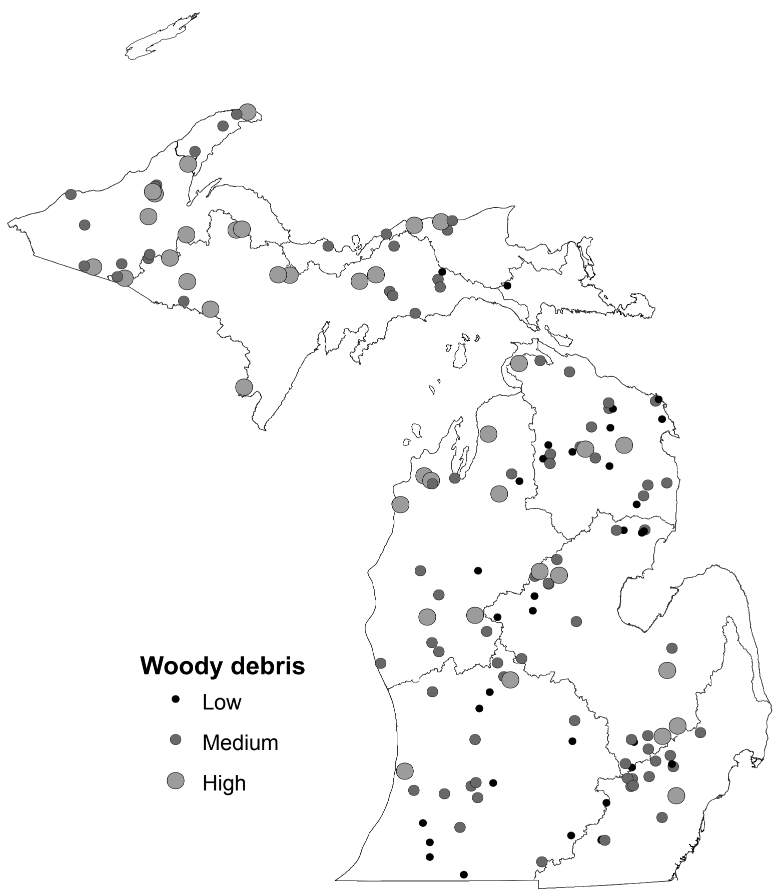


Figure 13.–Density of large woody debris in Status and Trends lakes classified into low (<0.7 trees/km), medium (0.7 to 14.1 trees/km) and high (>14.1 trees/km) categories.

Table 12.–Mean density of large woody debris (trees/km) in Status and Trends lakes stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		9.8	0.2	13.4				8.5	8.4
	Shallow	1.1		9.5	13.7		41.1	5.1		17.3
Medium	Deep	3.6	4.9	138.6	24.1	30	5.5	6.7	5.1	14.5
	Shallow		12	205.1	19.9	2.8	2.5	11.1	0.3	46.3
	Unknown	7.3	7.2	100		21.6	8.1	9.2		27.5
Small	Deep	8.6	30	327.9	47.6	4.5	3.8	7.3	4.8	74.5
	Shallow									
	Unknown	2.3	22.6				2.5	3.9	12.2	6.3
All		5.2	13.6	166.4	21.3	19.8	8.7	7.3	5.8	30.2

Biological Indicators

Chlorophyll a

Chlorophyll a is a pigment used by plants for photosynthesis. Summer chlorophyll a concentration in the epilimnion provides a measure of lake primary production by phytoplankton. Chlorophyll a can be used to estimate trophic state and overall lake productivity. High chlorophyll a concentrations suggest high production of phytoplankton, high nutrient inputs, and high overall lake productivity. Low chlorophyll a concentrations suggest that phytoplankton production is limited by low nutrient availability, by low transparency due to turbidity or humic acids, or by high rates of grazing by zooplankton.

Chlorophyll a concentrations varied widely across the state with lakes having low (<1.9 ug/L), medium (1.9 to 4.8 ug/L), and high (>4.8 ug/L), values occurring in all management units (Figure 14). Mean chlorophyll a concentration was highest in the Southern Lake Huron Management Unit followed by the Eastern Lake Superior, Southern Lake Michigan, and Central Lake Michigan management units (Table 13). Mean chlorophyll a concentrations were lowest in the Lake Erie, Northern Lake Michigan, and Western Lake Superior management units. Chlorophyll a concentrations tended to be higher in deeper lakes across all size categories.

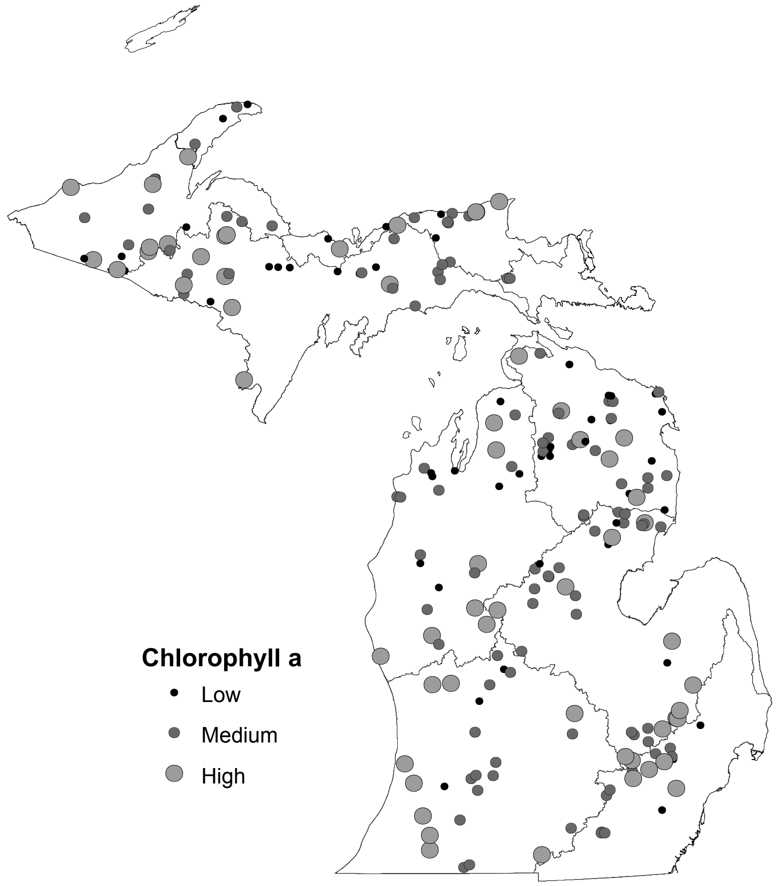


Figure 14.–Chlorophyll a concentrations in Status and Trends lakes classified into low (<1.9 ug/L), medium (1.9 to 4.8 ug/L) and high (>4.8 ug/L) categories.

Table 13.–Mean chlorophyll a concentration (ug/L) in Status and Trends lakes stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		5.5	5.6	3.0		1.8	2.0	6.6	4.2
	Shallow	2.5		2.9	2.9		2.0	3.7		2.8
Medium	Deep	4.6	4.2	4.2	4.2	3.8	2.6	6.4	2.5	4.2
	Shallow		4.2	5.6	3.1	2.9	2.7	4.0	2.0	3.8
	Unknown	5.0	3.9	2.1		0.0	2.2	7.7		3.8
Small	Deep	6.4	3.5	3.2	6.6	10.4	3.1	6.0	3.6	4.9
	Shallow			0.0					2.0	1.0
	Unknown	2.9	1.7			3.8	3.3	3.2	11.0	3.6
All		4.8	4.0	3.7	3.7	5.0	2.7	5.6	3.5	4.1

Trophic status

Trophic status is an index of the amount of phytoplankton production in a lake. Trophic status was determined using Carlson's Trophic State Index (TSI) which rescales measures of phosphorus concentration, Secchi depth, and chlorophyll a concentration from 0 to 100. Low TSI values represent lakes with low phytoplankton production while lakes with high TSI values represent lakes with high phytoplankton production. We computed Carlson's TSI for each variable and took the average. Threshold values for trophic state were taken from the Michigan Department of Water Quality where TSI values <38 were oligotrophic, from 38 to 48 were mesotrophic, from 49 to 61 were eutrophic, and > 61 were hypereutrophic.

Trophic state varied widely across the state with a higher proportion of oligotrophic lakes occurring in the northern portion of the Lower Peninsula (Figure 15). Mesotrophic lakes comprised the greatest proportion of lakes sampled and were distributed throughout the state. Eutrophic lakes were more common in the southern portion of the Lower Peninsula and in the Lake Superior drainage. Only two lakes were hypereutrophic and both occurred in the Southern Lake Huron Management Unit.

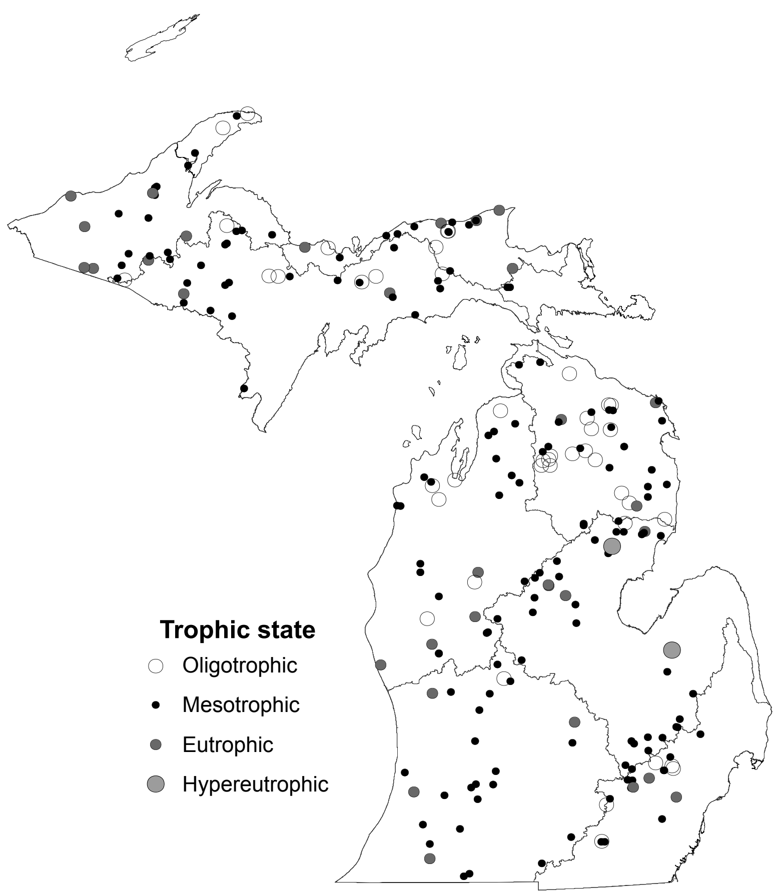


Figure 15.–Trophic state of Status and Trends lakes.

Zooplankton

Average zooplankton length is an index of size structure. Zooplantkon are an important food source for many species of fish and zooplankton size can influence fish mortality and growth rates. Zooplankton also play an important role in maintaining water quality in lakes. Large-bodied zooplankton can graze on excess phytoplankton that often result following elevated nutrient inputs. Low average zooplankton size may reflect high rates of fish predation which can occur in shallow lakes or in deeper lakes that lack a predation refuge because of inadequate oxygen levels in the hypolimnion.

Average zooplankton length varied widely across the state with lakes having low (<0.357 mm), medium (0.357 to 0.649 mm), and high (>0.649 mm) values occurring in all management units (Figure 16). Mean zooplankton length was highest in the Southern Lake Michigan Management Unit followed by the Lake Erie, Southern Lake Huron, and Central Lake Michigan management units (Table 14). Mean zooplankton length was intermediate in Northern Lake Huron and Northern Lake Michigan management unit lakes and lowest in Western and Eastern Lake Superior management units lakes. Average zooplankton length tended to be greater in deeper lakes probably because the deeper, colder water in these lakes provided a refuge where large zooplankton could escape predation from fish.

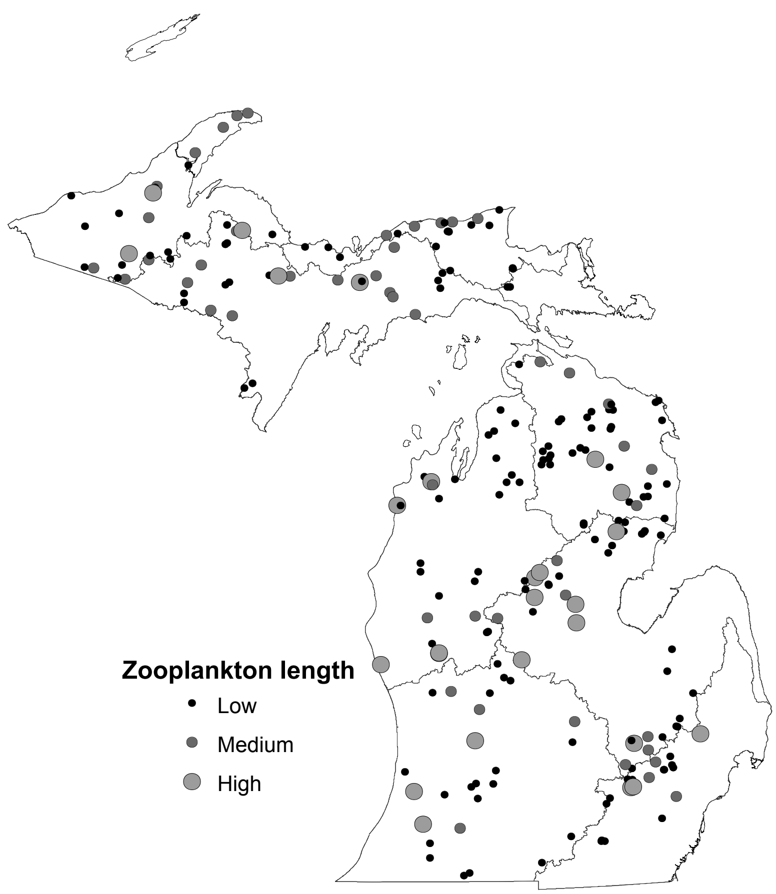


Figure 16.–Mean zooplankton length in Status and Trends lakes classified into low (<0.357 mm), medium (0.357 to 0.649 mm) and high (>0.649 mm) categories.

Table 14.–Mean zooplankton length (mm) in Status and Trends lakes stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.649	0.091	0.382		0.597	0.885	0.607	0.484
	Shallow			0.232	0.379		0.342	0.532		0.352
Medium	Deep	0.555	0.543	0.480	0.518	0.281	0.435	0.553	0.661	0.517
	Shallow		0.317	0.609	0.391	0.371		0.629		0.495
	Unknown	0.551		0.616		0.473	0.324	0.606		0.53
Small	Deep	0.883	0.504	0.540	0.467	0.41	0.851	0.306	0.612	0.55
	Shallow			0.481						0.481
	Unknown		0.792				0.389	0.738	0.389	0.539
All		0.591	0.538	0.485	0.444	0.339	0.472	0.564	0.580	0.505

Status of Lake Fishes

The purpose of this section was to describe the broad-scale patterns in lake fishes and to provide biological reference points that can be used as benchmarks for comparison within and among lakes. Readers seeking information on the life history, identification, and fishing regulations of Michigan fishes should consult Bailey et al. (2004), Hubbs et al. (2004) and the DNR Fisheries Division website (http://www.michigan.gov/dnr/0,1607,7-153-10364_52261_52262---,00.html). Readers seeking information on individual water bodies should contact a DNR full service center in the appropriate management unit within which the water body is located (Figure 1).

The statewide status of lake fish assemblages were described using several metrics including species richness, species of greatest conservation need (SGCN), and invasive species. The statewide status of individual fish species were also documented using more detailed information on the distribution, abundance, size structure, and growth of lake fishes.

The status of individual species were listed in phylogenetic order by family and then alphabetically by scientific name. For fish species that were found in fewer than 5% of lakes statewide, we described species distribution patterns by mapping presence or absence data and computing frequency of occurrence by lake type and management unit. For species that occurred in more than 5% of lakes statewide, we described patterns of species distribution and abundance. Species abundance was based on the total number of individuals caught summed across all gear types. Depending on data availability, we also described size-selectivity of different gear types, catch rate reference points for each gear type, and growth rate reference points.

Status of Lake Fish Assemblages

Species Richness

Species richness, the number of fish species found in a lake, showed a strong geographic pattern. A greater number of lakes having low species richness (<10) occurred in the north and a greater number of lakes having high species richness (>17) occurred in the south (Figure 17). Lakes having a moderate number of species (10 to 17) were more evenly distributed across the state. Average species richness was highest in the Lake Erie and Southern Lake Michigan management units and intermediate in the Southern Lake Huron, Northern Lake Huron, Central Lake Michigan, and Western Lake Superior management units (Table 15). Lakes in the Northern Lake Michigan and Eastern Lake Superior management units tended to support the lowest number of species. Species richness tended to be highest in large lakes and in lakes with a connection to the Great Lakes.

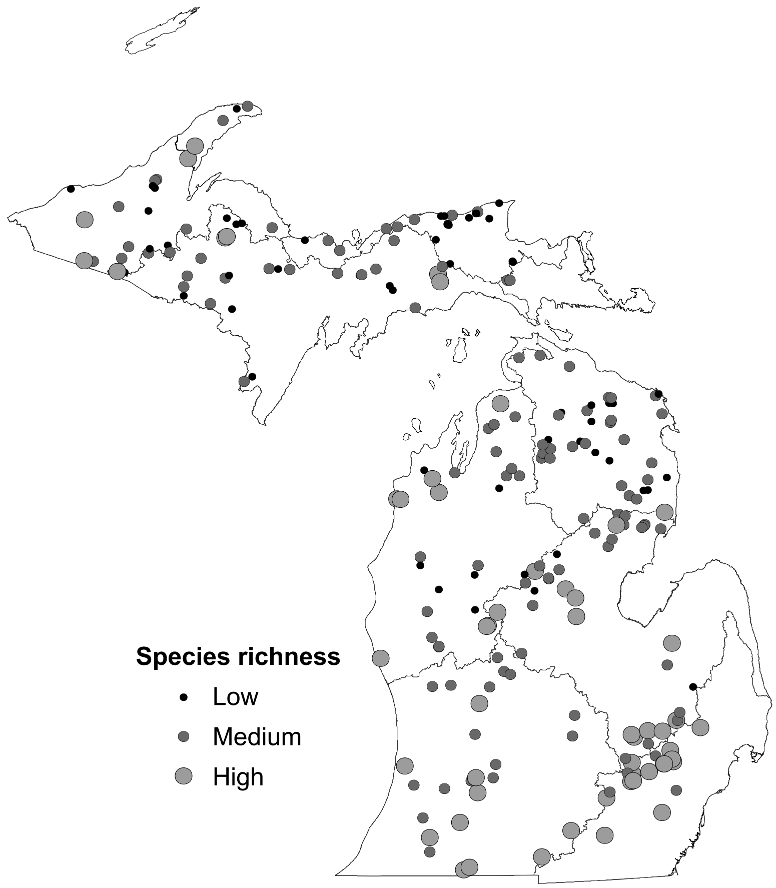


Figure 17.–Number of fish species captured in Status and Trends lakes classified into low (<10 species), medium (10 to 17 species), and high (>17 species) categories.

Table 15.–Fish species richness in Status and Trends lakes stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		15.0	8.0	20.0		16.0	22.0	20.0	16.6
	Shallow	25.0		17.3	10.7		11.4	10.7		13.2
Medium	Deep	15.7	12.3	11.0	11.9	9.6	13.1	15.4	20.1	14.2
	Shallow		12.8	14.6	18.8	9.0	12.7	16.0	11.0	14.7
	Unknown	15.3	14.7	6.3	15.0	12.0	12.2	10.5		11.7
Small	Deep	15.0	9.9	10.4	8.5	12.7	15.6	14.4	16.2	13.1
	Shallow			10.0		12.5			14.0	12.3
	Unknown	19.0	20.0			10.6	15.9	13.0	16.5	14.5
All		16.1	12.8	11.2	14.7	11.0	13.8	14.3	17.9	13.8

Species of Greatest Conservation Need

Species that consisted of only a few populations statewide or that had exhibited declines in distribution and abundance over the past 50 years were listed as species of greatest conservation need (SGCN) in the State of Michigan's Wildlife Action Plan (Eagle et al. 2005). These species and their habitats are priorities for conservation efforts. Species of greatest conservation need captured in Status and Trends lake surveys and used in this analysis included: spotted gar, brassy minnow, pugnose shiner, finescale dace, golden redhorse, brown bullhead, tadpole madtom, grass pickerel, cisco, fantail darter, and least darter. Additional information about these species was detailed later in this report under the status of individual fish species. Readers wishing to view a complete listing of all SGCN in Michigan should consult the Wildlife Action Plan (Eagle et al. 2005; http://www.michigan.gov/dnrwildlifeactionplan).

The majority of lakes (68%) in the state contained at least one SGCN (Figure 18; Table 16). Lakes supporting two to three SGCN were less common but were distributed across Michigan. Only three lakes contained four SGCN and were found in the Western Lake Superior, Northern Lake Huron, and Southern Lake Michigan management units (Table 16). The highest proportion (~75%) of lakes supporting SGCN occurred in the Northern Lake Huron and Southern Lake Michigan management units. The proportion of lakes supporting SGCN was slightly lower in the Central Lake Michigan, Lake Erie, Southern Lake Michigan, and Southern Lake Huron management units. Just over half of the lakes in the Western Lake Superior Management Unit contained SGCN. Species of Greatest Conservation Need tended to occur more often in large deep lakes and small shallow lakes (Table 16).

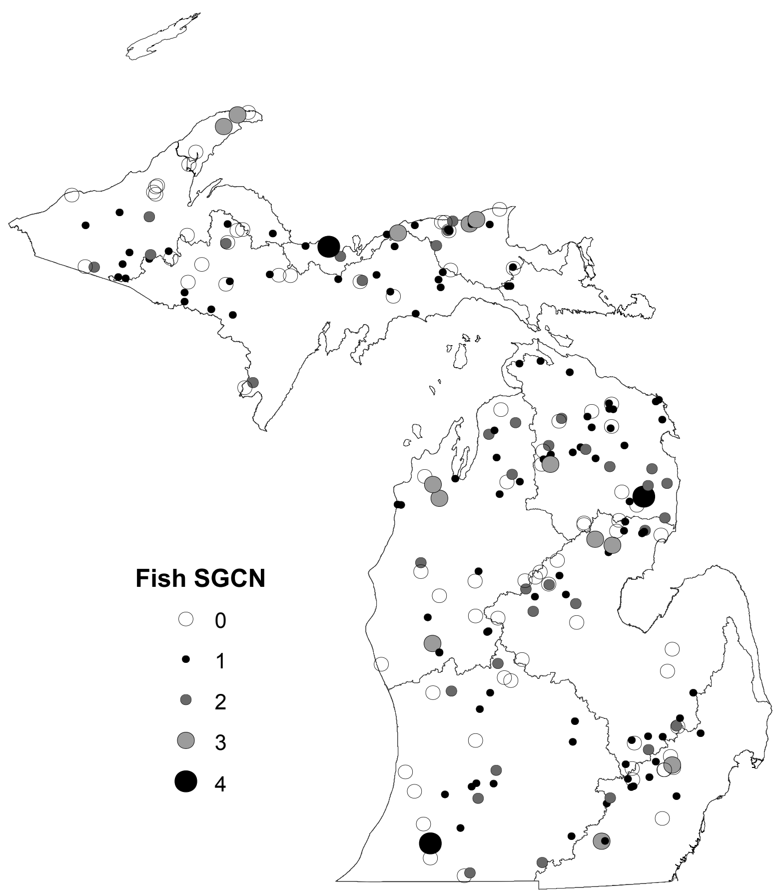


Figure 18.–Number of fish species of greatest conservation need captured in Status and Trends lakes.

Table 16.–Proportion of Status and Trends lakes where fish species of greatest conservation need (SGCN) were collected stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.33	1.00	0.75		1.00	1.00	1.00	0.75
	Shallow	1.00		1.00	0.33		0.80			0.60
Medium	Deep	0.57	1.00	0.80	0.50	1.00	0.71	0.64	0.56	0.70
	Shallow		0.75	0.60	0.50	0.50	0.67	0.75	1.00	0.64
	Unknown	1.00	0.33	0.50	1.00	0.50	0.80	0.75		0.68
Small	Deep	0.50	0.43	0.44	0.50	1.00	0.63	0.75	0.60	0.61
	Shallow			1.00		0.50			1.00	0.75
	Unknown	1.00	1.00			0.63	0.88	0.50	1.00	0.79
All		0.65	0.70	0.66	0.54	0.76	0.75	0.64	0.68	0.68

Non-native Species

Non-native fishes have the potential to harm native species, disrupt lake ecosystems, and spread to other lakes. Non-native fishes such as rainbow trout, rainbow smelt, and redear sunfish, intentionally introduced for management purposes, were not considered in this group. Non-native species collected in Status and Trends lake surveys and used in this analysis included: sea lamprey, alewife, goldfish, common carp, and white perch. Additional information about these species was provided later in this report under the status of individual fish species.

Non-native species were collected in about 20% of the lakes sampled and these waters were spread throughout the state (Figure 19; Table 17). Most lakes affected contained only one non-native species while six lakes contained two or more non-native species (Figure 19). The highest proportion of lakes containing non-native species were found in management units in the lower peninsula (Table 17). The lowest porportion of lakes with non-native species occurred in the Northern Lake Michigan and Western Lake Superior management units. A higher proportion of small lakes tended to contain non-native species.

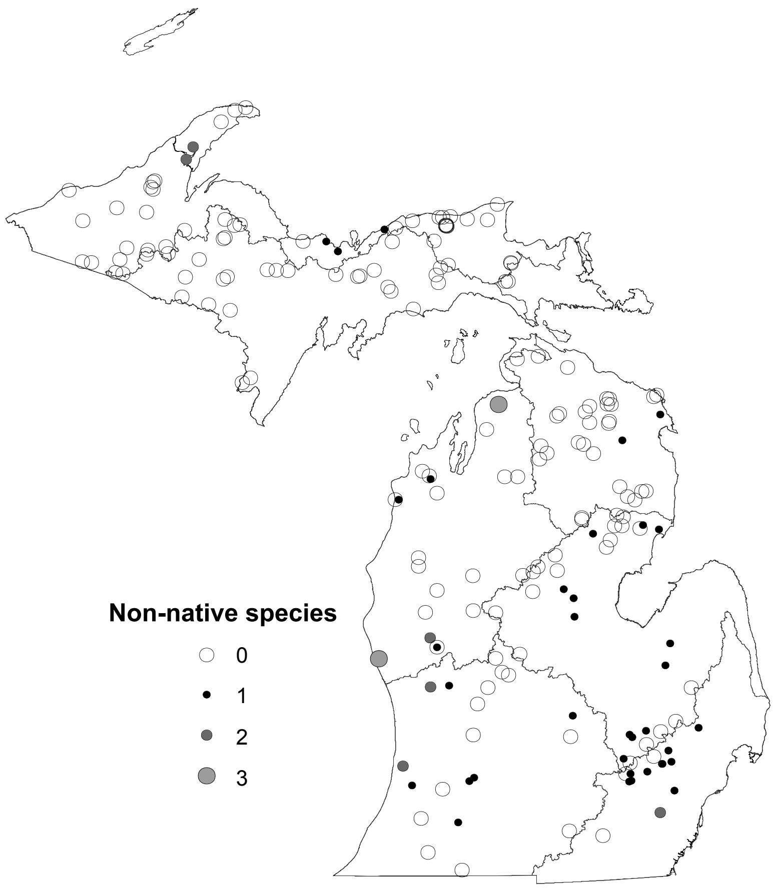


Figure 19.–Number of non-native fish species captured in Status and Trends lakes. Non-native fishes such as rainbow trout, rainbow smelt, and redear sunfish, intentionally introduced for management purposes, are not considered in this group.

Table 17.–Proportion of Status and Trends lakes where non-native fish species were captured stratified by lake size, depth, and fisheries management unit. Non-native fishes such as rainbow trout, rainbow smelt, and redear sunfish, intentionally introduced for management purposes, are not considered in this group. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0		1.00	1.00	0	0.17
	Shallow	1.00		0	0.33		0.20	0		0.20
Medium	Deep	0.21	0.36	0.20	0	0	0.14	0	0.11	0.14
	Shallow		0.75	0	0	0	0.33	0.25	1.00	0.24
	Unknown	0	0.33	0	0	0	0	0.25		0.09
Small	Deep	0.17	0.14	0	0	0.50	0.25	0.50	0.40	0.25
	Shallow			0		0			1.00	0.25
	Unknown	0.50	0			0.13	0.38	0.50	0	0.25
All		0.23	0.30	0.03	0.04	0.16	0.23	0.22	0.26	0.19

Petromyzontidae

- Sea Lamprey *Petromyzon marinus*

  Sea lamprey is an invasive species that is parasitic on other fishes. Sea lampreys are common in the Great Lakes and in lower reaches of Great Lakes tributaries; they are relatively rare in inland lakes. Sea lampreys were captured in two inland lakes which represent <1% of all lakes sampled. Both lakes were in the Eastern Lake Superior Management Unit (Figure 20) and were primarily large and deep. Too few sea lamprey individuals were caught to reliably determine typical catch rates, size distribution, or growth rates.

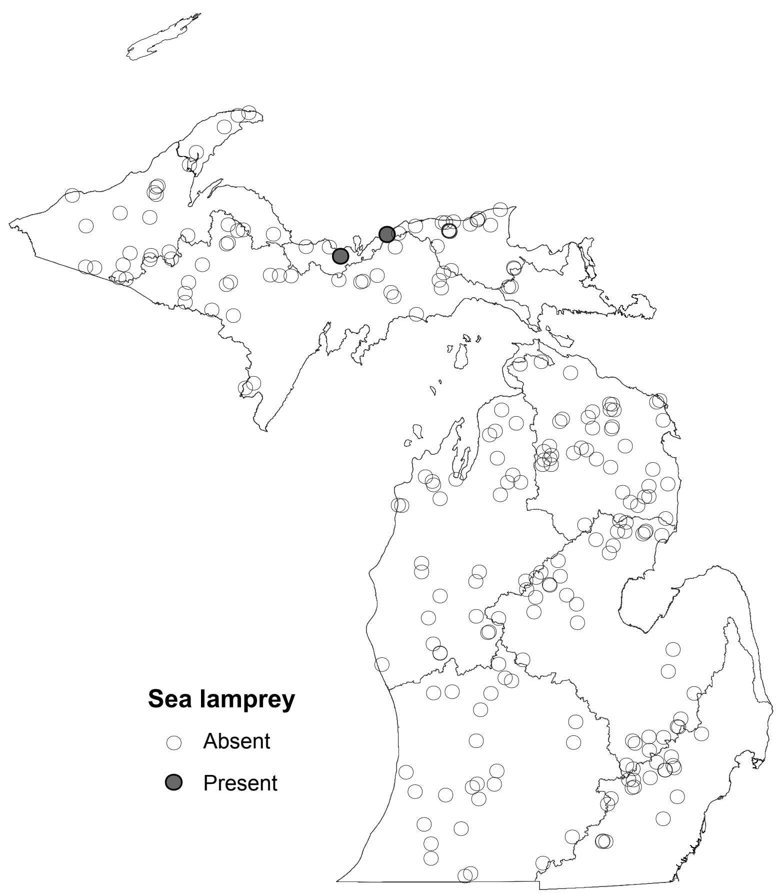


Figure 20.–Distribution of sea lampreys collected from Status and Trends lakes.

Lepisosteidae

- Spotted gar *Lepisosteus oculatus*

Spotted gars were listed as a species of greatest conservation need within Michigan's Wildlife Action Plan. Spotted gars had a limited distribution (Figure 21) and were rarely caught in Status and Trends surveys, occurring in only 3% of lakes sampled statewide (Table 18). Spotted gars were found only in the Southern Lake Michigan Management Unit primarily in medium-sized lakes. Just over 100 spotted gars were captured, allowing for an initial description of their size distribution (Figure 22). When data were pooled across all gear types, lengths of spotted gars ranged from 16 to 31 inches and the majority of fish captured were of intermediate length, measuring between 21 and 26 inches. Reliable estimates of typical catch rates and growth rates could not be determined because of the limited number of lakes where spotted gar populations were found.

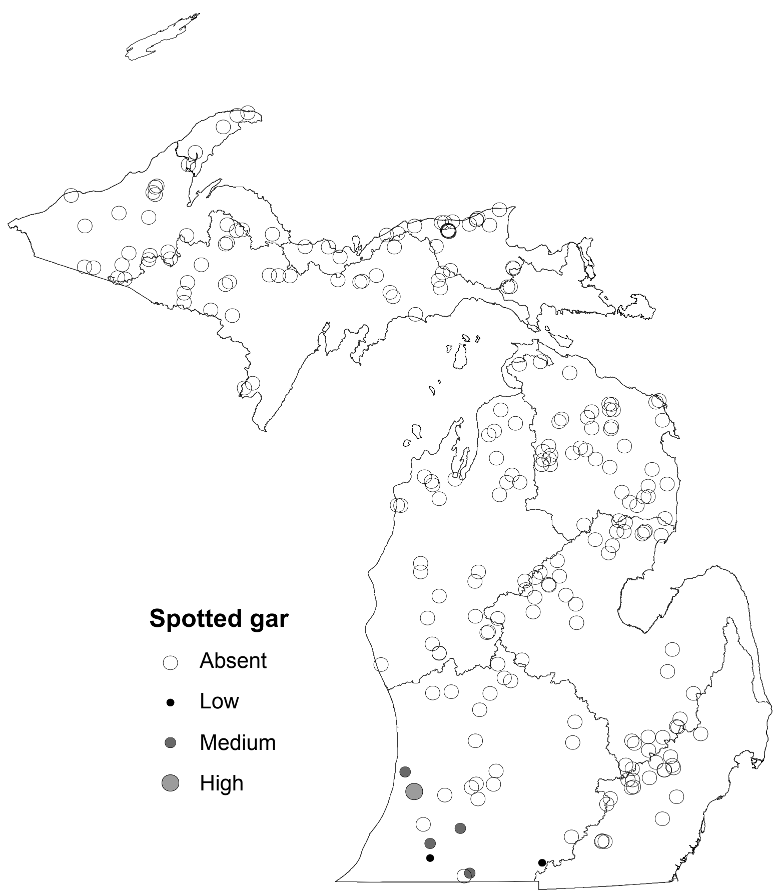


Figure 21.–Distribution and abundance of spotted gars collected from Status and Trends lakes.

Table 18.–Proportion of Status and Trends lakes containing spotted gar, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0		0	0	0	0
	Shallow	0		0	0		0	0		0
Medium	Deep	0.29	0	0	0	0	0	0	0	0.05
	Shallow		0	0	0	0	0	0	0	0
	Unknown	0.33	0	0	0	0	0	0		0.05
Small	Deep	0.33	0	0	0	0	0	0	0	0.04
	Shallow			0		0			0	0
	Unknown	0	0			0	0	0	0	0
All		0.27	0	0	0	0	0	0	0	0.03

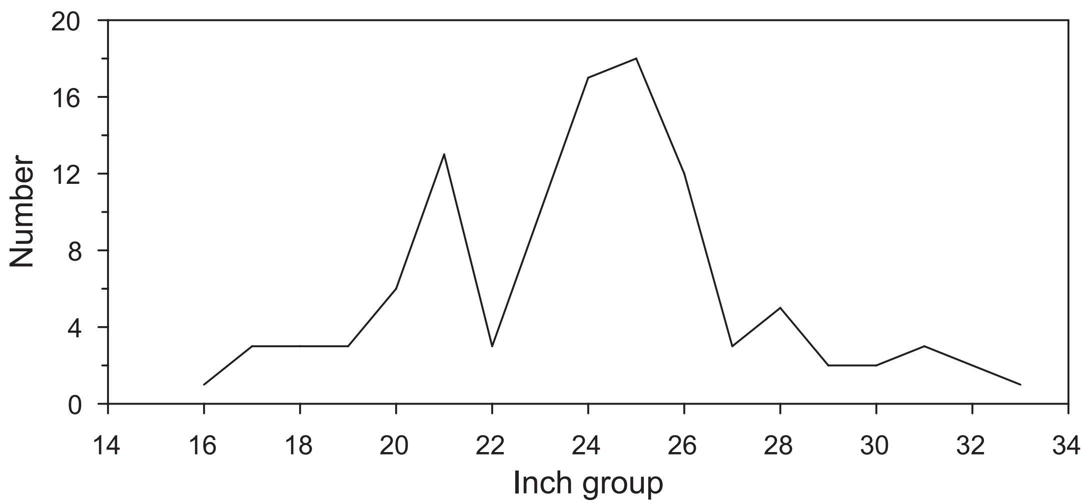


Figure 22.–Size distribution of spotted gars in all gears combined.

- Longnose gar *Lepisosteus osseus*

Longnose gars were caught only in the lower peninsula (Figure 23), and for the state as a whole were found in only 12% of lakes sampled. Longnose gars occurred most frequently in the larger lakes within the Lake Erie and Southern Lake Michigan management units (Table 19).

Longnose gars were only collected often enough with trap nets to provide a typical range of catch rates (0.2 to 4 fish per lift in the 22 lakes where catches occurred). Catch rates of longnose gars in trap nets showed relatively higher abundance in large lakes within the Lake Erie and Southern Lake Michigan management units (Table 20).

The size distribution of longnose gars (all gears combined) showed a broad peak between 24 and 36 inches (Figure 24).

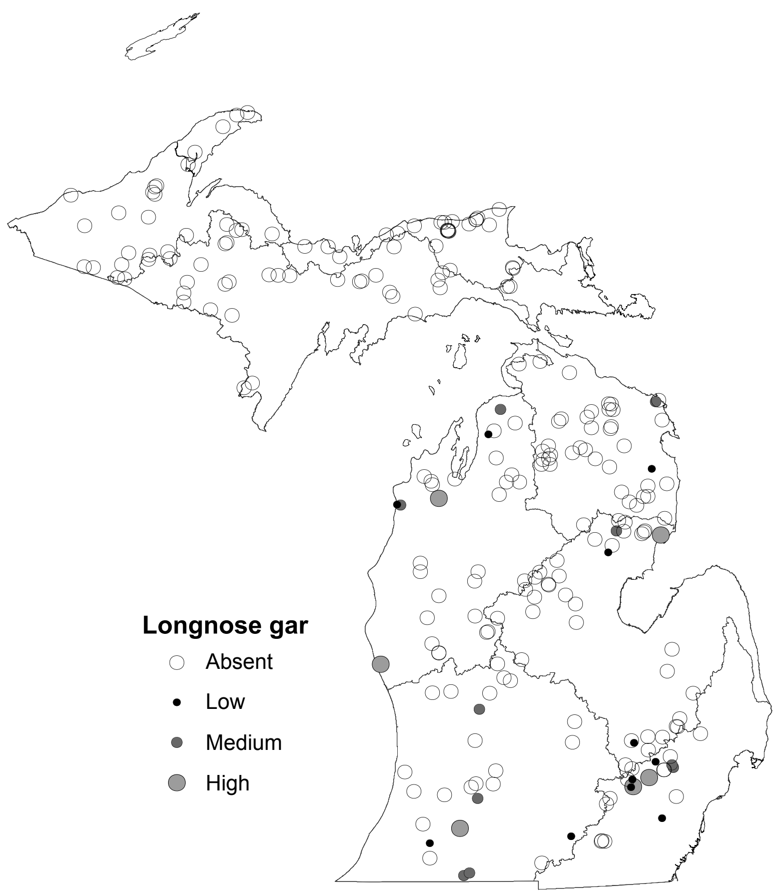


Figure 23.–Distribution and abundance of longnose gars collected from Status and Trends lakes.

Table 19.–Proportion of Status and Trends lakes containing longnose gar, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.00	0	0		1.00	0	1.00	0.42
	Shallow	1.00		0	0		0.20	0.33		0.20
Medium	Deep	0.36	0.18	0	0	0	0	0.14	0.67	0.19
	Shallow		0	0	0	0	0	0	0	0
	Unknown	0.33	0	0	0	0	0	0		0.05
Small	Deep	0	0.14	0	0	0	0	0.13	0	0.06
	Shallow			0		0			0	0
	Unknown	0	0			0	0	0	0	0
All		0.27	0.20	0	0	0	0.05	0.11	0.42	0.12

Table 20.–Mean CPUE (catch per lift, including sites with zero catches) of longnose gars in trap nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		2.03	0	0		0	0	6.08	1.74
	Shallow	4.50		0	0		0.16	2.00		1.03
Medium	Deep	0.73	0.01	0	0	0	0	0.11	0.21	0.21
	Shallow		0	0	0	0	0	0	0	0
	Unknown	2.00	0	0	0	0	0	0		0.38
Small	Deep	0	0.04	0	0	0	0	0.13	0	0.01
	Shallow			0		0			0	0
	Unknown	0	0			0	0	0	0	0
All		0.80	0.25	0	0	0	0.02	0.21	0.42	0.27

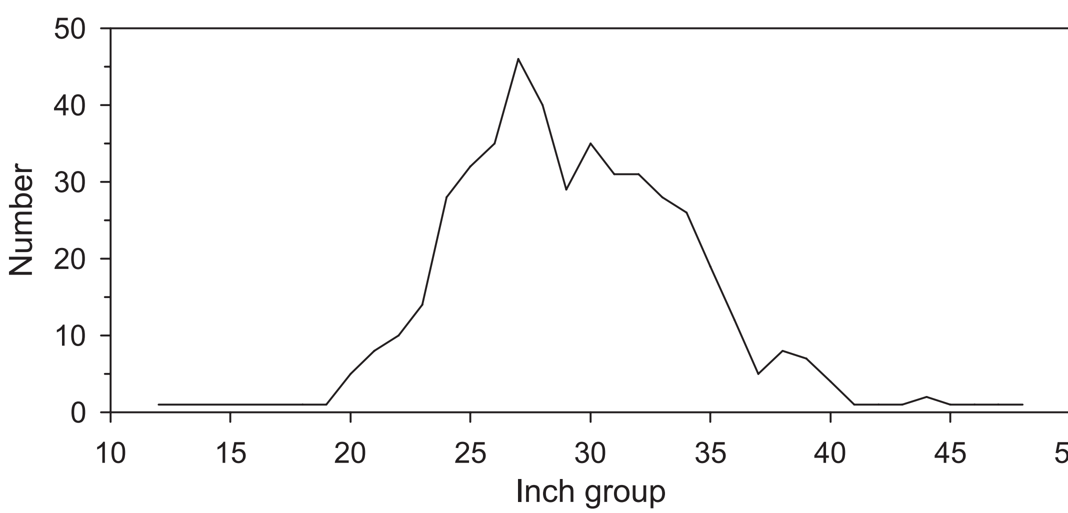


Figure 24.–Size distribution of longnose gars in all gears combined.

Amiidae

- Bowfin *Amia calva*

Bowfin occurred frequently, being caught in 30% of all lakes sampled (Table 21). Bowfin were rarely captured in the Upper Peninsula and occurred most frequently in the Southern Lake Michigan and Lake Erie management units (Figure 25; Table 21). Bowfin were somewhat more prevalent in larger lakes, and were rarely caught in small lakes (Table 21).

Bowfin were not caught in large numbers, and the majority were caught by trap and fyke nets. For the state as a whole, the typical range of catch rates for electrofishing gear was very low at 0.03 to 0.10 fish per minute (Table 22). Catch rates in trap nets and fyke nets were similar, with typical ranges of about 0.3 to 1.5 fish per lift. Catches in other gears were too infrequent to determine typical catch rates. Patterns in CPUE in fyke and trap nets (Tables 23 and 24), which provided the highest total catch, indicate higher abundance in the southern part of the state, and some indication of higher abundance in large shallow lakes.

The size composition of bowfin in fyke nets and trap nets was similar (Figure 26), with mean lengths of 22.5 (SE=0.5) and 23.6 inches (SE=0.3), respectively.

Table 21.–Proportion of Status and Trends lakes containing bowfin, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.00	0	0		0	1.00	1.00	0.42
	Shallow	1.00		0	0		0.40	1.00		0.40
Medium	Deep	0.86	0.45	0	0	0	0	0.57	0.89	0.41
	Shallow		0	0	0	0	0	0.50	1.00	0.12
	Unknown	1.00	0	0	0	0	0.40	0.25		0.27
Small	Deep	0.50	0	0.22	0	0	0	0.13	0.80	0.21
	Shallow			0		0			0	0
	Unknown	0.50	0			0	0.13	0.50	0.50	0.20
All		0.77	0.27	0.07	0	0	0.12	0.47	0.79	0.30

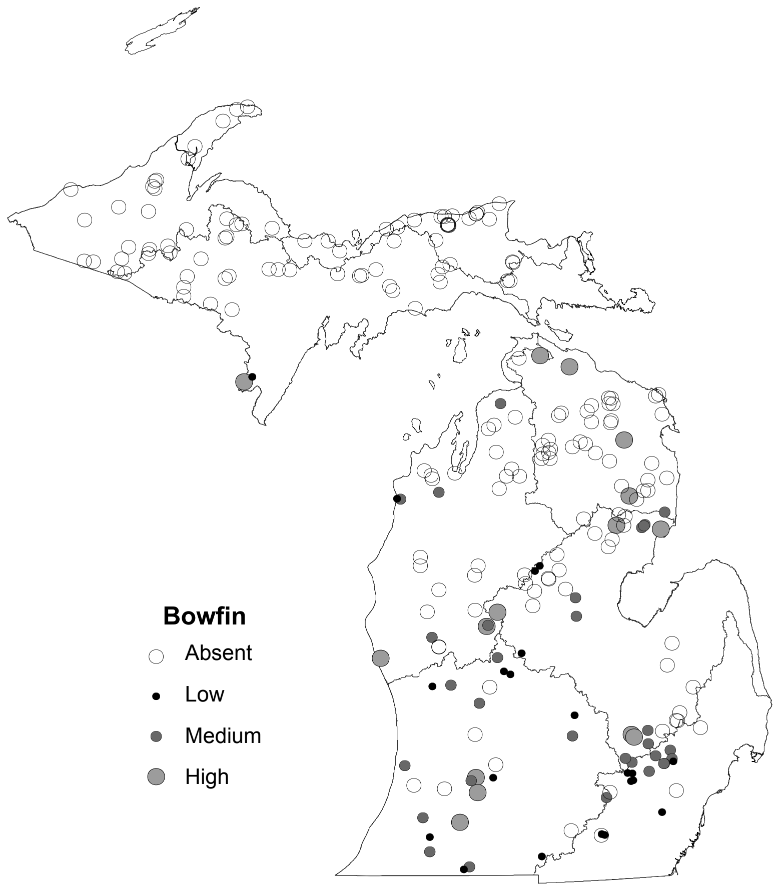


Figure 25.–Distribution and abundance of bowfin collected from Status and Trends lakes.

Table 22.–Summary of catch per unit effort of bowfin by gear, including only sites and gears with catches greater than zero. Catch per unit effort for electrofishing is number of fish per minute. Catch per unit effort for fyke net and trap net is number of fish per lift. Number of lakes with positive catches for each gear is denoted by n.

Gear	Low	Typical range					High	Maximum	n
		25th		Median		75th			
Electrofishing	<0.03	0.03	to	0.04	to	0.10	>0.10	0.4	25
Fyke net	<0.24	0.24	to	0.92	to	1.33	>1.33	3.2	34
Trap net	<0.30	0.3	to	0.81	to	1.58	>1.58	6.3	60

Table 23.–Mean CPUE (catch per lift, including sites with zero catches) of bowfin in fyke nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.23	0	0		0	0.13	0.08	0.06
	Shallow	1.25		0	0		0.63	0.98		0.52
Medium	Deep	0.66	0.46	0	0	0	0	0.48	0.06	0.20
	Shallow		0	0	0	0	0	0.33	0	0.05
	Unknown	0.58	0	0	0	0	0.47	0		0.18
Small	Deep	0	0	0.31	0	0	0	0.08	0.19	0.10
	Shallow			0		0				0
	Unknown		0			0	0.10	0	0.50	0.10
All		0.59	0.14	0.1	0	0	0.15	0.34	0.14	0.16

Table 24.–Mean CPUE (catch per lift, including sites with zero catches) of bowfin in trap nets, stratified by lake size, depth, and management unit. Trap nets were not used in Western Lake Superior.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.70	0			0	0.50	0.33	0.42
	Shallow	3.00		0			0.45	3.05		1.31
Medium	Deep	0.57	0.89			0	0	0.89	0.30	0.48
	Shallow		0			0	0	0.53	4.00	0.44
	Unknown	0.92	0	0		0	0.59	0.22		0.41
Small	Deep	0.46	0			0	0	0.19	0.47	0.21
	Shallow					0			0	0
	Unknown	0.75	0				0.17	0.08	0.25	0.24
All		0.69	0.42	0		0	0.16	0.74	0.52	0.45

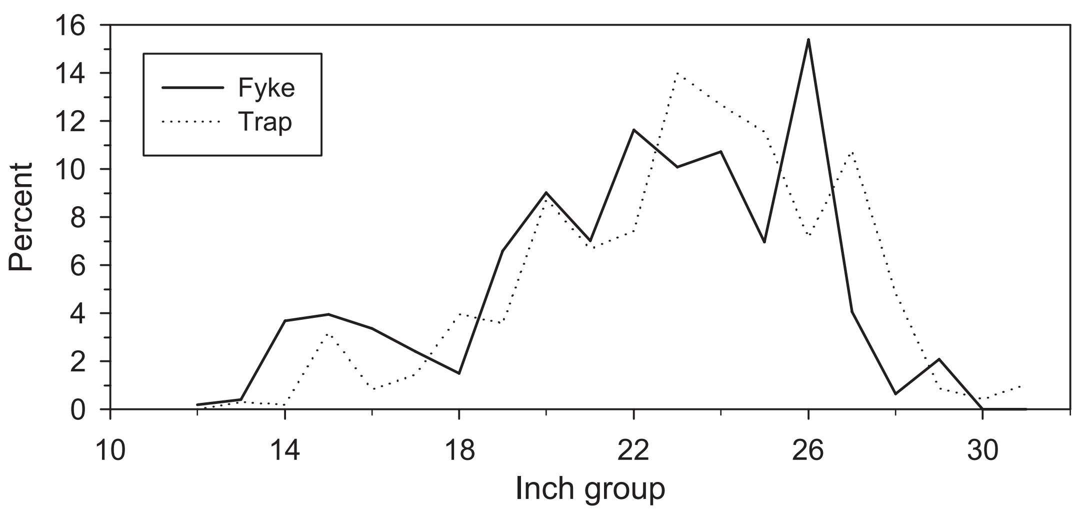


Figure 26.–Size distribution of bowfin in trap nets and fyke nets.

Clupeidae

- Alewife *Alosa pseudoharengus*

The alewife is an invasive species that has vastly altered the ecology of the Great Lakes. Alewives were relatively uncommon in inland lakes, being caught in only 3% of all lakes sampled (Table 25). Their distribution was sporadic (Figure 27), reflective of their low percentage occurrence. They occurred somewhat more frequently in large and medium sized lakes in the Central Lake Michigan Management Unit (Table 25).

A total of 237 alewives were caught, precluding more detailed analyses of catch per effort. The size distribution of catches in all gear peaked at 6 inches (Figure 28).

Table 25.–Proportion of Status and Trends lakes containing alewife, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.67	0	0.25		0	0	0	0.25
	Shallow	0		0	0.33		0	0		0.07
Medium	Deep	0.14	0.09	0	0	0	0	0	0	0.04
	Shallow		0	0	0	0	0	0	0	0
	Unknown	0	0	0	0	0	0	0		0
Small	Deep	0	0	0	0	0	0	0	0	0
	Shallow			0		0			0	0
	Unknown	0	0			0	0	0	0	0
All		0.08	0.10	0	0.08	0	0	0	0	0.03

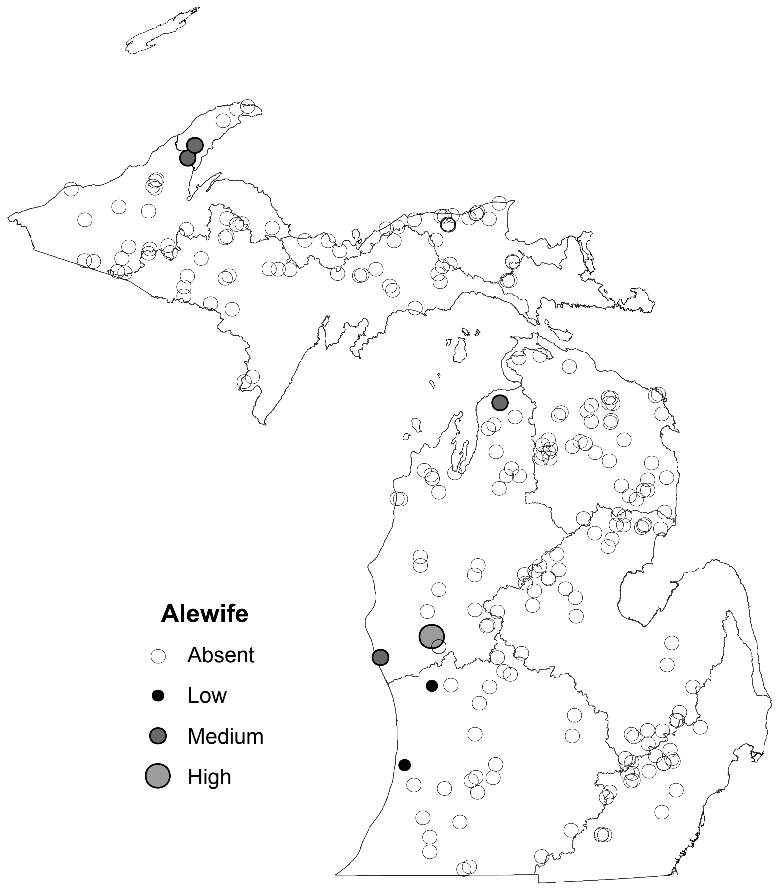


Figure 27.–Distribution and abundance of alewives collected from Status and Trends lakes.

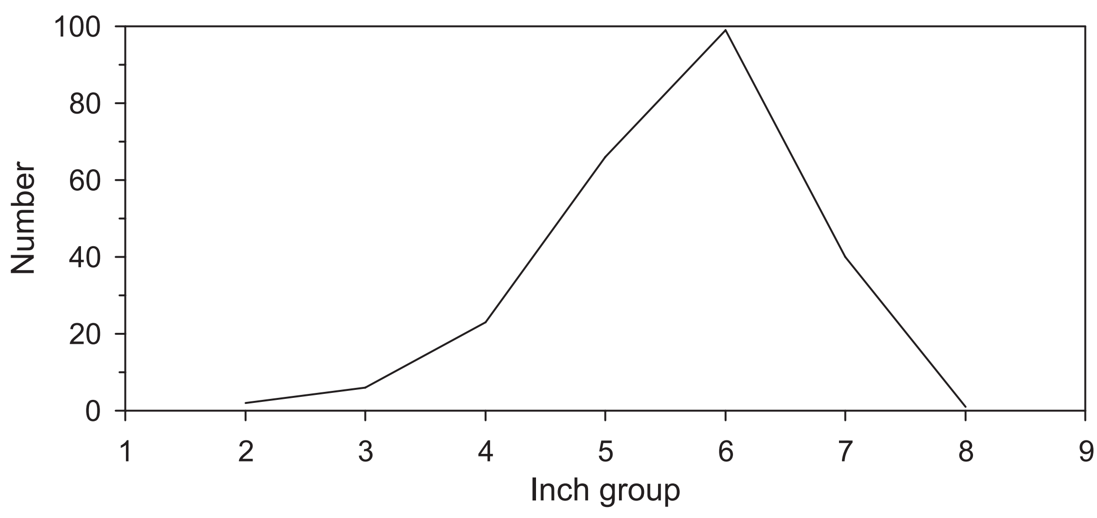


Figure 28.–Size distribution of alewives captured in all gear types combined.

Cyprinidae

- Goldfish *Carassius auratus*

Goldfish are an invasive species, but only a single individual was caught in one inland lake (<1% of lakes sampled). The only lake where a goldfish was caught was in the Southern Lake Huron Management Unit (Figure 29). Too few goldfish were caught to reliably determine typical catch rates, size distribution or growth rates.

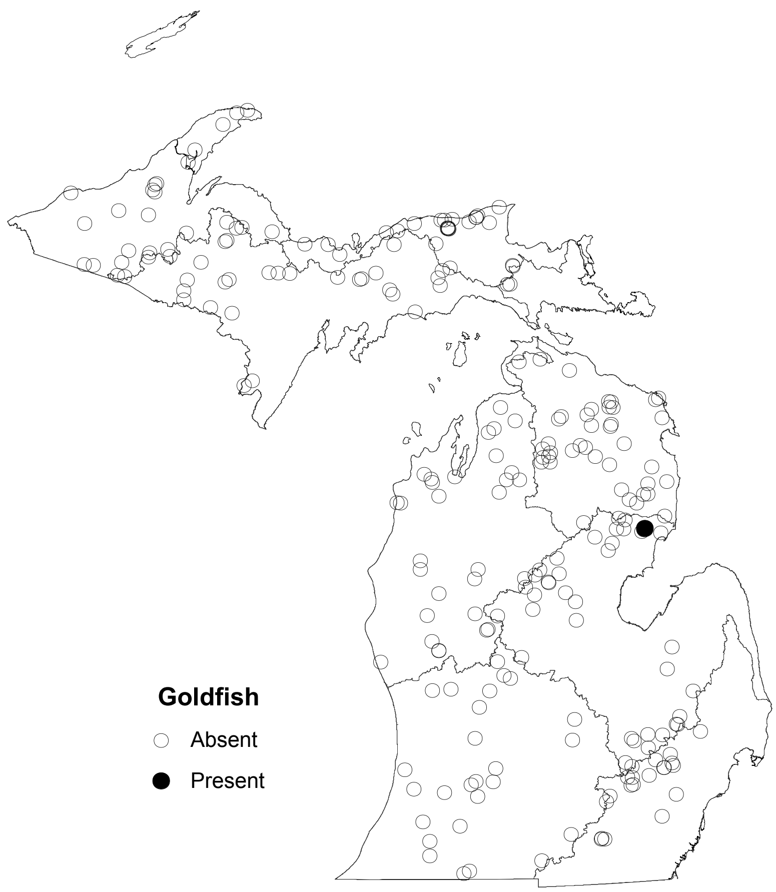


Figure 29.–Distribution goldfish collected from Status and Trends lakes.

- Spotfin shiner *Cyprinella spiloptera*

Spotfin shiners were modestly common in the state, being caught in 7% of all lakes sampled. Spotfin shiners were caught only in the Lower Peninsula (Figure 30) but showed their highest frequency of occurrence in the Lake Erie Management Unit (Table 26) where they occurred in nearly 50% of lakes sampled.

Over 500 spotfin shiners were caught, mostly in seine nets, but they were only caught in 14 lakes with this gear, making it difficult to characterize typical catch rates. The range of catches in seine nets between the 25th and 75th percentile was broad, from 0.5 to over 12 fish per haul.

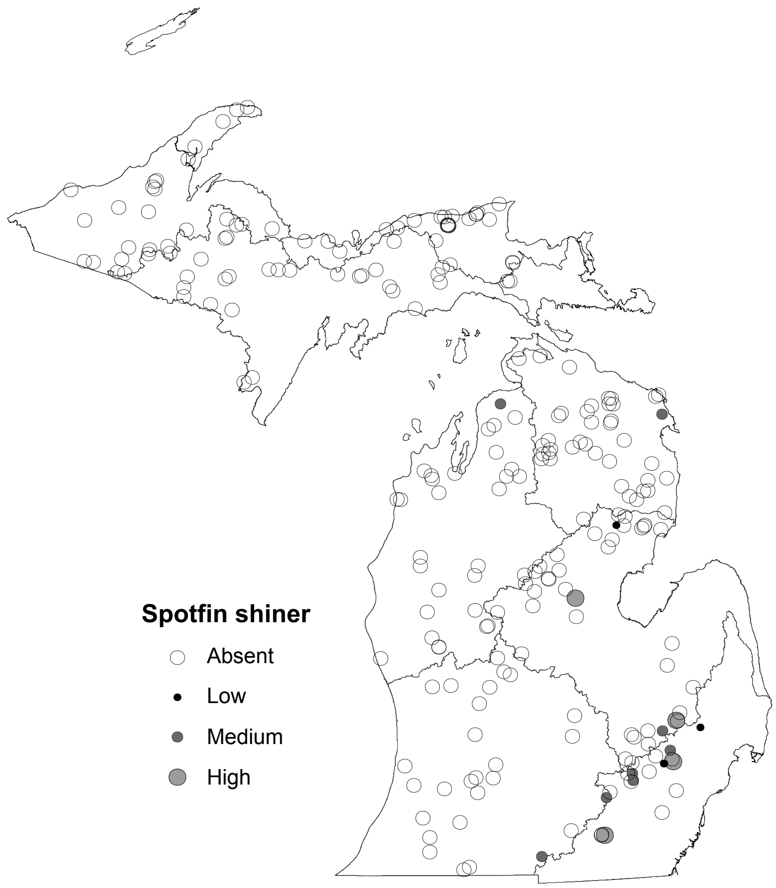


Figure 30.–Distribution and abundance of spotfin shiners collected from Status and Trends lakes.

