MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER RESOURCES DIVISION
DECEMBER 2016

STAFF REPORT

2016 ALGAL BLOOM TRACKING

A work group composed of Michigan Department of Environmental Quality (MDEQ) and Michigan Department of Health and Human Services 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 2016 tracking effort.

In 2016, the MDEQ provided funding to 53 Michigan counties for beach monitoring, primarily *E. coli* sampling. Many of the counties (19) also conducted standard "sanitary surveys" that document daily, site-specific conditions, which include the amount of algae on the beach and in nearshore waters.

The MDEQ-Water Resources Division (WRD) and Office of the Great Lakes staff were also instructed to send algal bloom complaints to a newly developed "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 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 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 water body were green algae, which are not capable of producing toxins. A separate study, focusing on randomly-selected and targeted lakes, was conducted 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 Michigan inland 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 recreational contact guideline of 20 micrograms per liter (µg/l) 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 2,327 sanitary surveys conducted by local officials at 107 inland lake beaches and 131 Great Lakes beaches (includes Lake St. Clair) in 2016 are presented in Figures 1-4. The majority of monitored beaches did not have any algal blooms recorded. “Low,” “medium,” and “high” algal abundances were recorded during 22%, 8.5%, and 5% of surveys, respectively. Only one “high” abundance was recorded in the Upper Peninsula, which was in Menominee County, on Green Bay. The remaining “high” abundances were concentrated in Oakland and Macomb Counties in the southeast part of the state (Figure 2).

In 2016, WRD district staff recorded 25 algal bloom complaints from concerned citizens or MDEQ staff at 22 inland lakes, 1 small stream, and 2 large river reservoirs. Complaints were received from late June through the beginning of November. 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 “low” algal abundances recorded in the sanitary surveys. However, inland lakes had higher incidences of “medium” and “high” 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. 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 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 a half mile from the beach (Figure 7).

All but one of the “high” algal abundances in inland lakes that were reported in the sanitary surveys were in Oakland and Macomb Counties, in the southeast past 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.

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. It should also be noted that multiple complaints were received for Moores River Impoundment/Grand River (Eaton/Ingham County), Lamberton Lake (Kent County), Lime Lake (Hillsdale County), Houghton Lake (Roscommon County) and Ford Lake (Washtenaw County). The increased number of recorded complaints from 2014-2016, compared to 2013, may be a result of the MDEQ maintaining a newly-created database for algal bloom complaints and increased awareness and reporting by the public and MDEQ staff. 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 MDEQ staff who observe worrisome algal blooms should continue to report blooms through the 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, 7 beaches extending from Luna Pier north to Estral Beach were sampled roughly every 2 weeks from June to September, for a total of 8 to 10 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. 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, 4 in 2013, and 3 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. The 2016 weekly cyanotoxin monitoring at 4 beaches resulted in 13 sampling events.

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, 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. Scum samples (dense surface accumulations of cyanobacteria) ranged from single digits up to 330 ug/L. A separate report summarizing these results will be released at a later date.

Report by: Aaron Parker
Surface Water Assessment Section
Water Resources Division

