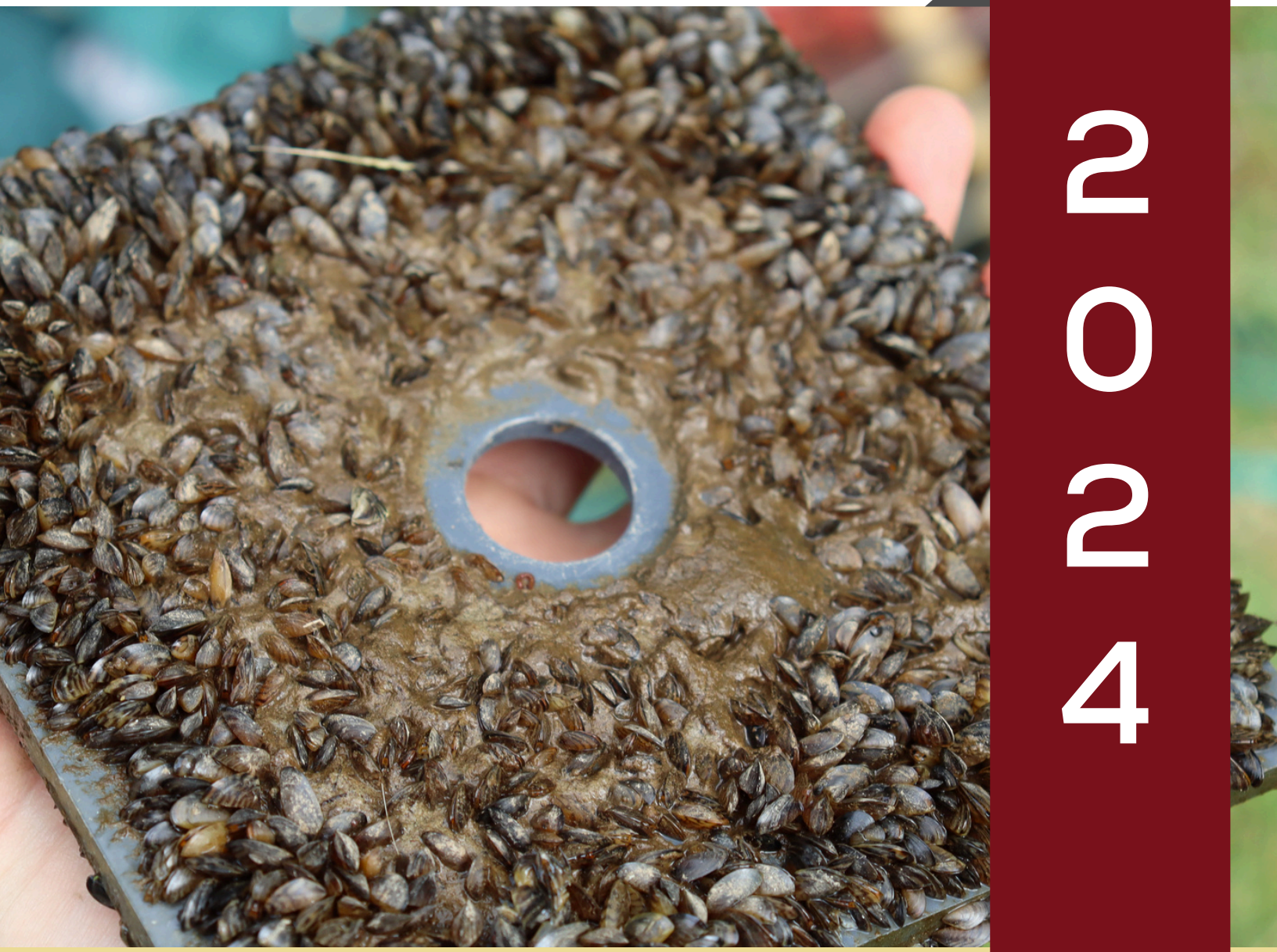


2024

MINNESOTA AQUATIC INVASIVE SPECIES RESEARCH CENTER
UNIVERSITY OF MINNESOTA
Driven to Discover℠

ZEBRA MUSSEL SAFARI ANNUAL REPORT

A WORD FROM MAISRC

The Minnesota Aquatic Invasive Species Research Center (MAISRC) is a nationally acclaimed research facility based at the University of Minnesota that focuses specifically on aquatic invasive species threatening the beloved waters of Minnesota.

We work to develop an in-depth understanding of the biology and ecology of AIS, and the complex systems in which they live. We work with partners across the University, state, and country to maximize our impact and use the most technologically advanced and cost-effective methods available.

At MAISRC, we frequently receive questions from lake residents about how and why zebra mussel population's shift in density, abundance, and distribution. These dynamics are poorly understood and very difficult to study, but one small and easy step that helps us begin to shed light on this is to monitor their settlement rates.

We've been working with 15 lake associations statewide who have been willing to help us do such monitoring. Without all of our amazing volunteers, the Zebra Mussel Safari would not be possible. We are so grateful for your help in closing the knowledge gap on zebra mussel dyanmics.

Sawyer Lorentz

MAISRC GRAD FELLOW

Table of Contents

PROGRAM OVERVIEW

Invasive species are one of the top reasons for biodiversity loss across the globe. Zebra mussels (Dreissena polymorpha), specifically, have fundamentally re-engineered ecosystems, degraded natural resources, and cost billions in direct and indirect management costs and impacts to the economy across their invaded range. Zebra mussels are small bivalves native to the Ponto-Caspian region of Eurasia. They were introduced to the US in the ballast water of transatlantic ships into the Great Lakes of North America in the 1980's. Rapid spread to inland lakes and rivers has led them to have become one of the most widely established and problematic invasive species in the United States.

Many eradication efforts have been initiated, including those relying on oxidants, flocculants, heat, physical removal, and paint coatings. However, these methods have so far proven to be unsuccessful in well-invaded ecosystems; there is still no established protocol for eradication of zebra mussels. **The best management option is, therefore, early detection and monitoring to prevent and forecast future spread**. Stakeholders have recognized the importance of establishing a comprehensive monitoring program for zebra mussels as a valuable and urgently needed tool to enhance management and predict zebra mussel outbreaks. Consequently, the Zebra Mussel Safari program was created to fulfill this role.

Program Goals

These objectives have been co-developed with partners from state and tribal natural resource agencies with the goal of engaging the public and supporting cost-effective management decisions.

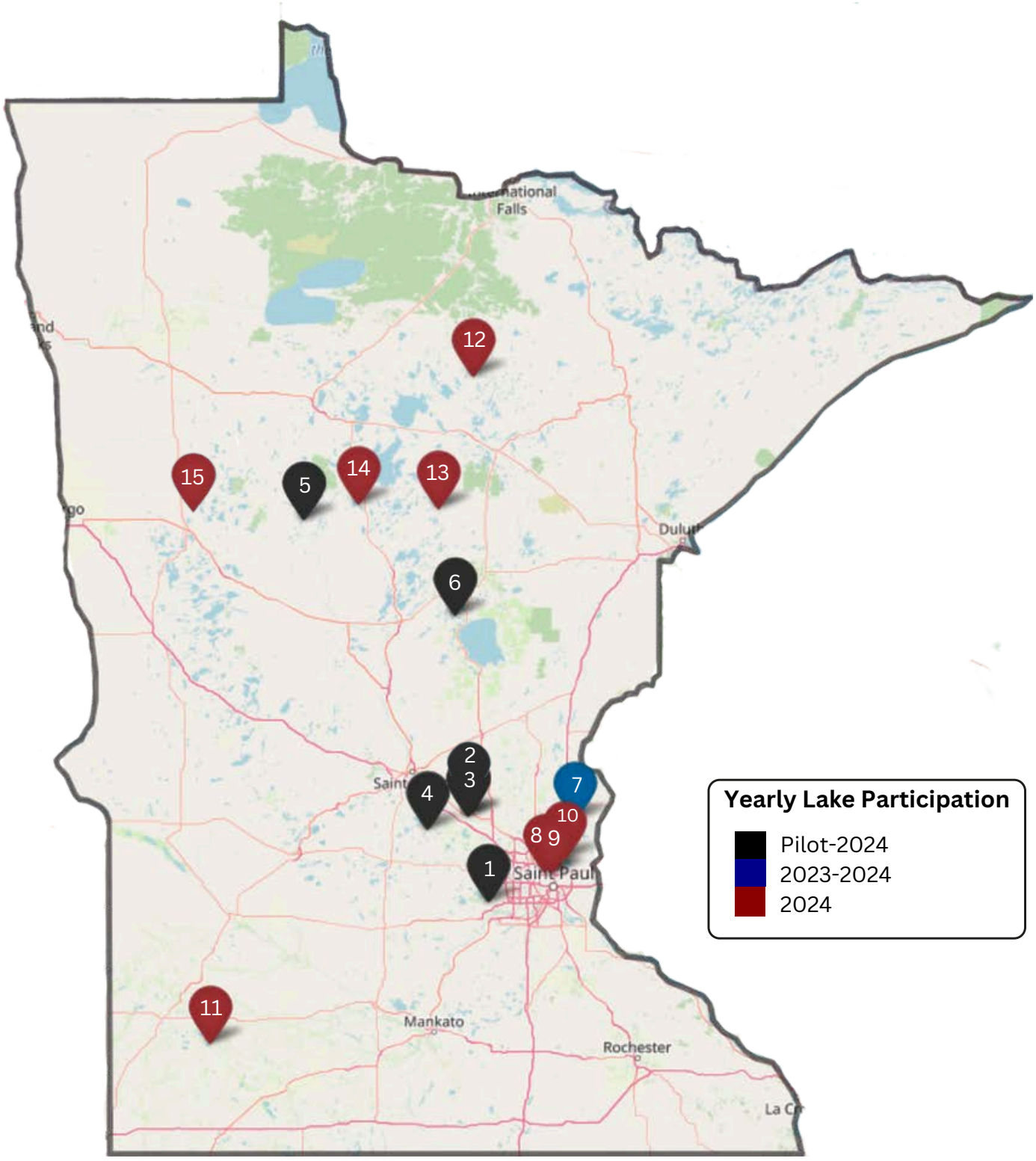
1

Develop a working and expandable participatory science program for Minnesota residents to monitor zebra mussel populations.

2

Collect, analyze, and leverage this high-volume citizen science data to model zebra mussel occupancy, suitability, and dispersal dynamics within and across Minnesota lakes.