Table 26.–Proportion of Status and Trends lakes containing spotfin shiner, stratified by lake size, depth, and Fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.33	0	0		0	1.00	0	0.17
	Shallow	0		0	0		0.20	0		0.07
Medium	Deep	0	0	0	0	0	0	0.07	0.67	0.09
	Shallow		0	0	0	0	0	0	1.00	0.04
	Unknown	0	0	0	0	0	0	0.25		0.05
Small	Deep	0.17	0	0	0	0	0	0.13	0.40	0.08
	Shallow			0		0			0	0
	Unknown	0	0			0	0	0	0	0
All		0.04	0.03	0	0	0	0.02	0.11	0.47	0.07

- Common carp *Cyprinus carpio*

Carp are an invasive species and were caught in only 18% of lakes sampled. Although carp occurred across the entire state (Figure 31), they were much more prevalent in the southern management units (Table 27) and were much more common in large and medium lakes than small lakes (Table 27).

Although carp were caught in all gears deployed (Appendix A), the vast majority were caught by trap nets. For the state as a whole, the typical range of catch rates for trap nets was 0.33 to 1.83 fish per lift, with a maximum of 18 fish per lift. Electrofishing provided modest numbers of carp, with typical catch rates of 0.03 to 0.13 fish per minute. Patterns in CPUE in trap nets showed highest catch rates in large and medium-sized deep lakes in the Lake Erie Management Unit (Table 28).

The size distribution of catches in trap nets was broad, ranging from 3 to 36 inches (Figure 32) and average length was 23.8 inches (SE=0.2).

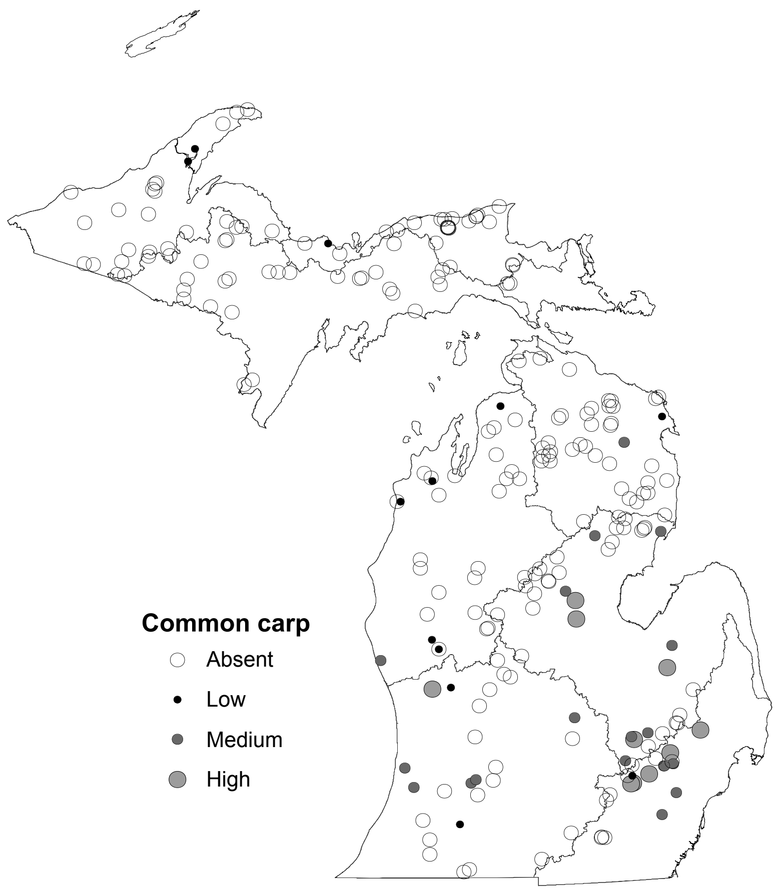


Figure 31.–Distribution and abundance of common carp collected from Status and Trends lakes.

Table 27.–Proportion of Status and Trends lakes containing common carp, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.67	0	0.25		0	1.00	1.00	0.42
	Shallow	0		0	0.33		0.40	0.67		0.33
Medium	Deep	0.36	0.27	0	0	0.20	0	0.36	0.78	0.26
	Shallow		0	0	0	0	0	0.25	0	0.04
	Unknown	1.00	0	0	0	0	0	0.50		0.23
Small	Deep	0	0.14	0	0	0	0	0	0.40	0.06
	Shallow			0		0			0	0
	Unknown	0	0			0	0	0	0.50	0.05
All		0.31	0.20	0	0.08	0.05	0.05	0.31	0.58	0.18

Table 28.–Mean CPUE (catch per lift, including sites with zero catches) of common carp in trap nets, stratified by lake size, depth, and management unit. Trap nets were not used in Western Lake Superior.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.18	0			0	1.38	2.08	0.57
	Shallow	0		0			0.18	1.03		0.36
Medium	Deep	0.37	0.03			0	0	0.52	4.42	0.79
	Shallow		0			0	0	0.04	0	0.01
	Unknown	0.22	0	0		0	0	0.48		0.16
Small	Deep	0	0.02			0	0	0	0.60	0.10
	Shallow					0			0	0
	Unknown	0	0				0	0	0.44	0.07
All		0.22	0.04	0		0	0.02	0.38	2.41	0.42

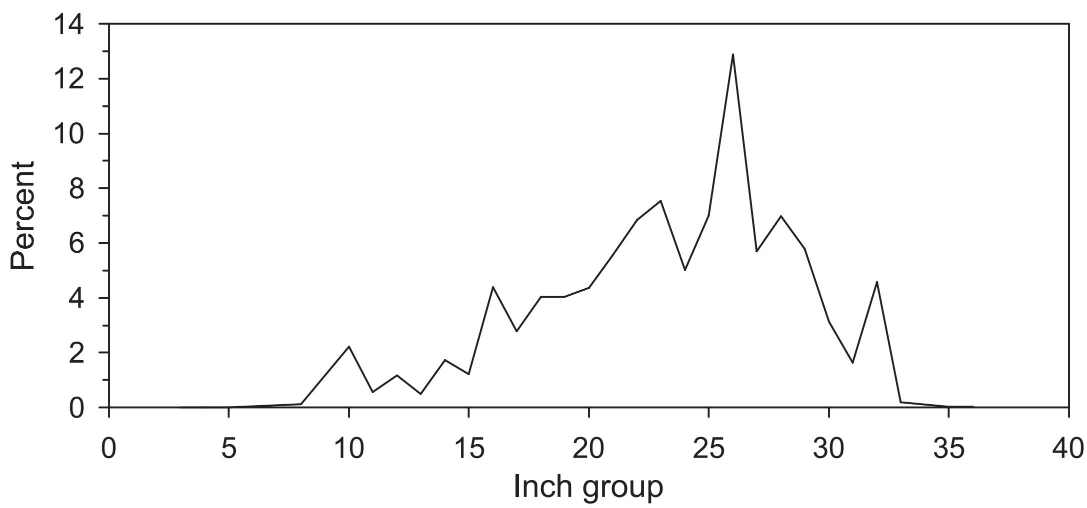


Figure 32.–Size distribution of common carp in trap nets and fyke nets.

- Brassy minnow *Hybognathus hankinsoni*

  Brassy minnow is currently listed as a species of greatest conservation need within Michigan's Wildlife Action Plan. Brassy minnows were caught in two inland lakes (<1% of lakes sampled) one within the Lake Erie Management Unit and the other within the Northern Lake Huron Management Unit (Figure 33). Too few brassy minnows were caught to reliably determine typical catch rates, size distribution or growth rates.

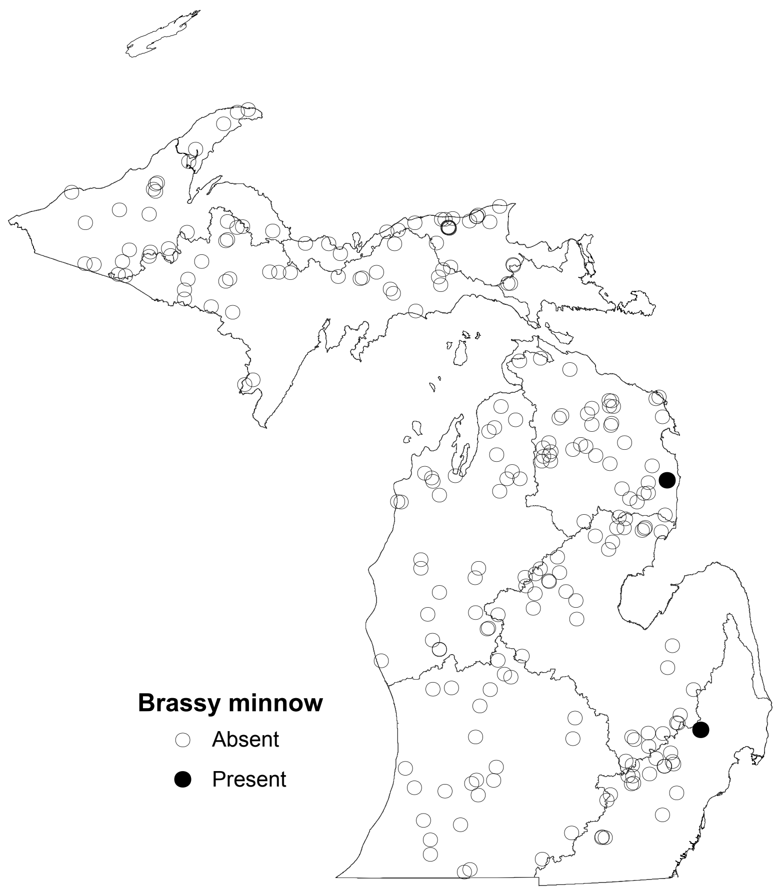


Figure 33.–Distribution of brassy minnows collected from Status and Trends lakes.

- Common shiner *Luxilus cornutus*

Common shiners were relatively common in the state, being caught in 20% of all lakes sampled. Common shiners were more prevalent in the northern part of the state (Figure 34), with no clear pattern in distribution across lake size and depth except somewhat higher occurrence in larger lakes (Table 29).

Common shiners were caught in all gears deployed (Appendix A), but the majority of the catch occurred in mini fyke nets. Even though most of the catch occurred in mini fyke nets, common shiner was not caught in any single gear frequently enough to accurately characterize typical catch rates. The 25th to 75th percentile catches for mini fyke nets, for example, ranged from 0.25 to 36 for the 19 lakes where common shiner was caught in this gear.

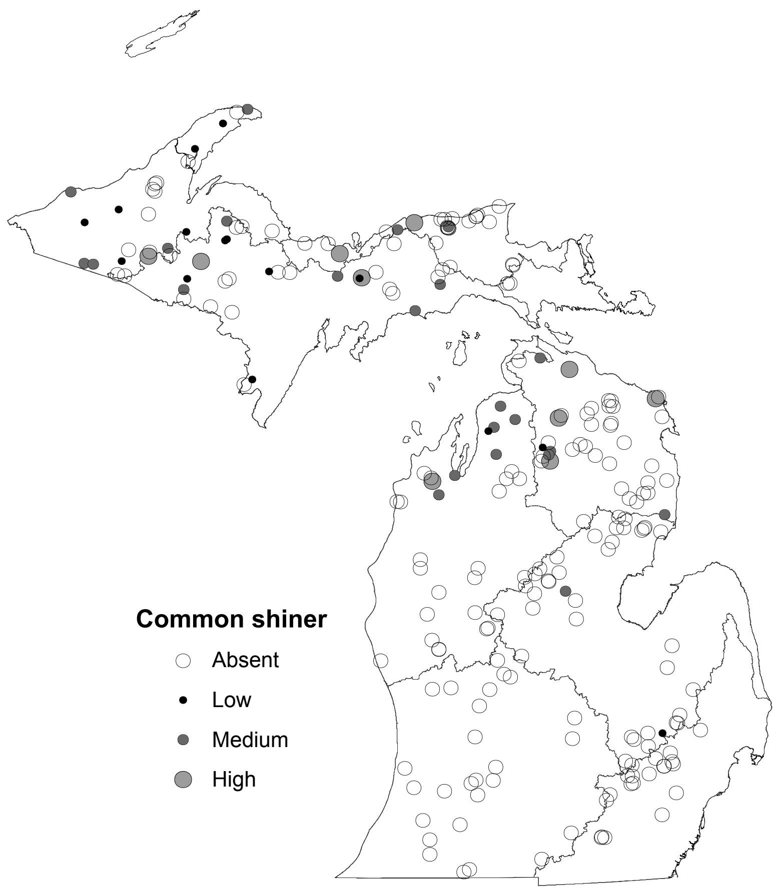


Figure 34.–Distribution and abundance of common shiner collected from Status and Trends lakes.

Table 29.–Proportion of Status and Trends lakes containing common shiner, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.67	0.50	0.50		0	0	0	0.42
	Shallow	0		0.33	0.33		0.60	0		0.33
Medium	Deep	0	0.18	0.80	0.13	0.60	0.07	0	0	0.14
	Shallow		0.50	0.20	0.83	0	0	0.25	0	0.36
	Unknown	0	0.33	0	1.00	0	0.20	0.25		0.18
Small	Deep	0	0.14	0.56	0.50	0	0.29	0	0	0.19
	Shallow			1.00		0			0	0.25
	Unknown	0	0			0	0.25	0	0	0.10
All		0	0.27	0.45	0.46	0.16	0.21	0.06	0	0.20

- Northern pearl dace *Margariscus nachtriebi*

Northern pearl dace were caught in only 2% of lakes sampled, all within the Northern or Central Lake Michigan management unit (Figure 35). Too few northern pearl dace were caught to reliably determine typical catch rates, size distribution or growth rates.

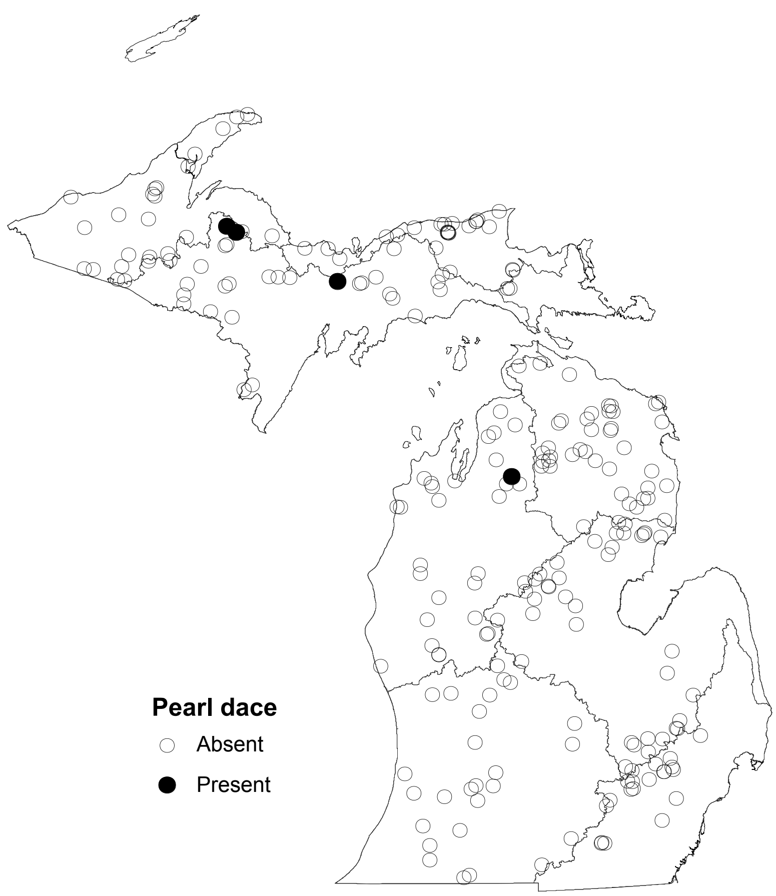


Figure 35.–Distribution of northern pearl dace collected from Status and Trends lakes.

- Hornyhead chub *Nocomis biguttatus*

Hornyhead chub were caught in only 3% of lakes sampled, scattered throughout the state (Figure 36). Too few hornyhead chub were caught to reliably determine typical catch rates, size distribution or growth rates.

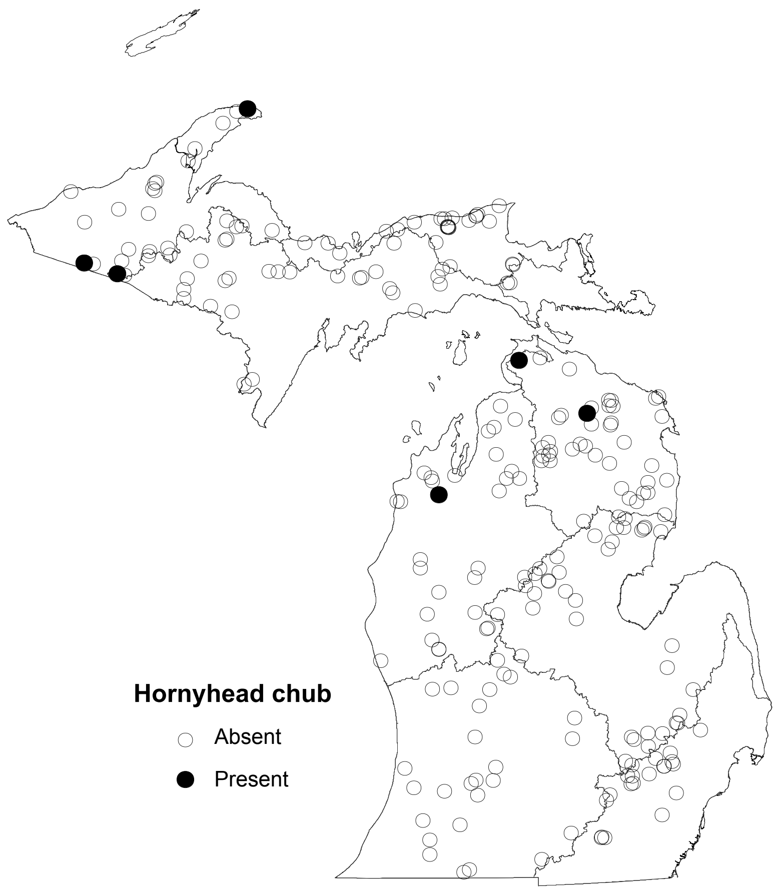


Figure 36.–Distribution hornyhead chub collected from Status and Trends lakes.

- Golden shiner *Notemigonus crysoleucas*

Golden shiners were common in the state, being caught in 46% of all lakes sampled. Golden shiners occurred across the entire state (Figure 37), with no clear pattern in distribution across lake size, depth, or region (Table 30).

Golden shiners were caught in all gears deployed (Appendix A), with no single gear dominating catches. For the state as a whole, the typical range of catch rates for electrofishing gear was roughly 0.03 to 0.25 fish per minute (Table 31). Catch rates in fyke and trap nets were similar, with a typical range of roughly 0.1 to 1 fish per lift. Catch rates in mini fyke nets and seines were also roughly similar, typically ranging from about 0.5 to 5.5 fish per lift. Catches in gill nets were fairly consistent at 0.25 to 2 fish per lift. Catch rates of golden shiners varied across gears, management units, lake size and lake depth (Tables 32-37). Patterns in CPUE in fyke and trap nets (Tables 33 and 37), which provided the highest total catch, were highly variable between regions and gears, with no consistent pattern evident.

Each gear appeared to select for a particular size range of golden shiners (Figure 38). Seines selected for the smallest golden shiners (Figure 38), with an average length of 2.9 inches (SE=0.2). Mini fyke nets also caught relatively small fish, averaging 3.8 inches (SE=0.2). Electrofishing gear selected for somewhat larger fish than mini fykes (mean=4.7 inches, SE=0.2), as did fyke nets with a mean length of 6.0 inches (SE=0.3). Gill nets and trap nets caught the largest fish, averaging 6.8 (SE=0.2) and 7.5 inches (SE=0.1) respectively.

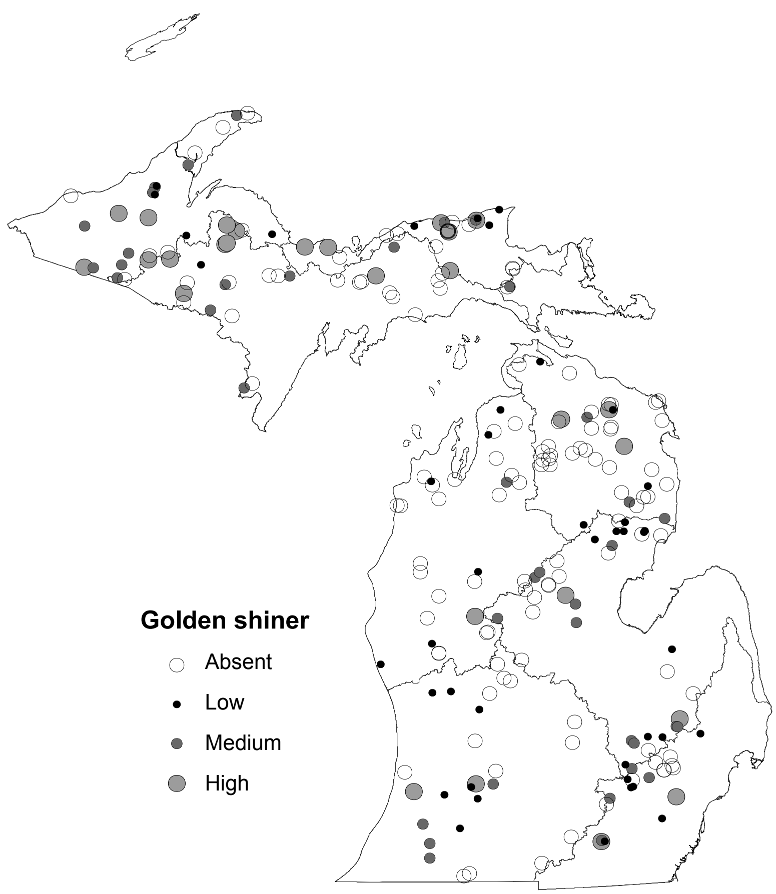


Figure 37.–Distribution and abundance of golden shiners collected from Status and Trends lakes.

Table 30.–Proportion of Status and Trends lakes containing golden shiner, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.67	0.50	0.75		0	1.00	1.00	0.67
	Shallow	1.00		0.33	0.67		0.40	0.67		0.53
Medium	Deep	0.57	0.18	0.20	0.63	0.40	0.14	0.64	0.56	0.43
	Shallow		0.25	0.60	0.83	0.50	0.67	1.00	0	0.64
	Unknown	0.67	0	0.50	1.00	1.00	0.40	0.75		0.55
Small	Deep	0.33	0.29	0.44	0.50	0.50	0.14	0.50	0.40	0.38
	Shallow			0		0			1.00	0.25
	Unknown	0	0.50			0.75	0.25	0	1.00	0.40
All		0.50	0.27	0.41	0.71	0.53	0.26	0.64	0.58	0.46

Table 31.–Summary of catch per unit effort of golden shiner by gear, including only sites and gears with catches greater than zero. Catch per unit effort for electrofishing is number of fish per minute. Catch per unit effort for fyke net, gill net, mini fyke, and trap net is number of fish per lift. Catch per unit effort for seining is number of fish per haul. Number of lakes with positive catches for each gear is denoted by n.

		Typical range							
Gear	Low	25th		Median		75th	High	Maximum	n
Electrofishing	<0.03	0.03	to	0.10	to	0.25	>0.25	2.00	52
Fyke net	<0.13	0.13	to	0.33	to	0.78	>0.78	10.10	25
Gill net	<0.25	0.25	to	0.50	to	2.00	>2.00	15.30	21
Mini fyke	<0.50	0.5	to	1.00	to	6.17	>6.17	452.50	31
Seine	<0.33	0.33	to	0.67	to	5.00	>5.00	57.30	15
Trap net	<0.13	0.13	to	0.17	to	1.22	>1.22	29.50	39

Table 32.–Mean CPUE (catch per minute, including sites with zero catches) of golden shiner in electrofishing surveys, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0.15		0	0.17	0	0.07
	Shallow	0		0.06	0.04		0	0.03		0.03
Medium	Deep	0.07	0.01	0.04	0.01	0.03	0.02	0.03	0	0.03
	Shallow		0.02	0.71	0.08	0.37		0.15	0	0.25
	Unknown	0.01	0	0.12	0.30	1.03	0	0.02		0.11
Small	Deep	0.06	0.01	0.06	0		0	0.06	0	0.04
	Shallow									
	Unknown	0	0			0	0	0		0
All		0.05	0.01	0.20	0.07	0.21	0.01	0.05	0	0.07

Table 33.–Mean CPUE (catch per lift, including sites with zero catches) of golden shiner in fyke nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0		0	0	0.25	0.02
	Shallow	0		0	3.38		0.08	0		0.75
Medium	Deep	0.22	0.08	0.16	0.05	0.15	0	0	0	0.07
	Shallow		0	0.11	0.58	0	0	0.08	0	0.18
	Unknown	0.13	0	0.03	0	0	0.24	0		0.08
Small	Deep	0.06	0.53	0.03	0	0	0	0	0	0.09
	Shallow			0		0				0
	Unknown		0.05			0.25	0.01	0	0	0.07
All		0.16	0.17	0.06	0.59	0.09	0.04	0.01	0.02	0.13

Table 34.–Mean CPUE (catch per lift, including sites with zero catches) of golden shiner in gill nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.06	0	0		0	0	2.00	0.21
	Shallow	0		0	0		0.04	0.54		0.09
Medium	Deep	1.18	0	0	0.05	0	0	0	0	0.21
	Shallow		0.06	2.00	0.13	0.13	0	0.13	0	0.41
	Unknown	0	0	0	0		0	0		0
Small	Deep	0	0	0.24	0	0	0	0.13	0.10	0.08
	Shallow			0					2.50	1.25
	Unknown	0	0.17			0	0.25	0	0	0.14
All		0.63	0.02	0.36	0.05	0.02	0.05	0.08	0.26	0.18

Table 35.–Mean CPUE (catch per lift, including sites with zero catches) of golden shiner in mini fyke nets, stratified by lake size, depth, and management unit. Mini fyke nets were not used in Southern Lake Huron.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0.25		0			0.10
	Shallow				2.06		0.58			1.13
Medium	Deep	0		0.38	0.71		0.01		0	0.28
	Shallow		0	0.34	10.44		3.25			4.63
	Unknown	0	0	0.17	0.50	0	0.13			0.13
Small	Deep	0	0	62.63	0.25	3.38	0.67		0	20.75
	Shallow			0		0			0	0
	Unknown					5.70	18.63		0	12.78
All		0	0	22.94	3.61	2.78	4.26		0	7.13

Table 36.–Mean CPUE (catch per haul, including sites with zero catches) of golden shiner in seines, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.02	2.50	0.03			0.33	0	0.50
	Shallow	0.33		0	0		0	0		0.04
Medium	Deep	0	0	0.58	0	0	0	0.09	0.07	0.06
	Shallow		0	0.08	0.13	21.25	0	0	0	2.41
	Unknown	0	0	0	57.25	1.00		0		4.16
Small	Deep	0.07	0	3.33	0	0	0	0	0	0.44
	Shallow			0		0			0	0
	Unknown	0	0			0	0	0	0	0
All		0.03	0	1.00	2.75	2.72	0	0.05	0.04	0.76

Table 37.–Mean CPUE (catch per lift, including sites with zero catches) of golden shiner in trap nets, stratified by lake size, depth, and management unit. Trap nets were not used in Western Lake Superior.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0			0	0.25	0.17	0.06
	Shallow	0		0			0.06	0.03		0.04
Medium	Deep	0.44	0			0.03	0	0.24	0.05	0.15
	Shallow		0			0	0.17	0.44	0	0.16
	Unknown	0.06	0	0		0	0	0.06		0.03
Small	Deep	0	1.08			0	0	1.35	6.60	1.62
	Shallow					0			2.75	1.38
	Unknown	0	0				0.03	0	3.22	0.51
All		0.24	0.25	0		0.01	0.03	0.46	2.25	0.46

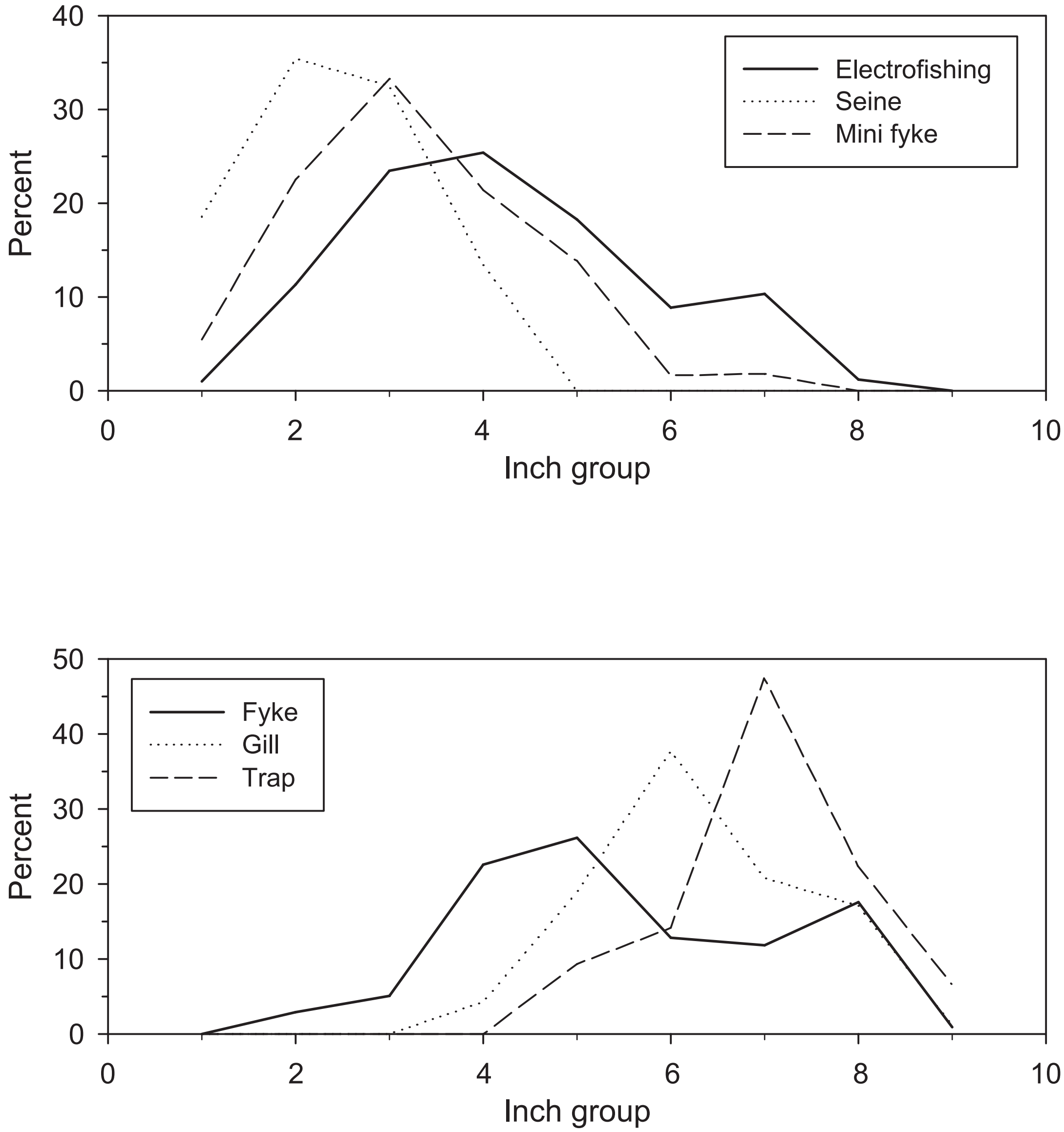


Figure 38.–Size distribution of golden shiners in different gear types.

- Pugnose shiner *Notropis anogenus*

Pugnose shiner is currently listed as a species of greatest conservation need within Michigan's Wildlife Action Plan. Pugnose shiners were caught in only two lakes (<1% of lakes sampled), both within the Southern Lake Michigan Management Unit (Figure 39). Too few pugnose shiners were caught to reliably determine typical catch rates, size distribution or growth rates.

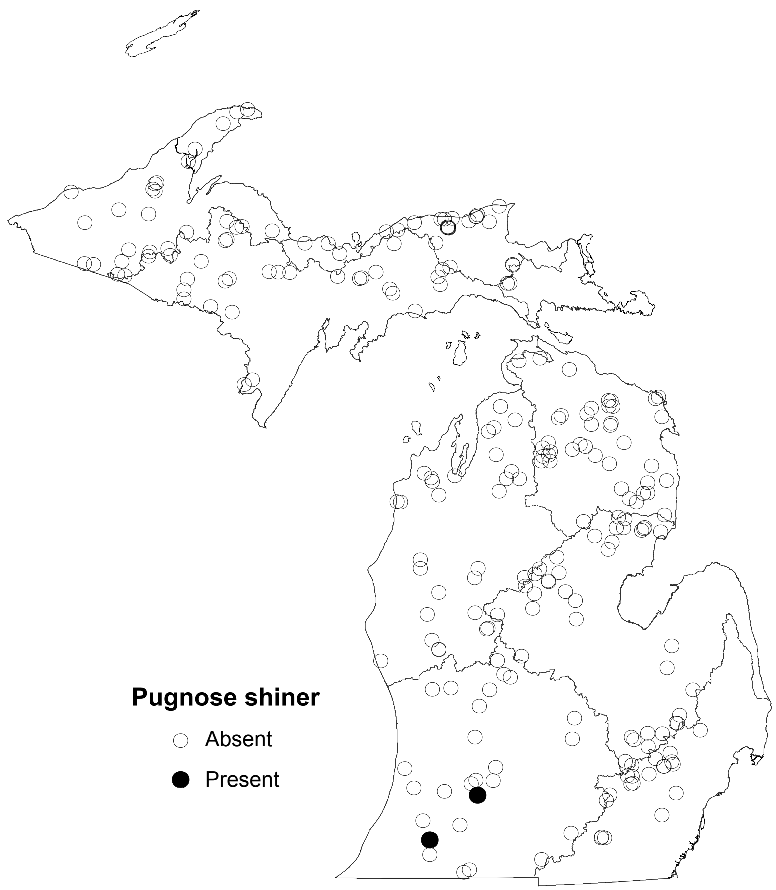


Figure 39.–Distribution and abundance of pugnose shiners collected from Status and Trends lakes.

- Emerald shiner *Notropis atherinoides*

Emerald shiners are widely distributed (Figure 40), but only occurred in 7% of lakes sampled (Table 38). Emerald shiners generally occurred more frequently in larger lakes (Table 38).

The vast majority of emerald shiners were caught in seines and mini fyke nets, but emerald shiners were not caught in any single gear frequently enough to accurately characterize typical catch rates.

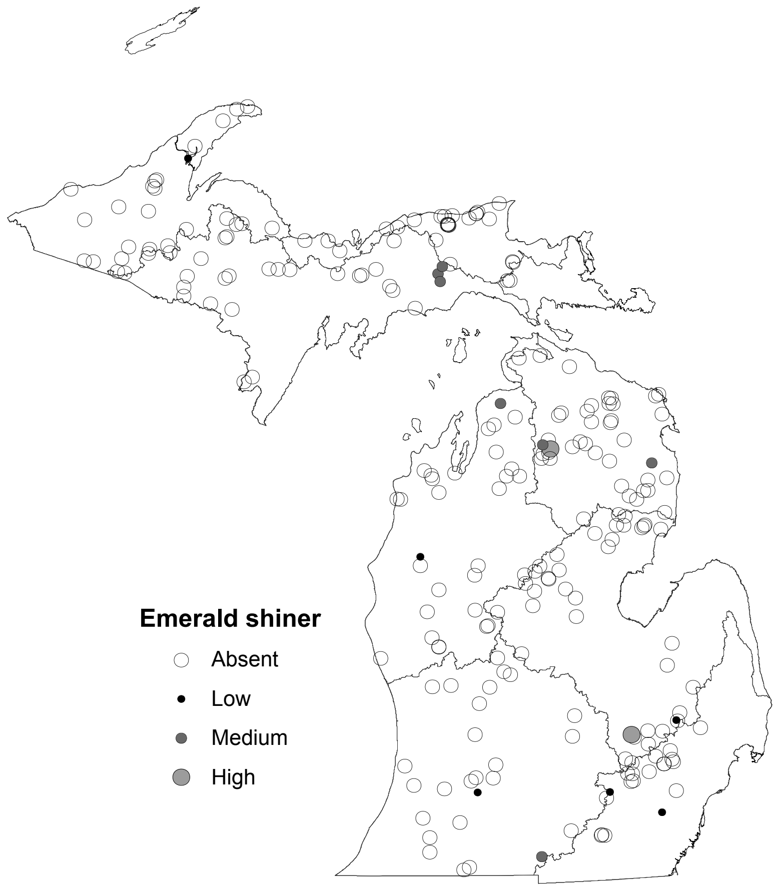


Figure 40.–Distribution and abundance of emerald shiners collected from Status and Trends lakes.

Table 38.–Proportion of Status and Trends lakes containing emerald shiner, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.33	0.50	0.25		1.00	0	0	0.33
	Shallow	1.00		0.67	0		0.20	0		0.27
Medium	Deep	0	0	0	0	0	0.07	0.07	0.11	0.04
	Shallow		0	0	0	0	0	0	0	0
	Unknown	0	0	0	0	0	0	0		0
Small	Deep	0.17	0	0	0	0	0	0.13	0	0.04
	Shallow			0		0			1.00	0.25
	Unknown	0	0.50			0	0	0	0	0.05
All		0.08	0.07	0.10	0.04	0	0.07	0.06	0.11	0.07

- Blackchin shiner *Notropis heterodon*

Blackchin shiners were widely distributed (Figure 41), but only occurred in 7% of lakes sampled (Table 39). Blackchin shiners generally occurred more frequently in large and medium-sized shallow lakes (Table 39).

The vast majority of blackchin shiners were caught in seines, but blackchin shiners were not caught in any single gear frequently enough to accurately characterize typical catch rates.

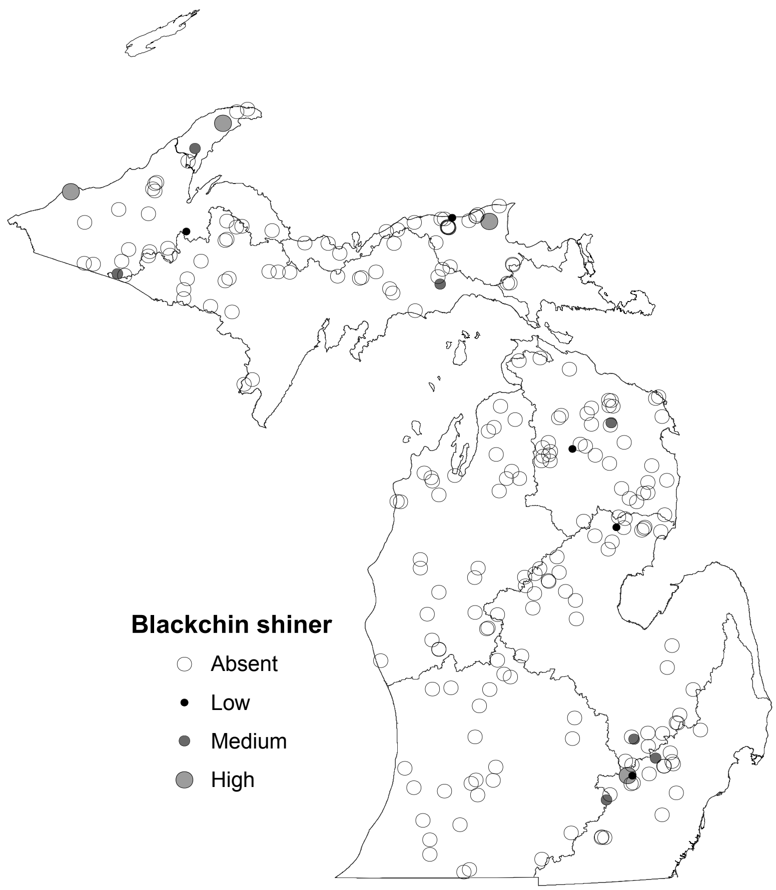


Figure 41.–Distribution and abundance of blackchin shiners collected from Status and Trends lakes.

Table 39.–Proportion of Status and Trends lakes containing blackchin shiner, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSE	LSW	LHN	LHS	LE	All
Large	Deep		0	0		0.25	0	0	0	0.08
	Shallow	0		0.33		0.33	0	0		0.13
Medium	Deep	0	0	0	0	0.13	0.14	0.14	0.11	0.08
	Shallow		0	0	0.50	0.33	0	0	1.00	0.16
	Unknown	0	0	0	0.50	0	0	0		0.05
Small	Deep	0	0	0	0	0	0	0	0.20	0.02
	Shallow			0	0				0	0
	Unknown	0	0		0		0	0	0.50	0.05
All		0	0	0.03	0.11	0.21	0.05	0.06	0.21	0.07

- Blacknose shiner *Notropis heterolepis*

Blacknose shiners were widely distributed (Figure 42), occurring in 13% of lakes sampled (Table 40). Blacknose shiners generally occurred more frequently in small to medium-sized lakes (Table 40).

Although the majority of blacknose shiners were caught in seines, they were caught in more lakes (19) by electrofishing. Typical catch rates ranged from 0.03 to 0.7 fish per minute in electrofishing gear.

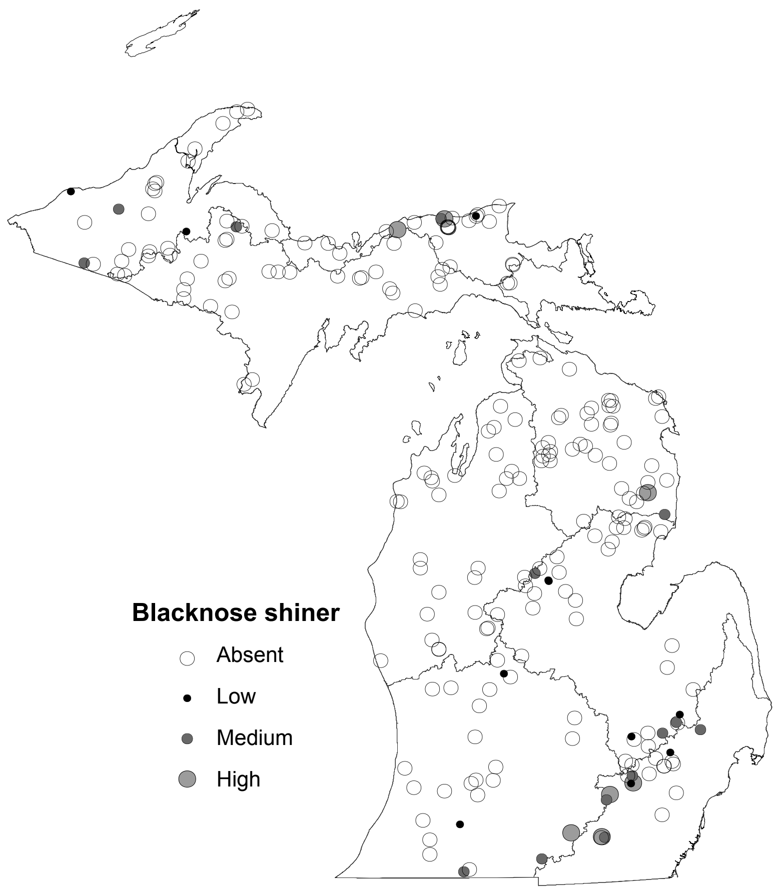


Figure 42.–Distribution and abundance of blacknose shiners collected from Status and Trends lakes.

Table 40.–Proportion of Status and Trends lakes containing blacknose shiner, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0		0	0	0	0
	Shallow	0		0	0		0.20	0		0.07
Medium	Deep	0.21	0	0	0	0.20	0	0.14	0.67	0.15
	Shallow		0	0	0.50	0	0	0	1.00	0.16
	Unknown	0.33	0	0	1.00	0.50	0	0.25		0.18
Small	Deep	0.17	0	0.11	0	0	0	0.25	0.20	0.10
	Shallow			0		0			1.00	0.25
	Unknown	0	0			0.25	0.13	0.50	0	0.15
All		0.19	0	0.03	0.17	0.16	0.05	0.17	0.47	0.13

- Spottail shiner *Notropis hudsonius*

Spottail shiners were relatively common in the state, being caught in 17% of all lakes sampled. Spottail shiners occurred across the entire state (Figure 43) with little difference in frequency of occurrence across management units (Table 41). Spottail shiners showed a trend of higher occurrence in larger lakes and lower occurrence in smaller lakes (Table 41), and they occur more frequently in deeper lakes within a lake size category.

The majority of spottail shiners were caught in seine nets. Even though most of the catch occurred in seine nets, spottail shiners were only caught in 18 lakes using seines, making it difficult to characterize the typical catch rate in this gear. The 25th to 75th percentile catches in seine nets was very broad, from 1.8 to over 25. Spottail shiners were caught in 23 lakes in electrofishing gear, with a typical catch rate of 0.1 to 0.75 fish per minute. Although the number of lakes with catches of spottail shiners in seine nets was rather low, there was a trend of higher catch rates in large and medium-sized deep lakes (Table 42).

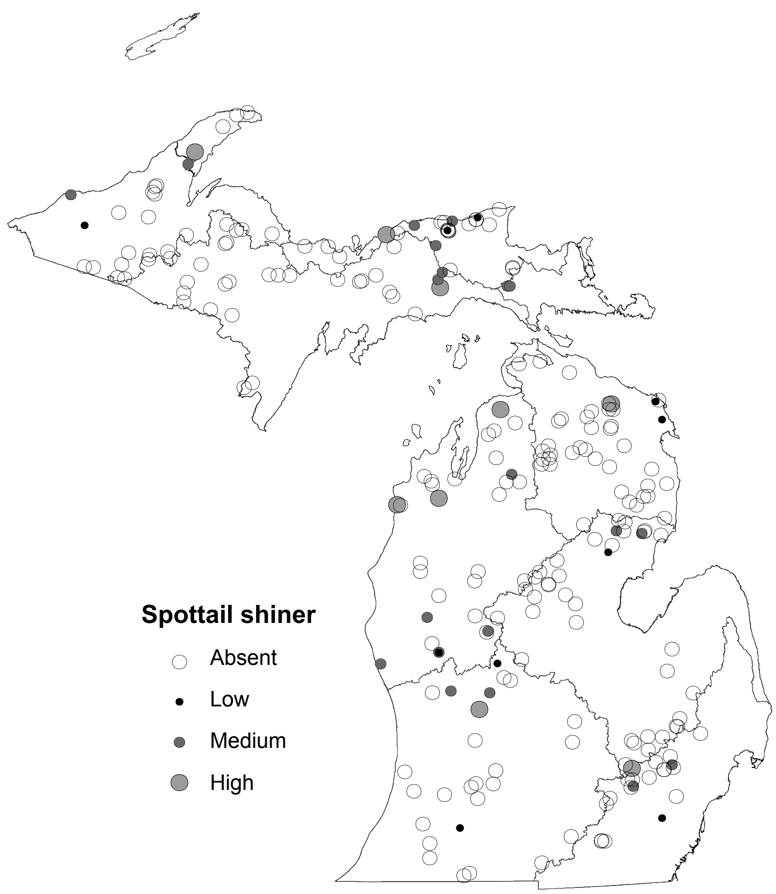


Figure 43.–Distribution and abundance of spottail shiners collected from Status and Trends lakes.

Table 41.–Proportion of Status and Trends lakes containing spottail shiner, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.00	0.50	0.50		0	0	0	0.50
	Shallow	0		0.67	0.33		0.40	0		0.33
Medium	Deep	0.14	0.36	0	0	0.40	0.14	0.21	0.33	0.20
	Shallow		0.25	0	0.17	0.50	0.33	0	0	0.16
	Unknown	0.33	0	0	0	0	0	0		0.05
Small	Deep	0.17	0.14	0	0	0.75	0	0.13	0	0.13
	Shallow			0		0			0	0
	Unknown	0.50	0			0	0	0	0	0.05
All		0.19	0.30	0.10	0.17	0.32	0.12	0.11	0.16	0.17

Table 42.–Mean CPUE (catch per haul, including sites with zero catches) of spottail shiner in seines, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		22.64	0	0.80			0	0	6.47
	Shallow	0		0.19	0		0	0		0.06
Medium	Deep	3.49	29.88	0	0	0	0	2.16	0	5.59
	Shallow		0	0	0.06	5.00	25.33	0	0	1.98
	Unknown	0	0	0	0	0		0		0
Small	Deep	1.07	0	0	0	0	0	0	0	0.17
	Shallow			0		0			0	0
	Unknown	0.33	0			0	0	0	0	0.06
All		2.14	17.46	0.03	0.16	0.63	3.17	0.89	0	2.97

- Sand shiner *Notropis stramineus*

Sand shiners were modestly common in the state and were caught in 15% of all lakes sampled. Sand shiners occurred primarily in the Lower Peninsula (Figure 44) with little difference in frequency of occurrence across management units except they had lower occurrence in the Northern Lake Michigan unit (Table 43). Sand shiners appearred to occur somewhat more frequently in large shallow and medium-sized deep lakes (Table 43).

Even though sand shiners occurred with modest frequency, they often occurred in large numbers when present. The majority of sand shiners were caught in mini fyke nets and seine nets. The 25th to 75th percentile catches in seine nets was very broad, from 8.5 to 73 in the 27 lakes where this species was caught with this gear. Although sand shiners were only caught in eight lakes in mini fyke nets, catches were often in the hundreds to thousands, with a maximum average catch of almost 3,500 fish per lift.

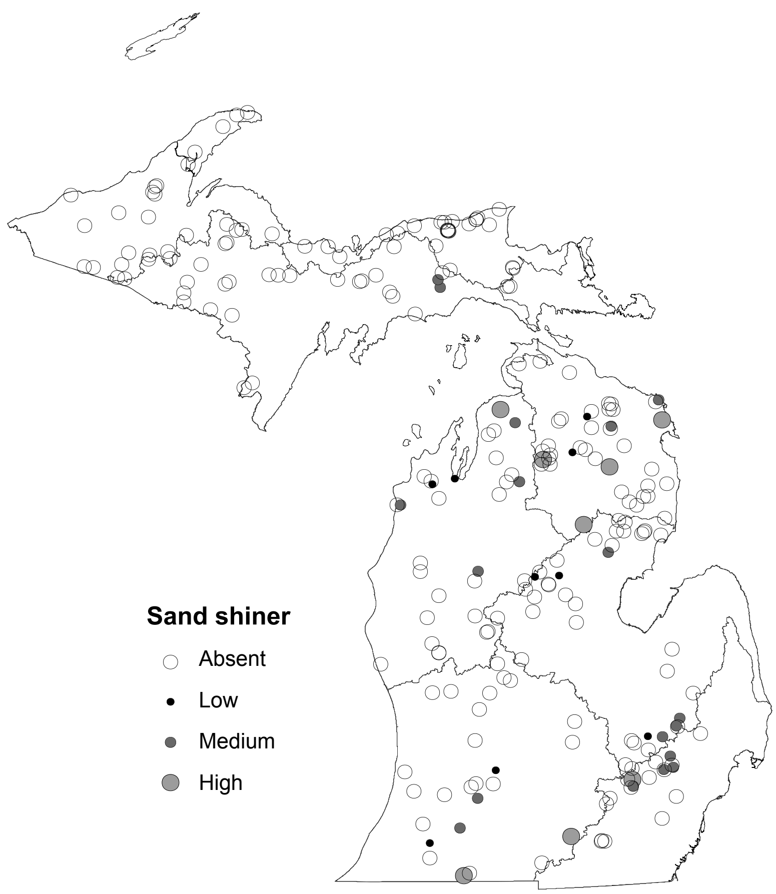


Figure 44.–Distribution and abundance of sand shiners collected from Status and Trends lakes.

Table 43.–Proportion of Status and Trends lakes containing sand shiner, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.33	0	0		0	0	0	0.08
	Shallow	1.00		0.67	0		0.20	0		0.27
Medium	Deep	0.21	0.45	0	0	0	0.29	0.14	0.44	0.23
	Shallow		0.25	0	0	0	0	0	0	0.04
	Unknown	0.33	0	0	0	0	0	0.50		0.14
Small	Deep	0	0	0	0	0	0.29	0.38	0.20	0.13
	Shallow			0		0			0	0
	Unknown	0.50	0			0	0.13	0	0	0.10
All		0.23	0.23	0.07	0	0	0.19	0.19	0.26	0.15

- Mimic shiner *Notropis volucellus*

Mimic shiners are widely distributed (Figure 45), but only occurred in 7% of lakes sampled (Table 44). Mimic shiners occurred more frequently in large and medium-sized lakes (Table 44).

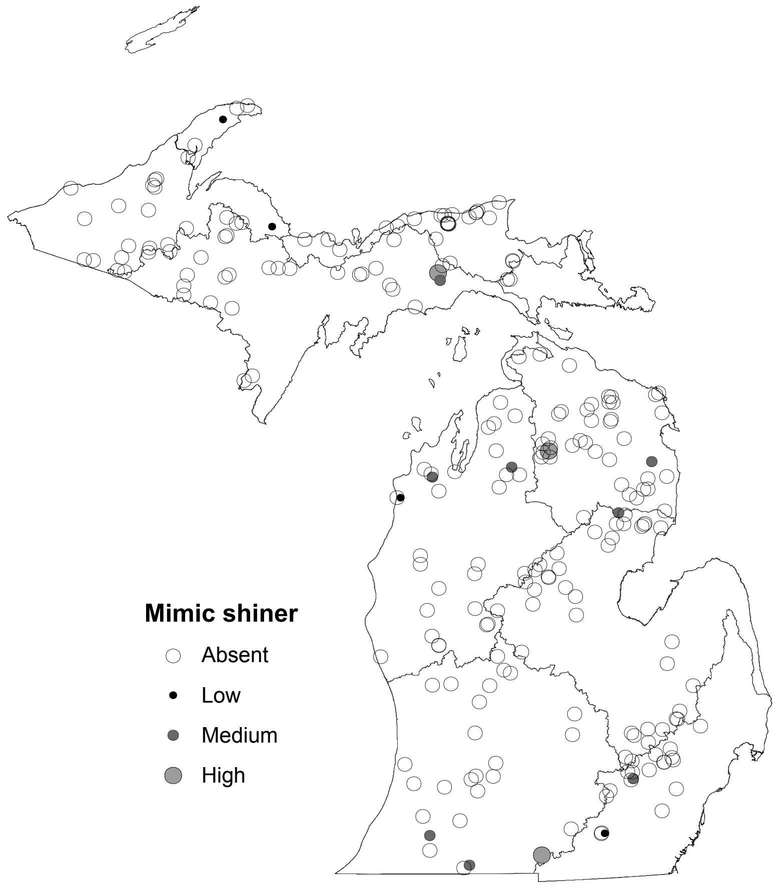


Figure 45.–Distribution and abundance of mimic shiners collected from Status and Trends lakes.

Table 44.–Proportion of Status and Trends lakes containing mimic shiner, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0.25		1.00	0	0	0.17
	Shallow	0		0.67	0.33		0	0		0.20
Medium	Deep	0.14	0.18	0	0	0	0.07	0	0.22	0.09
	Shallow		0.25	0	0	0	0	0	0	0.04
	Unknown	0	0	0	0	0	0	0		0
Small	Deep	0.17	0	0	0	0	0.14	0	0	0.04
	Shallow			0		0			0	0
	Unknown	0	0			0	0	0	0	0
All		0.12	0.10	0.07	0.08	0	0.07	0	0.11	0.07

- Northern redbelly dace *Phoxinus eos*

Northern redbelly dace were caught in 5% of lakes sampled and were found in a few lakes in the western Upper Peninsula and in two lakes in the northern Lower Peninsula (Figure 46). Too few northern redbelly dace were caught to reliably determine typical catch rates, size distribution or growth rates.

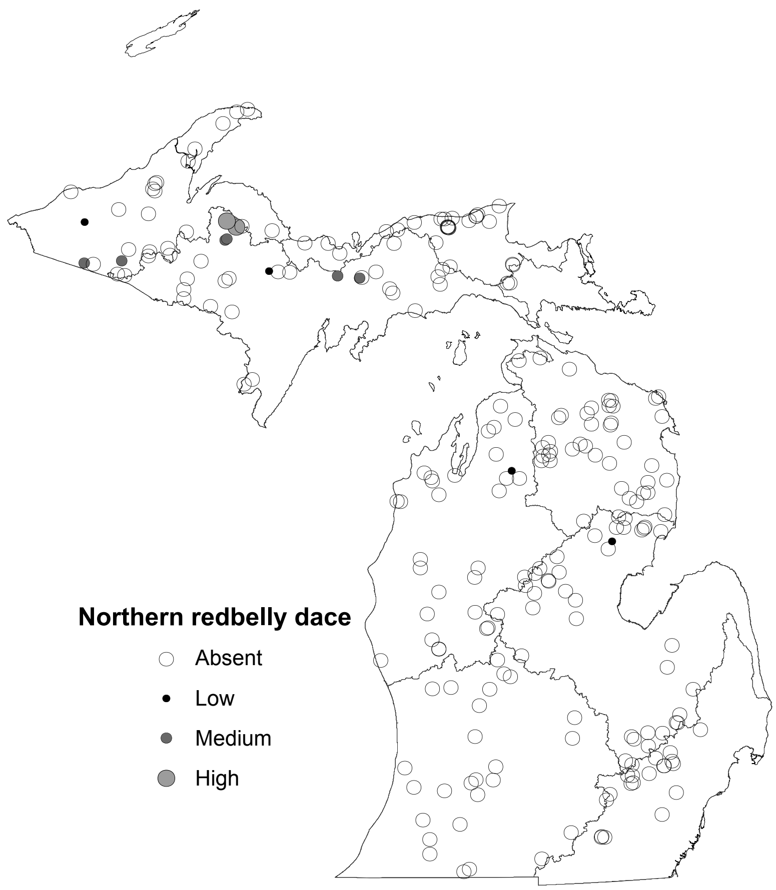


Figure 46.–Distribution and abundance of northern redbelly dace collected from Status and Trends lakes.

- Finescale dace *Phoxinus neogaeus*

Finescale dace is currently listed as a species of greatest conservation need within Michigan's Wildlife Action Plan. Finescale dace were caught in one inland lake (<1% of lakes sampled) within the Northern Lake Huron Management Unit (Figure 47). Too few finescale dace were caught to reliably determine typical catch rates, size distribution or growth rates.

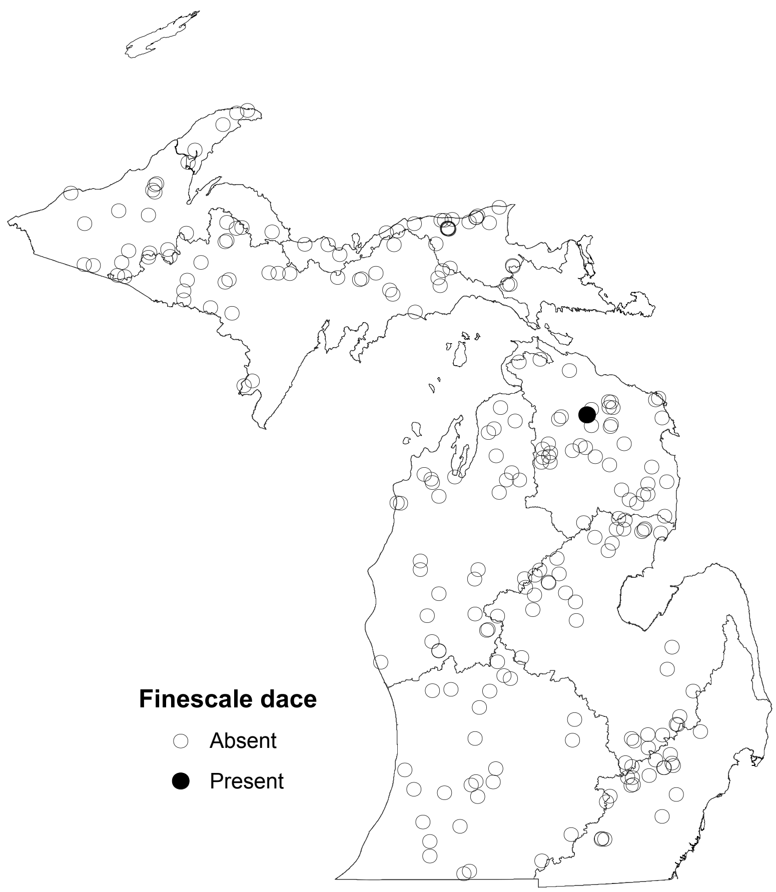


Figure 47.–Distribution and abundance of finescale dace collected from Status and Trends lakes.

- Bluntnose minnow *Pimephales notatus*

Bluntnose minnows were common across Michigan and were caught in 53% of all lakes sampled. Bluntnose minnows were widely distributed across the entire state and did not show any specific habitat preference (Figure 48; Table 45).

The majority of bluntnose minnows were caught by seines and mini fyke nets, with electrofishing providing most of the remainder of the catch. For the state as a whole, the typical range of catch rates for electrofishing gear was 0.1 to 0.5 fish per minute (Table 46). Catch rates in seines and mini fyke nets were much higher, with typical ranges of about 3.5 to 45 and 1.75 to 35 fish per lift, respectively. Catches in other gears were too infrequent to determine typical catch rates. Patterns in CPUE in seine and mini fyke nets (Tables 47 and 48) showed no clear pattern except possibly lower abundance in small shallow lakes.