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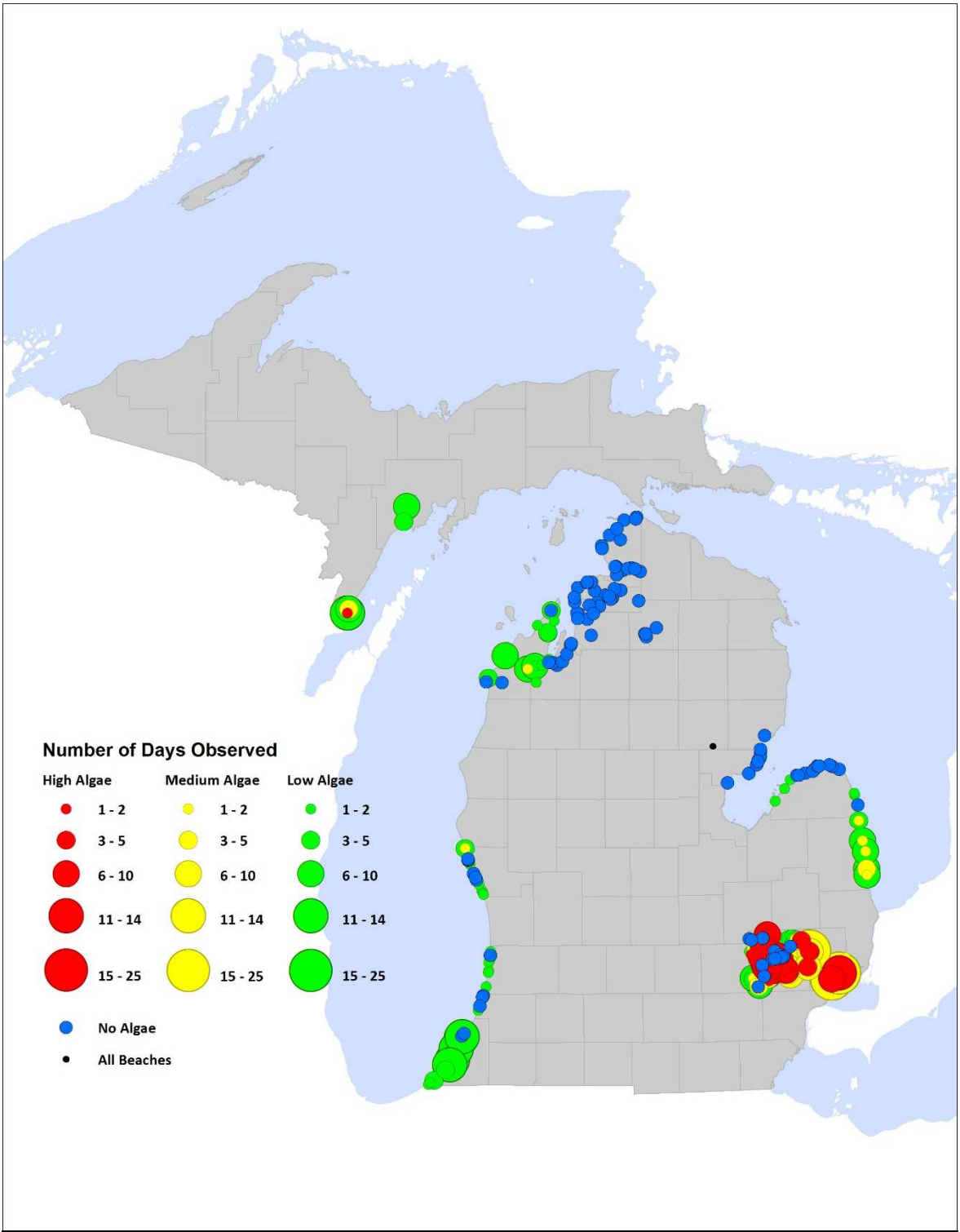

Figure 1. Michigan beaches monitored in 2016 and beaches where algae was noted as being present either in nearshore waters or on the beach. Results based on 2,327 sanitary surveys conducted by local officials at 107 inland lake beaches and 131 Great Lakes beaches.

