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MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER RESOURCES DIVISION
JANUARY 2018

STAFF REPORT

2017 ALGAL BLOOM TRACKING

A work group composed of Michigan Department of Environmental Quality (MDEQ) and Michigan Department of Health and Human Services (MDHHS) staff was 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 are documenting the severity and extent of algal blooms in Michigan each year, in part by tracking complaints. This report summarizes the 2017 tracking effort.

In 2017, MDEQ provided funding to 55 Michigan counties for beach monitoring, primarily *E. coli* sampling. Many of the counties (29) 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-WRD and Office of the Great Lakes (OGL) staff, as well as citizens with whom we have communicated, were instructed to send algal bloom complaints to the "Algae Bloom" mailbox (algaebloom@michigan.gov). Any complaints called in to the MDEQ's Pollution Emergency Alerting System (PEAS) were also forwarded to algaebloom@michigan.gov.

This report summarizes both citizen complaints of perceived algal blooms as well as reports of blooms recorded by MDEQ staff. Therefore, the magnitude and intensity of the reported blooms varies 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 may not have been analyzed for algal toxins such as microcystin. Therefore, in the majority of reported cases, it is unknown whether the blooms were "harmful" or not. In some cases the predominant algae in the reported waterbody were green algae, which are not capable of producing toxins. Separate reports are available summarizing cyanotoxin sampling efforts by MDEQ (i.e. Holden 2016). This report also summarizes microcystin sampling efforts along Lake Erie beaches.

Previous, random sampling of Michigan inland lakes for microcystin have indicated that few lakes have elevated microcystin concentrations. Sarnelle et al. (2010) found that only 2 of the 77 inland lakes sampled by volunteers in August and September 2006 had microcystin concentrations greater than 20 µg/L. Recreational use of water with microcystin concentrations greater than 20 ug/L is suggested to have high risk levels by the World Health Organization (WHO; WHO 1999). Rediske et al. (2007) also sampled 7 drowned-river mouth lakes in western Michigan in 2006 and did not find any microcystin samples above 20 µg/L. During the United States Environmental Protection Agency's (USEPA) National Lake Assessments (NLA), in 2007 and 2012, no samples exceeded 20 µg/L (Kohlhepp, 2015).

Recently, the State of Ohio issued a recreational guidance of 6 µg/L for total microcystins (*The link provided was broken and has been removed*). A revisit of the abovementioned work revealed 2 of the 7 drowned river mouth lakes sampled by Rediske et al. (2007) had instances where microcystin concentrations were greater than 6 µg/L. The State of Ohio guidance value did not change the number of elevated microcystin values found by Sarnelle et al. (2010) and the NLA surveys.

Results and Discussion

The results of 2,556 sanitary surveys conducted by local officials at 165 inland lake beaches and 140 Great Lakes beaches (includes Lake St. Clair) in 2017 are presented in Figures 1-5. In 2017, the survey methods by beach managers changed slightly. Rather than only assessing the amount of algae in the water, managers separately rated algal biomass on the beach shoreline and in the water. In some surveys, two different ratings were given for a beach (i.e. high algae in the water, but low algae on the beach). In these situations the greater rating was assigned to the beach for this report (i.e. if a beach had low algae on the beach, but high algae in the water, that survey would be categorized as having “high” algal biomass on that survey).

The majority of monitored beaches did not have any algal blooms recorded. “Low,” “medium,” and “high” algal abundances were recorded during 23.5%, 7%, and 3% of surveys respectively. “High” abundances were recorded on several occasions for Lake Michigan beaches in Muskegon County. Isolated high abundances were also recorded for Lake Michigan in Allegan County and at one Saginaw Bay beach. The remaining “high” abundances were concentrated in Oakland and Macomb Counties in the southeast part of the state (Figure 2). Inland lakes had more assigned algae abundances, in all categories, than the large lakes (Great Lakes and Lake St. Clair) did (Figure 6).

