Indiana Lake Water Quality Assessment Report
For 2019-2022

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Acknowledgments

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Cover: Crooked Lake, Whitley County. September 2015

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INDIANA CLEAN LAKES PROGRAM

The Indiana Clean Lakes Program was created in 1989 as a program within the Indiana Department of Environmental Management's (IDEM) Office of Water Management. The program is administered through a grant to Indiana University's School of Public and Environmental Affairs (SPEA) in Bloomington. The Indiana Clean Lakes Program is a comprehensive, statewide public lake management program having five components:

1. Public information and education
2. Technical assistance
3. Volunteer lake monitoring
4. Lake water quality assessment
5. Coordination with other state and federal lake programs.

This document is a summary of lake water quality assessment (LWQA) results for 2019 to 2022.

Lake Water Quality Assessment

The goals of the LWQA include: (a) identifying water quality trends in individual lakes, (b) identifying lakes that need special management, and (c) tracking water quality improvements due to industrial discharge and runoff reduction programs (Jones 1996).

This program only samples public lakes that generally have boat trailer access from a public right-of-way. Public lakes are defined as those that have navigable inlets or outlets, or those that exist on or adjacent to public land. Sampling occurs in late June, July, and August of each year to coincide with the period of thermal stratification and the period of poorest annual water quality in lakes (Figure 1). Most Indiana lakes with maximum depths of 16 to 23 feet (5–7 m) or greater undergo thermal stratification during the summer. The warming of lake surface water by sunlight and higher air temperatures cause the water to become less dense. The less dense water will then rise above the cold, denser water at the lake's bottom. Summer wind and waves may not be strong enough to overcome the density differences between the surface and bottom waters and ***thermal stratification*** occurs. In a stratified lake, the surface waters (***epilimnion***) circulate and are well mixed throughout the summer while the bottom waters (***hypolimnion***) may stagnate because they are isolated from the surface. Thus, water characteristics in the epilimnion and hypolimnion of a given lake may be considerably different during stratification.

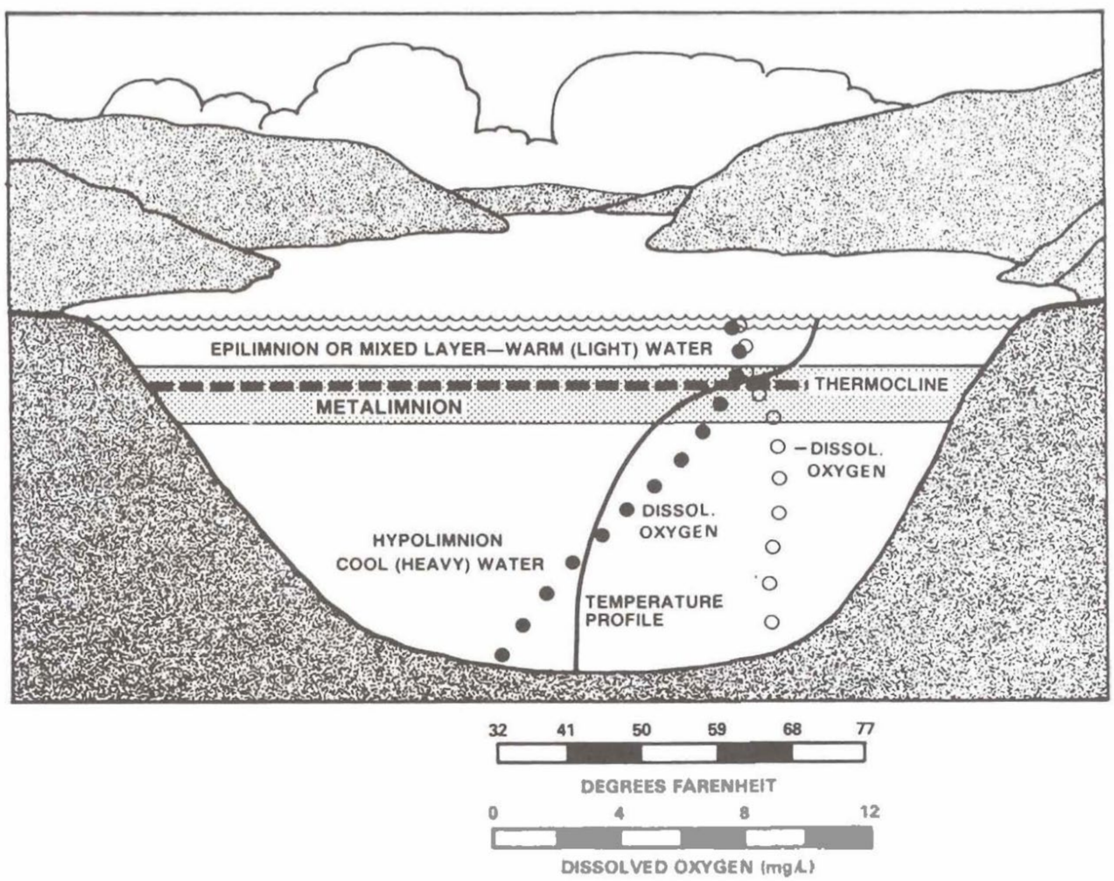

Figure 1 Cross-section of a lake experiencing summer thermal stratification. Adapted from Olem and Flock (1990).

To account for potential differences between the epilimnion and hypolimnion of stratified lakes, water samples are collected from the top two meters of the surface and from one to two meters above the bottom. In addition, dissolved oxygen and temperature are measured at one-meter intervals from the surface to the bottom of each lake.

Lakes were randomized and selected from our list of all public lakes and impoundments having a) a minimum surface area of 5 acres, and b) a usable boat ramp. This process was similar to that used by the United States Environmental Protection Agency (USEPA) in the National Lakes Assessment (NLA) of 2007, 2012, and 2017. The resulting list contained a total of 320lakes and impoundments. We randomize the candidate lake list each survey year. We sampled lakes from this list beginning with the first lake at the top and working downward until we had sampled 80 lakes each survey year, repeating the randomization for the next year. Using this sampling scheme, our 2019-2022 results should be statistically significant for the entire state and we could then better discuss lake water quality in Indiana.

The 320 lakes in our randomized pool are a small fraction of the 1475 lakes, reservoirs, and ponds in our master lake list for Indiana. However, many of these other lakes are private, smaller than 5 acres in surface area, and/or have no usable boat ramp. While the randomized sampling scheme allows us to gain a better understanding of Indiana lake quality each year, it is possible that the sampling frequency for any given lake would create long gaps between individual lake surveys.

Water Quality Parameters Included in Lake Assessments

Monitoring lakes requires many different parameters to be sampled. The parameters analyzed in this assessment include:

pH

pH is the measure of the acidity of a solution of water. The pH scale commonly ranges from 0 to 14 (Figure 2). The scale is not linear but rather logarithmic. For example, a solution with a pH of 6.0 is ten times more acidic than a solution with a pH of 7.0. Pure water is said to be neutral, with a pH of 7.0. Water with a pH below 7.0 is considered acidic while water with pH greater than 7.0 is considered basic or alkaline. The pH of most natural waters in Indiana is between 6.5 and 8.0. However, acidic deposition may cause lower pH in susceptible waters and high phytoplankton productivity (which consumes CO_2, a weak acid) can result in pH values exceeding 9.0.

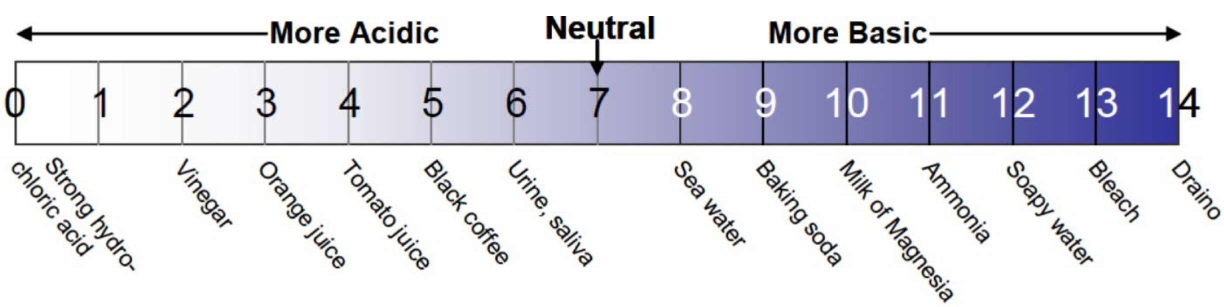

Figure 2 The pH scale compared with common solutions. Source: Addy et al. (2004).

Conductivity

Conductivity is a numerical expression of an aqueous solution's capacity to carry an electric current. This ability depends on the presence of ions, their total concentration, mobility, valence, relative concentrations, and on the temperature of the liquid (APHA 2005). Solutions of most inorganic acids, bases, and salts are relatively good conductors. Conductivities of natural lakes in Indiana generally range from 50 to 1,000 µmhos/cm, but the conductivity of old coal mine lakes can be as high as 3,000 µmhos/cm. In contrast, the conductivity of distilled water is less than 1 µmhos/cm. As conductivity is the inverse of resistance, the unit of conductance is the mho, or in low-conductivity natural waters, the micromho (µmhos).

Acid Neutralizing Capacity

Acid neutralizing capacity (ANC) is the sum total of components in the water that tend to elevate the pH to the alkaline side of neutrality, and is expressed commonly as milligrams per liter as calcium carbonate (mg/L as $CaCO_3$). ANC is a measure of the *buffering capacity* (ability to resist changes in pH) of the water, and since pH has a direct effect on organisms as well as an indirect effect on the toxicity of certain pollutants in the water, the buffering capacity is important to water quality. Commonly occurring materials in water that increase alkalinity are carbonates, bicarbonates, phosphates, and hydroxides. Limestone bedrock and thick deposits of glacial till are good sources of carbonate buffering. Lakes within such areas are usually well-buffered.

Phosphorus

Phosphorus is an essential plant nutrient and most often controls aquatic plant (algae and macrophyte) growth in freshwater. It is found in fertilizers, human and animal wastes, and yard waste. There is no atmospheric (vapor) form of phosphorus. Because there are few natural sources of phosphorus and the lack of an atmospheric cycle, phosphorus is often a *limiting nutrient* in aquatic systems. This means that the relative scarcity of phosphorus may limit the ultimate growth and production of algae and rooted aquatic plants. Therefore, management efforts often focus on reducing phosphorus input to a receiving waterway because: (a) it can be managed, and (b) reducing phosphorus can reduce algae production. Two common forms of phosphorus are:

> ***Soluble reactive phosphorus (SRP)*** – SRP is dissolved phosphorus readily usable by algae. SRP is often found in very low concentrations in phosphorus-limited systems where the phosphorus is tied up in the algae and cycled very rapidly. Sources of SRP include fertilizers, animal wastes, and septic systems.
>
> ***Total phosphorus (TP)*** – TP includes dissolved and particulate forms of phosphorus. TP concentrations greater than 0.03 mg/L (or 30g/L) can cause algal blooms in lakes and reservoirs.

Nitrogen

Nitrogen is an essential plant nutrient found in fertilizers, human and animal wastes, yard waste, and the air. About 80 percent of the atmosphere is nitrogen gas. Nitrogen gas diffuses into water where it can be “fixed” (converted) by blue-green algae to ammonia for algal use. Nitrogen can also enter lakes and streams as inorganic nitrogen and ammonia. Because nitrogen can enter aquatic systems in many forms, there is an abundant supply of available nitrogen in these systems. The three common forms of nitrogen are:

> ***Nitrate (NO_3^-)*** – Nitrate is an oxidized form of dissolved nitrogen that is converted to ammonia by algae under anoxic (low or no oxygen) conditions. It is found in streams and runoff when dissolved oxygen is present, usually in the surface waters.

Ammonia (NH_4^+) – Ammonia is a form of dissolved nitrogen that is readily used by algae. It is the reduced form of nitrogen and is found in water where dissolved oxygen is lacking such as in a eutrophic hypolimnion. Important sources of ammonia include fertilizers and animal manure. In addition, ammonia is produced as a by-product by bacteria as dead plant and animal matter are decomposed.

Organic Nitrogen (Org-N) – Organic nitrogen includes nitrogen found in plant and animal materials and may be in dissolved or particulate form. Organic nitrogen is determined by analyzing samples for total nitrogen (TN) and subtracting the non-organic species of ammonia and nitrate.

Light Transmission

Light transmission is used to determine the amount of the lake that is photosynthetically active. We use a light meter (photocell) to determine the *rate* at which light transmission is diminished in the water column to 1% of the surface level. The 1% light level is considered the lower limit of algal growth in lakes and this area is referred to as the *euphotic zone*.

Dissolved Oxygen

Dissolved oxygen (DO) is the dissolved gaseous form of oxygen. It is essential for respiration of fish and other aquatic organisms. DO enters water by diffusion from the atmosphere and as a by-product of photosynthesis by algae and plants. The concentration of DO in epilimnetic waters continually equilibrates with the concentration of atmospheric oxygen to maintain 100 percent DO saturation. Excessive algae growth can over-saturate (greater than 100 percent saturation) the water with DO when the rate of photosynthesis is greater than the rate of oxygen diffusion to the atmosphere. Hypolimnetic DO concentration is typically low as there is no mechanism to replace oxygen that is consumed by respiration and decomposition. Fish need at least 3-5 mg/L of DO to survive.

Secchi Disk Transparency

Secchi disk transparency is the depth to which a black and white Secchi disk can be seen in lake water that indicates water clarity. Water clarity, is affected by two primary factors: algae and suspended particulate matter. Particulates (soil or dead leaves) come from runoff or sediments already on the lake bottom. Erosion from construction, agricultural, and riverbanks all lead to increased sediment. Bottom sediments can be resuspended by bottom-feeding fish, boats, or strong winds.

Plankton

Plankton include phytoplankton and zooplankton. They are the base of the aquatic food chain (Figure 3).

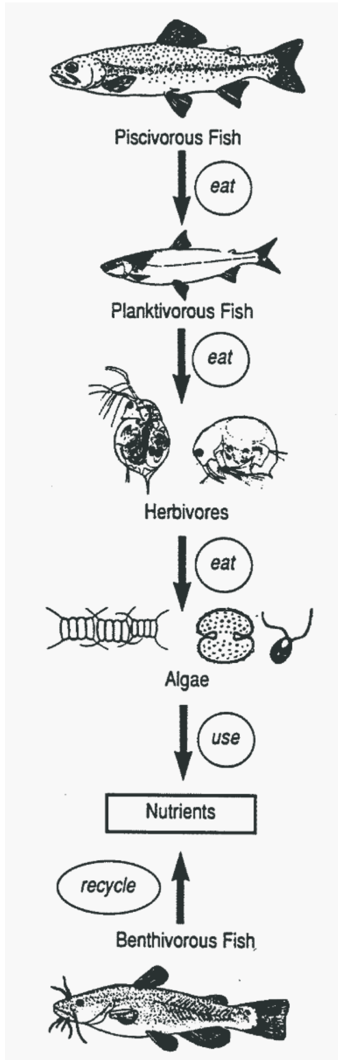

Figure 3 A simplified aquatic food chain.

The phytoplankton are organized taxonomically largely by color. Important phyla (groups) include: Cyanobacteria (blue-green algae), Chlorophyta (green algae), Chrysophyta (yellow-brown algae), and Bacillariophyta (diatoms). Cyanobacteria can out compete other algae, produce toxins, and produce taste and odder issues.

Chlorophyll-a

The plant pigments of algae consist of the chlorophylls (green color) and carotenoids (yellow color). Chlorophyll-a is the most dominant chlorophyll pigment in green algae (Chlorophyta) but is only one of several pigments in cyanobacteria (Cyanophyta), yellow-brown algae

(Chrysophyta), and others. Despite this, chlorophyll-a is used as a direct estimate of algal biomass although it might underestimate the production of algae that contain multiple pigments.

LAKE CLASSIFICATION

There are many factors that influence the condition of a lake including physical dimensions (*morphometry)*, nutrient concentrations, oxygen availability, temperature, light, and fish species. To simplify the analysis of lakes, there are a variety of lake classifications that are used. Lake classifications serve to aid in the decision-making process, in prioritizing, and in creating public awareness. Lakes can be classified based on their origin, thermal stratification regime, or by trophic status.

Lake Origin Classification

Hutchinson (1957) classified lakes according to how they were formed which resulted in 76 different classifications; the following are several important lake types in Indiana.

Glacial Lakes

As the glacier ice sheets moved south and then receded some 10,000 to 12,000 years ago, they created several types of lakes including scour lakes and kettle lakes. **Scour lakes** were formed when the sheet moved over the land creating a groove in the surface of the earth which later filled with meltwater. **Kettle lakes** were formed when large chunks of ice, deposited by the retreating glacier, left depressions in the thick deposits of *till* (sand and gravel ground up by the glacier) that covered the landscape. When the ice blocks melted the depressions filled in with water and lakes were formed. Most lakes in Indiana are kettle lakes including Lake Tippecanoe, the deepest lake (123 feet), and Lake Wawasee, the largest glacial lake (3,410 acres). Glacial lakes in Indiana are primarily in the north and are found between the western Valparaiso Morainal Area and the eastern Steuben Morainal Area where the Lake Michigan, Saginaw, and Erie lobes occurred (Figure 4). Glacial lakes are thus limited to this part of the state.

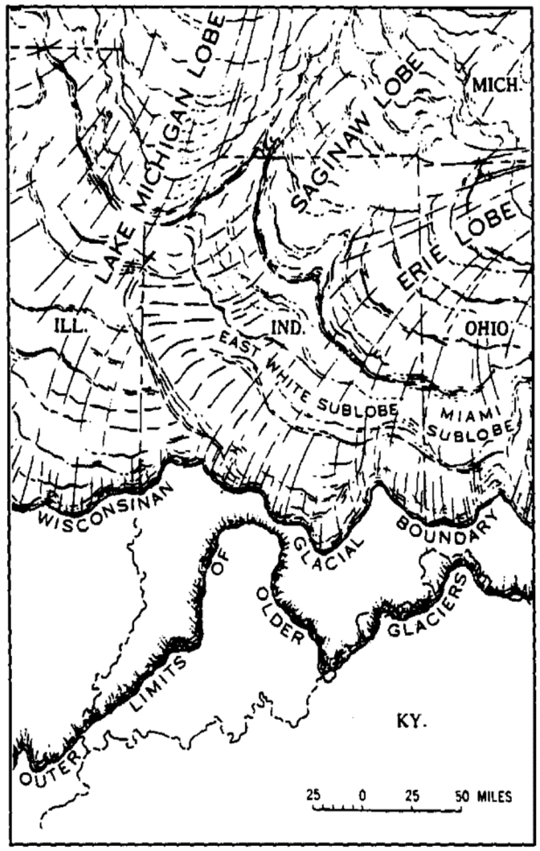

Figure 4 The Lake Michigan, Saginaw, and Erie lobes of the most recent glacial episode affecting northern Indiana.

Solution Lakes

Solution lakes form when water collects in basins formed by the solution of limestone found in regions of karst topography. These lakes tend to be circular and are primarily found in the Mitchell Plain of southern Indiana.

Oxbow Lakes

Oxbow lakes are formed from former river channels that have been isolated from the original river channel due to deposition of sedimentation or erosion. Oxbow lakes can be found throughout the state of Indiana.

Artificial Lakes

Artificial lakes are created by humans due to excavation of a site or to damming a stream or river. Artificial lakes include ponds, strip pits, borrow pits, quarries, and reservoirs (Jones 1996). Reservoirs, also called impoundments, are typically elongated with many branches representing the tributaries of the former stream or river. Strip pits are coal mine lakes found in southwestern Indiana where coal mines are located. Many coal mine lakes formed when water filled the final cut excavated during surface mining. Borrow pits were originally excavated as a source of fill dirt for highway and other large construction projects. For our purposes, we aggregated strip pits, borrow pits, and quarry pits into a singular classification, surface mine lakes (SML).

Trophic Classification

Trophic state is an indication of a lake's nutritional level or biological productivity. The following definitions are used to describe the trophic state of a lake:

> *Oligotrophic* **-** lakes with clear waters, low nutrient levels (total phosphorus < 6 µg/L), supports few algae, hypolimnion has dissolved oxygen, and can support salmonids (trout and salmon).
>
> *Mesotrophic* - water is less clear, moderate nutrient levels (total phosphorus 10-30 µg/L), support healthy populations of algae, less dissolved oxygen in the hypolimnion, and lack of salmonids.
>
> *Eutrophic* **-** water transparency is less than 2 meters, high concentrations of nutrients (total phosphorus > 35 µg/L), abundant algae and weeds, lack of dissolved oxygen in the hypolimnion during the summer.
>
> *Hypereutrophic* **-** water transparency less than 1 meter, extremely high concentrations of nutrients (total phosphorus > 80 µg/L), thick algal scum, dense weeds.