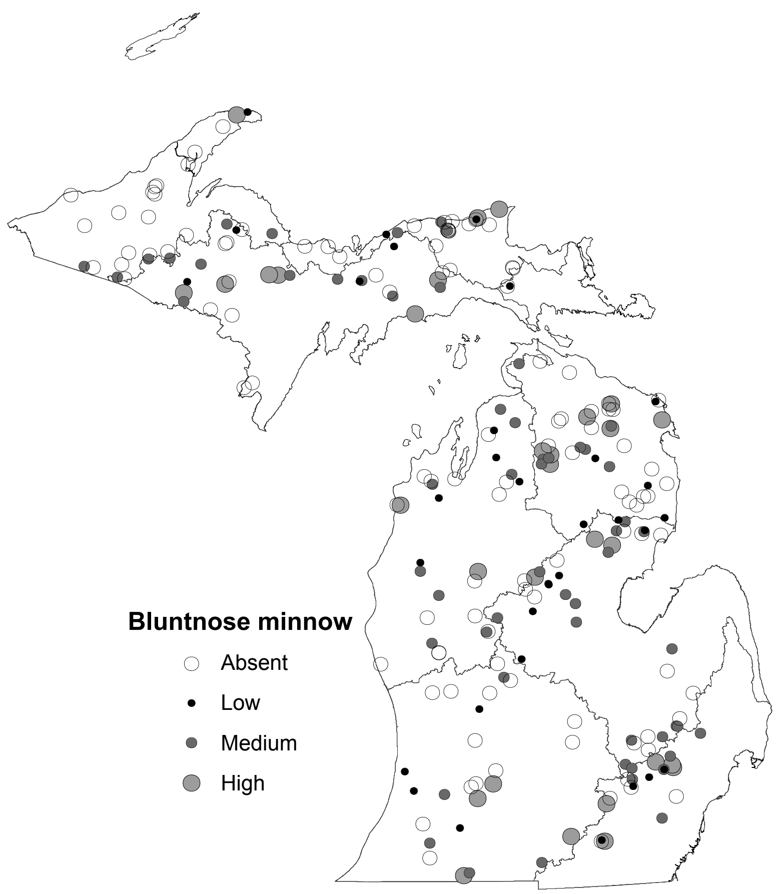


Figure 48.–Distribution and abundance of bluntnose minnows collected from Status and Trends lakes.

Table 45.–Proportion of Status and Trends lakes containing bluntnose minnow, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.67	0	0		0	1.00	1.00	0.33
	Shallow	1.00		0.67	0.67		0.80	0.67		0.73
Medium	Deep	0.64	0.55	1.00	0.38	0.40	0.57	0.64	0.89	0.63
	Shallow		0.75	0.40	0.17	0	0.67	0.75	1.00	0.48
	Unknown	0.33	0.67	0.75	0	0.50	0.40	0.75		0.55
Small	Deep	0.33	0.14	0.67	0	0.50	0.57	0.50	0.80	0.48
	Shallow			1.00		0			0	0.25
	Unknown	0	0.50			0.25	0.25	1.00	0	0.30
All		0.50	0.50	0.66	0.25	0.32	0.51	0.67	0.74	0.53

Table 46.–Summary of catch per unit effort of bluntnose minnow by gear, including only sites and gears with catches greater than zero. Catch per unit effort for electrofishing is number of fish per minute. Catch per unit effort for mini fyke is number of fish per lift. Catch per unit effort for seining is number of fish per haul. Number of lakes with positive catches for each gear is denoted by n.

		Typical range							
Gear	Low	25^{th}		Median		75^{th}	High	Maximum	n
Electrofishing	<0.10	0.10	to	0.23	to	0.50	>0.50	2.50	67
Mini fyke	<1.75	1.75	to	10	to	35.50	>35.5	451.00	44
Seine	<3.43	3.43	to	12.30	to	45.00	>45.0	231.50	73

Table 47.–Mean CPUE (catch per lift, including sites with zero catches) of bluntnose minnows in mini fyke nets, stratified by lake size, depth, and management unit. Mini fyke nets were not used in Southern Lake Huron.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.25	0	0		0			0.05
	Shallow				2.26		15.13			10.31
Medium	Deep	21.50		29.25	5.06		48.17		0	29.12
	Shallow		3.50	11.85	1.21		0.67			4.72
	Unknown	0.25	0	9.00	0	0.33	5.13			4.03
Small	Deep	0	0	9.91	0	0.63	50		0.13	15.29
	Shallow			10		0			0	2.50
	Unknown					7.08	9.29		0	7.35
All		7.25	1.45	13.30	2.60	2.22	26.94		0.06	13.32

Table 48.–Mean CPUE (catch per haul, including sites with zero catches) of bluntnose minnow in seines, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.14	0	0			3.50	0.60	0.68
	Shallow	71.17		21.39	0		35.00	0.42		19.02
Medium	Deep	21.46	17.55	34.25	2.60	1.54	0.08	24.18	64.78	23.01
	Shallow		4.13	0	0	0	45.00	2.27	95.67	8.78
	Unknown	0.83	5.75	62.17	0	0		3.94		15.45
Small	Deep	4.73	5.44	14.92	0	57.38	0	6.13	9.20	13.49
	Shallow			0		0			0	0
	Unknown	0	0			26.67	0	0.25	0	7.32
All		15.68	10.24	21.30	0.99	19.83	10.04	12.09	38.17	15.81

- Fathead minnow *Pimephales promelas*

Fathead minnows were widely distributed (Figure 49) and occurred in 9% of lakes sampled (Table 49). Fathead minnows did not show any clear preference for lake size or depth (Table 49). Fathead minnows were caught in too few lakes to accurately characterize catch rates or size distribution.

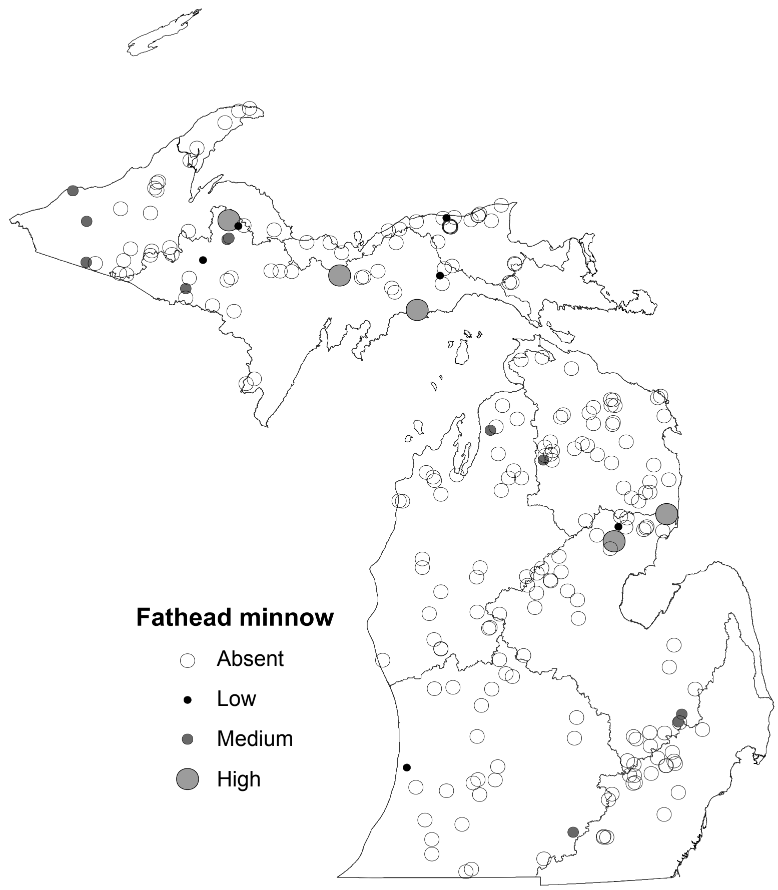


Figure 49.–Distribution and abundance of fathead minnows collected from Status and Trends lakes.

Table 49.–Proportion of Status and Trends lakes containing fathead minnow, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0.50	0.25		0	0	0	0.17
	Shallow	0		0.33	0		0.20	0		0.13
Medium	Deep	0.14	0	0.40	0	0	0	0.14	0	0.08
	Shallow		0	0	0.33	0	0	0	0	0.08
	Unknown	0	0	0	0	0	0.20	0		0.05
Small	Deep	0	0.14	0.33	0	0	0	0.25	0	0.13
	Shallow			1.00		0			0	0.25
	Unknown	0	0			0.25	0	0	0	0.05
All		0.08	0.03	0.28	0.13	0.05	0.05	0.11	0	0.09

- Western blacknose dace *Rhinichthys obtusus*

  Western blacknose dace were caught in 5% of lakes sampled (Figure 50). Western blacknose dace were caught in too few lakes to accurately characterize catch rates or size distribution.

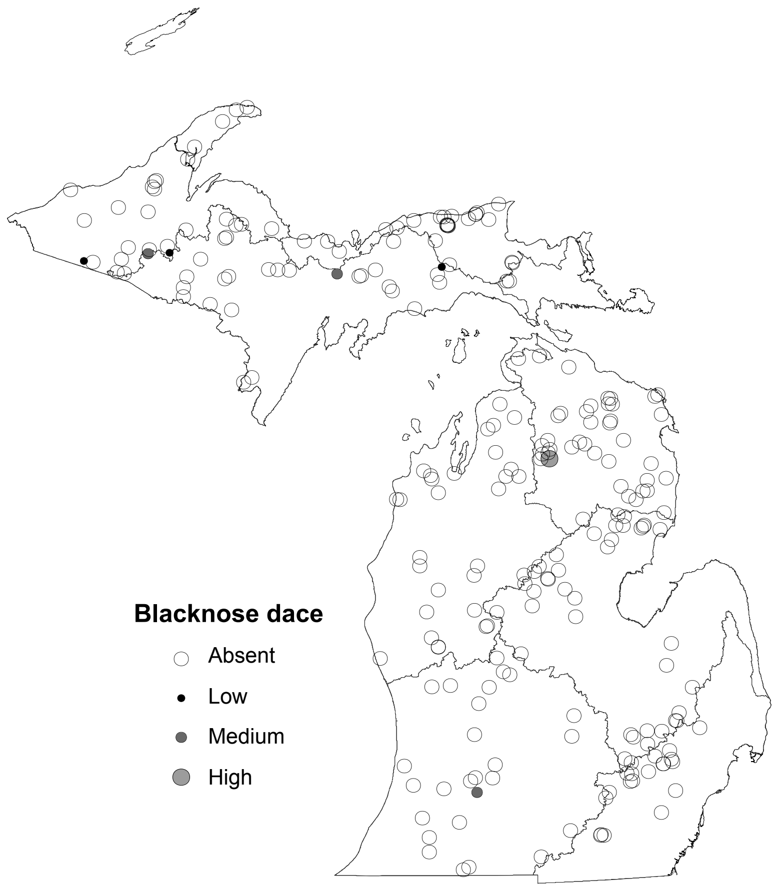


Figure 50.–Distribution and abundance of western blacknose dace collected from Status and Trends lakes.

- Longnose dace *Rhinichthys cataractae*

Longnose dace were caught in three lakes (<2% of lakes sampled; Figure 51). Longnose dace were caught in too few lakes to accurately characterize catch rates or size distribution.

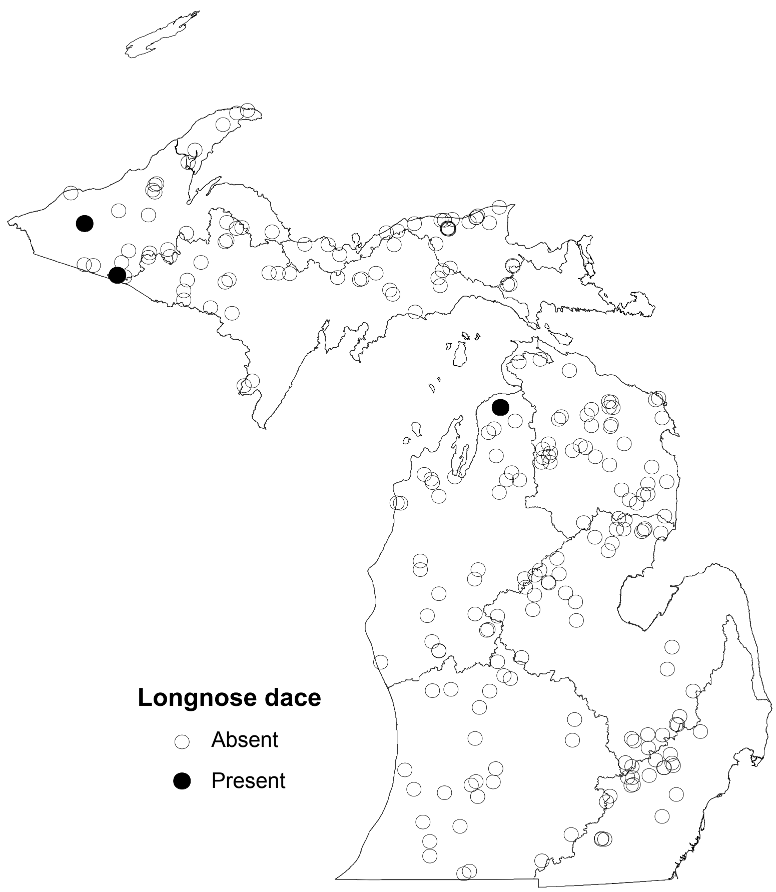


Figure 51.–Distribution of longnose dace collected from Status and Trends lakes.

- Creek chub *Semotilus atromaculatus*

  Creek chub were distributed across northern Michigan (Figure 52) but only occurred in 8% of lakes sampled (Table 50). Creek chub generally occurred more frequently in large lakes (Table 50).

  Creek chub were not caught in any single gear frequently enough to accurately characterize typical catch rates. For all gears combined, the size distribution of creek chub showed a 1–2 in peak (Figure 53).

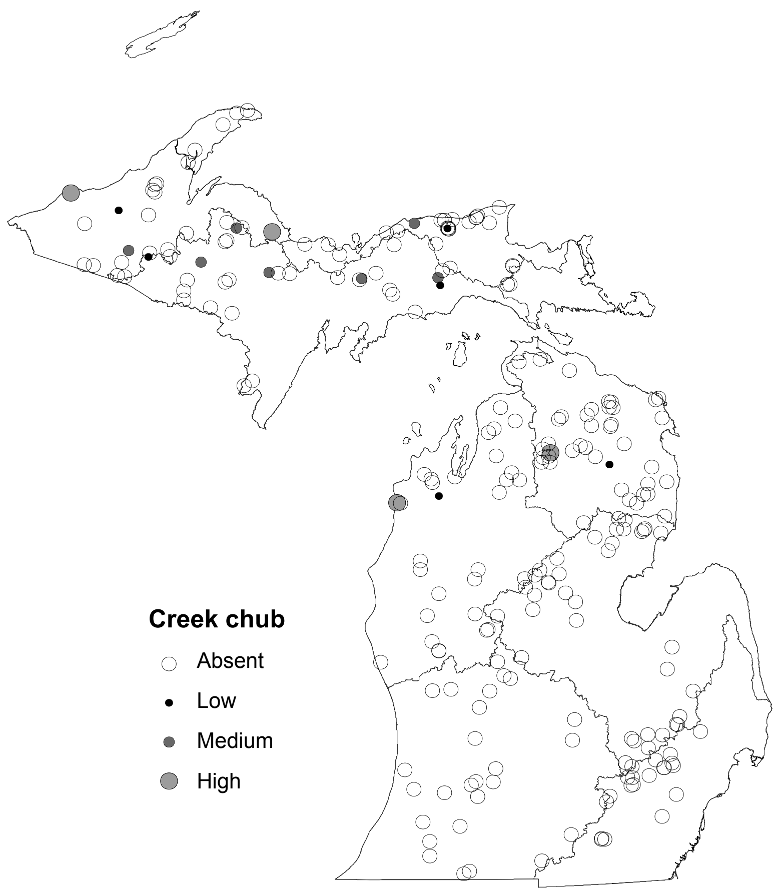


Figure 52.–Distribution and abundance of creek chub collected from Status and Trends lakes.

Table 50.–Proportion of Status and Trends lakes containing creek chub, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.33	0	0.25		0	0	0	0.17
	Shallow	0		0.67	0.33		0	0		0.20
Medium	Deep	0	0.09	0.20	0	0.20	0.07	0	0	0.05
	Shallow		0	0.20	0.17	0	0	0	0	0.08
	Unknown	0	0	0	1.00	0	0	0		0.05
Small	Deep	0	0	0.33	0	0.25	0.14	0	0	0.10
	Shallow			0		0			0	0
	Unknown	0	0			0	0	0	0	0
All		0	0.07	0.24	0.17	0.11	0.05	0	0	0.08

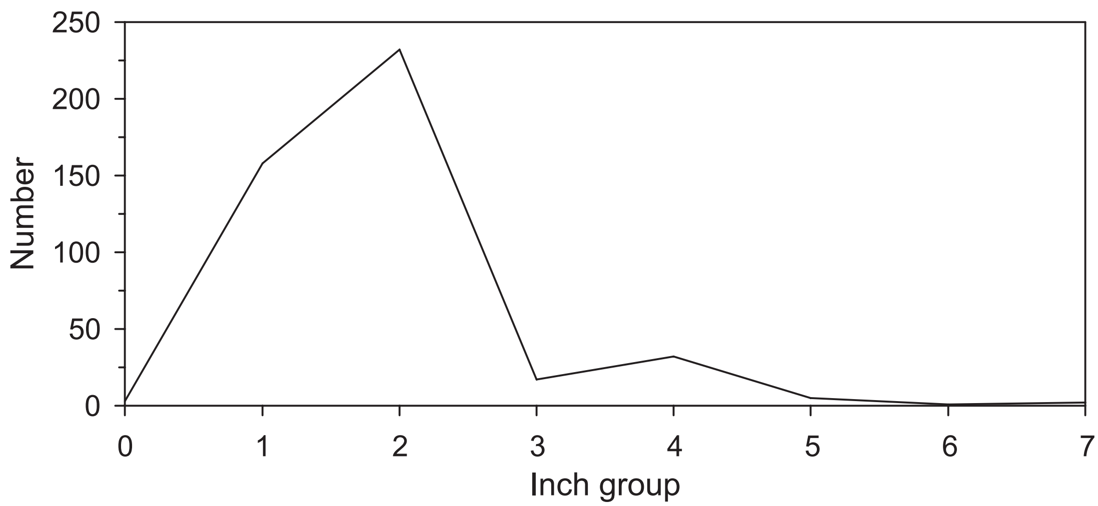


Figure 53.–Size distribution of creek chub in all gears combined.

Catostomidae

- Quillback *Carpiodes cyprinus*

Quillback were relatively uncommon, being caught in only 2% of lakes sampled (Table 51). Quillback were only caught in lakes within the southern part of the Lower Peninsula (Figure 54), primarily within the Central Lake Michigan Management Unit (Table 51).

Quillback were not caught in any single gear frequently enough to accurately characterize typical catch rates. For all gears combined, the size distribution of quillback showed bimodal distribution, with peaks at approximately 13 and 18 inches (Figure 55).

Table 51.–Proportion of Status and Trends lakes containing quillback, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.67	0	0		0	0	0	0.17
	Shallow	0		0	0		0	0		0
Medium	Deep	0.07	0.09	0	0	0	0	0	0	0.03
	Shallow		0	0	0	0	0	0	0	0
	Unknown	0	0	0	0	0	0	0.25		0.05
Small	Deep	0	0	0	0	0	0	0	0	0
	Shallow			0		0			0	0
	Unknown	0	0			0	0	0	0	0
All		0.04	0.10	0	0	0	0	0.03	0	0.02

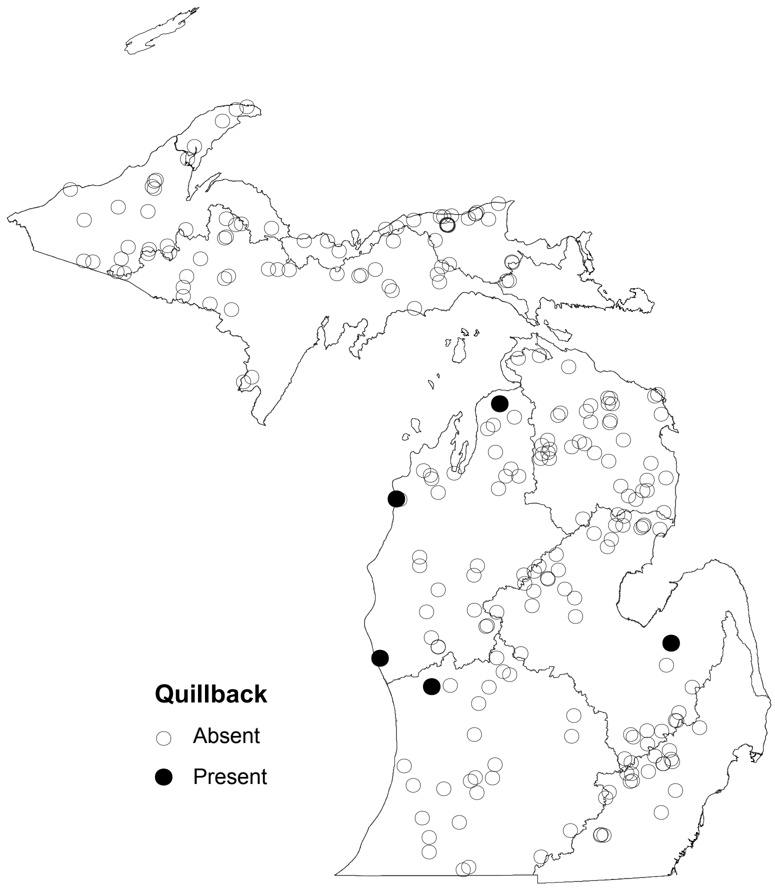


Figure 54.–Distribution of quillback collected from Status and Trends lakes.

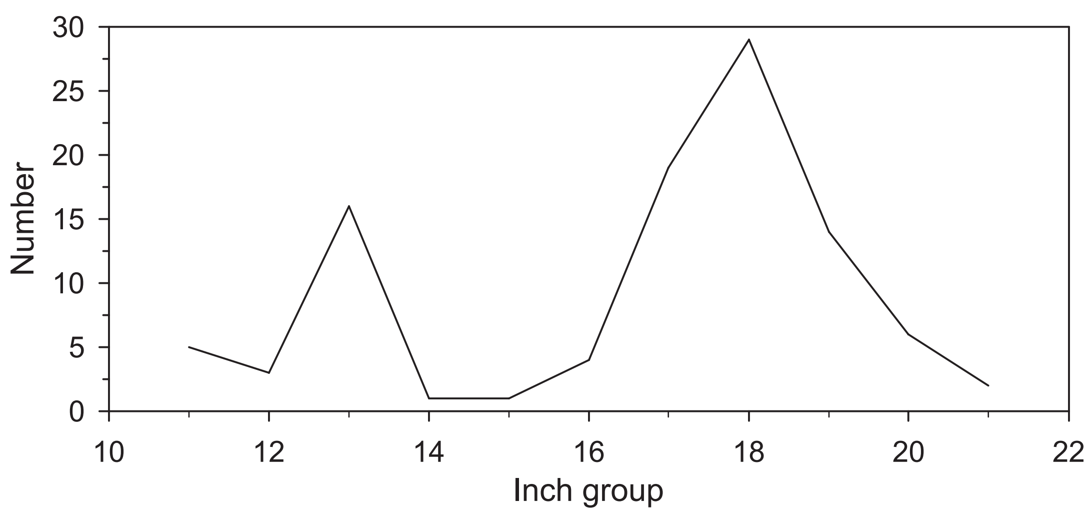


Figure 55.–Size distribution of quillback in all gears combined.

- Longnose sucker *Catostomus catostomus*

Longnose suckers were relatively uncommon, being caught in only 2% of lakes sampled (Table 52). Longnose suckers were caught sporadically across the state (Figure 56), primarily in larger lakes (Table 52). Longnose suckers were not caught frequently enough or in sufficient numbers to accurately characterize typical catch rates or size distribution.

Table 52.–Proportion of Status and Trends lakes containing longnose sucker, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.67	0	0		0	0	0	0.17
	Shallow	0		0	0		0	0		0
Medium	Deep	0.07	0.09	0	0	0	0	0	0	0.03
	Shallow		0	0	0	0	0	0	0	0
	Unknown	0	0	0	0	0	0	0.25		0.05
Small	Deep	0	0	0	0	0	0	0	0	0
	Shallow			0		0			0	0
	Unknown	0	0			0	0	0	0	0
All		0.04	0.10	0	0	0	0	0.03	0	0.02

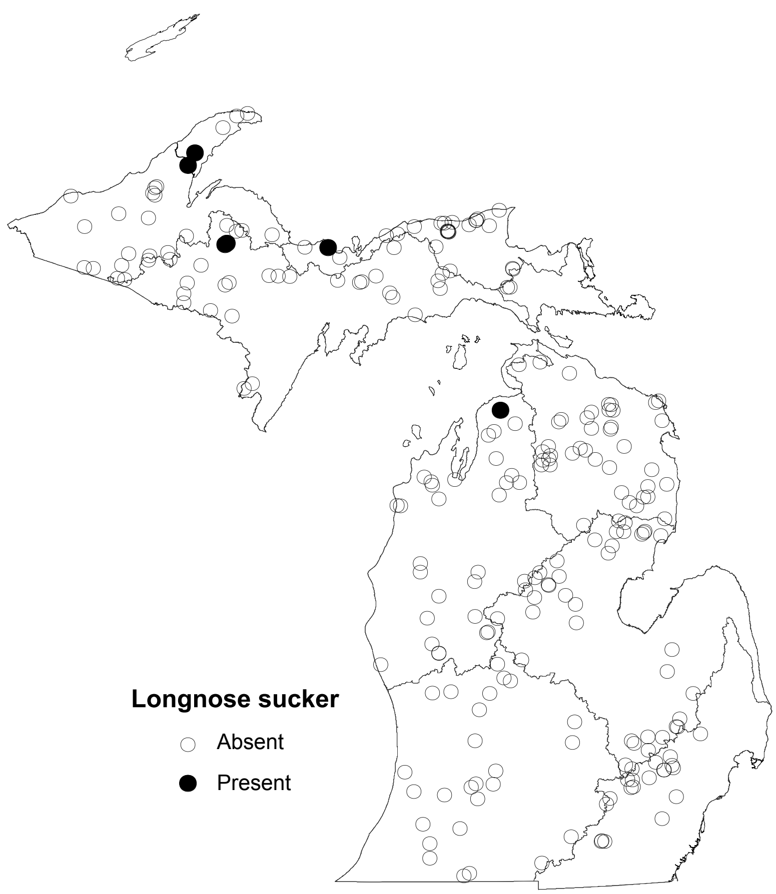


Figure 56.–Distribution of longnose suckers collected from Status and Trends lakes.

- White sucker *Catostomus commersoni*

White sucker was among the most frequently encountered species, being caught in 70% of all lakes sampled. Although they occurred across the entire state (Figure 57), they were somewhat more prevalent in the northern management units in the Lower Peninsula, and in the Upper Peninsula (Table 53). White suckers showed a preference for larger and deeper lakes (Table 53).

Although white suckers were caught in all gears deployed (Appendix A), the vast majority were caught in fyke and trap nets, and by seining. For the state as a whole, the typical range of catch rates for electrofishing gear was roughly 0.1 to 0.4 fish per minute. Catches in trap nets and fyke nets were similar, with typical catch rates of 0.25 to 3 fish per lift for both gears. Typical catch rates in gill nets were approximately 0.5 to 2.5 fish per lift. Catch rates in seine hauls varied widely; the lower 25th percentile was 0.25 fish per haul, but the upper 75th percentile was over 100 fish per haul (Table 54). These estimates were based, however, on a small sample size of sites where white suckers were caught by seine. Catch rates of white suckers varied across gears, management units, lake size and lake depth (Tables 55-60). Focusing on fyke nets and trap nets (Tables 56 and 57), which provided the highest total catch, CPUE tended to be higher in larger lakes and in the northern part of the state.

Seines selected for the smallest white suckers (Figure 58), with an average length of 2.3 inches (SE=0.4). The catch of white sucker in mini fyke nets also included small fish (likely young-of-the-year or age 1+), but a second mode in the size distribution of the catch occurred between 6 and 9 inches (Figure 58). The mean size of the catch in mini fykes was 7.6 inches (SE=0.8). Electrofishing gear selected for somewhat larger fish than mini fykes (mean=8.2 inches, SE=0.4), but also captured a wide size range of individuals (Figure 58). The size distributions of fish caught in fyke nets, gill nets, and trap nets were similar (Figure 58) and averaged larger than the other gears, with mean size of the catch of 12.8 inches (SE=0.3), 13.7 inches (SE=0.5), and 13.6 inches (SE=0.3), respectively.

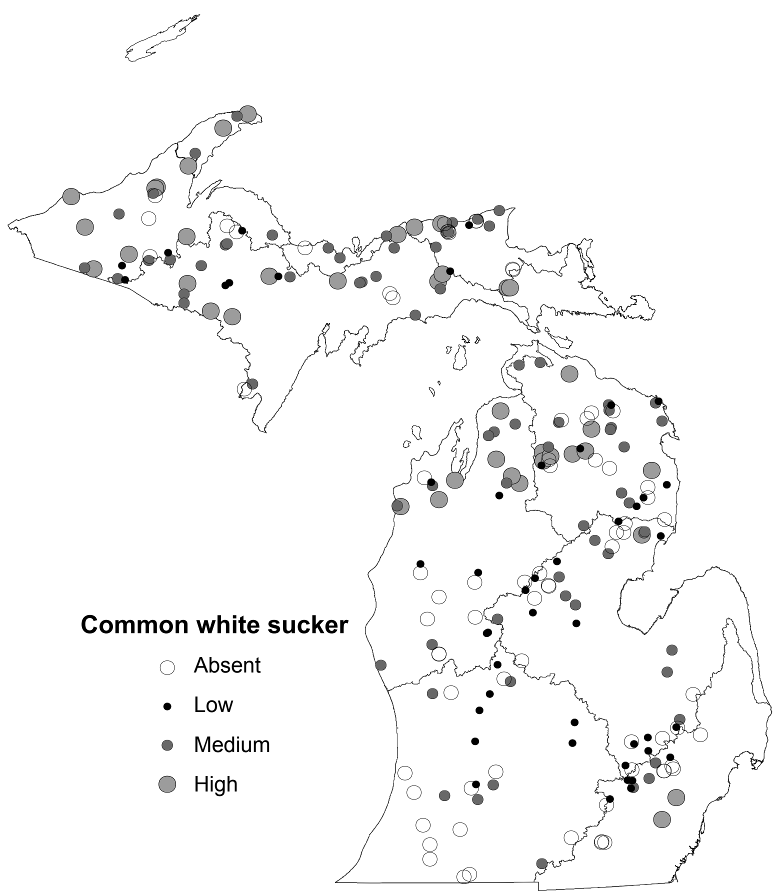


Figure 57.–Distribution and abundance of common white suckers collected from Status and Trends lakes.

Table 53.–Proportion of Status and Trends lakes containing common white sucker, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.00	1.00	1.00		1.00	1.00	1.00	1.00
	Shallow	1.00		1.00	1.00		0.80	1.00		0.93
Medium	Deep	0.36	0.82	1.00	0.88	1.00	1.00	0.57	0.56	0.73
	Shallow		1.00	1.00	0.83	1.00	0.67	0.50	0	0.80
	Unknown	0.33	0.33	1.00	1.00	1.00	0.80	0.75		0.73
Small	Deep	0.83	0.29	0.44	0.50	0.75	0.43	0.75	0.20	0.52
	Shallow			1.00		0			1.00	0.50
	Unknown	0.50	1.00			0.50	0.50	0	1.00	0.55
All		0.50	0.70	0.83	0.88	0.74	0.74	0.64	0.53	0.70

Table 54.–Summary of catch per unit effort of common white sucker by gear, including only sites and gears with catches greater than zero. Catch per unit effort for electrofishing is number of fish per minute. Catch per unit effort for fyke net, gill net, minifyke, and trap net is number of fish per lift. Catch per unit effort for seining is number of fish per haul. Number of lakes with positive catches for each gear is denoted by n.

		Typical range							
Gear	Low	25th		Median		75th	High	Maximum	n
Electrofishing	<0.07	0.07	to	0.14	to	0.37	>0.37	1.33	60
Fyke net	<0.25	0.25	to	0.90	to	3.00	>3.00	34.17	108
Gill net	<0.50	0.50	to	1.17	to	2.50	>2.50	37.00	103
Mini fyke	<0.25	0.25	to	0.50	to	1.50	>1.50	9.00	21
Seine	<0.25	0.25	to	2.83	to	118.50	>118.5	256.17	10
Trap net	<0.25	0.25	to	1.00	to	3.00	>3.00	32.33	98

Table 55.–Mean CPUE (catch per minute, including sites with zero catches) of common white sucker in electrofishing surveys, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSE	LSW	LHN	LHS	LE	All
Large	Deep		0.13	0.38		0.15	0	0.10	0	0.16
	Shallow	0		0.30		0.11	0.10	0.02		0.13
Medium	Deep	0.08	0.09	0.20	0.24	0.02	0.37	0.11	0.02	0.11
	Shallow		0.03	0.10	0	0.10		0.03	0	0.06
	Unknown	0	0.08	0.14	0.70	0.15	0	0.04		0.10
Small	Deep	0.09	0	0		0	0	0.06	0	0.04
	Shallow									
	Unknown	0	0		0		0	0		0
All		0.06	0.06	0.16	0.24	0.08	0.17	0.07	0.02	0.09

Table 56.–Mean CPUE (catch per lift, including sites with zero catches) of common white sucker in fyke nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.58	0.63	8.57		3.44	0.88	0.17	3.93
	Shallow	0.25		0.91	1.10		0.97	0.05		0.74
Medium	Deep	0	2.29	2.93	7.65	2.64	5.23	3.86	0.31	3.38
	Shallow		5.23	0.27	8.53	0.36	0.43	0.02	0	3.02
	Unknown	0	0.15	0.87	0.22	3.28	1.49	0.58		1.02
Small	Deep	0.78	0	1.12	0.06	1.60	0.09	0.60	0.08	0.58
	Shallow			7.25		0				2.42
	Unknown		0			0.46	0.63	0	1.08	0.50
All		0.14	1.66	1.42	6.26	1.51	2.23	1.50	0.34	2.09

Table 57.–Mean CPUE (catch per lift, including sites with zero catches) of common white sucker in gill nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.34	1.99	2.56		0.29	0.50	0	1.51
	Shallow	0.23		1.00	4.48		1.63	0.33		1.82
Medium	Deep	0.71	1.13	1.94	0.95	0.93	1.02	0.02	0.57	0.80
	Shallow		1.50	0.58	8.54	2.38	0	0.25	0	2.72
	Unknown	0	0.50	1.11	1.50		1.21	0		0.72
Small	Deep	1.01	0.07	0.89	0	0.83	1.00	0.50	0	0.60
	Shallow			14.25					0	7.13
	Unknown	0	0.22			1.50	0.05	0	1.25	0.29
All		0.63	0.82	1.63	3.54	1.22	0.84	0.19	0.40	1.09

Table 58.–Mean CPUE (catch per lift, including sites with zero catches) of common white sucker in mini fyke nets, stratified by lake size, depth, and management unit. Mini fyke nets were not used in Southern Lake Huron.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0		0			0
	Shallow				0.13		0.05			0.08
Medium	Deep	0		0	0.06		1.11		0	0.53
	Shallow		1.00	0.12	0.29		0			0.27
	Unknown	0	0	0	0	0	0			0
Small	Deep	0	0	0	0	0	0.25		0	0.06
	Shallow			4.00		0			0	1.00
	Unknown					0	0.28		0	0.17
All		0	0.40	0.21	0.13	0	0.44		0	0.24

Table 59.–Mean CPUE (catch per haul, including sites with zero catches) of common white sucker in seines, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.06	0	64.04			0	0	23.30
	Shallow	0		29.33	0		0	0		9.78
Medium	Deep	0	17.04	0	0	0	0	0	0	2.54
	Shallow		0.13	0	0.06	0	0	0	0	0.03
	Unknown	0	0	0	0	0		0		0
Small	Deep	0	0	0	0	0	0	0	0	0
	Shallow			0		0			0	0
	Unknown	0	0			0	0	0	59.25	10.77
All		0	8.13	4.19	12.21	0	0	0	6.24	3.86

Table 60.–Mean CPUE (catch per lift, including sites with zero catches) of common white sucker in trap nets, stratified by lake size, depth, and management unit. Trap nets were not used in Western Lake Superior.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.63	2.31			2.58	1.63	0.75	1.74
	Shallow	1.75		1.23			2.60	0.31		1.65
Medium	Deep	0.58	2.26			3.69	3.79	1.93	0.65	2.05
	Shallow		11.54			1.23	0.11	0.92	0	3.76
	Unknown	0.03	0.25	0.33		0.50	2.71	0.16		0.97
Small	Deep	0.74	0.10			2.50	0.21	1.80	0.20	0.85
	Shallow					0			0.75	0.38
	Unknown	0.06	0				5.40	0	2.25	2.85
All		0.56	2.87	1.27		2.40	3.05	1.34	0.68	1.86

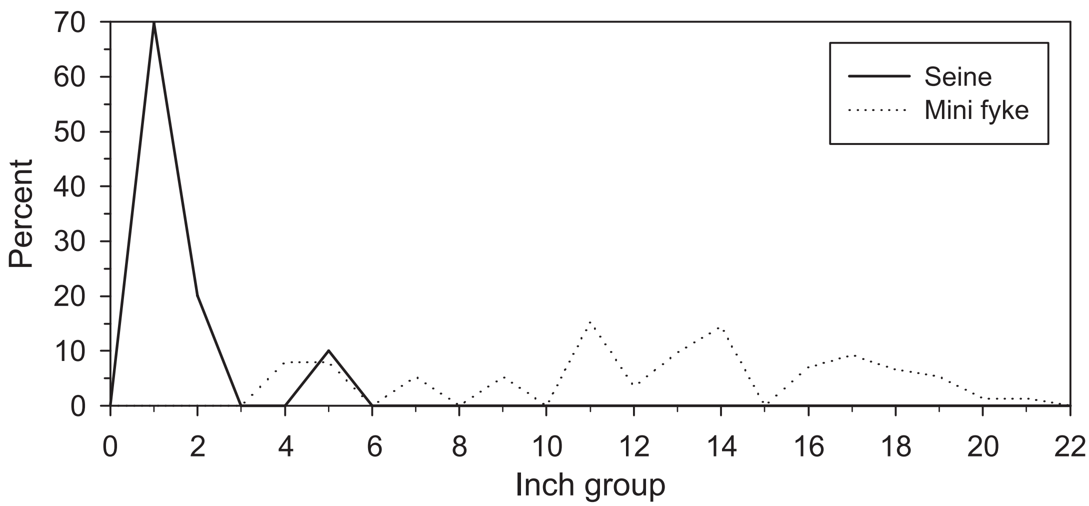


Figure 58.–Size distribution of common white suckers in different gear types.

● Lake chubsucker *Erimyzon sucetta*

Lake chubsuckers were relatively uncommon, being caught in 7% of lakes sampled (Table 61). Lake chubsuckers were only caught in the southern three management units (Figure 59), with no clear preference for lake size or depth (Table 61).

Lake chubsucker were not caught frequently enough to accurately characterize typical catch rates. For all gears combined, the size distribution of lake chubsucker showed a peak between 5 and 7 inches (Figure 60).

Table 61.–Proportion of Status and Trends lakes containing lake chubsucker, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0		0	0	0	0
	Shallow	0		0	0		0	0.67		0.13
Medium	Deep	0.14	0	0	0	0	0	0.21	0.22	0.09
	Shallow		0	0	0	0	0	0	0	0
	Unknown	0.67	0	0	0	0	0	0		0.09
Small	Deep	0.17	0	0	0	0	0	0.13	0.40	0.08
	Shallow			0		0			1.00	0.25
	Unknown	0	0			0	0	0	0.50	0.05
All		0.19	0	0	0	0	0	0.17	0.32	0.08

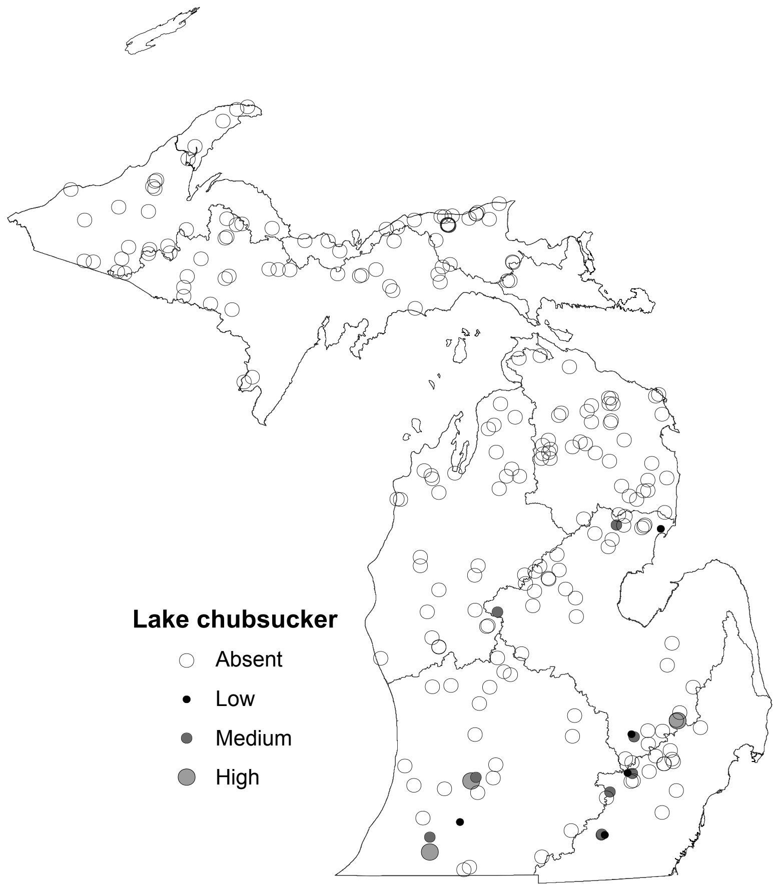


Figure 59.–Distribution and abundance of lake chubsuckers collected from Status and Trends lakes.

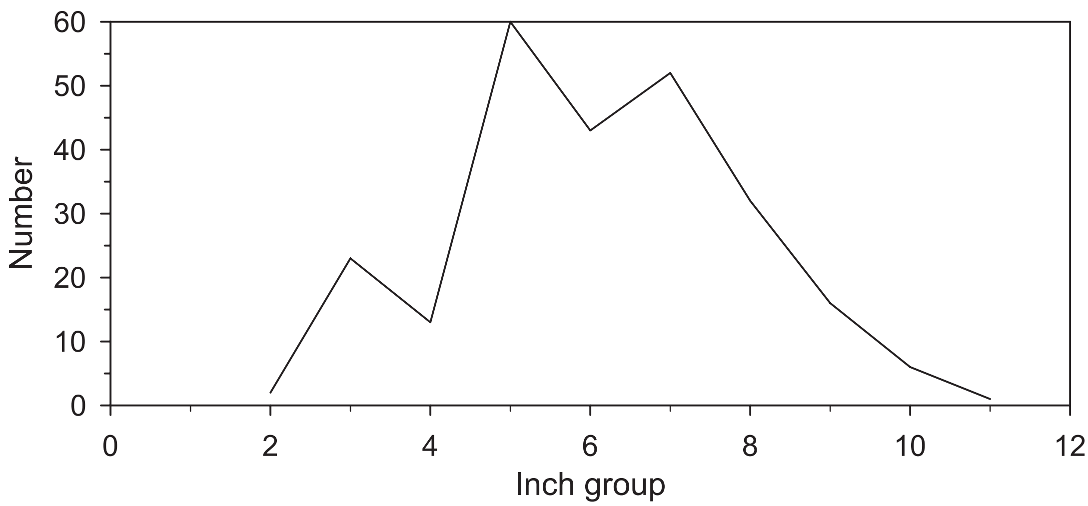


Figure 60.–Size distribution of lake chubsuckers in all gear types combined.

- Northern hogsucker *Hypentelium nigricans*

Northern hogsuckers were caught in three inland lakes (<2% of lakes sampled; Figure 61). Too few northern hogsuckers were caught to reliably determine typical catch rates, size distribution or growth rates.

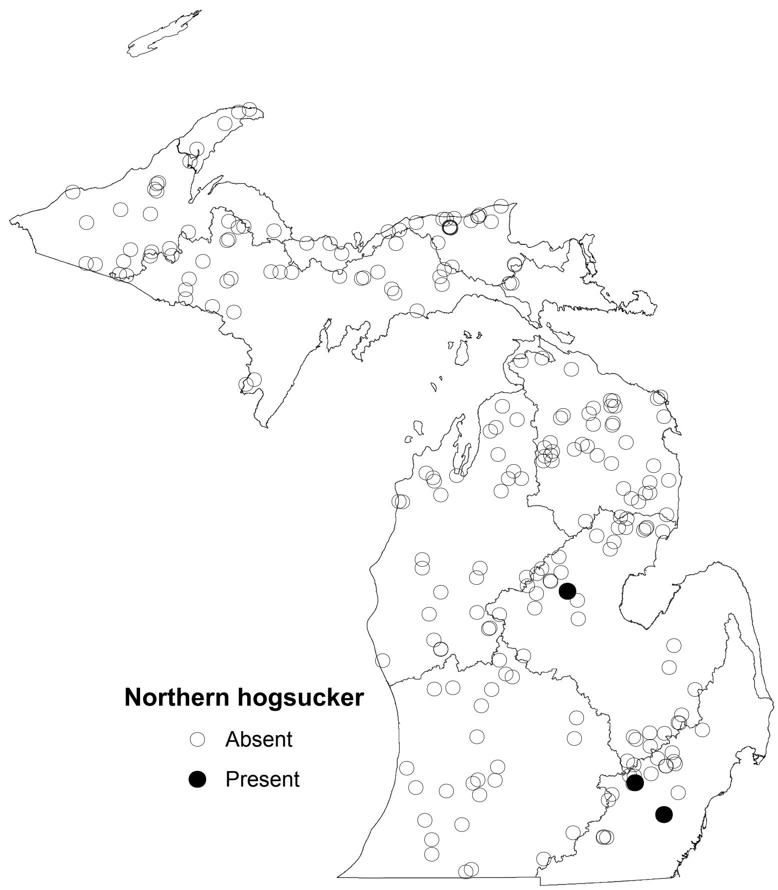


Figure 61.–Distribution of northern hogsuckers collected from Status and Trends lakes.

- Silver redhorse *Moxostoma anisurum*

Silver redhorses were caught in four inland lakes (<2% of lakes sampled; Figure 62). Too few silver redhorses were caught to reliably determine typical catch rates, size distribution, or growth rates.

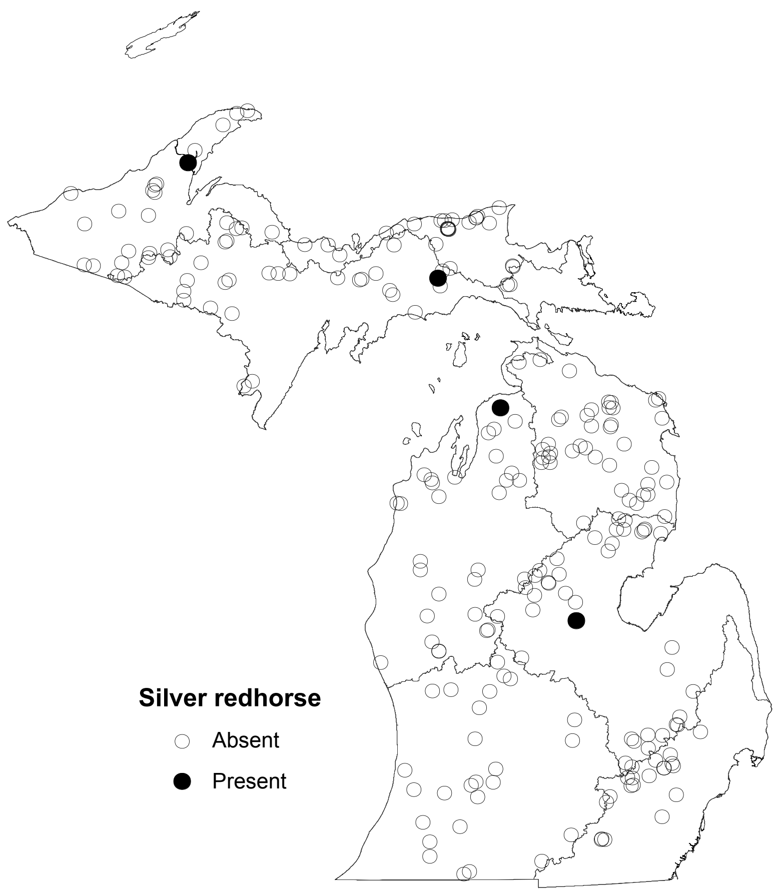


Figure 62.–Distribution of silver redhorses collected from Status and Trends lakes.

- Golden redhorse *Moxostoma erythrurum*

  Golden redhorse is currently listed as a species of greatest conservation need within Michigan's Wildlife Action Plan. Golden redhorses were caught in 3% of lakes sampled (Table 62), all located within the southern-most management units (Figure 63).

  Golden redhorses were not caught in any single gear frequently enough to accurately characterize typical catch rates. For all gears combined, the size distribution of golden redhorses showed three modes, with the major peak between approximately 13 and 16 inches (Figure 64).

Table 62.–Proportion of Status and Trends lakes containing golden redhorse, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0		0	0	0	0
	Shallow	0		0	0		0	0.33		0.07
Medium	Deep	0.07	0	0	0	0	0	0	0.22	0.04
	Shallow		0	0	0	0	0	0	0	0
	Unknown	0	0	0	0	0	0	0.25		0.05
Small	Deep	0.17	0	0	0	0	0	0	0	0.02
	Shallow			0		0			0	0
	Unknown	0	0			0	0	0	0	0
All		0.08	0	0	0	0	0	0.06	0.11	0.03

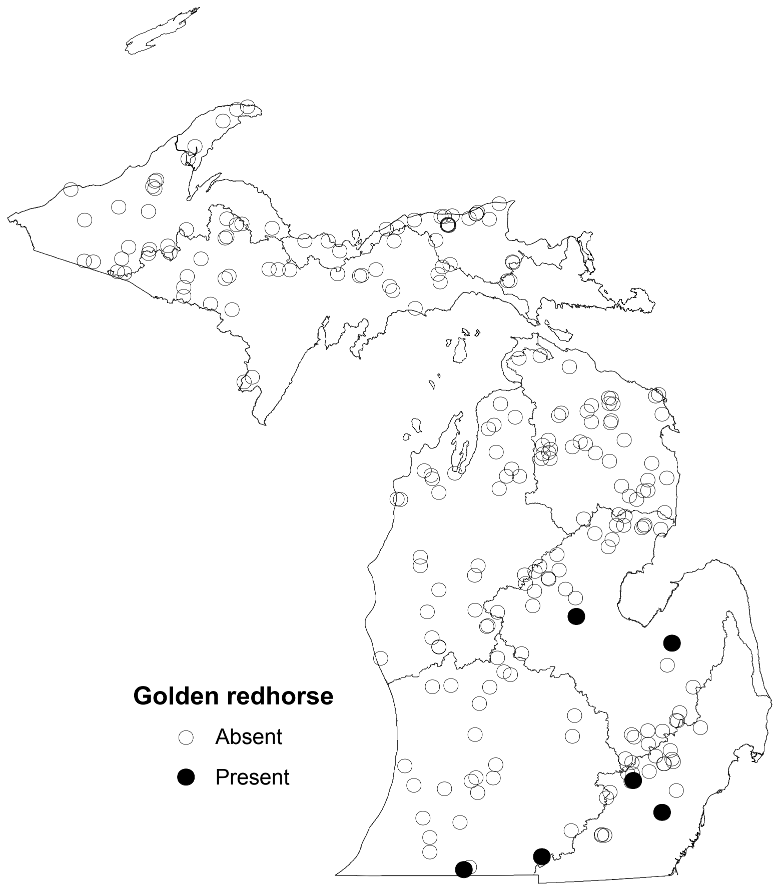


Figure 63.–Distribution of golden redhorses collected from Status and Trends lakes.

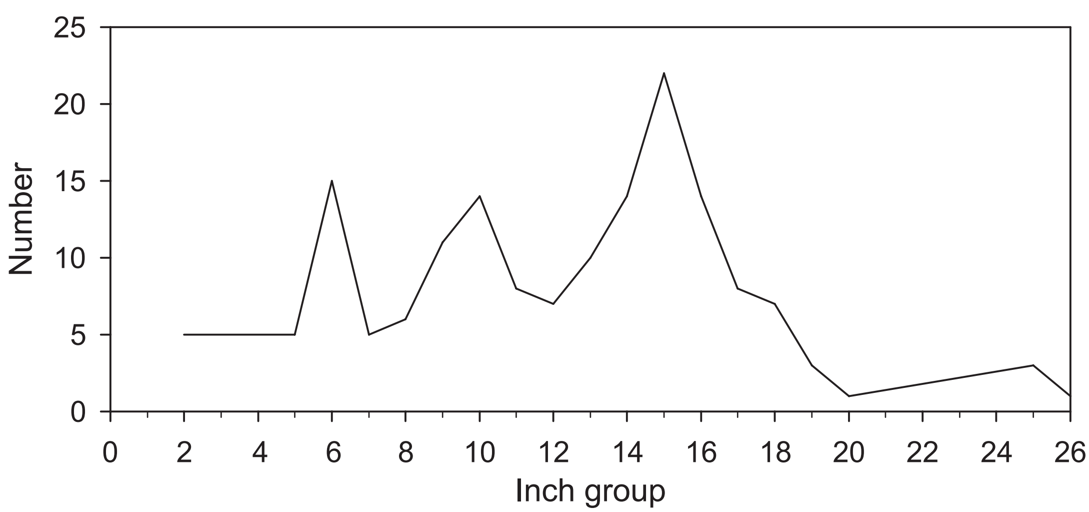


Figure 64.–Size distribution of golden redhorses in all gear types combined.

- Shorthead redhorse *Moxostoma macrolepidotum*

Shorthead redhorses were caught in five lakes (<3% of lakes sampled) scattered widely around the state (Figure 65). Shorthead redhorses were not caught in any single gear frequently enough to accurately characterize typical catch rates. For all gears combined, the size distribution of shorthead redhorses was bimodal, with peaks around 16 and 24 inches (Figure 66).

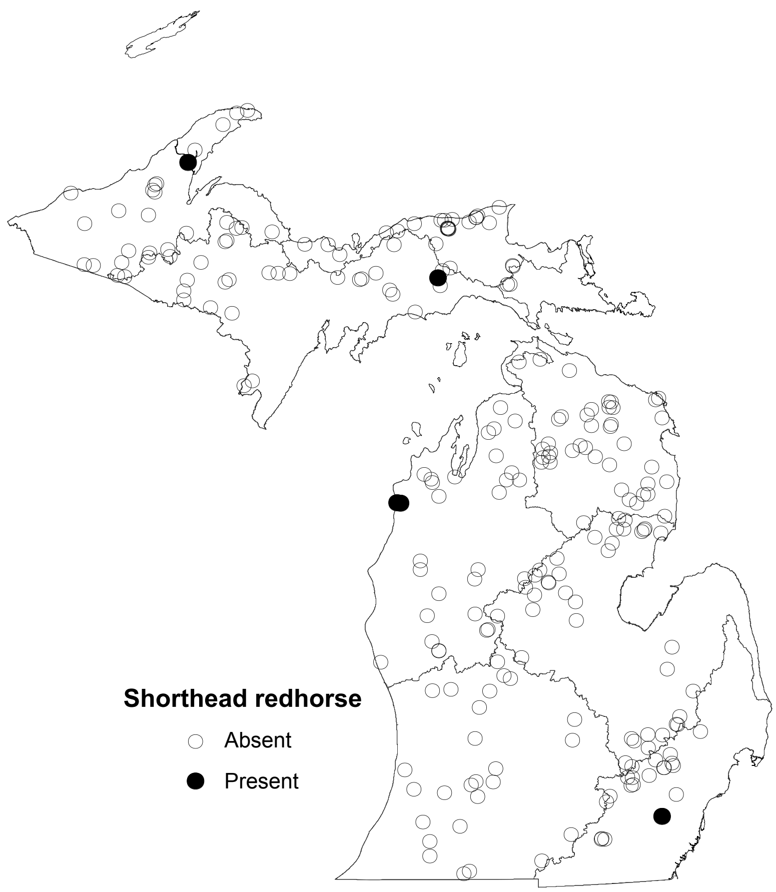


Figure 65.–Distribution of shorthead redhorses collected from Status and Trends lakes.

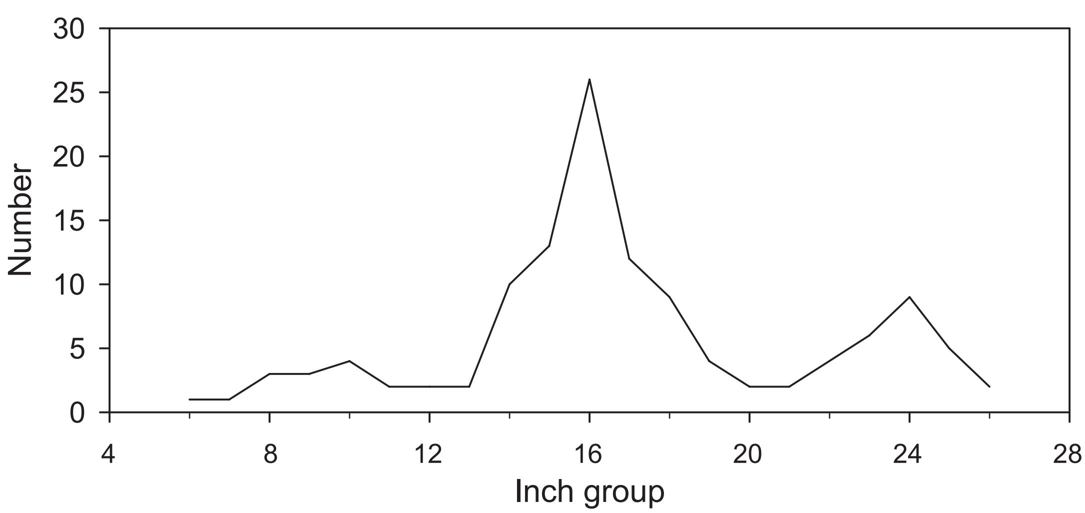


Figure 66.–Size distribution of shorthead redhorses in all gear types combined.

- Greater redhorse *Moxostoma valenciennesi*

  Greater redhorses were caught in five lakes (<3% of lakes sampled), all within the Lake Huron management units (Figure 67). Greater redhorses were not caught frequently enough to accurately characterize typical catch rates, and insufficient numbers were caught to characterize their size distribution.

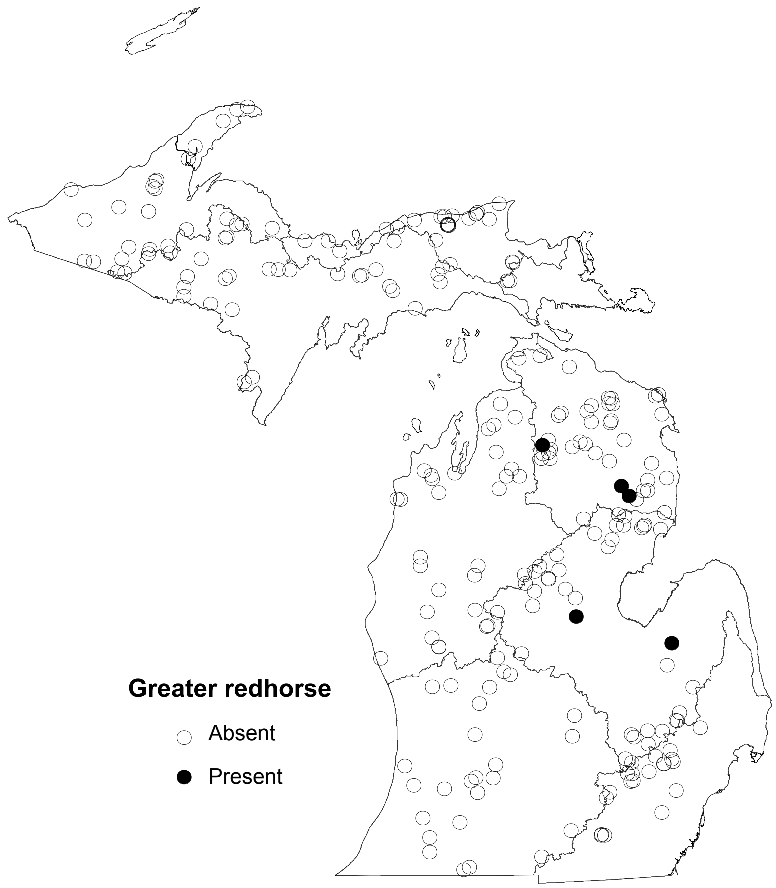


Figure 67.–Distribution of greater redhorses collected from Status and Trends lakes.