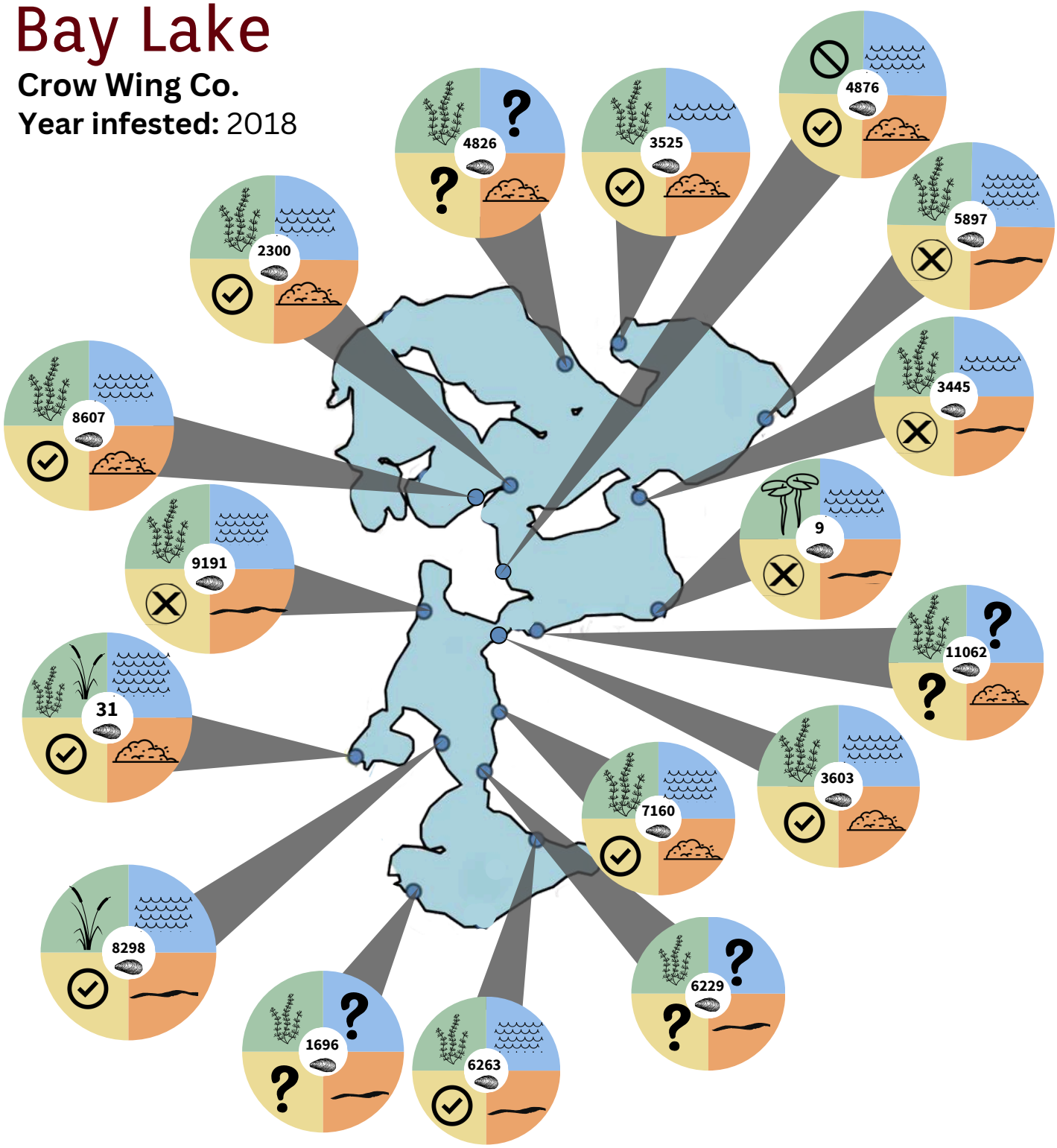
Program Lakes



Bay Lake

Crow Wing Co.

Year infested: 2018



Key

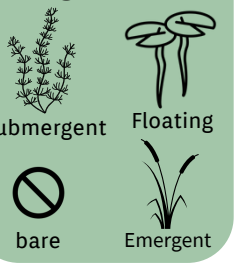
Please note: Correlation does not equal causation. More research is needed to understand the relationship between the environmental conditions displayed above and zebra mussel abundance.

Total Zebra Mussels on sampler

?

info not recieved

Majority Vegetation



Majority Substrate

Amount of boater disturbance

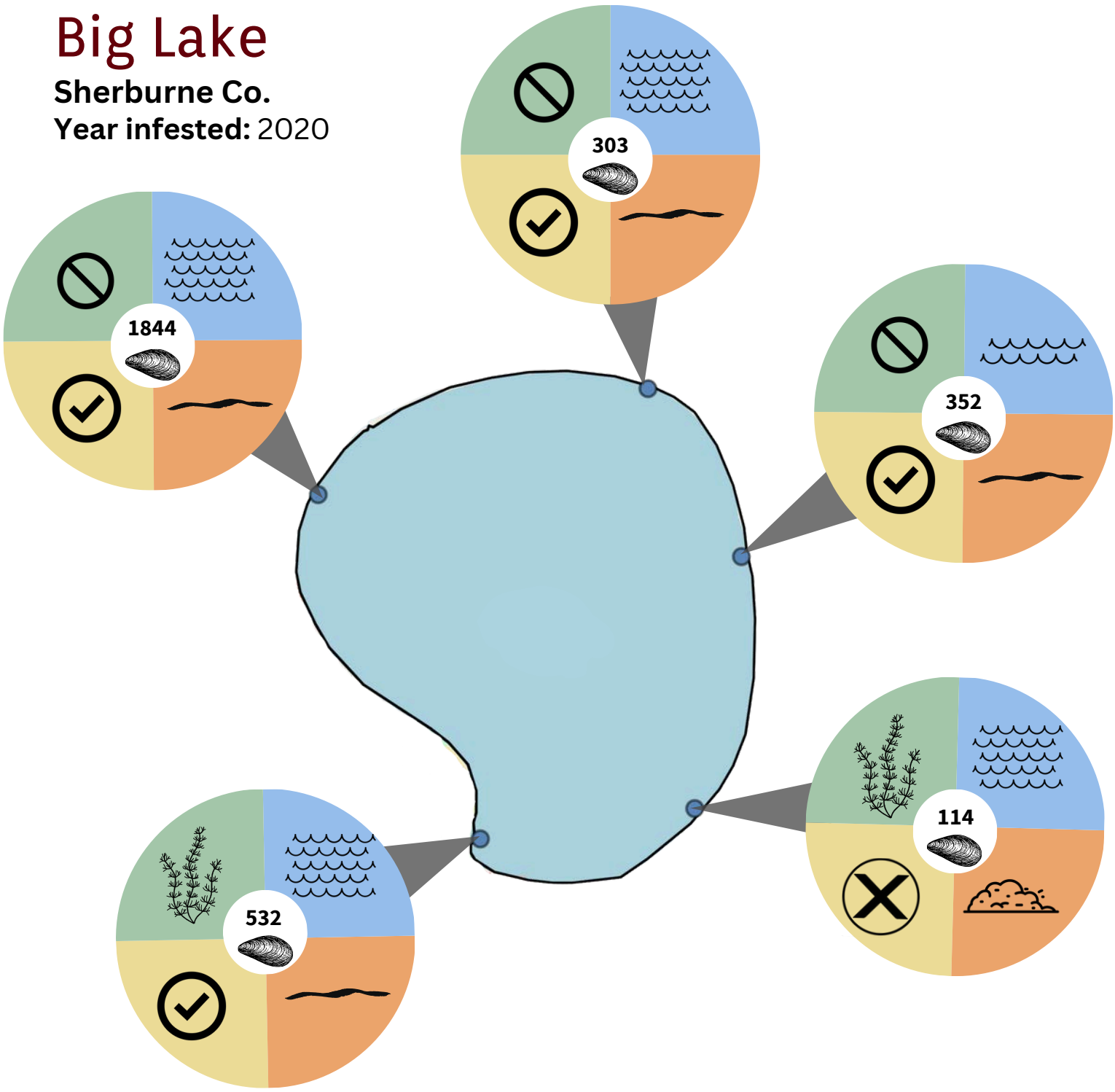
1 = almost never
2 = 1-10 days/ season
3 = 10-40 days /season
4 = 41-100 days/ season
5= >100 days /season

Any type of treatment used?

Big Lake

Sherburne Co.

Year infested: 2020



Key

Please note: Correlation does not equal causation. More research is needed to understand the relationship between the environmental conditions displayed above and zebra mussel abundance.

Total Zebra Mussels on sampler

?

info not recieved

Majority Vegetation

Submergent

Floating

bare

Emergent

Majority Substrate

Rocky

Sand

Silt

Amount of boater disturbance

1 = almost never
2 = 1-10 days/ season
3 = 10-40 days /season
4 = 41-100 days/ season
5= >100 days /season

Any type of treatment used?

