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MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER RESOURCES DIVISION
JUNE 2016

STAFF REPORT

2015 ALGAL BLOOM TRACKING

A work group composed of Michigan Department of Environmental Quality (MDEQ) and Michigan Department of Health and Human Services staff were assembled and charged with developing an approach to monitor, assess, and report on nuisance and hazardous algal conditions, in order to improve our understanding of the nature, extent, and frequency of algal blooms in inland waters and nearshore Great Lakes. In recent years, harmful algal blooms (cyanobacteria) have been receiving more attention on a national and global scale. We intend to document the severity and extent of algal blooms in Michigan each year, in part, by tracking complaints. This report summarizes the 2015 tracking effort.

In 2015, the MDEQ provided funding to 54 Michigan counties for beach monitoring, primarily *E. coli* sampling. Many of the counties (26) also conducted standard “sanitary surveys” that document daily, site-specific conditions, which include the amount of algae on the beach and in nearshore waters.

MDEQ district staff were asked to record all algae complaints received in 2015 in the Pollution Emergency Alerting System (PEAS) database. Similarly, MDEQ staff in Lansing and Office of the Great Lakes were instructed to send algal bloom complaints they received to a newly developed “Algae Bloom” mailbox (algaebloom@michigan.gov).

This report summarizes both citizen complaints of perceived algal blooms as well as reports of blooms recorded by MDEQ biologists. Therefore, the magnitude and intensity of the reported blooms varied considerably. In some cases, concerned citizens reported unknown substances or “green paint” in the water, which were determined by MDEQ staff to be algae. An important caveat is that in the majority of cases where algal blooms were reported or “high” algal abundances were noted during beach surveys, water samples were not analyzed for toxins such as microcystin. Therefore, in the majority of reported cases, it is unknown whether the blooms were “harmful” or not. A separate study, which focused on targeted lakes, was performed by MDEQ and Michigan Department of Natural Resources staff, in which microcystin samples were collected. A separate report will be produced summarizing that effort.

Sarnelle et al. (2010) found that the majority of inland Michigan lakes that were sampled by volunteers in August and September 2006 had low chlorophyll a concentrations and only 2 out of 77 lakes contained microcystin concentrations above the provisional standard of 20 micrograms per liter (µg/l) for no recreational contact set by the World Health Organization. Rediske et al. (2007) also regularly sampled 7 drowned-river mouth lakes along western Michigan throughout the summer of 2006. None of those lakes were found to contain microcystin concentrations above 20 µg/l.

Results and Discussion

The results of 2,306 sanitary surveys conducted by local officials at 189 inland lake beaches and 117 Great Lakes beaches (includes Lake St. Clair) in 2015 are presented in Figures 1-4. The majority of the beaches that were monitored did not have any algal bloom occurrences recorded. "Low," "medium," and "high" algal abundances were recorded during 24%, 9%, and 3% of surveys, respectively. No "high" abundances were recorded in the Upper Peninsula. One "high" abundance was recorded in the northern Lower Peninsula, near Saginaw Bay. The remaining "high" abundances were concentrated in Oakland and Macomb Counties in the southeast part of the state (Figure 2).

In 2015, Water Resources Division (WRD) district staff recorded 16 algal bloom complaints from concerned citizens and/or MDEQ staff at 9 inland lakes, 2 canals, and 1 large river. Complaints were received from June through the end of October. The locations of these complaints are displayed in Figure 5.

Inland lakes and large water bodies, such as southern Lake Michigan, Saginaw Bay, and Lake St. Clair, had similar amounts of "high," "medium," and "low" algal abundances recorded (Figure 6).

"High" algal abundances in the large lakes were mostly observed along the shorelines of Lake St. Clair, particularly Metropark and Memorial Park Beaches, which have a long history of nuisance algal blooms. Over the last decade, beach managers and residents near Metropark Beach have observed large algal mats accumulating at the beach. Recent work by Vijayavel et al. (2013) has identified the algae as cyanobacteria, *Lyngbya wollei*. The authors also reported that *L. wollei* is capable of sequestering high concentrations of fecal indicator bacteria such as *E. coli*. Vijayavel et al. (2013) proposed that a combination of water circulation in Lake St. Clair and predominant wind patterns (Anderson and Schwab, 2011; Holtschlag et al., 2008) leads to the large accumulation of algae at Metropark Beach, which is on a small peninsula on the northwestern shore. Vijayavel et al. (2013) estimated that 1,490 metric tons of algae washed onto Metropark Beach in 2010. Currently, beach managers must groom the beach daily during the recreation season and place the algae in a nearby mound about one-half mile from the beach (Figure 7).