Ictaluridae

- Black bullhead *Ameiurus melas*

Black bullheads were widely distributed across the state (Figure 68) but occurred in only about 25% of lakes sampled (Table 63). Black bullhead did not show a clear preference for particular lake sizes or depth strata but occurred somewhat less frequently in lakes within the Lake Superior management units (Table 63).

Black bullheads were caught in all gears deployed (Appendix A), but the vast majority were caught by trap and fyke nets. For the state as a whole, the typical range of catch rates for electrofishing gear was very low at 0.03 to 0.07 fish per minute (Table 64). Typical catch rates in trap nets ranged from 0.25 to 3 fish per lift. Catch rates in fyke nets broadly overlapped those in trap nets, ranging from 0.4 to 2.5 fish per lift. Catches in gill nets occurred relatively infrequently (Table 64), with typical catch rates of 0.25 to 0.67 fish per lift. Black bullheads were infrequently caught in mini fyke nets (six lakes) and seines (one lake), and as such typical catch rates were not determined. Catch rates of black bullheads varied across gears, management units, lake size and lake depth (Tables 65-68). Patterns in CPUE in fyke and trap nets (Tables 66 and 68), which provided the highest total catch, indicate generally higher abundance in larger lakes, and lakes in the Upper Peninsula.

The size distribution of black bullheads in trap nets and fyke nets were similar (Figure 69); average length was about 11.5 inches for each gear.

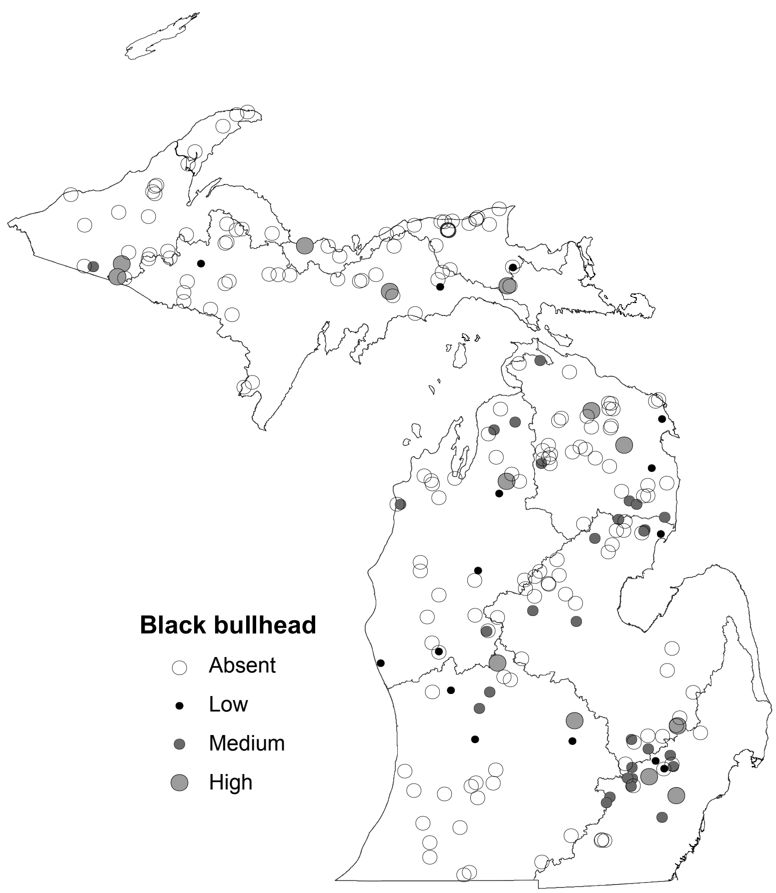


Figure 68.–Distribution and abundance of black bullheads collected from Status and Trends lakes.

Table 63.–Proportion of Status and Trends lakes containing black bullhead, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.33	0	0		1.00	0	1.00	0.25
	Shallow	0		0.33	0		0.60	0.67		0.40
Medium	Deep	0.21	0.36	0	0.13	0	0.21	0.29	0.56	0.25
	Shallow		0.50	0	0.33	0	0	0.25	1.00	0.24
	Unknown	0.33	0.33	0	0	0	0.40	0.25		0.23
Small	Deep	0.33	0.14	0.22	0	0	0	0.25	0.40	0.19
	Shallow			0		0.50			1.00	0.50
	Unknown	0.50	0			0.25	0.25	0	1.00	0.30
All		0.27	0.30	0.10	0.13	0.11	0.26	0.28	0.63	0.25

Table 64.–Summary of catch per unit effort of black bullhead by gear, including only sites and gears with catches greater than zero. Catch per unit effort for electrofishing is number of fish per minute. Catch per unit effort for fyke net, gill net, and trap net is number of fish per lift. Number of lakes with positive catches for each gear is denoted by n.

		Typical range							
Gear	Low	25^{th}		Median		75^{th}	High	Maximum	n
Electrofishing	<0.03	0.03	to	0.03	to	0.07	>0.07	0.10	10
Fyke net	<0.44	0.44	to	1.00	to	2.47	>2.47	299.50	35
Gill net	<0.25	0.25	to	0.50	to	0.67	>0.67	0.80	11
Trap net	<0.22	0.22	to	0.67	to	3.00	>3.00	26.50	41

Table 65.–Mean CPUE (catch per minute, including sites with zero catches) of black bullhead in electrofishing surveys, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0		0	0	0	0
	Shallow	0		0	0		0	0		0
Medium	Deep	0	0.01	0	0	0	0.01	0	0	0
	Shallow		0	0	0	0		0	0	0
	Unknown	0.03	0	0	0	0	0	0		0.01
Small	Deep	0.02	0	0	0		0	0	0	0
	Shallow									
	Unknown	0.04	0			0	0	0		0.01
All		0.01	0	0	0	0	0	0	0	0

Table 66.–Mean CPUE (catch per lift, including sites with zero catches) of black bullhead in fyke nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0		0.04	0	1.50	0.14
	Shallow	0		0	0		0.77	0		0.27
Medium	Deep	0	0.17	0	0.19	0	0.35	0.13	0.54	0.21
	Shallow		4.25	0	0.81	0	0	0.25	3.00	1.03
	Unknown	0	0.48	0	0	0	0.31	0		0.16
Small	Deep	0	0	2.56	0	0	0	0.17	0.19	0.63
	Shallow			0		0.17				0.11
	Unknown		0			74.88	0.53	0	4.00	17.32
All		0	0.85	0.82	0.27	15.78	0.34	0.12	1.16	2.00

Table 67.–Mean CPUE (catch per lift, including sites with zero catches) of black bullhead in gill nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.06	0	0		0	0	0	0.01
	Shallow	0		0	0		0	0		0
Medium	Deep	0.02	0.06	0	0.04	0	0.04	0	0.10	0.03
	Shallow		0.19	0	0	0	0	0	0	0.03
	Unknown	0.26	0	0	0		0	0		0.04
Small	Deep	0.09	0	0	0	0	0	0.06	0	0.02
	Shallow			0					0	0
	Unknown	0	0			0	0	0	0	0
All		0.06	0.05	0	0.01	0	0.01	0.01	0.05	0.03

Table 68.–Mean CPUE (catch per lift, including sites with zero catches) of black bullhead in trap nets, stratified by lake size, depth, and management unit. Trap nets were not used in Western Lake Superior.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0			0.03	0	0.75	0.11
	Shallow	0		0.07			0.83	0.10		0.41
Medium	Deep	0.06	0.28			0	0.32	0.15	0.48	0.22
	Shallow		6.68			0	0	1.25	0.67	2.31
	Unknown	4.86	0.08	0		0	0.08	0.50		1.07
Small	Deep	0.35	0.05			0	0	0.51	0.05	0.22
	Shallow					0			3.00	1.50
	Unknown	1.56	0				0.88	0	3.00	1.11
All		0.79	1.15	0.03		0	0.38	0.38	0.79	0.58

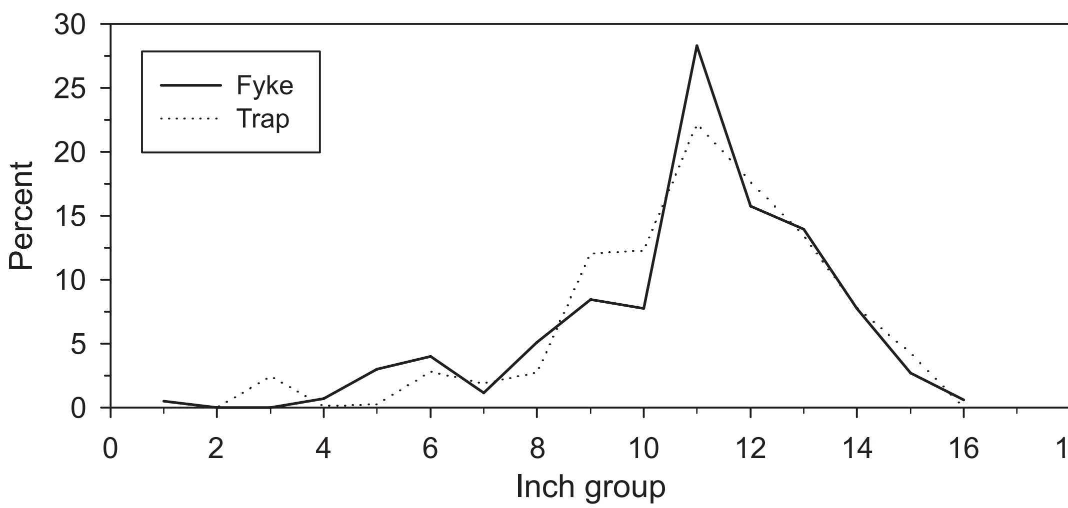


Figure 69.–Size distribution of black bullheads in trap nets and fyke nets.

- Yellow bullhead *Ameiurus natalis*

Yellow bullheads were caught in 40% of all lakes sampled. Yellow bullheads were rarely captured in the Upper Peninsula and occurred most frequently in the Southern Lake Michigan Management Unit (Figure 70; Table 69). Yellow bullheads did not show a clear preference for particular lake sizes or depth classes, but were relatively rarely caught in small shallow lakes (Table 69).

Yellow bullheads were caught in all gears deployed except seines (Appendix A), but as with the other bullhead species the vast majority were caught by trap and fyke nets. For the state as a whole, the typical range of catch rates for electrofishing gear was very low at 0.03 to 0.10 fish per minute (Table 70). Catch rates in trap nets and fyke nets were similar, with typical ranges of 0.5 to 5-7 fish per lift. Catches in gill nets typically ranged between 0.25 to 1.6 fish per lift. Yellow bullheads were infrequently caught in mini fyke nets (six lakes) and seines (no lakes), and as such typical catch rates were not determined. Catch rates of yellow bullheads varied across gears, management units, lake size and lake depth (Tables 71-74). Patterns in CPUE in fyke and trap nets (Tables 72 and 74), which provided the highest total catch, indicated higher abundance in the Southern Lake Michigan and Lake Huron management units, but showed not clear preference for lake size or depth.

Too few yellow bullheads were caught in seines and mini fyke nets to reliably characterize the size composition of the catch in these gears. The size composition of yellow bullheads was similar in all of the other gears (Figure 71), with mean lengths ranging from 9.6 to 11.0 inches.

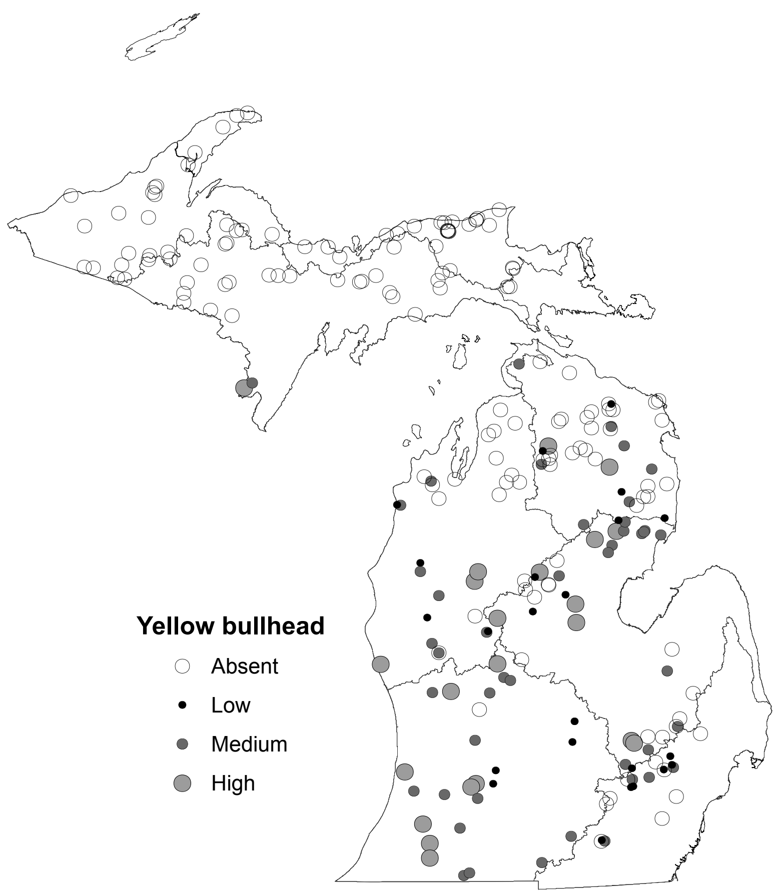


Figure 70.–Distribution and abundance of yellow bullheads collected from Status and Trends lakes.

Table 69.–Proportion of Status and Trends lakes containing yellow bullhead, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.33	0	0		1.00	1.00	1.00	0.33
	Shallow	1.00		0	0		0.60	1.00		0.47
Medium	Deep	0.93	0.64	0	0	0	0.21	0.93	0.78	0.54
	Shallow		0	0	0	0	0.33	1.00	0	0.20
	Unknown	1.00	0.33	0	0	0	0.60	0.25		0.36
Small	Deep	1.00	0.43	0.22	0	0	0.43	0.38	0.40	0.40
	Shallow			0		0			0	0
	Unknown	1.00	1.00			0	0	0	0	0.20
All		0.96	0.47	0.07	0	0	0.33	0.69	0.53	0.40

Table 70.–Summary of catch per unit effort of yellow bullhead by gear, including only sites and gears with catches greater than zero. Catch per unit effort for electrofishing is number of fish per minute. Catch per unit effort for fyke net, gill net, and trap net is number of fish per lift. Number of lakes with positive catches for each gear is denoted by n.

		Typical range							
Gear	Low	25th		Median		75th	High	Maximum	n
Electrofishing	<0.03	0.03	to	0.05	to	0.10	>0.10	0.70	42
Fyke net	<0.50	0.50	to	1.89	to	5.00	>5.00	41.00	59
Gill net	<0.25	0.25	to	0.50	to	1.63	>1.63	3.00	28
Trap net	<0.47	0.47	to	1.76	to	6.79	>6.79	22.50	72

Table 71.–Mean CPUE (catch per minute, including sites with zero catches) of yellow bullhead in electrofishing surveys, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.05	0	0		0	0	0	0.01
	Shallow	0		0	0		0	0.02		0
Medium	Deep	0.05	0.05	0	0	0	0.01	0.03	0	0.03
	Shallow		0	0	0	0		0.18	0	0.04
	Unknown	0.08	0	0	0	0	0	0		0.01
Small	Deep	0.09	0.13	0.03	0		0	0	0	0.04
	Shallow									
	Unknown	0.07	0.03			0	0	0		0.03
All		0.06	0.05	0.01	0	0	0.01	0.03	0	0.03

Table 72.–Mean CPUE (catch per lift, including sites with zero catches) of yellow bullhead in fyke nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0		0.28	2.88	0.50	0.33
	Shallow	0		0	0		0.14	3.54		0.81
Medium	Deep	8.73	3.15	0	0	0	0.12	3.82	1.35	2.15
	Shallow		0	0	0	0	0	4.90	0	0.78
	Unknown	2.54	0	0	0	0	0.40	0.67		0.44
Small	Deep	1.28	3.75	1.40	0	0	1.83	0.42	0	1.36
	Shallow			0		0				0
	Unknown		0.51			0	0	0	0	0.06
All		5.96	1.84	0.45	0	0	0.41	2.64	0.76	1.21

Table 73.–Mean CPUE (catch per lift, including sites with zero catches) of yellow bullhead in gill nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.56	0	0		0	0	0	0.11
	Shallow	0.19		0	0		0	0		0.01
Medium	Deep	0.67	0.42	0	0	0	0	0.05	0.04	0.19
	Shallow		0	0	0	0	0	0.31	0	0.05
	Unknown	0.95	0	0	0		0.05	0		0.17
Small	Deep	0.08	0.05	0	0	0	0.39	0.13	0	0.10
	Shallow			0					0	0
	Unknown	0	0.05			0	0	0	0	0.01
All		0.50	0.22	0	0	0	0.07	0.09	0.02	0.12

Table 74.–Mean CPUE (catch per lift, including sites with zero catches) of yellow bullhead in trap nets, stratified by lake size, depth, and management unit. Trap nets were not used in Western Lake Superior.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		2.33	0			0.11	5.38	0.08	1.79
	Shallow	1.75		0			0.19	2.96		1.05
Medium	Deep	5.17	1.52			0	0.11	3.84	0.81	2.28
	Shallow		0			0	0.04	6.99	0	2.01
	Unknown	3.69	1.33	0		0	0.48	0		1.01
Small	Deep	4.29	2.10			0	3.51	0.65	0.13	1.88
	Shallow					0			0	0
	Unknown	5.25	0				0	0	0	0.81
All		4.67	1.44	0		0	0.50	2.81	0.42	1.80

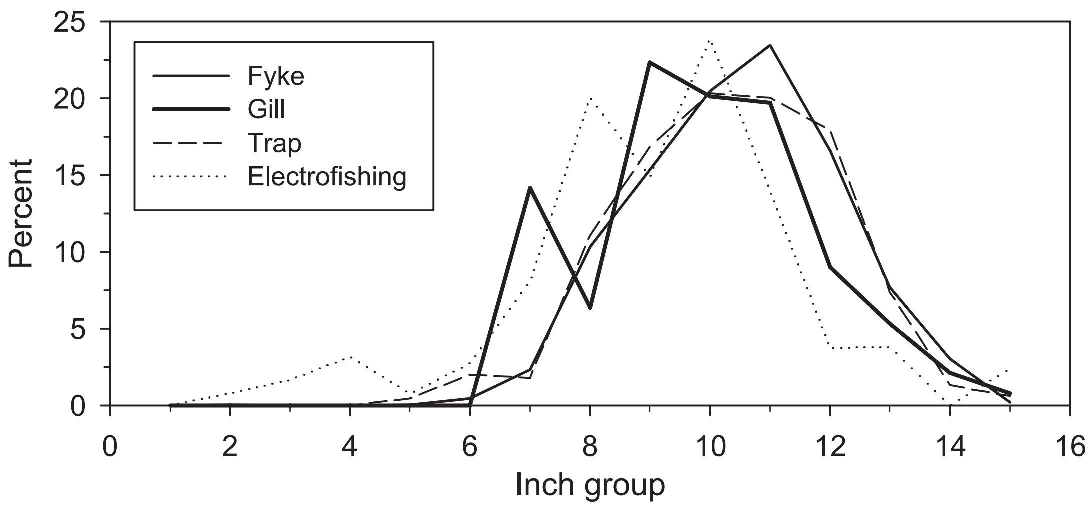


Figure 71.–Size distribution of yellow bullheads in different gear types.

- Brown bullhead *Ameiurus nebulosus*

Brown bullheads were widely distributed, being caught in 67% of all lakes sampled. Brown bullheads occurred across the entire state, but were somewhat less prevalent in the Northern Lake Michigan and Lake Superior management units (Figure 72; Table 75). Brown bullheads did not show a clear preference for particular lake sizes or depth classes (Table 75).

Brown bullheads were caught in all gears deployed (Appendix A) but the vast majority were caught by trap and fyke nets. For the state as a whole, the typical range of catch rates for electrofishing gear was very low at 0.03 to 0.15 fish per minute (Table 76). Catch rates in trap nets and fyke nets were similar, with typical ranges of 1 to 8 fish per lift. Catches in gill nets typically ranged between 0.25 to 1 fish per lift. Catch rates in mini fyke nets were typically between 0.5 and 4 fish per lift. Brown bullheads were infrequently caught in seines (one lake), and as such typical catch rates were not determined. Catch rates of brown bullheads varied across gears, management units, lake size and lake depth (Tables 77-81). Patterns in CPUE in fyke and trap nets (Tables 78 and 81), which provided the highest total catch, indicated higher abundance in small to medium sized shallow lakes.

Too few brown bullheads were caught in seines to reliably characterize the size composition of the catch in this gear. Mini fyke nets, electrofishing and gill nets caught a similar size range of fish (Figure 73), averaging 10.2 inches (SE=0.4), 10.8 inches (SE=0.3), and 10.7 inches (SE=0.3), respectively. The size distribution of catches in trap nets and fyke nets were nearly identical (Figure 73) and averaged larger than the other gears, with a mean size of the catch of 11.6 (SE=0.1) and 11.4 inches (SE=0.2).

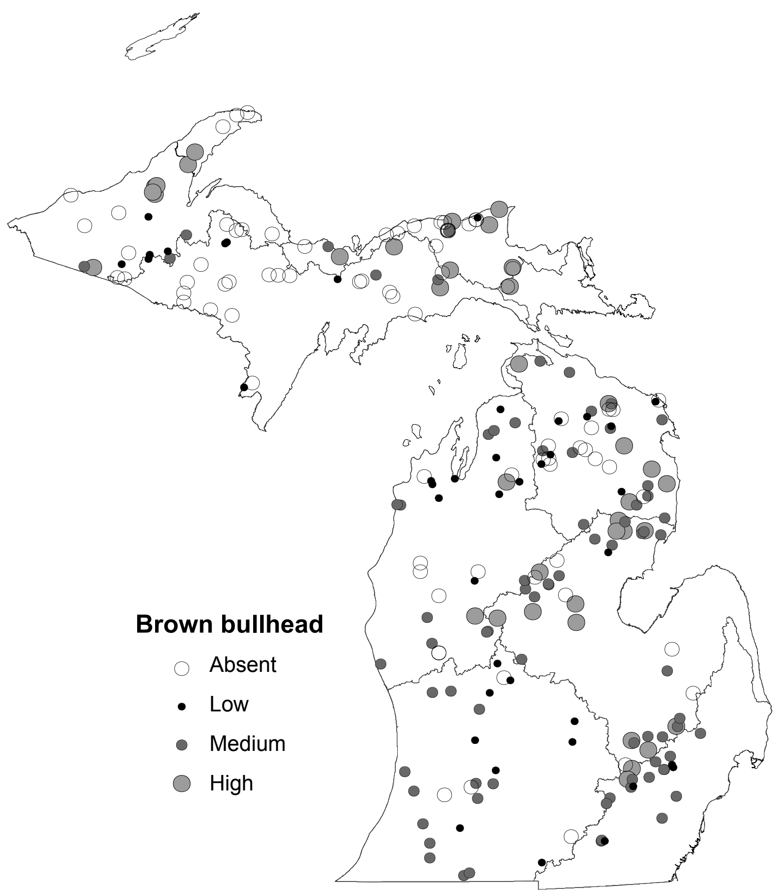


Figure 72.–Distribution and abundance of brown bullheads collected from Status and Trends lakes.

Table 75.–Proportion of Status and Trends lakes containing brown bullhead, stratified by lake size, depth, and Fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.00	0.50	0.25		1.00	1.00	1.00	0.67
	Shallow	1.00		0.67	0.67		1.00	1.00		0.87
Medium	Deep	0.86	0.82	0	0.50	0.40	0.64	0.86	1.00	0.71
	Shallow		0.75	0.40	0.83	1.00	0.67	0.75	1.00	0.72
	Unknown	0.67	0.67	0.25	0	0.50	0.80	0.75		0.59
Small	Deep	0.83	0.57	0.11	1.00	0.50	0.43	0.75	1.00	0.58
	Shallow			1.00		0.50			1.00	0.75
	Unknown	1.00	0.50			0.25	0.50	1.00	1.00	0.60
All		0.85	0.73	0.28	0.58	0.47	0.65	0.83	1.00	0.67

Table 76.–Summary of catch per unit effort of brown bullhead by gear, including only sites and gears with catches greater than zero. Catch per unit effort for electrofishing is number of fish per minute. Catch per unit effort for fyke net, gill net, mini fyke, and trap net is number of fish per lift. Number of lakes with positive catches for each gear is denoted by n.

		Typical range							
Gear	Low	25th		Median		75th	High	Maximum	n
Electrofishing	<0.03	0.03	to	0.07	to	0.15	>0.15	1.50	54
Fyke net	<0.83	0.83	to	2.44	to	8.00	>8.00	417.70	107
Gill net	<0.25	0.25	to	0.50	to	1.00	>1.00	72.50	41
Mini fyke	<0.50	0.50	to	1.50	to	4.00	>4.00	283.50	38
Trap net	<1	1.00	to	3.19	to	8.63	>8.63	663.50	116

Table 77.–Mean CPUE (catch per minute, including sites with zero catches) of brown bullhead in electrofishing surveys, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.25	0	0.24		0.10	0	0.07	0.15
	Shallow	0.01		0.02	0.11		0	0.22		0.08
Medium	Deep	0.04	0.03	0	0.01	0	0.03	0.23	0.02	0.07
	Shallow		0	0	0.10	0.20		0.16	0.03	0.07
	Unknown	0	0.07	0.07	0	0	0	0.03		0.03
Small	Deep	0.03	0.03	0	0		0	0.02	0.03	0.02
	Shallow									
	Unknown	0	0			0	0	0.05		0.01
All		0.03	0.05	0.01	0.08	0.03	0.02	0.14	0.03	0.06

Table 78.–Mean CPUE (catch per lift, including sites with zero catches) of brown bullhead in fyke nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.10	0.07	10.14		21.68	5.13	3.17	6.44
	Shallow	0		0.49	9.11		1.93	6.61		4.13
Medium	Deep	0.82	1.61	0	6.41	4.12	2.40	2.68	1.77	2.54
	Shallow		105.73	0.61	3.75	51.66	1.17	8.04	21.00	24.34
	Unknown	0	2.50	1.27	0	51.00	7.80	5.67		8.68
Small	Deep	1.00	24.14	0.06	12.14	0.35	0.02	5.86	1.94	5.49
	Shallow			1.00		83.44				55.96
	Unknown		0.25			3.38	4.17	4.67	13.67	4.67
All		0.66	25.46	0.38	6.91	21.46	3.28	5.08	4.77	7.96

Table 79.–Mean CPUE (catch per lift, including sites with zero catches) of brown bullhead in gill nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.06	0	0.07		0	0	0.75	0.11
	Shallow	0.08		0	0.05		0.07	0.08		0.05
Medium	Deep	0.24	0.34	0	0.16	0	0.39	0.11	0	0.19
	Shallow		5.19	0	0.54	36.25	0.17	0.06	0	4.05
	Unknown	0	0	0.25	0		2.29	0		0.69
Small	Deep	0	0.07	0	0	0	0.04	0.25	0.10	0.07
	Shallow			0.25					0	0.13
	Unknown	0	0			0	0.38	0	0	0.18
All		0.13	0.90	0.04	0.21	6.59	0.49	0.12	0.07	0.63

Table 80.–Mean CPUE (catch per lift, including sites with zero catches) of brown bullhead in mini fyke nets, stratified by lake size, depth, and management unit. Mini fyke nets were not used in Southern Lake Huron.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.25	0	0		1.00			0.25
	Shallow				0.72		0.14			0.36
Medium	Deep	0		0	0.84		1.50		3.33	1.08
	Shallow		141.75	0.05	0.73		0			18.01
	Unknown	0	7.50	0	0	1.83	2.63			1.81
Small	Deep	0	0	0	0.25	0	0.33		2.00	0.41
	Shallow			0		71.00			1.00	35.75
	Unknown					1.67	1.06		0.50	1.12
All		0	58.25	0.01	0.65	13.70	1.04		1.67	4.68

Table 81.–Mean CPUE (catch per lift, including sites with zero catches) of brown bullhead in trap nets, stratified by lake size, depth, and management unit. Trap nets were not used in Western Lake Superior.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		2.17	0			15.63	8.38	0.92	4.49
	Shallow	4.00		2.28			2.92	8.58		4.44
Medium	Deep	4.15	1.91			2.52	3.88	9.02	1.75	4.34
	Shallow		166.82			44.73	2.08	17.88	16.33	60.77
	Unknown	0.50	0.33	4.17		0	22.88	7.21		9.35
Small	Deep	1.14	17.71			1.00	0	6.22	4.93	6.11
	Shallow					45.89			19.75	32.82
	Unknown	0.69	0				9.06	3.08	15.75	7.19
All		2.76	30.76	2.18		13.63	6.83	8.80	5.73	10.72

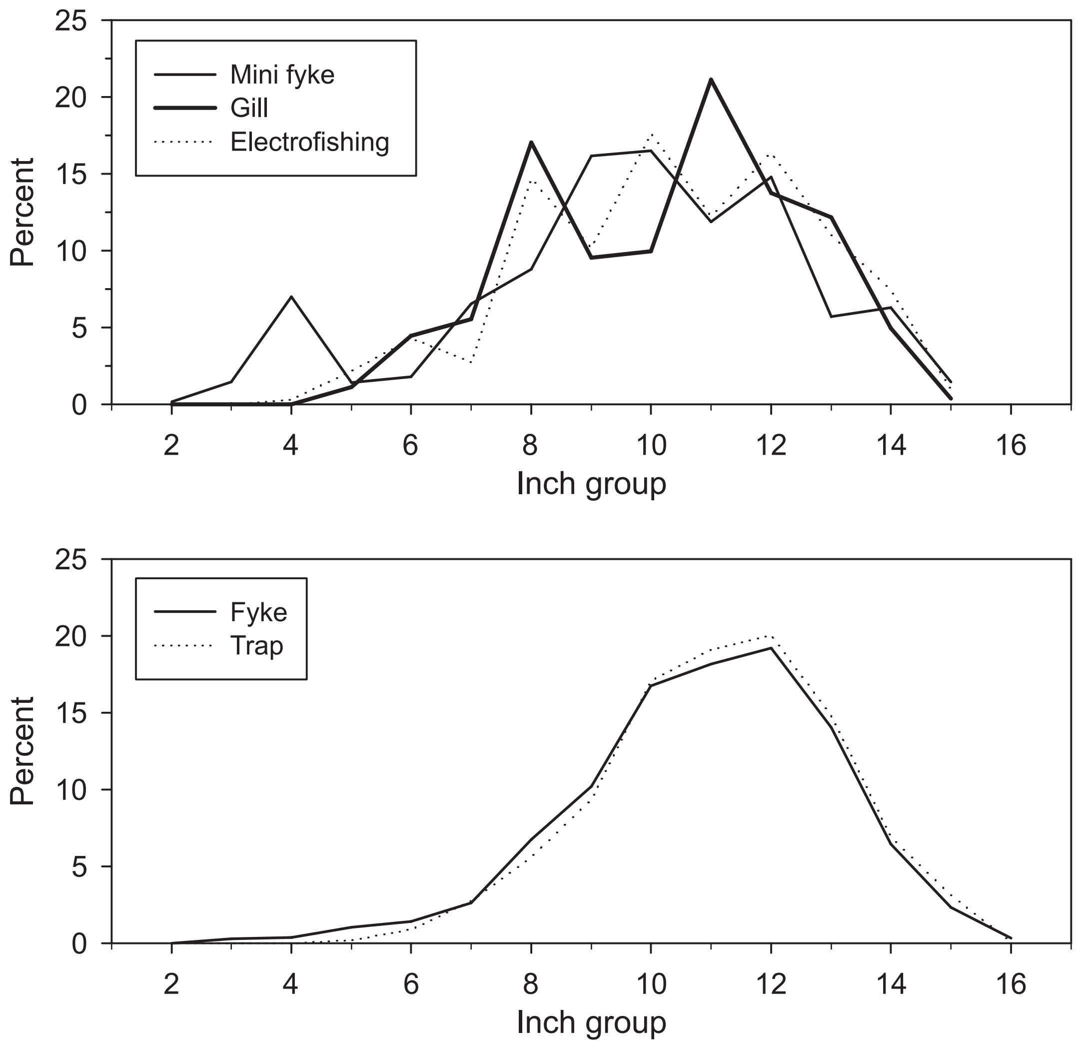


Figure 73.–Size distribution of brown bullheads in different gear types.

- Channel catfish *Ictalurus punctatus*

Channel catfish were relatively uncommon and were caught in only 9% of all lakes sampled. Lakes where channel catfish were caught were located in the southern and eastern part of the state (Figure 74). The low prevalence of channel catfish made it difficult to clearly identify preferences for lake size or depth categories (Table 82).

The vast majority of channel catfish were caught by trap nets, followed by fyke and gill nets, with insufficient fish caught in other gears to develop criteria for typical catches. Catch rates in these three gears were broadly similar, with some indication of higher catch rates in trap nets (Table 83). Catch rates of channel catfish varied across gears, management units, lake size and lake depth (Tables 84-86). Patterns in CPUE in fyke and trap nets (Tables 85 and 86), which provided the highest total catch, indicated generally higher abundance in larger lakes, and lakes in the Lake Erie and Southern Lake Huron management units.

The mean size of channel catfish sampled was quite large; mean length in fyke nets was 19.2 inches (SE=1.5), 19.7 inches (SE=0.7) in gill nets, and 21.9 (SE=1.1) in trap nets. The overall size distribution of catches in each gear was quite erratic (Figure 75), likely due to the relatively small number of fish captured.

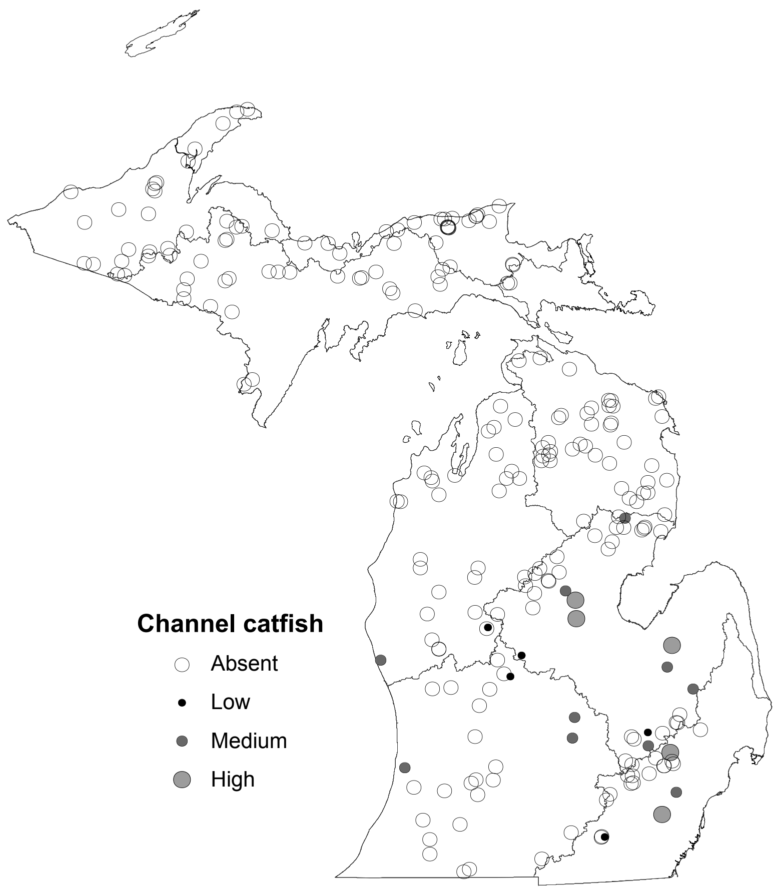


Figure 74.–Distribution and abundance of channel catfish collected from Status and Trends lakes.

Table 82.–Proportion of Status and Trends lakes containing channel catfish, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.33	0	0		0	1.00	0	0.17
	Shallow	0		0	0		0	0.33		0.07
Medium	Deep	0.14	0.09	0	0	0	0	0.21	0.33	0.11
	Shallow		0	0	0	0	0	0.25	0	0.04
	Unknown	0.33	0	0	0	0	0	0.50		0.14
Small	Deep	0.17	0	0	0	0	0	0.13	0	0.04
	Shallow			0		0			0	0
	Unknown	0	0			0	0	0.50	0.50	0.10
All		0.15	0.07	0	0	0	0	0.28	0.21	0.09

Table 83.–Summary of catch per unit effort of channel catfish by gear, including only sites and gears with catches greater than zero. Catch per unit effort for fyke net, gill net, and trap net is number of fish per lift. Number of lakes with positive catches for each gear is denoted by n.

Gear	Low	Typical range					High	Maximum	n
		25^{th}		Median		75^{th}			
Fyke net	<0.33	0.33	to	1.13	to	2.75	>2.75	19.75	9
Gill net	<0.58	0.58	to	1.00	to	1.42	>1.42	6.67	12
Trap net	<0.44	0.44	to	2.18	to	5.55	>5.55	42.29	16

Table 84.–Mean CPUE (catch per lift, including sites with zero catches) of channel catfish in fyke nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0		0	2.75	0	0.25
	Shallow	0		0	0		0	0.65		0.14
Medium	Deep	0	0	0	0	0	0	0.01	0.79	0.10
	Shallow		0	0	0	0	0	0.17	0	0.03
	Unknown	0	0	0	0	0	0	9.88		1.04
Small	Deep	0	0	0	0	0	0	0	0	0
	Shallow			0		0				0
	Unknown		0			0	0	0.17	0.17	0.04
All		0	0	0	0	0	0	0.95	0.44	0.17

Table 85.–Mean CPUE (catch per lift, including sites with zero catches) of channel catfish in gill nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.33	0	0		0	1.67	0	0.23
	Shallow	0		0	0		0	0.50		0.07
Medium	Deep	0.11	0	0	0	0	0	0.14	0.89	0.14
	Shallow		0	0	0	0	0	0	0	0
	Unknown	0.44	0	0	0		0	0		0.07
Small	Deep	0	0	0	0	0	0	0.13	0	0.02
	Shallow			0					0	0
	Unknown	0	0			0	0	0	0	0
All		0.11	0.02	0	0	0	0	0.17	0.42	0.08

Table 86.–Mean CPUE (catch per lift, including sites with zero catches) of channel catfish in trap nets, stratified by lake size, depth, and management unit. Trap nets were not used in Western Lake Superior.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.17	0			0	4.00	0	0.64
	Shallow	0		0			0	2.09		0.57
Medium	Deep	0.35	0.03			0	0	0.07	7.31	1.09
	Shallow		0			0	0	0.27	0	0.08
	Unknown	1.31	0	0		0	0	5.57		1.64
Small	Deep	0.02	0			0	0	0.28	0	0.08
	Shallow					0			0	0
	Unknown	0	0				0	0	1.06	0.16
All		0.34	0.03	0		0	0	1.02	3.58	0.72

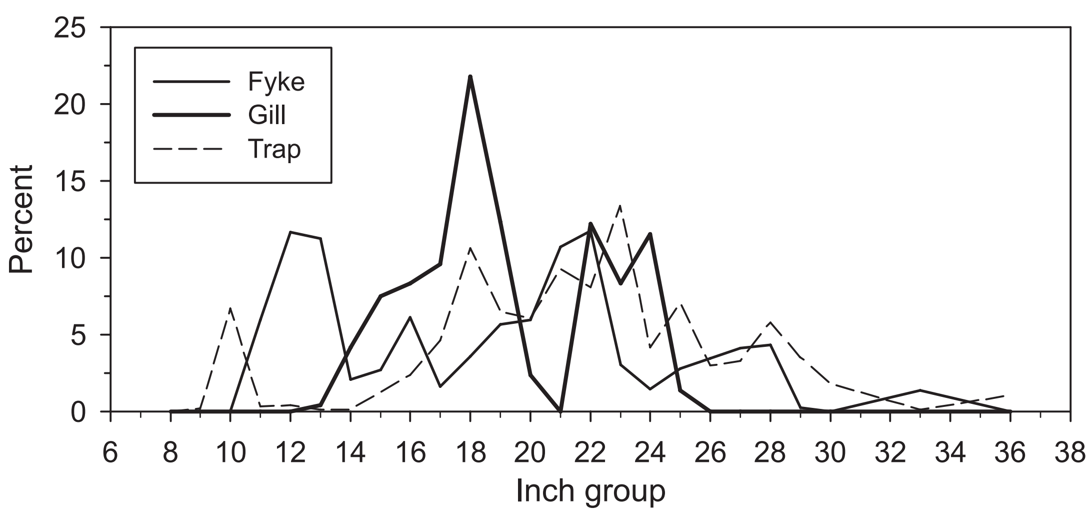


Figure 75.–Size distribution of channel catfish in different gear types.

- Tadpole madtom *Noturus gyrinus*

  Tadpole madtom is currently listed as a species of greatest conservation need within Michigan's Wildlife Action Plan. Tadpole madtoms were caught in two inland lakes (<1% of lakes sampled) one within the Northern Lake Michigan and the other within the Southern Lake Huron Management Unit (Figure 76). Too few tadpole madtoms were caught to reliably determine typical catch rates, size distribution or growth rates.

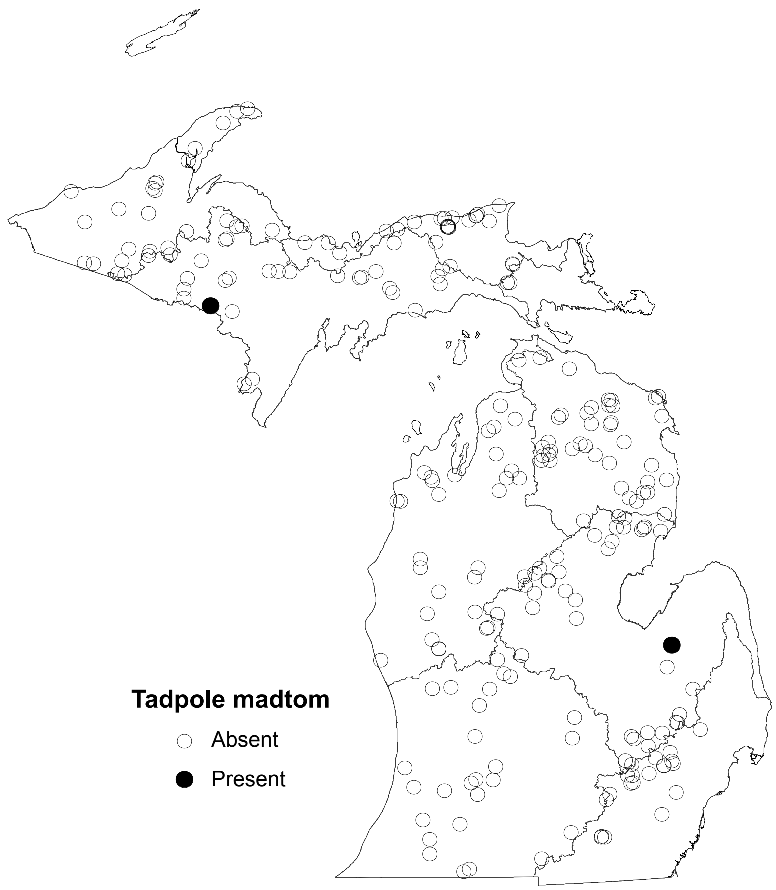


Figure 76.–Distribution of tadpole madtoms collected from Status and Trends lakes.

- Flathead catfish *Pylodictus olivaris*

Flathead catfish were relatively uncommon in inland lakes and were caught in only three lakes (<2% of lakes sampled), all within the Southern Lake Michigan Management Unit (Figure 77). Too few flathead catfish were caught to characterize catch rates or size distribution.

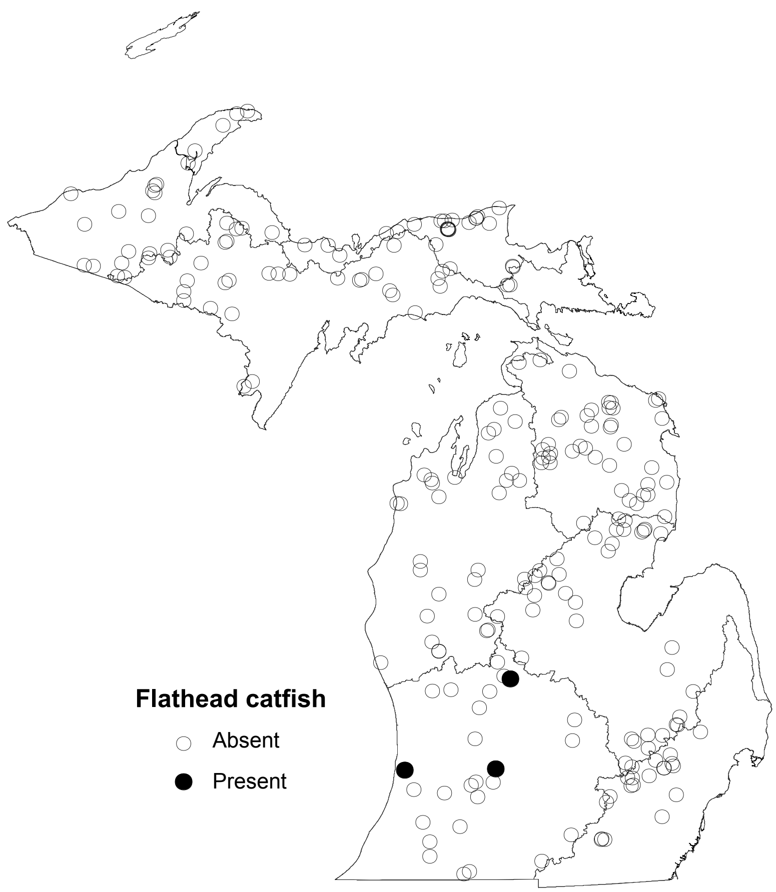


Figure 77.–Distribution of flathead catfish collected from Status and Trends lakes.

Esocidae

- Grass pickerel *Esox americanus vermiculatus*

Grass pickerel is currently listed as a species of greatest conservation need within Michigan's Wildlife Action Plan. Grass pickerel were modestly common, being caught in 10% of lakes sampled (Table 87). Grass pickerel were only caught in lakes within the southern part of the Lower Peninsula (Figure 78), and were most frequently caught in within the Southern Lake Michigan and Lake Huron management units (Table 87).

Electrofishing provided the vast majority of the catch of grass pickerel, with typical catch rates ranging from 0.03 to 0.2 fish per minute in the 23 lakes where catches occurred with this gear. The size distribution of grass pickerel caught by electrofishing showed a broad peak between 5 and 11 inches (Figure 79).

Table 87.–Proportion of Status and Trends lakes containing grass pickerel, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0		0	0	0	0
	Shallow	0		0	0		0	0.33		0.07
Medium	Deep	0.36	0.09	0	0	0	0	0.29	0.22	0.15
	Shallow		0	0	0	0	0	0	1.00	0.04
	Unknown	0.33	0	0	0	0	0	0.50		0.14
Small	Deep	0.50	0	0	0	0	0	0.38	0	0.13
	Shallow			0		0			0	0
	Unknown	0	0			0	0	0	0	0
All		0.35	0.03	0	0	0	0	0.28	0.16	0.10

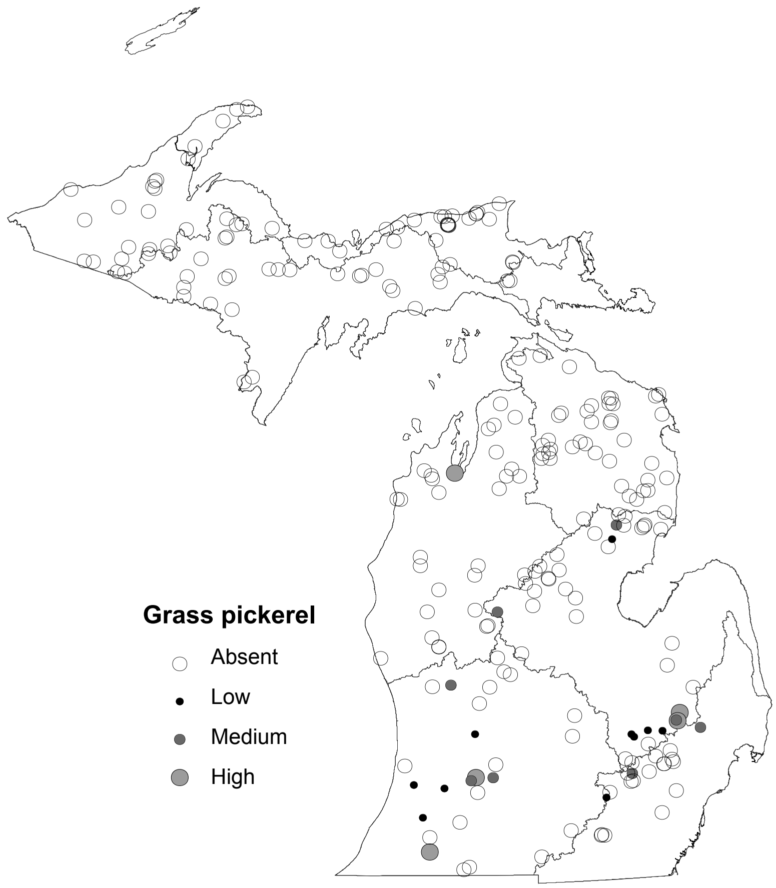


Figure 78.–Distribution and abundance of grass pickerel collected from Status and Trends lakes.

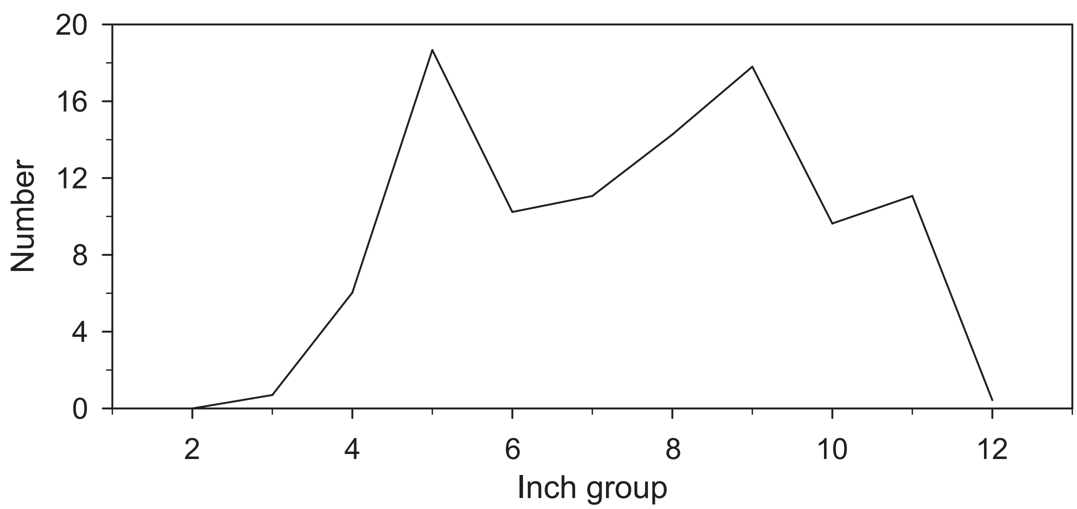


Figure 79.–Size distribution of grass pickerel caught by electrofishing.

- Northern pike *Esox lucius*

Northern pike was one of the most frequently encountered species, being caught in 80% of all lakes sampled. Northern pike occurred across the entire state and tended to occur in highest abundance in northern lakes (Figure 80). Northern pike occurred somewhat less frequently in smaller lakes, particularly small shallow lakes, although this lake category did not have a high representation in lakes selected for sampling (Table 88).

The majority of northern pike were caught in fyke nets, trap nets, and gill nets (Appendix A). Although northern pike were widely distributed, catch rates were often lower than for many other species of fish. For the state as a whole, the typical range of catch rates for electrofishing gear was roughly 0.03 to 0.1 fish per minute (Table 89). Catch rates in fyke nets and trap nets were quite similar, with typical catch rates of 0.3 to 1.5 fish per lift for both gears. Typical catch rates in gill nets were higher than fyke nets or trap nets, ranging from 1 to 4 fish per lift. Northern pike were not commonly caught in seines or mini fykes, and catch rate statistics should be interpreted cautiously for these gear types. Catch rates of northern pike varied across gears, management units, lake size and lake depth (Tables 90-95). Catch rates in gill nets (Table 92), which provided the highest total catch, showed no clear pattern across lake size, depth, or location, with the possible exception of lower catch rates in small shallow lakes.

The size distributions of northern pike caught in seines and mini fyke nets (Figure 81) were quite erratic, likely due to the relatively small number of fish caught by these gears. The size distributions of northern pike caught in other gears were remarkably similar. The seine selected

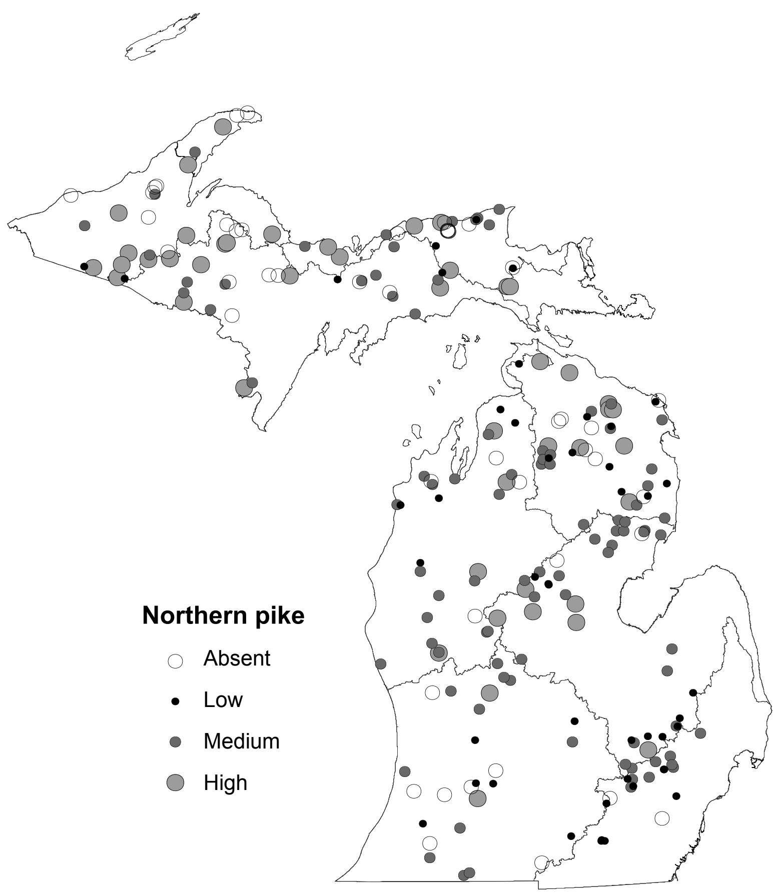


Figure 80.–Distribution and abundance of northern pike collected from Status and Trends lakes.

for the smallest northern pike (Figure 81), with an average length of 2.9 inches (SE=0.1). The size distribution of catches of northern pike in mini fyke nets was very similar to that in seines (Figure 81), and had a mean of 3.9 inches (SE=0.2). Electrofishing selected for smaller fish than the large-mesh passive gear (Figure 81), with a mean length of 4.6 inches (SE=0.1). The size distribution of catches in fyke nets, gill nets, and trap nets differed slightly (Figure 81) with the mean length being lowest in gill nets (6.6 inches [SE=0.2]), next lowest in fyke nets (7.7 inches [SE=0.2]), and largest in trap nets at 8.5 inches (SE=0.2).

The range of typical growth for northern pike was provided in Table 96. Using the mean length at age, northern pike typically reach the current minimum size of 24 inches between age 4 and 5.

Table 88.–Proportion of Status and Trends lakes containing northern pike, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.00	1.00	1.00		1.00	1.00	1.00	1.00
	Shallow	1.00		1.00	1.00		1.00	1.00		1.00
Medium	Deep	0.79	0.91	1.00	0.38	0.80	0.79	0.93	0.89	0.81
	Shallow		0.75	0.60	0.67	1.00	1.00	1.00	1.00	0.80
	Unknown	0.67	1.00	0.50	1.00	1.00	1.00	1.00		0.86
Small	Deep	0.67	0.86	0.44	0.50	0.50	0.71	0.88	1.00	0.71
	Shallow			1.00		0.50			0	0.50
	Unknown	0.50	0.50			0.50	0.75	1.00	1.00	0.70
All		0.73	0.87	0.69	0.67	0.68	0.84	0.94	0.89	0.80

Table 89.–Summary of catch per unit effort of northern pike by gear, including only sites and gears with catches greater than zero. Catch per unit effort for electrofishing is number of fish per minute. Catch per unit effort for fyke net, gill net, mini fyke, and trap net is number of fish per lift. Catch per unit effort for seining is number of fish per haul. Number of lakes with positive catches for each gear is denoted by n.

		Typical range							
Gear	Low	25^{th}		Median		75^{th}	High	Maximum	n
Electrofishing	<0.03	0.03	to	0.06	to	0.10	>0.10	0.37	55
Fyke net	<0.33	0.33	to	0.75	to	1.55	>1.55	12.95	121
Gill net	<1.00	1.00	to	1.89	to	4.00	>4.00	14.50	153
Mini fyke	<0.25	0.25	to	0.50	to	0.75	>0.75	2.00	21
Seine	<0.33	0.33	to	0.50	to	1.00	>1.00	1.00	7
Trap net	<0.27	0.27	to	0.67	to	1.33	>1.33	21.00	121

Table 90.–Mean CPUE (catch per minute, including sites with zero catches) of northern pike in electrofishing surveys, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSE	LSW	LHN	LHS	LE	All
Large	Deep		0.02	0.03		0.02	0	0.03	0	0.02
	Shallow	0.02		0.12		0.08	0.02	0		0.06
Medium	Deep	0	0.02	0.03	0.02	0.01	0.04	0.01	0.01	0.02
	Shallow		0.02	0.13	0.37	0		0.03	0.03	0.06
	Unknown	0	0.02	0.04	0.23	0.18	0	0.01		0.04
Small	Deep	0	0.03	0.04		0.06	0.03	0.01	0	0.02
	Shallow									
	Unknown	0	0		0		0	0.02		0
All		0	0.02	0.06	0.10	0.03	0.02	0.01	0.01	0.03

Table 91.–Mean CPUE (catch per lift, including sites with zero catches) of northern pike in fyke nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.05	0.86	0.99		0.08	1.88	0.33	0.73
	Shallow	0.25		0.45	0.73		0.47	4.50		1.37
Medium	Deep	0	0.55	1.66	0.48	1.13	0.48	0.42	0.40	0.55
	Shallow		0.67	1.81	1.36	2.59	0.86	0.56	0	1.20
	Unknown	0.17	2.50	0.38	4.22	2.14	1.17	1.92		1.45
Small	Deep	0	0.64	0.70	0.11	1.29	0.17	0.83	0.22	0.57
	Shallow			0.75		0.50				0.58
	Unknown		0			2.25	0.63	0.50	0.25	0.86
All		0.04	0.76	1.02	0.94	1.59	0.56	1.16	0.31	0.83

Table 92.–Mean CPUE (catch per lift, including sites with zero catches) of northern pike in gill nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.54	0.51	3.10		0	1.17	2.25	1.68
	Shallow	2.81		2.15	2.92		1.55	3.42		2.33
Medium	Deep	1.76	1.78	2.54	0.58	1.54	1.92	2.72	2.41	1.95
	Shallow		2.31	2.03	3.13	6.13	2.42	3.19	1.00	2.89
	Unknown	1.17	1.83	1.40	2.50		2.10	1.08		1.61
Small	Deep	2.20	2.08	1.36	0.50	0	0.87	2.38	2.30	1.65
	Shallow			0					0	0
	Unknown	0.25	0.20			0	0.90	2.25	0.25	0.77
All		1.72	1.81	1.65	1.96	1.82	1.53	2.52	1.94	1.86

Table 93.–Mean CPUE (catch per lift, including sites with zero catches) of northern pike in mini fyke nets, stratified by lake size, depth, and management unit. Mini fyke nets were not used in Southern Lake Huron.