In 2017, WRD district staff recorded 49 algal bloom complaints from concerned citizens or MDEQ staff at 39 inland lakes and 10 rivers/streams. Complaints in 2017 were received earlier than previous years, starting in mid-May and ended later than they have previously (last complaint received November, 27th). The locations of these complaints are displayed in Figure 5.

“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. Work by Vijayavel et al. (2013) identified the algae as the cyanobacteria *Lyngbya wollei*. The authors 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 1490 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 a half mile from the beach (Figure 7).

Inland lakes with “high” amounts of algae were concentrated in Muskegon County on the west side of the Lower Peninsula and Oakland and Macomb Counties in the southeast 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 those counties compared to the rest of the state. This is the first year that Muskegon County inland lakes (Bear, Muskegon, and White Lakes) had sanitary surveys performed. All three lakes had high algal abundances reported at their beaches at some time in 2017. These lakes all have long histories of nutrient enrichment and nuisance algal blooms that have been reported by others (Luttenton et al. 2007; Xie et al. 2011).

The number of recorded algae bloom complaints has increased since 2013. In 2013, nine complaints were recorded, whereas in 2014, 2015, and 2016, 25, 17, and 25 complaints were received respectively. In 2017, the number of different waterbodies that MDEQ received complaints about was nearly double what the previous high number was. Multiple complaints were received for: Moores River Impoundment/Grand River (Eaton/Ingham County), Posey Lake (Lenawee County), Pleasant Lake (Washtenaw County), West Bloomfield Lake (Oakland County), Thornapple Lake (Barry County), Sugden Lake (Oakland County), Pontiac Lake (Oakland County), and Ford Lake (Washtenaw County).

The increase in the number of citizen and staff complaints about suspected algal blooms is likely a result of both an increased awareness by citizens and staff that algal blooms can be reported to MDEQ, as well as an increase in the frequency and magnitude of algal blooms in 2017. Significant blooms with elevated microcystin concentrations occurred in 2017, which received widespread media attention and motivated citizens to contact MDEQ with concerns about algal blooms in other waterbodies.

The southern part of the state has received the most reports, and therefore is a logical area to focus future monitoring or mitigation efforts. However, reports of algal blooms further north are increasing. Citizens or DEQ staff who observe worrisome algal blooms should continue to report blooms through the Pollution Emergency Alerting System (PEAS) or algaebloom@michigan.gov.

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) to Michigan designated uses. From 2012-2015, seven beaches extending from Luna Pier north to Estral Beach were sampled roughly every two weeks from June to September, for a total of eight to ten visits a year. The monitoring included photos, nutrient sampling (grab sample from approximately 0.5 meters depth) and a qualitative assessment of beach and splash-zone debris. Beginning in 2016, nutrient-related beach sampling on Lake Erie was primarily conducted by the Monroe County Health Department in conjunction with routine pathogen monitoring. In 2016 and 2017 four Lake Erie beaches were sampled weekly for cyanotoxins from mid-June through early September. In addition, concurrent nutrient grab samples were collected by the MDEQ on a monthly basis.

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 seven beaches during all visits, resulting in nine sampling events for the cyanotoxin. The 2016 and 2017 weekly cyanotoxin monitoring at four beaches resulted in 13 and 14 sampling events, respectively.

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. For samples collected in 2016 and 2017, each was initially screened for total microcystins using rapid test strips manufactured by Abraxis. Any sample with a strip showing detectable total microcystins was submitted to the State of Michigan, Department of Health and Human Services Laboratory for additional microcystin, anatoxin-a, and cylindrospermopsin analyses using High-Performance Liquid Chromatography with Mass Spectrometry.

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 and from 2016 were all below 8 ug/L. Results from 2017 were generally below 10 ug/L total microcystins, with four samples in the 11-15 ug/L range and one water column sample at 31 ug/L. Scum samples (dense surface accumulations of cyanobacteria), when present, ranged from single digits up to 330 ug/L. No scum samples were taken in 2017. A separate report summarizing these results will be released at a later date.