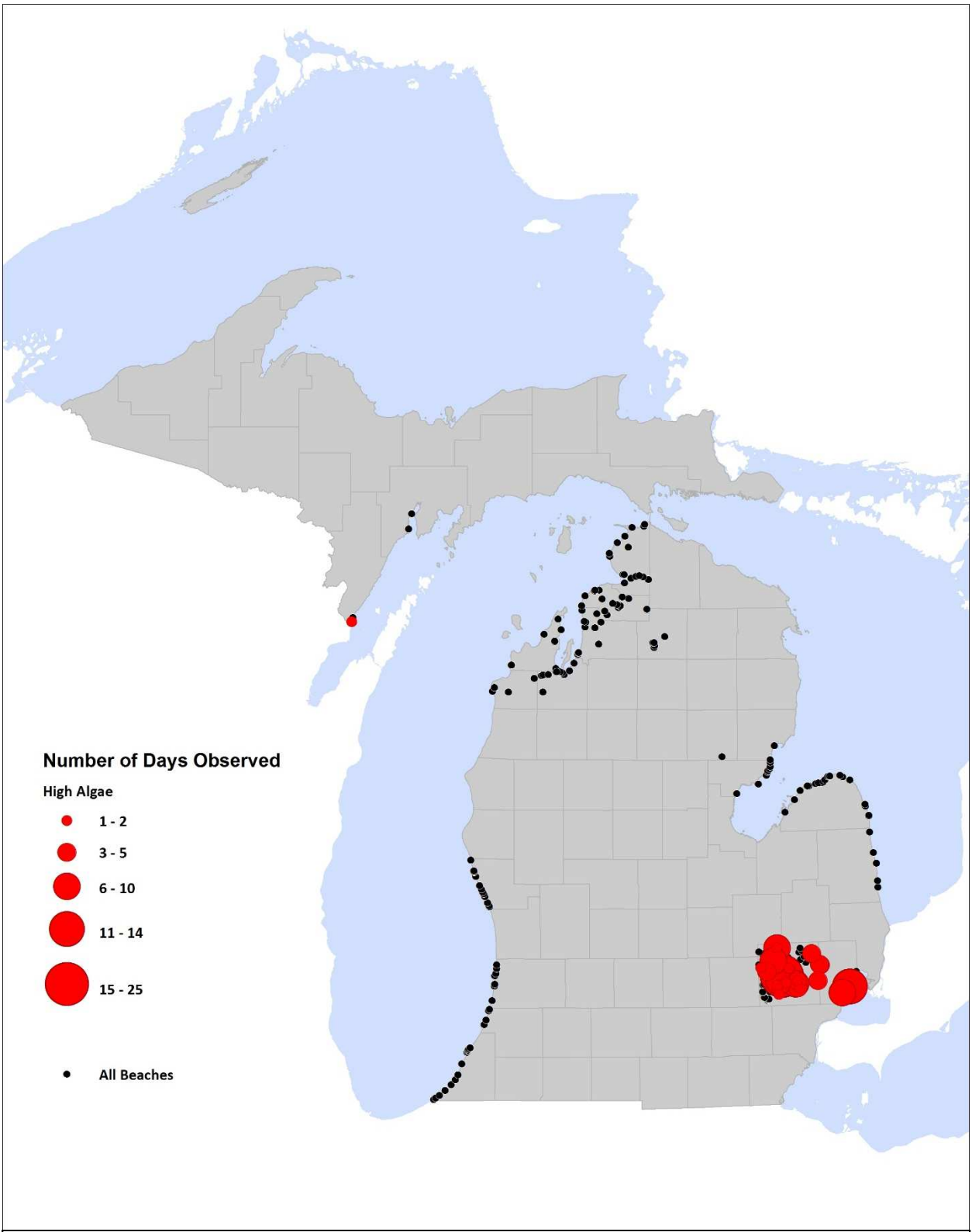

Figure 2. Michigan beaches monitored in 2016 and beaches where algal abundance was noted as High (>50%) either in nearshore waters or on the beach. Results based on 2,327 sanitary surveys conducted by local officials at 107 inland lake beaches and 131 Great Lakes beaches.