Eutrophication is the biological response observed in a lake caused by increased nutrients, organic material, and/or silt (Cooke et al. 1993). Nutrients enter the lake through runoff or through eroded soils to which they are attached. Increased nutrient concentrations stimulate the growth of aquatic plants. Sediments and plants accumulate at the bottom of the lake decreasing the mean depth of the lake. The filling-in of a lake is a natural process that usually occurs over thousands of years. However, this natural process can be accelerated by human activities such as increased watershed erosion and increased nutrient loss from the land. Thus, ***cultural eutrophication*** can degrade a lake in as little as a few decades.

Although it is widely known that nutrients, especially phosphorus, are responsible for increased productivity, the concentration of nutrients alone cannot determine the trophic state of a lake. Other factors such as the presence of algae and plants aid in the determination of the trophic status, and other factors such as light and temperature impact the growth of algae and plants.

Trophic State Indices

Due to the complex nature and variability of water quality data, a trophic state index (TSI) is used to aid in the evaluation of water quality data. A TSI assigns a numerical value to different levels of standard water quality measurements. The sum of these points for all parameters in the TSI represents the standardized trophic status of a lake that can be compared in different years or can be compared to other lakes. When using a TSI for comparison, it is important to not disregard other data collected as these results may help in explaining other differences between lakes. As with any index, when the data are reduced to a single number for a comparison some information is lost.

The Carlson Trophic State Index

The Carlson Trophic State Index, developed by Carlson (1977) is the most widely used TSI in the United States (Figure 5). Carlson used mathematical equations developed from the relationships observed between summer measurements of Secchi disk transparency, total phosphorus, and chlorophyll-a in north temperate lakes. With Carlson's TSI, one parameter, Secchi disk transparency, total phosphorus, or chlorophyll-a, can be used to yield a TSI value for that lake. One parameter can also be used to predict the value of the other parameters. Values for the Carlson's TSI range from 0 to 100 and each increase of 10 trophic points represents a doubling of algal biomass.

Not all lakes exhibit the same relationship between Secchi disk transparency, total phosphorus, and chlorophyll-a that Carlson's lakes show. However, in these cases Carlson's TSI gives valuable insight into the functioning of a particular lake.

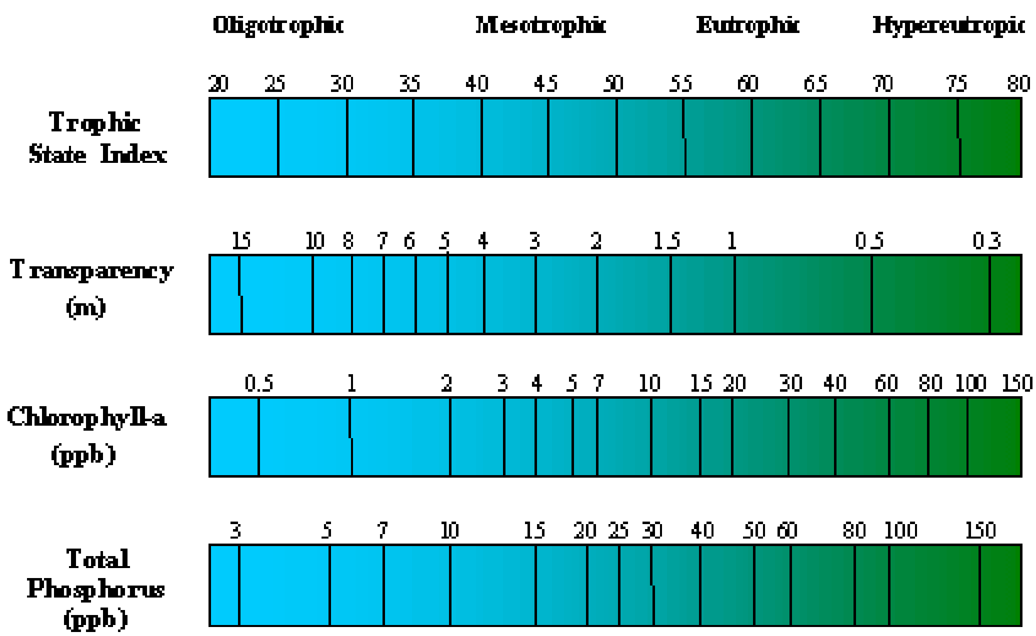

Figure 5 The Carlson Trophic State Index.

Ecoregion Descriptions

Lakes are connected to their watershed through soil types, land slope, and land use. These relationships can be expanded to a larger scale, known as ecoregions, that incorporate this relationship across a larger geographic area. Omernik and Gallant (1988) defined ecoregions in the Midwest through the examination of land use, soils, and potential natural vegetation. Ecoregions have similar ecological properties and can influence lake water quality characteristics. Six ecoregions are present in Indiana (Figure 6). Descriptions of the ecoregions are as follows:

Central Corn Belt Plains (#54): Ecoregion 54 covers 46,000 square miles of Indiana and Illinois. This ecoregion is primarily cultivated for feed crops, only 5 percent of the area is woodland. Crops and livestock are responsible for the nonpoint source pollution in this region.

Eastern Corn Belt Plains (#55): Ecoregion 55 covers 31,800 square miles of Indiana, Ohio, and Michigan. Hardwood forests can thrive in this area; 75 percent of the land is used for crop production. Few natural lakes or reservoirs are located in this area.

Southern Michigan/Northern Indiana Till Plain (#56): Ecoregion 56 covers 25,800 square miles of Michigan and Indiana. Oak-hickory forests are the dominant vegetation in this area; however, 25 percent of this area is urbanized.

Huron/Erie Lake plain (#57): Ecoregion 57 covers 11,000 square miles of Indiana, Ohio, and Michigan. This area used to be occupied by forested wetlands; however, the primary use is now farming and 10 percent of this region is urbanized. There are no lakes in this region that could be assessed by the present study.

Interior Plateau (#71): Ecoregion 71 56,000 square miles from Indiana and Ohio down to Alabama. Land is used for pasture, livestock, and crops. Woodlands and forests remain in this area. There are many quarries and coal mines in this area; however, there are few natural lakes.

Interior River Lowland (#72): Ecoregion 72 covers 29,000 square miles in Indiana, Kentucky, Illinois, and Missouri. One third of this area is maintained as oak-hickory forest; other land uses include pasture, livestock, crops, timber, and coal mines. Water quality disturbances come from livestock, crops, and surface mining.

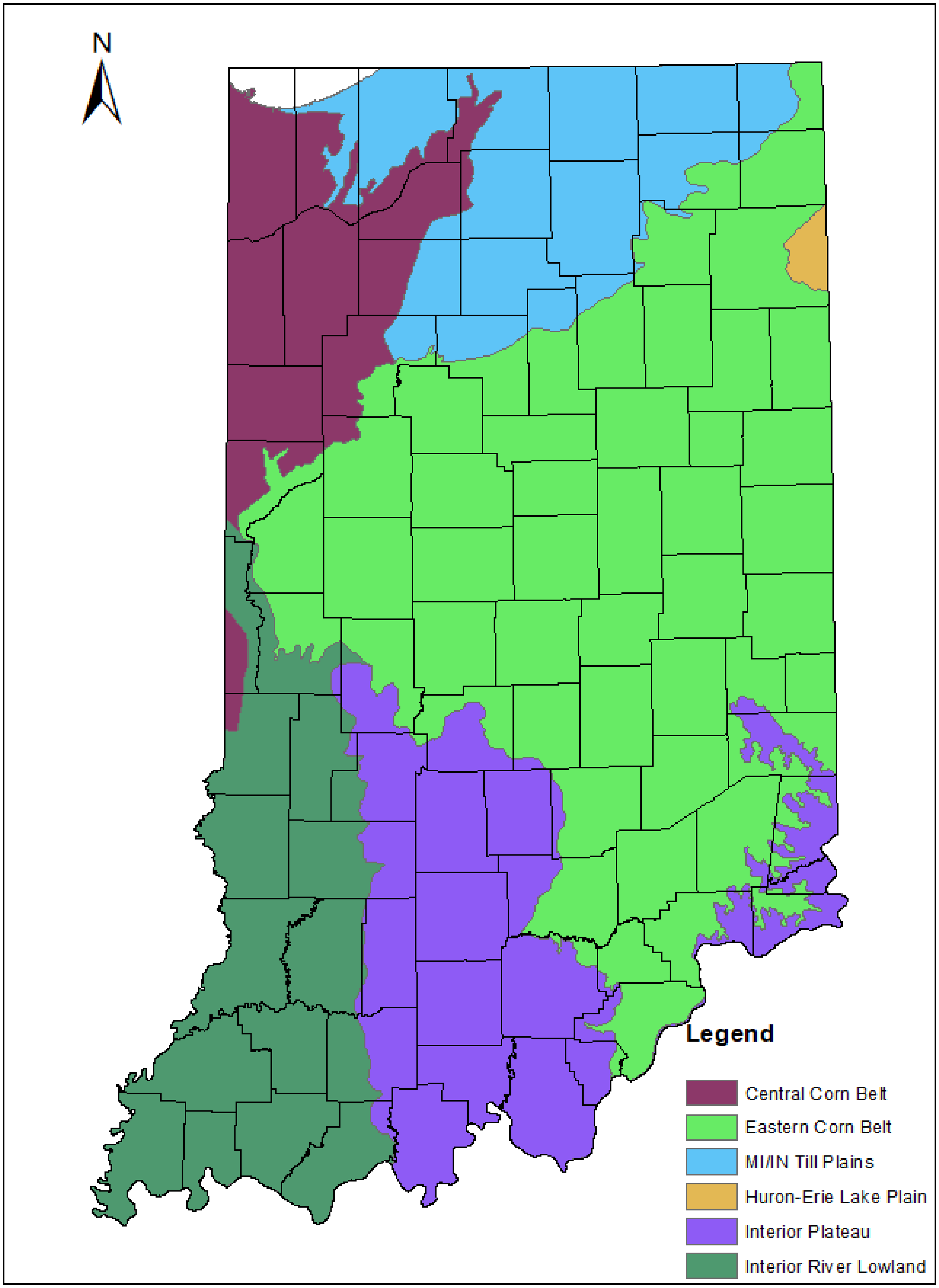

Figure 6 Ecoregions of Indiana.

METHODS

Field Procedures

Water samples are collected from the epilimnion and hypolimnion. Epilimnetic water samples are collected using a 2-meter integrated sampler. Hypolimnion samples are collected at least one meter from the bottom of the lake using a VanDoren sampler. Water samples are collected for soluble reactive phosphorus (SRP), total phosphorus (TP), nitrate (NO_3^-), ammonia (NH_4^+), and total nitrogen (TN). SRP is filtered in the field using a 47 µm membrane filter. TP nitrate/ammonia, and TN are preserved with sulfuric acid (H_2SO_4) resulting in a pH of the sample between 1 and 2.

Dissolved oxygen (DO), temperature, conductivity, and pH are measured using an In-Situ multi-parameter sonde. Measurements are taken at 1-meter intervals through the water column to the lake bottom.

Secchi disk transparency is measured by lowering a black and white disk through the water column until it is no longer visible. Light penetration is measured with a LiCor Spherical Quantum Sensor.

Phytoplankton are collected using a 2-meter integrated sampler. Phytoplankton samples are preserved with glutaraldehyde. Zooplankton are collected with a tow net through the whole water column, utilizing an 80-micron mesh on the net and bucket. Zooplankton samples were preserved with 95% ethyl alcohol.

Chlorophyll-a is collected with an integrated sampler that reaches to a 2-m depth. The sample is filtered with Whatman GF/F filter paper and sample volume filtered is recorded.

Lab Procedures

SRP is determined using an ascorbic acid method and then measured colormetrically on a spectrophotometer (APHA 2005).

NO_3^- is analyzed using the cadmium reduction method (US EPA Method 353.3). NH_4^+ is processed using in-line gas diffusion through 2021(US EPA Method 350.1) (US EPA 1993). NH_4^+ is processed the salicylate and hypochlorite method (Seal Method EPA-150-C Revision 1, U.S. EPA Method 350.1 Rev. 2.0) using discrete analysis. TN samples are digested in an alkaline persulfate solution then processed as nitrite-nitrate using the cadmium reduction method.

TP samples are digested in an alkaline persulfate solution releasing particulate bound phosphorus and analyzed using the ascorbic acid method.

Zooplankton analysis is done by transferring one milliliter of sample to a Sedgwick-Rafter Cell for identification and enumeration. The entire cell is scanned, and all zooplankton counted.

Phytoplankton samples are analyzed using an Imaging FlowCytobot (IFCB) that is an automated submersible imaging flow cytometer, manufactured by McLane Research Laboratories, that generates high-resolution images of suspended particles in water. PhycoTech, Inc. uses the IFCB as a benchtop application to capture algal images for identification. The IFCB can reliably capture particulates between 8 and 250 µm (average phytoplankton ~ 50 µm). The general process of analysis includes sample injection, image processing, and classification. Classification of algal images uses a random forest model developed and trained by Dr. Ann St. Amand and can accurately identify algal images to genus and species (70-80% accuracy). However, classification to functional group is more accurate and allows for sufficient assessment of ecological conditions in a waterbody.

1. ***Natural Unit density (NU/L)*** – this is the historic unit used for many years to quantify plankton in Indiana lakes. A natural unit represents a single organism, regardless of whether the organism is single-celled or a multi-celled colonial form. The size range of natural units may be several orders of magnitude (100 – 1000x).

2. ***Cell density (cells/mL)*** – Counting and recording at the cell level is preferred by phycologists and limnologists today. Each phytoplankton cell can live and reproduce independently of other cells, even in those taxa that aggregate in colonies. Public health warnings regarding toxigenic cyanobacteria are determined, in part, by cell densities.

3. ***Blue-green dominance (%)*** – This valuable variable is the percentage of a plankton population that is dominated by cyanobacteria. Since cyanobacteria are more likely to become a nuisance in aquatic systems, this simple indicator is still useful. Caution is necessary in interpreting this metric because dominance by cyanobacteria in a lake with a low density of phytoplankton does not necessarily indicate a problem in that lake.

Chlorophyll-*a* filters are frozen then filters are ground, and chlorophyll-a is extracted using 90% aqueous acetone and measured using a spectrophotometer. Samples are corrected for pheophyton pigments with dilute acid.

All sampling techniques and laboratory analytical methods were performed in accordance with procedures in APHA (2012). Details can be found in the Quality Assurance Protection Plan (QAPP).

RESULTS

Information about the lakes sampled from 2019 to 2022 is included in Appendix A and B. Raw data for all lakes assessed are available on the Indiana Clean Lakes Program website at: www.clp.indiana.edu.

Lakes Assessed

We assessed a total of 320 lakes during this four-year period, 80 each year from 2019-2022 (Figure 7).

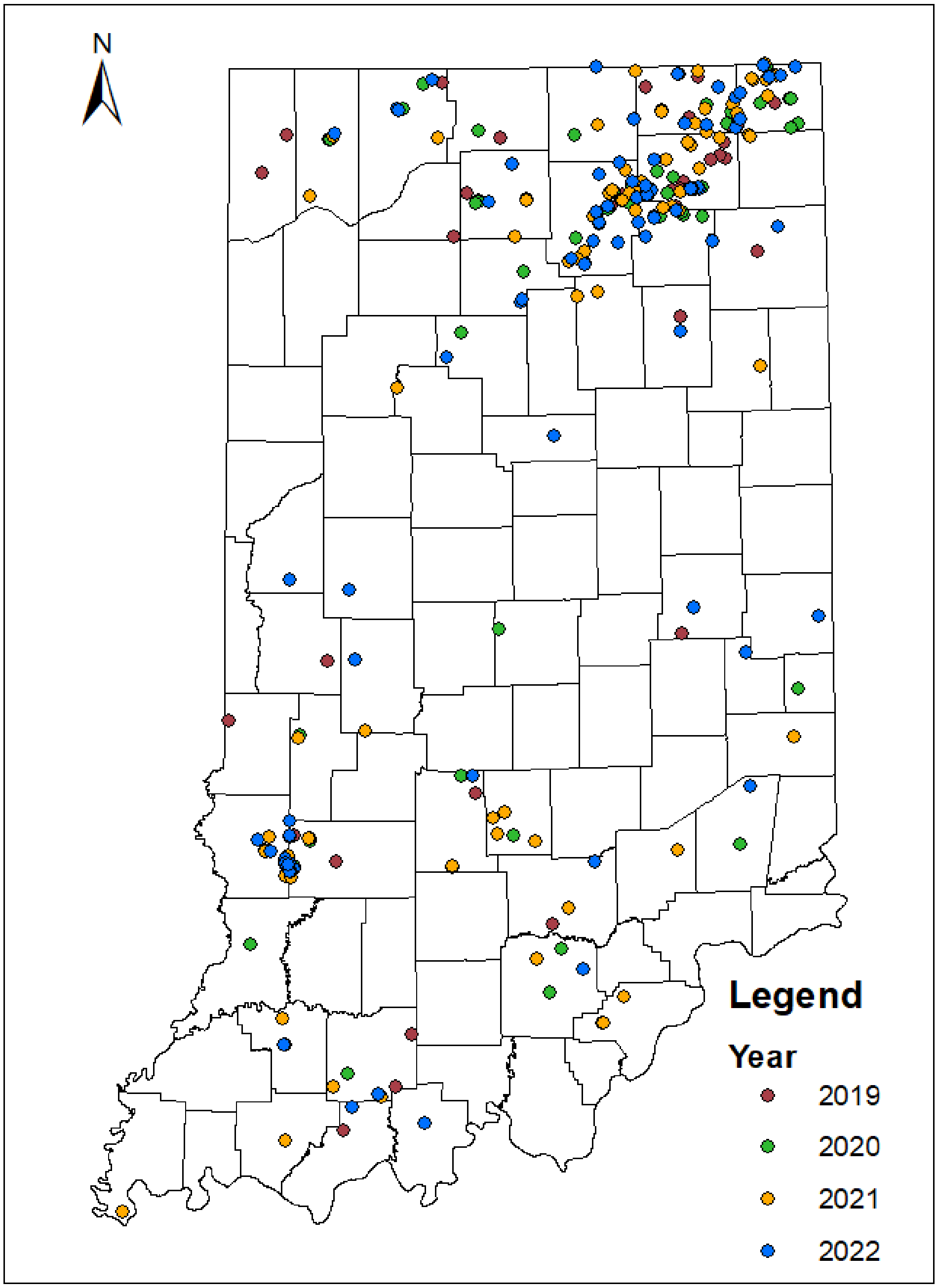

Figure 7 Lakes assessed from 2019- 2022.

Lake surface area ranged from 0.81 hectares (White Pine) to 8880 hectares (Patoka Reservoir), with a median surface area of 28 ha (Figure 8). Fifteen lakes had surface areas greater than 500 ha, while 60percent (n = 204) of all lakes sampled were under 50 ha.

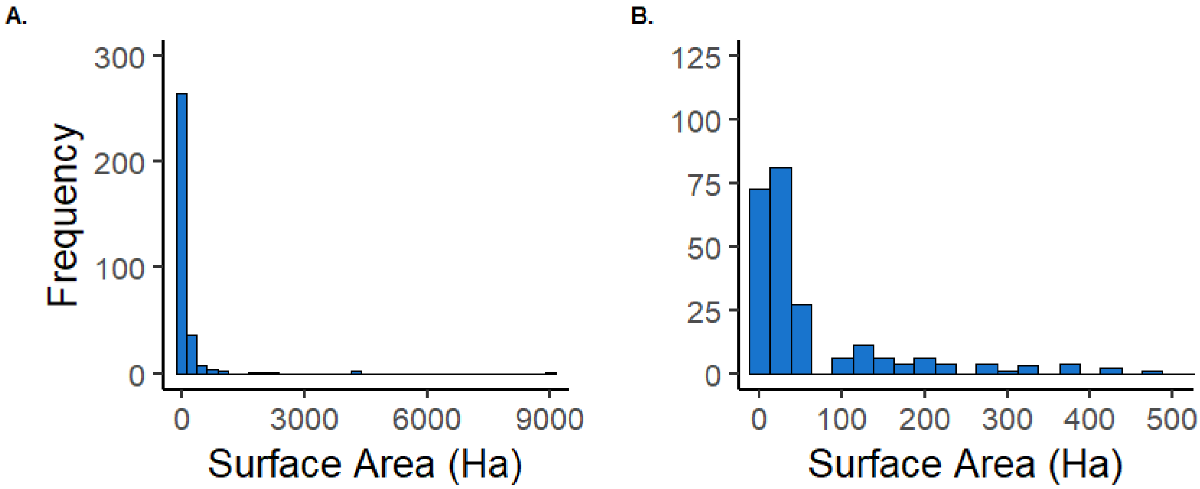

Figure 8 Surface area distribution for (A) all 320 lakes sampled from 2019 to 2022, and (B) the distribution of lakes under 500 hectares.

Maximum depth ranged from 1.5 meters (Spectacle Lake) to 37 meters (Tippecanoe Lake), with a median of 9.8 meters (Figure 9). Natural lakes had the deepest median maximum depth (11 meters), followed by surface mine lakes (7.8 meters) and impoundments (7.3 meters).