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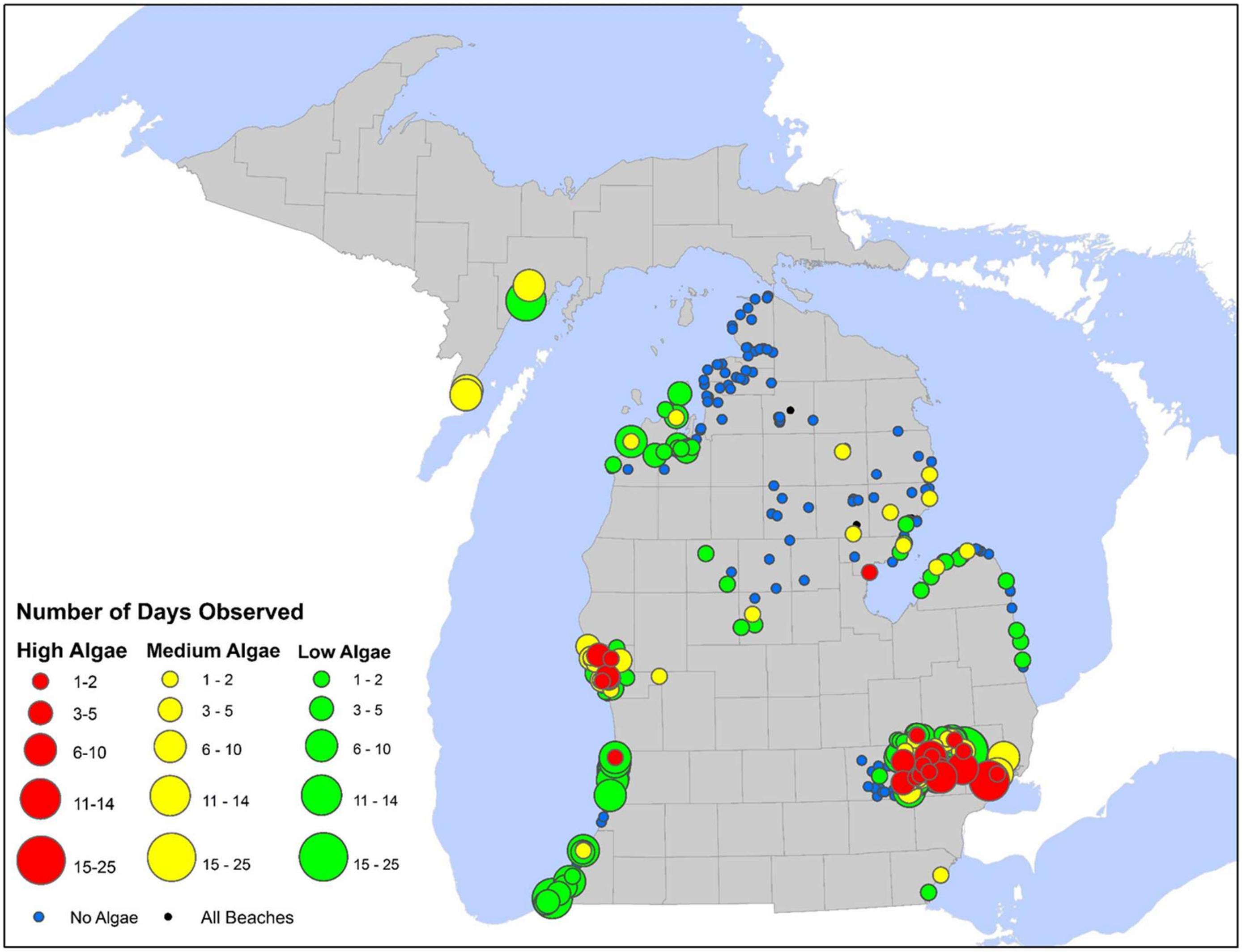

Figure 1. Michigan beaches monitored in 2017 and beaches where algae was noted as being present either in nearshore waters or on the beach. Results based on 2,556 sanitary surveys conducted by local officials at 165 inland lake beaches and 140 Great Lakes beaches.