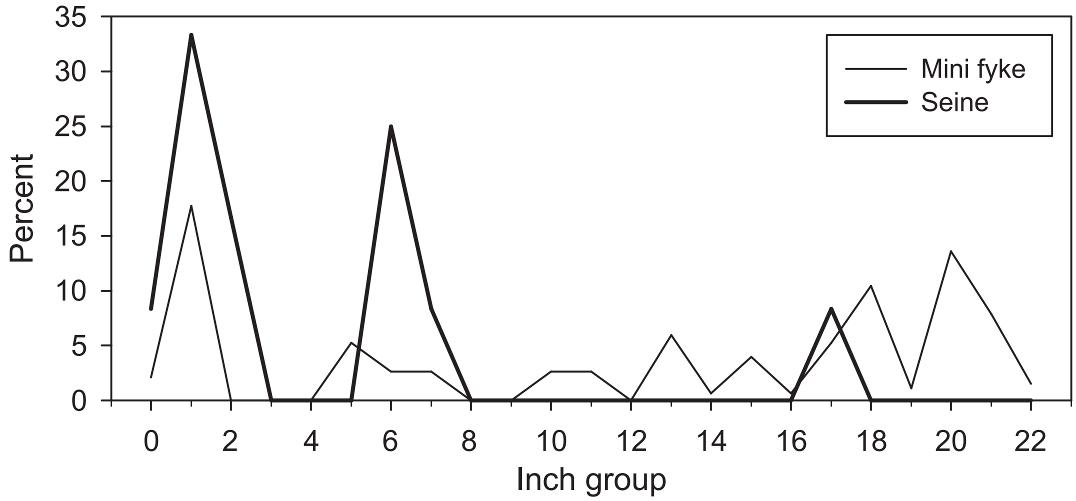
Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0.17		0			0.07
	Shallow				0.42		0			0.16
Medium	Deep	0		0	0.05		0		2.00	0.09
	Shallow		0.50	0.52	0		0.08			0.24
	Unknown	0	0	0.25	0.50	0	0.52			0.28
Small	Deep	0	0	0	0	0	0		0	0
	Shallow			0.50		0			0	0.13
	Unknown					0.23	0.06		0	0.09
All		0	0.20	0.18	0.12	0.06	0.07		0.25	0.12

Table 94.–Mean CPUE (catch per haul, including sites with zero catches) of northern pike in seines, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0.08			0	0	0.03
	Shallow	0		0	0.17		0	0		0.04
Medium	Deep	0	0	0	0	0.15	0	0	0	0.01
	Shallow		0	0	0	0	0	0	0	0
	Unknown	0	0	0.33	0.50	0		0		0.11
Small	Deep	0	0	0.05	0	0	0	0	0	0.01
	Shallow			0		0			0	0
	Unknown	0	0			0	0	0	0.50	0.09
All		0	0	0.06	0.06	0.05	0	0	0.05	0.03

Table 95.–Mean CPUE (catch per lift, including sites with zero catches) of northern pike in trap nets, stratified by lake size, depth, and management unit. Trap nets were not used in Western Lake Superior.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.11	0.19			0.32	2.38	0.67	0.55
	Shallow	0.50		0.63			1.08	6.36		2.39
Medium	Deep	0.22	0.61			2.55	0.93	0.71	0.53	0.75
	Shallow		5.69			8.65	1.57	1.40	0.33	3.63
	Unknown	0.22	4.04	1.25		3.00	0.97	2.72		1.79
Small	Deep	0.33	0.57			2.75	0.45	2.51	0.10	1.08
	Shallow					0			0	0
	Unknown	0.50	0				0.75	0.08	0.17	0.46
All		0.28	1.57	0.67		3.51	0.91	1.89	0.35	1.24



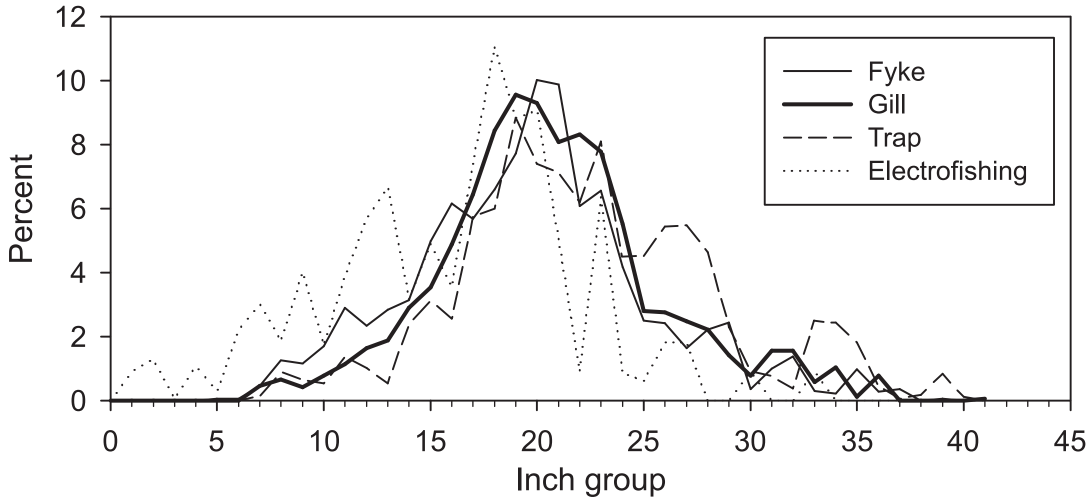


Figure 81.–Size distribution of northern pike in different gear types.

Table 96.–Mean and standard error (SE) of length at age of northern pike, with upper and lower quartiles as indicators of typical growth range. The sample size (n) is number of lakes containing fish with the specified age class; only those age classes with more than three lakes are reported.

Age	Lower 25%	Mean	SE	Upper 75%	n
0	5.7	7.7	1.8	9.8	4.0
1	11.2	12.6	0.3	13.7	56.0
2	16.1	17.6	0.2	19.3	99.0
3	19.4	21.1	0.2	22.4	124.0
4	21.6	23.5	0.3	25.0	130.0
5	23.1	25.3	0.3	27.0	125.0
6	24.4	26.9	0.3	29.2	109.0
7	25.4	28.6	0.5	30.9	62.0
8	25.8	30.4	0.9	35.1	39.0
9	29.5	32.9	1.0	36.4	30.0
10	36.3	38.2	0.7	40.4	12.0

- Muskellunge *Esox masquinongy*

Muskellunge were relatively uncommon, being caught in only 8% of all lakes sampled (Table 97). Their distribution was sporadic (Figure 82), reflecting their low percentage occurrence. Muskellunge occurred somewhat more frequently in the Northern and Southern Lake Michigan management units, and in larger lakes (Table 97).

A total of 127 muskellunge were caught, precluding more detailed analyses of catch per effort. The size distribution of catches in all gear was provided in Figure 83. The range of typical growth for muskellunge was provided in Table 98, even though sample sizes were very small for this species.

Table 97.–Proportion of Status and Trends lakes containing muskellunge, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0.25		0	1.00	0	0.17
	Shallow	0		0.33	0		0	0.33		0.13
Medium	Deep	0.21	0	0.20	0	0.20	0	0.07	0	0.08
	Shallow		0	0.20	0.17	0	0	0.25	0	0.12
	Unknown	0.67	0.33	0.25	0	0	0	0		0.18
Small	Deep	0	0	0	0	0	0	0	0	0
	Shallow			0		0			0	0
	Unknown	0	0			0	0	0	0	0
All		0.19	0.03	0.14	0.08	0.05	0	0.11	0	0.08

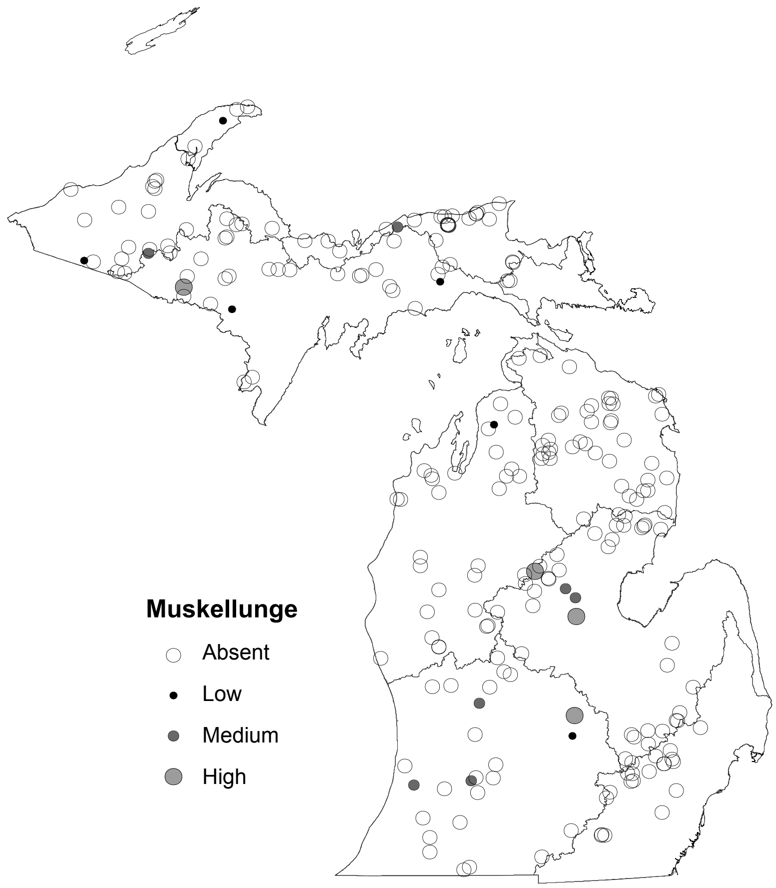


Figure 82.–Distribution and abundance of muskellunge collected from Status and Trends lakes.

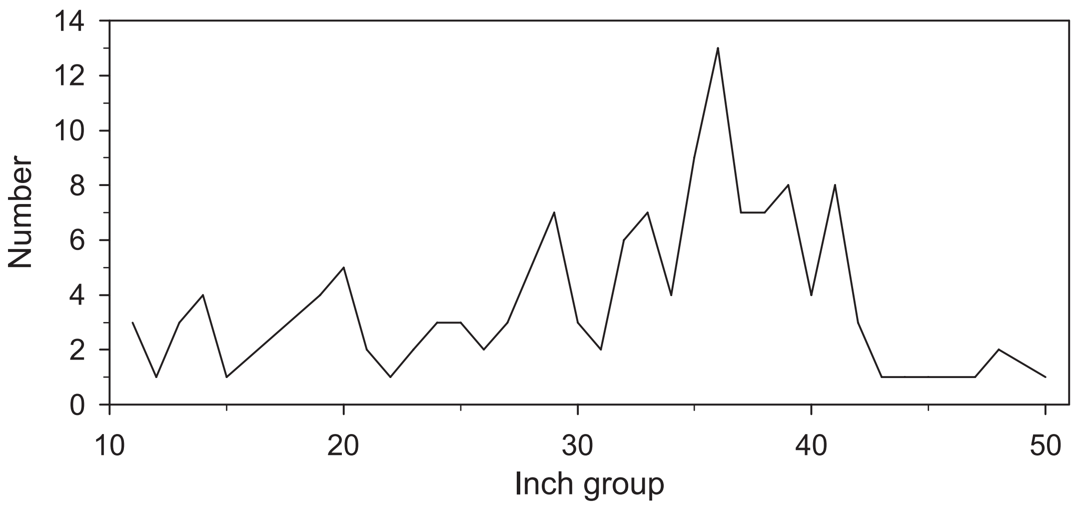


Figure 83.–Size distribution of muskellunge in all gear types combined.

Table 98.–Mean and standard error (SE) of length at age of muskellunge, with upper and lower quartiles as indicators of typical growth range. The sample size (n) is number of lakes containing fish with the specified age class; only those age classes with three or more lakes are reported.

Age	Lower 25%	Mean	SE	Upper 75%	n
1	12.8	13.5	0.4	14.2	3.0
2	20.1	20.6	0.6	20.8	5.0
3	26.1	27.2	0.7	28.5	3.0
4	24.7	29.1	3.4	33.6	4.0
5	29.6	32.8	1.2	35.7	7.0
6	35.8	35.8	1.9	39.0	5.0
7	33.9	36.1	1.1	37.7	3.0
8	37.3	38.5	1.0	39.7	4.0

Umbridae

- Central mudminnow *Umbra limi*

Central mudminnows were modestly common, being caught in 13% of lakes sampled (Table 99). Central mudminnows were widely distributed across the entire state (Figure 84), and were most frequently caught in small to medium-sized lakes (Table 99).

Electrofishing provided the vast majority of the catch of central mudminnows, with typical catch rates ranging from 0.03 to 0.17 fish per minute in the 21 lakes where catches occurred with this gear. The size distribution of central mudminnows caught by electrofishing showed a strong peak at the 2-inch size class (Figure 85).

Table 99.–Proportion of Status and Trends lakes containing central mudminnow, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0		0	0	0	0
	Shallow	0		0	0		0	0.33		0.07
Medium	Deep	0.14	0	0	0.13	0	0.07	0.14	0.11	0.09
	Shallow		0	0.20	0.33	0.50	0	0.50	0	0.24
	Unknown	0.33	0	0.25	0	0.50	0	0.50		0.23
Small	Deep	0.17	0	0.33	0	0.25	0.14	0.38	0	0.19
	Shallow			1.00		0			0	0.25
	Unknown	0	0			0	0.13	0	0	0.05
All		0.15	0	0.21	0.13	0.16	0.07	0.28	0.05	0.13

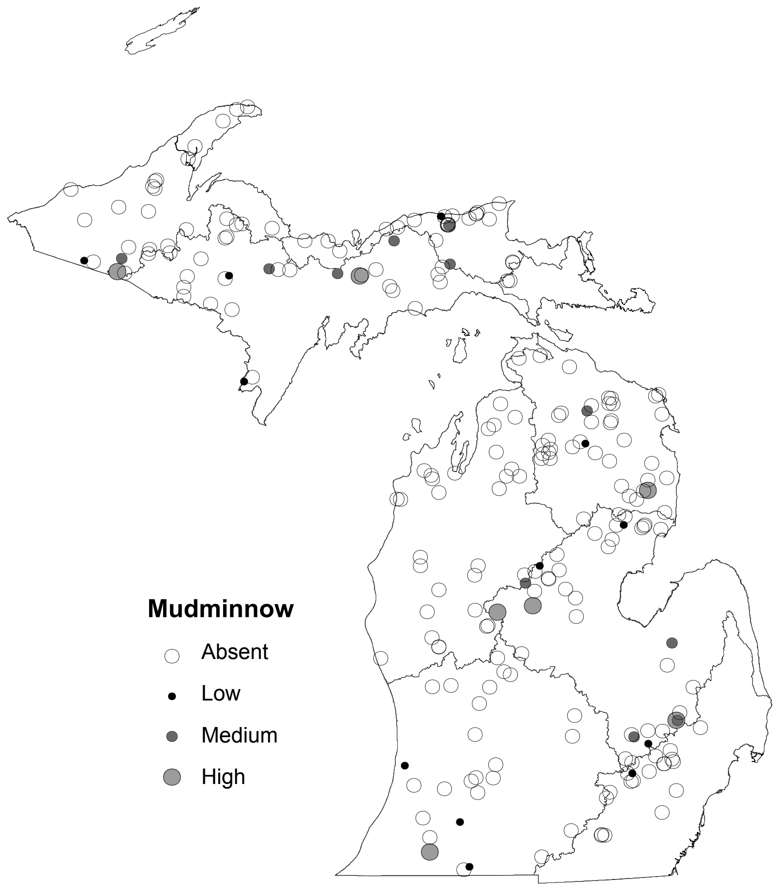


Figure 84.–Distribution and abundance of central mudminnows collected from Status and Trends lakes.

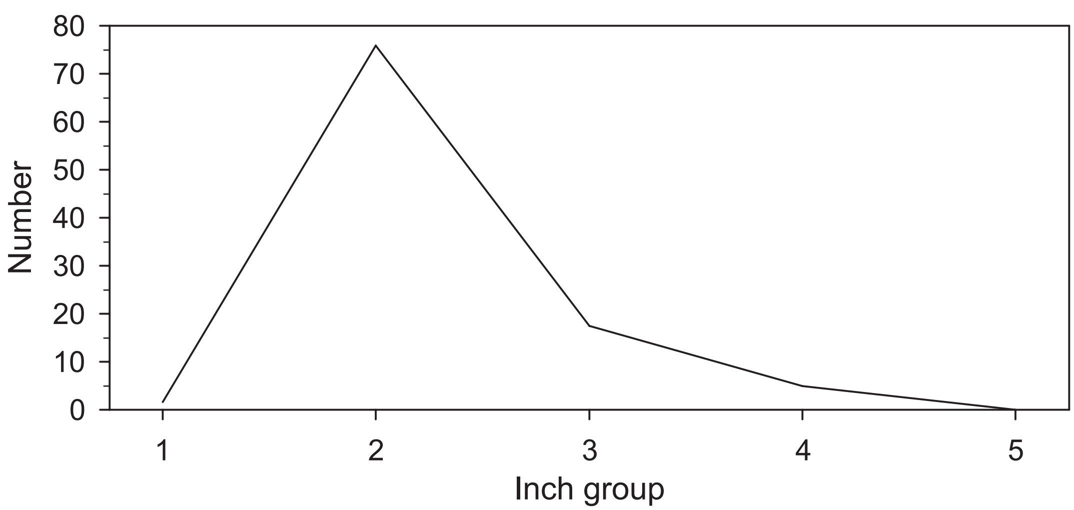


Figure 85.–Size distribution of central mudminnows captured by electrofishing.

Osmeridae

- Rainbow Smelt *Osmerus mordax*

Smelt were relatively uncommon, being caught in only eight lakes (<4% of lakes sampled). Smelt were widely distributed across the northern portion of the state (Figure 86), and were most frequently caught in large, deep lakes where they occurred in about 25% of lakes sampled (Table 100). Too few smelt were caught to accurately characterize catch rates or their size distribution

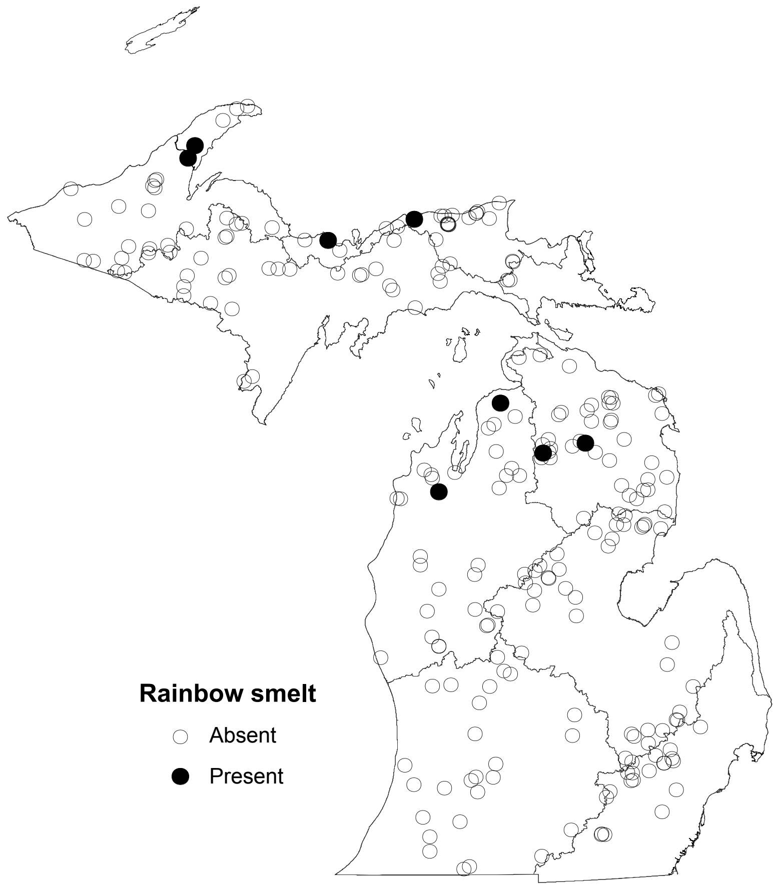


Figure 86.–Distribution of rainbow smelt collected from Status and Trends lakes.

Table 100.–Proportion of Status and Trends lakes containing rainbow smelt, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.67	0	0.25		0	0	0	0.25
	Shallow	0		0	0.33		0	0		0.07
Medium	Deep	0	0	0	0	0.40	0.07	0	0	0.04
	Shallow		0	0	0	0	0	0	0	0
	Unknown	0	0	0	0	0	0	0		0
Small	Deep	0	0	0	0	0	0	0	0	0
	Shallow			0		0			0	0
	Unknown	0	0			0	0.13	0	0	0.05
All		0	0.07	0	0.08	0.11	0.05	0	0	0.04

Salmonidae

- Cisco *Coregonus artedi*

Cisco is currently listed as a species of greatest conservation need within Michigan's Wildlife Action Plan. Ciscoes were relatively uncommon, being caught in eight lakes (<4% of lakes sampled). Ciscoes were widely distributed across the state (Figure 87), and were most frequently caught in large, deep lakes where they occurred in about 25% of lakes sampled (Table 101). Too few ciscoes were caught to accurately characterize catch rates or their size distribution.

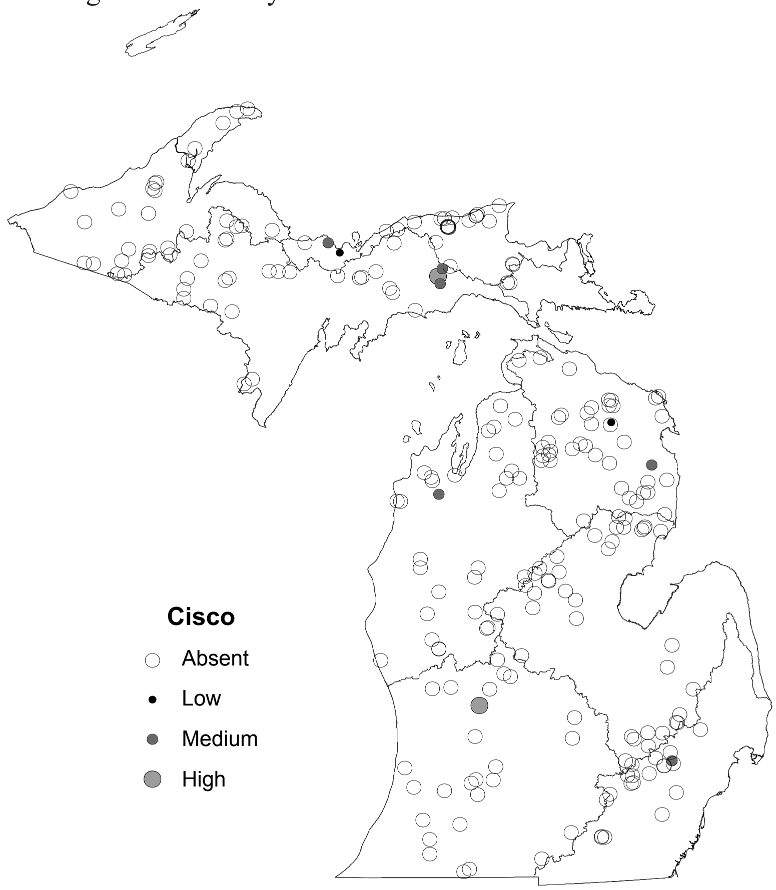


Figure 87.–Distribution and abundance of ciscoes collected from Status and Trends lakes.

Table 101.–Proportion of Status and Trends lakes containing cisco, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.67	0	0.25		0	0	0	0.25
	Shallow	0		0	0.33		0	0		0.07
Medium	Deep	0	0	0	0	0.40	0.07	0	0	0.04
	Shallow		0	0	0	0	0	0	0	0
	Unknown	0	0	0	0	0	0	0		0
Small	Deep	0	0	0	0	0	0	0	0	0
	Shallow			0		0			0	0
	Unknown	0	0			0	0.13	0	0	0.05
All		0	0.07	0	0.08	0.11	0.05	0	0	0.04

- Lake whitefish *Coregonus clupeaformis*

Lake whitefish were relatively uncommon, being caught in five lakes (<3% of lakes sampled). Lake whitefish were caught primarily in the northern Lower Peninsula and Upper Peninsula (Figure 88), and were most frequently caught in large, deep lakes where they occurred in about 25% of lakes sampled and large shallow lakes where they occurred in about 13% of lakes sampled (Table 102). Too few lake whitefish were caught to accurately characterize catch rates or their size distribution.

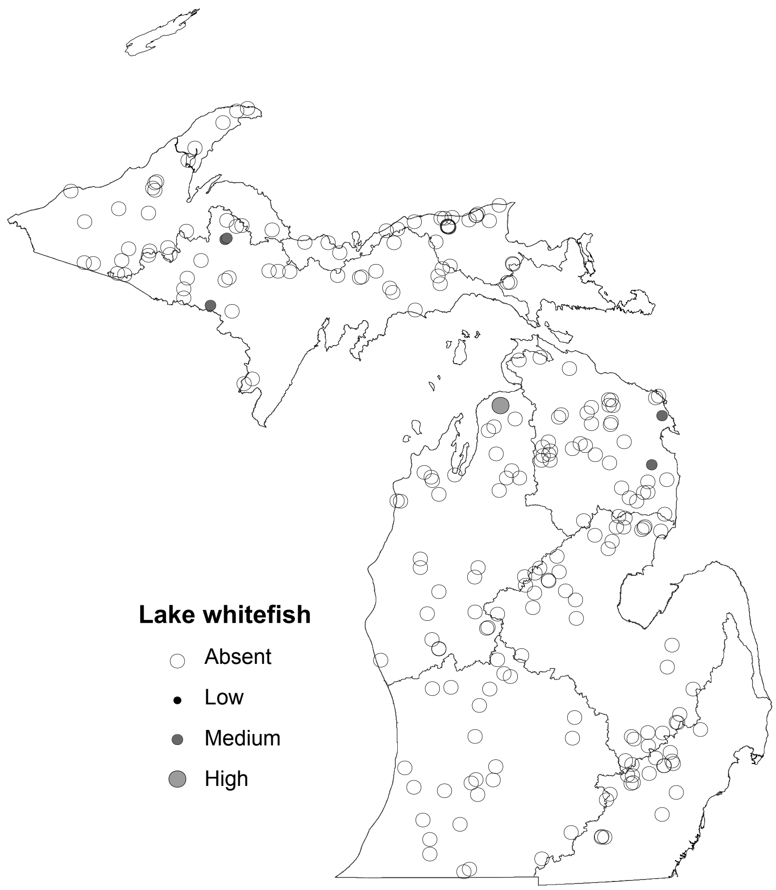


Figure 88.–Distribution and abundance of lake whitefish collected from Status and Trends lakes.

Table 102.–Proportion of Status and Trends lakes containing lake whitefish, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.33	0.50	0		1.00	0	0	0.25
	Shallow	0		0.33	0		0.20	0		0.13
Medium	Deep	0	0	0	0	0	0	0	0	0
	Shallow		0	0	0	0	0	0	0	0
	Unknown	0	0	0	0	0	0	0		0
Small	Deep	0	0	0	0	0	0	0	0	0
	Shallow			0		0			0	0
	Unknown	0	0			0	0	0	0	0
All		0	0.03	0.07	0	0	0.05	0	0	0.02

- Rainbow trout *Oncorhynchus mykiss*

Rainbow trout are relatively uncommon in inland lakes, being caught in only 8% of all lakes sampled. Rainbow trout are mainly distributed in the northern part of the state (Figure 89), but also occur sporadically in other parts of the state. They occur most frequently in large deep lakes (Table 103).

A total of 125 rainbow trout were caught, precluding more detailed analyses of catch per effort. The size distribution of catches in all gear was provided in Figure 90. The range of typical growth for rainbow trout was provided in Table 104, even though sample sizes were very small for this species.

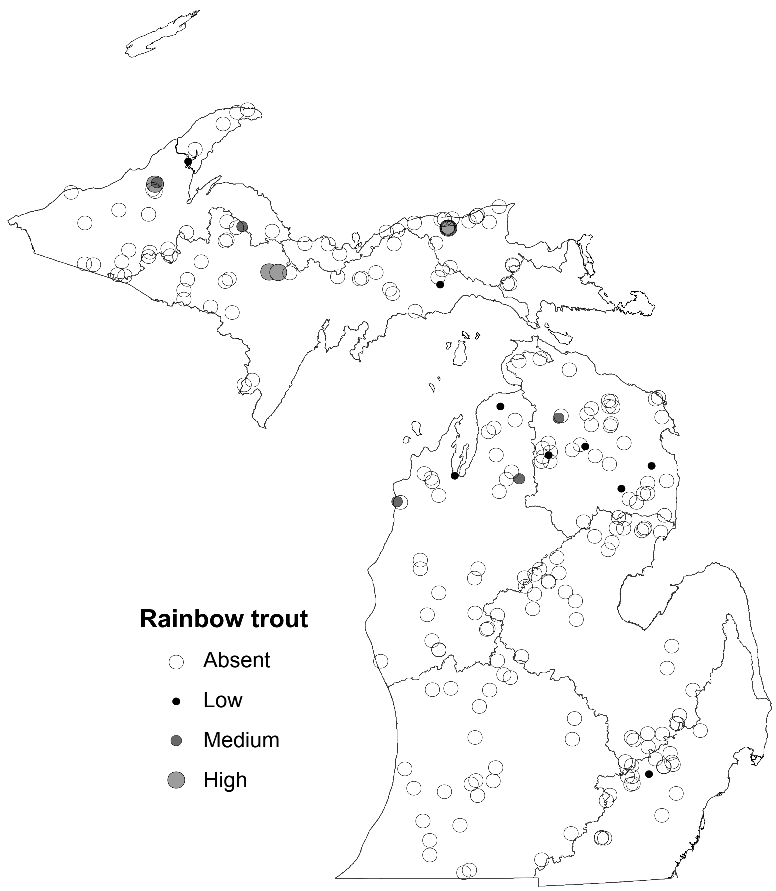


Figure 89.–Distribution and abundance of rainbow trout collected from Status and Trends lakes.

Table 103.–Proportion of Status and Trends lakes containing rainbow trout, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.33	0	0.25		1.00	0	1.00	0.33
	Shallow	0		0.33	0		0	0		0.07
Medium	Deep	0	0.27	0	0.25	0	0.07	0	0	0.08
	Shallow		0	0.20	0	0	0	0	0	0.04
	Unknown	0	0	0.25	0	0	0	0		0.05
Small	Deep	0	0	0.11	0	0	0.43	0	0	0.08
	Shallow			0		0			0	0
	Unknown	0	0			0.25	0	0	0	0.05
All		0	0.13	0.14	0.13	0.05	0.12	0	0.05	0.08

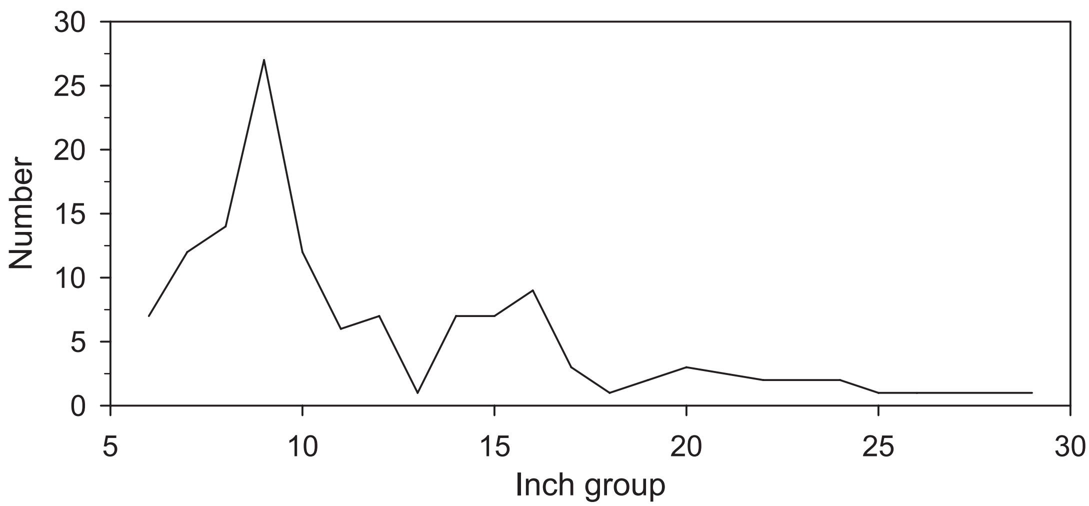


Figure 90.–Size distribution of rainbow trout in all gear types combined.

Table 104.–Mean and standard error (SE) of length at age of rainbow trout, with upper and lower quartiles as indicators of typical growth range. The sample size (n) is number of lakes containing fish with the specified age class; only those age classes with more than three lakes are reported.

Age	Lower 25%	Mean	SE	Upper 75%	n
1	8.7	9.0	0.3	9.4	5
2	10.1	12.3	1.0	14.5	8
3	14.0	16.4	1.3	19.1	8
4	16.8	20.4	2.5	24.1	4

- Brown trout *Salmo trutta*

Brown trout were rarely caught, occurring in only 6% of lakes sampled (Table 105). Brown trout occurred most frequently in the northern-most part of the Lower Peninsula and only sporadically elsewhere (Figure 91), and occurred primarily in large deep lakes. Too few brown trout were caught to reliable determine typical catch rates, size distribution or growth rates.

Table 105.–Proportion of Status and Trends lakes containing brown trout, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.67	0	0.25		0	0	1.00	0.33
	Shallow	0		0.33	0		0.20	0		0.13
Medium	Deep	0	0.18	0	0	0	0.14	0	0	0.05
	Shallow		0.25	0	0	0	0	0	0	0.04
	Unknown	0	0	0	0	0	0	0		0
Small	Deep	0.17	0	0	0	0	0.14	0	0	0.04
	Shallow			0		0			0	0
	Unknown	0	0.50			0	0	0	0	0.05
All		0.04	0.20	0.03	0.04	0	0.09	0	0.05	0.06

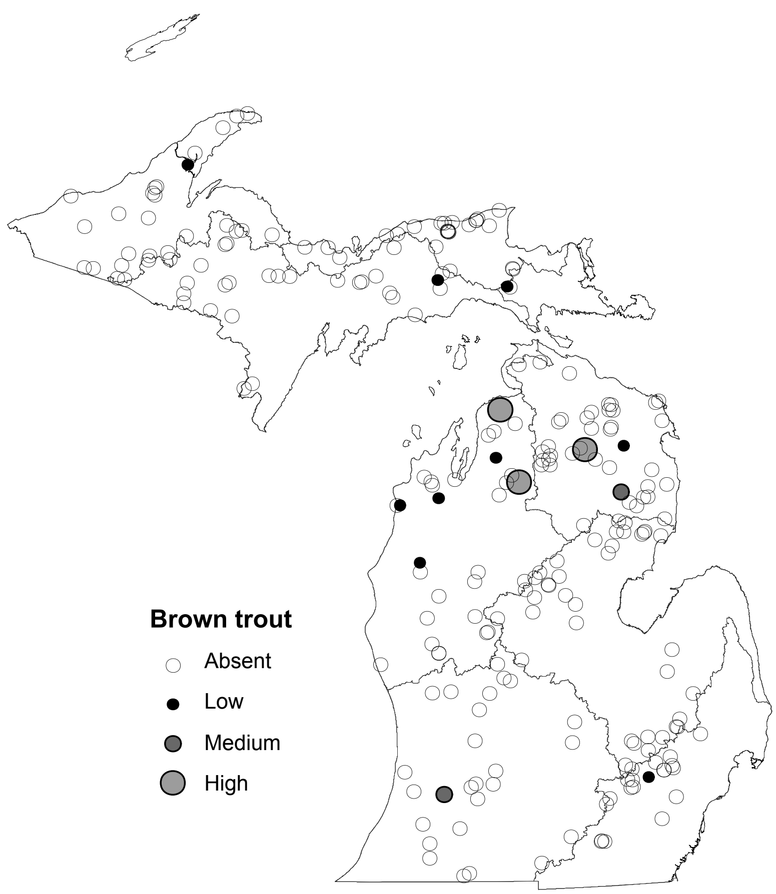


Figure 91.–Distribution and abundance of brown trout collected from Status and Trends lakes.

- Brook trout *Salvelinus fontinalis*

Brook trout were rarely caught, occurring in only 3% of lakes sampled (Table 106). Brook trout occurred sporadically in the Upper Peninsula and northern-most part of the Lower Peninsula (Figure 92). Too few brook trout were caught to reliable determine typical catch rates, size distribution or growth rates.

Table 106.–Proportion of Status and Trends lakes containing brook trout, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0			0	0	0
	Shallow	0		0	0		0	0		0
Medium	Deep	0	0	0	0	0	0	0	0	0
	Shallow		0	0	0	0	0	0	0	0
	Unknown	0	0	0	0	0		0		0
Small	Deep	0	0	0	0	0	0	0	0	0
	Shallow			2.50		0			0	0.83
	Unknown	0	0			0	0	0	0	0
All		0	0	0.12	0	0	0	0	0	0.02

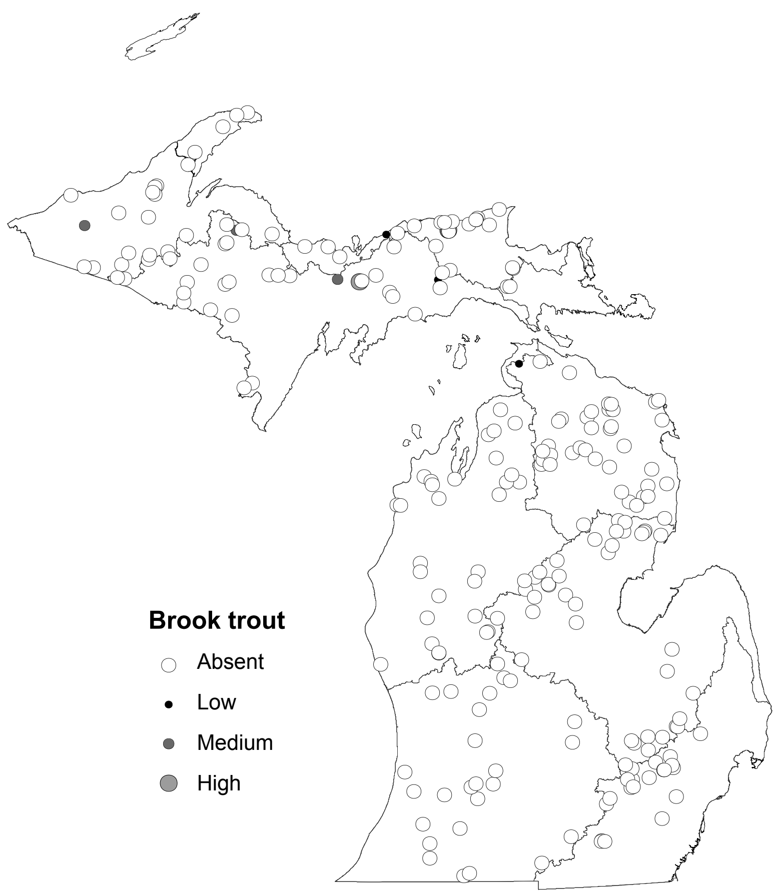


Figure 92.–Distribution and abundance of brook trout collected from Status and Trends lakes.

- Lake trout *Salvelinus naymaycush*

  Lake trout were rarely caught, occurring in only 3% of lakes sampled (Table 107). Lake trout occurred most frequently in the northern-most part of the Lower Peninsula and only sporadically elsewhere (Figure 93), and occurred primarily in large deep lakes. Too few lake trout were caught to reliable determine typical catch rates, size distribution or growth rates.

Table 107.–Proportion of Status and Trends lakes containing lake trout, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.67	0	0		0	0	0	0.17
	Shallow	0		0	0		0	0		0
Medium	Deep	0	0	0	0.25	0.20	0	0.07	0	0.05
	Shallow		0	0	0	0	0	0	0	0
	Unknown	0	0	0	0	0	0	0		0
Small	Deep	0	0	0	0	0	0	0	0	0
	Shallow			0		0			0	0
	Unknown	0	0			0	0	0	0	0
All		0	0.07	0	0.08	0.05	0	0.03	0	0.03

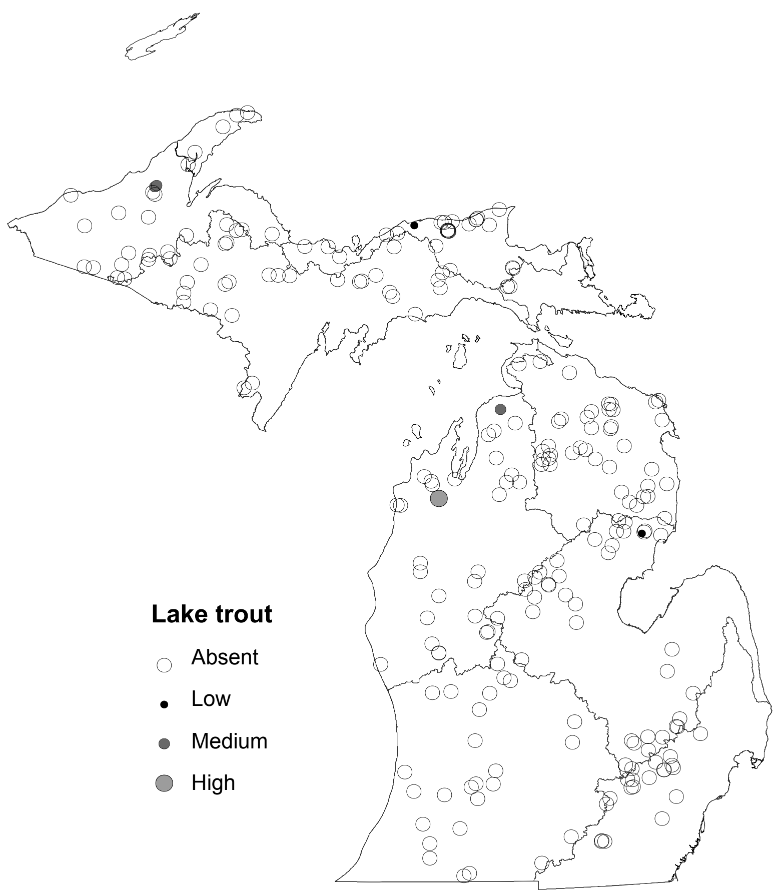


Figure 93.–Distribution and abundance of lake trout collected from Status and Trends lakes.

Percopsidae

- Trout-perch *Percopsis omiscomaycus*

  Trout-perch were uncommon, being caught in three lakes (<2% of lakes sampled). Trout-perch were caught only in the Upper Peninsula (Figure 94). Too few trout-perch were caught to accurately characterize catch rates or their size distribution.

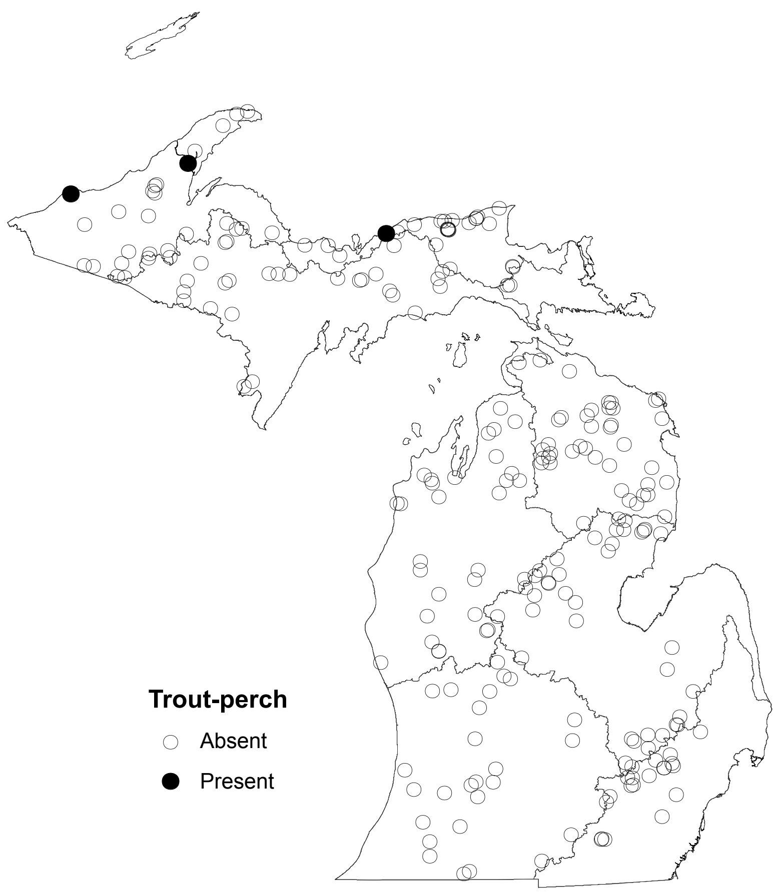


Figure 94.–Distribution of trout-perch collected from Status and Trends lakes.

Gadidae

- Burbot *Lota lota*

Burbot were rarely caught, occurring in only 2% of lakes sampled (Table 108). Burbot occurred most frequently in the northern-most part of the Lower Peninsula and the Upper Peninsula (Figure 95), and occurred primarily in large deep lakes. Too few burbot were caught to reliable determine typical catch rates, size distribution or growth rates.

Table 108.–Proportion of Status and Trends lakes containing burbot, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.33	0.50	0.25		0	0	0	0.25
	Shallow	0		0	0.33		0	0		0.07
Medium	Deep	0	0	0	0	0	0	0	0	0
	Shallow		0	0	0	0	0	0	0	0
	Unknown	0	0	0	0	0	0	0		0
Small	Deep	0	0	0	0	0	0	0	0	0
	Shallow			0		0			0	0
	Unknown	0	0			0	0	0	0	0
All		0	0.03	0.03	0.08	0	0	0	0	0.02

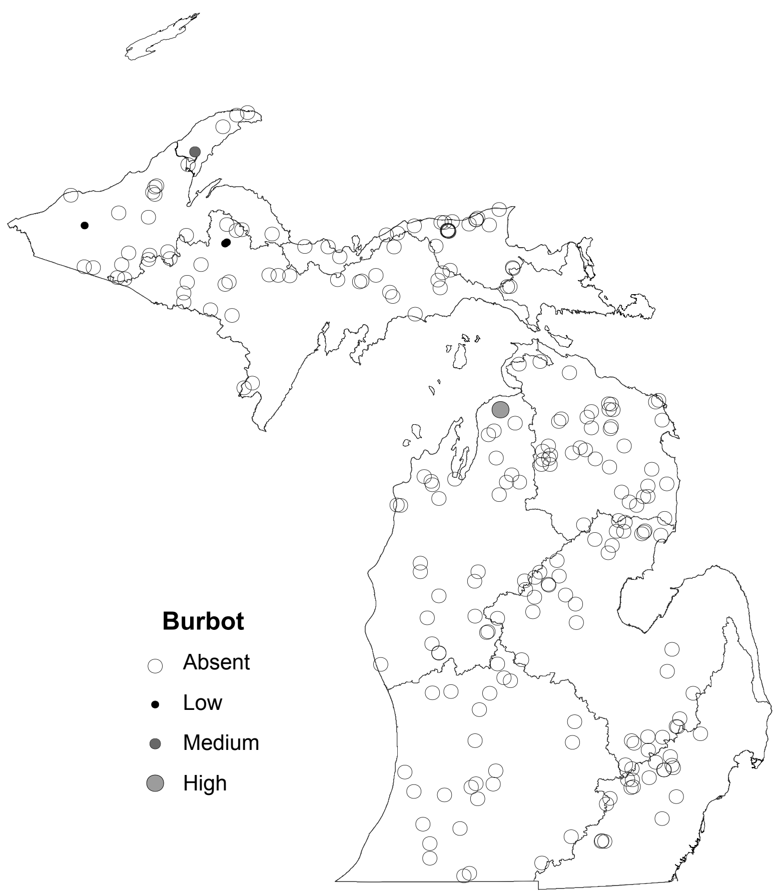


Figure 95.–Distribution and abundance of burbot collected from Status and Trends lakes.

Fundulidae

- Western banded killifish *Fundulus diaphanus menona*

Western banded killifish were modestly common, being caught in 8% of lakes sampled (Table 109). Banded killifish were only caught in the Lower Peninsula (Figure 96), and were most frequently caught in small and medium-sized deep lakes in the Southern Lake Michigan and Lake Erie management units (Table 109).

Seining provided the vast majority of the catch of western banded killifish, with typical catch rates ranging from 0.5 to 9.5 fish per haul in the 15 lakes where catches occurred with this gear.

Table 109.–Proportion of Status and Trends lakes containing western banded killifish, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.33	0	0		0	0	0	0.08
	Shallow	0		0	0		0	0		0
Medium	Deep	0.36	0.09	0	0	0	0.07	0.07	0.44	0.15
	Shallow		0	0	0	0	0	0	0	0
	Unknown	0	0	0	0	0	0	0		0
Small	Deep	0.33	0	0	0	0	0	0.13	0.20	0.08
	Shallow			0		0			0	0
	Unknown	0	0			0	0	0	0	0
All		0.27	0.07	0	0	0	0.02	0.06	0.26	0.08

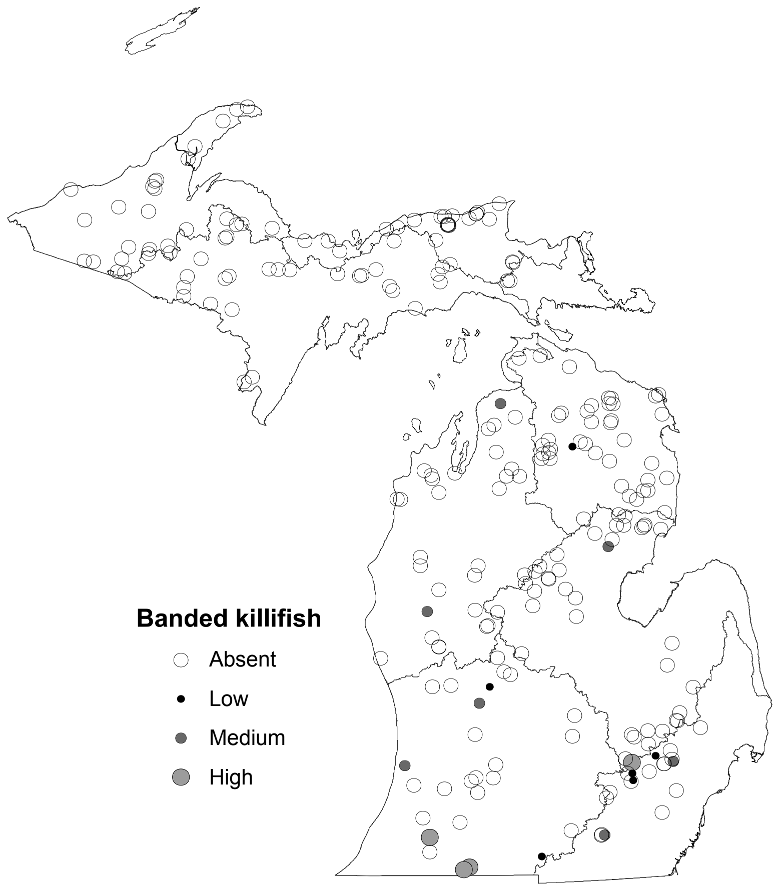


Figure 96.–Distribution and abundance of western banded killifish collected from Status and Trends lakes.

- Blackstripe topminnow *Fundulus notatus*

Blackstripe topminnows were relatively uncommon, being caught in six lakes (<3% of lakes sampled), primarily within the Lake Erie Management Unit (Figure 97). Too few blackstripe topminnows were caught to characterize typical catch rates or size distribution of this species.

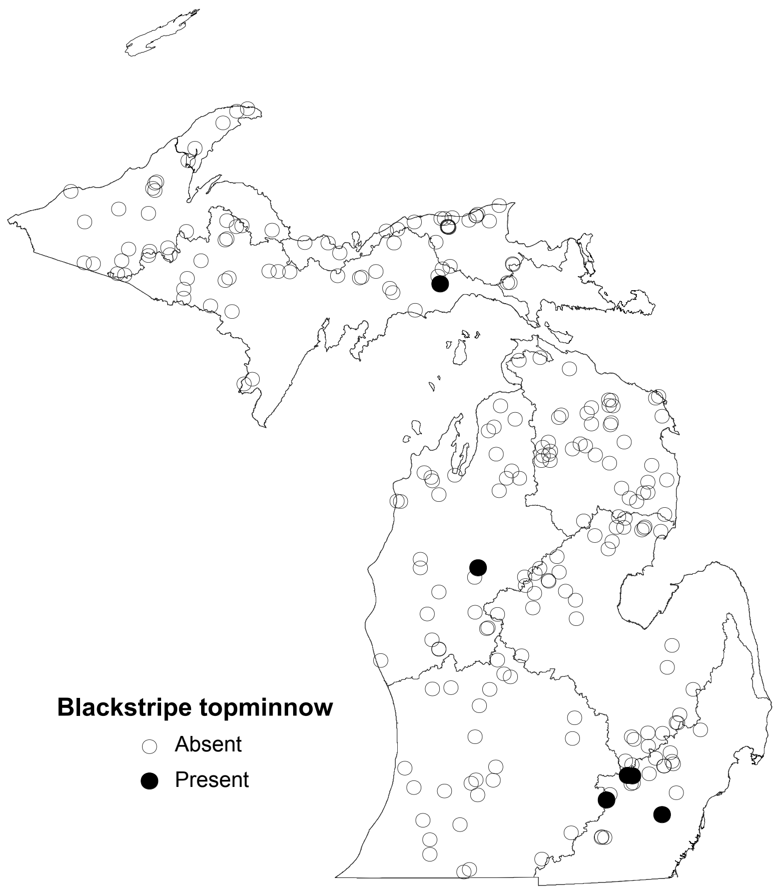


Figure 97.–Distribution of blackstripe topminnows collected from Status and Trends lakes.

Atherinidae

- Brook silverside *Labidesthes sicculus*

Brook silversides occurred primarily in the Lake Erie and Southern Lake Michigan management units (Figure 98; Table 110), but for the state as a whole were found in 13% of lakes sampled.

Brook silversides were only collected often enough with electrofishing gear to provide a typical range of catch rates (0.03 to 0.2 fish per minute in the 24 lakes where catches occurred), but did not occur frequently enough to provide clear measures of CPUE in this gear.

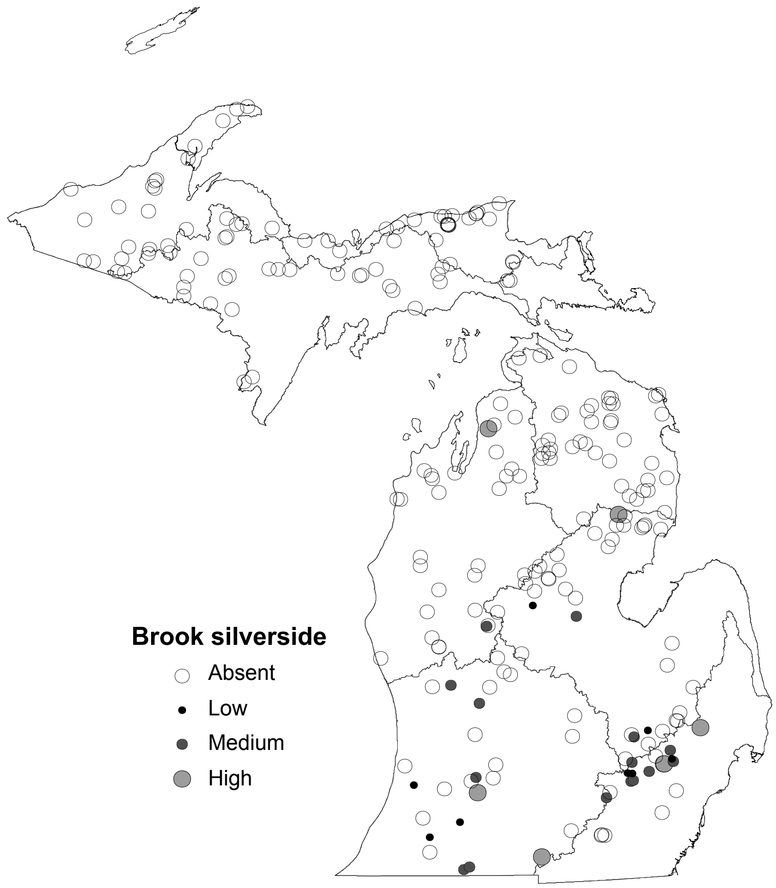


Figure 98.–Distribution and abundance of brook silversides collected from Status and Trends lakes.

Table 110.–Proportion of Status and Trends lakes containing brook silverside, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0		0	0	0	0
	Shallow	0		0	0		0.20	0		0.07
Medium	Deep	0.21	0	0	0	0.20	0	0.14	0.67	0.15
	Shallow		0	0	0.50	0	0	0	1.00	0.16
	Unknown	0.33	0	0	1.00	0.50	0	0.25		0.18
Small	Deep	0.17	0	0.11	0	0	0	0.25	0.20	0.10
	Shallow			0		0			1.00	0.25
	Unknown	0	0			0.25	0.13	0.50	0	0.15
All		0.19	0	0.03	0.17	0.16	0.05	0.17	0.47	0.13

Gasterosteidae

- Brook stickleback *Culaea inconstans*

Brook sticklebacks were relatively uncommon, being caught in five lakes (<2% of lakes sampled), primarily within the Lake Erie Management Unit (Figure 99). Too few brook sticklebacks were caught to characterize typical catch rates or size distribution of this species.

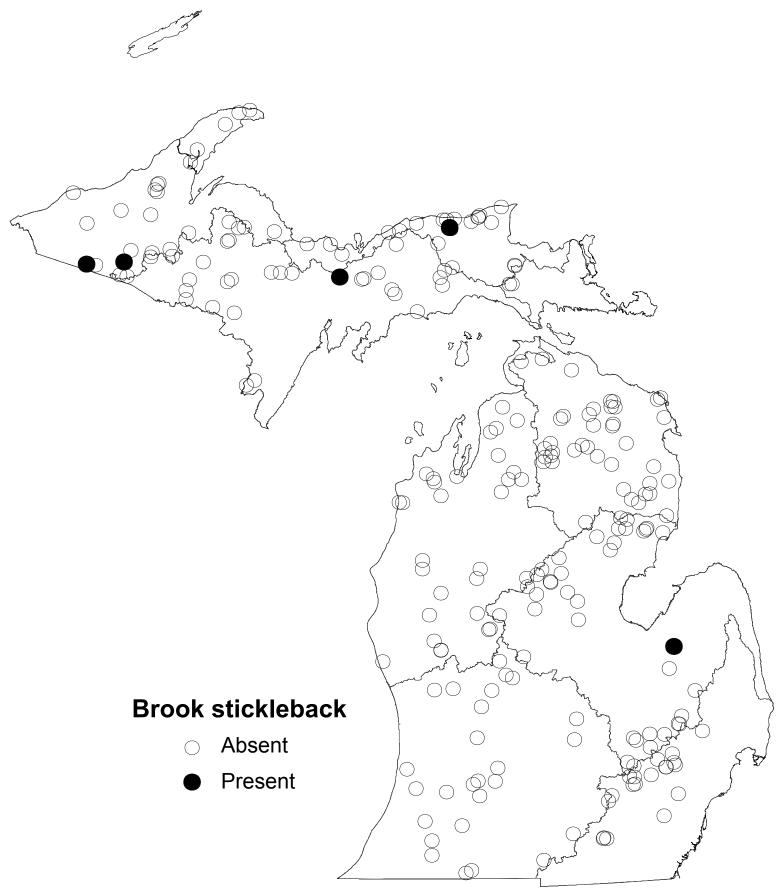


Figure 99.–Distribution of brook sticklebacks collected from Status and Trends lakes.

Cottidae

- Mottled *sculpin Cottus bairdii*

Mottled sculpins were caught in seven (about 3%) lakes sampled and were restricted to the Northern Lake Michigan and Western Lake Superior management units (Figure 100). Too few mottled sculpins were caught to characterize typical catch rates or size distribution of this species.

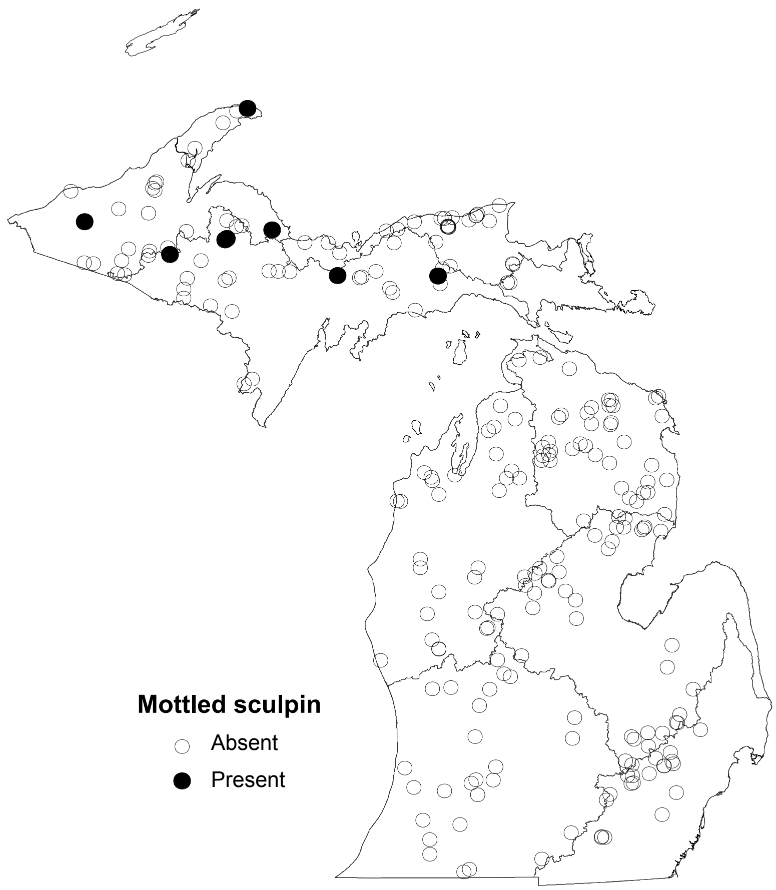


Figure 100.–Distribution of mottled sculpins collected from Status and Trends lakes.