All of the "high" algal abundances in inland lakes were in Oakland and Macomb Counties in the southeastern part of the state. Past surveys have also revealed high algal abundances in southeast Michigan lakes. However, it should be noted that a disproportionately large amount of inland lakes were sampled in that part of the southeast compared to the rest of the state. Monitoring results for inland lakes were compared to the most recent predicted trophic status indices (TSI) based on Secchi depth transparency (SDT) available for all Michigan inland lakes greater than 20 acres (www.usgs.gov/media/images/michigan-lake-water-clarity-interactive-map-viewer). The TSI SDT values reported in the interactive Michigan lakes Web site were derived from Fuller et al. (2011). Fuller et al. (2011) related *in situ* lake Secchi-depth measurements to Landsat bands and found that measured lake TSI SDT and predicted TSI SDT were strongly related and that predictions could be reliably extrapolated to unmeasured lakes greater than 20 acres in size.

As mentioned earlier, the majority of sites monitored had no algal blooms reported in 2015. Predicted TSI SDT for the lakes with no reported blooms had a normal distribution and ranged from the low 30s (oligotrophic) to mid-50s (eutrophic; Figure 8). The majority of lakes fell in the mesotrophic range. Predicted TSI SDT for the lakes where citizen complaints were filed or high abundances were recorded ranged from 39-65, putting all of them in the mesotrophic to hypereutrophic classification (Figure 9). All of the nuisance algal bloom complaints were in the southern Lower Peninsula (Figure 5).

Some lakes with no reported nuisance algae had high predicted TSI SDT. This may be an artifact of the observations being made from one point in a lake. Uneven algal distributions in lakes are common and can be caused by factors such as differences in nutrient inputs along the lakeshore (Levine and Lewis Jr., 1985) or wind-driven accumulations on one side of the lake (Carmichael, 2008). Because of this, accurate monitoring for harmful algae toxins, such as microcystins, typically should include all sides of a lake (Sarnelle et al., 2010).

The number of recorded algae bloom complaints has increased since 2013. In 2013, 9 complaints were recorded, whereas in 2014 and 2015, 25 and 17 complaints, respectively, were received. It should be noted that two separate complaints were made about algae blooms in both Thorofare Canal (Wayne County) and Belleville Lake (Wayne County) in 2015. Big Wolf Lake in Jackson County had three separate complaints about algae blooms in 2015. The increased number of recorded complaints in 2014 and 2015, compared to 2013, is likely a result of the MDEQ maintaining a newly-created database for algal bloom complaints and increased awareness and reporting by MDEQ staff. The southeastern part of the state has received the most reports, and therefore is a logical area to focus future monitoring or mitigation efforts. Citizens and/or MDEQ staff who observe worrisome algal blooms should continue to report blooms through the PEAS.

Lake Erie Monitoring

The MDEQ has been conducting beach monitoring along the Michigan portion of Lake Erie since 2012 to investigate possible impacts of harmful algal blooms and other nutrient-related impacts (e.g., nearshore attached algae, beach/shoreline muck) on Michigan designated uses. Seven beaches extending from Luna Pier north to Estral Beach have been sampled roughly every two weeks from June to September each year, for a total of eight to ten visits a year. The monitoring includes photos, nutrient sampling (grab sample from approximately 0.5 meters depth) and a qualitative assessment of beach and splash-zone debris.

The limited sampling for microcystin that occurred each year from 2012-2015 primarily focused on bloom conditions, although a background 'no bloom' sample was taken in 2012 and 2013. Three microcystin sampling events were conducted in 2012, four in 2013, and three in 2014. During the 2015 sampling season, microcystin samples were collected at all 7 beaches during all visits, resulting in 9 sampling events for the cyanotoxin. Microcystin samples were taken as grab samples from the same 0.5 meter depth locations as corresponding nutrient grab samples. Additional samples of surface scum were taken, when present, to understand possible 'worst case' scenarios for exposure to bathers and pets. Microcystin samples were analyzed by the National Oceanic and Atmospheric Administration-Great Lakes Environmental Research Laboratory in 2012 and a laboratory at Michigan State University in 2013 through 2015, all using the enzyme-linked immunosorbent assay (ELISA) method. Total microcystin results during visible bloom conditions were typically less than 10 ug/L, often less than 5 ug/L, but with a few around 15 ug/L. Microcystin water column results from 2015 were all below 5 ug/L. Scum samples (dense surface accumulations of cyanobacteria) ranged from single digits up to 300 ug/L. A separate report summarizing these results will be released at a later date.