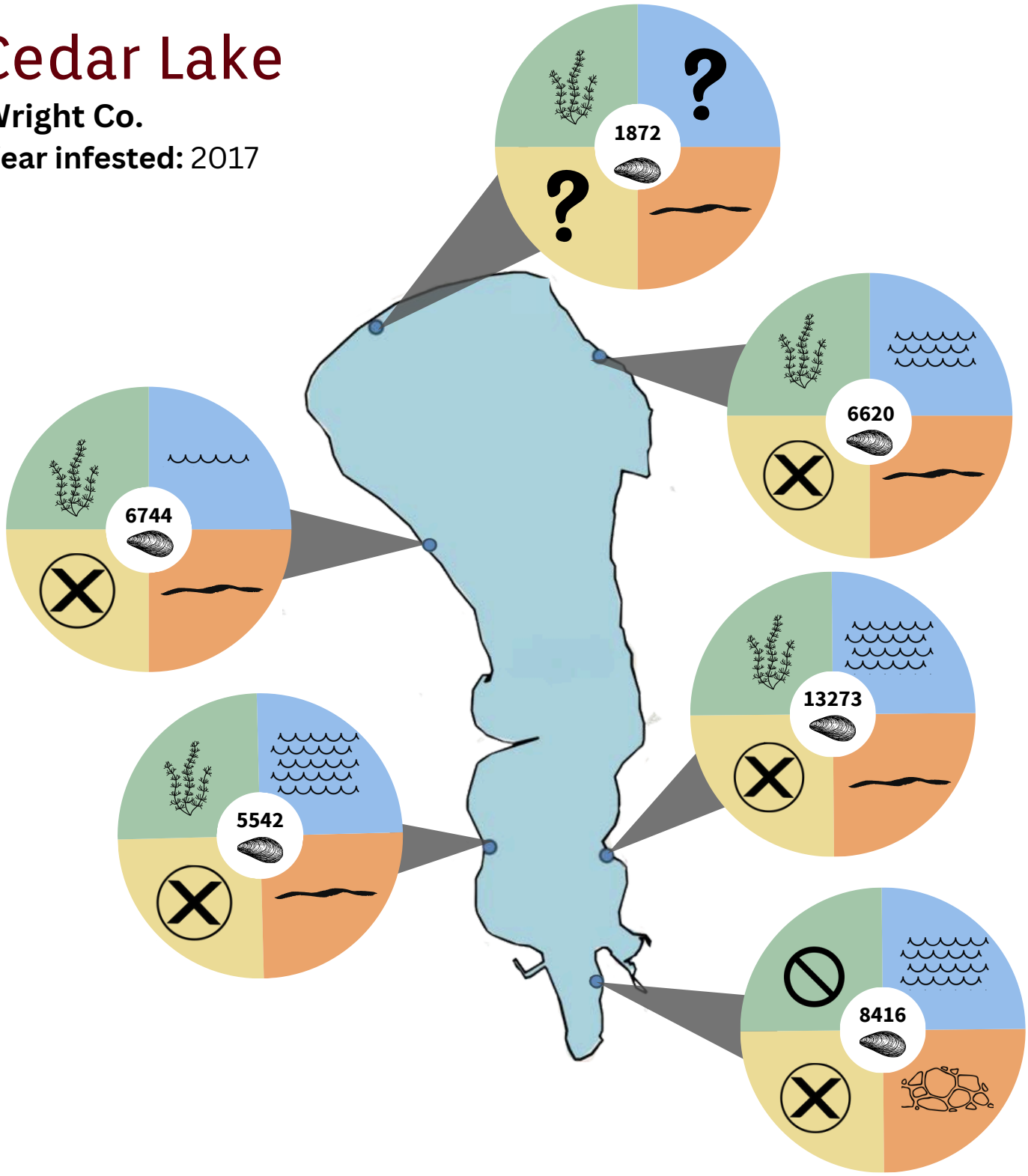
Yes

No

Cedar Lake

Wright Co.

Year infested: 2017



Key

Please note: Correlation does not equal causation. More research is needed to understand the relationship between the environmental conditions displayed above and zebra mussel abundance.

Total Zebra Mussels on sampler

?

info not recieved

Majority Vegetation

Submergent

Floating

bare

Emergent

Majority Substrate

Rocky

Sand

Silt

Amount of boater disturbance

1 = almost never
2 = 1-10 days/ season
3 = 10-40 days /season
4 = 41-100 days/ season
5= >100 days /season

Any type of treatment used?

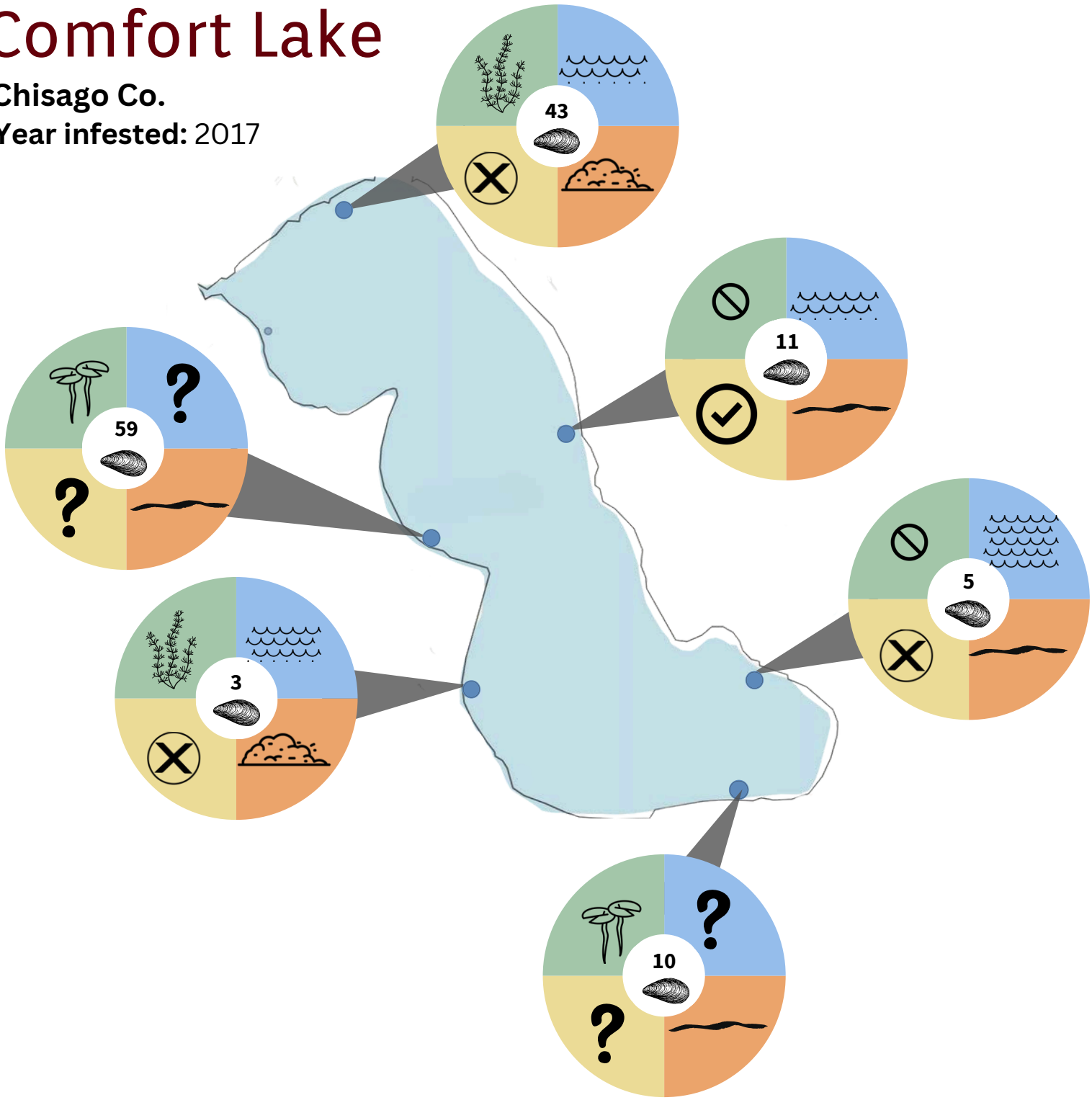
Yes

No

Comfort Lake

Chisago Co.

Year infested: 2017



Key

Please note: Correlation does not equal causation. More research is needed to understand the relationship between the environmental conditions displayed above and zebra mussel abundance.

Total Zebra Mussels on sampler

? info not recieved

Majority Vegetation

Submergent, Floating, bare, Emergent

Majority Substrate

Rocky, Sand, Silt

Amount of boater disturbance

1 = almost never
2 = 1-10 days/ season
3 = 10-40 days /season
4 = 41-100 days/ season
5= >100 days /season

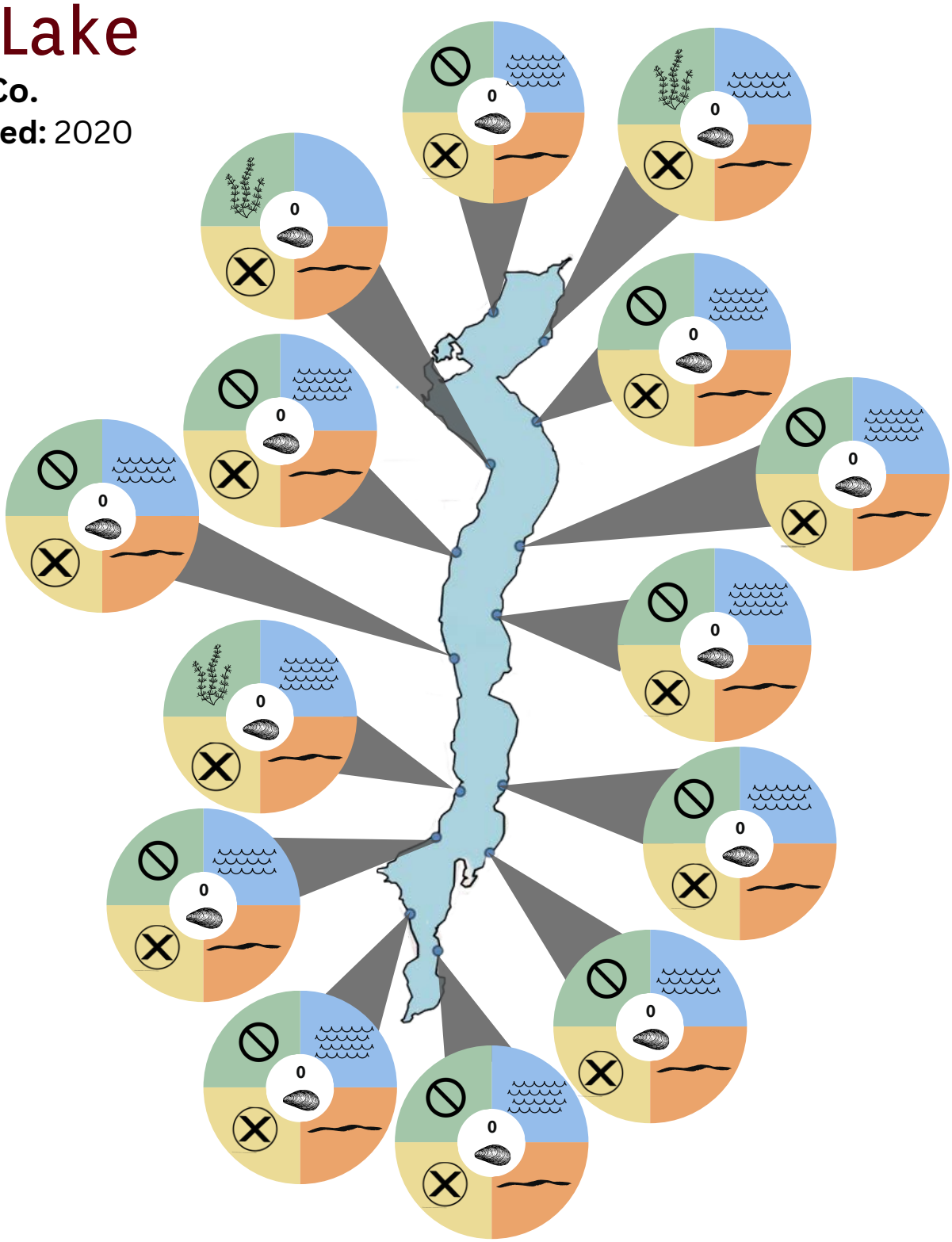
Any type of treatment used?