Moronidae

- White perch *Morone americana*

White perch is an invasive species common in the Great Lakes. White perch were caught in three lakes (about 1% of lakes sampled; Figure 101) that were relatively close to Great Lakes waters. Too few white perch were caught to characterize typical catch rates or size distribution of this species.

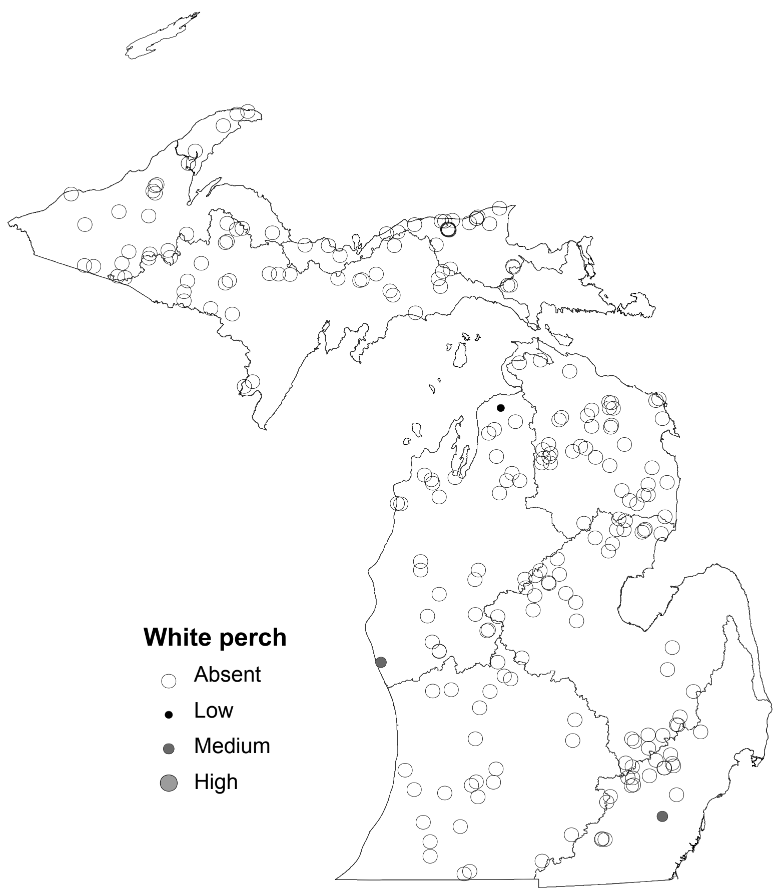


Figure 101.–Distribution and abundance of white perch collected from Status and Trends lakes.

- White bass *Morone chrysops*

White bass occur primarily in the Great Lakes but were caught in two inland lakes (<1% of lakes sampled; Figure 102). Too few white bass were caught to characterize typical catch rates or size distribution of this species.

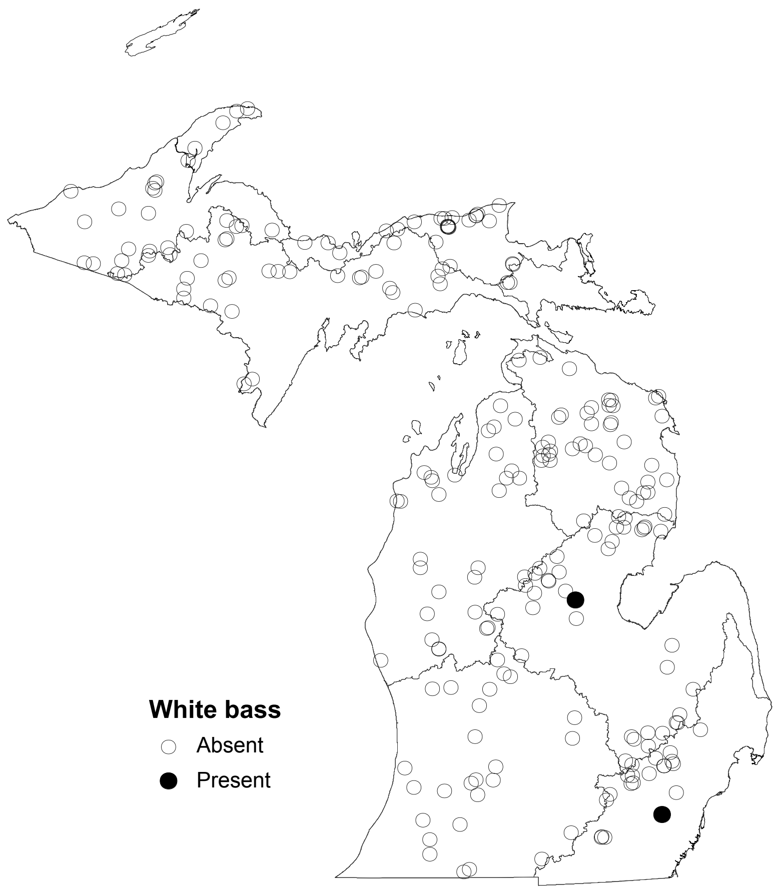


Figure 102.–Distribution of white bass collected from Status and Trends lakes.

Centrarchidae

- Rock bass *Ambloplites rupestris*

Rock bass were somewhat less common than bluegills and pumpkinseeds being caught in 72% of all lakes sampled. Rock bass occur across the entire state (Figure 103) but were somewhat less prevalent in the Southern Lake Michigan and Eastern Lake Superior management units (Table 111). Rock bass also showed a clear preference for larger lakes and relatively deeper lakes within each size class.

Rock bass were caught in all gears deployed (Appendix A) but the vast majority were caught by fyke and trap nets. For the state as a whole, the typical range of catch rates for electrofishing gear was 0.1 to 0.6 fish per minute (Table 112). Catch rates in trap nets and fyke nets were similar, with a typical range of about 1 to 9 fish per lift. Typical catch rates in mini fyke nets were also relatively high, ranging between 1 and 5.5 fish per lift. Catches in seines were fairly consistent at 0.2 to 0.6 fish per lift. Typical catch rates in gill nets were low compared to other gear at 0.4 to 2 fish per haul. Catch rates of rock bass varied across gears, management units, lake size and lake depth (Tables 113–118). Patterns in CPUE in fyke and trap nets (Tables 114 and 118), which provided the highest total catch, indicated generally higher abundance in larger lakes, and lakes in the Upper Peninsula.

Seines selected for the smallest rock bass (Figure 104), with an average length of 3.4 inches (SE=0.9). Mini fyke nets also caught relatively small fish, averaging 5.2 inches (SE=0.3).

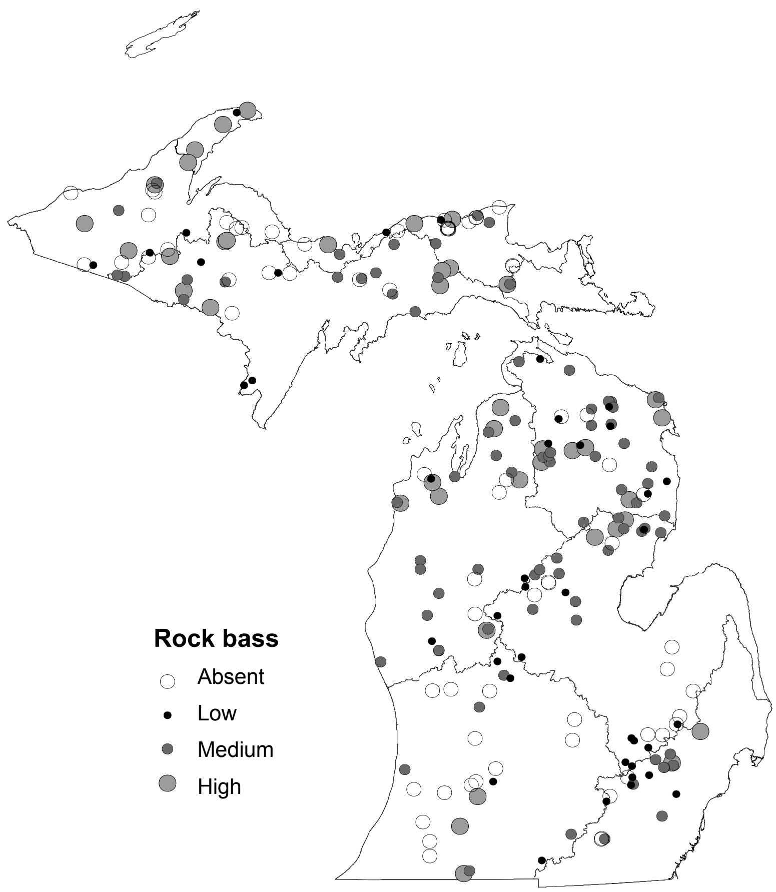


Figure 103.–Distribution and abundance of rock bass collected from Status and Trends lakes.

Electrofishing gear selected for somewhat larger fish than mini fykes (mean=5.6 inches, SE=0.2) but the overall size distribution was quite similar to mini fyke nets. The size distributions of catches in gill nets, trap nets and fyke nets were similar (Figure 104) and averaged larger than for the other gears, with a mean size of the catch of 6.7 inches (SE=0.1), 7.2 inches (SE=0.1) and 7.3 inches (SE=0.1), respectively.

The range of typical growth conditions for rock bass was provided in Table 119. Based on the mean length at age, rock bass reached a size of 7 inches at age 5.

Table 111.–Proportion of Status and Trends lakes containing rock bass, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.00	1.00	1.00		1.00	1.00	1.00	1.00
	Shallow	1.00		1.00	0.67		1.00	1.00		0.93
Medium	Deep	0.50	1.00	1.00	0.88	0.80	1.00	0.79	1.00	0.85
	Shallow		0.75	0.40	0.33	1.00	1.00	1.00	1.00	0.68
	Unknown	0.33	1.00	0.50	1.00	1.00	1.00	0.25		0.68
Small	Deep	0.33	0.43	0.44	0	0.50	0.71	0.63	0.60	0.50
	Shallow			1.00		0			0	0.25
	Unknown	0.50	1.00			0	0.75	0.50	0.50	0.55
All		0.46	0.83	0.66	0.67	0.53	0.91	0.72	0.79	0.72

Table 112.–Summary of catch per unit effort of rock bass by gear, including only sites and gears with catches greater than zero. Catch per unit effort for electrofishing is number of fish per minute. Catch per unit effort for fyke net, gill net, mini fyke, and trap net is number of fish per lift. Catch per unit effort for seining is number of fish per haul. Number of lakes with positive catches for each gear is denoted by n.

		Typical range							
Gear	Low	25th		Median		75th	High	Maximum	n
Electrofishing	<0.09	0.09	to	0.27	to	0.59	>0.59	2.40	95
Fyke net	<1.17	1.17	to	3.46	to	9.39	>9.39	75.69	136
Gill net	<0.40	0.40	to	0.75	to	2.00	>2.00	35.00	79
Mini fyke	<1.00	1.00	to	2.50	to	5.67	>5.67	19.00	63
Seine	<0.23	0.23	to	0.25	to	0.58	>0.58	15.67	12
Trap net	<0.78	0.78	to	3.00	to	8.00	>8.00	135.00	123

Table 113.–Mean CPUE (catch per minute, including sites with zero catches) rock bass in electrofishing surveys, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.90	0.98	0.69		0	0.43	0.13	0.64
	Shallow	0.59		1.02	0.21		0.24	0.03		0.44
Medium	Deep	0.08	0.48	0.69	0.24	0.28	0.71	0.20	0.42	0.33
	Shallow		0.02	0.11	0	0.97		0.10	0.10	0.10
	Unknown	0.28	0.19	0.12	0.25	0.23	0	0.05		0.14
Small	Deep	0.04	0.18	0.10	0		0	0.08	0.60	0.11
	Shallow									
	Unknown	0.01	0.27			0	0.33	0.02		0.09
All		0.11	0.34	0.42	0.25	0.33	0.37	0.13	0.38	0.26

Table 114.–Mean CPUE (catch per lift, including sites with zero catches) of rock bass in fyke nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		21.12	16.54	31.16		1.36	1.00	0.08	18.40
	Shallow	19.00		6.56	10.93		6.58	0.51		7.09
Medium	Deep	4.78	9.85	7.43	6.05	2.76	5.02	5.21	1.83	5.22
	Shallow		3.90	0.82	0.11	25.28	2.97	1.27	0	3.40
	Unknown	3.08	5.29	1.12	10.78	0.82	6.49	1.17		3.88
Small	Deep	0.50	0.41	1.08	0	2.75	1.66	2.04	4.33	1.56
	Shallow			7.25		0				2.42
	Unknown		2.87			0	1.09	0.17	0.25	0.85
All		4.96	6.13	3.89	9.05	4.05	3.86	2.57	1.88	4.54

Table 115.–Mean CPUE (catch per lift, including sites with zero catches) of rock bass in gill nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		3.81	0.29	3.19		0.06	0.50	0	1.84
	Shallow	2.96		0.01	2.36		1.05	0.13		1.11
Medium	Deep	0.47	5.14	0.42	0.94	0.08	0.53	0.48	0.60	1.16
	Shallow		0.19	0	0.04	0.75	0.08	0	0	0.11
	Unknown	0.06	0.17	0	1.50		1.46	0		0.52
Small	Deep	0.13	0.80	0.06	0	0	0	0	0.50	0.20
	Shallow			0.25					0	0.13
	Unknown	0	0.60			0	0.15	0.25	0	0.17
All		0.40	2.57	0.12	1.13	0.17	0.50	0.24	0.42	0.71

Table 116.–Mean CPUE (catch per lift, including sites with zero catches) of rock bass in mini fyke nets, stratified by lake size, depth, and management unit. Mini fyke nets were not used in Southern Lake Huron.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		6.75	0.75	3.83		0.20			3.07
	Shallow				2.72		6.25			4.93
Medium	Deep	0.50		1.31	2.13		3.73		6.50	2.85
	Shallow		0.50	0.30	0		1.67			0.47
	Unknown	4.25	1.00	0	7.50	0	5.29			2.83
Small	Deep	0	3.00	0.25	0	0.75	7.42		0.38	2.16
	Shallow			3.00		0			0	0.75
	Unknown					0	3.05		0.50	1.95
All		1.58	2.35	0.57	1.92	0.27	4.39		1.13	2.32

Table 117.–Mean CPUE (catch per haul, including sites with zero catches) of rock bass in seines, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.05	0	0			0	0	0.01
	Shallow	0.17		5.22	0		0	0		1.76
Medium	Deep	0.02	0.03	0.17	0.03	0	0	0	0.03	0.02
	Shallow		0	0	0	0	0	0	0	0
	Unknown	0	0	0	0	0		0.13		0.04
Small	Deep	0	0	0.05	0	0	0	0	0.05	0.01
	Shallow			0		0			0	0
	Unknown	0.33	0			0	0	0	0	0.06
All		0.05	0.02	0.79	0.01	0	0	0.01	0.03	0.12

Table 118.–Mean CPUE (catch per lift, including sites with zero catches) of rock bass in trap nets, stratified by lake size, depth, and management unit. Trap nets were not used in Western Lake Superior.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		15.25	6.88			1.68	3.75	0	8.29
	Shallow	26.25		5.73			7.27	1.51		7.14
Medium	Deep	3.11	11.21			2.65	5.07	3.92	7.70	5.51
	Shallow		2.35			25.66	4.63	3.54	0.67	6.39
	Unknown	6.28	2.63	0.25		0.17	6.81	0.25		3.72
Small	Deep	0.30	1.00			5.50	1.42	1.43	3.88	1.78
	Shallow					0			0	0
	Unknown	0.31	0				0.89	0.25	0.06	0.51
All		3.50	6.86	4.64		6.89	4.42	2.51	4.71	4.45

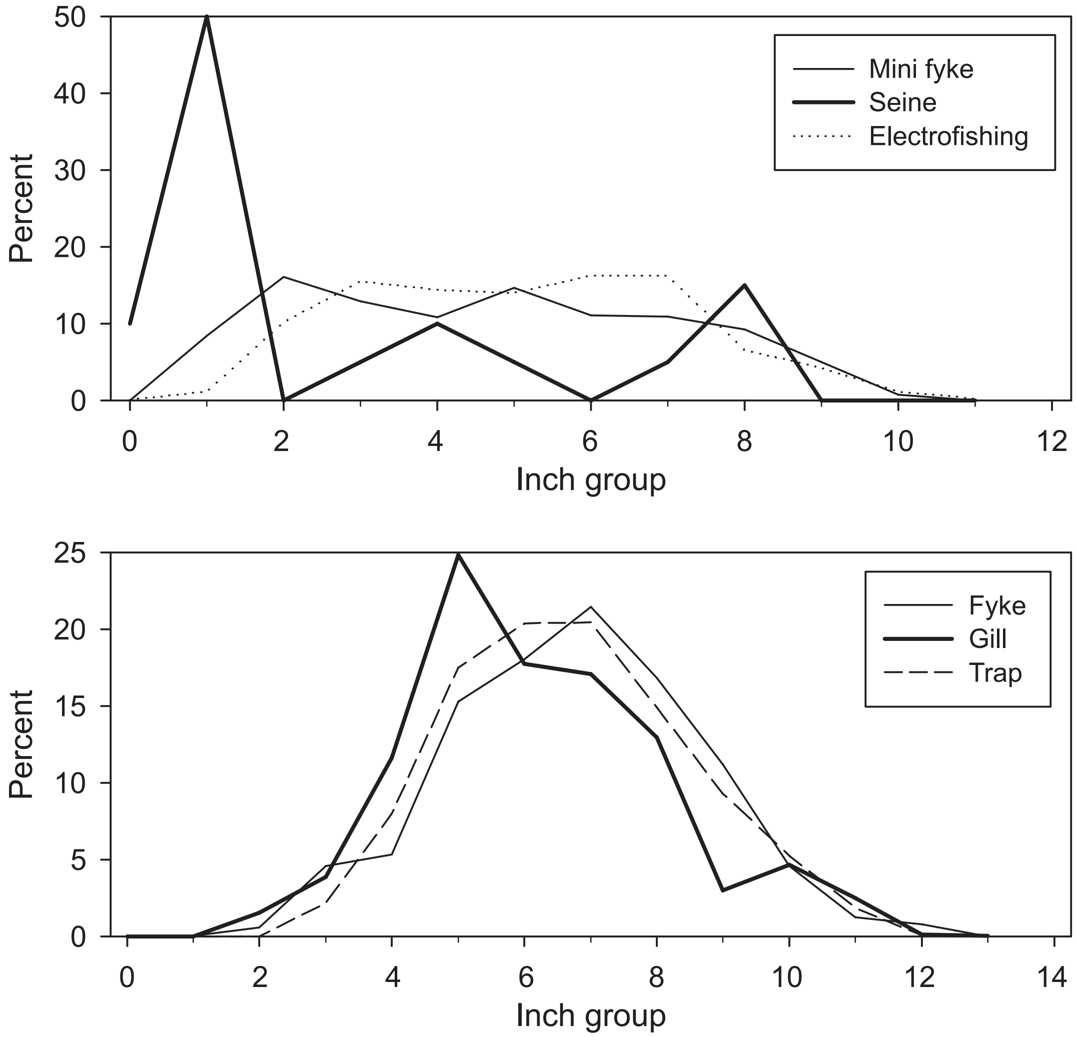


Figure 104.–Size distribution of rock bass in different gear types.

Table 119.–Mean and standard error (SE) of length at age of rock bass, with upper and lower quartiles as indicators of typical growth range. The sample size (n) is number of lakes containing fish with the specified age class; only those age classes with more than 3 lakes are reported.

Age	Lower 25%	Mean	SE	Upper 75%	n
1	1.9	2.6	0.2	3.4	15
2	3.4	3.8	0.1	4.2	65
3	4.6	5.1	0.1	5.5	85
4	5.6	6.2	0.1	6.8	91
5	6.6	7.2	0.1	7.8	87
6	7.4	8.0	0.1	8.7	84
7	8.2	8.7	0.1	9.2	75
8	8.8	9.4	0.1	9.8	67
9	9.3	9.8	0.1	10.4	52
10	9.8	10.2	0.1	10.6	34
11	10.4	10.9	0.1	11.2	23
12	10.2	10.8	0.3	11.4	14

- Green sunfish Lepomis cyanellus

Green sunfish were caught in 24% of all lakes sampled. Green sunfish were caught primarily in the Lower Peninsula (Figure 105), and were much more prevalent in the more southerly management units (Table 120).

Green sunfish were caught in all gears deployed (Appendix A), but the total number of individuals caught was not very large compared to some of the other members of the sunfish family. Because of the low number of individuals caught, and the sporadic catch in each gear, typical catch rates could only be determined for electrofishing where green sunfish were caught in 29 lakes. For the state as a whole, the typical range of catch rates for electrofishing gear was 0.03 to 0.13 fish per minute. Patterns of catch rates in electrofishing gear (Table 121) showed no clear pattern for lake size or depth in the Lower Peninsula.

The only gears with sufficient numbers of green sunfish to determine the size composition of the catch were electrofishing and fyke nets. Electrofishing gear selected for somewhat smaller fish than fyke nets (Figure 106), with a mean size of 4.2 inches (SE=0.2) versus 5.3 inches (SE=0.4).

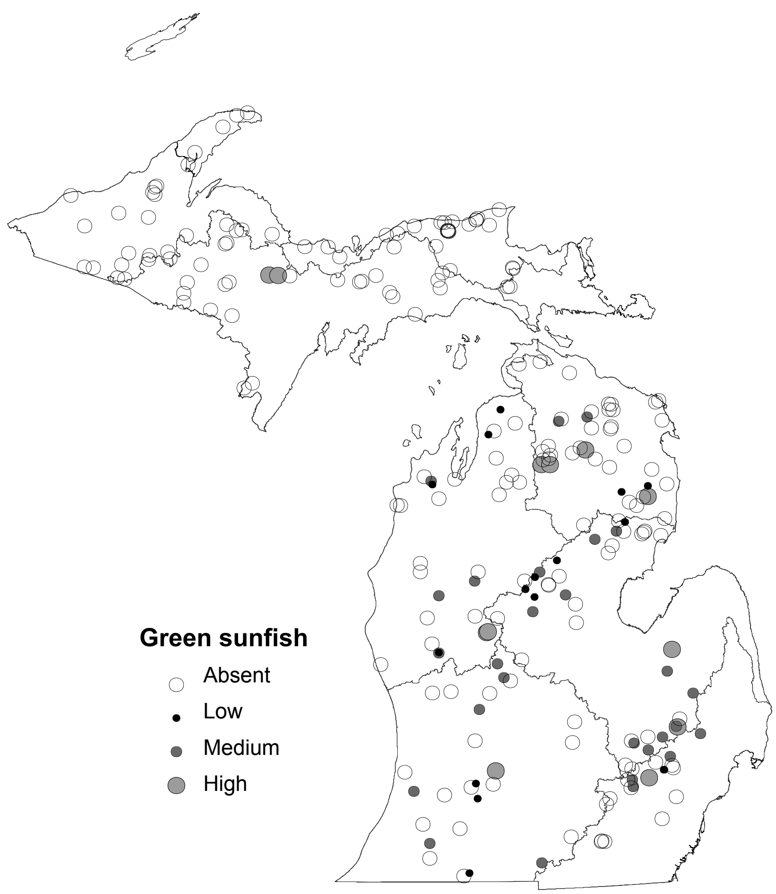


Figure 105.–Distribution and abundance of green sunfish collected from Status and Trends lakes.

Table 120.–Proportion of Status and Trends lakes containing green sunfish, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.33	0	0		0	0	1.00	0.17
	Shallow	1.00		0	0		0	0		0.07
Medium	Deep	0.43	0.36	0	0	0	0.07	0.57	0.44	0.29
	Shallow		0	0	0	0	0.33	0.50	0	0.12
	Unknown	0	0.33	0.25	0	0	0.20	0.75		0.27
Small	Deep	0.17	0.43	0.11	0	0	0.43	0.63	0.40	0.31
	Shallow			0		0			0	0
	Unknown	1.00	0.50			0	0.25	0	0	0.25
All		0.38	0.33	0.07	0	0	0.19	0.50	0.37	0.24

Table 121.–Mean CPUE (catch per minute, including sites with zero catches) green sunfish in electrofishing surveys, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0		0	0	0.60	0.05
	Shallow	0.01		0	0		0	0		0
Medium	Deep	0.02	0.03	0	0	0	0	0.01	0.04	0.02
	Shallow		0	0	0	0		0.03	0	0.01
	Unknown	0	0.01	0.03	0	0	0	0.01		0.01
Small	Deep	0.01	0.01	0.16	0		0.07	0.04	0	0.05
	Shallow									
	Unknown	0.03	0			0	0.37	0		0.06
All		0.01	0.02	0.04	0	0	0.04	0.02	0.08	0.02

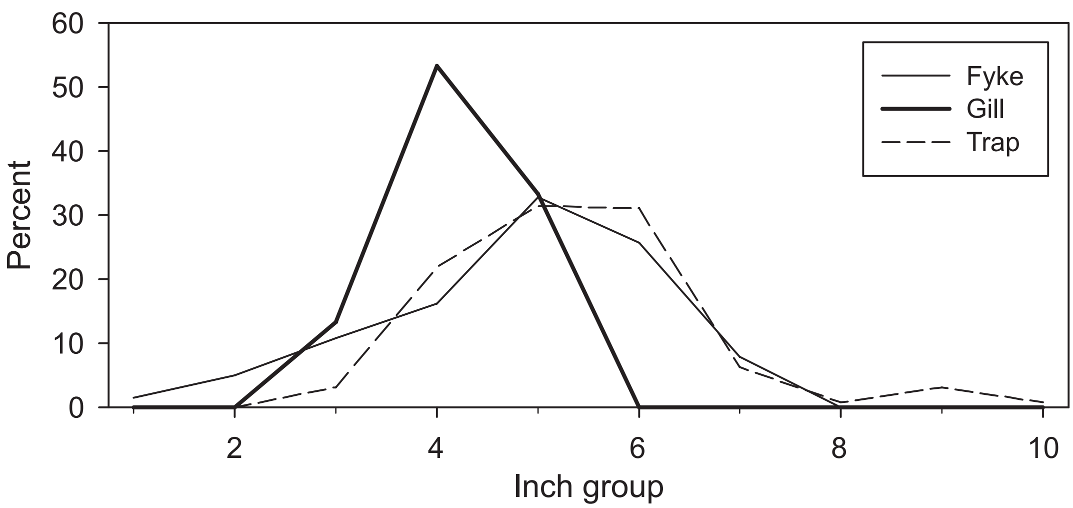


Figure 106.–Size distribution of green sunfish captured in fyke nets and electrofishing.

- Pumpkinseed *Lepomis gibbosus*

Pumpkinseed was among the most widely distributed species in the state and was caught in 88% of all lakes sampled. Pumpkinseeds occurred across the entire state (Figure 107) and showed no pattern in distribution across lake size, depth, or region except for a slightly lower occurrence in the Eastern Lake Superior Management Unit (Table 122).

Pumpkinseeds were caught in all gears deployed (Appendix A), but the greatest numbers were caught by fyke and trap nets, followed by electrofishing and mini fyke nets. For the state as a whole, the typical range of catch rates for electrofishing gear was 0.2 to 1 fish per minute (Table 123). Trap net catch rates were generally higher than for other fixed gear, with a typical range of 0.7 to 8 fish per lift. Typical catch rates in fyke nets were also high, at approximately 0.5 to 5 fish per lift. Catch rates in mini fyke nets were typically between 1 and 5.5 fish per lift. Catches in seines were fairly consistent at 0.5 to 2 fish per lift. Typical catch rates in gill nets were low compared to other gear at 0.25 to 1 fish per lift. Catch rates of pumpkinseed varied across gears, management units, lake size and lake depth (Tables 124-129). Patterns in CPUE in fyke and trap nets (Tables 125 and 129), which provided the highest total catch, were highly variable between regions and gears and showed no consistent pattern.

Seines selected for the smallest pumpkinseed (Figure 108), with an average length of 3.8 inches (SE=0.2). Mini fyke nets also caught relatively small fish, averaging 4.4 inches (SE=0.2). Electrofishing gear selected for somewhat larger fish than mini fykes (mean=4.9 inches, SE=0.1), but the overall size distribution was quite similar to mini fyke nets. The size distribution of catches from fyke nets and trap nets were similar (Figure 108) and averaged larger than the other gears, with a mean size of the catch of 6.3 inches (SE=0.1) and 6.5 inches (SE=0.1), respectively.

The range of typical growth conditions for pumpkinseed was provided in Table 130. Based on the mean length at age, pumpkinseeds reached a size of 7 inches at about age 6.

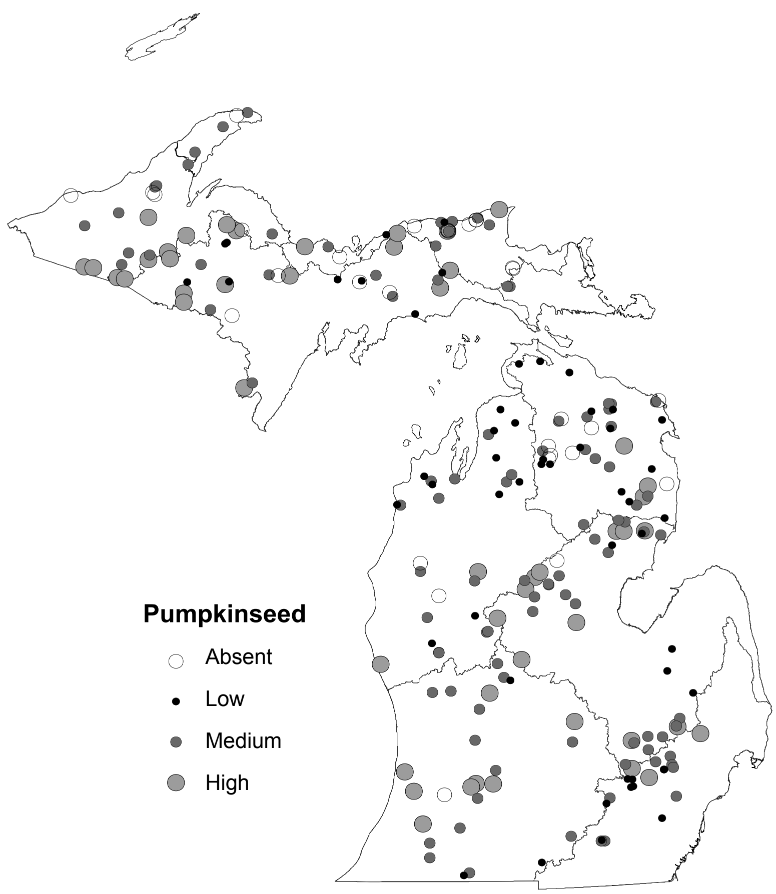


Figure 107.–Distribution and abundance of pumpkinseeds collected from Status and Trends lakes.

Table 122.–Proportion of Status and Trends lakes containing pumpkinseed, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.00	1.00	1.00		1.00	1.00	1.00	1.00
	Shallow	1.00		1.00	1.00		1.00	1.00		1.00
Medium	Deep	1.00	1.00	1.00	0.75	0.60	0.71	1.00	1.00	0.90
	Shallow		1.00	0.80	0.83	1.00	1.00	1.00	1.00	0.92
	Unknown	1.00	0.67	0.50	1.00	1.00	1.00	1.00		0.86
Small	Deep	0.83	1.00	0.78	0.50	1.00	0.71	0.88	1.00	0.85
	Shallow			1.00		0			1.00	0.50
	Unknown	1.00	0.50			0.75	0.75	1.00	1.00	0.80
All		0.96	0.93	0.83	0.83	0.74	0.81	0.97	1.00	0.88

Table 123.–Summary of catch per unit effort of pumpkinseed by gear, including only sites and gears with catches greater than zero. Catch per unit effort for electrofishing is number of fish per minute. Catch per unit effort for fyke net, gill net, mini fyke, and trap net is number of fish per lift. Catch per unit effort for seining is number of fish per haul. Number of lakes with positive catches for each gear is denoted by n.

		Typical range							
Gear	Low	25th		Median		75th	High	Maximum	n
Electrofishing	<0.17	0.17	to	0.39	to	0.97	>0.97	6.34	127
Fyke net	<0.44	0.44	to	1.67	to	4.67	>4.67	67.33	151
Gill net	<0.25	0.25	to	0.50	to	1.00	>1.00	2.50	45
Mini fyke	<1.00	1.00	to	1.90	to	5.60	>5.60	317.00	62
Seine	<0.5	0.50	to	1.00	to	2.00	>2.00	35.50	59
Trap net	<0.67	0.67	to	2.67	to	8.00	>8.00	40.67	129

Table 124.–Mean CPUE (catch per minute, including sites with zero catches) pumpkinseed in electrofishing surveys, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.77	0	0.32		0.07	0.07	2.20	0.47
	Shallow	0.08		1.41	0.01		2.13	0.79		0.92
Medium	Deep	0.78	0.53	0.70	0.24	0.07	0.23	0.92	0.31	0.56
	Shallow		0.59	1.35	1.52	3.63		2.03	0.10	1.43
	Unknown	1.57	0.56	0.80	0.25	2.77	0	0.23		0.75
Small	Deep	0.39	0.38	0.63	0		0.36	0.55	0.13	0.46
	Shallow									
	Unknown	0.25	0			0	0.27	0.65		0.30
All		0.73	0.52	0.87	0.50	0.96	0.51	0.84	0.44	0.68

Table 125.–Mean CPUE (catch per lift, including sites with zero catches) of pumpkinseed in fyke nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.55	0.04	0.89		0	0.88	2.08	0.70
	Shallow	4.25		3.12	1.93		2.51	1.60		2.40
Medium	Deep	10.02	1.02	8.12	2.50	2.43	0.63	3.40	0.46	3.21
	Shallow		1.08	4.37	14.37	5.95	3.28	7.75	0	6.60
	Unknown	14.29	1.31	2.44	1.44	2.26	0.18	0.63		2.65
Small	Deep	1.00	2.68	10.38	4.14	10.08	0.49	3.08	0.58	4.71
	Shallow			0		0				0
	Unknown		2.30			5.19	2.19	3.50	0.42	2.82
All		8.85	1.57	6.14	5.22	4.72	1.23	3.48	0.55	3.61

Table 126.–Mean CPUE (catch per lift, including sites with zero catches) of pumpkinseed in gill nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.00	0	0.03		0	0	1.50	0.36
	Shallow	0		0	0		0.51	0		0.18
Medium	Deep	0.27	0.09	0.20	0.14	0	0.01	0.11	0.29	0.14
	Shallow		0	0	0.46	0.75	0.08	0.69	0	0.30
	Unknown	0.72	0	0.05	0		0	0.08		0.15
Small	Deep	0.06	0.06	0.08	0	0	0	0.06	0	0.04
	Shallow			0					0	0
	Unknown	0	0.67			0	0	1.25	0	0.23
All		0.24	0.17	0.07	0.17	0.14	0.07	0.22	0.21	0.16

Table 127.–Mean CPUE (catch per lift, including sites with zero catches) of pumpkinseed in mini fyke nets, stratified by lake size, depth, and management unit. Mini fyke nets were not used in Southern Lake Huron.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0.50	1.19		1.80			0.94
	Shallow				0.88		1.16			1.05
Medium	Deep	0		0.38	1.68		2.11		3.33	1.68
	Shallow		1.00	3.67	9.66		1.25			5.13
	Unknown	1.00	4.50	0	8.00	0.08	1.04			1.49
Small	Deep	1.00	0	44.44	0	1.13	0.17		0.38	14.54
	Shallow			0.50		0			1.00	0.38
	Unknown					23.65	12.20		2.00	13.27
All		0.67	1.30	17.11	4.02	6.87	3.58		1.23	6.37

Table 128.–Mean CPUE (catch per haul, including sites with zero catches) of pumpkinseed in seines, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0			0.17	0.20	0.03
	Shallow	0		0	0		2.50	1.40		0.59
Medium	Deep	0.45	0.63	0	0.45	0	0	0.62	1.24	0.53
	Shallow		0.13	0.58	3.31	0	0.67	0.85	0	1.11
	Unknown	0.94	0	0.67	7.75	0		0.75		1.11
Small	Deep	0.33	0	9.25	2.00	0	0	5.21	0	2.55
	Shallow			0		0			0	0
	Unknown	0.17	0			0.67	0	0.75	0.75	0.48
All		0.44	0.31	1.97	1.36	0.13	0.40	1.65	0.68	0.98

Table 129.–Mean CPUE (catch per lift, including sites with zero catches) of pumpkinseed in trap nets, stratified by lake size, depth, and management unit. Trap nets were not used in Western Lake Superior.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		4.72	0.19			0	2.13	2.67	2.74
	Shallow	0.50		4.41			8.22	1.89		5.10
Medium	Deep	7.65	1.82			0.58	1.09	7.63	2.47	4.13
	Shallow		1.69			7.37	9.57	13.38	0.67	7.46
	Unknown	13.75	0	15.50		0	0.38	3.00		4.42
Small	Deep	3.60	2.41			2.25	1.49	7.34	3.10	3.90
	Shallow					0			11.25	5.63
	Unknown	4.31	0				1.00	18.00	0.72	4.00
All		6.89	2.06	6.13		2.01	2.60	7.64	2.83	4.42

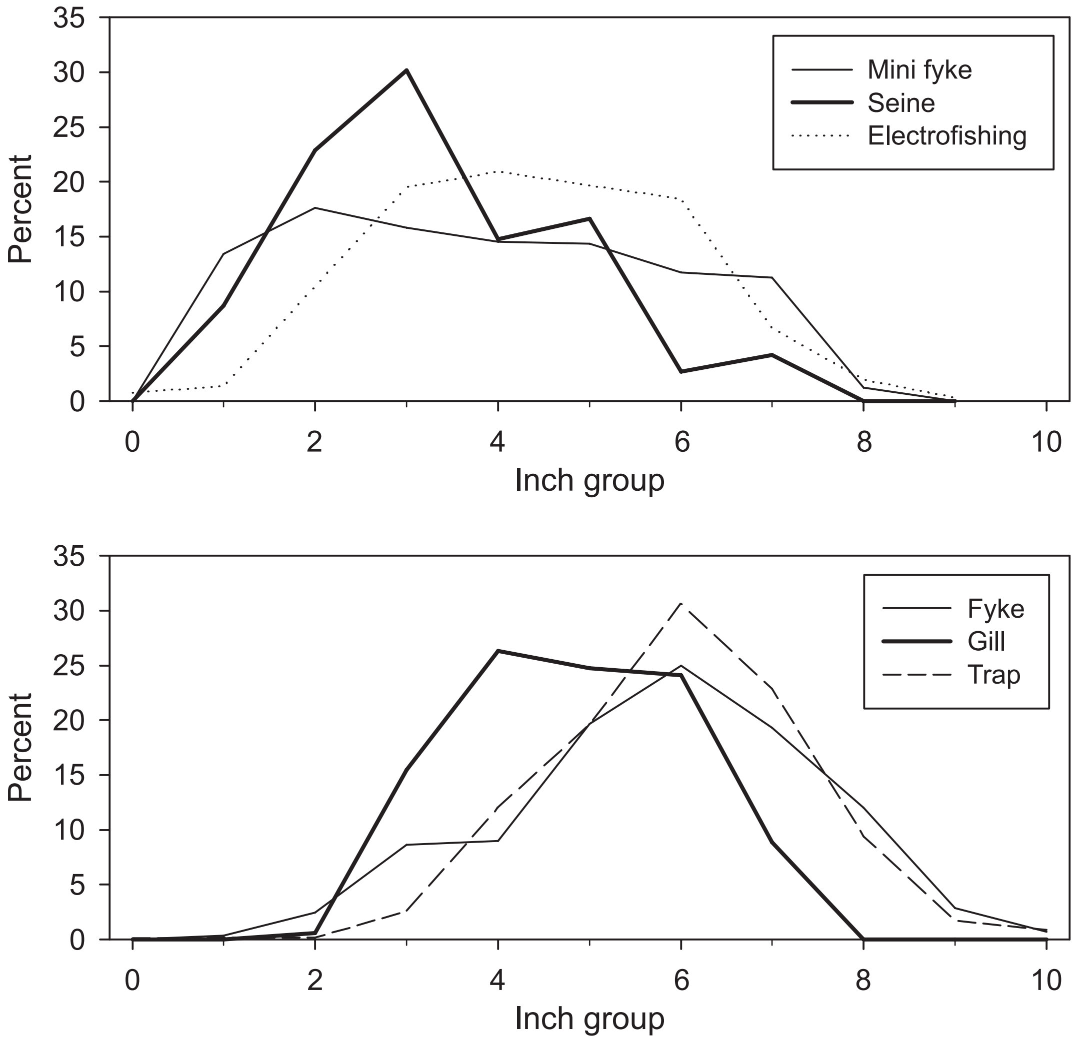


Figure 108.–Size distribution of pumpkinseeds captured in different gear types.

Table 130.–Mean and standard error (SE) of length at age of pumpkinseed, with upper and lower quartiles as indicators of typical growth range. The sample size (n) is number of lakes containing fish with the specified age class; only those age classes with more than 3 lakes are reported.

Age	Lower 25%	Mean	SE	Upper 75%	n
1	2.1	2.5	0.1	2.8	28
2	3.1	3.7	0.1	4.2	93
3	4.1	4.9	0.1	5.7	126
4	5.3	5.9	0.1	6.6	122
5	6.1	6.7	0.1	7.1	120
6	6.6	7.1	0.1	7.7	107
7	7.2	7.6	0.1	8.0	84
8	7.5	8.0	0.1	8.4	50
9	8.0	8.4	0.1	9.0	26
10	8.5	8.8	0.2	9.1	13

- Warmouth *Lepomis gulosus*

Warmouths occurred modestly frequently, being caught in 19% of all lakes sampled. Warmouths were caught only in the Lower Peninsula (Figure 109), and were much more prevalent in the more southerly management units (Table 131).

Warmouths were caught in all gears deployed (Appendix A) but the total number of individuals caught was not very large compared to some of the other members of the sunfish family. Because of the low number of individuals caught and the sporadic catch in each gear, typical catch rates could only be determined for electrofishing and trap nets, where warmouths were caught in 33 and 34 lakes, respectively. For the state as a whole, the typical range of catch rates for electrofishing gear was 0.1 to 0.33 fish per minute. Typical catch rates in trap nets were 0.4 to 1.3 fish per lift. Patterns of catch rates in electrofishing gear and trap nets (Tables 132 and 133) showed no clear pattern for lake size or depth in the Lower Peninsula.

The only gears with sufficient numbers of warmouths to determine the size composition of the catch were electrofishing and trap nets. Electrofishing gear selected for somewhat smaller fish than trap nets (Figure 110), with a mean size of 5.1 inches (SE=0.2) versus 6.6 inches (SE=0.2).

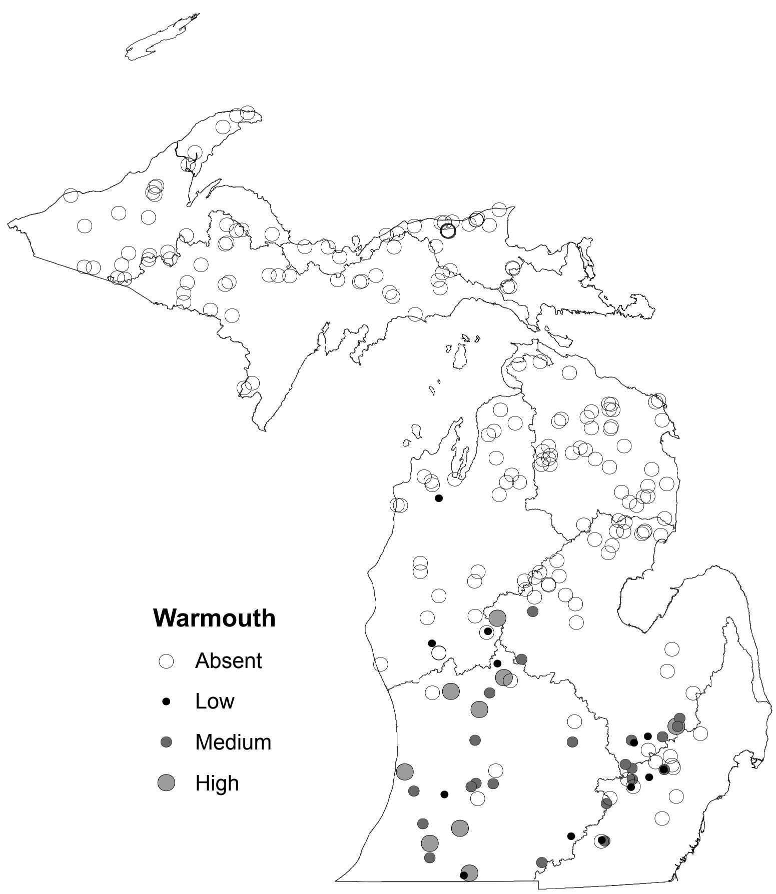


Figure 109.–Distribution and abundance of warmouths collected from Status and Trends lakes.

Table 131.–Proportion of Status and Trends lakes containing warmouth, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.33	0	0		0	0	1.00	0.17
	Shallow	0		0	0		0	0.33		0.07
Medium	Deep	0.93	0.18	0	0	0	0	0.29	0.33	0.28
	Shallow		0	0	0	0	0	0	1.00	0.04
	Unknown	0.67	0	0	0	0	0	0.75		0.23
Small	Deep	0.83	0	0	0	0	0	0.38	0.60	0.23
	Shallow			0		0			0	0
	Unknown	0.50	0			0	0	0.50	0	0.10
All		0.81	0.10	0	0	0	0	0.33	0.42	0.19

Table 132.–Mean CPUE (catch per minute, including sites with zero catches) warmouth in electrofishing surveys, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.02	0	0		0	0	0.10	0.01
	Shallow	0		0	0		0	0.34		0.06
Medium	Deep	0.23	0	0	0	0	0	0.03	0.06	0.06
	Shallow		0	0	0	0		0	0.07	0
	Unknown	0.07	0	0	0	0	0	0.09		0.03
Small	Deep	0.23	0	0	0		0	0.16	0	0.09
	Shallow									
	Unknown	0	0			0	0	0.10		0.03
All		0.18	0	0	0	0	0	0.08	0.06	0.05

Table 133.–Mean CPUE (catch per lift, including sites with zero catches) of warmouth in trap nets, stratified by lake size, depth, and management unit. Trap nets were not used in Western Lake Superior.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0			0	0	0	0
	Shallow	0		0			0	0.06		0.02
Medium	Deep	2.24	0.13			0	0	0.19	0.16	0.56
	Shallow		0			0	0	0	0.33	0.02
	Unknown	0.92	0	0		0	0	0.44		0.28
Small	Deep	0.93	0			0	0	0.30	0.20	0.29
	Shallow					0			0	0
	Unknown	0	0				0	0.42	0	0.06
All		1.52	0.05	0		0	0	0.22	0.15	0.32

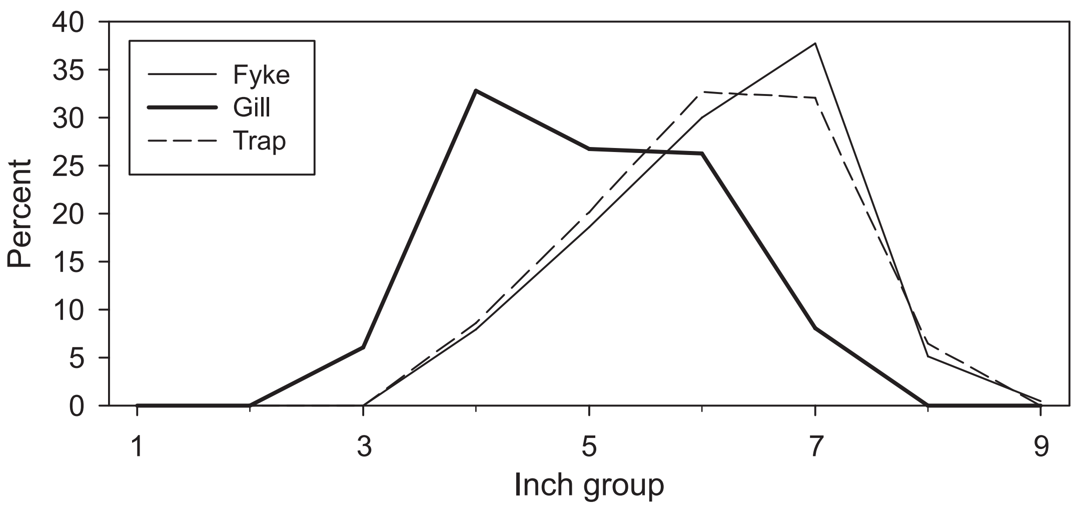


Figure 110.–Size distribution of warmouths captured in trap nets and electrofishing.

- Bluegill *Lepomis macrochirus*

Bluegill was among the most widely distributed species in the state and were caught in 81% of all lakes sampled. Their distribution was similar to largemouth bass, being found in all regions except for the counties bordering the south shore of Lake Superior (Figure 111). Bluegills occurred in nearly equal percentages across all lake size and depth groups sampled, and across most management units except for the Lake Superior Basin (Table 134).

Bluegills were caught in all gears deployed (Appendix A) but the greatest numbers were caught by trap nets, followed by electrofishing and fyke nets. For the state as a whole, the typical range of catch rates for electrofishing gear was 1 to 6.5 fish per minute (Table 135). Trap net catch rates were generally higher than for other fixed gear, with a typical range of 8 to 64 fish per lift. Typical catch rates in fyke nets were also high, at 2.5 to 25 fish per lift. Catch rates in mini fyke nets and seines were similar, running 1.5 to almost 20 fish per lift. Typical catch rates in gill nets were low compared to other gear at 0.3 to 2.5 fish per lift. Catch rates of bluegills varied across gears, management units, lake size and lake depth (Tables 136-141). Focusing on trap nets (Table 141), which provided the highest total catch, CPUE tended to be higher in smaller lakes and in the southern part of the state.

Seines selected for the smallest bluegills (Figure 112), with an average length of 2.9 inches (SE=0.1). Mini fyke nets also caught relatively small fish, averaging 3.8 inches (SE=0.2). Electrofishing gear selected for slightly larger fish than mini fykes (mean=4.0 inches, SE=0.1), but the overall size distribution was quite similar to mini fyke nets. The size distribution of catches in gill nets, fyke nets, and trap nets were similar (Figure 112) and averaged larger than the previous gears, with mean size of the catch of 6.0 inches (SE=0.1) for gill nets, and 6.5 inches (SE=0.1) for fyke and trap nets.

The range of typical growth for bluegills was provided in Table 142. Based on the mean length at age, bluegills reached a size of 7 inches between age 5 and 6.

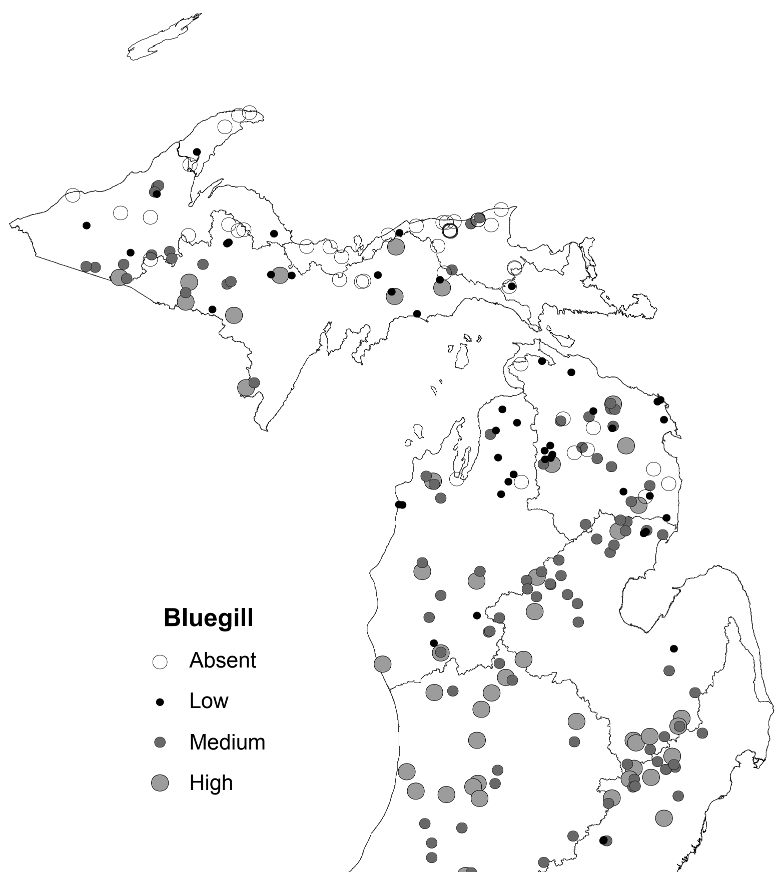


Figure 111.–Distribution and abundance of bluegills collected from Status and Trends lakes.

Table 134.–Proportion of Status and Trends lakes containing bluegill, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.00	0.50	0.50		0	1.00	1.00	0.67
	Shallow	1.00		1.00	1.00		1.00	1.00		1.00
Medium	Deep	1.00	0.82	0.80	0.75	0.20	0.71	1.00	1.00	0.84
	Shallow		1.00	0.60	0.50	0.50	1.00	1.00	1.00	0.76
	Unknown	1.00	1.00	1.00	0	0	0.80	1.00		0.82
Small	Deep	1.00	1.00	0.67	1.00	0.25	1.00	1.00	1.00	0.88
	Shallow			0		0			1.00	0.25
	Unknown	1.00	1.00			0	0.63	1.00	1.00	0.65
All		1.00	0.93	0.72	0.67	0.16	0.79	1.00	1.00	0.81

Table 135.–Summary of catch per unit effort of bluegill by gear, including only sites and gears with catches greater than zero. Catch per unit effort for electrofishing is number of fish per minute. Catch per unit effort for fyke net, gill net, mini fyke, and trap net is number of fish per lift. Catch per unit effort for seining is number of fish per haul. Number of lakes with positive catches for each gear is denoted by n.

		Typical range							
Gear	Low	25th		Median		75th	High	Maximum	n
Electrofishing	<1.10	1.10	to	3.50	to	6.57	>6.57	36.60	130
Fyke net	<2.50	2.50	to	8.51	to	25.86	>25.86	262.00	140
Gill net	<0.33	0.33	to	1.00	to	2.50	>2.50	20.50	100
Mini fyke	<1.50	1.50	to	6.25	to	19.50	>19.5	194.50	67
Seine	<1.25	1.25	to	4.67	to	16.25	>16.25	149.33	83
Trap net	<7.75	7.75	to	25.96	to	64.33	>64.33	348.50	138

Table 136.–Mean CPUE (catch per minute, including sites with zero catches) bluegill in electrofishing surveys, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		6.60	0.06	0.12		0	1.70	11.70	2.47
	Shallow	4.35		2.36	0.31		1.09	4.12		2.07
Medium	Deep	6.28	4.02	7.83	2.49	0	1.92	4.89	10.52	5.22
	Shallow		0.22	1.13	1.64	1.17		3.76	6.43	1.87
	Unknown	6.91	5.90	1.32	0	0	0	5.39		3.63
Small	Deep	5.00	3.98	1.62	1.14		4.74	5.00	8.27	4.09
	Shallow									
	Unknown	4.68	4.60			0	0.20	6.88		3.99
All		5.90	3.85	2.72	1.39	0.17	1.39	4.82	10.09	3.99

Table 137.–Mean CPUE (catch per lift, including sites with zero catches) of bluegill in fyke nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		2.35	0	0.21		0	12.38	32.83	4.61
	Shallow	180		19.36	0.67		4.26	6.28		18.63
Medium	Deep	58.39	3.63	32.23	12.43	0.42	4.01	18.46	25.93	18.75
	Shallow		5.44	8.01	4.89	19.92	12.61	8.90	13.00	8.70
	Unknown	125.42	10.63	30.75	0	0	6.52	19.54		25.13
Small	Deep	4.89	15.49	49.21	15.42	7.75	3.89	17.24	17.42	20.27
	Shallow			0		0				0
	Unknown		49.66			0	0.93	9.67	23.83	9.65
All		69.82	11.84	28.78	6.77	3.84	4.25	14.62	23.55	16.42

Table 138.–Mean CPUE (catch per lift, including sites with zero catches) of bluegill in gill nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.56	0	0		0	0.50	13.00	1.66
	Shallow	1.23		0.11	0		0.68	0.54		0.43
Medium	Deep	2.57	0.78	0.91	0.77	0	0.09	2.57	1.57	1.33
	Shallow		0	0.17	0.46	0	1.08	0.56	1.00	0.41
	Unknown	3.47	0.17	1.70	0		0.15	1.75		1.31
Small	Deep	2.88	1.51	0	0	0	0.21	0.91	1.07	0.89
	Shallow			0					1.50	0.75
	Unknown	0.38	1.03			0	0.06	0.75	0.50	0.34
All		2.52	0.88	0.44	0.39	0	0.25	1.58	1.89	1.00

Table 139.–Mean CPUE (catch per lift, including sites with zero catches) of bluegill in mini fyke nets, stratified by lake size, depth, and management unit. Mini fyke nets were not used in Southern Lake Huron.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.25	0	4.00		0			1.65
	Shallow				2.39		3.48			3.07
Medium	Deep	72.00		0.31	7.56		15.20		2.17	12.24
	Shallow		5.75	18.65	1.96		54.17			17.44
	Unknown	6.00	69.00	20.94	0	0	6.60			13.69
Small	Deep	0	0	27.78	6.25	4.50	5.83		2.75	11.70
	Shallow			0		0			194.50	48.63
	Unknown					0	21.37		55.50	21.69
All		26.00	16.15	17.25	4.46	1.64	15.25		39.83	14.34

Table 140.–Mean CPUE (catch per haul, including sites with zero catches) of bluegill in seines, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.24	0	0.04			2.33	1.60	0.44
	Shallow	0		0.42	0		10	2.56		1.82
Medium	Deep	7.38	5.43	0.08	10.65	0	0	4.14	11.86	5.98
	Shallow		0.50	0.08	4.44	0	149.33	7.38	0	11.00
	Unknown	7.22	5.25	31.33	0	0		9.44		11.71
Small	Deep	17.27	3.33	11.33	1.67	0	4.00	4.73	0.50	5.95
	Shallow			0		0			39.00	13.00
	Unknown	7.75	0.67			0	0	34.75	2.50	8.24
All		9.14	3.67	6.73	5.07	0	20.42	6.92	8.15	6.69

Table 141.–Mean CPUE (catch per lift, including sites with zero catches) of bluegill in trap nets, stratified by lake size, depth, and management unit. Trap nets were not used in Western Lake Superior.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		24.02	0			0	23.88	36.75	18.96
	Shallow	107.75		13.30			7.45	8.05		17.79
Medium	Deep	76.56	13.25			0.09	18.80	47.27	34.28	36.94
	Shallow		2.58			14.67	13.35	16.67	41.00	13.39
	Unknown	126.25	10.08	66.25		0	8.98	98.13		56.41
Small	Deep	53.77	44.96			10.25	44.21	105.83	32.23	57.98
	Shallow					0			153.25	76.63
	Unknown	83.75	20				4.68	114.33	193.81	63.99
All		78.79	20.19	23.21		4.57	15.54	62.34	57.28	41.50

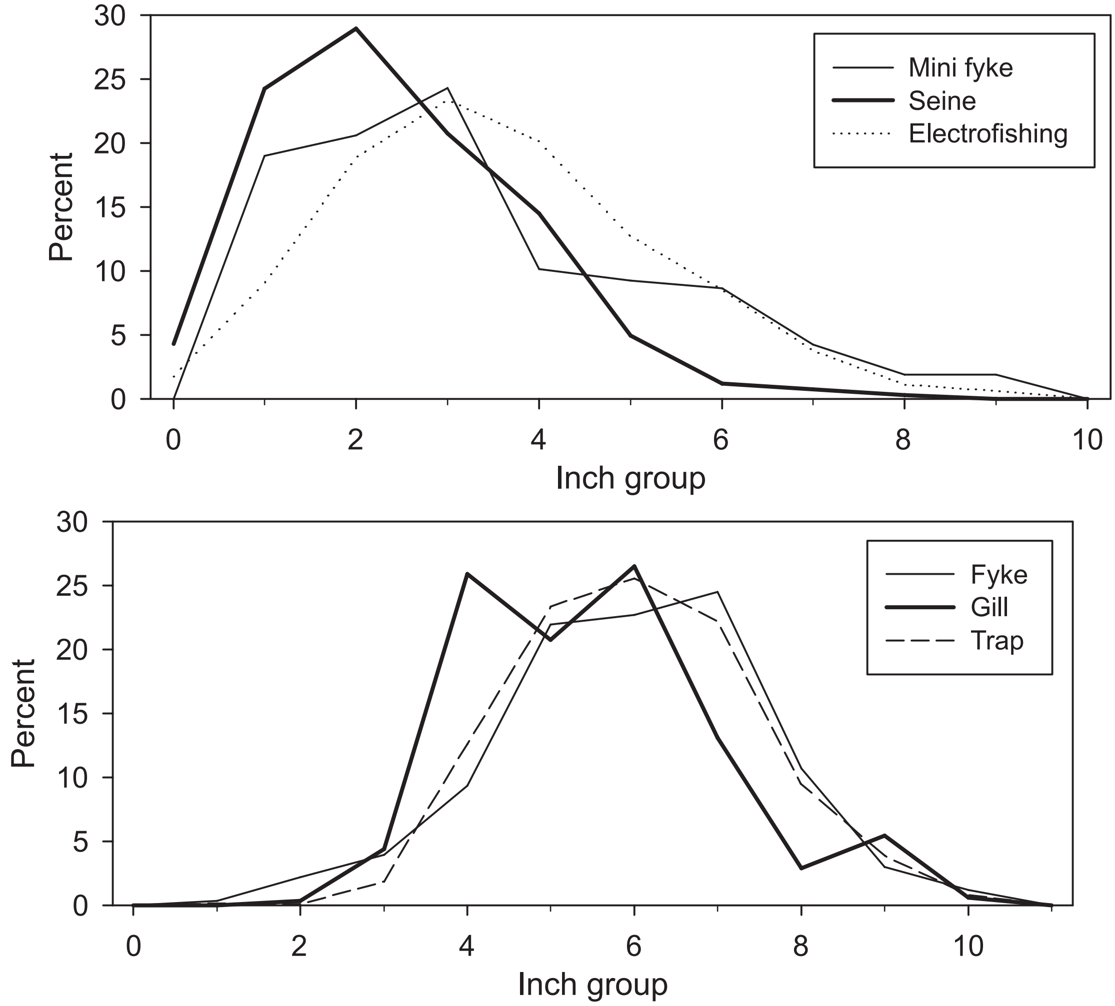


Figure 112.–Size distribution of bluegills captured in different gear types.