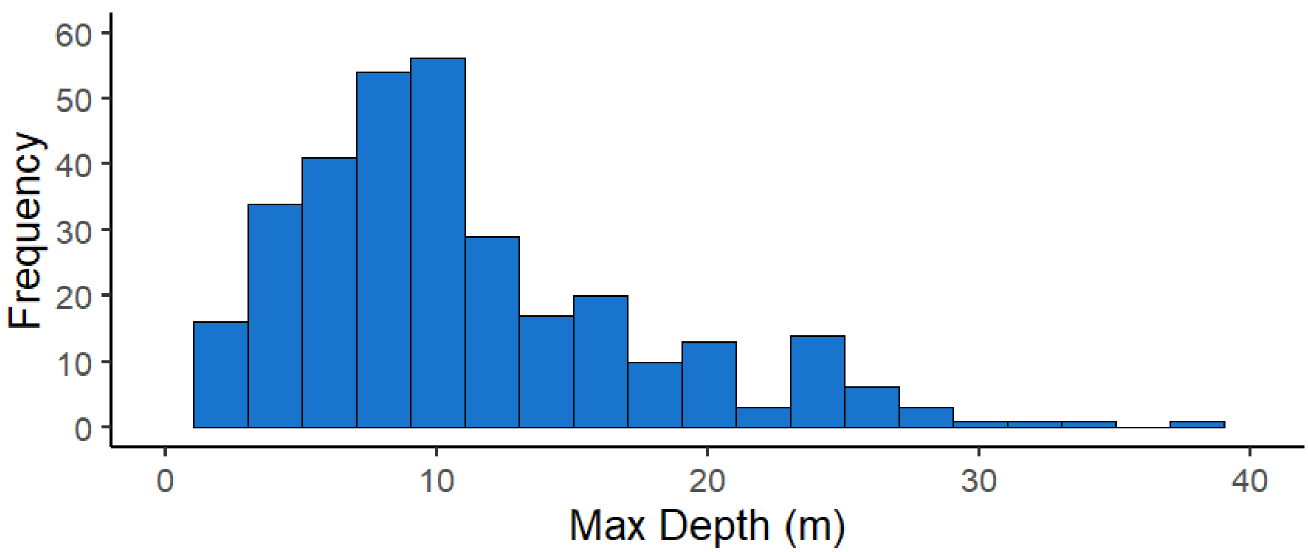

Figure 9 Maximum depth distribution for 320 lakes sampled from 2019 to 2022.

Water Characteristics

pH, Conductivity, and Alkalinity

Epilimnetic pH ranged from 6.39 to 12.39 for all lakes sampled. John Hay Lake had the lowest epilimnetic pH of 6.39 and White Oak #1 Lake – a surface mine lake – had the highest epilimnetic pH of 12.39 (Figure 10). Median epilimnetic pH for all lakes was 8.35. Hypolimnetic pH was comparable to epilimnetic pH, with a median hypolimnetic pH of 7.37. Hammond Lake had the lowest hypolimnetic pH of 6.02 and Eagle Creek Reservoir had the highest hypolimnetic pH of 11.36.

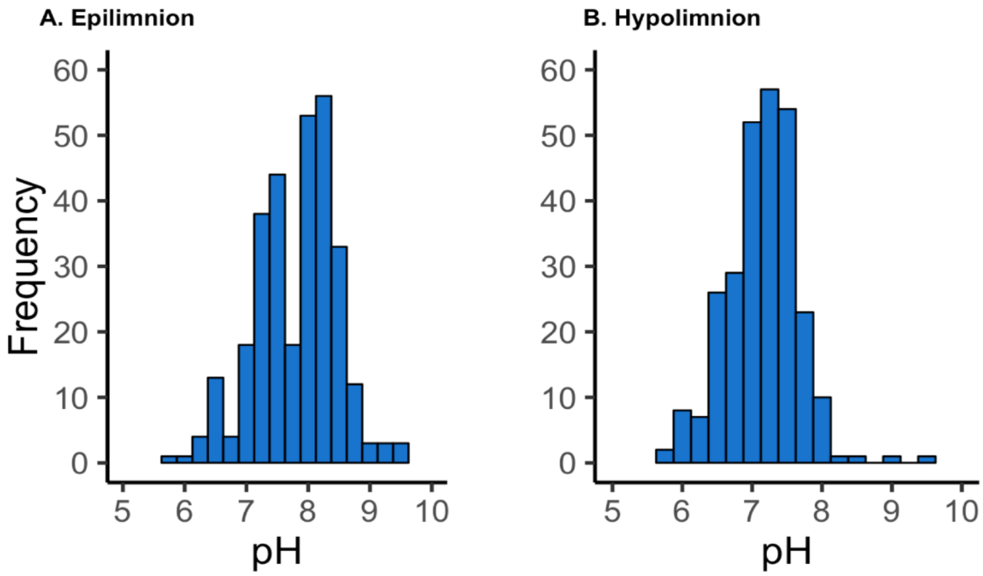

Figure 10 pH distribution for 320 lakes sampled from 2019 to 2022 by (A) epilimnion and (B) hypolimnion.

Median epilimnetic and hypolimnetic values were comparable for both conductivity and acid neutralizing capacity (ANC) (Figure 11). Minimum epilimnetic and hypolimnetic conductivity values were 77 µmhos/cm and 2 µmhos/cm, respectively. Maximum hypolimnetic conductivity was higher than maximum epilimnetic conductivity, with values of 3,230 and 6,130 µmhos/cm, respectively. These values come from Trimble Lake in Sullivan County, a surface mine lake. Median epilimnetic conductivity was 449.89 µmhos/cm compared to 527.24 for hypolimnetic samples.

The median ANC concentration for epilimnetic samples was 148.5 mg $CaCO_3$/L and 193.3 mg $CaCO_3$/L for hypolimnetic samples. Pintail Lake (303.5 mg $CaCO_3$/L) and Airline Lake (2,378 mg $CaCO_3$/L) represented the maximum values for both epilimnion and hypolimnion. Both are surface mine lakes located in Sullivan and Greene Counties.

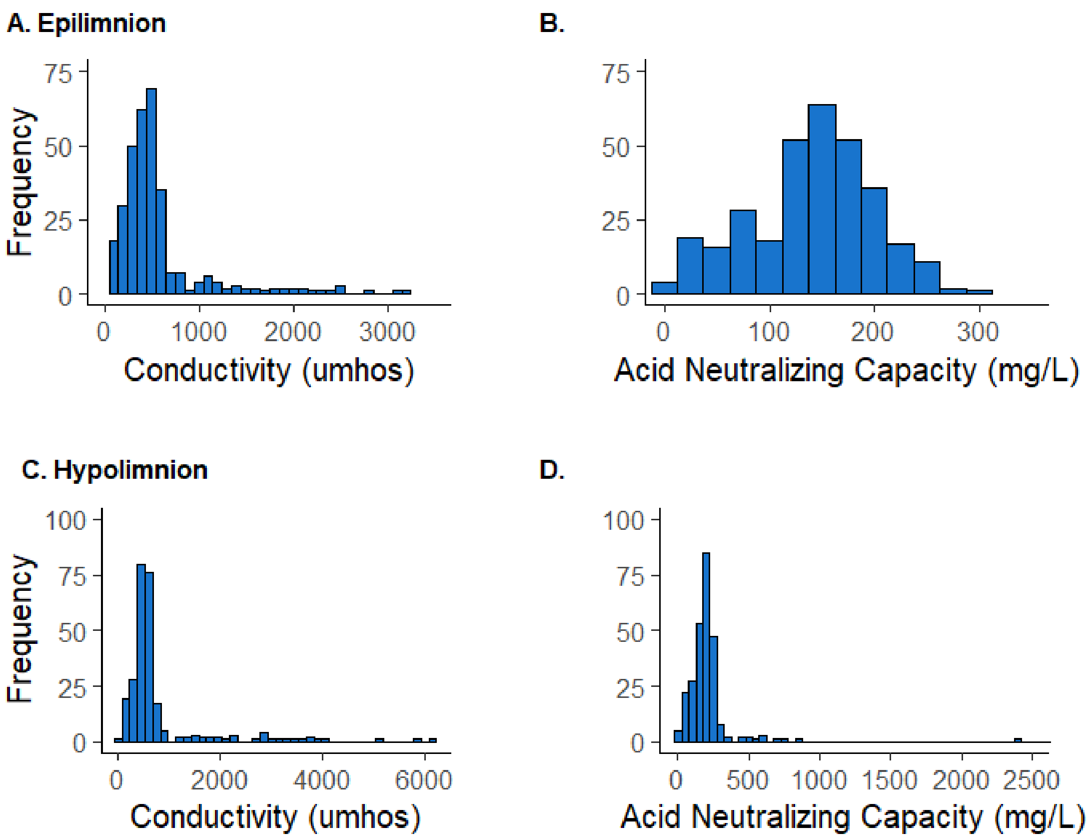

Figure 11 Conductivity and alkalinity distribution for 320 lakes sampled from 2019 to 2022 by (A) epilimnetic conductivity, (B) epilimnetic acid neutralizing capacity (ANC), (C) hypolimnetic conductivity, and (D) hypolimnetic ANC.

SRP and TP

Epilimnetic soluble reactive phosphorus (SRP) concentrations were generally low across all lakes, with a median concentration of 0.01 mg/L (Figure 12). Seventeen lakes (5.3 percent) were at or below the method detection limit of 0.002 mg/L. However, Hovey Lake in Posey County had an SRP concentration of 0.244 mg/L. Hypolimentic SRP were higher than epilimnetic samples, with a median concentration of 0.09 mg/L. Only three lakes (1.1 percent) were at or below the method detection limit. Airline Lake had the highest concentration of 8.284 mg/L.

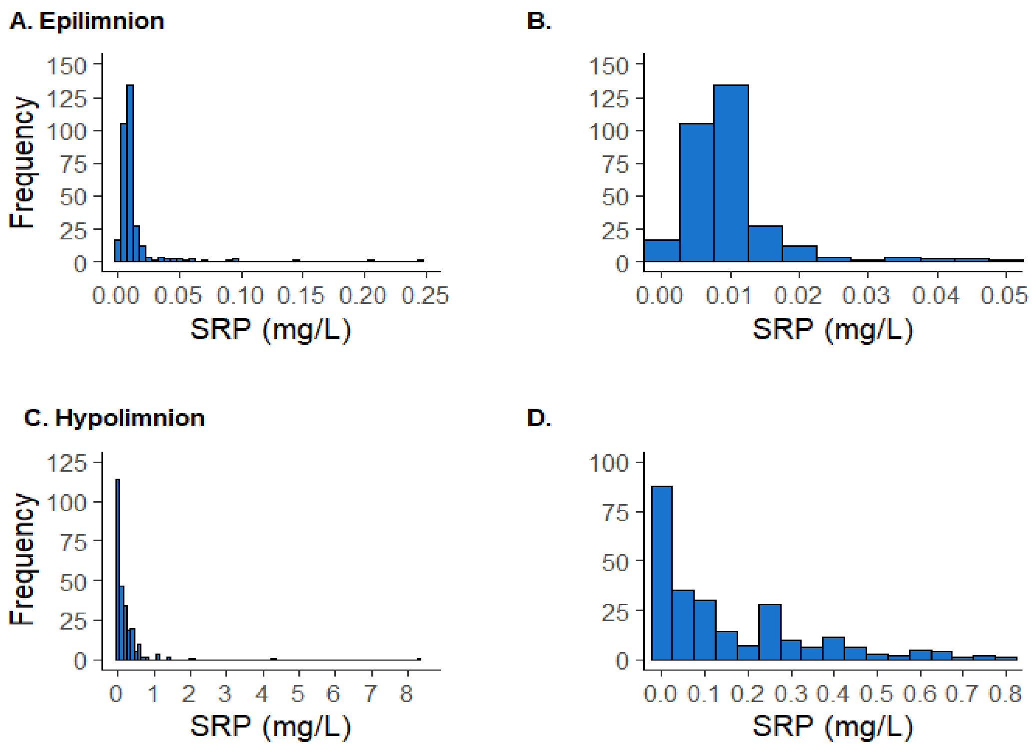

Figure 12 Soluble reactive phosphorus (SRP) distribution for 320 lakes sampled from 2019 to 2022 by (A) total distribution of epilimnetic SRP concentrations, (B) epilimnetic SRP concentrations under 0.05 mg/L, (C) all hypolimnetic SRP concentrations, and (D) hypolimnetic SRP concentrations under 0.80 mg/L.

Epilimnetic total phosphorus (TP) concentrations were lower compared to hypolimnetic samples, with median concentrations of 0.0.028 and 0.142 mg/L, respectively (Figure 13). Barton Lake (Steuben County) had the highest epilimnetic TP concentration of 1.076 mg/L and Airline Lake had the highest hypolimnetic concentration of 6.25 mg/L.

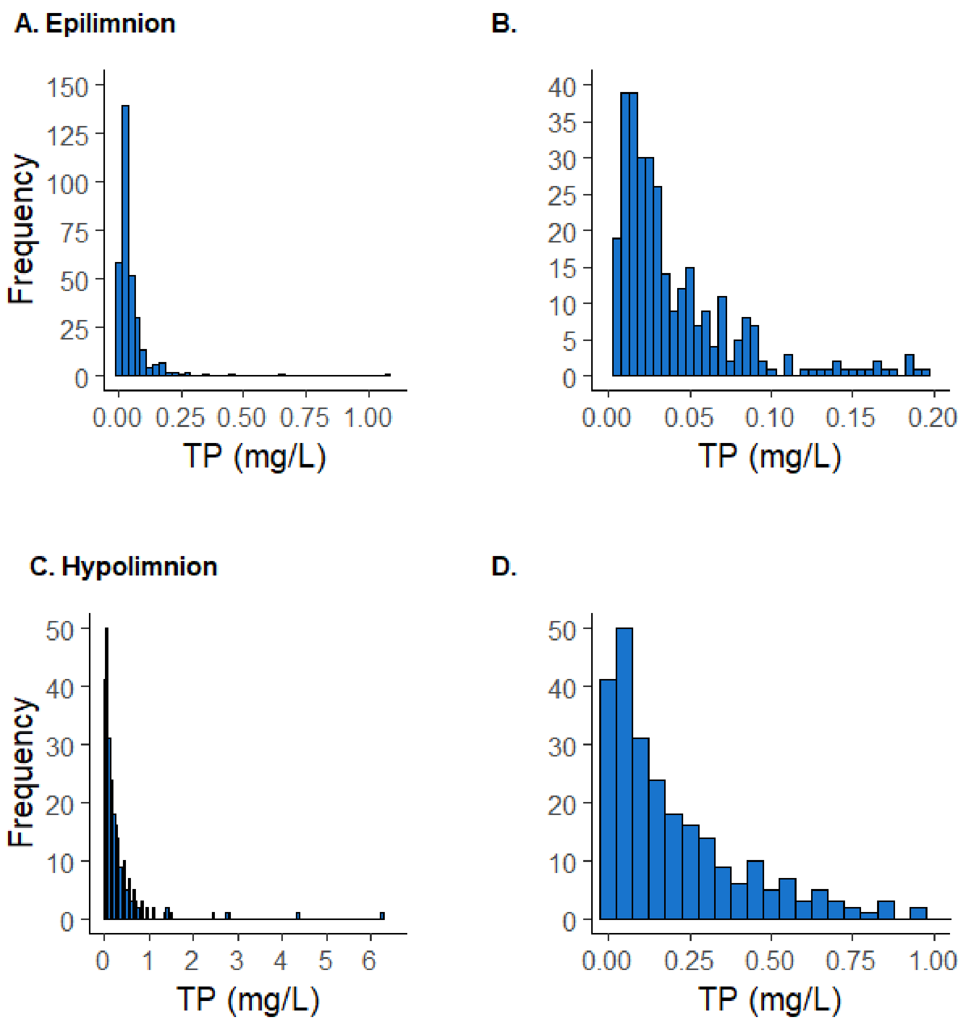

Figure 13 Total phosphorus (TP) distribution for 320 lakes sampled from 2019 to 2022 by (A) the total distribution of epilimnetic TP concentrations, (B) epilimnetic TP concentrations under 0.20 mg/L, (C) all hypolimnetic TP concentrations, and (D) hypolimnetic TP concentrations, and (D) hypolimnetic TP concentrations under 1.00 mg/L.

NO_3-N, NH_3-N, and Org-N

Nitrate-nitrogen median epilimnetic and hypolimnetic concentrations were similar, with concentrations of 0.022 and 0.029 mg/L, respectively (Figure 14). For the lakes sampled, 30.3 percent (97 lakes) had epilimnetic nitrate-nitrogen concentrations below the method detection limit of 0.008 mg/L, and 24.5 percent (64 lakes) had hypolimnetic concentrations below the method detection limit.

Ammonia-nitrogen concentrations were higher in the hypolimnion than the epilimnion (Figure 14). The median epilimnetic ammonia-nitrogen concentration was 0.022 mg/L, with 42.8 percent of lakes sampled below the method detection limit of 0.014 mg/L. In contrast, the median hypolimnetic concentration was 1.002 mg/L with only 7.3 percent of lakes below the method detection limit. Airline Lake had the highest hypolimnetic concentration of 215.7 mg/L.

The median organic-nitrogen concentration was 0.712 mg/L (Figure 14). While Barton Lake had the highest organic-nitrogen concentration of 8.411 mg/L, organic-nitrogen concentrations across the 320 lakes were more normally distributed compared to nitrate-nitrogen and ammonia-nitrogen.

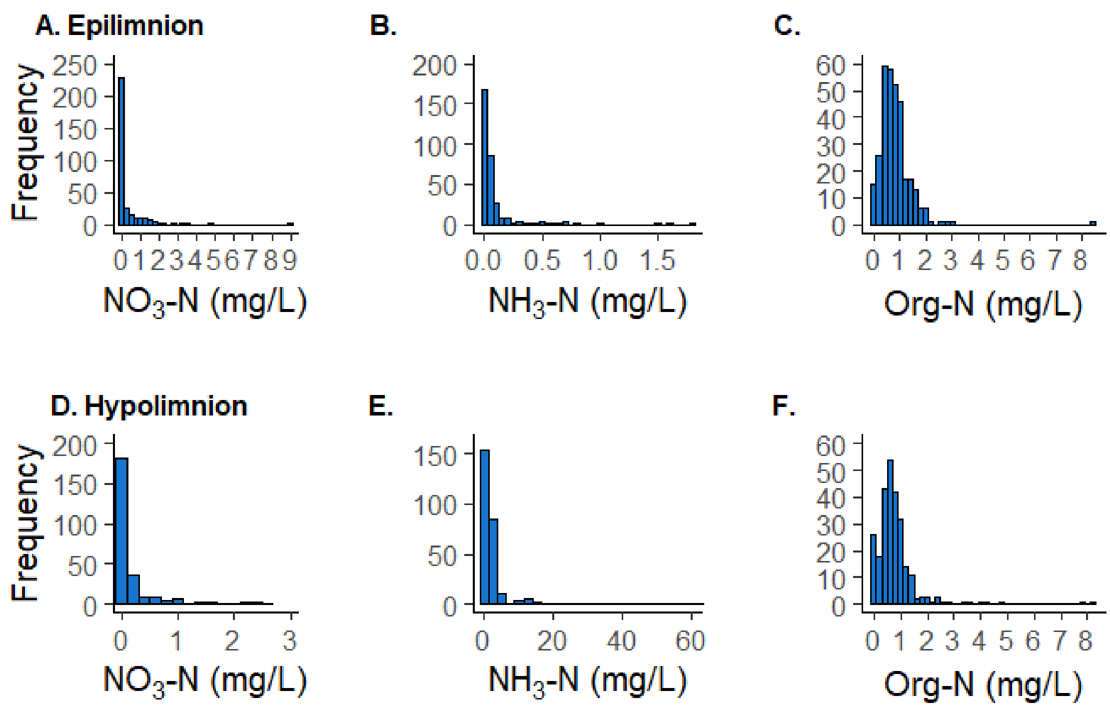

Figure 14 Nitrate-nitrogen (NO3-N), ammonia-nitrogen (NH3-N), and organic-nitrogen (Org-N) distributions for 320 lakes sampled from 2019 to 2022 by (A) epilimnetic NO3-N, (B) epilimnetic NH3-N, (C) epilimnetic Org-N, (D) hypolimnetic NO3-N, (E) hypolimnetic NH3-N, and (F) hypolimnetic Org-N.

Chlorophyll-a and Phytoplankton

Chlorophyll-a concentrations ranged from 0.353 ug/L (Henderson Lake, Noble County) to 285.77 µg/L (Thomas Lake, Marshall County), with a median concentration of 7.25 µg/L. Chlorophyll-a concentrations were highest in impoundments with a mean concentration of 33.85 µg/L, compared to 19.59 µg/L for natural lakes and 8.84 µg/L for surface mine lakes (Figure 15). Hypereutrophic lakes had the highest mean chlorophyll-a concentration of 93.46 µg/L, followed by eutrophic lakes (23.53 µg/L), mesotrophic lakes (3.68 µg/L), and oligotrophic lakes (1.07 µg/L) (Figure 16).