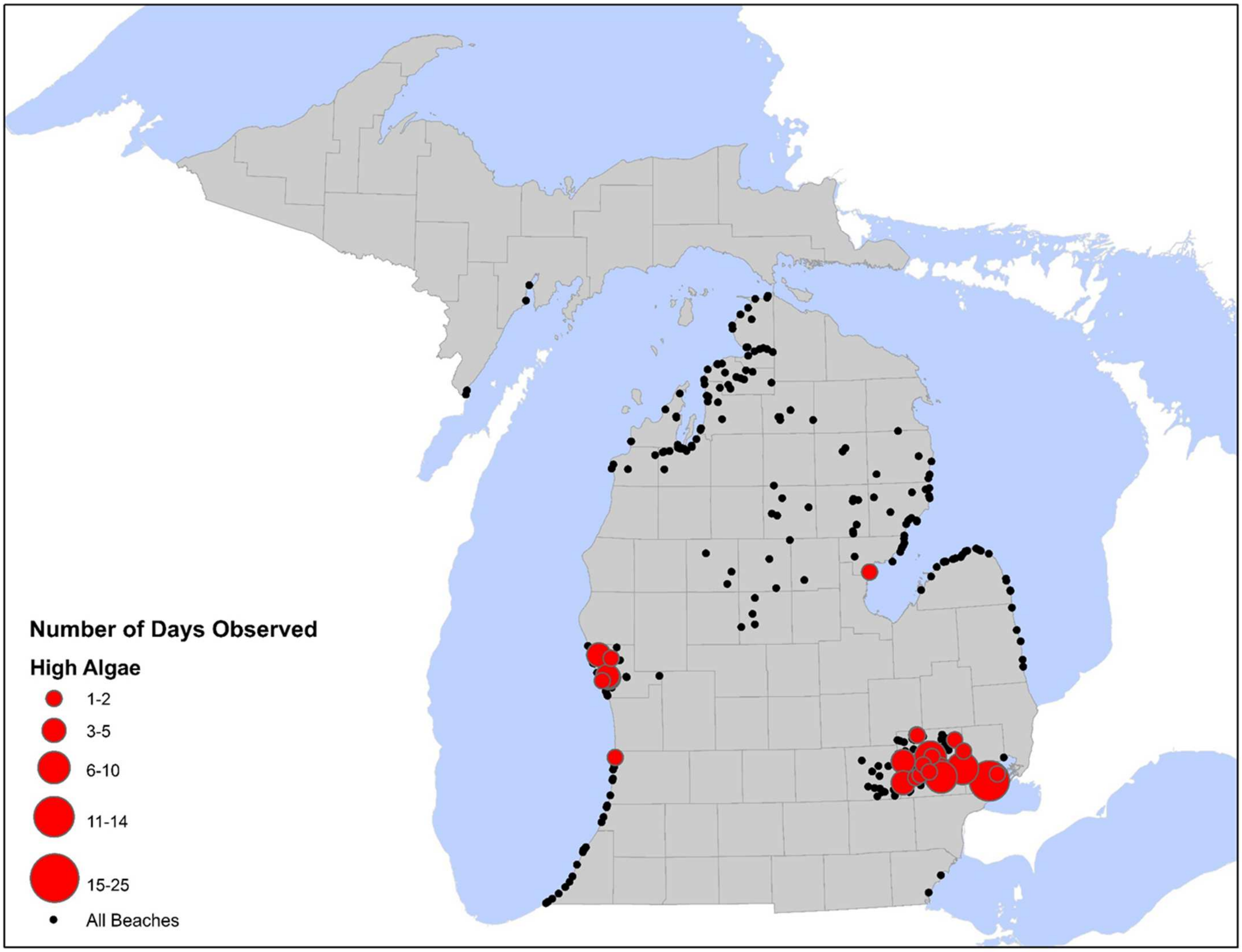

Figure 2. Michigan beaches monitored in 2017 and beaches where algal abundance was noted as High (>50%) either in nearshore waters or on the beach. Results based on 2,556 sanitary surveys conducted by local officials at 165 inland lake beaches and 140 Great Lakes beaches.