Table 142.–Mean and standard error (SE) of length at age of bluegill, with upper and lower quartiles as indicators of typical growth range. The sample size (n) is number of lakes containing fish with the specified age class; only those age classes with more than three lakes are reported.

Age	Lower 25%	Mean	SE	Upper 75%	n
0	1.5	1.6	0.1	1.8	8
1	1.8	2.3	0.1	2.7	86
2	2.9	3.5	0.1	4.0	132
3	4.0	4.7	0.1	5.4	155
4	5.0	5.8	0.1	6.5	159
5	6.1	6.7	0.1	7.3	157
6	6.9	7.6	0.1	8.1	149
7	7.4	8.0	0.1	8.4	129
8	7.7	8.4	0.1	9.1	94
9	8.1	8.8	0.1	9.5	72
10	8.2	9.0	0.2	9.8	32
11	9.2	9.6	0.2	10.2	12
12	9.5	9.9	0.2	10.3	4
13	8.9	9.9	0.7	11.0	4

- Northern longear sunfish *Lepomis peltastes*

Northern longear sunfish were uncommon, occurring in only three lakes (about 1% of lakes sampled; Figure 113). Too few longear sunfish were caught to characterize typical catch rates or size distribution of this species.

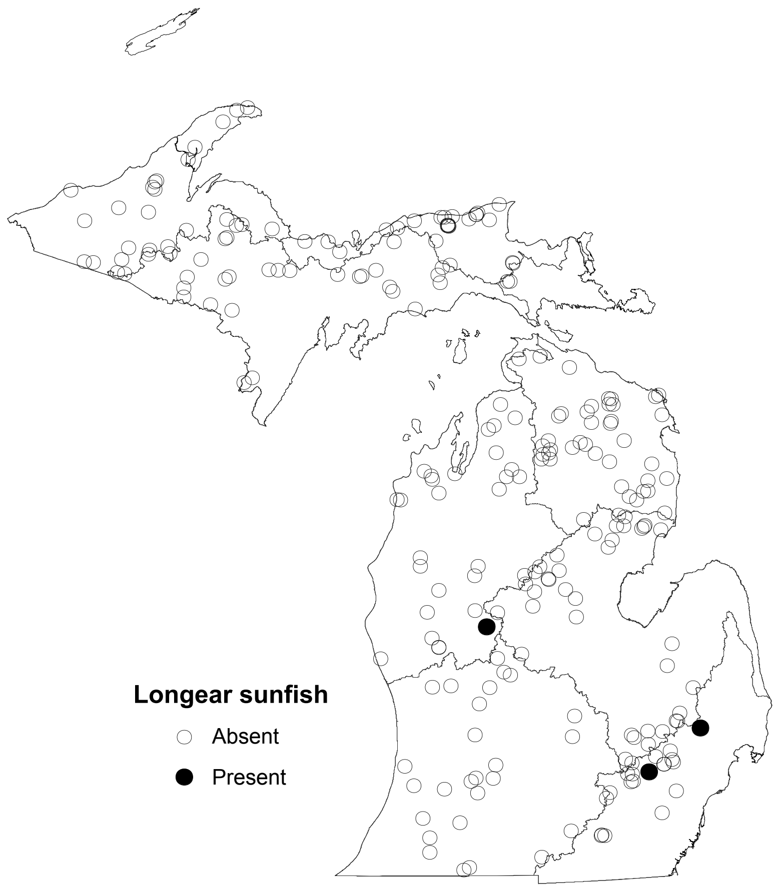


Figure 113.–Distribution and abundance of northern longear sunfish collected from Status and Trends lakes.

- Redear sunfish *Lepomis microlophus*

Redear sunfish had a relatively restricted distribution and were caught only in the southern part of the state (Figure 114). Overall, redear sunfish occurred in only 8% of lakes sampled (Table 143) and occurred much more frequently in the Lake Erie Management Unit (Table 143).

Redear sunfish were primarily caught in trap and fyke nets, followed by electrofishing. Because of their relatively low frequency of occurrence, catch rate statistics should be interpreted cautiously. For the state as a whole, the typical range of catch rates for electrofishing gear was 0.1 to 1 fish per minute (Table 144). When redear sunfish were present, catch rates in trap nets and fyke nets were often quite high, with a typical range of 1 to over 20 fish per lift. Catch rates of redear sunfish varied across gears, management units, lake size and lake depth (Tables 145-147), but highest catch rates were generally in medium-sized lakes within the Lake Erie Management Unit.

Too few redear sunfish were collected to typify the size composition of the catch except for electrofishing, fyke nets and trap nets. Electrofishing gear selected for smaller fish than the other gear (Figure 115) with a mean length of 6.2 inches (SE=0.4). The size distributions of catches in fyke nets and trap nets were similar (Figure 115), with a mean size of the catch of 8.5 inches (SE=0.4) and 8.2 inches (SE=0.2), respectively.

The range of typical growth for redear sunfish was provided in Table 148. Based on the mean length at age, redear sunfish reached a size of 7 inches at about age 4.

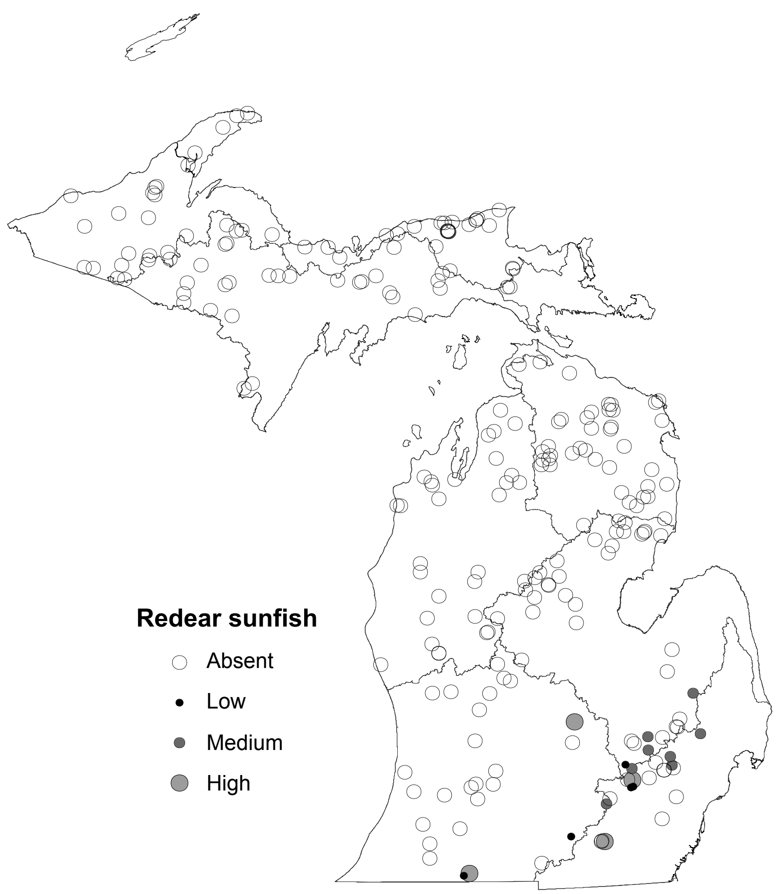


Figure 114.–Distribution and abundance of redear sunfish collected from Status and Trends lakes.

Table 143.–Proportion of Status and Trends lakes containing redear sunfish, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0		0	0	0	0
	Shallow	0		0	0		0	0		0
Medium	Deep	0.21	0	0	0	0	0	0.21	0.78	0.16
	Shallow		0	0	0	0	0	0	1.00	0.04
	Unknown	0.33	0	0	0	0	0	0.25		0.09
Small	Deep	0	0	0	0	0	0	0.13	0	0.02
	Shallow			0		0			0	0
	Unknown	0	0			0	0	0	0	0
All		0.15	0	0	0	0	0	0.14	0.42	0.08

Table 144.–Summary of catch per unit effort of redear sunfish by gear, including only sites and gears with catches greater than zero. Catch per unit effort for electrofishing is number of fish per minute. Catch per unit effort for fyke net, gill net, and trap net is number of fish per lift. Catch per unit effort for seining is number of fish per haul. Number of lakes with positive catches for each gear is denoted by n.

		Typical range							
Gear	Low	25th		Median		75th	High	Maximum	n
Electrofishing	<0.13	0.13	to	0.40	to	0.90	>0.90	3.33	11
Fyke net	<0.70	0.70	to	10	to	58.33	>58.33	75.00	7
Trap net	<1.50	1.50	to	6.25	to	21.33	>21.33	109.00	17

Table 145.–Mean CPUE (catch per minute, including sites with zero catches) redear sunfish in electrofishing surveys, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0		0	0	0	0
	Shallow	0		0	0		0	0		0
Medium	Deep	0.01	0	0	0	0	0	0.04	0.22	0.04
	Shallow		0	0	0	0		0	0.90	0.05
	Unknown	0.09	0	0	0	0	0	0.01		0.02
Small	Deep	0	0	0	0		0	0.48	0	0.14
	Shallow									
	Unknown	0	0			0	0	0		0
All		0.02	0	0	0	0	0	0.12	0.24	0.05

Table 146.–Mean CPUE (catch per lift, including sites with zero catches) of redear sunfish in fyke nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0		0	0	0	0
	Shallow	0		0	0		0	0		0
Medium	Deep	9.38	0	0	0	0	0	0	11.00	2.59
	Shallow		0	0	0	0	0	0	10	0.40
	Unknown	0	0	0	0	0	0	0		0
Small	Deep	0	0	0	0	0	0	0	0	0
	Shallow			0		0				0
	Unknown		0			0	0	0	0	0
All		5.77	0	0	0	0	0	0	6.54	0.90

Table 147.–Mean CPUE (catch per lift, including sites with zero catches) of redear sunfish in trap nets, stratified by lake size, depth, and management unit. Trap nets were not used in Western Lake Superior.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0			0	0	0	0
	Shallow	0		0			0	0		0
Medium	Deep	7.92	0			0	0	2.20	11.19	3.67
	Shallow		0			0	0	0	35.33	2.52
	Unknown	7.11	0	0		0	0	1.56		1.72
Small	Deep	0	0			0	0	2.00	0	0.52
	Shallow					0			0	0
	Unknown	0	0				0	0	0	0
All		5.09	0	0		0	0	1.47	7.16	2.01

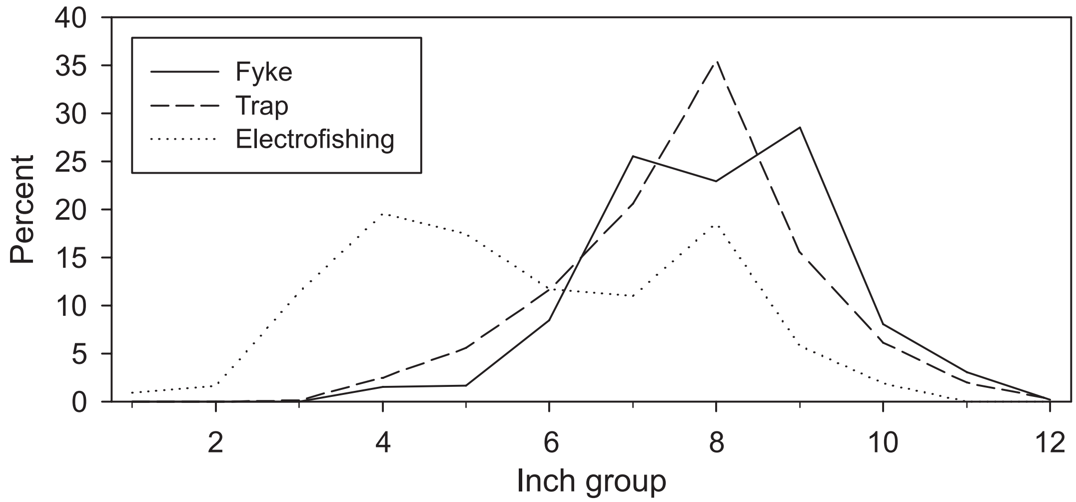


Figure 115. Distribution of redear sunfish captured in fyke nets, trap nets, and electrofishing.

Table 148.–Mean and standard error (SE) of length at age of redear sunfish, with upper and lower quartiles as indicators of typical growth range. The sample size (n) is number of lakes containing fish with the specified age class; only those age classes with more than three lakes are reported.

Age	Lower 25%	Mean	SE	Upper 75%	n
2	3.5	3.6	0.2	3.6	5
3	5.0	6.1	0.4	7.0	16
4	6.1	7.2	0.4	8.7	16
5	7.0	8.0	0.4	9.3	16
6	6.7	8.3	0.4	9.5	13
7	7.5	9.1	0.5	10.4	12
8	7.8	9.8	0.7	10.5	6

- Smallmouth bass *Micropterus dolomieu*

Smallmouth bass ranked modestly high in frequency of occurrence and were caught in 45% of all lakes sampled. Although they occurred across nearly the entire state (Figure 116), smallmouth bass were much more prevalent in the northern management units in the Lower Peninsula and in the Western Lake Superior Management Unit (Table 149). Smallmouth bass showed a clear preference for larger and deeper lakes (Table 149).

Although smallmouth bass were caught in all gears deployed (Appendix A), the vast majority were from electrofishing, trap nets, and fyke nets. For the state as a whole, the typical range of catch rates for electrofishing gear was roughly 0.1 to 0.4 fish per minute (Table 150). Catches in trap nets and fyke nets were quite similar, with typical catch rates of 0.3 to 2.7, and 0.3 to 2.2 fish per lift, respectively. Typical catch rates in gill nets were generally lower, running approximately 0.2 to 0.7 fish per lift. Typical catch rates in seine hauls were 0.5 to 1.3 fish per haul. Catch rates of smallmouth bass varied across gears, management units, lake size and lake depth (Tables 151-156). Focusing on fyke nets and trap nets (Tables 152 and 156), which provided the highest total catch, CPUE tended to be higher in larger lakes and in the northern part of the state.

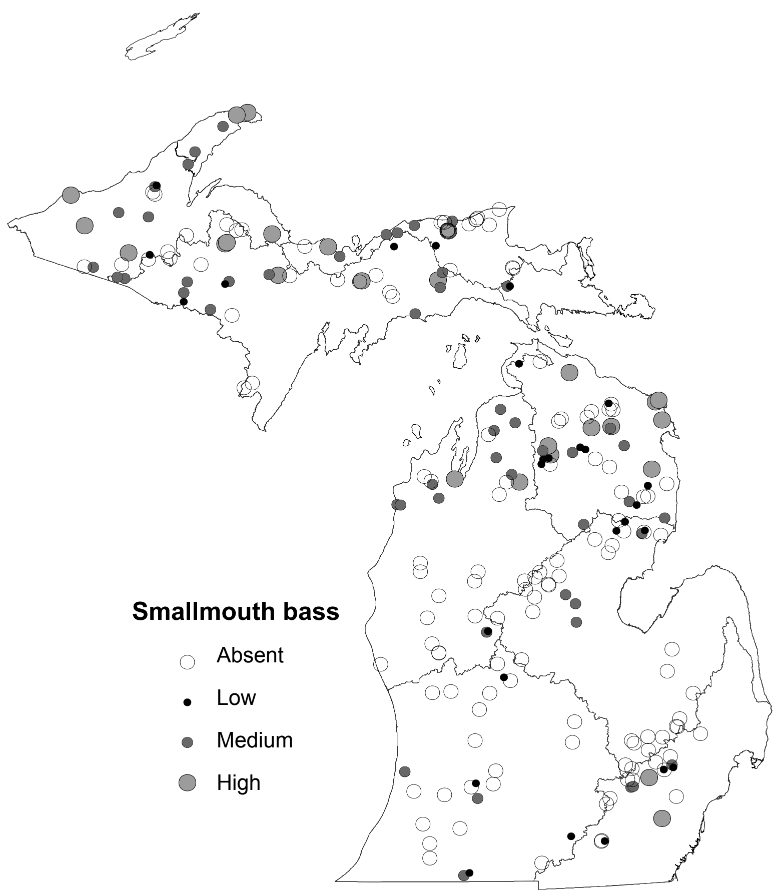


Figure 116.–Distribution and abundance of smallmouth bass collected from Status and Trends lakes.

Seines selected for the smallest smallmouth bass (Figure 117), with an average length of 2.3 inches (SE=0.4). The catch of smallmouth bass in mini fyke nets also included small fish (likely young-of-the-year or age 1+), but a second mode in the size distribution of the catch occurred between 6 and 9 inches (Figure 117). The mean size of the catch in mini fykes was 7.6 inches (SE=0.8). Electrofishing gear selected for somewhat larger fish than mini fykes (mean=8.2 inches, SE=0.4), but also captured a wide size range of individuals (Figure 117). The size distribution of catches in fyke nets, gill nets, and trap nets were similar (Figure 117) and averaged larger than the other gears, with mean size of the catch of 12.8 inches (SE=0.3), 13.7 inches (SE=0.5), and 13.6 inches (SE=0.3), respectively.

The range of typical growth for smallmouth bass was provided in Table 157. Based on the mean length at age, smallmouth bass reached the current minimum size of 14 inches between ages 4 and 5.

Table 149.–Proportion of Status and Trends lakes containing smallmouth bass, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.67	1.00	1.00		1.00	1.00	1.00	0.92
	Shallow	1.00		1.00	0.67		1.00	0.33		0.80
Medium	Deep	0.43	0.64	1.00	0.88	1.00	0.93	0.21	0.67	0.65
	Shallow		0.75	0.40	0.50	0.50	0.33	0.50	0	0.48
	Unknown	0	0.33	0.50	1.00	0	0.80	0		0.36
Small	Deep	0	0	0.11	0	0.25	0.29	0	0.20	0.10
	Shallow			0		0			0	0
	Unknown	0	0			0.25	0.13	0	0	0.10
All		0.27	0.43	0.52	0.71	0.42	0.63	0.19	0.42	0.45

Table 150.–Summary of catch per unit effort of smallmouth bass by gear, including only sites and gears with catches greater than zero. Catch per unit effort for electrofishing is number of fish per minute. Catch per unit effort for fyke net, gill net, mini fyke, and trap net is number of fish per lift. Catch per unit effort for seining is number of fish per haul. Number of lakes with positive catches for each gear is denoted by n.

Gear	Low	Typical range					High	Maximum	n
		25^{th}		Median		75^{th}			
Electrofishing	<0.08	0.08	to	0.27	to	0.40	>0.40	2.57	67
Fyke net	<0.33	0.33	to	0.77	to	2.25	>2.25	12.80	85
Gill net	<0.17	0.17	to	0.25	to	0.67	>0.67	3.50	37
Mini fyke	<0.25	0.25	to	0.50	to	1.00	>1.00	5.33	19
Seine	<0.50	0.50	to	1.00	to	1.33	>1.33	8.00	14
Trap net	<0.33	0.33	to	1.11	to	2.67	>2.67	47.00	61

Table 151.–Mean CPUE (catch per minute, including sites with zero catches) smallmouth bass in electrofishing surveys, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.13	0.69	0.52		0.27	0.27	2.57	0.62
	Shallow	0.16		0.52	0.12		0.28	0.05		0.25
Medium	Deep	0.04	0.22	0.40	0.39	0.32	0.29	0.02	0.31	0.20
	Shallow		0.14	0.04	0	0		0.09	0	0.06
	Unknown	0	0.01	0.24	0.08	0	0	0		0.06
Small	Deep	0	0	0.06	0		0	0	0	0.01
	Shallow									
	Unknown	0	0			0.28	0	0		0.04
All		0.03	0.13	0.27	0.26	0.22	0.19	0.03	0.45	0.16

Table 152.–Mean CPUE (catch per lift, including sites with zero catches) of smallmouth bass in fyke nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.60	1.27	1.53		6.60	1.13	0	1.60
	Shallow	0.50		1.10	0.72		2.93	0.08		1.41
Medium	Deep	0.21	1.12	3.02	1.35	1.18	1.93	0.04	1.28	1.23
	Shallow		0.57	0.23	1.31	0.29	0	0.21	0	0.51
	Unknown	0	0.04	1.34	2.22	0	1.04	0		0.68
Small	Deep	0	0	0.05	0	0.04	0.74	0	0	0.15
	Shallow			0		0				0
	Unknown		0			2.38	0.04	0	0	0.55
All		0.17	0.45	0.96	1.22	0.85	1.37	0.09	0.68	0.81

Table 153.–Mean CPUE (catch per lift, including sites with zero catches) of smallmouth bass in gill nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LHN	LHS	LSE	LE	All
Large	Deep		0.02	0	0.30	0	0.33		0.25	0.15
	Shallow	0.19		0	0.51	0.15	0.13			0.20
Medium	Deep	0.06	0.26	0.09	0.15	0.08	0.11	0.23	0.07	0.12
	Shallow		0	0.88	0	0	0	0	0	0.15
	Unknown	0	0	0.13	0	0.09	0			0.05
Small	Deep	0	0	0	0	0	0	0	0	0
	Shallow			0					0	0
	Unknown	0	0			0.04	0	0	0	0.02
All		0.04	0.10	0.16	0.16	0.06	0.06	0.11	0.05	0.09

Table 154.–Mean CPUE (catch per lift, including sites with zero catches) of smallmouth bass in mini fyke nets, stratified by lake size, depth, and management unit. Mini fyke nets were not used in Southern Lake Huron.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.50	0	0.06		2.00			0.53
	Shallow				0.21		1.38			0.94
Medium	Deep	0		0	0.15		0.22		0	0.15
	Shallow		0	0	0		0			0
	Unknown	0	0	0.17	0	0	0.06			0.06
Small	Deep	0	0	0	0	0.13	0.25		0	0.08
	Shallow			0		0			0	0
	Unknown					0	0		0	0
All		0	0.10	0.02	0.09	0.05	0.34		0	0.15

Table 155.–Mean CPUE (catch per haul, including sites with zero catches) of smallmouth bass in seines, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0.25			0	0	0.09
	Shallow	0		0	0		0	0		0
Medium	Deep	0.04	0.90	0.17	0	0	0	0	1.16	0.31
	Shallow		0.50	0	0	0	0	0	0	0.06
	Unknown	0	4.00	0	0	0		0		0.57
Small	Deep	0	0	0	0	0	0	0	0.05	0.01
	Shallow			0		0			0	0
	Unknown	0	0			0.33	0	0	0	0.09
All		0.02	0.86	0.03	0.05	0.06	0	0	0.56	0.19

Table 156.–Mean CPUE (catch per lift, including sites with zero catches) of smallmouth bass in trap nets, stratified by lake size, depth, and management unit. Trap nets were not used in Western Lake Superior.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.16	1.19			13.37	3.00	0	3.00
	Shallow	2.25		0.98			2.03	0.03		1.31
Medium	Deep	0.04	1.71			0.64	2.16	0.04	0.60	0.86
	Shallow		1.74			0.81	0.08	0.81	0	0.86
	Unknown	0	0.83	0.08		0	1.24	0		0.50
Small	Deep	0	0			1.00	0.67	0	0	0.15
	Shallow					0			0	0
	Unknown	0	0				0	0	0	0
All		0.11	1.12	0.81		0.62	1.65	0.19	0.28	0.73

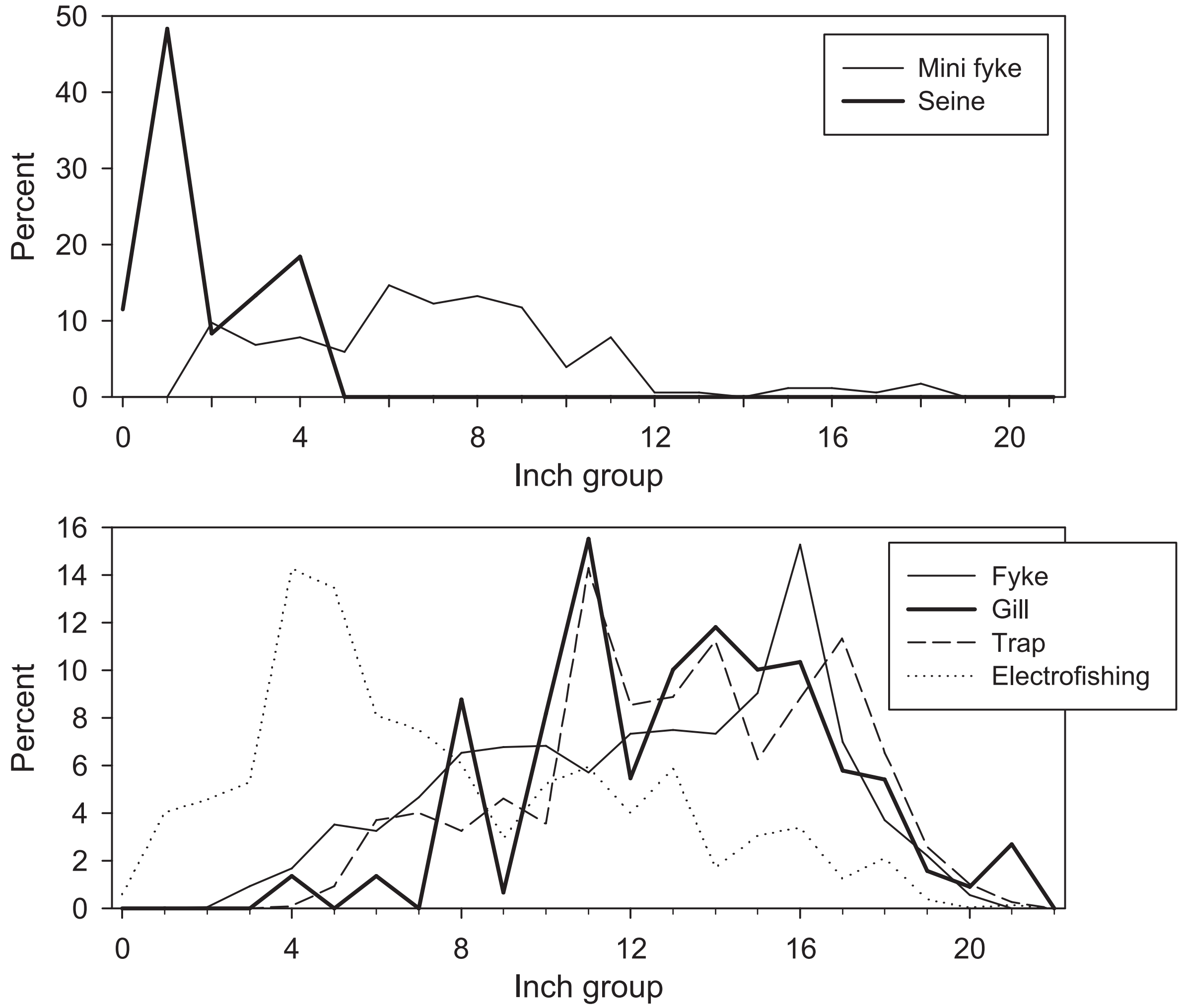


Figure 117.–Size distribution of smallmouth bass captured in different gear types.

Table 157.–Mean and standard error (SE) of length at age of smallmouth bass, with upper and lower quartiles as indicators of typical growth range. The sample size (n) is number of lakes containing fish with the specified age class; only those age classes with more than three lakes are reported.

Age	Lower 25%	Mean	SE	Upper 75%	n
1	4.2	5.0	0.2	5.3	33
2	6.7	7.5	0.2	8.6	67
3	9.1	10.4	0.2	11.7	75
4	11.6	12.7	0.2	13.6	70
5	13.5	14.5	0.2	15.6	70
6	15.1	15.6	0.2	16.7	63
7	15.7	16.6	0.2	17.6	52
8	16.4	17.2	0.2	18.1	33
9	17.4	17.9	0.2	18.7	29
10	18.3	18.9	0.3	19.6	20
11	17.4	18.8	0.6	20.0	7
12	16.7	18.4	1.0	20.1	4

- Largemouth bass *Micropterus salmoides*

Largemouth bass were among the most widely distributed species in the state and were caught in 82% of all lakes sampled. They were found in all regions except for the counties bordering the south shore of Lake Superior (Figure 118). Largemouth bass occurred in nearly equal percentages across all lake size and depth groups sampled, and across most management units except for the Lake Superior Basin (Table 158).

Largemouth bass were caught in all gears deployed (Appendix A) but the greatest numbers were caught by electrofishing. Trap nets, fyke nets and mini fyke nets also caught large numbers of largemouth bass. For the state as a whole, the typical range of catch rates for electrofishing gear was 0.4 to 1.6 fish per minute (Table 159). Trap net catch rates were generally higher than for other fixed gear, with a typical range of 1 to 5 fish per lift. Typical catch rates in fyke nets, gill nets, and mini fyke nets were similar, running approximately 0.5 to 2 fish per lift. Typical catch rates in seine hauls were 0.25 to 1 fish per haul. Catch rates of largemouth bass varied across gears, management units, lake size and lake depth (Tables 160-165). Focusing on electrofishing (Table 160), which provided the highest total catch, CPUE tended to be higher in smaller lakes and in the southern part of the state.

Seines selected for the smallest largemouth bass (Figure 119), with an average length of 3.3 inches (SE=0.2). The catch of largemouth bass in mini fyke nets also included small fish (likely young-of-the-year or age 1+), but a second mode in the size distribution of the catch occurred around 11 inches (Figure 119). The mean size of the catch in mini fykes was 6.7 inches (SE=1.0). Electrofishing gear selected for somewhat larger fish than mini fykes (mean=8.9 inches, SE=0.2), but also captured a wide size range of individuals. The size distribution of catches in fyke nets, gill nets, and trap nets were similar (Figure 119) and averaged larger than the other gears, with mean size of the catch of 11.9 inches (SE=0.3), 12.0 inches (SE=0.3), and 12.4 inches (SE=0.2), respectively.

The range of typical growth for largemouth bass was provided in Table 166. Based on the mean length at age, largemouth bass reached the current minimum size of 14 inches by age 6.

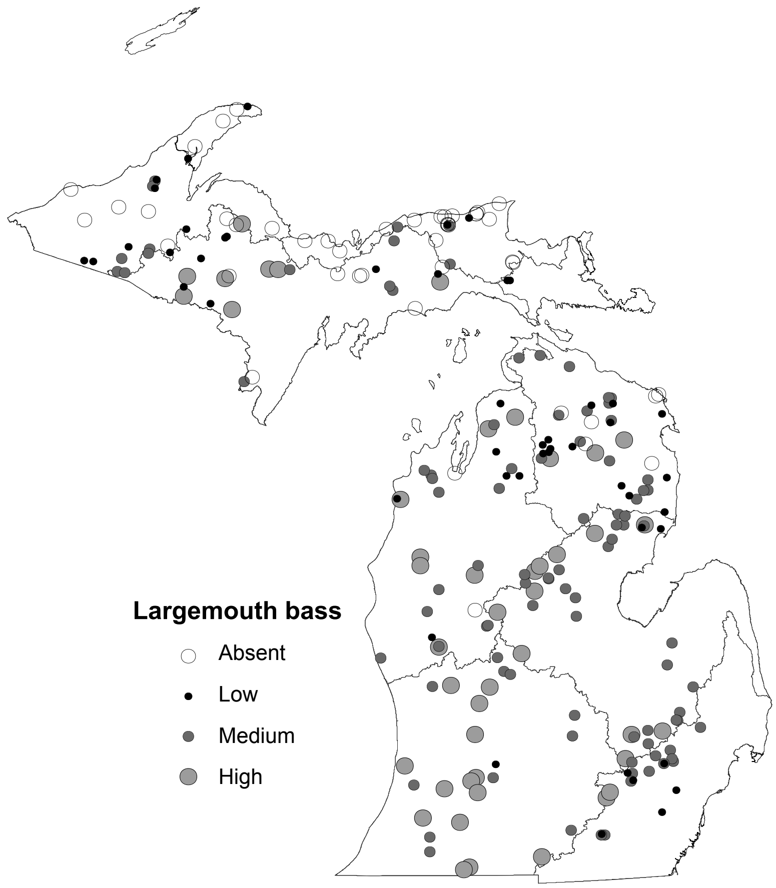


Figure 118.–Distribution and abundance of largemouth bass collected from Status and Trends lakes.

Table 158.–Proportion of Status and Trends lakes containing largemouth bass, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.00	0.50	0.50		0	1.00	1.00	0.67
	Shallow	1.00		1.00	0.33		0.80	1.00		0.80
Medium	Deep	1.00	0.91	0.60	0.88	0.20	0.79	1.00	1.00	0.86
	Shallow		1.00	0.80	0.67	0.50	1.00	1.00	1.00	0.84
	Unknown	1.00	1.00	1.00	0	0	1.00	1.00		0.86
Small	Deep	1.00	0.86	0.56	0.50	0.50	1.00	1.00	1.00	0.83
	Shallow			0		0			1.00	0.25
	Unknown	1.00	1.00			0	0.88	1.00	1.00	0.75
All		1.00	0.93	0.69	0.63	0.21	0.86	1.00	1.00	0.82

Table 159.–Summary of catch per unit effort of largemouth bass by gear, including only sites and gears with catches greater than zero. Catch per unit effort for electrofishing is number of fish per minute. Catch per unit effort for fyke net, gill net, mini fyke, and trap net is number of fish per lift. Catch per unit effort for seining is number of fish per haul. Number of lakes with positive catches for each gear is denoted by n.

		Typical range							
Gear	Low	25^{th}		Median		75^{th}	High	Maximum	n
Electrofishing	<0.37	0.37	to	0.73	to	1.57	>1.57	6.76	136
Fyke net	<0.44	0.44	to	1.39	to	2.75	>2.75	20.80	130
Gill net	<0.50	0.50	to	1.00	to	1.89	>1.89	13.50	93
Mini fyke	<0.50	0.50	to	1.00	to	2.00	>2.00	1,000	27
Seine	<0.25	0.25	to	0.50	to	1.00	>1.00	13.75	62
Trap net	<1.11	1.11	to	2.78	to	4.67	>4.67	34.67	137

Table 160.–Mean CPUE (catch per minute, including sites with zero catches) largemouth bass in electrofishing surveys, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.87	0.16	0.01		0	0.03	0.53	0.24
	Shallow	0.84		0.18	0.01		0.16	0.87		0.32
Medium	Deep	1.36	0.58	0.91	0.50	0.27	0.37	0.89	0.67	0.80
	Shallow		0.06	1.32	0.21	0.83		1.00	1.67	0.72
	Unknown	2.22	0.93	0.91	0	0	0.03	1.58		1.08
Small	Deep	2.41	2.04	1.03	0.10		0.56	1.91	1.57	1.71
	Shallow									
	Unknown	0.41	4.97			0	1.60	0.87		1.30
All		1.58	0.99	0.87	0.24	0.27	0.36	1.17	0.82	0.91

Table 161.–Mean CPUE (catch per lift, including sites with zero catches) of largemouth bass in fyke nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.15	0	0.02		0	0.38	0.08	0.26
	Shallow	10.50		0.37	0		0.25	0.28		0.95
Medium	Deep	6.06	1.46	0.70	0.63	0.32	0.58	1.61	2.64	1.76
	Shallow		1.56	4.17	0.14	0.04	3.59	3.13	0	2.05
	Unknown	8.46	1.25	2.21	0	0	0.88	0.29		1.81
Small	Deep	3.44	1.68	1.06	0.06	1.13	2.12	5.54	2.17	2.20
	Shallow			0		0				0
	Unknown		3.72			0	1.52	2.67	0.50	1.44
All		6.37	1.68	1.55	0.25	0.33	1.20	2.49	1.91	1.69

Table 162.–Mean CPUE (catch per lift, including sites with zero catches) of largemouth bass in gill nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.06	0	0		0	0.33	0	0.04
	Shallow	0.42		0	0		0.06	0.08		0.06
Medium	Deep	1.97	0.49	0.53	0.25	0	0.15	0.24	0.81	0.63
	Shallow		0.25	1.19	0	0	0.58	1.19	10.50	0.95
	Unknown	1.96	0	0.89	0		0.20	0.83		0.72
Small	Deep	0.85	0.65	0.50	0	0	1.07	0.53	0.20	0.57
	Shallow			0					2.00	1.00
	Unknown	0	2.90			0	0.46	6.75	0	1.35
All		1.50	0.60	0.55	0.09	0	0.38	0.85	1.10	0.66

Table 163.–Mean CPUE (catch per lift, including sites with zero catches) of largemouth bass in mini fyke nets, stratified by lake size, depth, and management unit. Mini fyke nets were not used in Southern Lake Huron.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.25	0	0		0			0.05
	Shallow				0		0.08			0.05
Medium	Deep	0		0	0.08		0.08		1.50	0.12
	Shallow		1.00	16.49	0		0.17			5.31
	Unknown	0	14.50	0.17	0	0	0.13			1.29
Small	Deep	0	250	0.41	0	0.25	166.75		0.38	50.25
	Shallow			0		0			1.50	0.38
	Unknown					0	3.55		0	2.18
All		0	53.35	3.92	0.03	0.09	26.44		0.56	12.76

Table 164.–Mean CPUE (catch per haul, including sites with zero catches) of largemouth bass in seines, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.44	0	0			0	0	0.12
	Shallow	0		0.06	0		0	0.23		0.07
Medium	Deep	0.60	0.30	0	1.61	0	0	0.08	0.15	0.39
	Shallow		0.63	3.44	0.19	0	3.67	0.15	0.33	1.13
	Unknown	0.67	2.00	0.08	0	0		0.50		0.59
Small	Deep	0.33	1.83	2.07	0.17	0	0	0.14	0.10	0.56
	Shallow			0		0			0	0
	Unknown	0.33	0			0	0	0.75	0.50	0.29
All		0.51	0.72	1.07	0.67	0	0.46	0.20	0.17	0.47

Table 165.–Mean CPUE (catch per lift, including sites with zero catches) of largemouth bass in trap nets, stratified by lake size, depth, and management unit. Trap nets were not used in Western Lake Superior.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.32	0			0	2.25	0.42	0.52
	Shallow	10.75		2.33			0.87	1.57		2.23
Medium	Deep	4.71	2.59			0.22	1.68	3.98	2.87	3.00
	Shallow		3.15			0.17	4.34	10.44	25.67	6.67
	Unknown	4.89	2.83	0.25		0	1.24	1.19		1.97
Small	Deep	3.95	2.47			0	2.93	7.48	6.50	4.60
	Shallow					0			26.50	13.25
	Unknown	2.75	3.00				1.87	6.33	3.11	2.97
All		4.64	2.42	1.23		0.13	1.84	5.05	6.17	3.49

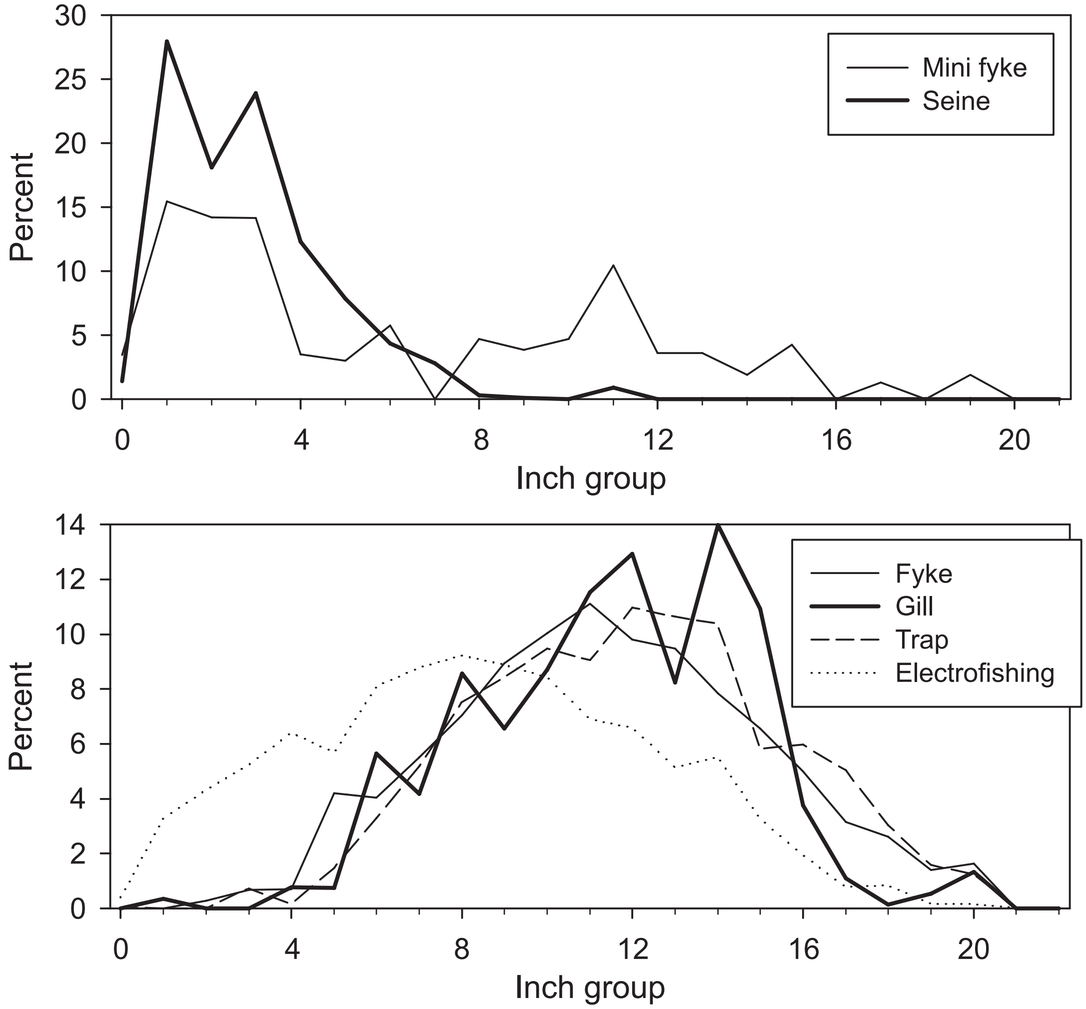


Figure 119.–Size distribution of largemouth bass captured in different gear types.

Table 166.–Mean and standard error (SE) of length at age of largemouth bass, with upper and lower quartiles as indicators of typical growth range. The sample size (n) is number of lakes containing fish with the specified age class; only those age classes with more than three lakes are reported.

Age	Lower 25%	Mean	SE	Upper 75%	n
0	1.4	2.6	0.5	3.6	7
1	3.7	4.6	0.2	5.4	74
2	6.6	7.5	0.1	8.2	128
3	8.5	9.7	0.1	10.6	151
4	10.2	11.5	0.1	12.7	153
5	11.8	13.0	0.1	14.1	150
6	13.2	14.1	0.1	15.2	135
7	14.2	15.3	0.1	16.4	116
8	15.4	16.3	0.1	17.3	100
9	16.0	17.4	0.2	18.5	67
10	17.4	18.3	0.2	19.5	53
11	18.4	19.0	0.2	19.7	29
12	18.5	19.3	0.3	19.7	19
13	19.9	20.3	0.4	20.4	5

- White crappie *Pomoxis annularis*

White crappies were uncommon and occurred in only five lakes (about 2% of lakes sampled; Figure 120), primarily within the Southern Lake Huron and Lake Erie management units. Too few white crappies were caught to characterize typical catch rates or size distribution of this species.

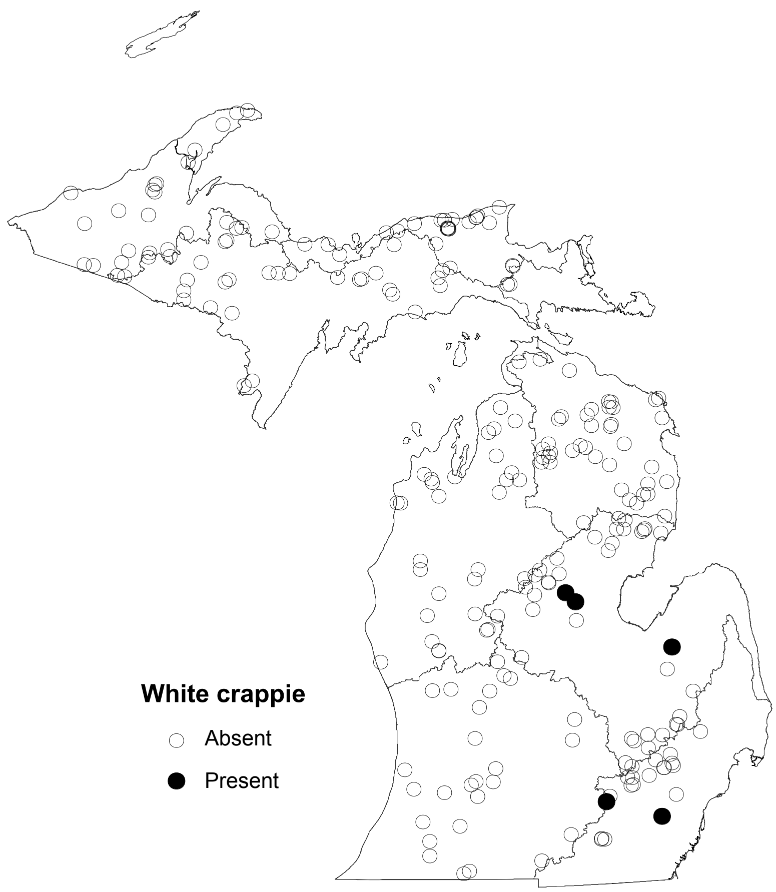


Figure 120.–Distribution of white crappies collected from Status and Trends lakes.

- Black crappie *Pomoxis nigromaculatus*

Black crappies were somewhat less common than bluegills and pumpkinseeds being caught in 63% of all lakes sampled. Black crappies occurred across the entire state, but were somewhat less prevalent in the northern Lower Peninsula and the eastern Upper Peninsula (Figure 121; Table 167). Black crappies did not show a clear preference for particular lake sizes or depth classes (Table 167).

Black crappies were caught in all gears deployed (Appendix A), but the vast majority were caught by trap and fyke nets. For the state as a whole, the typical range of catch rates for electrofishing gear was very low at 0.03 to 0.2 fish per minute (Table 168). Catch rates in trap nets were roughly double that in fyke nets, with typical ranges of 1 to 12 fish per lift and 0.7 to 5 fish per lift, respectively. Catches in gill nets occurred frequently, with typical catch rates of 0.3 to 1.75 fish per lift. Black crappies were infrequently caught in mini fyke nets (14 lakes) and seines (3 lakes), and as such typical catch rates were not determined. Catch rates of black crappies varied across gears, management units, lake size and lake depth (Tables 169-174). Patterns in CPUE in fyke and trap nets (Tables 170 and 174), which provided the highest total catch, indicated generally higher abundance in larger lakes, and in lakes in the Upper Peninsula.

Too few black crappies were caught in seines to reliably characterize the size composition of the catch in this gear. Mini fyke nets and electrofishing caught relatively small fish (Figure 122), averaging 7.4 inches (SE=0.8) and 6.9 inches (SE=0.3). Gill nets caught fish in a similar size range as these gears, with an average length of 7.5 inches (SE=0.2). The size distribution of catches in trap nets and fyke nets were similar (Figure 122) and averaged larger than the other gears, with a mean size of the catch of 8.8 inches (SE=0.1, SE=0.2) for both gears.

The range of typical growth for black crappie was provided in Table 175. Based on the mean length at age, black crappie reached a size of 8 inches between ages 3 and 4.

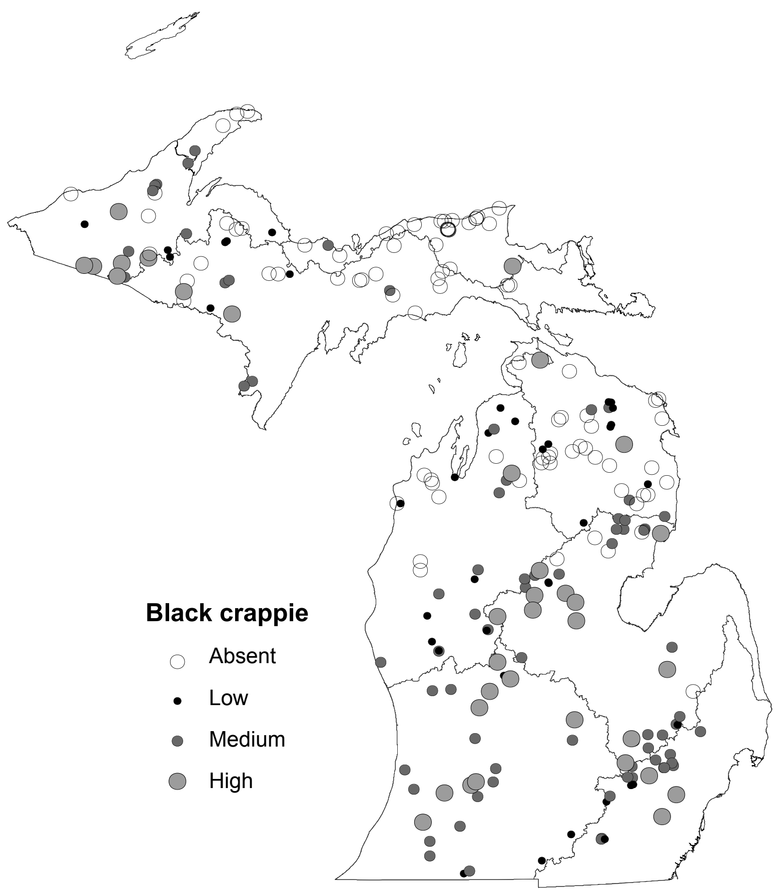


Figure 121.–Distribution and abundance of black crappies collected from Status and Trends lakes.

Table 167.–Proportion of Status and Trends lakes containing black crappie, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.67	0.50	0.75		0	1.00	1.00	0.67
	Shallow	1.00		0.33	1.00		0.60	1.00		0.73
Medium	Deep	1.00	0.73	0.20	0.63	0.20	0.36	0.86	1.00	0.69
	Shallow		0.75	0.60	0.67	0	1.00	1.00	1.00	0.72
	Unknown	1.00	1.00	0.50	1.00	0	0.40	1.00		0.68
Small	Deep	1.00	0.71	0.33	0.50	0	0.14	0.63	1.00	0.54
	Shallow			0		0.50			1.00	0.50
	Unknown	1.00	0			0	0.25	1.00	1.00	0.40
All		1.00	0.70	0.38	0.71	0.11	0.37	0.86	1.00	0.63

Table 168.–Summary of catch per unit effort of black crappie by gear, including only sites and gears with catches greater than zero. Catch per unit effort for electrofishing is number of fish per minute. Catch per unit effort for fyke net, gill net, and trap net is number of fish per lift. Number of lakes with positive catches for each gear is denoted by n.

		Typical range							
Gear	Low	25th		Median		75th	High	Maximum	n
Electrofishing	<0.03	0.03	to	0.05	to	0.20	>0.2	0.87	58
Fyke net	<0.67	0.67	to	2.80	to	5.31	>5.31	34.56	94
Gill net	<0.29	0.29	to	0.75	to	1.75	>1.75	26.33	69
Trap net	<1.22	1.22	to	4.33	to	11.78	>11.78	159.58	109

Table 169.–Mean CPUE (catch per minute, including sites with zero catches) black crappie in electrofishing surveys, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.02	0	0.22		0	0.37	0	0.12
	Shallow	0.01		0.04	0.02		0.02	0.03		0.03
Medium	Deep	0.02	0.02	0.01	0.06	0.01	0.01	0.01	0.03	0.02
	Shallow		0.09	0.13	0.25	0		0.10	0	0.13
	Unknown	0.02	0.21	0	0.80	0	0	0.10		0.11
Small	Deep	0.05	0.03	0	0		0	0.11	0.10	0.05
	Shallow									
	Unknown	0.10	0			0	0	0		0.03
All		0.03	0.05	0.03	0.16	0.01	0.01	0.06	0.03	0.06

Table 170.–Mean CPUE (catch per lift, including sites with zero catches) of black crappie in fyke nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0.01	0.87		0	14.50	4.92	2.09
	Shallow	8.25		0	1.20		6.97	2.11		3.79
Medium	Deep	2.68	0.02	1.06	2.18	0.05	0.04	1.35	3.22	1.32
	Shallow		2.95	1.44	7.35	0	0.33	12.17	0	4.51
	Unknown	2.54	4.03	2.07	12.89	0	0.14	2.79		2.35
Small	Deep	1.56	0.28	1.86	0.03	0	0	2.83	2.86	1.21
	Shallow			0		5.44				3.63
	Unknown		0			0	1.34	1.17	15.33	2.43
All		2.92	1.12	1.34	3.40	0.59	1.11	3.95	4.66	2.18

Table 171.–Mean CPUE (catch per lift, including sites with zero catches) of black crappie in gill nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.11	0	0		0	1.00	4.50	0.57
	Shallow	0.04		0	0.10		0.18	2.88		0.50
Medium	Deep	1.42	0.30	0.10	0.09	0	0.01	0.89	1.18	0.60
	Shallow		0	0.09	0.29	0	0	1.88	3.50	0.55
	Unknown	11.36	0.08	0	0		0.04	1.17		2.11
Small	Deep	0.99	0.02	0.09	0	0	0	0.31	0.50	0.25
	Shallow			0					0	0
	Unknown	0	0			0	0.37	1.25	0	0.32
All		2.30	0.13	0.06	0.12	0	0.10	1.04	1.11	0.61

Table 172.–Mean CPUE (catch per lift, including sites with zero catches) of black crappie in mini fyke nets, stratified by lake size, depth, and management unit. Mini fyke nets were not used in Southern Lake Huron.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0		0			0
	Shallow				0		0.87			0.54
Medium	Deep	0		0	0.03		0.08		1.50	0.11
	Shallow		3.50	1.24	0.08		0			0.86
	Unknown	0	1.50	0	0	0	0			0.13
Small	Deep	0	0	0	0	0	0		0.25	0.04
	Shallow			0		0			0	0
	Unknown					0	0		2.00	0.31
All		0	1.70	0.28	0.04	0	0.14		0.81	0.25

Table 173.–Mean CPUE (catch per haul, including sites with zero catches) of black crappie in seines, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0			0	0	0
	Shallow	0		0	0		0	0		0
Medium	Deep	0	0	0	0.06	0	0	0	0	0.01
	Shallow		0	0	0	0	0	0	0	0
	Unknown	0	0	0	0	0		0.06		0.02
Small	Deep	0.07	0	0	0	0	0	0	0	0.01
	Shallow			0		0			0	0
	Unknown	0	0			0	0	0	0	0
All		0.01	0	0	0.02	0	0	0.01	0	0.01

Table 174.–Mean CPUE (catch per lift, including sites with zero catches) of black crappie in trap nets, stratified by lake size, depth, and management unit. Trap nets were not used in Western Lake Superior.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.55	0			0	25.13	6.75	4.79
	Shallow	0.75		0			22.09	11.84		13.34
Medium	Deep	7.00	0.92			0.11	0.25	10.20	4.44	4.46
	Shallow		7.65			0	0.41	26.68	0.67	9.94
	Unknown	61.36	2.46	0		0	0.22	21.67		17.30
Small	Deep	9.59	2.63			0	0.03	12.57	13.18	7.74
	Shallow					12.00			7.25	9.63
	Unknown	12.19	0				2.36	3.67	27.56	7.77
All		14.03	2.39	0		1.14	3.44	14.02	9.25	7.82

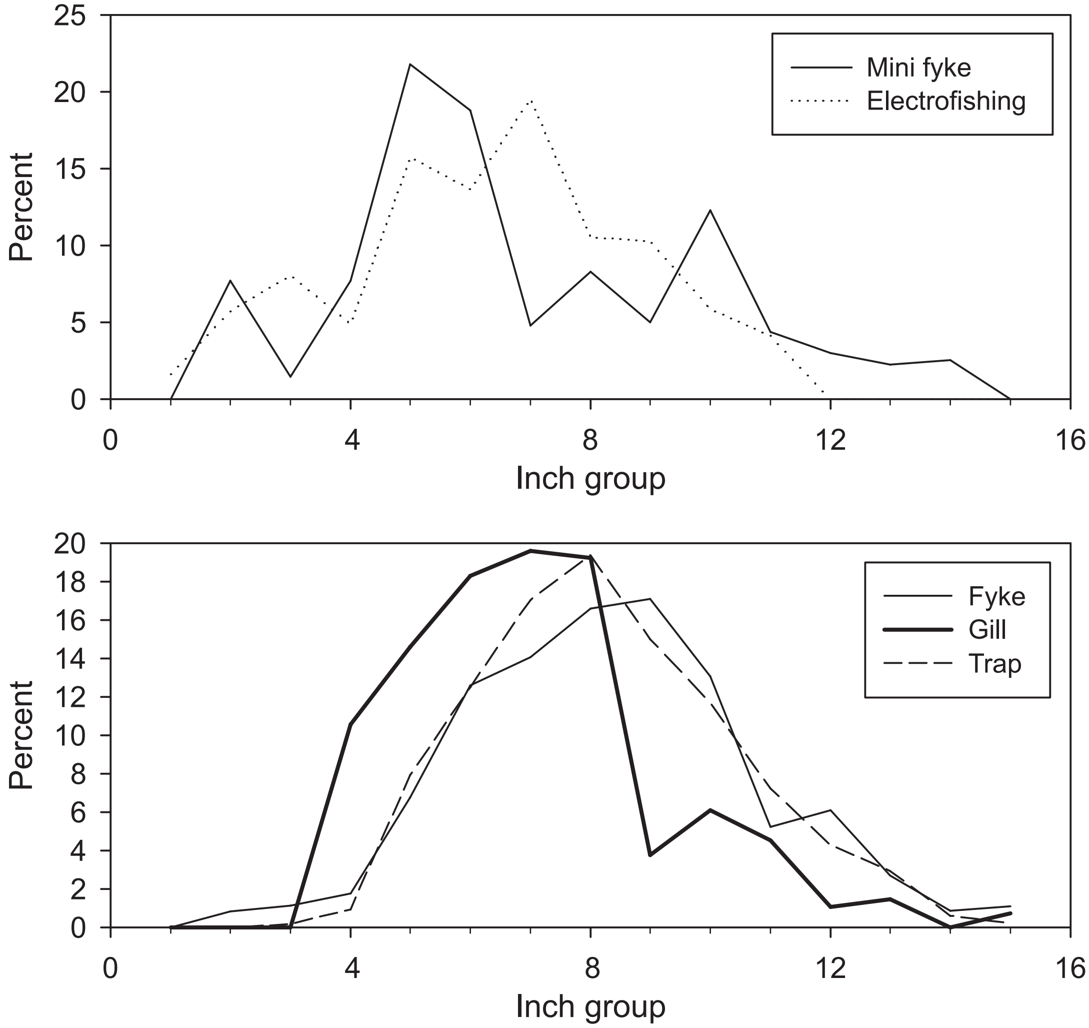


Figure 122.–Size distribution of black crappies captured in different gear types.

Table 175.–Mean and standard error (SE) of length at age of black crappie, with upper and lower quartiles as indicators of typical growth range. The sample size (n) is number of lakes containing fish with the specified age class; only those age classes with more than three lakes are reported.

Age	Lower 25%	Mean	SE	Upper 75%	n
0	2.5	2.7	0.2	2.8	2
1	3.6	4.5	0.2	5.3	26
2	5.6	6.2	0.1	6.9	77
3	6.7	7.7	0.1	8.7	100
4	8.0	8.9	0.1	9.8	104
5	8.8	9.7	0.1	10.7	103
6	9.4	10.4	0.1	11.3	93
7	10.5	11.2	0.2	11.9	74
8	11.0	11.8	0.2	12.7	57
9	11.3	12.1	0.2	12.8	32
10	11.9	12.6	0.2	13.1	26
11	12.2	13.2	0.4	14.1	15
12	12.3	13.0	0.4	13.9	8

Percidae

- Greenside darter *Etheostoma blennioides*

Greenside darters were caught in only three lakes (about 1% of lakes sampled; Figure 123). Too few greenside darters were caught to characterize typical catch rates or size distribution of this species.