Yes, No

Long Lake

Hubbard Co.

Year infested: 2020



Key

Please note: Correlation does not equal causation. More research is needed to understand the relationship between the environmental conditions displayed above and zebra mussel abundance.

Total Zebra Mussels on sampler

?

info not recieved

Majority Vegetation

Submergent

Floating

bare

Emergent

Majority Substrate

Rocky

Sand

Silt

Amount of boater disturbance

1 = almost never
2 = 1-10 days/ season
3 = 10-40 days /season
4 = 41-100 days/ season
5= >100 days /season

Any type of treatment used?

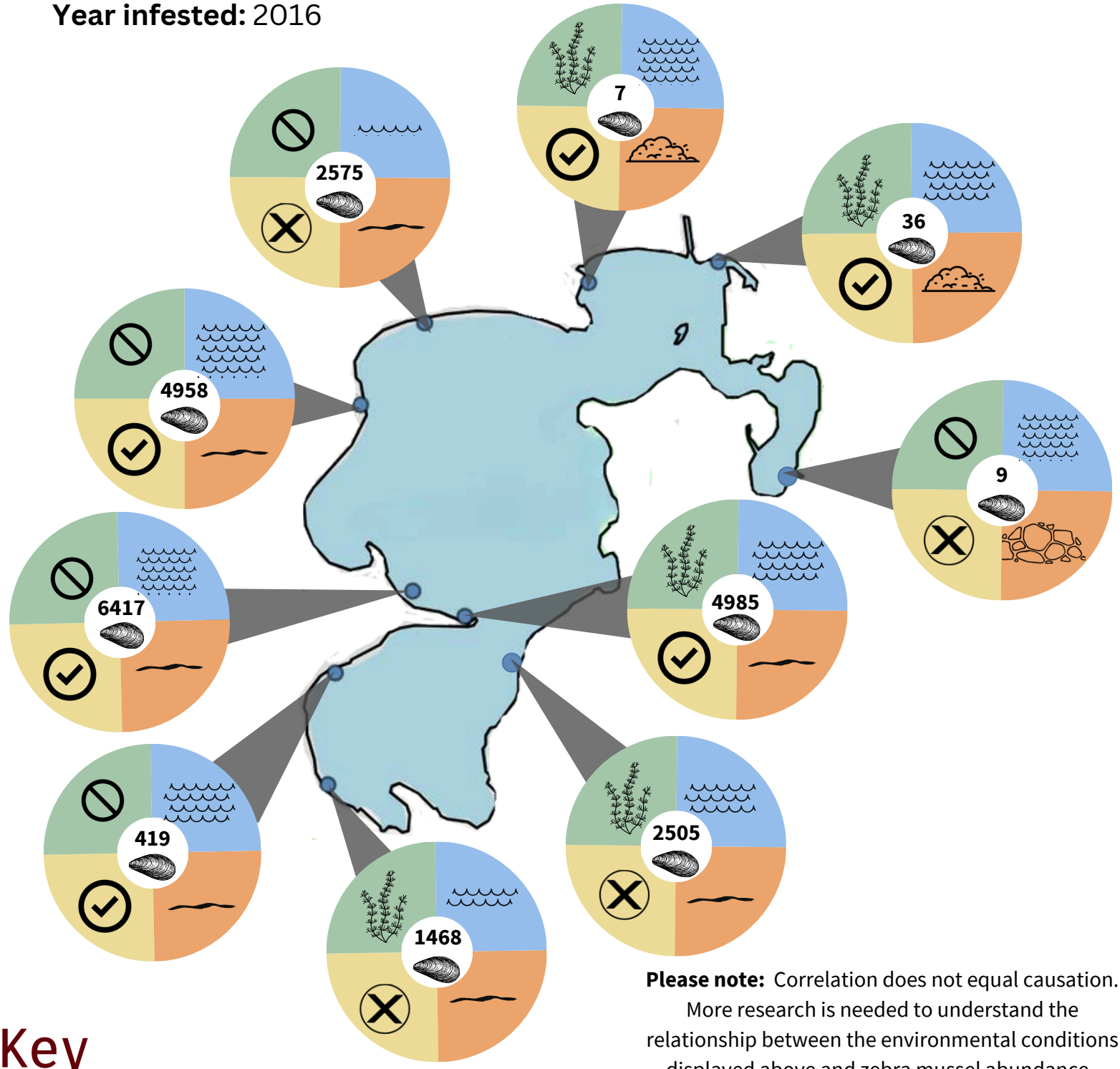
Yes

No

Lake Minnewashta

Carver Co.

Year infested: 2016



Please note: Correlation does not equal causation. More research is needed to understand the relationship between the environmental conditions displayed above and zebra mussel abundance.

Key

Total Zebra Mussels on sampler

?

info not recieved

Majority Vegetation

Submergent

Floating

bare

Emergent

Majority Substrate

Rocky

Sand

Silt

Amount of boater disturbance

1 = almost never
2 = 1-10 days/ season
3 = 10-40 days /season
4 = 41-100 days/ season
5= >100 days /season

Any type of treatment used?

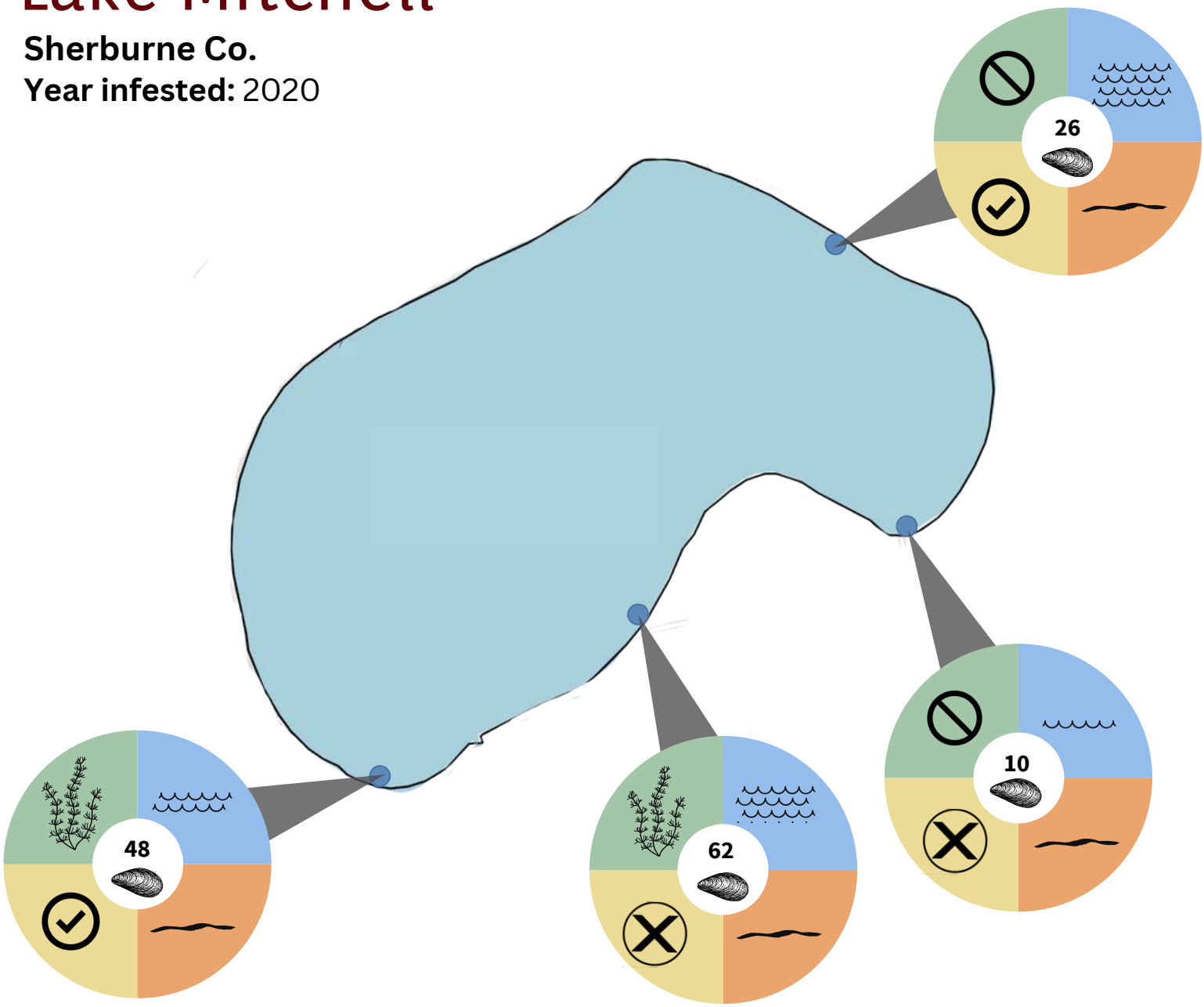
Yes

No

Lake Mitchell

Sherburne Co.

Year infested: 2020



Key

Please note: Correlation does not equal causation. More research is needed to understand the relationship between the environmental conditions displayed above and zebra mussel abundance.

Total Zebra Mussels on sampler

?

info not recieved

Majority Vegetation

Submergent

Floating

bare

Emergent

Majority Substrate

Rocky

Sand

Silt

Amount of boater disturbance

1 = almost never
2 = 1-10 days/ season
3 = 10-40 days /season
4 = 41-100 days/ season
5= >100 days /season

Any type of treatment used?