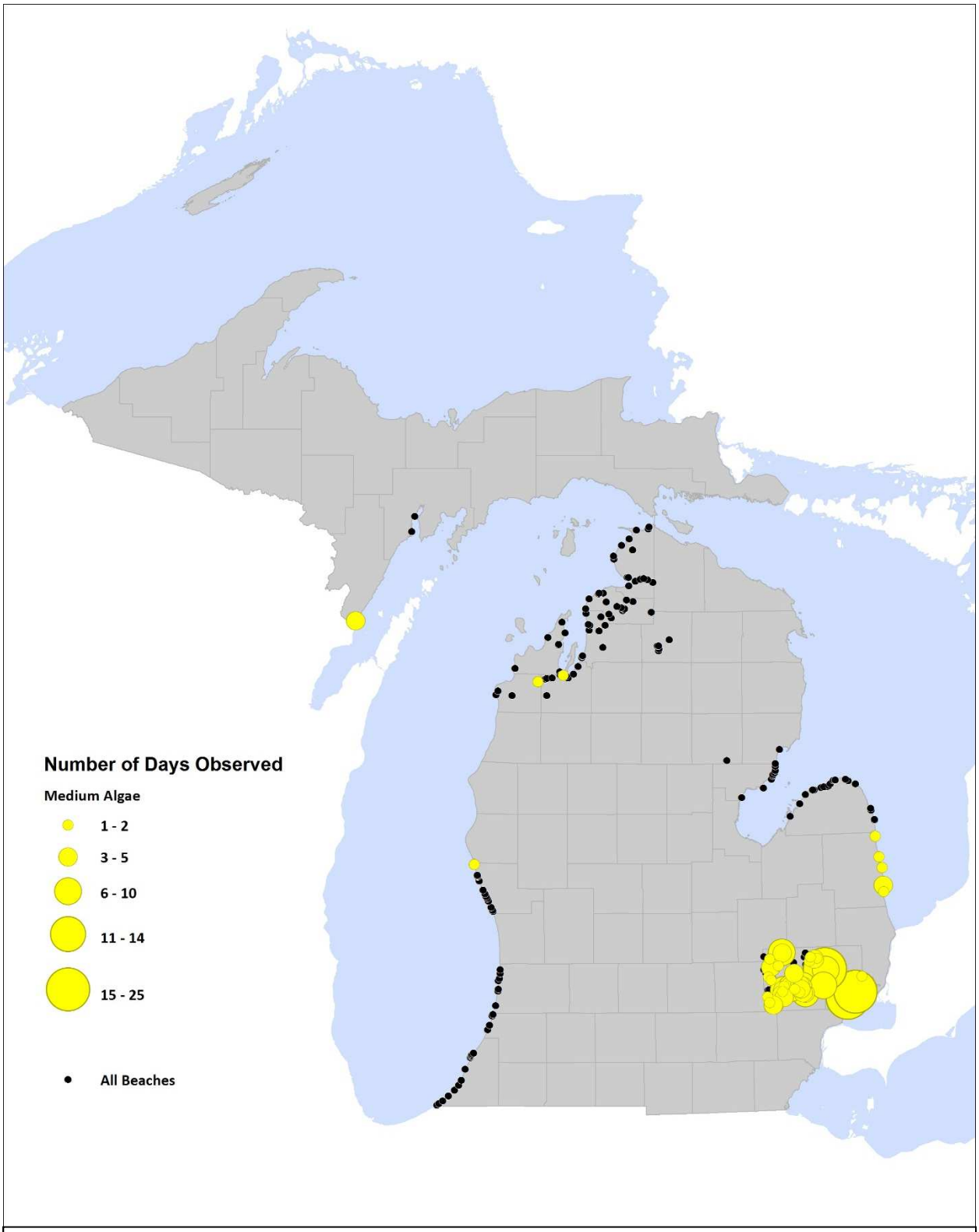

Figure 3. Michigan beaches monitored in 2016 and beaches where algal abundance was noted as moderate (21-50%) either in nearshore waters or on the beach. Results based on 2,327 sanitary surveys conducted by local officials at 107 inland lake beaches and 131 Great Lakes beaches.