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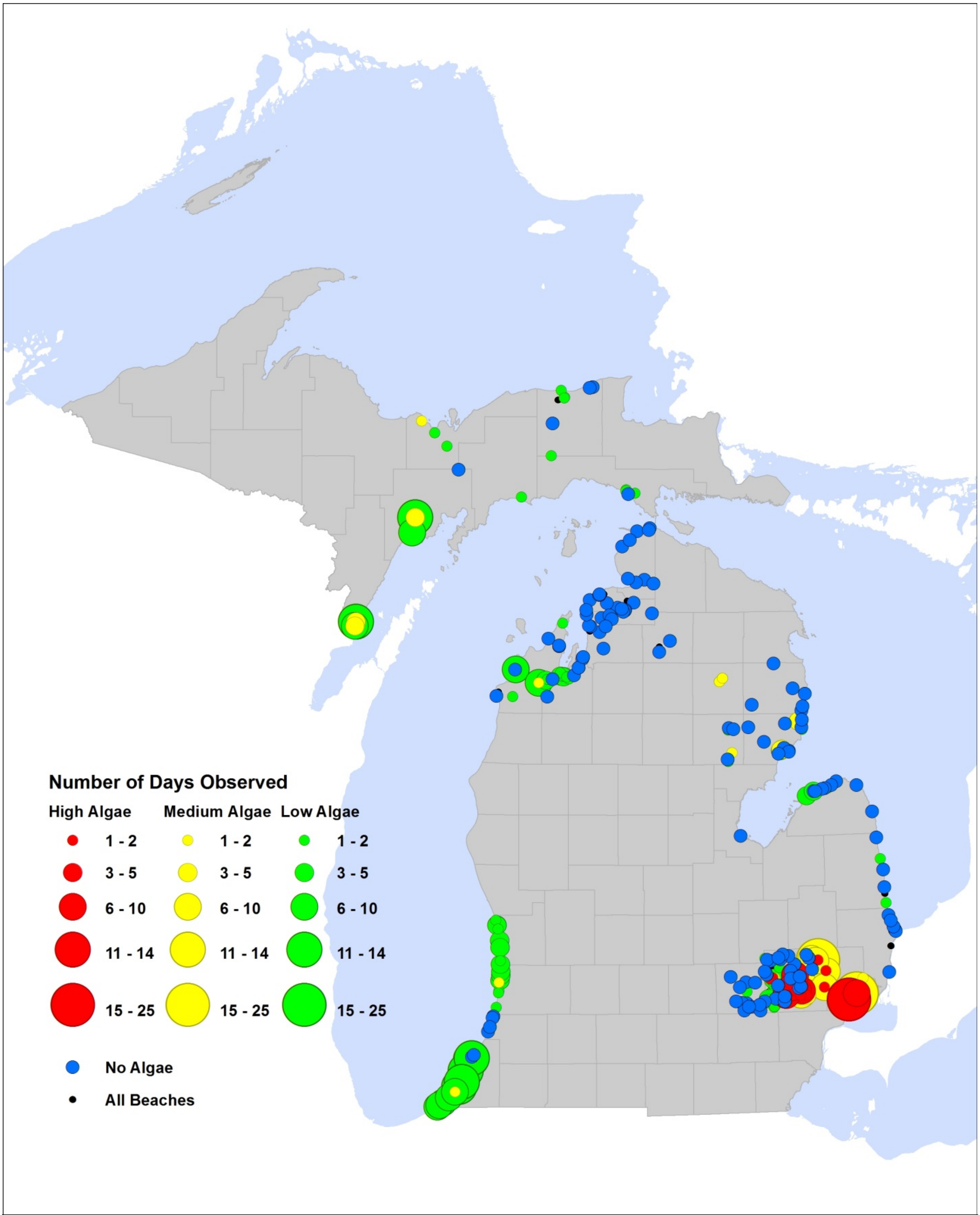

Figure 1. Michigan beaches monitored in 2015 and beaches where algae was noted as being present either in nearshore waters or on the beach. Results based on 2,306 sanitary surveys conducted by local officials at 189 inland lake beaches and 117 Great Lakes beaches.