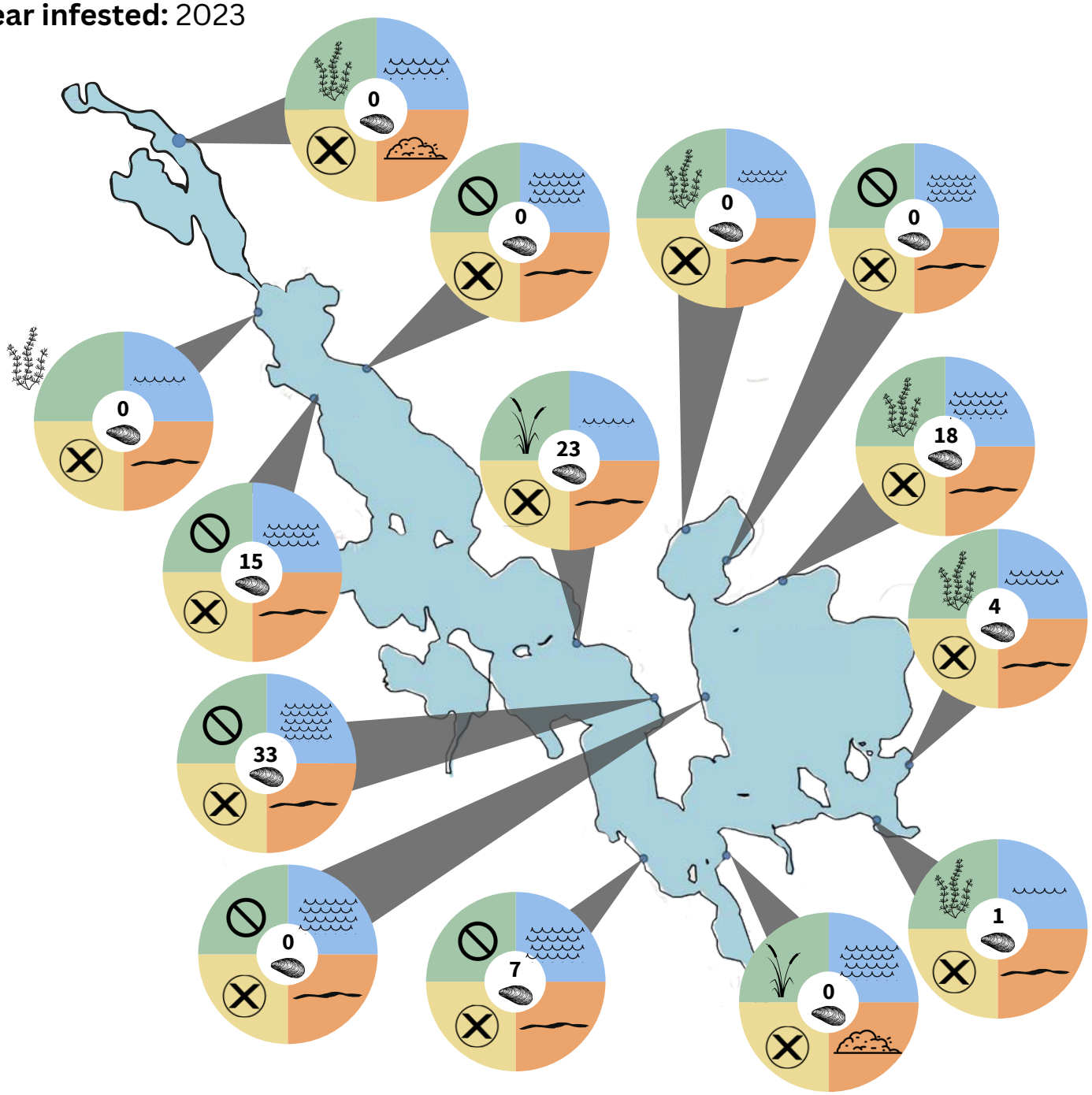
Yes

No

Turtle Lake

Itasca Co.

Year infested: 2023



Key

Please note: Correlation does not equal causation. More research is needed to understand the relationship between the environmental conditions displayed above and zebra mussel abundance.

Total Zebra Mussels on sampler

? info not recieved

Majority Vegetation

Submergent, Floating, bare, Emergent

Majority Substrate

Rocky, Sand, Silt

Amount of boater disturbance

1 = almost never
2 = 1-10 days/ season
3 = 10-40 days /season
4 = 41-100 days/ season
5= >100 days /season

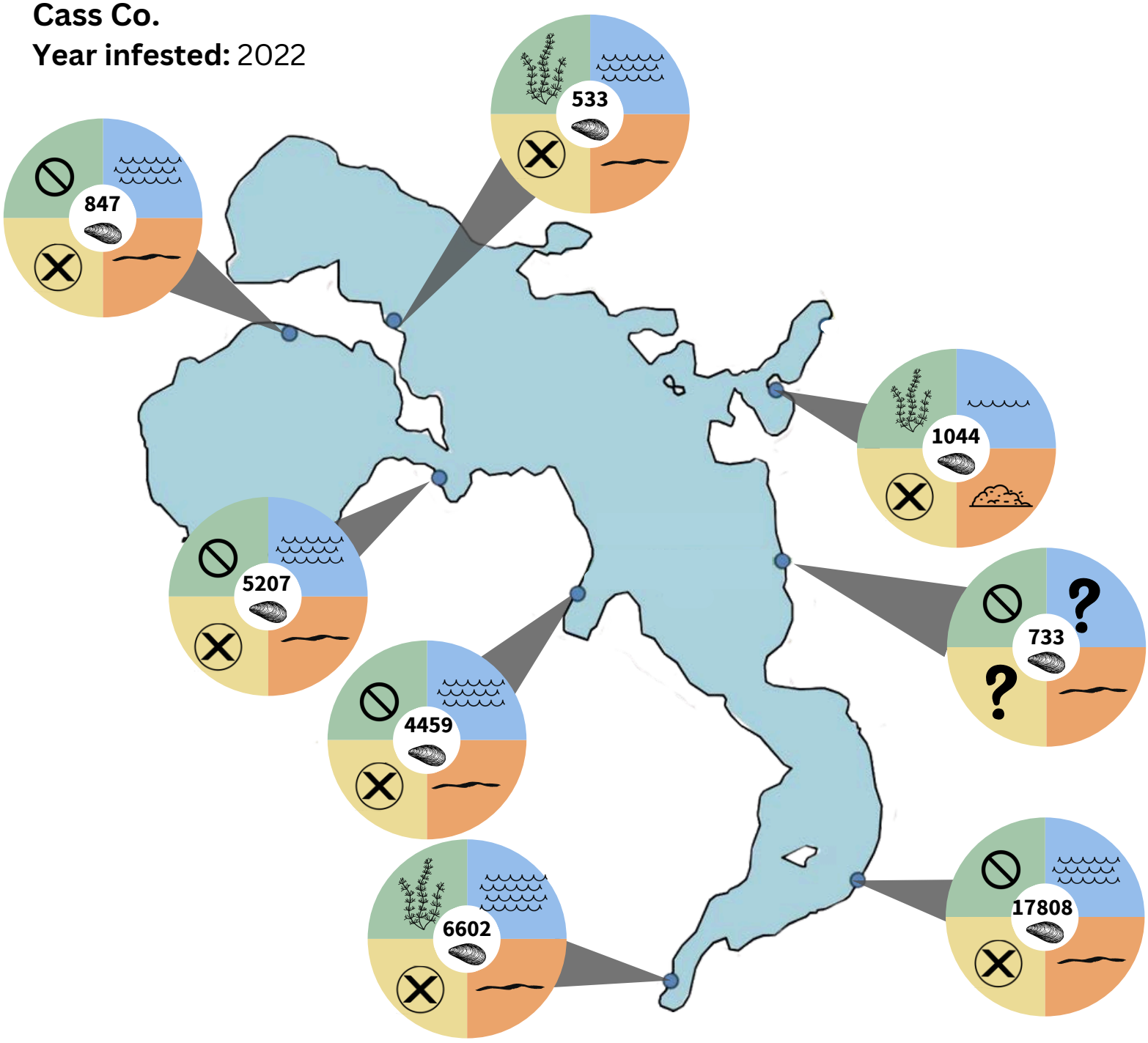
Any type of treatment used?

Yes, No

Thunder Lake

Cass Co.

Year infested: 2022



Key

Please note: Correlation does not equal causation. More research is needed to understand the relationship between the environmental conditions displayed above and zebra mussel abundance.

Total Zebra Mussels on sampler

?

info not recieved

Majority Vegetation

Submergent

Floating

bare

Emergent

Majority Substrate

Rocky

Sand

Silt

Amount of boater disturbance

1 = almost never
2 = 1-10 days/ season
3 = 10-40 days /season
4 = 41-100 days/ season
5= >100 days /season

Any type of treatment used?

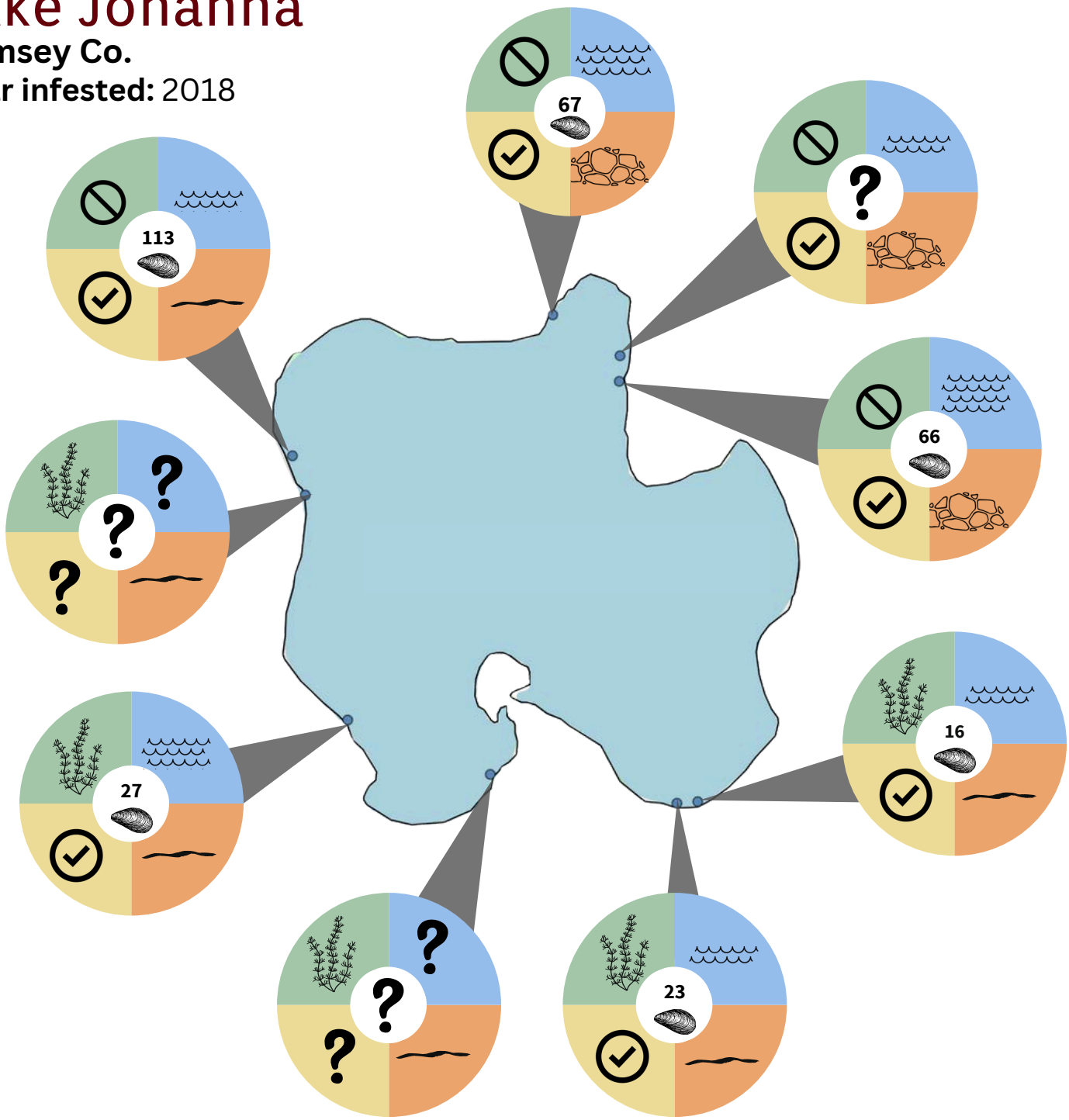
Yes

No

Lake Johanna

Ramsey Co.