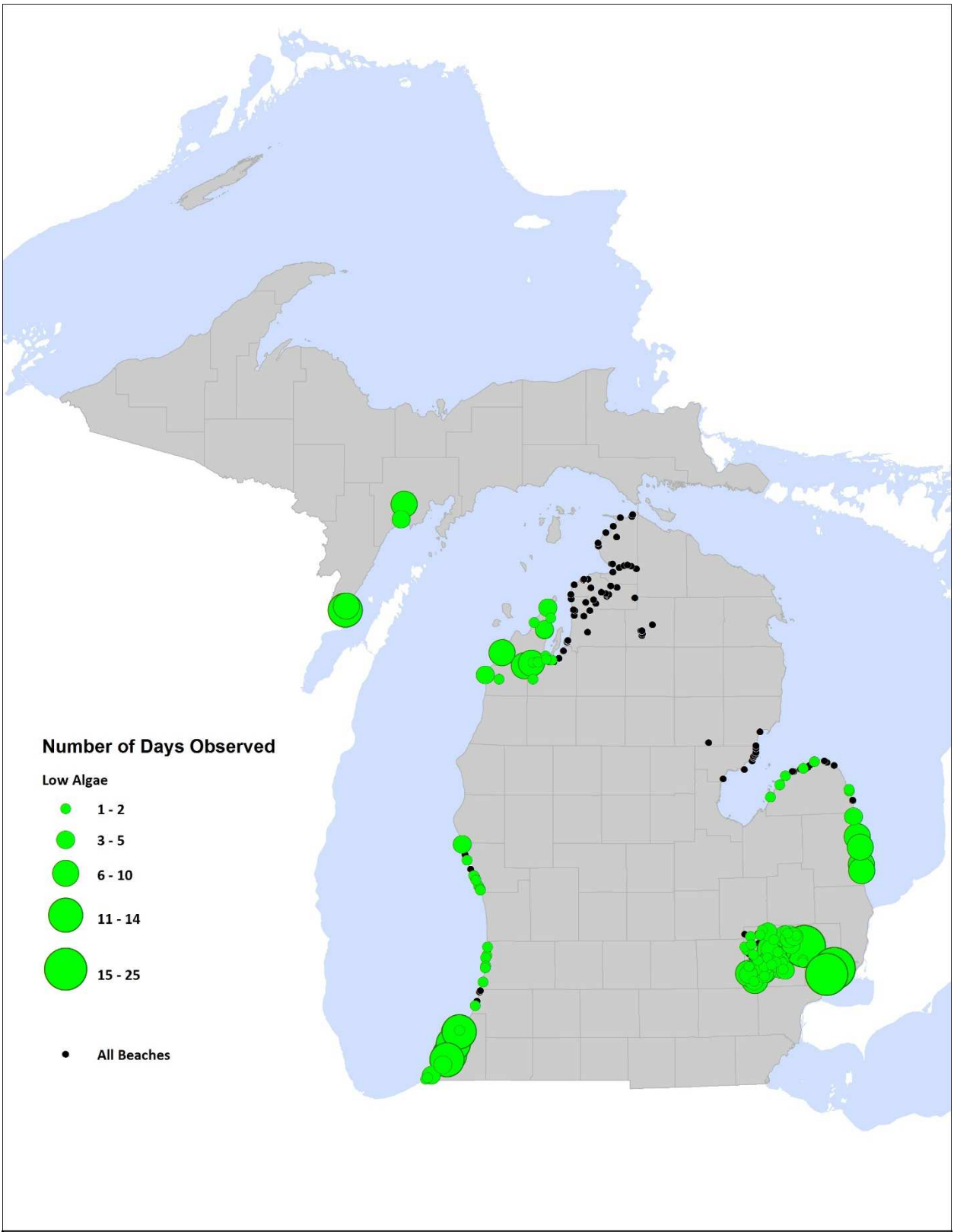

Figure 4. Michigan beaches monitored in 2016 and beaches where algal abundance was noted as low (1-20%) either in nearshore waters or on the beach. Results based on 2,327 sanitary surveys conducted by local officials at 107 inland lake beaches and 131 Great Lakes beaches.

