National Park Service U.S. Department of the Interior



When Lake Superior Turns Green: Characteristics and contributing factors in recent algal blooms

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What do blooms look like?

Green blobs, 2016







Where do blooms occur?

Usually just a thin band along shore... But the shore is where the people are.

August 9, 2018 (peak observed bloom on shore) RapidEye Ortho Tile (5m) What's their composition?
Dominated by Dolichospermum Iemmermanii
Akinetes and heterocysts present



Are they dangerous? Potential toxin producer, but little evidence to date Anecdotal reports of symptoms during 2018 bloom (?)



Contributing factors

Tributary inputs?



MODIS – Apr 23, 2019

Warming waters?



NOAA - 2012

Intense storms?



AirFox Photography – June 2018

Hydrodynamics?



D. Titze and J. Austin

Public reactions Sometimes indifference Other times: "What is that?" "Can I swim in it?" "Why is this happening?" "Is this because of the floods?" Needed: Coordinated outreach materials and messaging Coordinated response



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Contributing factors

Tributary inputs? Tribs contribute P and algae But blooms occur in lake water Warming waters? No blooms in cold years But only sometimes blooms in warm years

Intense storms?

- Biggest blooms followed biggest floods
- But blooms lagged weeks behind
- Concentration via currents?
 - Blooms patchy, along shore
 - P and chla concentrated in blooms

Climate change?

No blooms have been reported in cold years, but not all warm years produce blooms.



Temperature seems to be involved but isn't a sole trigger.

Yea	July	Pea
r		k
201	16.9	23.9
5		
201	16.8	23.3
2		
201	14.4	22.9
6		
201	13.9	21.3
8		
201	11.1	21.1
7		
201	9.7	20.6
3		

Is the bloom in river or lake water?

Dissolved silicate indicates that the 2018 bloom grew in nearshore lake water with little to no additional river contribution beyond typical nearshore baseline.



Where are the nutrients coming from?

TP in bloom vastly exceeds any river or lake samples.



Algae cause phosphorus!

Hydrodynamic concentration likely a factor.

"Algae causing P is like cancer causing smoking."



Joe Shapiro (1929-2017)



Major and minor blooms all occur during or shortly after seasonal peak temperature.



Blooms were not observed in the cool years of 2011, 2013, and 2014 but also not in warm year of 2015.

The two major blooms occurred in the two years with the greatest storm events, but weeks afterward.



Density plot shows how infrequent the 2012 and 2018 events were.