Year infested: 2018



Key

Please note: Correlation does not equal causation. More research is needed to understand the relationship between the environmental conditions displayed above and zebra mussel abundance.

Total Zebra Mussels on sampler

? info not recieved

Majority Vegetation

Submergent, Floating, bare, Emergent

Majority Substrate

Rocky, Sand, Silt

Amount of boater disturbance

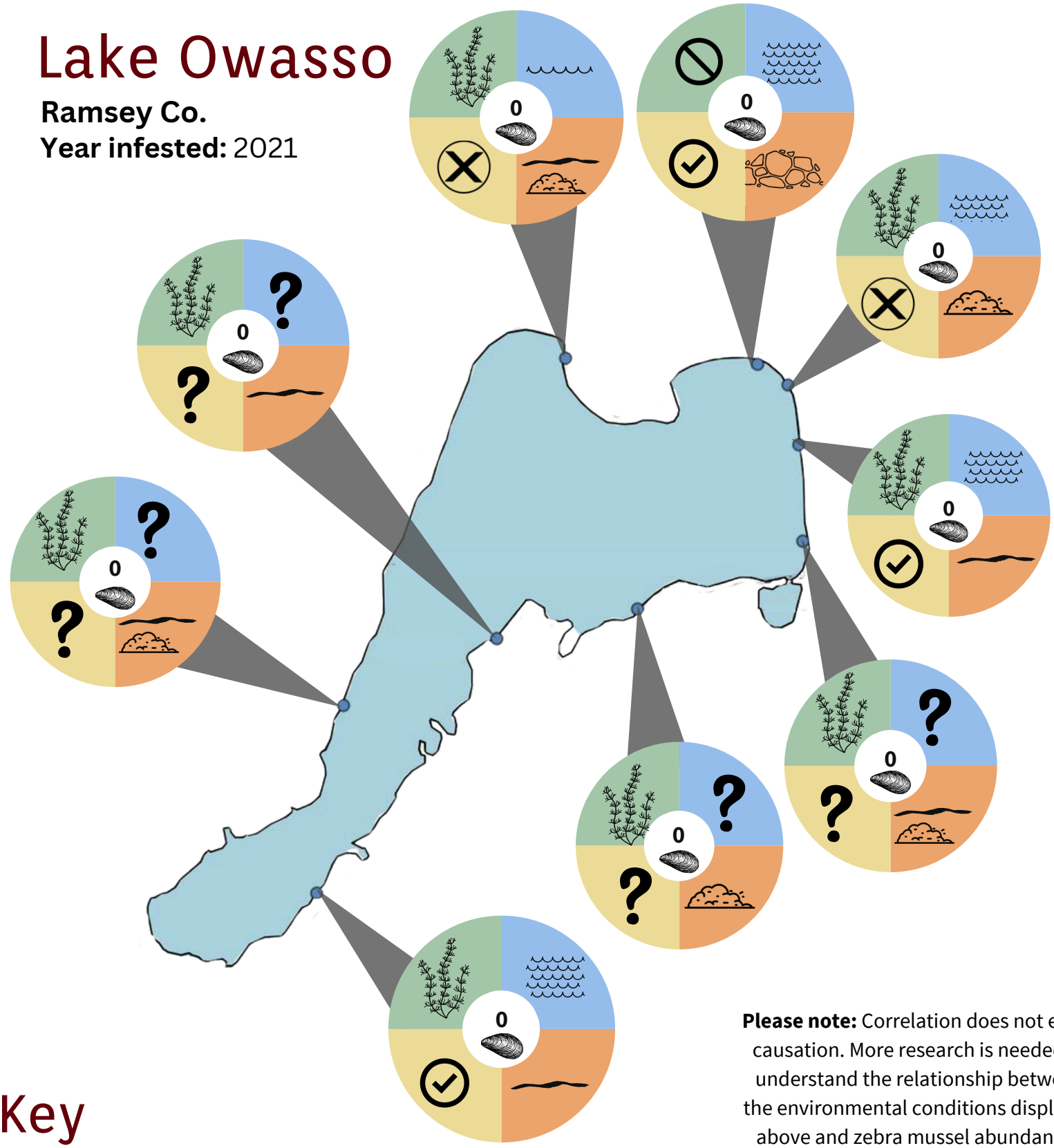
1 = almost never
2 = 1-10 days/ season
3 = 10-40 days /season
4 = 41-100 days/ season
5= >100 days /season

Any type of treatment used?

Yes, No

Lake Owasso

Ramsey Co.
Year infested: 2021



Please note: Correlation does not equal causation. More research is needed to understand the relationship between the environmental conditions displayed above and zebra mussel abundance.

Key

Total Zebra Mussels on sampler

?
info not recieved

Majority Vegetation
Submergent
Floating
bare
Emergent

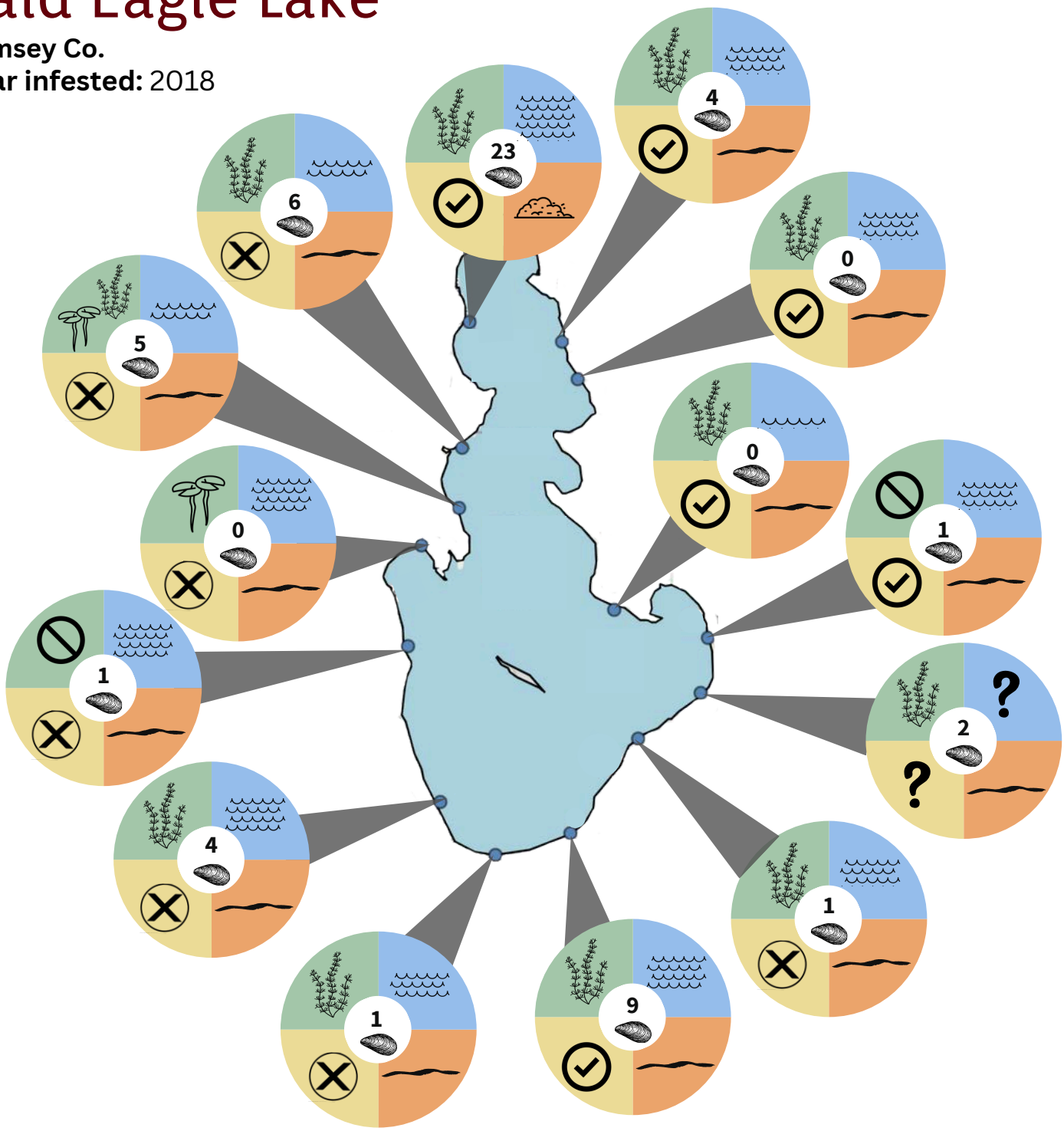
Majority Substrate
Rocky
Sand
Silt

Amount of boater disturbance
1 = almost never
2 = 1-10 days/ season
3 = 10-40 days /season
4 = 41-100 days/ season
5= >100 days /season

Any type of treatment used?
Yes
No

Bald Eagle Lake

Ramsey Co.
Year infested: 2018



Key

Please note: Correlation does not equal causation. More research is needed to understand the relationship between the environmental conditions displayed above and zebra mussel abundance.