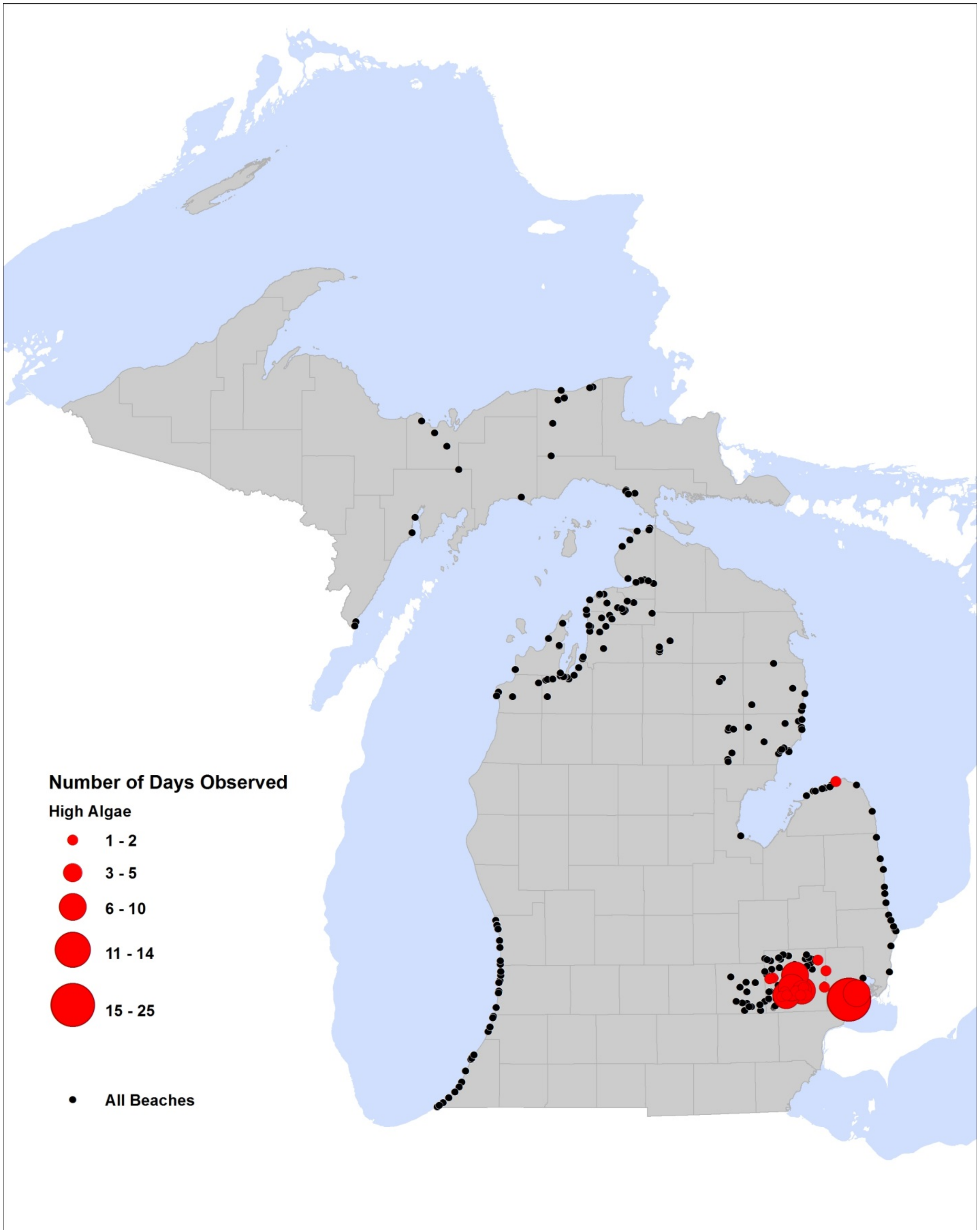

Figure 2. Michigan beaches monitored in 2015 and beaches where algal abundance was noted as High (>50%) either in nearshore waters or on the beach. Results based on 2,306 sanitary surveys conducted by local officials at 189 inland lake beaches and 117 Great Lakes beaches.