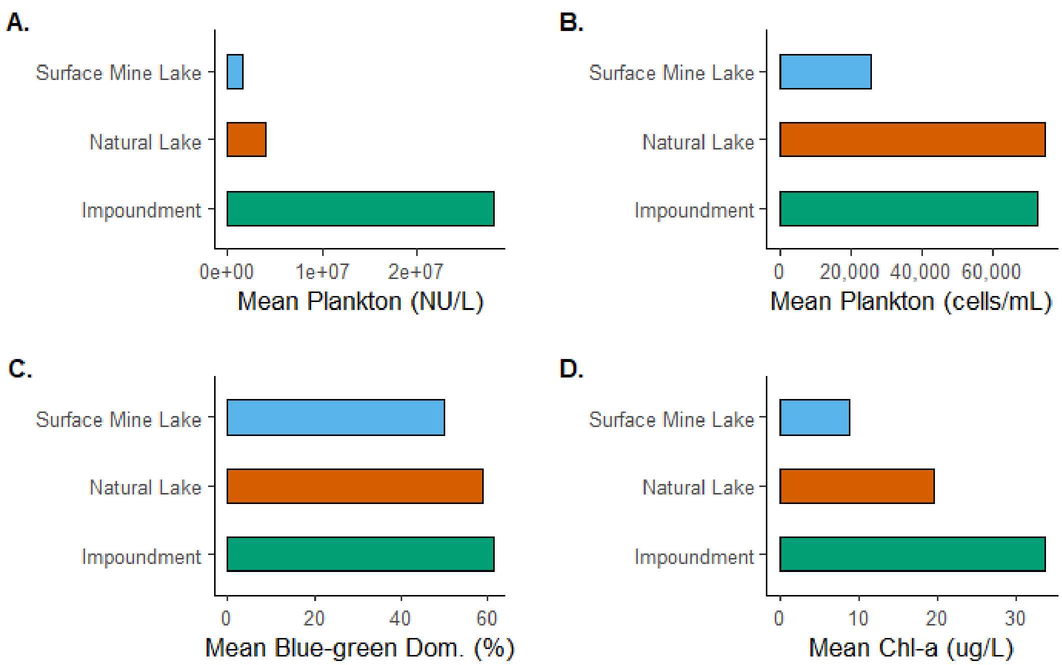

Figure 15 Distribution of (A) mean plankton natural units, (B) mean plankton cells, (C) mean blue-green cell dominance, and (D) mean chlorophyll-a concentration by lake type for 320 lakes sampled from 2019 to 2022.

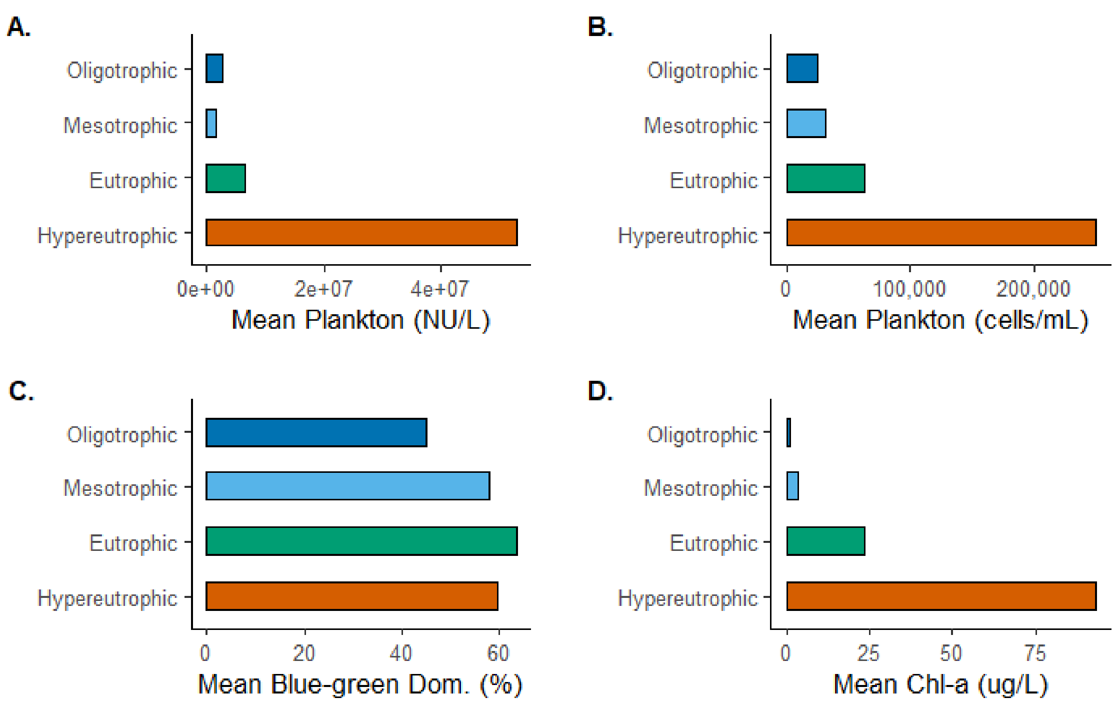

Figure 16 Distribution of (A) mean plankton natural units, (B) mean plankton cells, (C) mean blue-green cell dominance, and (D) mean chlorophyll-a concentration by lake type for 320 lakes sampled from 2019 to 2022.

Mean phytoplankton cell concentration was 65,788 cells/mL. Only Skinner Lake in Noble County's concentration exceeded 1 million cells/mL. Phytoplankton cell concentrations followed similar trends to chlorophyll-a in terms of lake type and trophic state. Mean cell concentrations were incrementally highest for natural lakes (74,741 cells/mL), followed by impoundments (72,405 cells/mL) and then surface mine lakes (25,793 cells/mL). Hypereutrophic lakes had the highest phytoplankton cell concentration, with a mean concentration of 250,180 cells/mL. The mean cell concentration for eutrophic lakes was 63,319 cells/mL. Mesotrophic and oligotrophic lakes had the lowest mean cell concentrations of 31,235 and 24,359 cells/mL, respectively.

Blue-green algae (cyanobacteria) were most dominant in impoundments, accounting for 61.5 percent of all algal cells, followed by natural lakes at 59 percent, then surface mine lakes at only 50 percent of all cells being cyanobacteria. Blue-green dominance had no notable variation for trophic status, aside from oligotrophic lakes. Eutrophic lakes had the highest blue-green dominance of 63.7 percent, followed by 59.7 percent for hypereutrophic lakes, then 58.2 percent for mesotrophic. Cyanobacteria were not the most dominant algal cell type for oligotrophic lakes, at only 45 percent.

Secchi Disk Transparency and Trophic State

Median Secchi depth for all lakes sampled was 1.65 meters (Figure 17). Impoundments have the lowest median Secchi depth of 0.8 meters, whereas surface mine lakes had a median Secchi depth of 2.5 meters. These trends followed for the overall lowest and highest Secchi depths. Hovey Lake (an impoundment) had a Secchi depth of only 0.15 meters and Little George Lake in Clay County (a surface mine lake) had the maximum Secchi depth of 6.05 meters. Falling in the middle, natural lakes had a median Secchi depth of 1.6 meters.

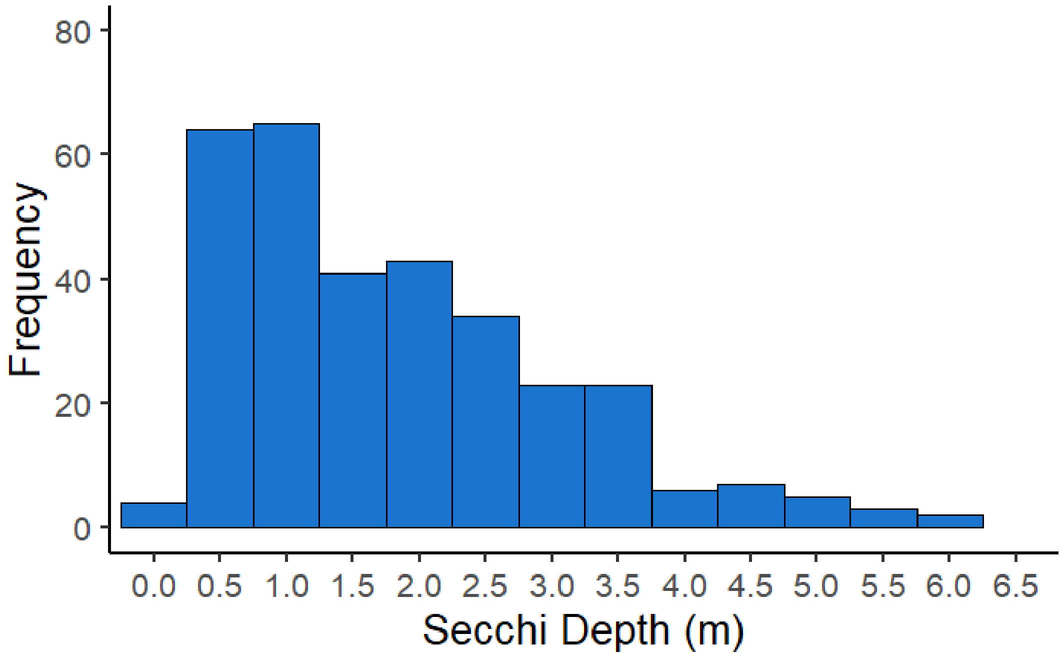

Figure 17 Secchi depth distribution for 320 lakes sampled from 2019 to 2022.

Eutrophic lakes were the most common based on TSI [chl-a], accounting for 36.9 percent of all lakes sampled (Figure 18). Mesotrophic lakes accounted for 34.4 percent of lakes sampled. Only 10.9 percent of lakes sampled were hypereutrophic. Referring back to the chlorophyll section, it is unsurprising that Thomas Lake in Marshall County had the lowest TSI [chl-a] of 20 and Henderson Lake in Noble County had the highest TSI [chl-a] of 86. Median TSI [chl-a] for all lakes sampled was 50.

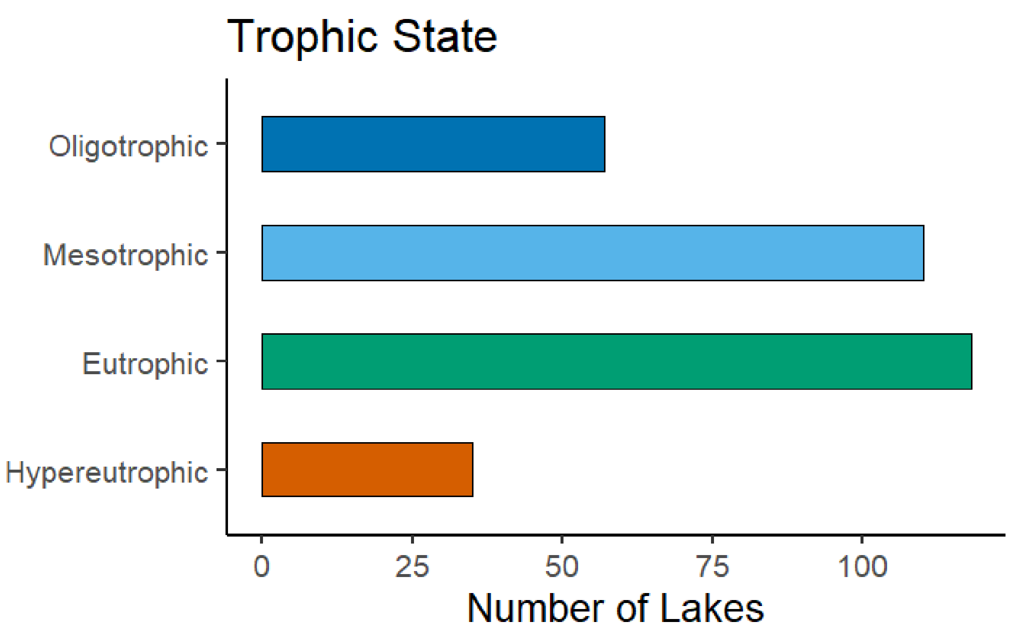

Figure 18 Number of lakes sampled from 2019 to 2022 (n = 320) by Carlson TSI[chl-a].

While TSI [chl-a] is reported consistently throughout this report as it is the best indicator of eutrophication, the relationship between TSI [chl-a] and TSI [TP] is important to examine(Figure 19). Approximately 42 percent of the lakes sampled from 2019 to 2022 fall below the predicted one to one relationship (red line in Figure 19) between chlorophyll-a and total phosphorus according to Carlson (1977). The 42 percent that fall below the predicted relationship indicate that a high percentage of Indiana lakes have non algal bound phosphorus likely a result of sediment bound phosphorus.

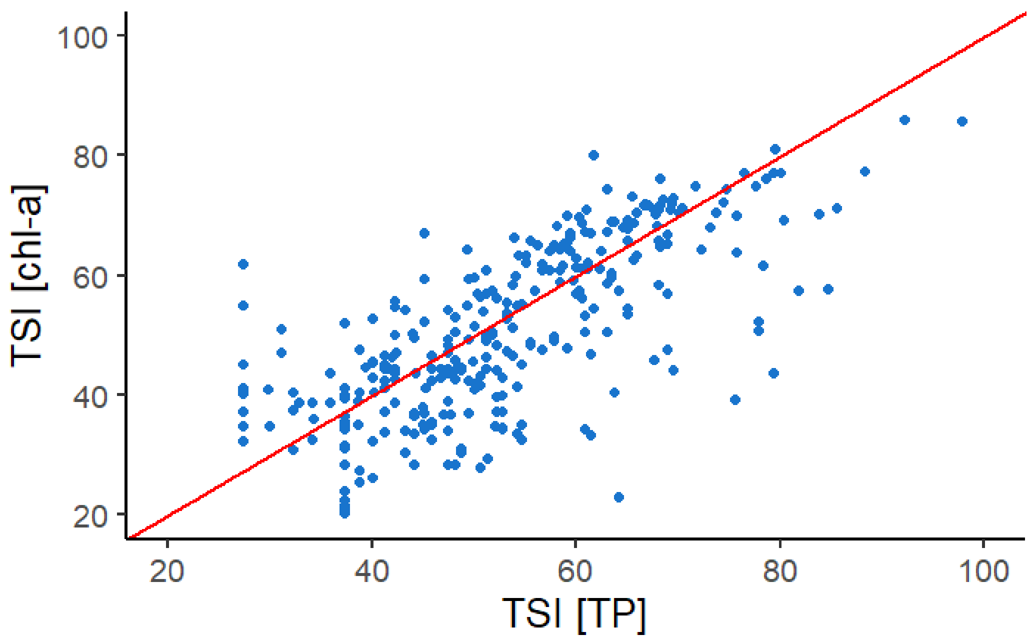

Figure 19 Carlson TSI[TP] plotted against Carlson TSI[chl-a] for 320 lakes sampled from 2019 to 2022. The red line indicates the predicted relationship between TSI[TP] and TSI[chl-a].

Spatial Patterns

The 320 lakes sampled from 2019 to 2022 were located in 5 of the 6 ecoregions in Indiana (Figure 20). The Huron-Erie Lake Plain (Ecoregion 57) was the only ecoregion without a lake sampled. A majority of lakes sampled were in northeastern Indiana, with 60 percent occurring in the Southern Michigan/Northern Indiana Till Plain (Ecoregion 56).

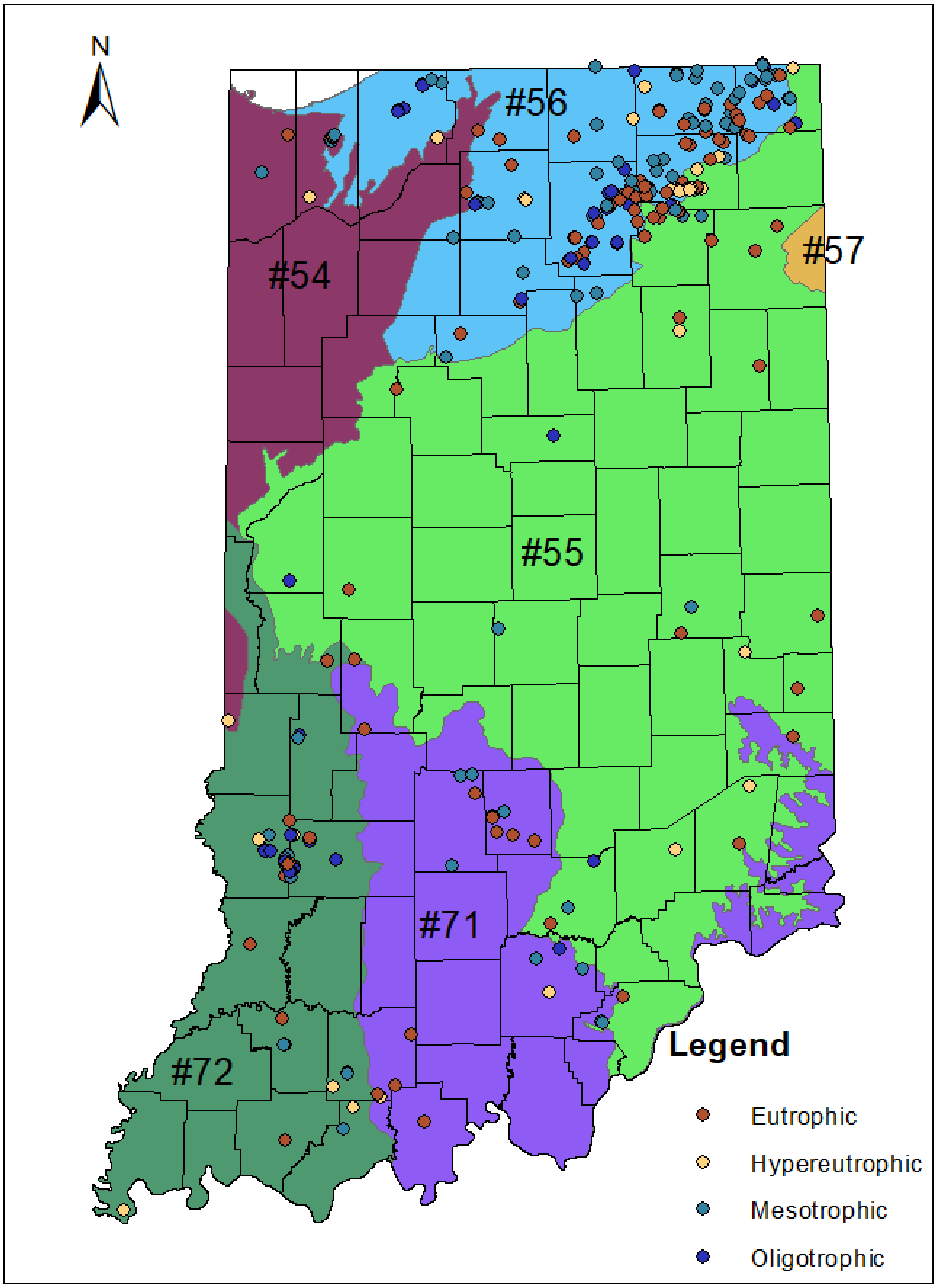

Figure 20 Location of lakes from 2019 to 2022 (n = 320) by Carlson TSI [chl-a] overlain on Indiana ecoregions (represented by color and corresponding number).

The Eastern Corn Belt Plains (Ecoregion 55) and the Central Corn Belt Plains (Ecoregion 54) had the highest median chlorophyll-a concentrations of 31.29 ug/L and 14.2 ug/L, respectively (Figure 21). The Interior Plateau (Ecoregion 71) had the lowest median chlorophyll-a concentration of 4.48 ug/L.

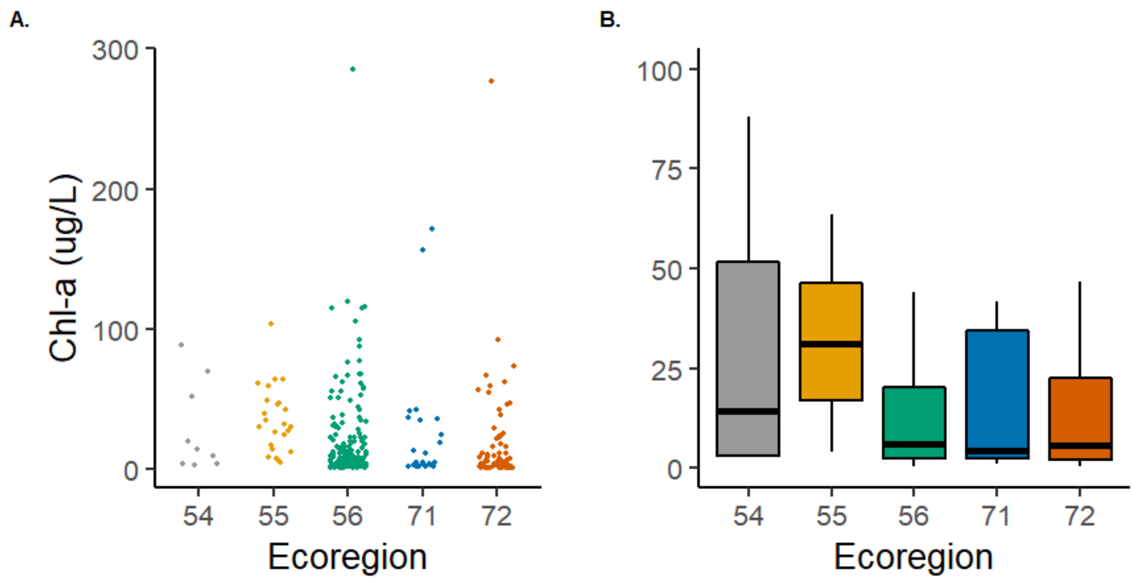

Figure 21 Chloropyll-a (chl-a) distribution by ecoregion for 320 lakes sampled from 2019 to 2022. Figure (A) illustrates the total distribution by a dot plot and (B) illustrates the same distribution with a box pot.