Total Zebra Mussels on sampler

? info not recieved

Majority Vegetation

Submergent, Floating, bare, Emergent

Majority Substrate

Rocky, Sand, Silt

Amount of boater disturbance

1 = almost never
2 = 1-10 days/ season
3 = 10-40 days /season
4 = 41-100 days/ season
5= >100 days /season

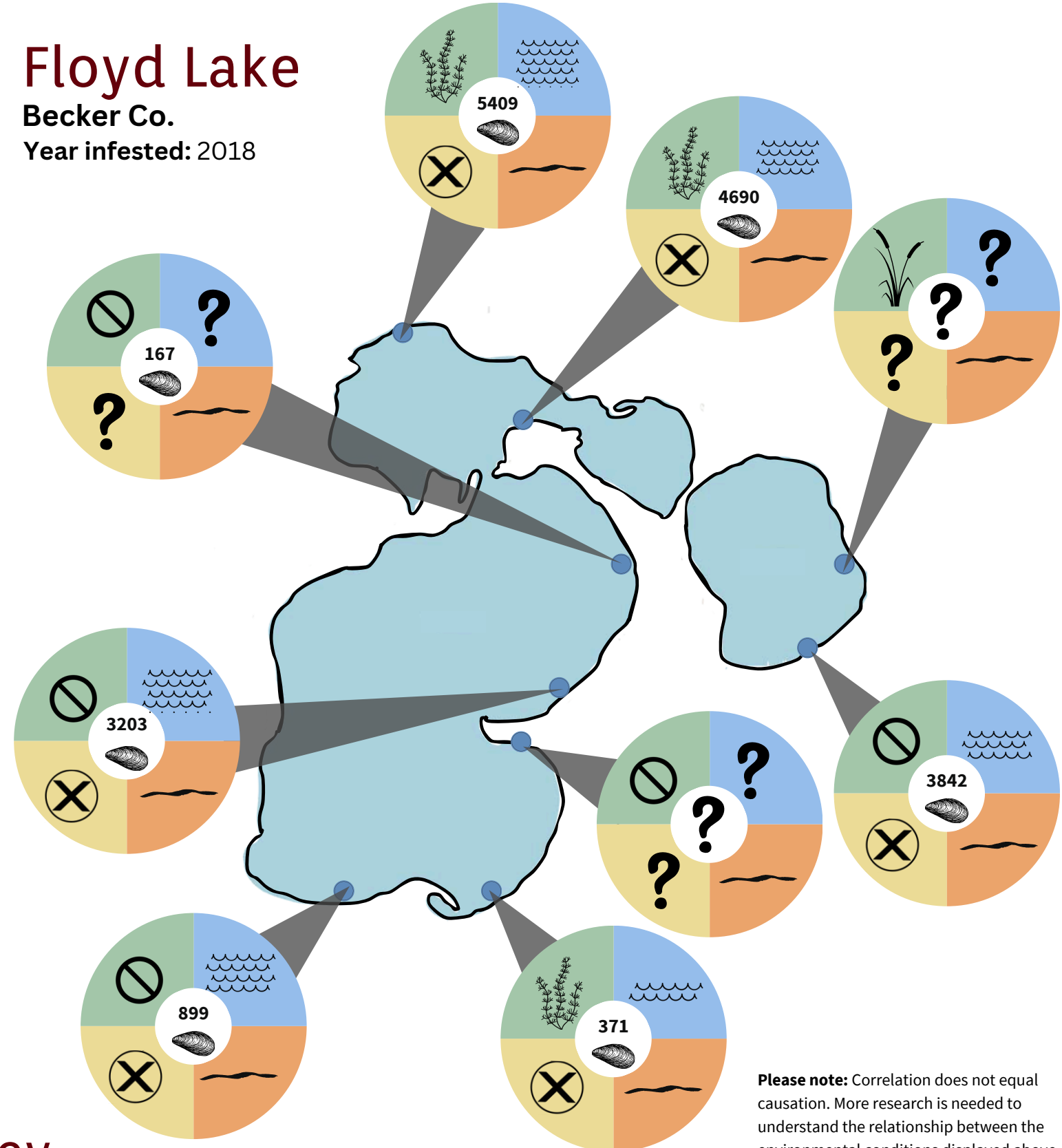
Any type of treatment used?

Yes, No

Floyd Lake

Becker Co.

Year infested: 2018



Please note: Correlation does not equal causation. More research is needed to understand the relationship between the environmental conditions displayed above and zebra mussel abundance.

Key

Total Zebra Mussels on sampler

?
info not recieved

Majority Vegetation

Submergent
Floating
bare
Emergent

Majority Substrate

Rocky
Sand
Silt

Amount of boater disturbance

1 = almost never
2 = 1-10 days/ season
3 = 10-40 days /season
4 = 41-100 days/ season
5= >100 days /season

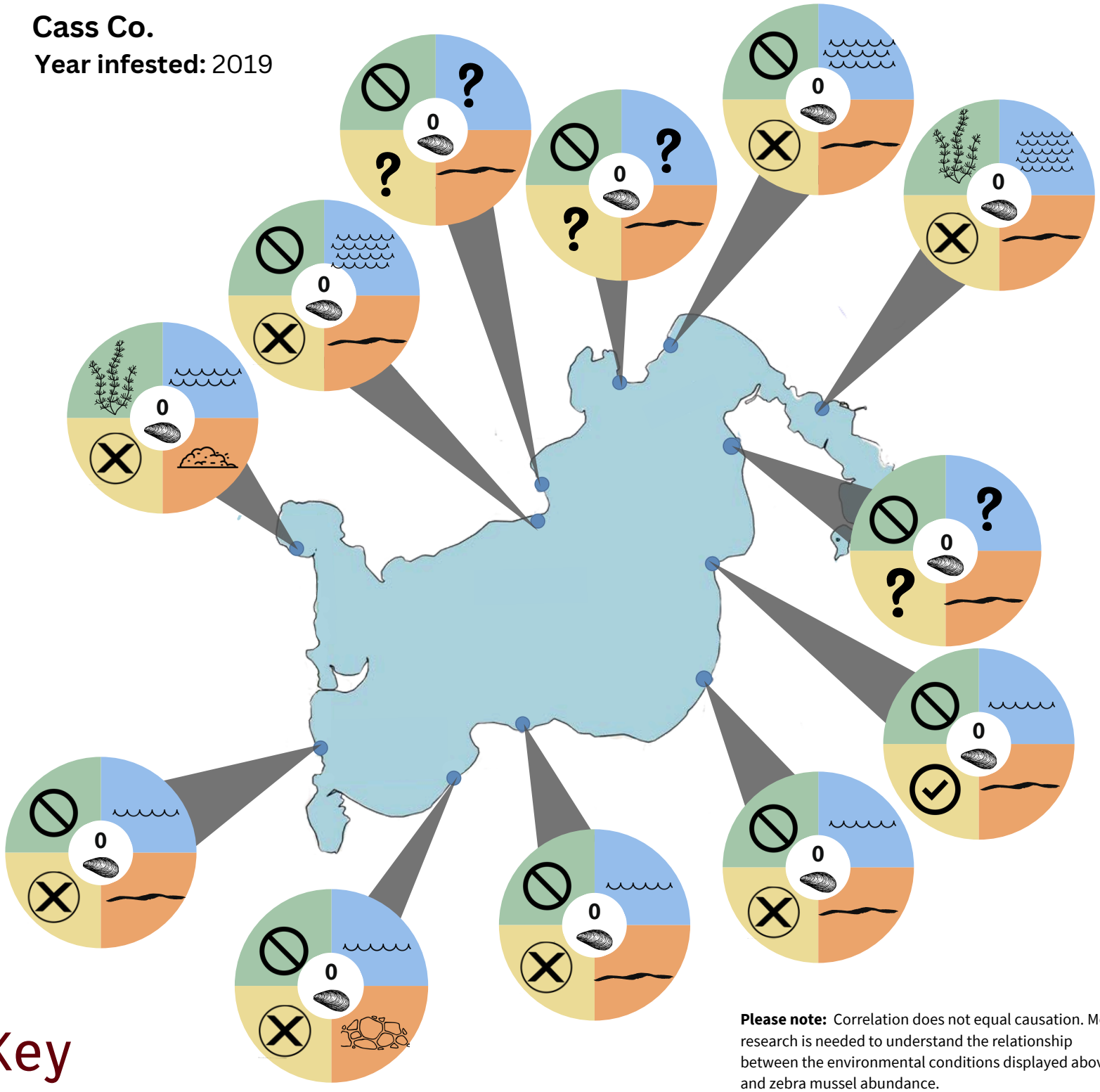
Any type of treatment used?

Yes
No

Ten Mile Lake

Cass Co.

Year infested: 2019



Key

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Total Zebra Mussels on sampler

?

info not recieved

Majority Vegetation

Submergent

Floating

bare

Emergent

Majority Substrate

Rocky

Sand

Silt

Amount of boater disturbance

1 = almost never
2 = 1-10 days/ season
3 = 10-40 days /season
4 = 41-100 days/ season
5= >100 days /season

Any type of treatment used?

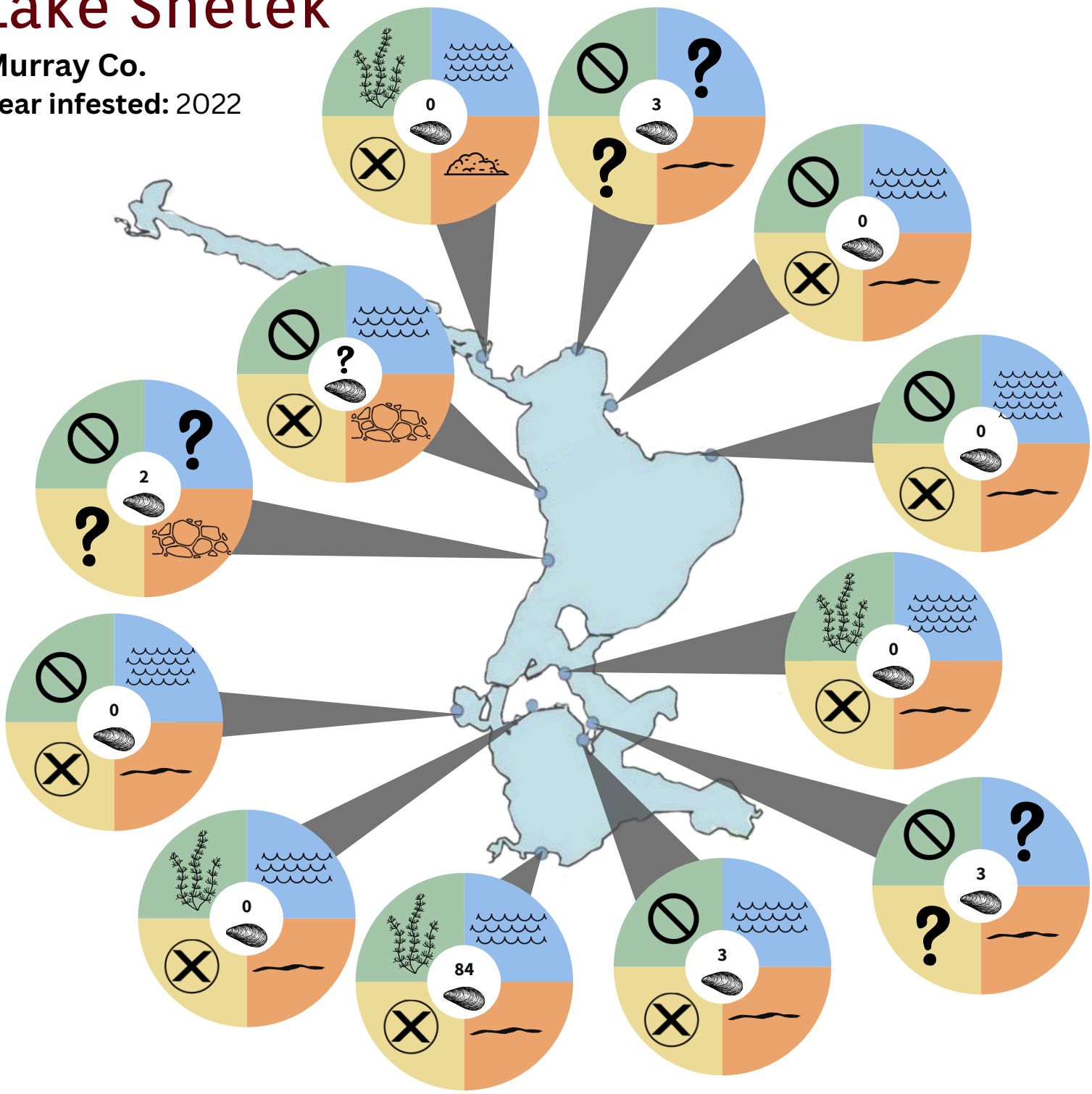
Yes

No

Lake Shetek

Murray Co.