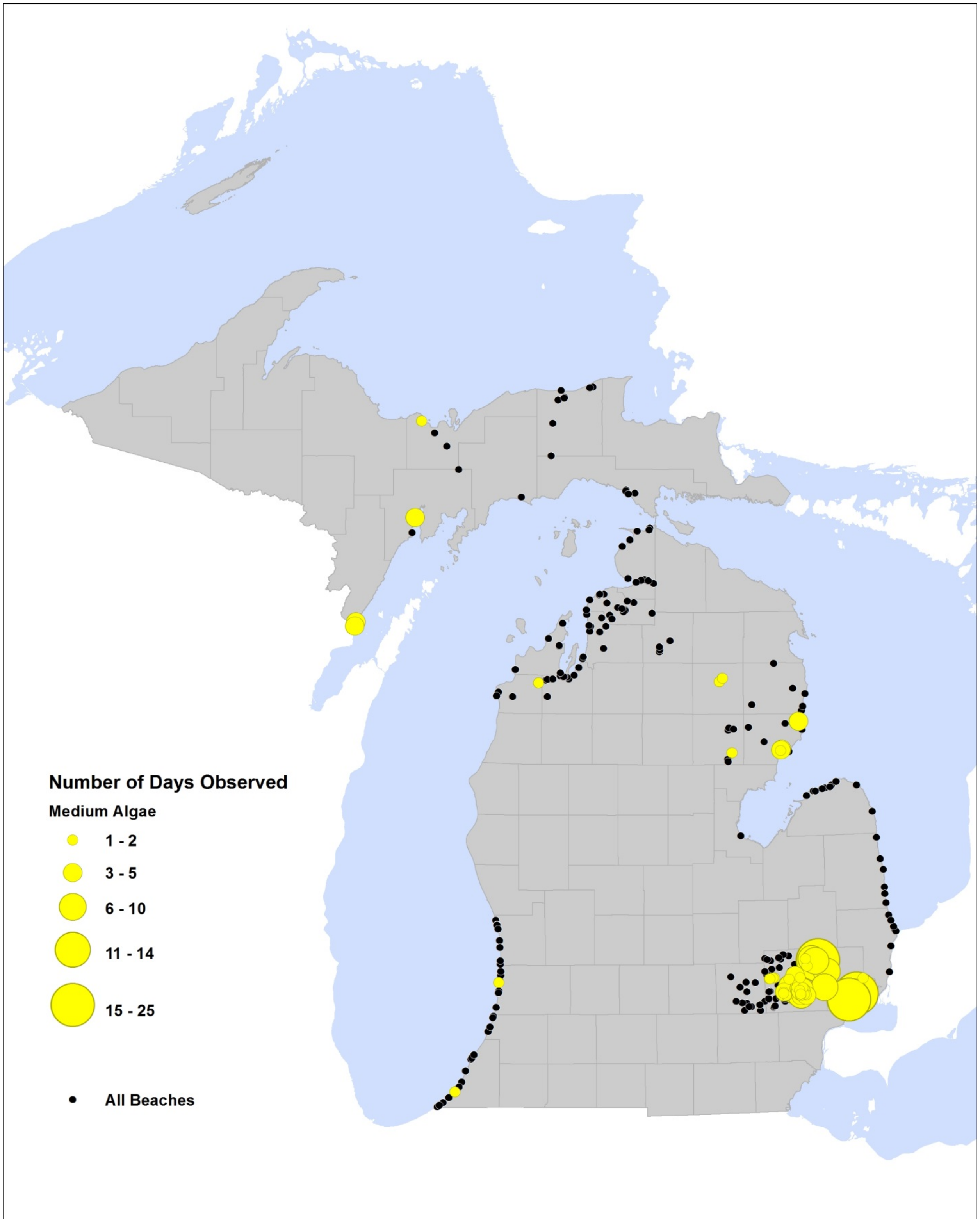

Figure 3. Michigan beaches monitored in 2015 and beaches where algal abundance was noted as moderate (21-50%) either in nearshore waters or on the beach. Results based on 2,306 sanitary surveys conducted by local officials at 189 inland lake beaches and 117 Great Lakes beaches.