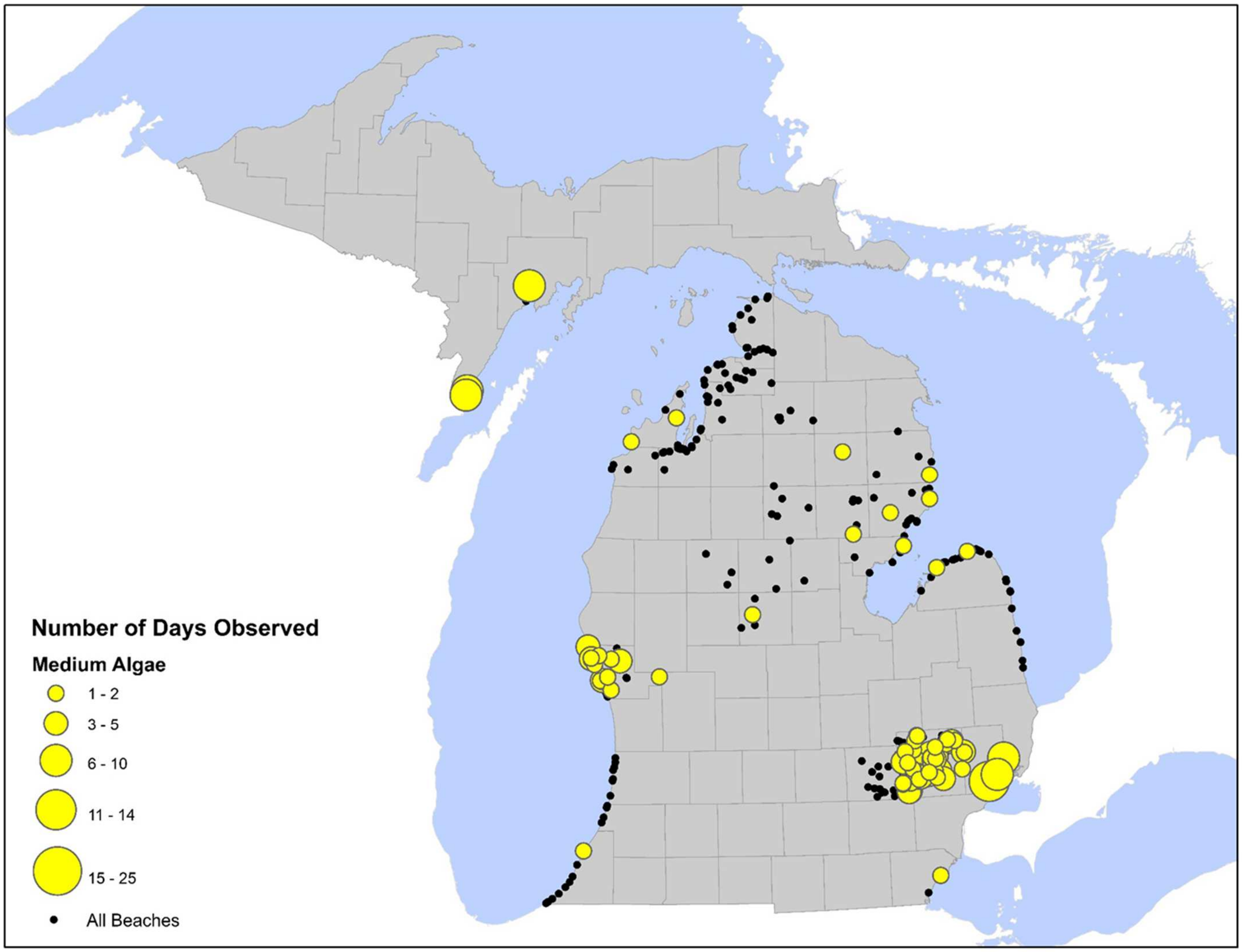

Figure 3. Michigan beaches monitored in 2017 and beaches where algal abundance was noted as moderate (21-50%) either in nearshore waters or on the beach. Results based on 2,556 sanitary surveys conducted by local officials at 165 inland lake beaches and 140 Great Lakes beaches.