Total phosphorus concentrations followed similar spatial patterns to that of chlorophyll-a concentrations (Figure 22). Ecoregion 54, 55, and 56 had higher median TP concentrations compared to that of Ecoregion 71 and 72. Median TP concentration was highest in Ecoregion 55 with a concentration of 0.068 mg/L, and Ecoregion 71 had the lowest median concentration of 0.017 mg/L.

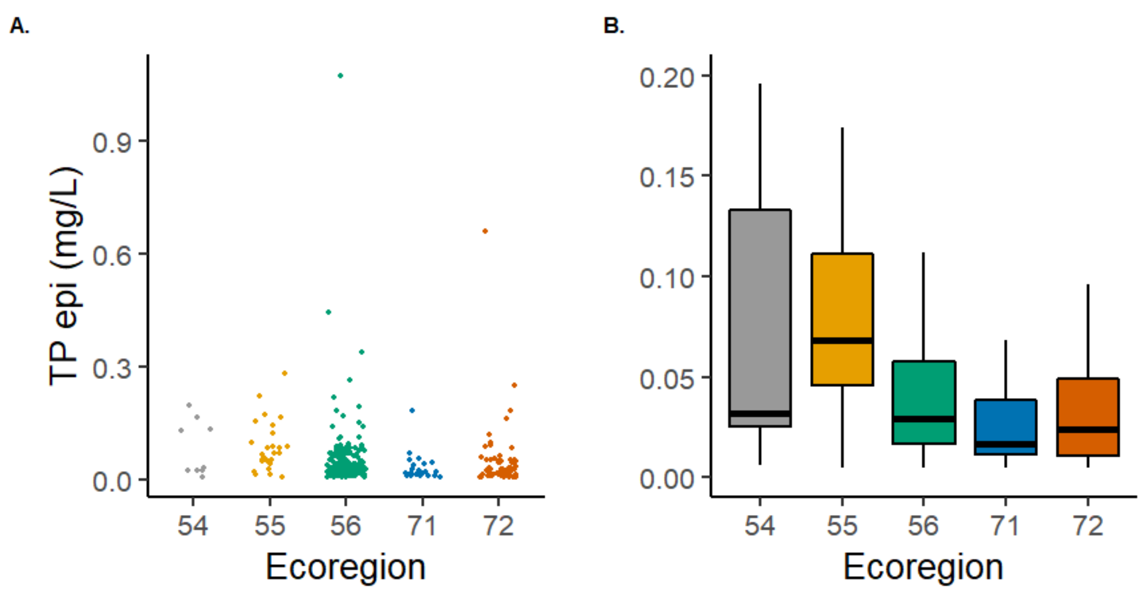

Figure 22 Total phosphorus (TP) distribution by ecoregion for 320 lakes sampled from 2019 to 2022 by the (A) total TP distribution via dot plot and the (B) TP distribution via box plot.

Median Secchi depths were highest in Ecoregion 72 (2.15 meters) and 71 (2.13 meters) (Figure 23). Ecoregion 55 had the lowest median Secchi depth of 0.70 meters. Little George Lake in Ecoregion 72 consistently had high Secchi depths, the highest overall value of 6.05 in 2021 and third highest of 5.75 in 2020.

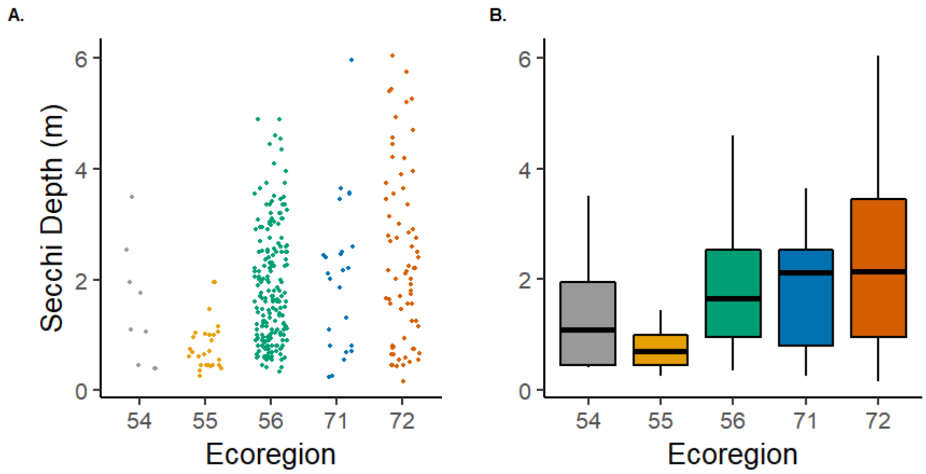

Figure 23 Secchi depth distribution by ecoregion for 320 lakes sampled from 2019 to 2022 by the (A) total Secchi depth distribution via dot plot and (B) Secchi depth distribution via box plot.

TSI [chl-a] median values followed similar trends across ecoregions with chlorophyll-a and total phosphorus (Figure 24). Median TSI [chl-a] values were highest in Ecoregion 54 and 55, both of which were above the bottom limit of the eutrophic classification of 51. Ecoregion 71 had the lowest median TSI [chl-a] value of 45.3.

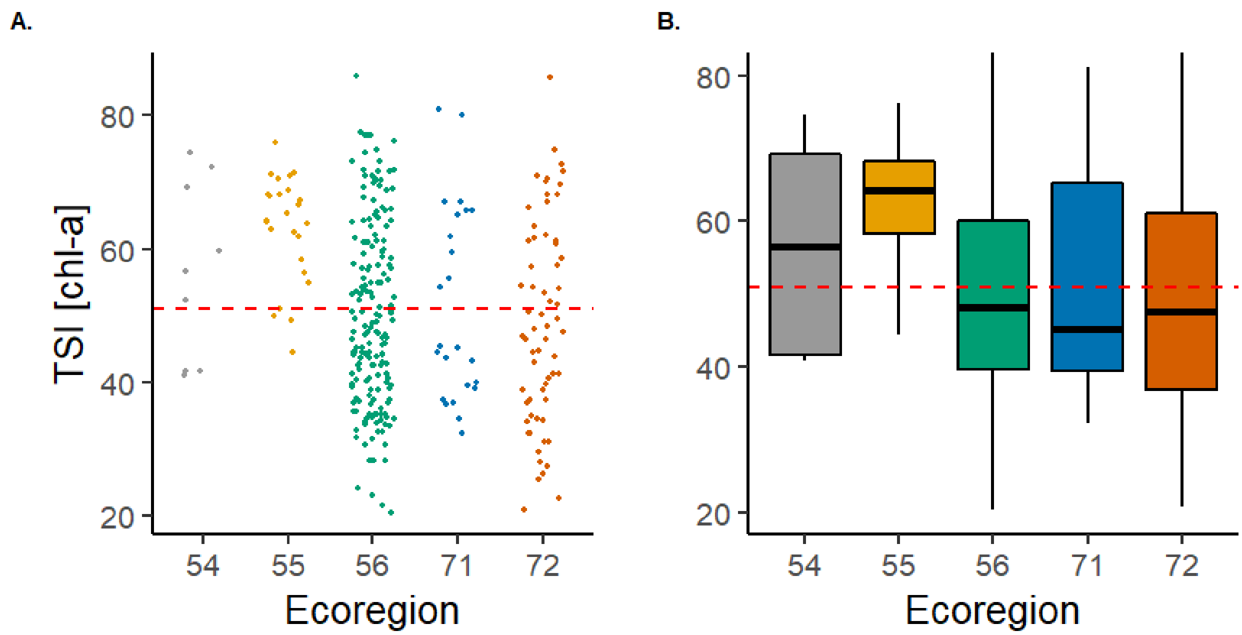

Figure 24 Carlson TSI [chl-a] distribution by ecoregion for 320 lakes sampled from 2019 to 2022. Figure (A) illustrates the total distribution by a dot plot and (B) illustrates the same distribution with a dox plot. The dashed line indicates the TSI break between eutrophic and mesotrophic.

Lake Type Characteristics

Natural lakes represented the most common lake type sampled during the project, accounting for 60 percent of all lakes sampled. Impoundments, or reservoirs, represented 23 percent of lakes sampled, and 17 percent of lakes were surface mine lakes.

Impoundments had the highest median surface area of all lake types, but the lowest median maximum depth (Figure 25, Figure 26). Impoundments also had the largest variation in surface area from 0.81 to 8,880 hectares. While the median surface area of natural lakes was less than half of the median for impoundments, natural lakes were the deepest of the three lake types. The median surface area and maximum depth for natural lakes was 29.95 hectares and 11 meters, respectively. Median surface area for surface mine lakes was the smallest of the three lake types, with a value of 4.45 hectares. Surface mine lakes were generally deeper than that of impoundments but shallower compared to natural lakes, with a median maximum depth of 7.8 meters. The largest lake sampled was Patoka Reservoir (Dubois County) and Tippecanoe Lake (Kosciusko County) was the deepest lake sampled.

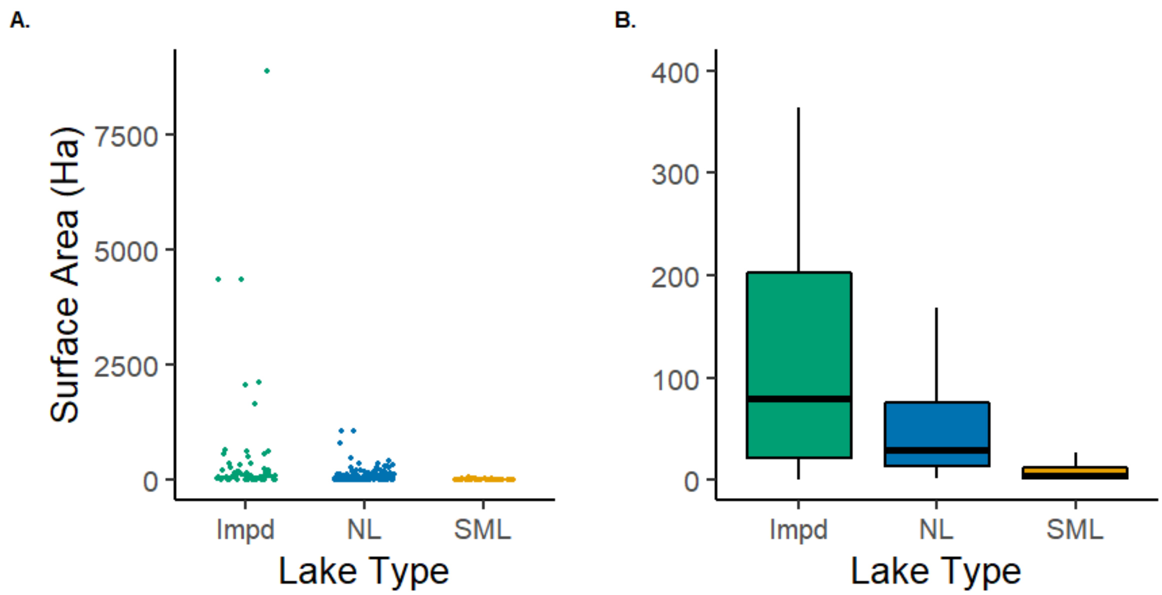

Figure 25 Surface area distribution by lake type for 320 lakes sampled from 2019 to 2022 by the (A) total surface area distribution by a dot plot and (B) surface area distribution by a box plot (Impd = impoundments; NL = natural lakes; SML = surface mine lakes).

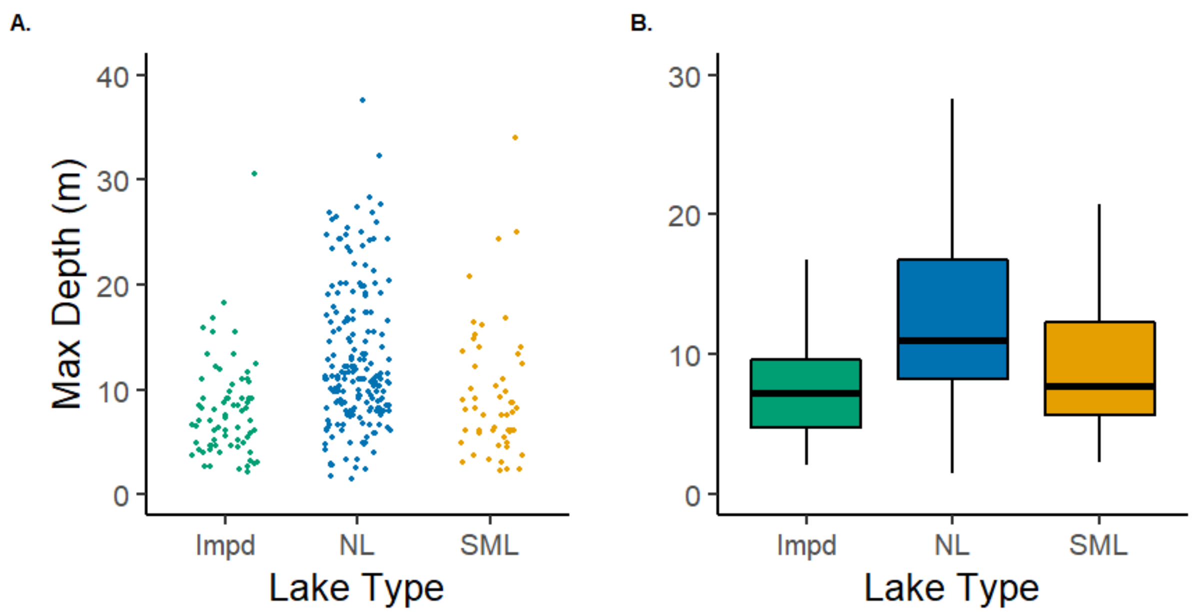

Figure 26Maximum depth distribution by lake type for 320 lakes sampled from 2019 to 2022. Figure (A) illustrates the total distribution by a dot plot and (B) illustrates the same distribution with a box plot (Impd = impoundments; NL = natural lakes; SML = surface mine lakes).

Natural lakes had the highest median epilimnetic ANC concentration of 160 mg $CaCO_3$/L (Figure 27). Median ANC concentration for surface mine lakes was 129 mg $CaCO_3$/L, and surface mine lakes had the greatest ANC variation of the three lake types (3.2 to 303.5 mg $CaCO_3$/L). The median ANC concentration for impoundments was 89.25 mg $CaCO_3$/L.

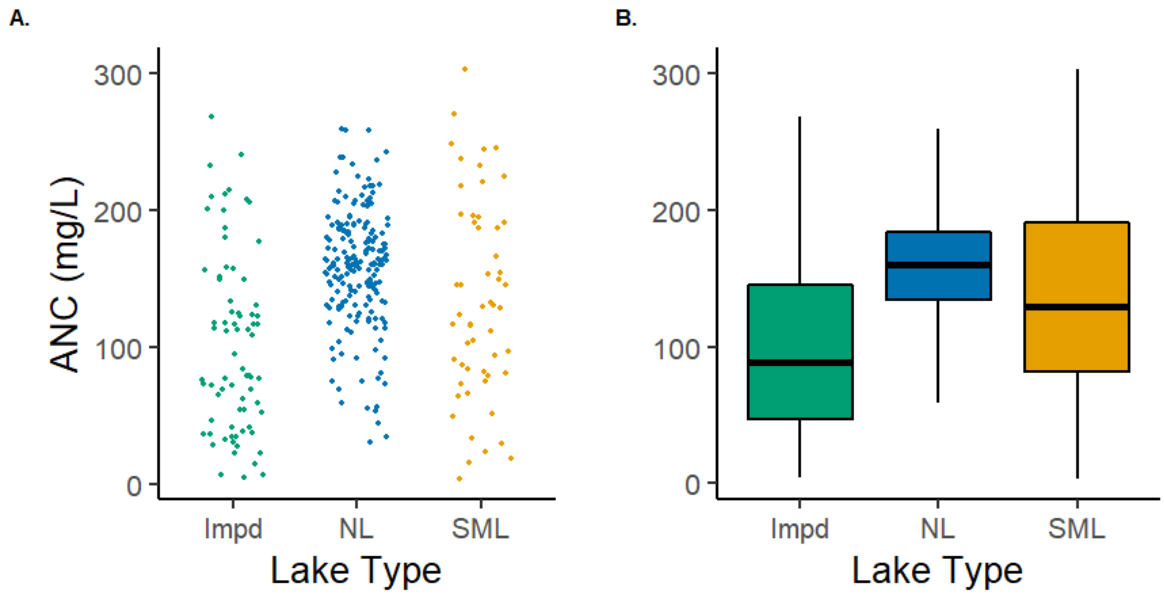

Figure 27 Acid neutralizing capacity (ANC) distribution by lake type for 320 lakes sampled from 2019 to 2022 by (A) total ANC distribution by a dot plot and (B) total distribution by a box plot (Impd = impoundments; NL = natural lakes; SML = surface mine lakes).

Median epilimnetic conductivity in surface mine lakes was almost three times the median of natural lakes, with conductivities of 1239.8 and 453.93 µmhos/cm, respectively (Figure 28). Surface mine lakes also had the greatest variation in conductivity, with values ranging from 142.07 to 3229.5 µmhos/cm. Impoundments had the lowest conductivity of the lake types, with a median conductivity of 262.46 µhmos/cm.

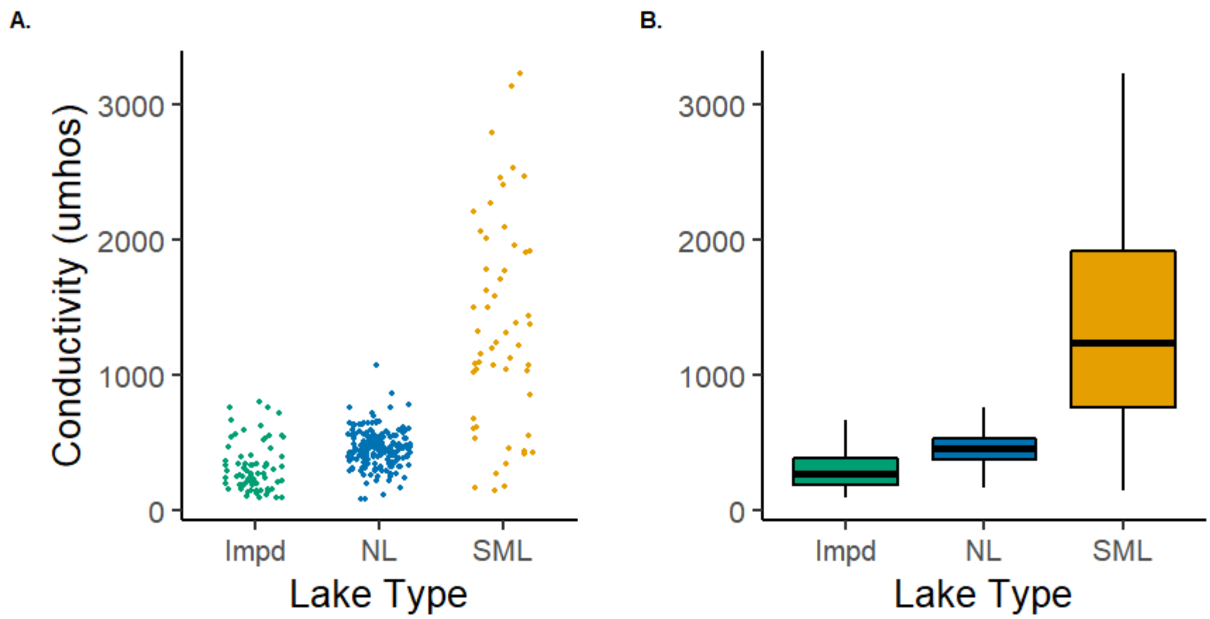

Figure 28 Conductivity distribution by lake type for 320 lakes sampled from 2019 to 2022. Figure (A) illustrates the total distribution by a dot plot and (B) illustrates the same distribution with a box plot (Impd = impoundments; NL = natural lakes; SML = surface mine lakes).