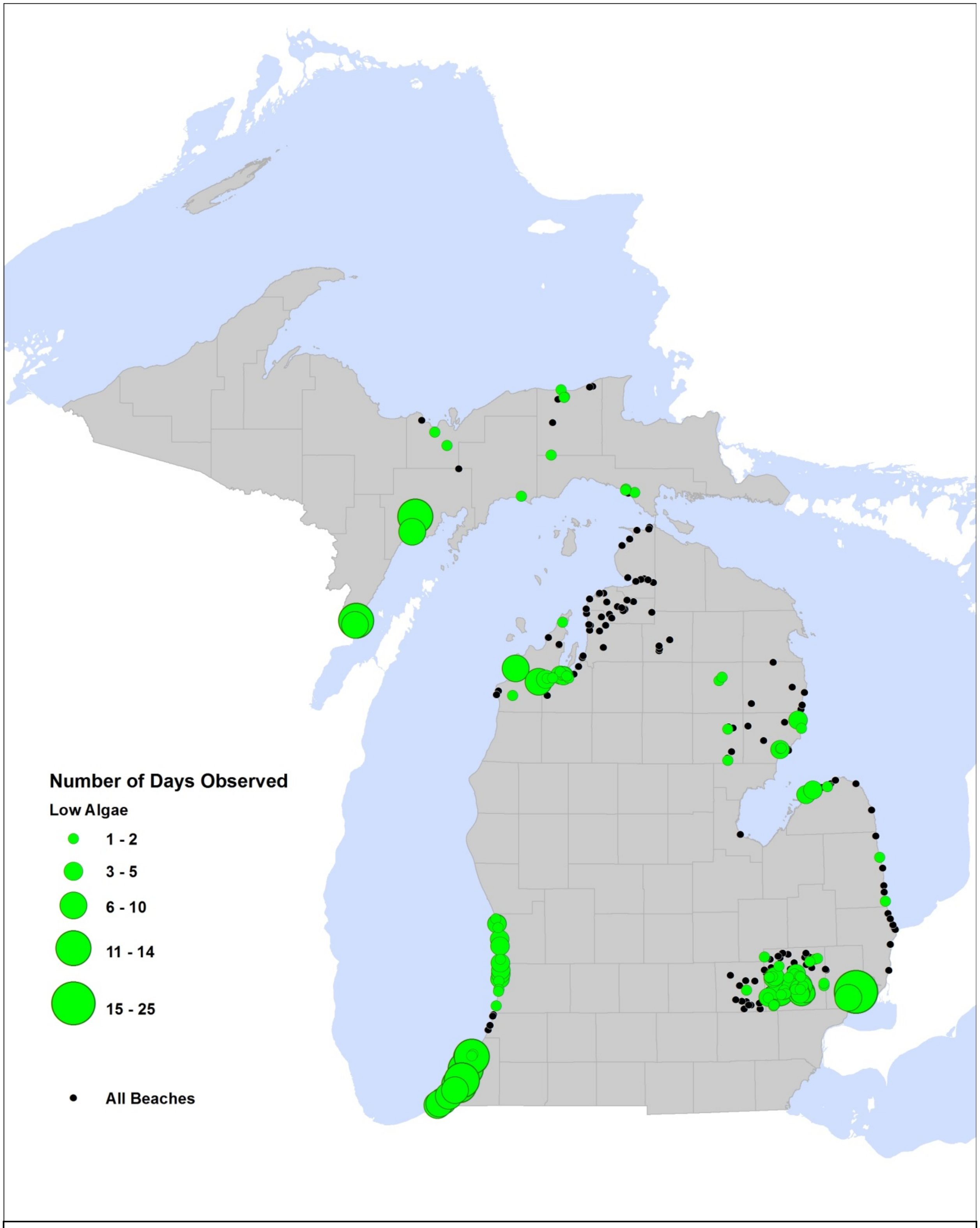

Figure 4. Michigan beaches monitored in 2015 and beaches where algal abundance was noted as low (1-20%) either in nearshore waters or on the beach. Results based on 2,306 sanitary surveys conducted by local officials at 189 inland lake beaches and 117 Great Lakes beaches.

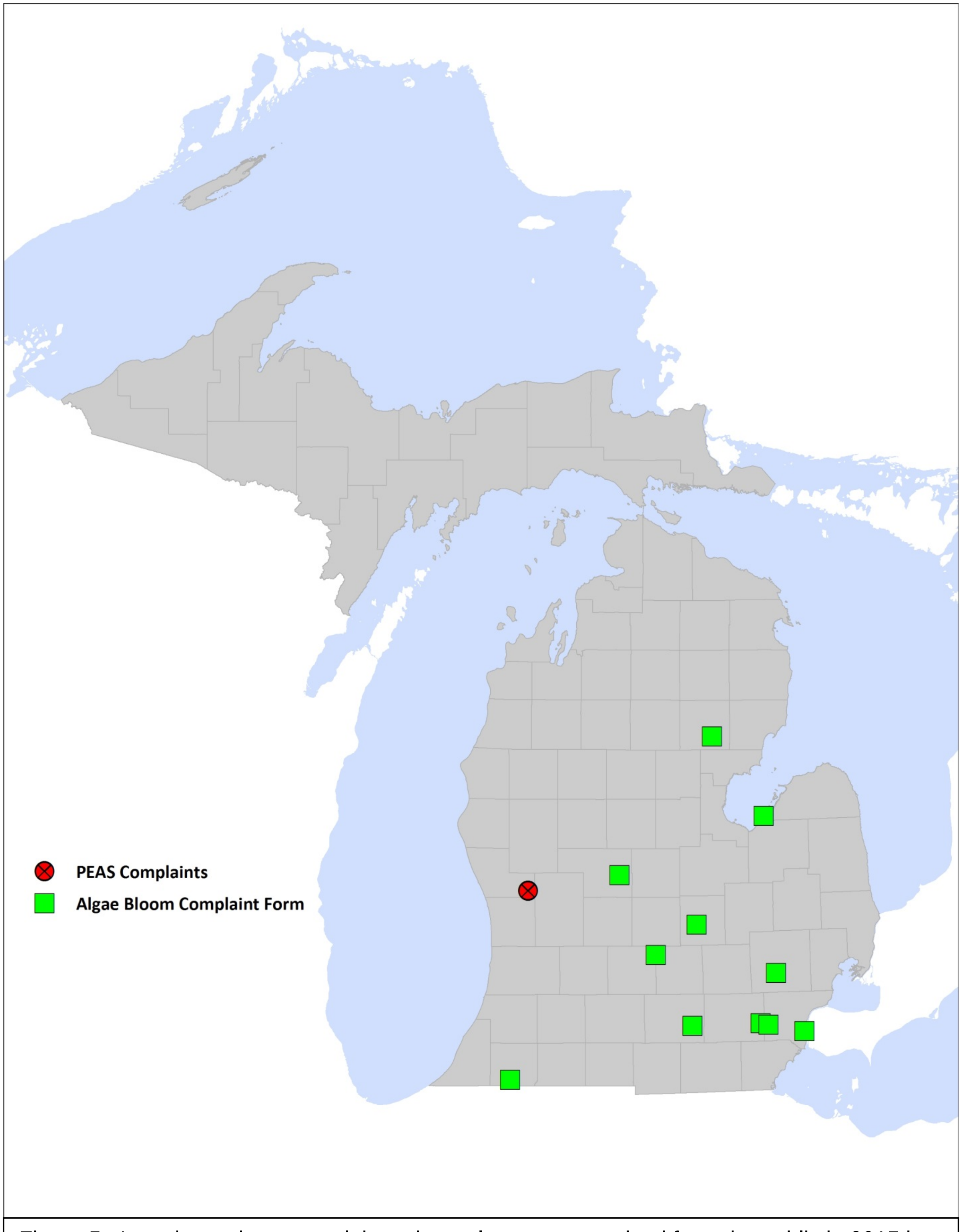

Figure 5. Locations where complaints about algae were received from the public in 2015 by either WRD district staff (PEAS) or other WRD staff (Algal Bloom Complaint form).