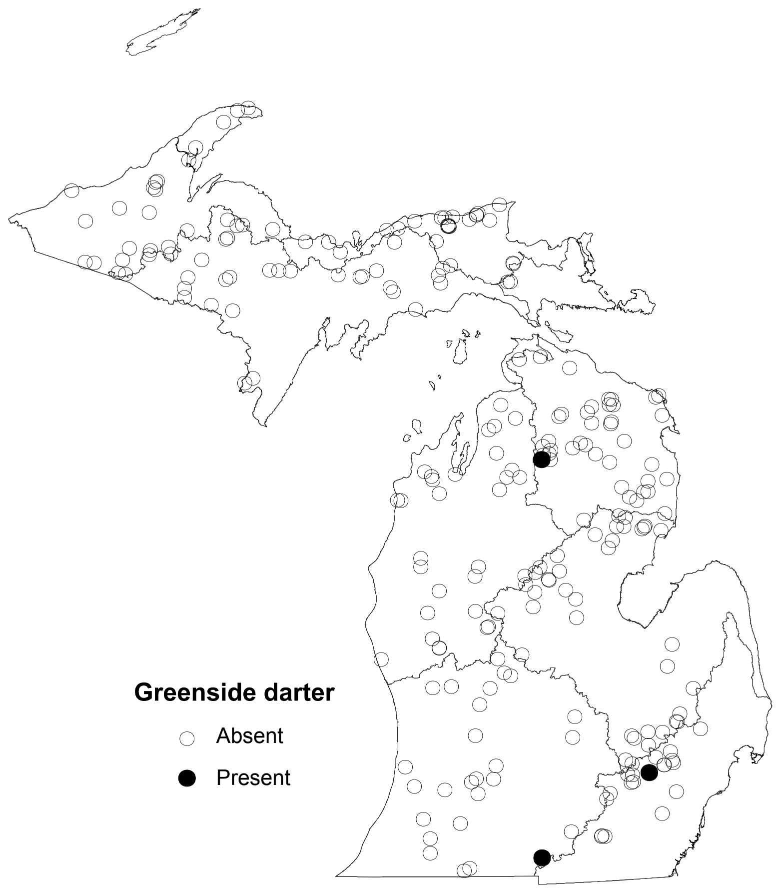


Figure 123.–Distribution of greenside darters collected from Status and Trends lakes.

- Rainbow darter *Etheostoma caeruleum*

Rainbow darters were caught in only 4% of lakes sampled (Figure 124; Table 176), scattered broadly around the Lower Peninsula. Too few rainbow darters were caught to characterize typical catch rates or size distribution of this species.

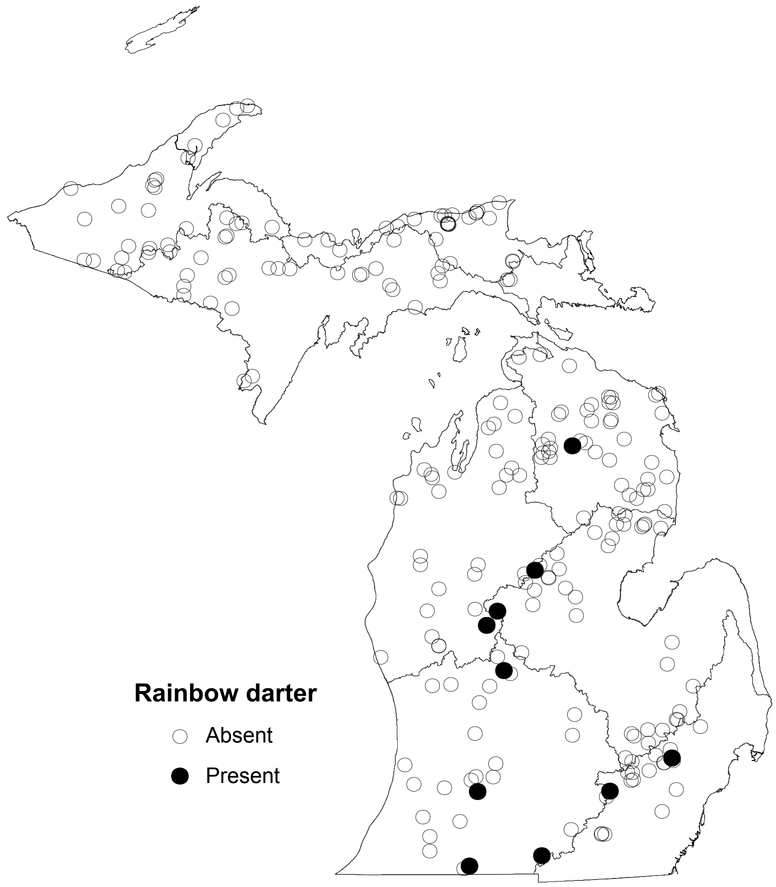


Figure 124.–Distribution of rainbow darters collected from Status and Trends lakes.

Table 176.–Proportion of Status and Trends lakes containing rainbow darter, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0		0	0	0	0
	Shallow	1.00		0	0		0	0.33		0.13
Medium	Deep	0.14	0.09	0	0	0	0.07	0.07	0.11	0.08
	Shallow		0	0	0	0	0	0	0	0
	Unknown	0	0	0	0	0	0	0		0
Small	Deep	0.17	0	0	0	0	0	0	0	0.02
	Shallow			0		0			1.00	0.25
	Unknown	0	0			0	0	0	0	0
All		0.15	0.03	0	0	0	0.02	0.06	0.11	0.04

- Iowa darter *Etheostoma exile*

Iowa darters were caught in 22% of all lakes sampled. Iowa darters were widely distributed across the entire state (Figure 125) but occurred less frequently in Lake Superior management units (Table 177). Iowa darters did not show any specific habitat preference but appeared to be somewhat more prevalent in smaller lakes (Table 177).

The majority of Iowa darters were caught by seines, with typical catch rates of 0.3 to 3 fish per haul. Catches in other gears were too infrequent to determine typical catch rates. CPUE of Iowa darters in seine nets (Table 178) was quite variable, and showed no clear pattern across lake size or regionally.

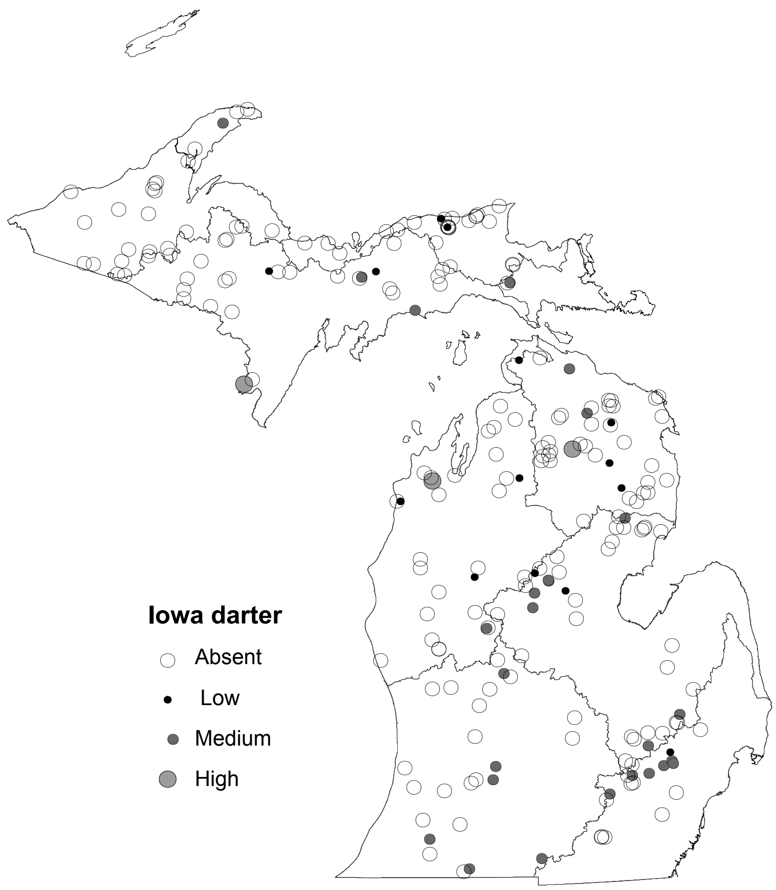


Figure 125.–Distribution and abundance of Iowa darters collected from Status and Trends lakes.

Table 177.–Proportion of Status and Trends lakes containing Iowa darter, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0.25		0	0	1.00	0.17
	Shallow	1.00		0	0		0.20	0		0.13
Medium	Deep	0.36	0.36	0.40	0	0	0.21	0.36	0.44	0.29
	Shallow		0.25	0.20	0	0	0	0.25	0	0.12
	Unknown	0	0	0	0	0.50	0.40	0.25		0.18
Small	Deep	0.17	0.14	0.33	0	0.25	0.43	0.13	0.60	0.27
	Shallow			0		0			1.00	0.25
	Unknown	0.50	0			0	0	0.50	0	0.10
All		0.31	0.20	0.21	0.04	0.11	0.21	0.25	0.47	0.22

Table 178.–Mean CPUE (catch per haul, including sites with zero catches) of Iowa darter in seines, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0			0	0.60	0.05
	Shallow	3.83		0	0		0	0		0.43
Medium	Deep	0.92	0.08	1.42	0	0	0.08	0.55	0.16	0.42
	Shallow		0	0.08	0	0	0	0	0	0.02
	Unknown	0	0	0	0	0		0.56		0.16
Small	Deep	0	0	4.67	0	0	0	0.19	4.50	1.37
	Shallow			0		0			0.33	0.11
	Unknown	0.75	0			0	0	2.00	0	0.50
All		0.72	0.04	1.17	0	0	0.04	0.45	1.31	0.51

- Fantail darter *Etheostoma flabellare*

Fantail darter is currently listed as a species of greatest conservation need within Michigan's Wildlife Action Plan. Fantail darters were caught in 2 (<1%) lakes sampled (Figure 126). Too few fantail darters were caught to characterize typical catch rates or size distribution of this species.

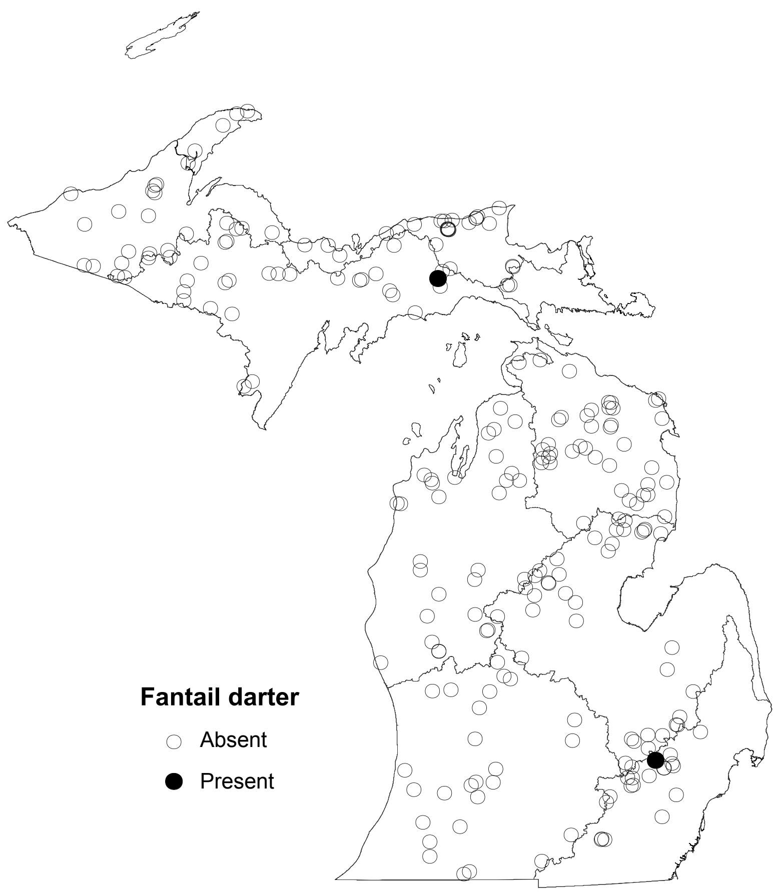


Figure 126.–Distribution of fantail darters collected from Status and Trends lakes.

- Least darter *Etheostoma microperca*

Least darter is currently listed as a species of greatest conservation need within Michigan's Wildlife Action Plan. Least darters were caught in five lakes (about 2% of lakes sampled; Figure 127). Too few least darters were caught to characterize typical catch rates or size distribution of this species.

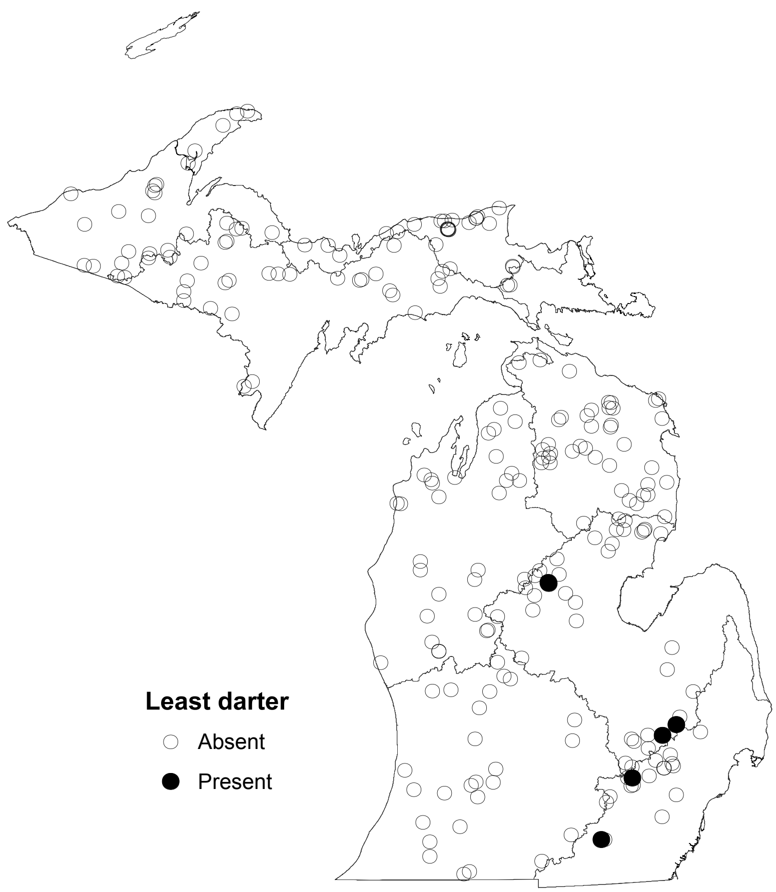


Figure 127.–Distribution of least darters collected from Status and Trends lakes.

- Johnny darter *Etheostoma nigrum*

Johnny darters were caught in 26% of all lakes sampled. Johnny darters were widely distributed across the entire state (Figure 128) and did not show any specific habitat preference, but appeared to be somewhat more prevalent in larger lakes (Table 179).

The majority of johnny darters were caught by seines, with typical catch rates of 0.3 to 2.5 fish per haul. Catches in other gears were too infrequent to determine typical catch rates. CPUE of johnny darters in seine nets (Table 180) was quite variable and showed no clear pattern across lake size or regionally.

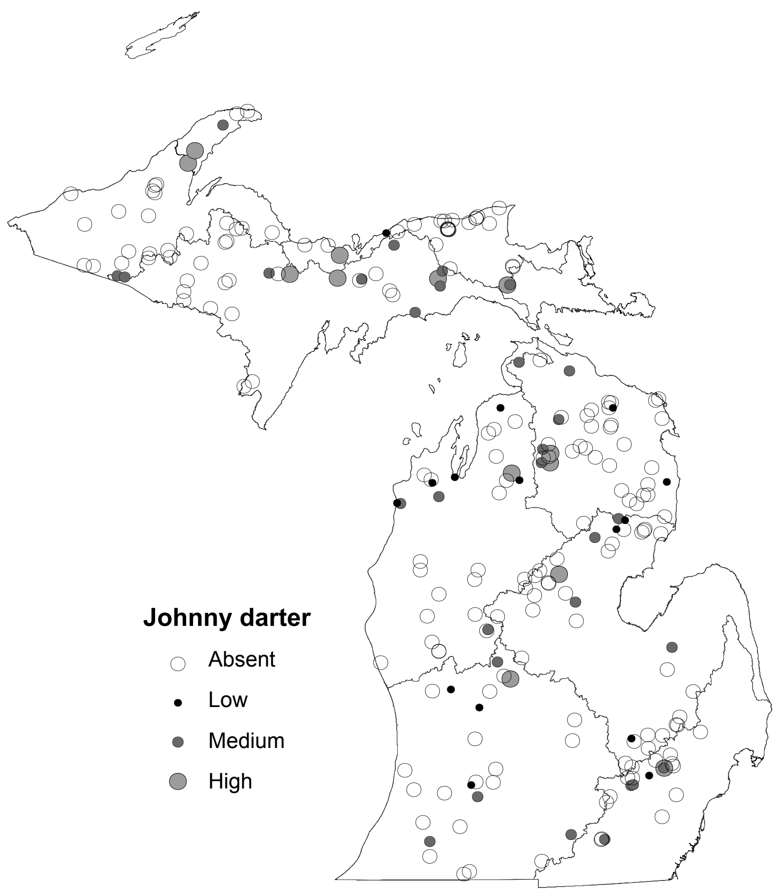


Figure 128.–Distribution and abundance of johnny darters collected from Status and Trends lakes.

Table 179.–Proportion of Status and Trends lakes containing johnny darter, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.67	0.50	0.50		0	1.00	1.00	0.58
	Shallow	1.00		0.67	0.33		0.20	0		0.33
Medium	Deep	0.29	0.55	0.40	0.25	0.40	0.29	0.36	0.33	0.35
	Shallow		0.25	0	0	0	0	0	0	0.04
	Unknown	0.33	0	0.50	0	0	0.80	0.25		0.36
Small	Deep	0.17	0	0.11	0	0	0.14	0	0.40	0.10
	Shallow			1.00		0			0	0.25
	Unknown	0.50	0			0	0.25	0	0	0.15
All		0.31	0.30	0.31	0.21	0.11	0.28	0.19	0.32	0.26

Table 180.–Mean CPUE (catch per haul, including sites with zero catches) of johnny darter in seines, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.02	0.42	0.95			0.33	0	0.46
	Shallow	1.00		0.87	1.93		0	0		0.83
Medium	Deep	0.20	0.29	1.00	0	0.79	0.78	0.35	0.52	0.39
	Shallow		0	0	0	0	0	0	0	0
	Unknown	0.17	0	1.75	0	0		0.06		0.43
Small	Deep	1.90	0	0.08	0	0	0.67	0	1.05	0.51
	Shallow			6.50		0			0	2.17
	Unknown	0.33	0			0	0	0	0	0.06
All		0.59	0.14	0.93	0.36	0.25	0.48	0.16	0.52	0.41

- Yellow perch *Perca flavescens*

Yellow perch was one of the most frequently encountered species and were caught in 96% of all lakes sampled. Yellow perch occurred across the entire state (Figure 129) but showed no patterns in distribution across lake size, depth, or region (Table 181).

Although yellow perch were caught in all gears deployed (Appendix A), the majority were caught by electrofishing and in fyke and mini fyke nets. For the state as a whole, the typical range of catch rates for electrofishing gear were 0.25 to 2.5 fish per minute. Catch rates in fyke nets were higher than in trap nets, with typical catch rates of 0.25 to 4 fish per lift for fyke nets, and 0.25 to 0.75 fish per lift in trap nets. Typical catch rates in gill nets varied widely, ranging from 0.75 to nearly 5 fish per lift. Catch rates in seine hauls also varied widely; the lower 25th percentile was 0.5 fish per haul, but the upper 75th percentile was nearly 10 fish per haul (Table 182). Catch rates of yellow perch varied across gears, management units, lake size and lake depth (Tables 183-188). Catch rates in electrofishing gear (Table 183), which provided the highest total catch, tended to be higher in larger lakes and in the northern part of the state. Catch rates in fyke nets and trap nets were highly variable among lake size and depth strata, as well as among regions.

Seines selected for the smallest yellow perch (Figure 130), with an average length of 2.9 inches (SE=0.1). The size distribution of catches of yellow perch in mini fyke nets was very similar to that in seines (Figure 130), and had a mean of 3.9 inches (SE=0.2). Electrofishing selected for smaller fish than the large-mesh passive gear (Figure 130), with a mean length of 4.6 inches (SE=0.1). The size distributions of catches in fyke nets, gill nets, and trap nets differed in the shape of their distributions (Figure 130) with the mean length being lowest in gill nets (6.6 inches (SE=0.2)), next lowest in fyke nets (7.7 inches (SE=0.2)), and largest in trap nets at 8.5 inches (SE=0.2).

The range of typical growth for yellow perch was provided in Table 189. Based on mean growth rates, yellow perch reached a size of 7 inches between ages 3 and 4.

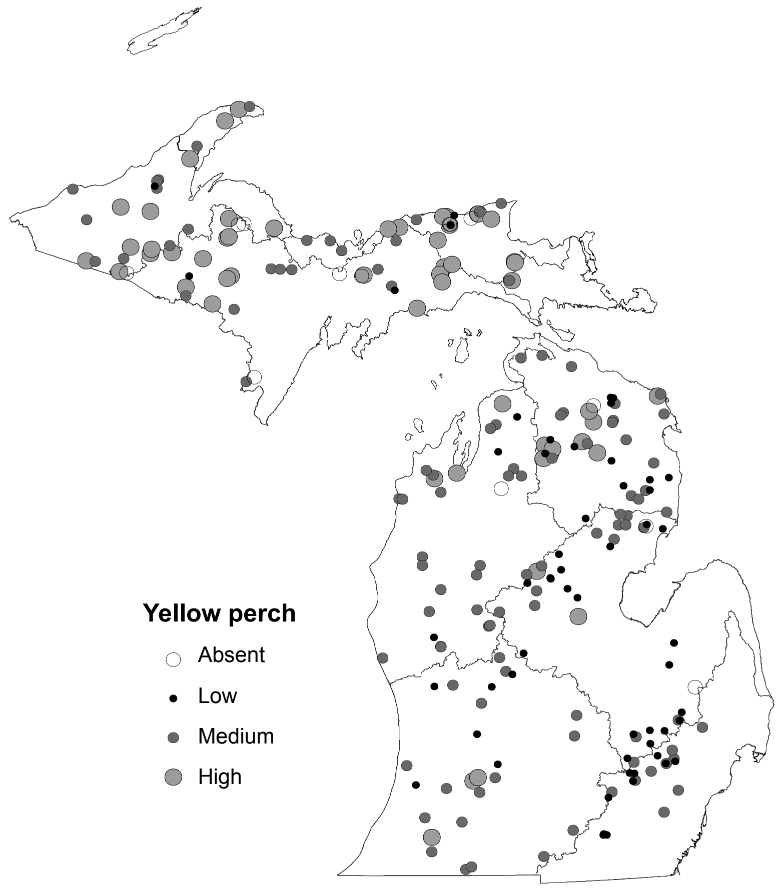


Figure 129.–Distribution and abundance of yellow perch collected from Status and Trends lakes.

Table 181.–Proportion of Status and Trends lakes containing yellow perch, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.00	1.00	1.00		1.00	1.00	1.00	1.00
	Shallow	1.00		1.00	1.00		1.00	1.00		1.00
Medium	Deep	1.00	1.00	1.00	0.88	1.00	1.00	1.00	1.00	0.99
	Shallow		1.00	0.80	1.00	1.00	1.00	1.00	1.00	0.96
	Unknown	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00
Small	Deep	1.00	0.86	0.67	1.00	1.00	1.00	0.75	1.00	0.88
	Shallow			0		1.00			1.00	0.75
	Unknown	1.00	1.00			1.00	0.88	1.00	1.00	0.95
All		1.00	0.97	0.83	0.96	1.00	0.98	0.94	1.00	0.96

Table 182.–Summary of catch per unit effort of yellow perch by gear, including only sites and gears with catches greater than zero. Catch per unit effort for electrofishing is number of fish per minute. Catch per unit effort for fyke net, gill net, mini fyke net, and trap net is number of fish per lift. Number of lakes with positive catches for each gear is denoted by n.

		Typical range							
Gear	Low	25th		Median		75th	High	Maximum	n
Electrofishing	<0.27	0.27	to	1.03	to	2.53	>2.53	16.60	147
Fyke net	<0.24	0.24	to	0.67	to	4.00	>4.00	190	114
Gill net	<0.75	0.75	to	2.11	to	4.87	>4.87	63.00	160
Mini fyke	<0.75	0.75	to	2.71	to	13.00	>13.00	1,352.00	61
Seine	<0.50	0.50	to	1.75	to	9.50	>9.50	100	54
Trap net	<0.24	0.24	to	0.45	to	0.78	>0.78	53.22	80

Table 183.–Mean CPUE (catch per minute, including sites with zero catches) yellow perch in electrofishing surveys, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.37	12.10	3.30		1.53	0.20	0.17	3.82
	Shallow	0.16		5.90	1.80		7.48	2.03		3.84
Medium	Deep	0.62	2.44	2.11	2.45	1.65	2.59	1.59	0.57	1.60
	Shallow		1.69	4.96	1.88	4.87		0.42	0.23	2.39
	Unknown	1.71	1.44	0.93	2.20	4.50	0.58	0.37		1.25
Small	Deep	0.26	0.69	3.30	1.75		4.84	0.22	0.17	1.20
	Shallow									
	Unknown	0.25	0.57			0.03	0.27	0.05		0.21
All		0.63	1.73	4.06	2.34	2.28	2.98	0.92	0.47	1.84

Table 184.–Mean CPUE (catch per lift, including sites with zero catches) of yellow perch in fyke nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.67	57.66	1.21		0.64	0.25	0.33	11.16
	Shallow	0.50		11.61	4.69		1.38	0.02		3.20
Medium	Deep	2.03	0.11	7.94	0.52	5.21	13.03	0.14	0.27	4.33
	Shallow		0.16	1.27	23.09	0.17	0.09	0.10	0	5.86
	Unknown	0.46	0.11	0.46	7.33	2.34	1.72	0		1.25
Small	Deep	0.11	1.32	7.15	4.53	12.12	0.09	0.18	0.22	3.39
	Shallow			0		131.83				87.89
	Unknown		3.07			50.71	3.45	0	0.25	13.17
All		1.38	0.74	8.96	7.42	28.74	5.28	0.11	0.24	6.48

Table 185.–Mean CPUE (catch per lift, including sites with zero catches) of yellow perch in gill nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		4.07	3.71	5.21		1.88	0.50	4.50	3.81
	Shallow	2.85		7.25	6.03		3.91	0.29		4.49
Medium	Deep	5.05	5.73	4.67	1.88	5.60	1.33	3.95	1.20	3.56
	Shallow		0.88	1.61	1.42	3.13	1.58	0.44	2.50	1.40
	Unknown	5.31	2.46	5.92	0.25		5.95	0.17		4.17
Small	Deep	4.33	5.08	4.55	0.38	21.00	1.05	0.84	2.13	4.06
	Shallow			0					4.00	2.00
	Unknown	0.50	11.83			0	2.31	0.25	2.50	2.86
All		4.48	4.96	4.41	2.53	8.84	2.33	1.94	1.97	3.48

Table 186.–Mean CPUE (catch per lift, including sites with zero catches) of yellow perch in mini fyke nets, stratified by lake size, depth, and management unit. Mini fyke nets were not used in Southern Lake Huron.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.25	0.50	1.29		6.60			2.19
	Shallow				4.07		27.78			18.89
Medium	Deep	0		26.94	53.67		41.98		0	40.03
	Shallow		17.00	3.32	3.84		0.92			4.78
	Unknown	0	0.50	0	0.50	0.17	1.63			0.65
Small	Deep	0	1.00	7.03	0.25	0.63	452.50		0	111.00
	Shallow			0		13.75			0	6.88
	Unknown					2.77	9.06		0.25	6.25
All		0	7.35	8.23	22.28	3.51	88.36		0.06	38.27

Table 187.–Mean CPUE (catch per haul, including sites with zero catches) of yellow perch in seines, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		1.43	0	0.38			0.17	0	0.54
	Shallow	0		6.92	0		20	0.19		4.57
Medium	Deep	1.27	6.93	5.75	0.68	10.23	37.00	0.87	0.71	4.95
	Shallow		0.75	2.17	0.56	10.85	0	0	0	1.90
	Unknown	0	0.25	4.33	0	70		0		5.96
Small	Deep	0.07	0	0.70	0.17	1.50	0.33	0	0	0.32
	Shallow			0		0			0	0
	Unknown	0	0			0.08	0	0.50	0	0.11
All		0.70	3.60	3.25	0.45	9.32	21.04	0.40	0.34	3.10

Table 188.–Mean CPUE (catch per lift, including sites with zero catches) of yellow perch in trap nets, stratified by lake size, depth, and management unit. Trap nets were not used in Western Lake Superior.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.49	4.44			0.16	0.50	0	0.94
	Shallow	0.25		0.09			0.67	0.29		0.42
Medium	Deep	0.43	0.11			0.27	0.18	0.36	0.22	0.27
	Shallow		0.75			0.29	0.23	0.41	0.67	0.47
	Unknown	0.25	0	0		0	0.67	0.03		0.26
Small	Deep	0.28	2.49			0.50	0.13	0.03	0.10	0.61
	Shallow					53.22			2.75	27.99
	Unknown	1.06	0				0.17	0	0.64	0.34
All		0.42	0.79	1.15		5.10	0.30	0.23	0.38	0.74

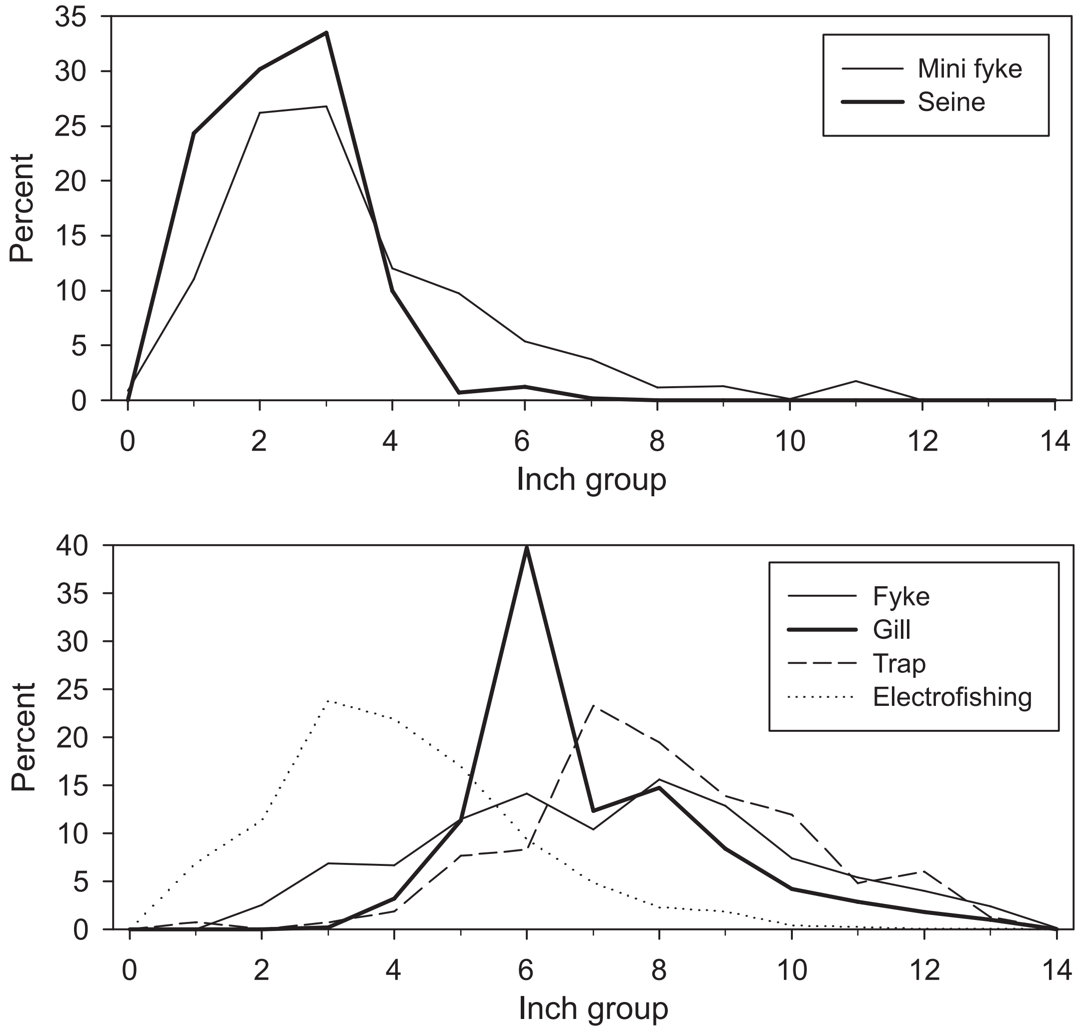


Figure 130.–Size distribution of yellow perch captured in different gear types.

Table 189.–Mean and standard error (SE) of length at age of yellow perch, with upper and lower quartiles as indicators of typical growth range. The sample size (n) is number of lakes containing fish with the specified age class; only those age classes with more than three lakes are reported.

Age	Lower 25%	Mean	SE	Upper 75%	n
0	1.9	2.3	0.2	2.7	8
1	3.2	3.6	0.1	3.9	89
2	4.5	5.1	0.1	5.7	130
3	5.8	6.4	0.1	6.8	159
4	6.8	7.6	0.1	8.2	155
5	7.9	8.6	0.1	9.3	125
6	8.6	9.4	0.1	10.4	96
7	9.4	10.3	0.2	10.9	65
8	10.0	11.0	0.2	12.3	43
9	11.1	11.7	0.2	12.1	28
10	11.3	12.1	0.3	12.6	10

- Northern logperch *Percina caprodes*

Northern logperch occurred across the state (Figure 131) but were captured most frequently in large lakes (Table 190). Their frequency of occurrence was somewhat lower in Lake Huron management units and in the Western Lake Superior Management Unit (Table 190).

Northern logperch were only collected often enough with electrofishing gear to provide a typical range of catch rates (0.1 to 0.6 fish per minute in the 22 lakes where catches occurred), but did not occur frequently enough to provide clear measures of CPUE in this gear.

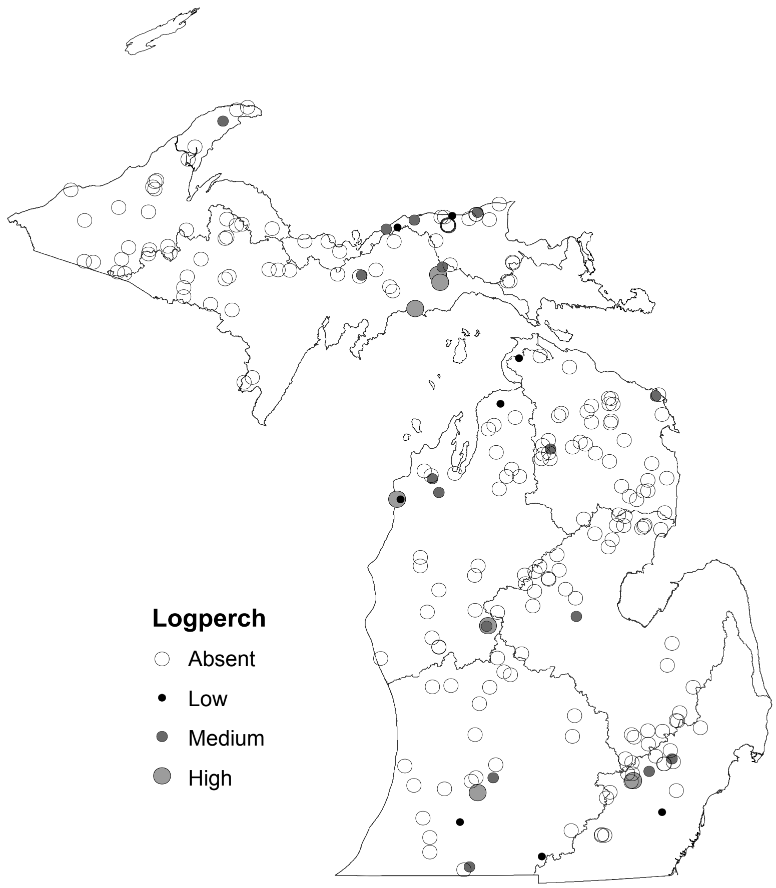


Figure 131.–Distribution and abundance of northern logperch collected from Status and Trends lakes.

Table 190.–Proportion of Status and Trends lakes containing northern logperch, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0	0		0	0	0	0
	Shallow	0		0	0		0.20	0		0.07
Medium	Deep	0.21	0	0	0	0.20	0	0.14	0.67	0.15
	Shallow		0	0	0.50	0	0	0	1.00	0.16
	Unknown	0.33	0	0	1.00	0.50	0	0.25		0.18
Small	Deep	0.17	0	0.11	0	0	0	0.25	0.20	0.10
	Shallow			0		0			1.00	0.25
	Unknown	0	0			0.25	0.13	0.50	0	0.15
All		0.19	0	0.03	0.17	0.16	0.05	0.17	0.47	0.13

- Blackside darter *Percina maculata*

Blackside darters were caught in two lakes (<1% of lakes sampled; Figure 132). Too few blackside darters were caught to characterize typical catch rates or size distribution of this species.

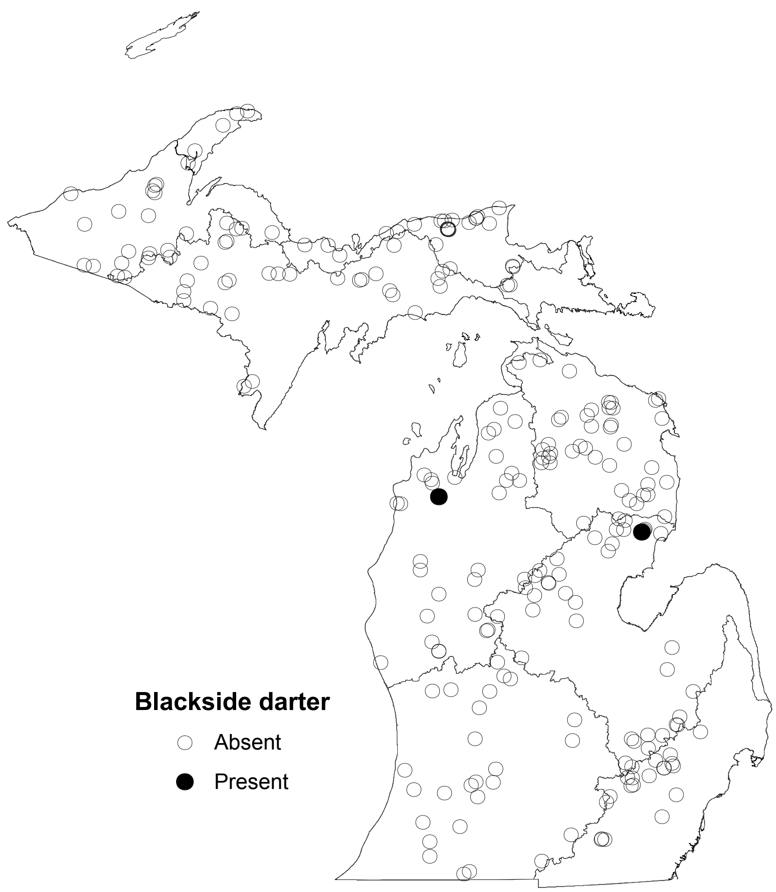


Figure 132.–Distribution of blackside darters collected from Status and Trends lakes.

- Walleye *Sander vitreus*

Walleyes were widely distributed, being caught in 53% of all lakes sampled (Table 191). They were captured throughout the state, but occurred much less frequently in the Southern Lake Michigan Management Unit and more frequently in the Western Lake Superior Management Unit (Figure 133; Table 191). Walleyes occurred most frequently in larger and deeper lakes (Table 191).

Walleyes were caught in all gears deployed (Appendix A), but the greatest numbers were caught by electrofishing. Trap nets, fyke nets and gill nets also caught large numbers of walleyes. For the state as a whole, the typical range of catch rates for electrofishing gear was 0.03 to 0.35 fish per minute (Table 192). Catch rates in trap nets and fyke nets were broadly similar, with a typical range of about 0.2 to 1.25 fish per lift. Typical catch rates in gill nets were slightly higher, with a typical range of 0.3 to 2 fish per lift. Walleyes were not caught frequently enough in mini fyke nets or seines to typify catch rates. Catch rates of walleyes varied across gears, management units, lake size and lake depth (Tables 193-196). Catch rates in electrofishing (Table 192), fyke nets (Table 194), and trap nets (Table 196) indicated that CPUE tended to be higher in the Western Lake Superior and Northern Lake Michigan management units, as well as in larger lakes.

Walleyes were rarely caught in seines or mini fyke nets, so the size composition of fish in these gears could not be well described. Electrofishing gear selected for smaller fish than the other gears (Figure 134), with a mean length of 12.7 inches (SE=0.7), but also captured a wide size range of individuals. The size distribution of catches in gill nets, fyke nets, and trap nets were similar (Figure 134) with mean size of the catch of 17.3 inches (SE=0.4), 19.0 inches (SE=0.4), and 19.7 inches (SE=0.4), respectively.

The range of typical growth for walleyes was provided in Table 197. Based on the mean length at age, walleyes typically reached the current minimum size of 15 inches between ages 3 and 4.

Table 191.–Proportion of Status and Trends lakes containing walleye, stratified by lake size, depth, and fisheries management unit. Blanks indicate categories where no lakes were surveyed.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.67	1.00	1.00		1.00	1.00	1.00	0.92
	Shallow	0		1.00	1.00		0.80	0.33		0.73
Medium	Deep	0.21	0.91	0.80	0.75	0.80	0.79	0.71	0.78	0.69
	Shallow		0.50	0.80	0.67	0.50	0.33	0.50	0	0.56
	Unknown	0	0.33	0.75	1.00	0	0.60	0.75		0.50
Small	Deep	0.33	0.14	0.11	1.00	0.75	0.14	0.25	0	0.25
	Shallow			0		0			0	0
	Unknown	0.50	0.50			0	0.13	0.50	0.50	0.25
All		0.23	0.57	0.59	0.83	0.42	0.51	0.56	0.47	0.53

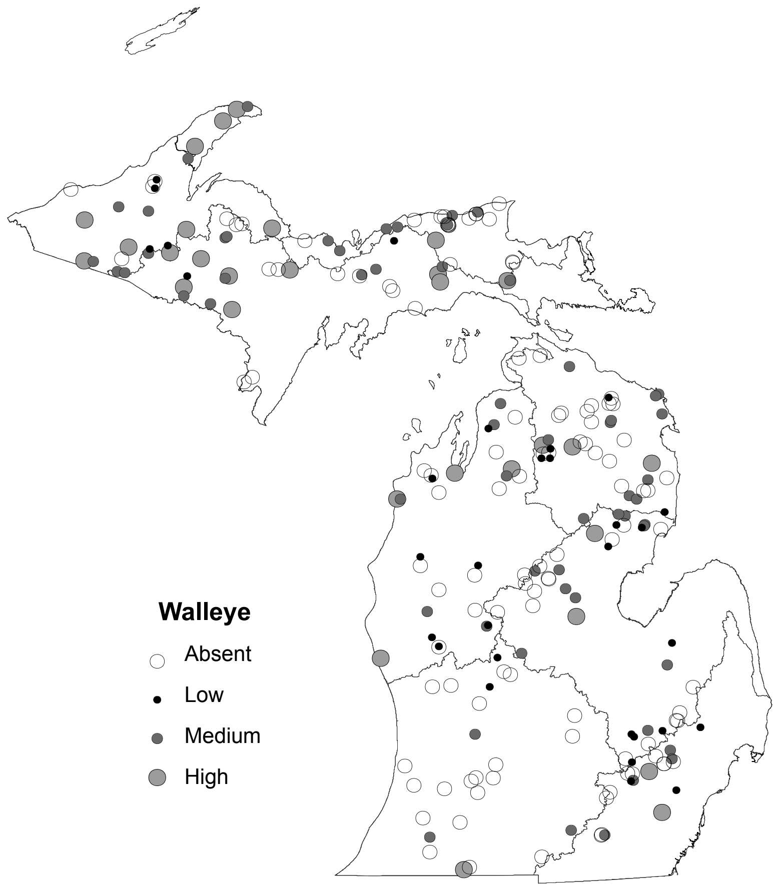


Figure 133.–Distribution and abundance of walleyes collected from Status and Trends lakes.

Table 192.–Summary of catch per unit effort of walleye by gear, including only sites and gears with catches greater than zero. Catch per unit effort for electrofishing is number of fish per minute. Catch per unit effort for fyke net, gill net, and trap net is number of fish per lift. Number of lakes with positive catches for each gear is denoted by n.

		Typical range							
Gear	Low	25th		Median		75th	High	Maximum	n
Electrofishing	<0.03	0.03	to	0.09	to	0.36	>0.36	3.76	63
Fyke net	<0.17	0.17	to	0.50	to	1.17	>1.17	6.00	82
Gill net	<0.33	0.33	to	1.00	to	2.00	>2.00	9.00	79
Trap net	<0.22	0.22	to	0.65	to	1.38	>1.38	11.00	74

Table 193.–Mean CPUE (catch per minute, including sites with zero catches) walleye in electrofishing surveys, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.10	0.22	1.16		0.07	0.13	0.03	0.50
	Shallow	0		1.59	0.73		0.18	0.02		0.67
Medium	Deep	0.02	0.24	0.34	0.02	0.06	0.27	0.07	0.03	0.11
	Shallow		0.03	0.09	0.55	0		0.12	0	0.19
	Unknown	0	0.01	0.10	0.08	0	0.02	0.02		0.03
Small	Deep	0.01	0.01	0.11	0.03		0	0	0	0.03
	Shallow									
	Unknown	0	0			0	0	0		0
All		0.01	0.12	0.35	0.45	0.04	0.15	0.05	0.03	0.16

Table 194.–Mean CPUE (catch per lift, including sites with zero catches) of walleye in fyke nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0	0.15	0.97		1.88	1.00	1.17	0.75
	Shallow	0		0.76	0.55		0.16	0.16		0.32
Medium	Deep	0.15	0.17	0.62	0.64	0.38	0.32	0.30	0.26	0.34
	Shallow		1.30	0.79	1.37	0	0.04	0.19	0	0.73
	Unknown	0	0.04	0.90	1.78	0	0.16	0		0.33
Small	Deep	0	0	0.19	0.08	2.60	0.06	0.08	0	0.34
	Shallow			0		0				0
	Unknown		0.06			0	0.02	0.17	0.25	0.06
All		0.09	0.28	0.51	0.87	0.65	0.20	0.21	0.25	0.38

Table 195.–Mean CPUE (catch per lift, including sites with zero catches) of walleye in gill nets, stratified by lake size, depth, and management unit.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		2.64	0.88	1.74		2.00	0.17	2.00	1.64
	Shallow	0		1.23	1.98		0.54	0.38		0.93
Medium	Deep	0.72	0.51	1.08	0.34	0.13	0.60	0.84	1.10	0.68
	Shallow		0.63	0.53	0.38	0.50	0	1.13	0	0.52
	Unknown	0	0.13	1.07	1.75		0.22	0		0.41
Small	Deep	0	0	0.22	0	1.33	0	0.25	0	0.17
	Shallow			0					0	0
	Unknown	0	0.05			0	0	4.50	0	0.54
All		0.39	0.49	0.69	0.78	0.52	0.33	0.83	0.63	0.57

Table 196.–Mean CPUE (catch per lift, including sites with zero catches) of walleye in trap nets, stratified by lake size, depth, and management unit. Trap nets were not used in Western Lake Superior.

Stratum		Fisheries management unit								
Size	Depth	LMS	LMC	LMN	LSW	LSE	LHN	LHS	LE	All
Large	Deep		0.18	0.19			6.61	0.75	1.25	1.33
	Shallow	0		1.93			0.87	0.20		0.80
Medium	Deep	0.09	0.50			0.72	1.23	0.38	0.79	0.60
	Shallow		2.46			0.12	0.25	0.63	0	0.95
	Unknown	0	0.08	0		0	0.29	0.35		0.19
Small	Deep	0.13	0.02			6.25	0.11	0.08	0	0.47
	Shallow					0			0	0
	Unknown	0.19	0				0	0.33	0	0.08
All		0.09	0.60	1.01		1.49	0.81	0.33	0.44	0.56

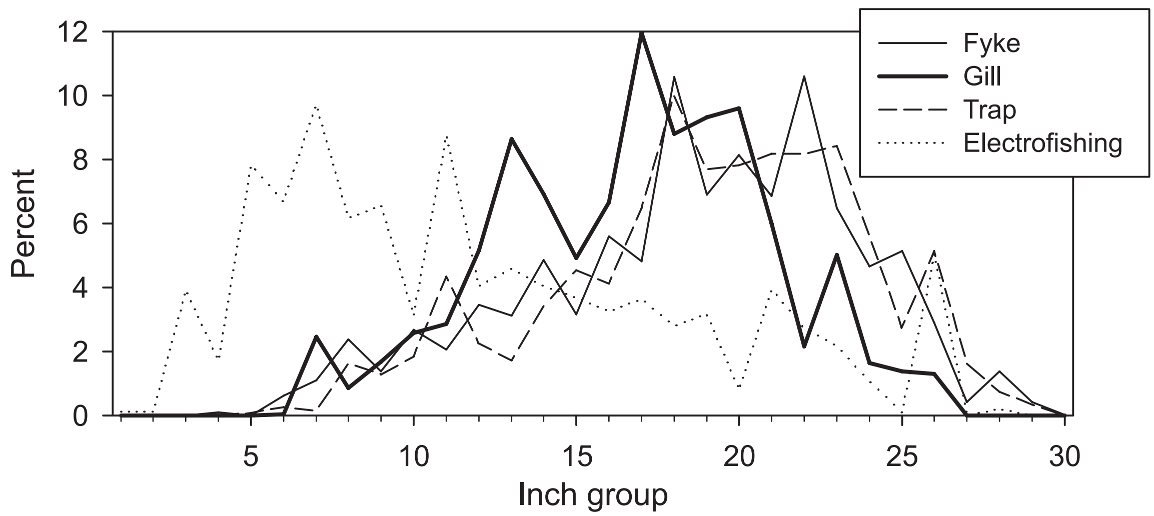


Figure 134.–Size distribution of walleyes captured in different gear types.

Table 197.–Mean and standard error (SE) of length at age of walleye, with upper and lower quartiles as indicators of typical growth range. The sample size (n) is number of lakes containing fish with the specified age class; only those age classes with more than three lakes are reported.

Age	Lower 25%	Mean	SE	Upper 75%	n
1	6.8	8.0	0.2	8.7	39
2	10.8	12.0	0.3	13.5	44
3	12.8	14.3	0.4	16.1	55
4	15.0	16.6	0.3	18.2	48
5	17.9	18.8	0.3	20.1	53
6	18.7	19.7	0.3	21.1	52
7	19.8	21.2	0.4	22.6	50
8	19.4	21.5	0.4	22.6	43
9	19.3	22.1	0.5	24.4	36
10	20.6	22.6	0.5	24.7	31
11	21.1	23.1	0.7	25.0	16
12	20.7	23.3	0.7	25.6	20
13	21.0	24.1	1.1	26.4	7
14	19.5	22.5	1.1	25.5	7
15	20.4	24.1	1.3	27.6	7
16	20.9	22.7	1.4	24.6	4
17	20.1	22.0	1.6	25.2	3

Sciaenidae

- Freshwater drum *Aplodinotus grunniens*

Freshwater drums occur primarily in the Great Lakes, but were caught in three inland lakes (about 1% of lakes sampled; Figure 135), all within the Central Lake Michigan Management Unit. Too few freshwater drum were caught to characterize typical catch rates or size distribution of this species.

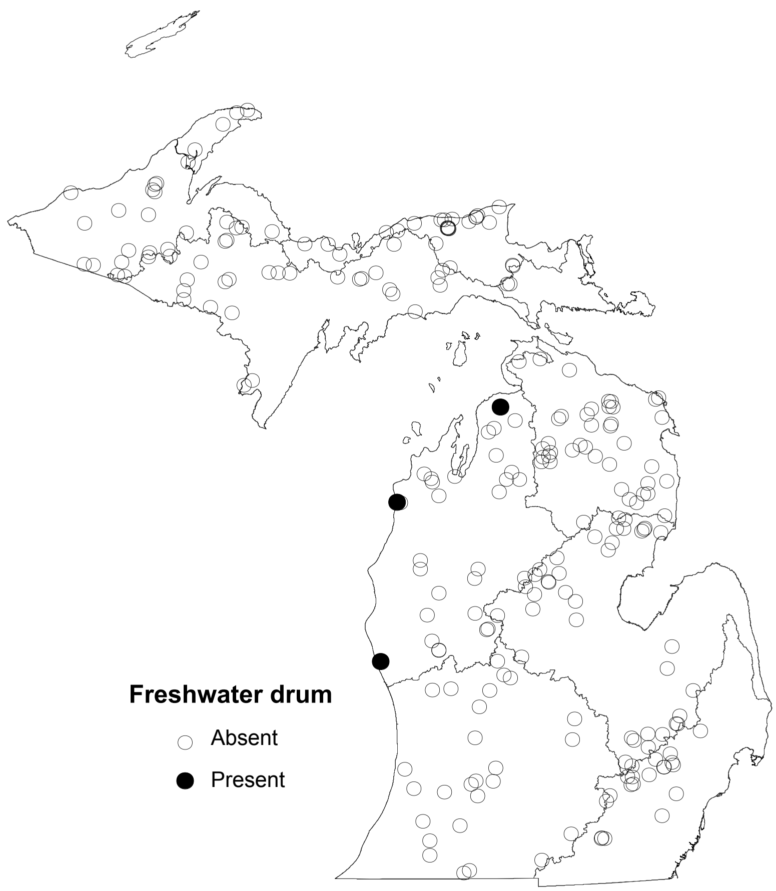


Figure 135.–Distribution of freshwater drums collected from Status and Trends lakes.

Concluding Remarks

The Status and Trends Program provides valuable information needed for science-based resource management. Habitat and fish community data collected using standardized sampling methods enable resource managers to make ecosystem-level comparisons among water bodies and the statewide reference points presented in this report. These data provide the foundation for interpreting field observations, identifying limiting factors, and developing defensible management recommendations. As collection of assessment data continues into the future, the value of status and trends information will only increase. Aquatic systems are responsive to many factors and exhibit considerable variability over time. Long-term data collection will enable resource managers to determine how variable aquatic systems are, identify the regional and temporal factors that control this variability, and distinguish the influences of natural processes from human activities.

Continued assessment and communication of the status and trends of Michigan's lakes is a necessity given the growing list of environmental issues that will potentially threaten aquatic resources. For example, changes in lake habitats resulting from shoreline armoring, removal of large woody debris and aquatic vegetation, excessive nutrient inputs, and agricultural and urban land use practices, are of great concern to resource managers and users alike. Invasive species are already competing with native organisms for food and habitat in Michigan's lakes. Threats from future invasions by unknown species on the verge of entering the Great Lakes watershed may also affect aquatic communities. Climate change is projected to affect aquatic ecosystems through changes in thermal regimes and hydrological cycles. The distribution and abundance of fishes, especially cold and cool water species, are expected to change in response to climate warming. Comparing and contrasting changes in a number of independent, concurrently sampled lakes throughout Michigan will provide insights into cause and effect relationships between these potential threats and fish community structure.

Michigan's lakes and their diverse aquatic communities are a valuable resource in need of wise management. Such management requires understanding the processes that shape lake communities as well as recognition of and response to future threats that originate from growing human populations and the increased pressure they exert on aquatic resources. Habitat changes resulting from poor land use practices, invasive species, and climate change have the potential to alter fish communities and habitat in lakes and reduce the societal benefits that these systems provide. Awareness of such threats and continued long-term assessment by the Status and Trends Program will ultimately lead to management practices that will help reduce or mitigate these threats, ensuring that Michigan's lakes are wisely managed well into the future.

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Appendix A.–Total number of fish captured in each gear type and in all gear types combined. Species are listed alphabetically by common name.

Species	Electrofishing	Fyke net	Gill net	Mini fyke	Seine	Trap net	Total
Alewife	58	19	150	4	0	5	236
Banded killifish	10	0	0	8	689	0	707
Black bullhead	17	1769	32	105	3	625	2551
Black crappie	299	4,315	635	89	4	11,359	16,701
Blackchin shiner	71	0	0	128	606	0	805
Blacknose dace	25	0	0	56	5	0	86
Blacknose shiner	383	0	0	380	1,169	0	1,932
Blackside darter	2	0	0	0	2	0	4
Blackstripe topminnow	1	0	0	1	11	0	13
Bluegill	20,755	26,610	982	4,116	3,898	41,274	97,635
Bluntnose minnow	834	34	0	2,745	9,260	0	12,873
Bowfin	80	297	15	13	0	592	997
Brassy minnow	14	0	0	1	0	0	15
Brook silverside	238	0	0	2	319	0	559
Brook stickleback	0	0	0	22	95	0	117
Brook trout	0	114	50	2	5	2	173
Brown bullhead	327	14,365	432	1,103	1	9,204	25,432
Brown trout	0	9	38	0	0	11	58
Burbot	1	0	6	1	0	0	8
Channel catfish	17	215	68	0	0	1,298	1,598
Cisco	0	0	225	0	0	1	226
Common carp	93	66	15	1	1	547	723
Common shiner	467	29	10	2,747	623	0	3,876
Common white sucker	488	4,644	1,181	70	2,741	2,648	11,772
Creek chub	10	9	1	235	328	1	584
Emerald shiner	12	0	0	204	224	0	440
Fantail darter	2	0	0	0	1	0	3
Fathead minnow	10	12	0	141	283	0	446
Finescale dace	0	0	0	5	0	0	5
Flathead catfish	0	0	0	0	0	6	6
Freshwater drum	0	0	4	0	0	5	9
Goldfish	0	1	0	0	0	0	1
Golden redhorse	123	11	4	0	5	16	159
Golden shiner	367	427	216	1,698	498	285	3,491
Grass pickerel	110	0	0	0	7	5	122
Greater redhorse	13	10	0	1	0	16	40
Greenside darter	0	0	0	3	2	0	5
Green sunfish	111	106	7	82	56	37	399
Hornyhead chub	1	4	0	11	0	0	16
Iowa darter	57	0	1	82	307	0	447
Johnny darter	44	0	0	86	280	0	410
Lake trout	0	2	15	0	0	1	18
Lake chubsucker	172	16	16	5	0	41	250

Appendix A.–Continued.

Species	Electrofishing	Fyke net	Gill net	Mini fyke	Seine	Trap net	Total
Lake whitefish	0	0	70	0	0	0	70
Largemouth bass	4,781	1,976	617	1,790	287	3,188	12,639
Least darter	2	0	0	0	28	0	30
Longear sunfish	4	0	0	0	2	0	6
Longnose dace	0	0	0	8	9	0	17
Longnose gar	23	111	37	3	0	391	565
Longnose sucker	0	0	5	0	1	0	6
Logperch	478	6	0	30	391	0	905
Mimic shiner	163	0	0	370	992	0	1,525
Mottled sculpin	15	1	0	9	3	0	28
Mudminnow	93	0	0	37	6	0	136
Muskellunge	6	28	17	0	0	76	127
Northern hogsucker	11	0	0	0	1	5	17
Northern pike	173	1,795	1,811	54	16	1,569	5,418
Northern redbelly dace	0	0	0	368	74	0	442
Pearl dace	0	0	47	28	2	0	77
Pugnose shiner	3	0	0	0	2	0	5
Pumpkinseed	3,553	7,118	152	1,841	542	5,403	18,609
Quillback	3	17	0	0	0	80	100
Rainbow darter	25	0	0	3	98	0	126
Rainbow smelt	0	1	29	5	0	0	35
Rainbow trout	0	54	52	5	0	10	121
Redear sunfish	151	457	5	2	25	1,621	2,261
Rock bass	1,497	11,355	943	764	63	6,556	21,178
Sand shiner	202	375	0	17,328	6,629	0	24,534
Sea lamprey	0	2	0	0	0	1	3
Shorthead redhorse	9	65	9	0	0	35	118
Silver redhorse	0	111	0	0	0	10	121
Smallmouth bass	948	2,030	113	56	119	1,507	4,773
Spotfin shiner	56	7	0	50	515	0	628
Spotted gar	3	33	0	7	0	62	105
Striped shiner	537	214	0	307	2,070	0	3,128
Tadpole madtom	4	0	0	0	0	0	4
Trout-perch	4	0	0	1	2	0	7
Walleye	1,173	1,007	650	12	21	875	3,738
Warmouth	303	153	48	10	5	230	749
White crappie	2	42	0	0	0	31	75
White bass	0	11	1	0	0	87	99
White perch	0	3	40	0	0	14	57
Yellow bullhead	150	1,368	111	16	0	2,233	3,878
Yellow perch	10,136	12,385	3,731	7,264	1,987	1,035	36,538
Total	50,700	96,311	12,994	44,705	35,444	95,429	335,583