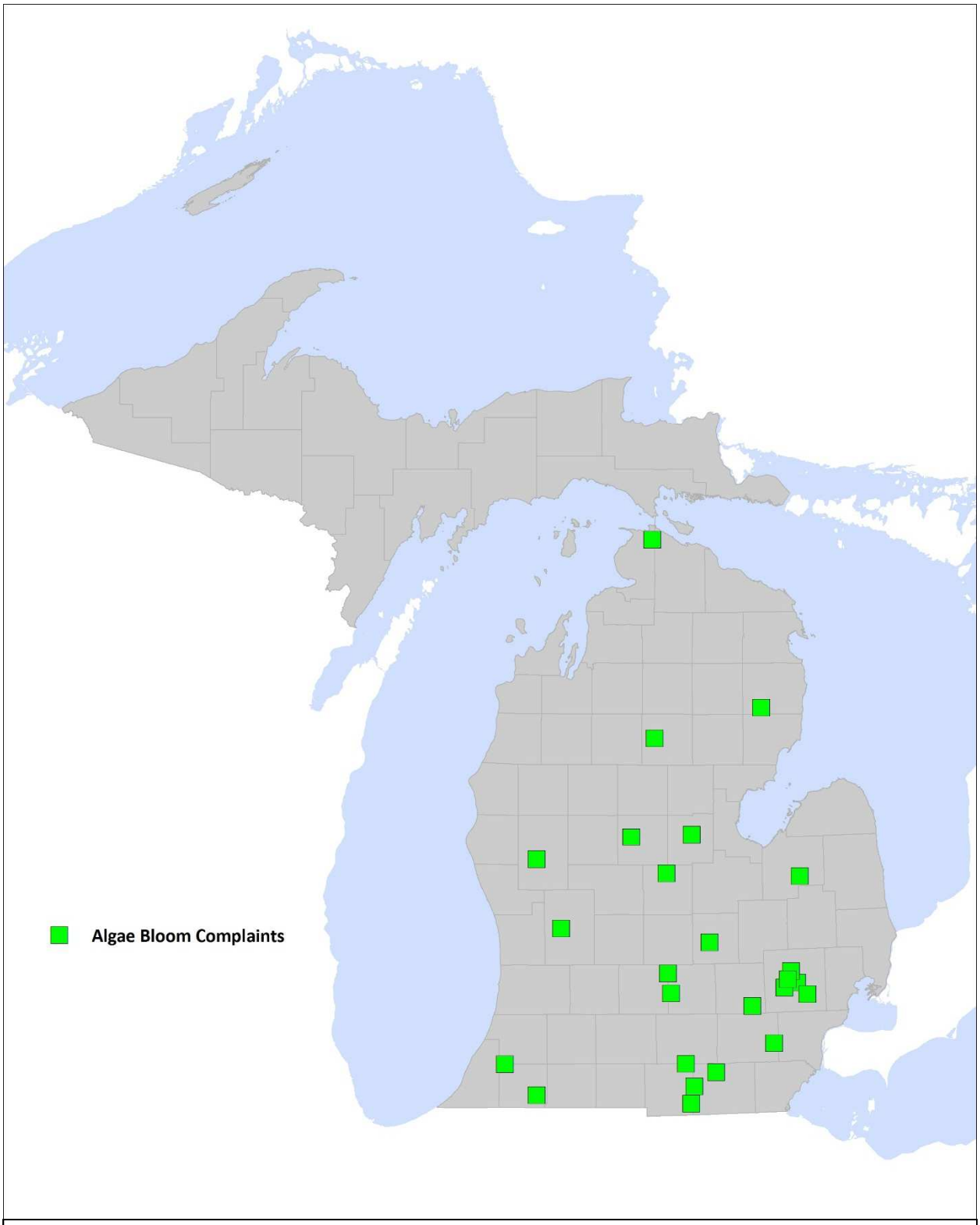

Figure 5. Locations where complaints about algae were received from the public in 2016 by either WRD district staff (PEAS) or other WRD staff (algaebloom@michigan.gov).