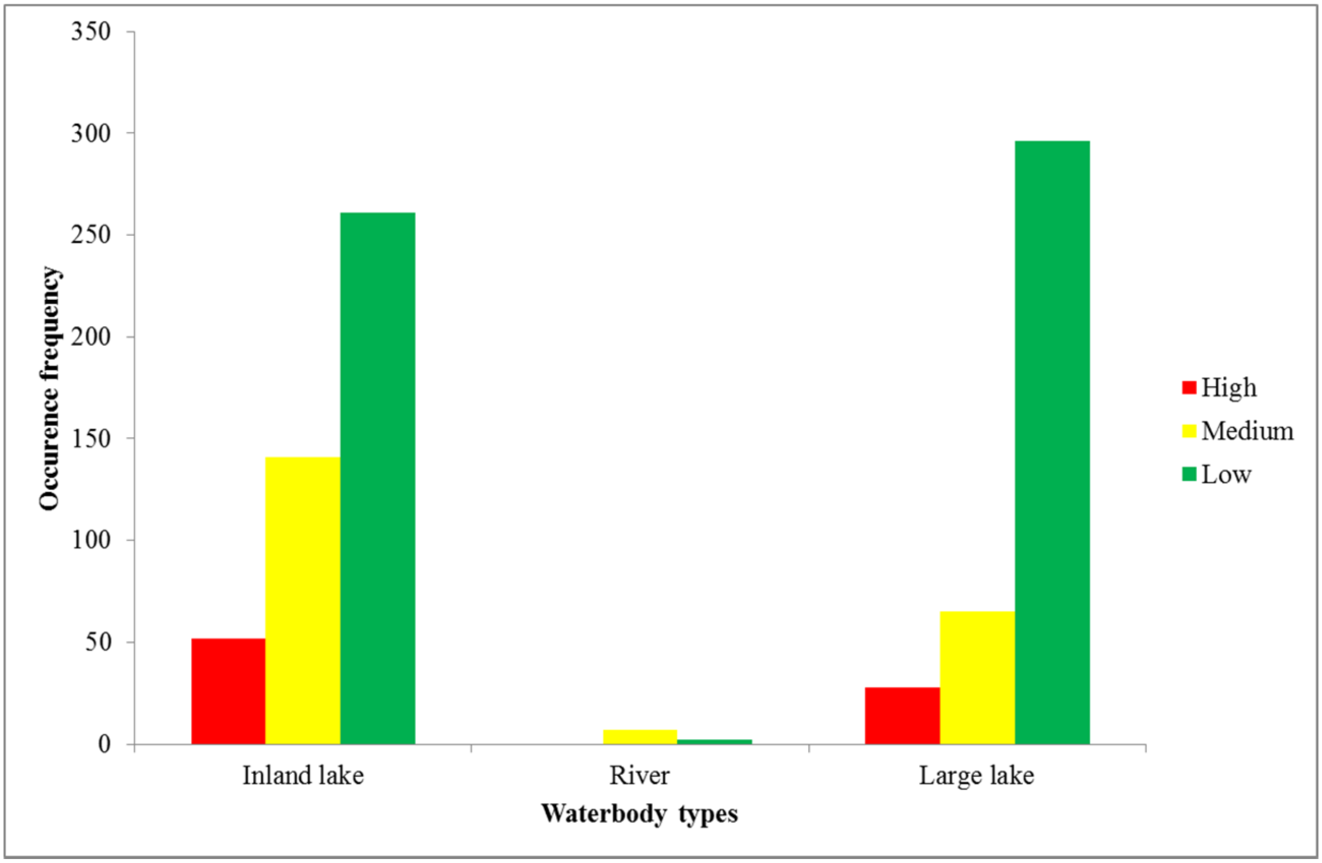

Figure 6. Frequencies of "low," "medium," and "high" recorded algal abundances in inland lakes, rivers, and large lakes (large lakes include Great Lakes and Lake St Clair).

Figure 7. Mound of algae removed from Metropark Beach, Lake St. Clair (fall 2014). Photo credit: Shannon Briggs, MDEQ.