Epilimnetic pH values were consistent across lake types, with only a 0.56 deviation between median pH values (Figure 29). Impoundments had a median pH of 8.52, natural lakes had a median pH of 8.37, and surface mine lakes had a median pH of 7.96.

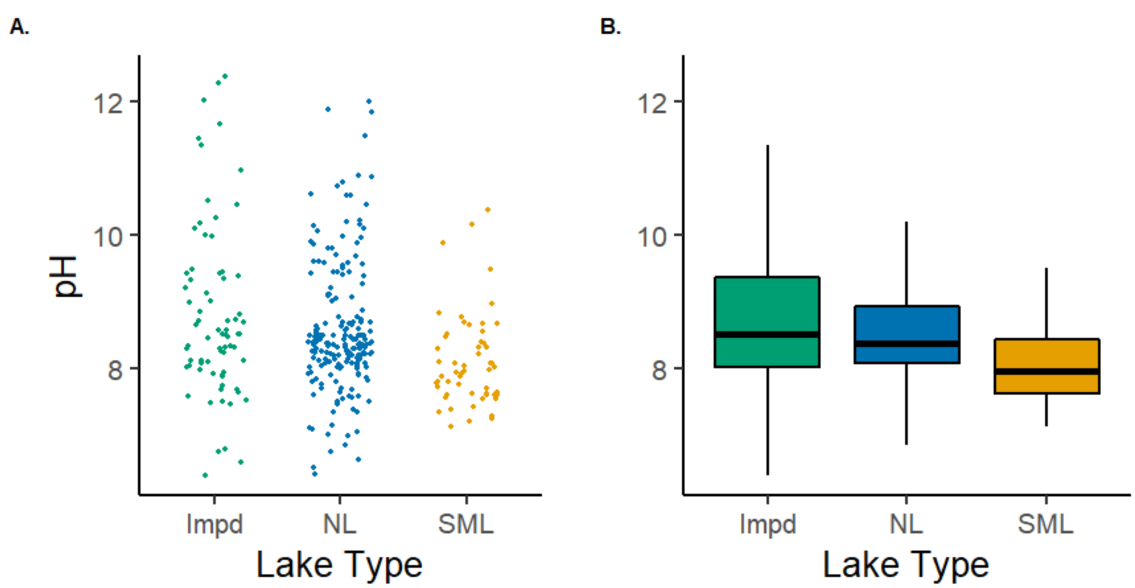

Figure 29 pH distribution by lake type for 320 lakes sampled from 2019 to 2022. Figure (A) illustrates the total distribution by a dot plot and (B) illustrates the same distribution with a box plot (Impd = impoundments; NL = natural lakes; SML = surface mine lakes).

Natural lakes had the highest median concentrations of NO_3-N, NH_3-N. Impoundments had the highest median TP concentrations (Figure 30, Figure 31, Figure 32). Median concentrations of NO_3-N and NH_3-N in natural lakes were also almost twice the median concentration of surface mine lakes. Natural lakes median TP concentration was almost half that of impoundments.

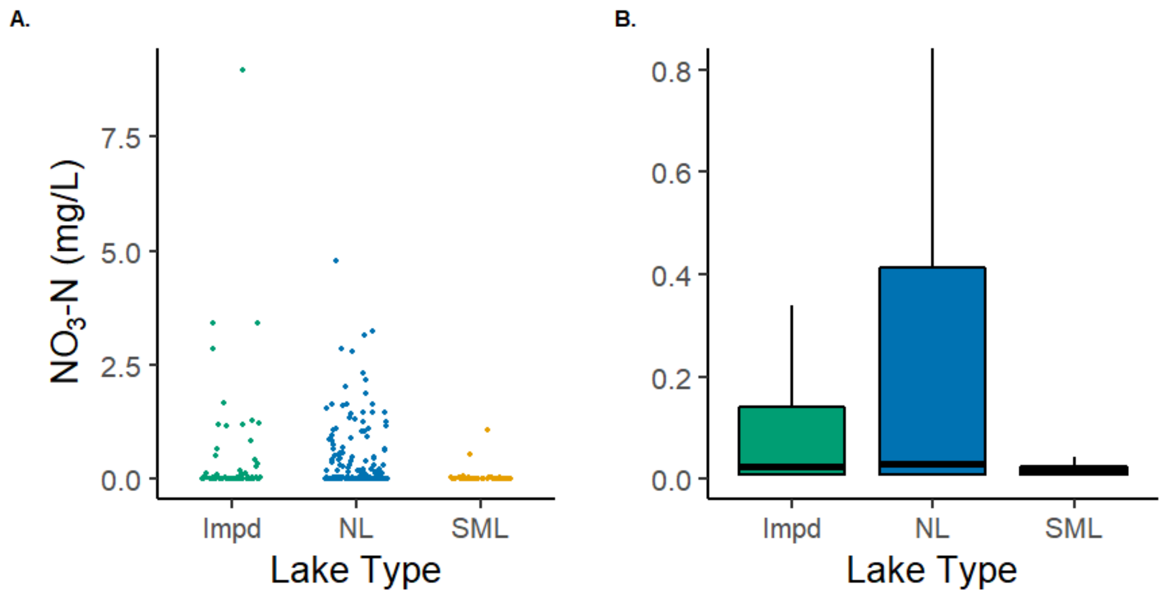

Figure 30 Nitrate-nitrogen (NO3-N) distribution by lake type for 320 lakes sampled from 2019 to 2022 by (A) total NO3-N distribution by a dot plot and (B) total distribution by a box plot (Impd = impoundments; NL = natural lakes; SML = surface mine lakes).

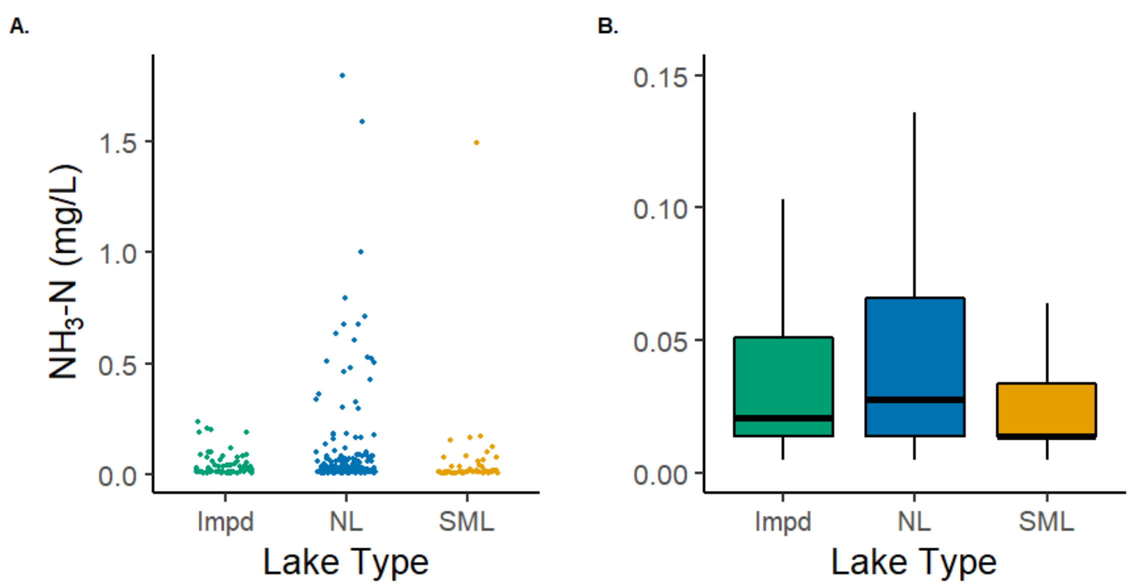

Figure 31 Ammonia-nitrogen (NH3-N) distribution by lake type for 320 lakes sampled from 2019 to 2022 by (A) total NH3-N distribution by dot plot and (B) total distribution by box plot (Impd = impoundments; NL = natural lakes; SML = surface mine lakes).

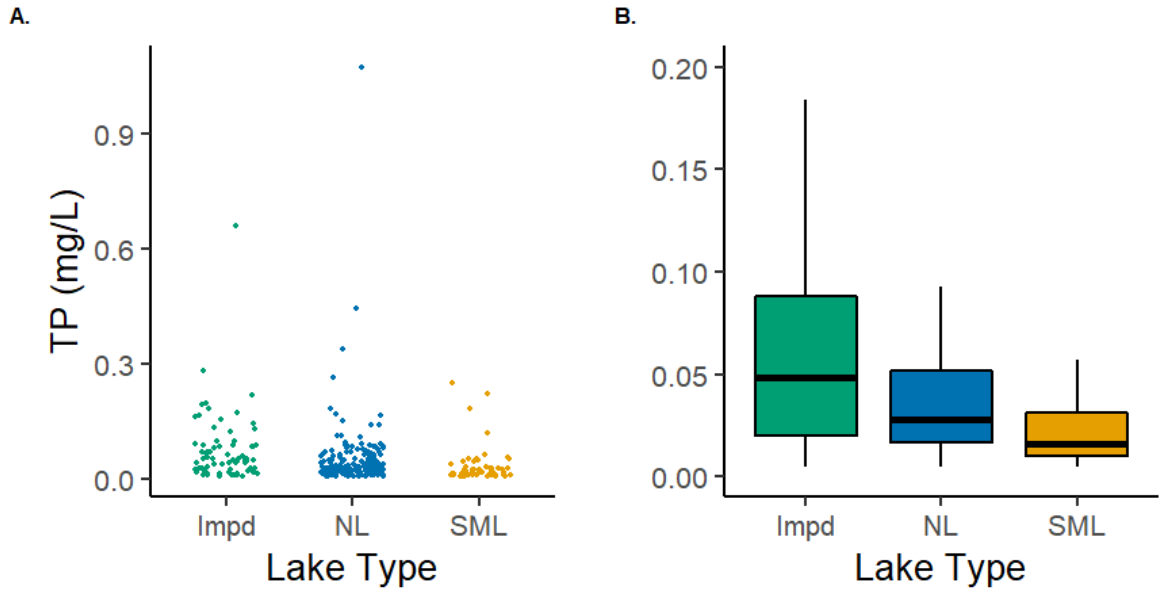

Figure 32 Total phosphorus (TP) distribution by lake type for 320 lakes sampled from 2019 to 2022 by the (A) total TP distribution via dot plot and the (B) TP distribution via box plot.

Chlorophyll-a concentrations were highest in impoundments, with a median chlorophyll-a concentration of 22.96 µg/L (Figure 33). Natural lakes had the second highest median chlorophyll-a concentration of 6.08 followed by surface mine lakes of 3.27. The maximum chlorophyll-a concentration, 285.77 µg/L, across all lakes sampled was in a natural lake.

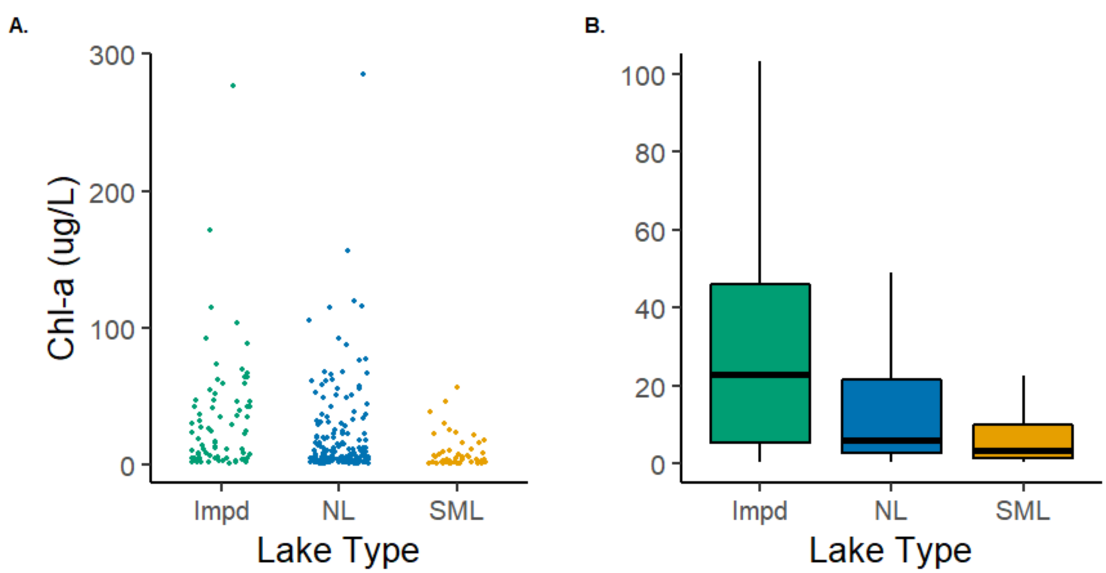

Figure 33 Chloropyll-a (chl-a) distribution by lake type for 320 lakes sampled from 2019 to 2022. Figure (A) illustrates the total distribution by a dot plot and (B) illustrates the same distribution with a box pot.

Secchi depths by lake type followed an inverse relationship to that of chlorophyll-a as expected (Figure 34). Median Secchi depth for surface mine lakes was 2.5 meters, 1.6 meters for natural lakes, and 0.8 meters for impoundments.

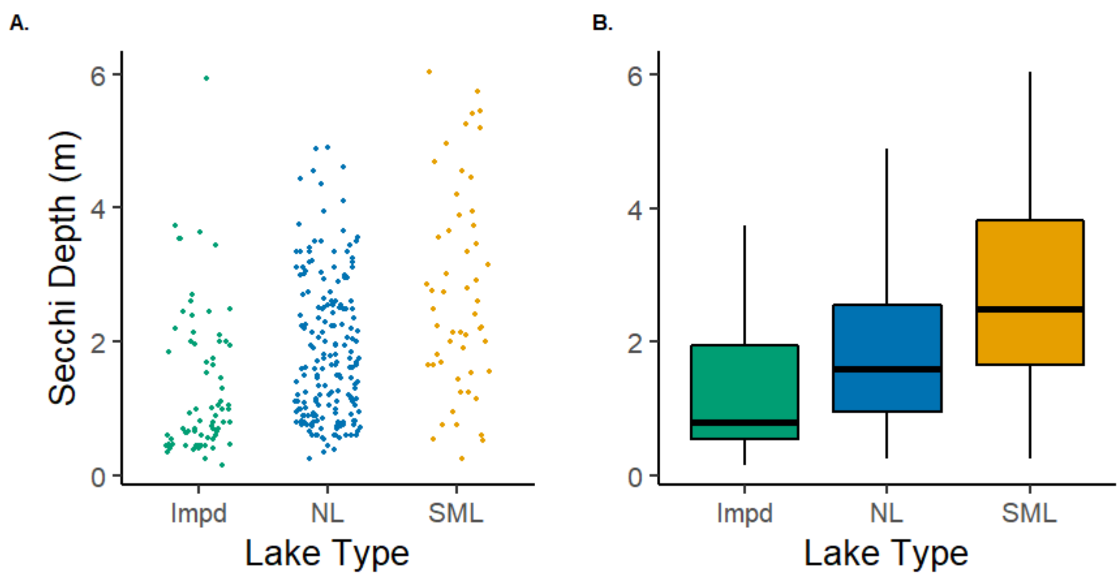

Figure 34 Secchi depth distribution by lake type for 320 lakes sampled from 2019 to 2022 by (A) total Secchi depth distribution via dot plot and (B) total distribution via box plot (Impd = impoundments; NL = natural lakes; SML = surface mine lakes).

Median TSI [chl-a] values for impoundments were greater than the bottom limit for the eutrophic interpretation, with a median of 63 (Figure 35). The median value for natural lakes was only slightly greater than the bottom of the eutrophic limit, with a value of 53. Median TSI [chl-a] for surface mine lakes was 46. Overall, 70 percent of impoundments were either eutrophic or hypereutrophic, compared to 45 percent of natural lakes and 14 percent of surface mine lakes.

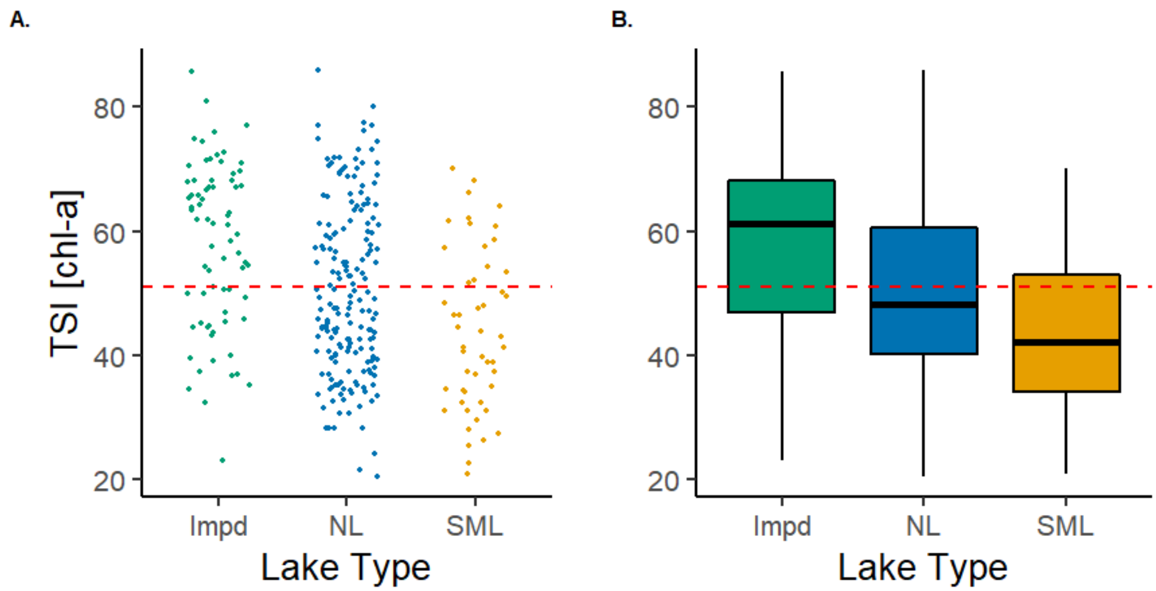

Figure 35 TSI [chl-a] distribution by lake type for 320 lakes sampled from 2019 to 2022. Figure (A) illustrates the total TSI [chl-a] distribution by a dot plot and (B) illustrates the same distribution with a box plot (Impd = impoundments; NL = natural lakes; SML = surface mine lakes).

DISCUSSION

State of Indiana Lakes

Many lakes throughout the state of Indiana receive high nutrient loads, and thus are productive aquatic systems. This was expected as agricultural activity is a dominant land use throughout the state, and the subsequent runoff of nutrients, specifically nitrogen and phosphorus, would contribute to increased productivity in lakes.

Nitrogen and phosphorus are two primary nutrients needed for plant growth. As a result, increased nutrient loading can contribute to increased algal growth. Algal communities occur in nearly all lakes and are an important part of the food chain. However, when nuisance blooms form, or cyanobacteria populations increase there is a potential for concern. Cyanobacteria can produce toxins that are harmful to human health and wildlife. Cyanobacteria accounted for more than 90 percent of algal cells measured in 35 percent of lakes sampled.

Trophic state is perhaps the most useful measure of the current state of Indiana Lakes, as well as a tool to compare Indiana to other states and regions across the United States. We found that nearly half (47.8 percent) of Indiana lakes were either eutrophic or hypereutrophic based on TSI [chl-a], indicating high levels of productivity. We did find some deviation in the relationship between the predicted relationship between TSI [chl-a] and TSI [TP]. According to Carlson (1977), chlorophyll-a concentrations can be predicted based on the TP concentration in the lake. However, we found that almost half of the actual values were less than the predicted values. Non-algal turbidity is likely driving this deviation. Indiana Lakes are generally more turbid as a result of sediment runoff compared to the lakes that Carlson used in his model. Increased non-algal turbidity would reduce light penetration, decreasing the depth of the euphotic zone, and decreasing algal photosynthesis. Leveraging the known relationship with Carlson TSI values we can gain additional insight on the function of Indiana lakes.

Spatial Patterns

Aggregating lakes by ecoregion is helpful to identify regional differences in lake water quality. Ecoregion 54 (Eastern Corn Belt Plains) and 55 (Central Corn Belt Plains) had higher median values for chlorophyll-a, TP, and TSI [chl-a] compared to Ecoregions 56, 71, and 72. Row crop agriculture is the primary land use with Ecoregions 54 and 55. The relationship between agricultural fertilizers and lake eutrophication is well established is likely the cause of increased nutrient concentrations and trophic state (Novotny 2003).

Ecoregions 71 and 72, located in southern Indiana, have less agricultural activity, more forested land, and are primarily impoundments. Even though reservoirs have larger watersheds and increased potential for higher nutrient loads, these ecoregions all had lower median productivity values. This indicates the importance of land use on lake water quality. Ecoregion 71 and 72 had higher median Secchi depth measurements compared to ecoregion 54 and 55.