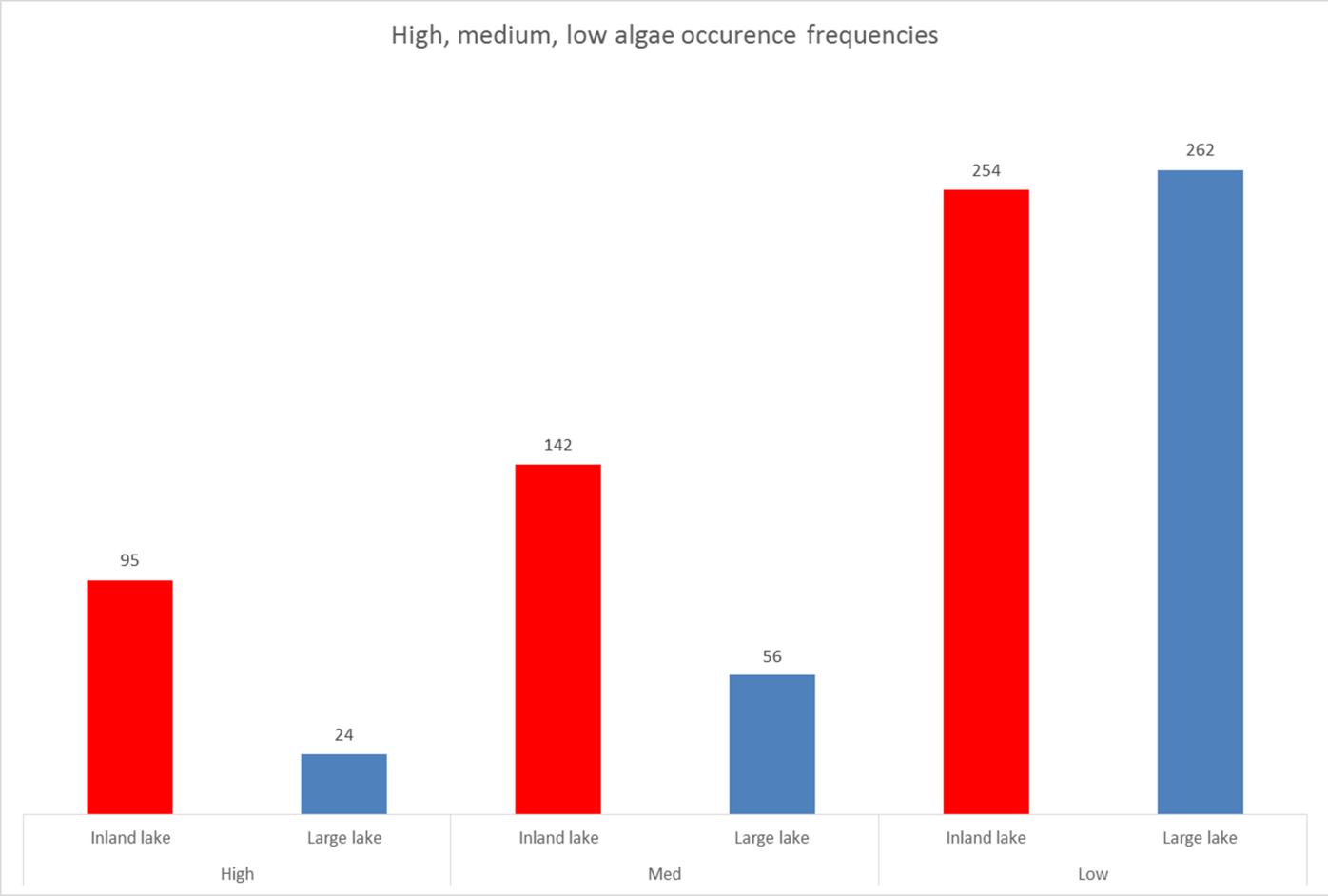

Figure 6. Frequencies of “low,” “medium,” and “high” recorded algal abundances in inland lakes, rivers, and large lakes (“large lakes” includes Great Lakes and Lake St Clair).

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