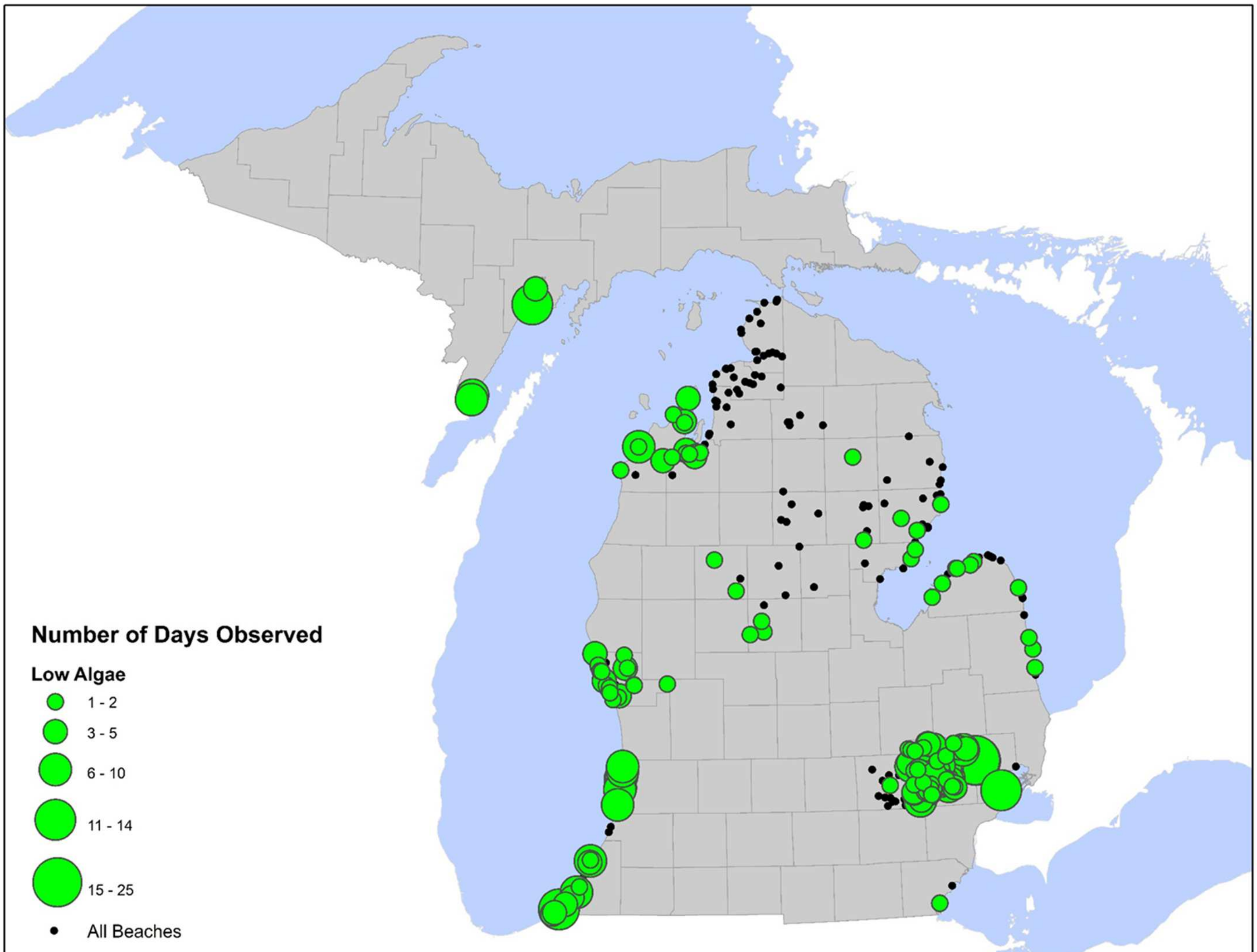

Figure 4. Michigan beaches monitored in 2017 and beaches where algal abundance was noted as low (1-20%) either in nearshore waters or on the beach. Results based on 2,556 sanitary surveys conducted by local officials at 165 inland lake beaches and 140 Great Lakes beaches.