While we see qualitative differences in our lakes aggregated by ecoregion, further statistical analysis is needed to develop a quantitative comparison. A previous study conducted by Tetra Tech (2008) concluded that there were no significant differences between the geographic regions of Indiana in terms of water quality. However, their analysis instead concluded that there were significant differences between the three dominant lake types in Indiana.

Lake Type Patterns

Limnological characteristics can vary greatly with lake type. Our data included three lake types: natural lakes, impoundments, and surface mine lakes. Impoundments generally had a larger surface area, were shallower, and more productive compared to natural lakes and surface mine lakes. This finding was expected as larger watersheds can contribute higher nutrient loads and shallower lakes have a large portion of the water column in the euphotic zone, contributing to increased productivity.

Natural lakes were the deepest lakes sampled, and had median hypolimentic nutrient samples (e.g. TP, SRP) that were higher than that of impoundments and surface mine lakes. This is likely from the depth of the lake promoting increased thermal stability, causing the hypolimnion to be anoxic longer, and promoting the release of sediment-bound phosphorus into the lake.

Surface mine lakes were unique compared to the other lake types. Surface mine lakes had low median pH, mid median ANC concentration, and extremely high conductivity values compared to the other lake types. High conductivity in surface mine lakes is a byproduct of the mining process, where iron-sulfur compounds in mine waste can leach ions out of the soil and into the water column (Gyure et al. 1987). As conductivity is a measure of the ability of water to pass an electrical current, increased concentrations of dissolved ions cause higher conductivities in these lakes.

CONCLUSIONS

Summary conclusions from the 2019 to 2022 lake water quality assessment program include:

- Phosphorus concentrations in many Indiana lakes can be excessive and contribute to eutrophication.
- Internal phosphorus from lake sediments is an important source of phosphorus in many lakes and is inherently difficult to control.
- High non-algal turbidity in many Indiana lakes may results in reduced algal communities otherwise predicted by available phosphorus concentrations.
- Cyanobacteria are common in Indiana lakes and should be monitored.
- Almost half of Indiana lakes assessed were either eutrophic or hypereutropohic. However, 34 percent of lakes were mesotrophic.
- Impoundments were generally the most productive lakes assessed.
- Carlson’s Trophic State Index is a useful measure of overall tropic state of Indiana Lakes.

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APPENDICES

Appendix A – Information for Indiana lakes sampled from 2019 to 2022.

Lake Name	*County*	*Lake Type*	*Year*	*Surface Area (ha)*	*Max Depth (m)*
St. Joseph Reservoir	Allen	Impoundment	2019	30.0	3.048
Deam	Clark	Impoundment	2019	195	8.5344
Oak	Clark	Impoundment	2019	2	3.9624
Stump Jumper	Clay	Surface Mine Lake	2019	6	9.7536
Ferdinand City (State Forest)	Dubois	Impoundment	2019	36	6.4008
Huntingburg City	Dubois	Impoundment	2019	181	7.0104
Patoka Reservoir	Dubois	Impoundment	2019	8880	15.8496
Nyona	Fulton	Natural Lake	2019	104.0	9.7536
South Mud	Fulton	Natural Lake	2019	94.0	8.2296
Airline	Greene	Surface Mine Lake	2019	25	20.7264
Long (Hillenbrand)	Greene	Surface Mine Lake	2019	8	6.096
Moss	Greene	Surface Mine Lake	2019	20	2.4384
Scott	Greene	Surface Mine Lake	2019	12.0	14.0208
Clair	Huntington	Surface Mine Lake	2019	43.0	16.4592
Starve Hollow	Jackson	Impoundment	2019	145.0	5.1816
Center	Kosciusko	Natural Lake	2019	120.0	12.192
Diamond	Kosciusko	Natural Lake	2019	105.0	10.9728
Hammond	Kosciusko	Natural Lake	2019	5.0	10.0584
James	Kosciusko	Natural Lake	2019	267.0	19.2024
Kuhn	Kosciusko	Natural Lake	2019	118.0	8.2296
Little Chapman	Kosciusko	Natural Lake	2019	120.0	8.8392
North Little	Kosciusko	Natural Lake	2019	12.0	7.9248
Oswego	Kosciusko	Natural Lake	2019	41.0	10.9728
Palestine	Kosciusko	Impoundment	2019	232.0	8.2296
Sellers	Kosciusko	Natural Lake	2019	32.0	6.7056
Silver	Kosciusko	Natural Lake	2019	102.0	9.4488
Winona	Kosciusko	Natural Lake	2019	478.0	24.384
Big Long	LaGrange	Natural Lake	2019	366.0	24.9936
North Twin	LaGrange	Natural Lake	2019	135.0	11.5824
Oliver	LaGrange	Natural Lake	2019	371.0	27.432
Royer	LaGrange	Natural Lake	2019	69.0	15.24
Shipshewana	LaGrange	Natural Lake	2019	202.0	3.9624
Fancher	Lake	Natural Lake	2019	4	12.2
George (Hobart)	Lake	Impoundment	2019	270	2.7432
Hog	LaPorte	Natural Lake	2019	59.0	10.3632
Hudson	LaPorte	Natural Lake	2019	432.0	12.8016
Flat	Marshall	Natural Lake	2019	23.0	6.7056

Lake Name	County	Lake Type	Year	Surface Area (ha)	Max Depth (m)
Kreighbaum	Marshall	Natural Lake	2019	20.0	10.0584
Thomas	Marshall	Natural Lake	2019	16.0	13.4112
Lemon	Monroe	Impoundment	2019	1650	8.5344
Bixler	Noble	Natural Lake	2019	117.0	11.5824
Bowen	Noble	Natural Lake	2019	30.0	10.9728
Crane	Noble	Natural Lake	2019	28.0	8.2296
Dock	Noble	Natural Lake	2019	16.0	6.7056
Henderson	Noble	Natural Lake	2019	22.0	3.3528
Knapp	Noble	Natural Lake	2019	88.0	17.3736
Port Mitchell	Noble	Natural Lake	2019	15	8.5344
Rivir (Chain of Lakes)	Noble	Natural Lake	2019	24.0	9.7536
Sacrider	Noble	Natural Lake	2019	33.0	16.4592
Shockapee	Noble	Natural Lake	2019	21.0	7.9248
Williams	Noble	Natural Lake	2019	46.0	13.4112
Wolf	Noble	Natural Lake	2019	10.1	4.3
Mansfield Reservoir (Harden)	Parke	Impoundment	2019	2060.0	18.288
Twin Pits, East	Pike	Surface Mine Lake	2019	31	5.4864
Spectacle	Porter	Natural Lake	2019	62.0	1.524
Lincoln	Spencer	Impoundment	2019	58	7.3152
Pleasant	St Joseph	Natural Lake	2019	29.0	8.8392
Worster (Potato Creek)	St Joseph	Impoundment	2019	327.0	7.62
Hartz	Starke	Natural Lake	2019	28.0	9.4488
Ball	Steuben	Natural Lake	2019	87.0	20.1168
Crooked	Steuben	Natural Lake	2019	802.0	25.908
Fox	Steuben	Natural Lake	2019	140.0	17.3736
Green	Steuben	Natural Lake	2019	24.0	8.2296
Little Otter	Steuben	Natural Lake	2019	34.0	11.2776
McClish	Steuben	Natural Lake	2019	35.0	17.3736
Pigeon	Steuben	Natural Lake	2019	61.0	11.5824
Dogwood	Sullivan	Surface Mine Lake	2019	4	10.0584
Duck	Sullivan	Surface Mine Lake	2019	59.0	12.192
Red Pine	Sullivan	Surface Mine Lake	2019	4	4.572
Sullivan	Sullivan	Impoundment	2019	507.0	7.0104
Tree	Sullivan	Surface Mine Lake	2019	6	6.096
Green Valley	Vigo	Impoundment	2019	50.0	4.572
Goose	Whitley	Natural Lake	2019	84.0	20.1168
Troy Cedar	Whitley	Natural Lake	2019	93.0	26.8224
Trimble	Greene	Surface Mine Lake	2019	9.0	3.048

Lake Name	County	Lake Type	Year	Surface Area (ha)	Max Depth (m)
Knightstown (Big Blue #7)	Henry	Impoundment	2019	40.0	4.8768
Goldeneye	Kosciusko	Impoundment	2019	20	4.2672
Price	Kosciusko	Natural Lake	2019	12.0	12.8016
Mateer	LaGrange	Natural Lake	2019	18.0	4.8768
Olin	LaGrange	Natural Lake	2019	103.0	24.384
Chapel	Greene	Surface Mine Lake	2020	1.21	5.8
Trimble	Sullivan	Surface Mine Lake	2020	3.64	3.1
Sullivan	Sullivan	Impoundment	2020	205.18	6.1
Goodman	Greene	Surface Mine Lake	2020	1.21	7.8
Big Fry	Sullivan	Surface Mine Lake	2020	1.82	3.1
Reservoir 26	Sullivan	Surface Mine Lake	2020	19.02	3.4
Hackberry	Sullivan	Surface Mine Lake	2020	2.02	8.8
Beaver Dam	Greene	Surface Mine Lake	2020	7.28	9
Front	Greene	Surface Mine Lake	2020	4.45	8.1
White Pine	Sullivan	Surface Mine Lake	2020	0.81	3.7
Lonnie	Sullivan	Surface Mine Lake	2020	1.62	9.3
Trout	Sullivan	Surface Mine Lake	2020	2.02	6
Hamilton	Steuben	Natural Lake	2020	324.57	23.1
Pigeon	Steuben	Natural Lake	2020	24.69	11.3
Snow	Steuben	Natural Lake	2020	125.46	26.5
Little Turkey	Steuben	Natural Lake	2020	54.63	8.6
Long	Noble	Natural Lake	2020	16.19	10.6
Bowen	Noble	Natural Lake	2020	12.14	19.3
Sand	Noble	Natural Lake	2020	19.02	18.9
Gordy	Noble	Natural Lake	2020	12.55	11
Stayner/Gannon	Steuben	Natural Lake	2020	2.02	5.8
Cedar	LaGrange	Natural Lake	2020	48.56	8.9
Emma	LaGrange	Natural Lake	2020	17	9
Fish Lake (Plato)	LaGrange	Natural Lake	2020	40.47	24.2
Big Long	LaGrange	Natural Lake	2020	148.12	19
Tamarack	Noble	Natural Lake	2020	20.24	10.7
Lower Long	Noble	Natural Lake	2020	26.71	16.7
Little Bause	Noble	Natural Lake	2020	2.83	4.8
Bear	Noble	Natural Lake	2020	55.04	17.9
Saugany	LaPorte	Natural Lake	2020	29.95	20.4
Hog	LaPorte	Natural Lake	2020	23.88	16.6
Clear	LaPorte	Natural Lake	2020	42.9	2.5
Pine	LaPorte	Natural Lake	2020	228.25	16.4
Kreighbaum	Marshall	Natural Lake	2020	8.09	10.1
Mill Pond (Zehner)	Marshall	Natural Lake	2020	67.99	4.9

Lake Name	County	Lake Type	Year	Surface Area (ha)	Max Depth (m)
Huntington Reservoir	Huntington	Impoundment	2020	364.23	6.6
Hogback	Steuben	Natural Lake	2020	59.09	6.2
Green	LaGrange	Natural Lake	2020	25.09	2.8
Ball	Steuben	Natural Lake	2020	35.21	19.8
Barton	Steuben	Natural Lake	2020	38.04	6.8
Blue	Whitley	Natural Lake	2020	96.72	13.8
Little Crooked	Whitley	Natural Lake	2020	6.1	15.5
Shriner	Whitley	Natural Lake	2020	7.28	21.8
Big Cedar	Whitley	Natural Lake	2020	58.28	22
Goose	Whitley	Natural Lake	2020	33.99	17.5
Wawasee	Kosciusko	Natural Lake	2020	1059.5	23.4
Barrel and a Half	Kosciusko	Natural Lake	2020	2.83	14.9
Tippecanoe	Kosciusko	Natural Lake	2020	286.12	25.4
Sawmill	Kosciusko	Natural Lake	2020	10.93	7.4
Little Chapman	Kosciusko	Natural Lake	2020	48.56	9
Winona	Kosciusko	Natural Lake	2020	193.45	23.7
Palestine	Kosciusko	Impoundment	2020	93.89	8.1
Manitou	Fulton	Natural Lake	2020	288.55	13.3
Deam	Clark	Impoundment	2020	78.92	9.2
Spurgeon Hollow	Washington	Impoundment	2020	4.86	8.8
Versailles	Ripley	Impoundment	2020	93.08	4.7
Whitewater	Union	Impoundment	2020	80.54	12.5
John Hay	Washington	Impoundment	2020	84.99	10.5
Huntingburg City	Dubois	Impoundment	2020	73.25	6.5
Salinda	Washington	Natural Lake	2020	50.99	7
Bryants Creek	Monroe	Impoundment	2020	3.64	5.5
Lake Lemon (Riddle)	Monroe	Impoundment	2020	667.76	8
Yellowwood	Brown	Impoundment	2020	53.83	9.1
White Oak #1	Knox	Impoundment	2020	9.71	2.9
Twin Pits, West	Pike	Surface Mine Lake	2020	7.28	2.3
Monroe (Lower)	Monroe	Impoundment	2020	4353.75	15.5
Eagle Creek	Marion	Impoundment	2020	611.1	11.7
Scheister	Clay	Surface Mine Lake	2020	4.13	12.5
Little George	Clay	Surface Mine Lake	2020	1.05	14.8
Glen Flint	Putnam	Impoundment	2020	153.38	11
Loomis	Porter	Natural Lake	2020	25.09	16.8
Potato Cr. (Worster)	St. Joseph	Impoundment	2020	132.34	5.6
Yellow Cr.	Elkhart	Natural Lake	2020	6.48	4.8
Goshen Dam Pond	Elkhart	Impoundment	2020	57.47	3.2
Thomas	Marshall	Natural Lake	2020	6.48	12.9

Lake Name	County	Lake Type	Year	Surface Area (ha)	Max Depth (m)
Carr	Kosciusko	Natural Lake	2020	25.9	10.3
Sparta	Noble	Natural Lake	2020	12.55	2.8
Price	Kosciusko	Natural Lake	2020	4.86	12.8
Kuhn	Kosciusko	Natural Lake	2020	47.75	8
Pike	Kosciusko	Natural Lake	2020	82.15	9.9
Caldwell	Kosciusko	Natural Lake	2021	18.21	12.2
Center	Kosciusko	Natural Lake	2021	48.56	12.2
Ridinger	Kosciusko	Natural Lake	2021	55.04	12.8
Goldeneye	Kosciusko	Impoundment	2021	8.09	4.3
Royer	LaGrange	Natural Lake	2021	27.92	15.2
Olin	LaGrange	Natural Lake	2021	41.68	24.4
Nauvoo	LaGrange	Natural Lake	2021	15.38	12.2
Norman	Noble	Natural Lake	2021	5.67	14
Oswego	Kosciusko	Natural Lake	2021	16.59	11
Tippecanoe	Kosciusko	Natural Lake	2021	286.12	37.5
Wawasee	Kosciusko	Natural Lake	2021	1059.5	23.5
Webster	Kosciusko	Natural Lake	2021	313.24	14.6
Village (Indian)	Kosciusko	Natural Lake	2021	4.86	6.7
Diamond	Noble	Natural Lake	2021	42.49	24.7
Skinner	Noble	Natural Lake	2021	50.59	9.8
Gage	Steuben	Natural Lake	2021	132.34	20.1
Hog	Steuben	Natural Lake	2021	19.43	7.9
Jimmerson	Steuben	Natural Lake	2021	114.53	17.1
Lime	Steuben	Natural Lake	2021	12.14	7.9
Little Otter	Steuben	Natural Lake	2021	13.76	11.3
Story (Lower)	Dekalb	Natural Lake	2021	20.23	9.1
Appleman	La Grange	Natural Lake	2021	21.04	8.8
Big Turkey	La Grange	Natural Lake	2021	182.12	19.8
Loon	Steuben	Natural Lake	2021	55.85	5.5
Story (Upper)	Dekalb	Natural Lake	2021	10.93	8.8
Sycamore	Greene	Surface Mine Lake	2021	2.83	8.2
Todd	Greene	Surface Mine Lake	2021	3.24	10.4
Tulip	Greene	Surface Mine Lake	2021	1.01	4.9
Wampler	Greene	Surface Mine Lake	2021	28.33	7.6
Graveyard	Sullivan	Surface Mine Lake	2021	19.43	14
Redbud	Sullivan	Surface Mine Lake	2021	1.62	6.4
George (Hobart)	Lake	Impoundment	2021	109.27	2.7
Holem	Marshall	Natural Lake	2021	12.14	8.5
Long	Porter	Natural Lake	2021	26.31	7.3
Pleasant	St. Joseph	Natural Lake	2021	11.74	11.9
Riddles	St. Joseph	Natural Lake	2021	31.16	6.1

Lake Name	County	Lake Type	Year	Surface Area (ha)	Max Depth (m)
Freeman	Carroll	Impoundment	2021	626.07	12.2
Tamarack	LaPorte	Natural Lake	2021	8.09	1.7
Canada	Porter	Natural Lake	2021	4.05	11
Ferdinand City New	Dubois	Impoundment	2021	4.05	4.6
Holland 2	Dubois	Impoundment	2021	8.09	4.9
Hovey	Posey	Impoundment	2021	97.94	2.1
Scales	Warrick	Surface Mine Lake	2021	26.71	6.1
Deam	Clark	Impoundment	2021	78.92	8.5
Oak	Clark	Impoundment	2021	0.81	4
John Hay	Washington	Impoundment	2021	84.99	8.5
Yellowwood	Brown	Impoundment	2021	53.83	9.1
Brookville Reservoir	Jennings	Impoundment	2021	2128.72	30.5
Brush Creek Reservoir	Jennings	Impoundment	2021	67.58	9.8
Knob	Jackson	Impoundment	2021	2.83	4
Goshen Dam Pond	Elkhart	Impoundment	2021	57.47	2.4
Cedar	LaGrange	Natural Lake	2021	48.56	9.4
Emma	LaGrange	Natural Lake	2021	17	9.8
Stone	LaGrange	Natural Lake	2021	46.95	9.1
Kunkel	Wells	Impoundment	2021	10.12	5.8
Beaver Dam	Kosciusko	Natural Lake	2021	59.09	17.4
Cree	Noble	Natural Lake	2021	23.47	7.9
Tamarack (Rome City)	Noble	Natural Lake	2021	20.24	10.4
Waldron	Noble	Natural Lake	2021	87.42	13.1
Diamond	Kosciusko	Natural Lake	2021	42.49	11
Little Crooked	Whitley	Natural Lake	2021	6.1	15.8
Big	Noble	Natural Lake	2021	92.27	21.3
Muncie	Noble	Natural Lake	2021	19.02	7.9
Loon	Whitley	Natural Lake	2021	6.07	28.3
Sawmill	Kosciusko	Natural Lake	2021	10.93	7.9
Monroe (lower)	Monroe	Impoundment	2021	4353.75	16.8
Lukens	Wabash	Natural Lake	2021	18.62	12.5
Long	Wabash	Natural Lake	2021	19.43	11.9
West	Sullivan	Surface Mine Lake	2021	39.2	25
Prides Creek	Pike	Impoundment	2021	36.42	9.1
Fox	Sullivan	Surface Mine Lake	2021	4.9	34
Front	Sullivan	Surface Mine Lake	2021	4.45	8.2
Black Cat	Greene	Surface Mine Lake	2021	12.5	24.4
Little George	Clay	Surface Mine Lake	2021	1.05	16.8
Pintail	Sullivan	Surface Mine Lake	2021	1.62	13.7