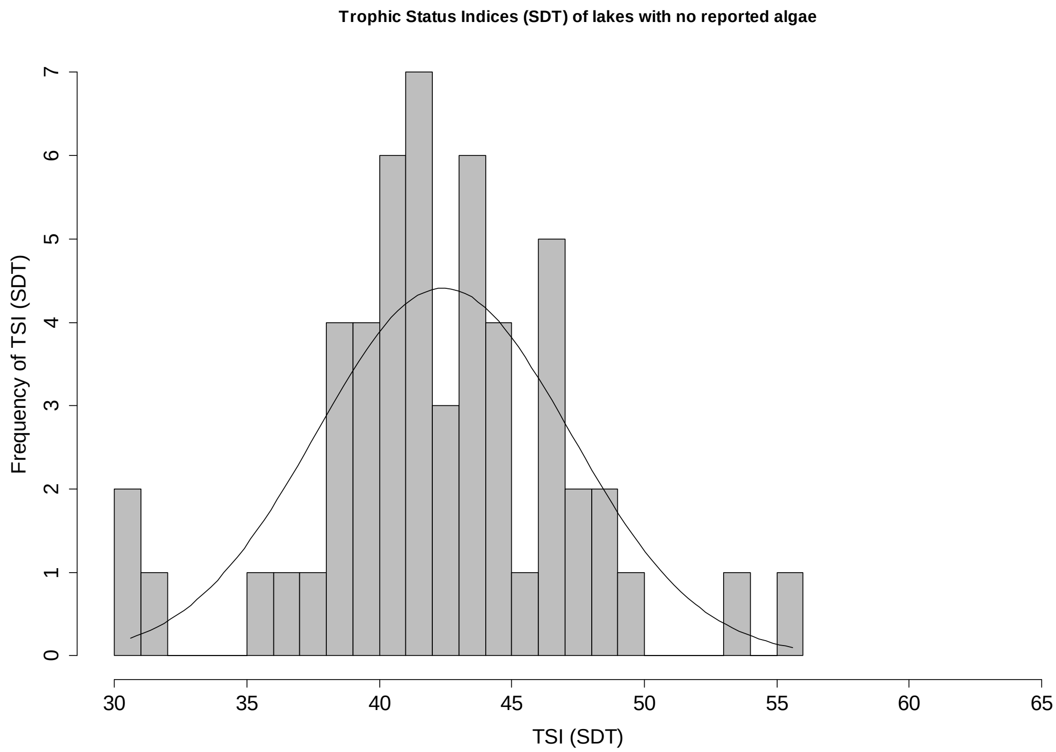

Figure 8. Frequency distribution of predicted TSI SDT values for lakes with no reported algal blooms.

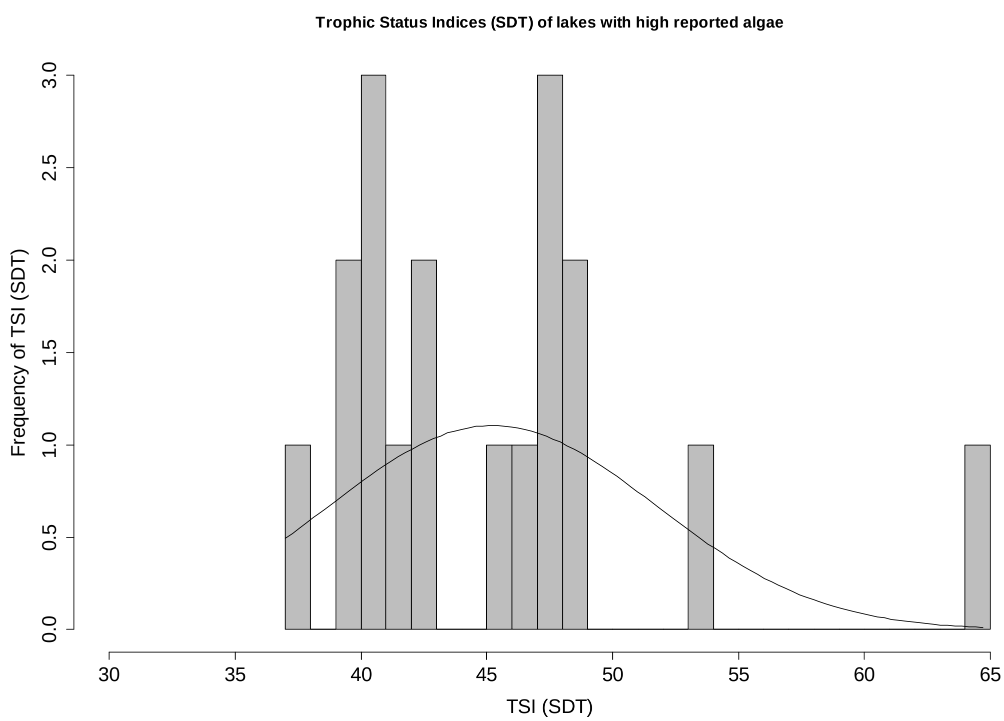

Figure 9. Frequency distribution of predicted TSI SDT values for lakes with nuisance algal blooms reported.