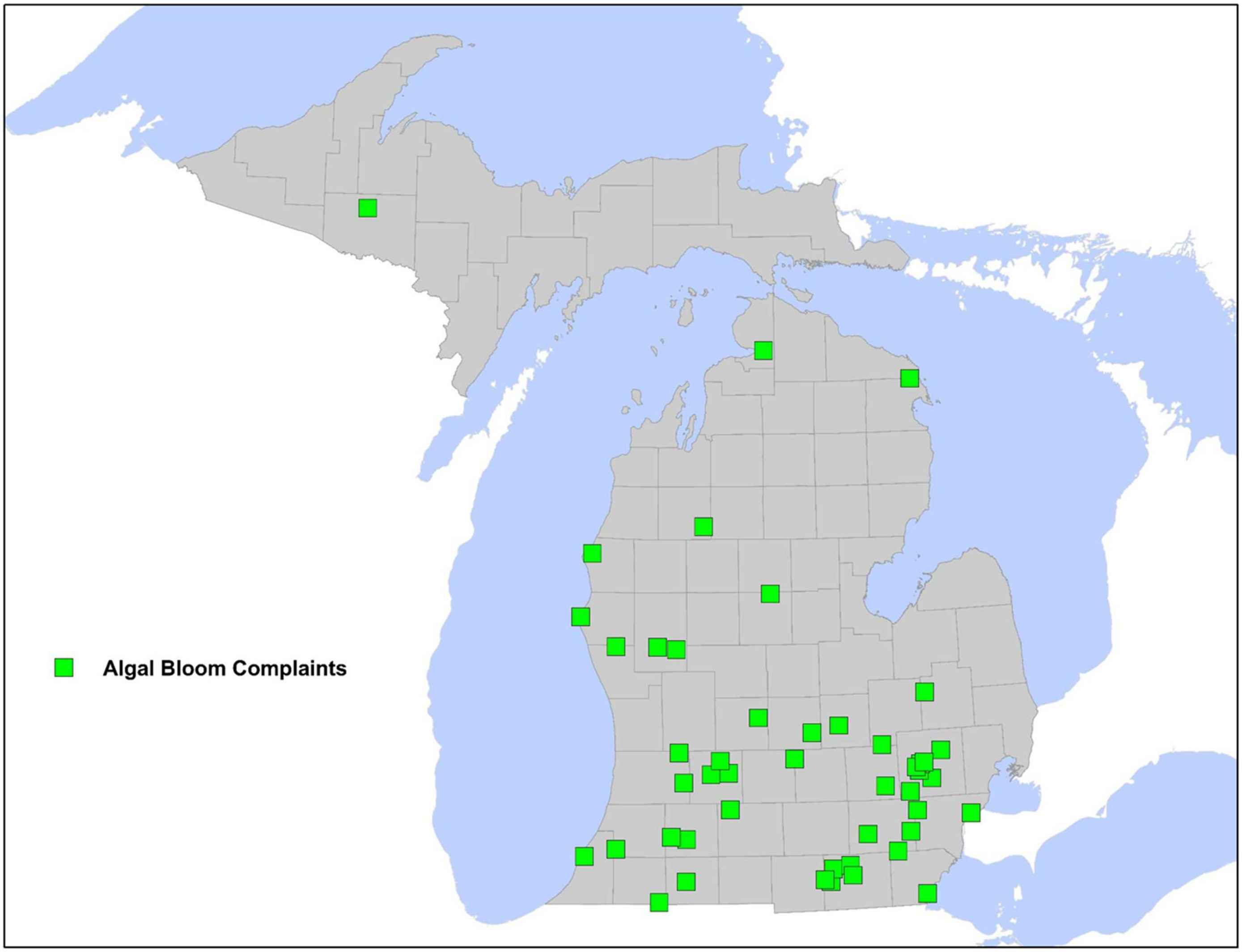

Figure 5. Locations where complaints about algae were received from the public in 2017 by either WRD district staff (PEAS) or other WRD staff (algaebloom@michigan.gov).