Lake Name	County	Lake Type	Year	Surface Area (ha)	Max Depth (m)
Trout	Sullivan	Surface Mine Lake	2021	2.02	6.1
Cagles Mill	Putnam	Impoundment	2021	566.58	11
Ogle	Brown	Impoundment	2021	8.09	8.2
Bryants Creek	Monroe	Impoundment	2021	3.64	6.1
Griffy	Monroe	Impoundment	2021	52.61	11
Cedarville Reservoir	Allen	Impoundment	2022	99.15	4.6
Cicott	Cass	Impoundment	2022	26.31	15.5
Ferdinand City Old	Dubois	Impoundment	2022	6.07	5.2
Indiana	Elkhart	Natural Lake	2022	49.37	19.8
Fish	Elkhart	Natural Lake	2022	13.76	9.8
Star	Greene	Surface Mine Lake	2022	2.02	6.1
Ellis	Greene	Surface Mine Lake	2022	1.62	4.9
Long (Hillenbrand)	Greene	Surface Mine Lake	2022	3.24	6.1
Chapel Pit	Greene	Surface Mine Lake	2022	1.21	6.1
Corky	Greene	Surface Mine Lake	2022	4.86	16.2
Lenape	Greene	Impoundment	2022	24.28	8.8
Big Blue #13 (Westwood)	Henry	Impoundment	2022	70.01	13.4
Huntington Reservoir	Huntington	Impoundment	2022	364.23	7.3
Cypress	Jackson	Surface Mine Lake	2022	8.5	3.7
Big Chapman	Kosciusko	Natural Lake	2022	167.55	11.6
Yellow Creek	Kosciusko	Natural Lake	2022	61.11	19.2
Hammond	Kosciusko	Natural Lake	2022	2.02	10.1
Kiser	Kosciusko	Natural Lake	2022	3.64	6.1
Silver	Kosciusko	Natural Lake	2022	41.28	8.8
Waubee	Kosciusko	Natural Lake	2022	47.35	15.5
Syracuse	Kosciusko	Natural Lake	2022	228.25	10.7
Winona	Kosciusko	Natural Lake	2022	193.45	24.4
North Twin	LaGrange	Natural Lake	2022	54.63	11.6
Hackenburg	LaGrange	Natural Lake	2022	17	11
Lake of the Woods	LaGrange	Natural Lake	2022	55.04	24.7
Adams	LaGrange	Natural Lake	2022	118.58	27.7
Green	LaGrange	Natural Lake	2022	25.09	3.4
Mongo Millpond	LaGrange	Natural Lake	2022	29.54	2.4
Saugany	LaPorte	Natural Lake	2022	29.95	20.1
Pine (North & South)	LaPorte	Natural Lake	2022	228.25	16.5
Stone	LaPorte	Natural Lake	2022	50.59	11.3
Lawrence	Marshall	Natural Lake	2022	27.92	19.2
Lake of the Woods	Marshall	Natural Lake	2022	168.36	14.6
Holiday	Montgomery	Impoundment	2022	132.34	11.9

Lake Name	County	Lake Type	Year	Surface Area (ha)	Max Depth (m)
Harper	Noble	Natural Lake	2022	4.45	6.7
Engle	Noble	Natural Lake	2022	19.43	7.6
Dock	Noble	Natural Lake	2022	6.48	6.4
Bowen	Noble	Natural Lake	2022	12.14	11
Little Bause	Noble	Natural Lake	2022	2.83	4.9
Mud (chain of lakes)	Noble	Natural Lake	2022	3.24	7.6
Gilbert	Noble	Natural Lake	2022	11.33	11
Baugher	Allen	Natural Lake	2022	12.95	10.4
Tipsaw	Perry	Impoundment	2022	574	4.6
Twin Pits, West	Pike	Surface Mine Lake	2022	7.28	2.4
Glen Flint	Putnam	Impoundment	2022	153.38	11
Bischoff Reservoir	Ripley	Impoundment	2022	80.94	6.4
Dale Reservoir	Spencer	Impoundment	2022	13.36	9.1
James	Steuben	Natural Lake	2022	418.46	26.2
Marsh	Steuben	Natural Lake	2022	22.66	11.6
Barton	Steuben	Natural Lake	2022	38.04	9.1
Henry	Steuben	Natural Lake	2022	8.09	6.1
Lonnie	Sullivan	Surface Mine Lake	2022	1.62	9.1
Goose (Dugger)	Sullivan	Surface Mine Lake	2022	29.14	15.2
Narrow	Sullivan	Surface Mine Lake	2022	3.64	7.6
Sullivan	Sullivan	Impoundment	2022	205.18	7
Downing	Sullivan	Surface Mine Lake	2022	12.95	13.4
Mayfield	Sullivan	Surface Mine Lake	2022	6.07	8.8
Elk Creek #9	Washington	Impoundment	2022	19.43	10.7
Middlefork Reservoir	Wayne	Impoundment	2022	112.1	9.1
Robinson	Whitley	Natural Lake	2022	23.88	15.5
Troy Cedar	Whitley	Natural Lake	2022	6.07	26.8
Larwill	Whitley	Natural Lake	2022	4.05	10.7
Crooked	Whitley	Natural Lake	2022	83.37	32.3
Everett	Allen	Impoundment	2022	17.4	13.4
Manlove	Fayette	Impoundment	2022	6.07	2.7
South Mud	Fulton	Natural Lake	2022	38.04	8.2
Nyona	Fulton	Natural Lake	2022	42.09	9.8
Crystal	Greene	Surface Mine Lake	2022	3.24	11
Kokomo Reservoir #2	Howard	Impoundment	2022	153.79	3.7
Little Pike	Kosciusko	Natural Lake	2022	10.12	3
Sellers	Kosciusko	Natural Lake	2022	12.95	6.4
Carr	Kosciusko	Natural Lake	2022	25.9	10.7
Cherry	Monroe	Impoundment	2022	1.62	6.1
Rivir (chain of lakes)	Noble	Natural Lake	2022	9.71	9.8

Lake Name	***County***	***Lake Type***	***Year***	***Surface Area (ha)***	***Max Depth (m)***
Hindman	Noble	Natural Lake	2022	5.26	5.5
Wauhob	Porter	Natural Lake	2022	8.5	14.6
Stayner/Gannon	Steuben	Natural Lake	2022	2.02	5.8
Fish	Steuben	Natural Lake	2022	23.88	7.6
T Lake	Sullivan	Surface Mine Lake	2022	2.02	7.6
Reservoir 26	Sullivan	Surface Mine Lake	2022	19.02	4.6

Appendix B – Trophic state indices for all lakes sampled from 2019 to 2022.

Lake Name	***County***	***Year***	***TSI(SD)***	***TSI(Chl)***	***TSI(TP_Epi)***
St. Joseph Reservoir	Allen	2019	73	64	76
Deam	Clark	2019	50	44	47
Oak	Clark	2019	60	63	60
Stump Jumper	Clay	2019	44	37	41
Ferdinand City (State Forest)	Dubois	2019	59	66	65
Huntingburg City	Dubois	2019	63	61	60
Patoka Reservoir	Dubois	2019	49	67	45
Nyona	Fulton	2019	67	73	70
South Mud	Fulton	2019	67	64	59
Airline	Greene	2019	36	25	39
Long (Hillenbrand)	Greene	2019	47	48	59
Moss	Greene	2019	50	70	84
Scott	Greene	2019	52	50	44
Clair	Huntington	2019	67	64	62
Starve Hollow	Jackson	2019	60	67	61
Center	Kosciusko	2019	43	41	64
Diamond	Kosciusko	2019	67	63	66
Hammond	Kosciusko	2019	53	56	61
James	Kosciusko	2019	56	50	52
Kuhn	Kosciusko	2019	48	43	49
Little Chapman	Kosciusko	2019	67	62	55
North Little	Kosciusko	2019	63	71	68
Oswego	Kosciusko	2019	53	47	47
Palestine	Kosciusko	2019	67	77	80
Sellers	Kosciusko	2019	67	70	76
Silver	Kosciusko	2019	60	59	60
Winona	Kosciusko	2019	60	61	58
Big Long	LaGrange	2019	37	34	44
North Twin	LaGrange	2019	43	32	37
Oliver	LaGrange	2019	42	44	42
Royer	LaGrange	2019	67	71	68
Shipshewana	LaGrange	2019	62	77	88
Fancher	Lake	2019	42	42	51
George (Hobart)	Lake	2019	73	69	80
Hog	LaPorte	2019	52	45	55
Hudson	LaPorte	2019	45	44	42
Flat	Marshall	2019	62	69	66
Kreighbaum	Marshall	2019	52	49	55
Thomas	Marshall	2019	47	44	48
Lemon	Monroe	2019	63	66	59

Bixler	Noble	2019	47	47	54
Bowen	Noble	2019	55	48	69
Crane	Noble	2019	60	70	66
Dock	Noble	2019	59	39	76
Henderson	Noble	2019	73	86	92
Knapp	Noble	2019	53	52	45
Port Mitchell	Noble	2019	55	60	63
Rivir (Chain of Lakes)	Noble	2019	57	64	72
Sacrider	Noble	2019	54	67	63
Shockapee	Noble	2019	59	69	63
Williams	Noble	2019	63	65	68
Wolf	Noble	2019	60	72	67
Mansfield Reservoir (Harden)	Parke	2019	63	67	59
Twin Pits, East	Pike	2019	40	34	37
Spectacle	Porter	2019	59	52	78
Lincoln	Spencer	2019	46	45	49
Pleasant	St Joseph	2019	63	68	65
Worster (Potato Creek)	St Joseph	2019	60	61	57
Hartz	Starke	2019	44	47	53
Ball	Steuben	2019	57	59	63
Crooked	Steuben	2019	47	44	52
Fox	Steuben	2019	45	34	53
Green	Steuben	2019	44	28	44
Little Otter	Steuben	2019	49	45	47
McClish	Steuben	2019	52	46	40
Pigeon	Steuben	2019	63	54	65
Dogwood	Sullivan	2019	38	34	43
Duck	Sullivan	2019	46	46	51
Red Pine	Sullivan	2019	49	62	61
Sullivan	Sullivan	2019	67	71	69
Tree	Sullivan	2019	50	44	51
Green Valley	Vigo	2019	73	75	75
Goose	Whitley	2019	67	61	61
Troy Cedar	Whitley	2019	63	69	65
Trimble	Greene	2019	49	50	42
Knightstown (Big Blue #7)	Henry	2019	67	67	69
Goldeneye	Kosciusko	2019	50	51	61
Price	Kosciusko	2019	53	43	53
Mateer	LaGrange	2019	40	39	42
Olin	LaGrange	2019	44	35	46
Chapel	Greene	2020	43	31	49
Trimble	Sullivan	2020	45	52	37
Sullivan	Sullivan	2020	66	72	68

Goodman	Greene	2020	37	23	37
Big Fry	Sullivan	2020	55	28	51
Reservoir 26	Sullivan	2020	69	44	79
Hackberry	Sullivan	2020	39	40	37
Beaver Dam	Greene	2020	40	21	37
Front	Greene	2020	54	34	61
White Pine	Sullivan	2020	43	37	49
Lonnie	Sullivan	2020	57	58	64
Trout	Sullivan	2020	48	37	41
Hamilton	Steuben	2020	43	28	48
Pigeon	Steuben	2020	59	40	52
Snow	Steuben	2020	51	45	41
Little Turkey	Steuben	2020	54	42	50
Long	Noble	2020	61	74	63
Bowen	Noble	2020	57	57	60
Sand	Noble	2020	57	35	55
Gordy	Noble	2020	49	53	48
Stayner/Gannon	Steuben	2020	42	53	40
Cedar	LaGrange	2020	44	36	37
Emma	LaGrange	2020	64	72	69
Fish Lake (Plato)	LaGrange	2020	61	43	48
Big Long	LaGrange	2020	44	37	44
Tamarack	Noble	2020	59	48	57
Lower Long	Noble	2020	49	45	46
Little Bause	Noble	2020	43	28	47
Bear	Noble	2020	48	54	53
Saugany	LaPorte	2020	37	24	37
Hog	LaPorte	2020	50	34	53
Clear	LaPorte	2020	59	35	52
Pine	LaPorte	2020	38	22	37
Kreighbaum	Marshall	2020	46	31	43
Mill Pond (Zehner)	Marshall	2020	52	37	53
Huntington Reservoir	Huntington	2020	62	58	68
Hogback	Steuben	2020	56	61	62
Green	LaGrange	2020	51	41	50
Ball	Steuben	2020	57	55	55
Barton	Steuben	2020	41	31	37
Blue	Whitley	2020	56	48	55
Little Crooked	Whitley	2020	46	47	46
Shriner	Whitley	2020	40	45	41
Big Cedar	Whitley	2020	42	36	46
Goose	Whitley	2020	52	53	53
Wawasee	Kosciusko	2020	47	34	41

Barrel and a Half	Kosciusko	2020	54	44	47
Tippecanoe	Kosciusko	2020	53	39	47
Sawmill	Kosciusko	2020	62	33	61
Little Chapman	Kosciusko	2020	57	34	54
Winona	Kosciusko	2020	62	46	48
Palestine	Kosciusko	2020	73	57	82
Manitou	Fulton	2020	63	40	53
Deam	Clark	2020	49	37	37
Spurgeon Hollow	Washington	2020	41	32	40
Versailles	Ripley	2020	75	51	78
Whitewater	Union	2020	66	65	69
John Hay	Washington	2020	34	34	45
Huntingburg City	Dubois	2020	72	47	61
Salinda	Washington	2020	80	80	62
Bryants Creek	Monroe	2020	65	37	52
Lake Lemon (Riddle)	Monroe	2020	65	65	58
Yellowwood	Brown	2020	49	37	45
White Oak #1	Knox	2020	66	51	63
Twin Pits, West	Pike	2020	49	26	40
Monroe (Lower)	Monroe	2020	42	40	37
Eagle Creek	Marion	2020	59	50	58
Scheister	Clay	2020	36	27	39
Little George	Clay	2020	34	31	37
Glen Flint	Putnam	2020	64	54	62
Loomis	Porter	2020	59	42	54
Potato Cr. (Worster)	St. Joseph	2020	66	54	65
Yellow Cr.	Elkhart	2020	69	58	85
Goshen Dam Pond	Elkhart	2020	53	23	64
Thomas	Marshall	2020	43	20	37
Carr	Kosciusko	2020	62	44	49
Sparta	Noble	2020	52	35	37
Price	Kosciusko	2020	46	33	46
Kuhn	Kosciusko	2020	44	28	37
Pike	Kosciusko	2020	63	49	58
Caldwell	Kosciusko	2021	47	55	55
Center	Kosciusko	2021	46	43	42
Ridinger	Kosciusko	2021	63	63	55
Goldeneye	Kosciusko	2021	50	50	51
Royer	LaGrange	2021	65	61	57
Olin	LaGrange	2021	50	39	34
Nauvoo	LaGrange	2021	59	64	57
Norman	Noble	2021	57	66	55
Oswego	Kosciusko	2021	43	33	55

Tippecanoe	Kosciusko	2021	44	31	49
Wawasee	Kosciusko	2021	52		44
Webster	Kosciusko	2021	50	51	54
Village (Indian)	Kosciusko	2021	54	59	58
Diamond	Noble	2021	42	41	39
Skinner	Noble	2021	66	70	59
Gage	Steuben	2021	44	33	34
Hog	Steuben	2021	47	43	46
Jimmerson	Steuben	2021	46	41	37
Lime	Steuben	2021	47	38	32
Little Otter	Steuben	2021	48	48	47
Story (Lower)	Dekalb	2021	55	55	54
Appleman	La Grange	2021	53	51	52
Big Turkey	La Grange	2021	48	60	49
Loon	Steuben	2021	50	51	48
Story (Upper)	Dekalb	2021	53	57	51
Sycamore	Greene	2021	41	54	47
Todd	Greene	2021	39	35	30
Tulip	Greene	2021	53	57	56
Wampler	Greene	2021	49	48	39
Graveyard	Sullivan	2021	69	61	51
Redbud	Sullivan	2021	42	43	40
George (Hobart)	Lake	2021	72	72	74
Holem	Marshall	2021	55	49	49
Long	Porter	2021	52	60	50
Pleasant	St. Joseph	2021	69	76	68
Riddles	St. Joseph	2021	66	75	72
Freeman	Carroll	2021	59	63	66
Tamarack	LaPorte	2021	72	77	76
Canada	Porter	2021	50	57	51
Ferdinand City New	Dubois	2021	80	81	79
Holland 2	Dubois	2021	72	73	68
Hovey	Posey	2021	87	86	98
Scales	Warrick	2021	64	66	54
Deam	Clark	2021	51	40	37
Oak	Clark	2021	65	56	52
John Hay	Washington	2021	42	44	36
Yellowwood	Brown	2021	56	59	45
Brookville Reservoir	Jennings	2021	55	55	42
Brush Creek Reservoir	Jennings	2021	72	71	74
Knob	Jackson	2021	50	44	42
Goshen Dam Pond	Elkhart	2021	52	46	68
Cedar	LaGrange	2021	42	37	44

Emma	LaGrange	2021	63	57	69
Stone	LaGrange	2021	43	34	37
Kunkel	Wells	2021	60	64	58
Beaver Dam	Kosciusko	2021	61	53	53
Cree	Noble	2021	55	58	60
Tamarack (Rome City)	Noble	2021	62	66	59
Waldron	Noble	2021	64	69	64
Diamond	Kosciusko	2021	64	65	59
Little Crooked	Whitley	2021	44	54	43
Big	Noble	2021	63		56
Muncie	Noble	2021	59	72	67
Loon	Whitley	2021	65	65	56
Sawmill	Kosciusko	2021	58	57	52
Monroe (lower)	Monroe	2021	47	45	40
Lukens	Wabash	2021	46	41	41
Long	Wabash	2021	47	43	41
West	Sullivan	2021	64	52	50
Prides Creek	Pike	2021	69	70	60
Fox	Sullivan	2021	58	48	52
Front	Sullivan	2021	57	59	54
Black Cat	Greene	2021	45	31	32
Little George	Clay	2021	35	39	36
Pintail	Sullivan	2021	45	41	32
Trout	Sullivan	2021	45	47	41
Cagles Mill	Putnam	2021	63	67	61
Ogle	Brown	2021	47	56	42
Bryants Creek	Monroe	2021	47	43	51
Griffy	Monroe	2021	47	54	47
Cedarville Reservoir	Allen	2022	72	62	27
Cicott	Cass	2022	41	35	39
Ferdinand City Old	Dubois	2022	52	54	51
Indiana	Elkhart	2022	44	40	27
Fish	Elkhart	2022	64	73	65
Star	Greene	2022	38	32	27
Ellis	Greene	2022	42	41	27
Long (Hillenbrand)	Greene	2022	49	62	59
Chapel Pit	Greene	2022	51	53	61
Corky	Greene	2022	36	30	51
Lenape	Greene	2022	54	63	54
Big Blue #13 (Westwood)	Henry	2022	50	49	47
Huntington Reservoir	Huntington	2022	72	71	86
Cypress	Jackson	2022	80		82
Big Chapman	Kosciusko	2022	45	43	47

Yellow Creek	Kosciusko	2022	56		44
Hammond	Kosciusko	2022	47	46	50
Kiser	Kosciusko	2022	50	54	53
Silver	Kosciusko	2022	62		56
Waubee	Kosciusko	2022	50	47	42
Syracuse	Kosciusko	2022	43	41	40
Winona	Kosciusko	2022	58	55	49
North Twin	LaGrange	2022	46	38	45
Hackenburg	LaGrange	2022	52	53	53
Lake of the Woods	LaGrange	2022	48	47	31
Adams	LaGrange	2022	39	40	27
Green	LaGrange	2022	45	37	27
Mongo Millpond	LaGrange	2022	53	35	45
Saugany	LaPorte	2022	38	36	34
Pine (North & South)	LaPorte	2022	43	34	47
Stone	LaPorte	2022	38	35	27
Lawrence	Marshall	2022	50	44	44
Lake of the Woods	Marshall	2022	48	51	31
Holiday	Montgomery	2022	69	68	65
Harper	Noble	2022	44	49	51
Engle	Noble	2022	55	46	42
Dock	Noble	2022	65	72	67
Bowen	Noble	2022	48	55	53
Little Bause	Noble	2022	50	57	50
Mud (chain of lakes)	Noble	2022	62	77	79
Gilbert	Noble	2022	48	37	47
Baugher	Allen	2022	58	60	63
Tipsaw	Perry	2022	69	62	57
Twin Pits, West	Pike	2022	53	41	45
Glen Flint	Putnam	2022	66	68	58
Bischoff Reservoir	Ripley	2022	72	71	70
Dale Reservoir	Spencer	2022	72	71	70
James	Steuben	2022	44	37	48
Marsh	Steuben	2022	49	55	27
Barton	Steuben	2022	48	40	105
Henry	Steuben	2022	57	64	49
Lonnie	Sullivan	2022	54	68	73
Goose (Dugger)	Sullivan	2022	38		50
Narrow	Sullivan	2022	45		27
Sullivan	Sullivan	2022	72	75	78
Downing	Sullivan	2022	36	39	33
Mayfield	Sullivan	2022	41	32	27
Elk Creek #9	Washington	2022	42	39	39

Middlefork Reservoir	Wayne	2022	72	68	65
Robinson	Whitley	2022	64	66	68
Troy Cedar	Whitley	2022	64	69	61
Larwill	Whitley	2022	75	62	78
Crooked	Whitley	2022	41	45	39
Everett	Allen	2022	65	68	68
Manlove	Fayette	2022	61	76	79
South Mud	Fulton	2022	64	60	54
Nyona	Fulton	2022	59		65
Crystal	Greene	2022	52		38
Kokomo Reservoir #2	Howard	2022	72		77
Little Pike	Kosciusko	2022	67		68
Sellers	Kosciusko	2022	69		72
Carr	Kosciusko	2022	64		51
Cherry	Monroe	2022	46	45	27
Rivir (chain of lakes)	Noble	2022	61	70	68
Hindman	Noble	2022	49	50	44
Wauhob	Porter	2022	46	41	30
Stayner/Gannon	Steuben	2022	53	44	69
Fish	Steuben	2022	58	71	61
T Lake	Sullivan	2022	47		42
Reservoir 26	Sullivan	2022	61	61	60