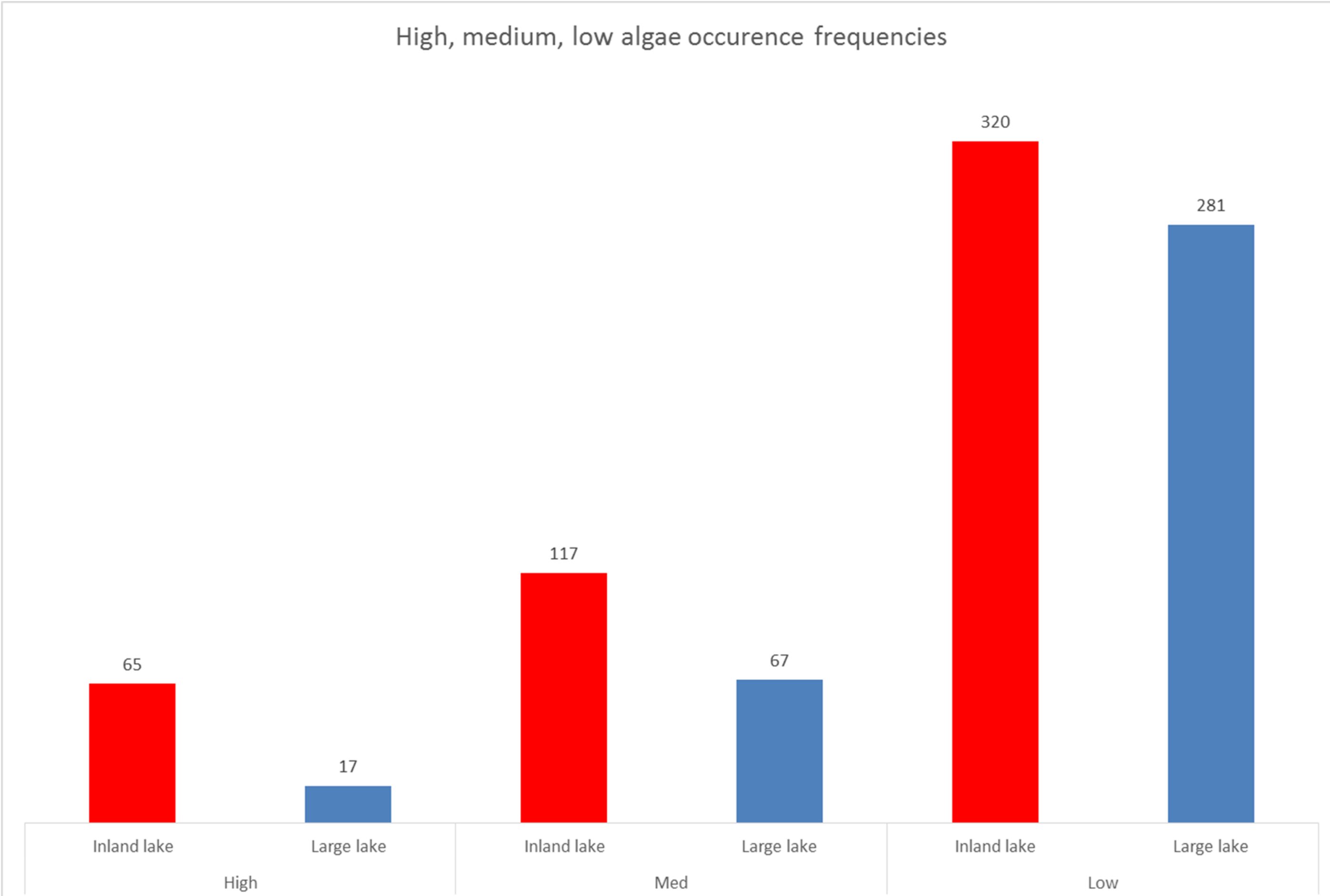

Figure 6. Frequencies of “low,” “medium,” and “high” recorded algal abundances in inland lakes, rivers, and large lakes (“large lakes” includes Great Lakes and Lake St Clair).

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