Year infested: 2022



Key

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Total Zebra Mussels on sampler

?

info not recieved

Majority Vegetation

Submergent

Floating

bare

Emergent

Majority Substrate

Rocky

Sand

Silt

Amount of boater disturbance

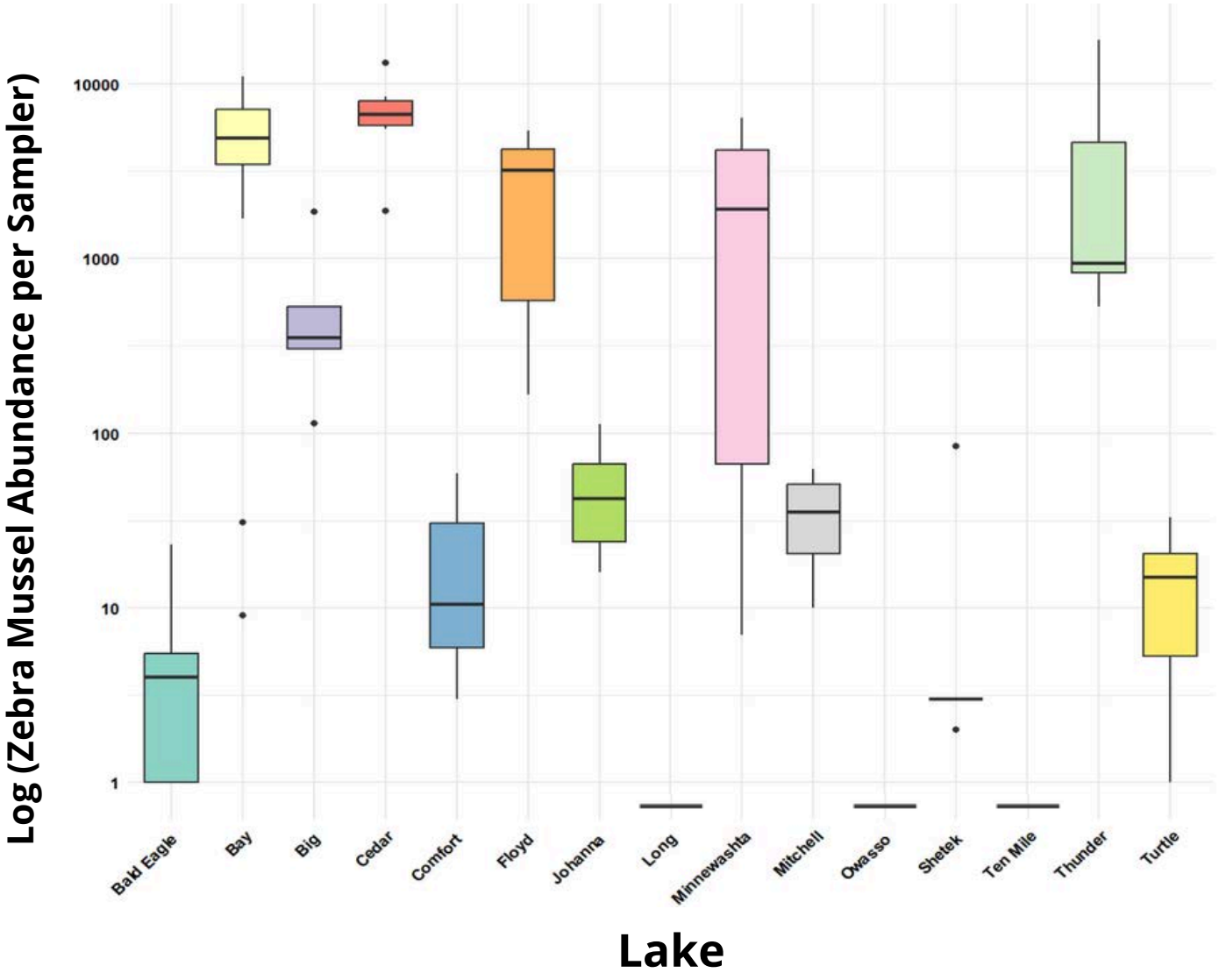
1 = almost never
2 = 1-10 days/ season
3 = 10-40 days /season
4 = 41-100 days/ season
5= >100 days /season

Any type of treatment used?

Yes

No

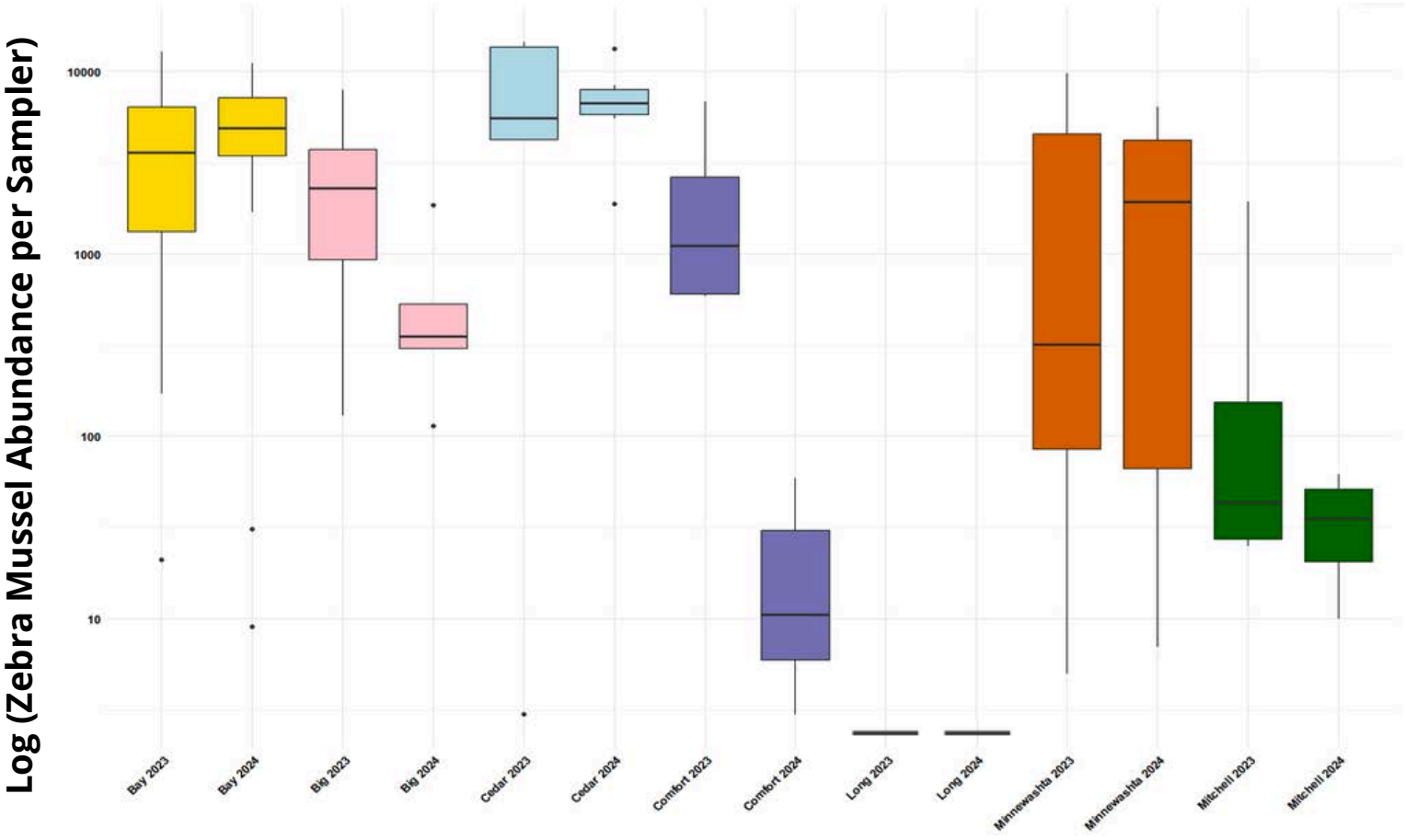
Comparing Lakes



What's a Box Plot?

1. Box: The length of the box shows the spread of the middle 50% of the data for each lake. The line in the box represents the median, the middle value of the dataset.
2. Whiskers: The whiskers extend from the box to the minimum and maximum values of zebra mussels
3. Outliers: Individual data points that fall outside the whiskers are plotted as dots and are considered outliers. They indicate extreme values in the dataset.
4. Log Transformation: The log scale is used because zebra mussel abundances can vary widely across lakes. By taking the logarithm, the data is compressed, making it easier to compare lakes with very small and very large numbers.

Comparing Years

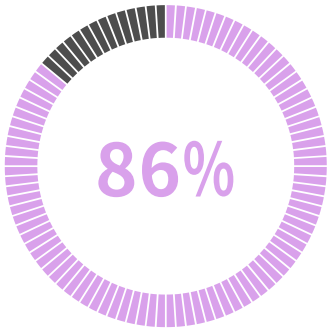


What's going on?

In both plots, we see significant variability in zebra mussel abundance between lakes, regardless of infestation year and location. This suggests that lake-specific factors, such as environmental conditions or habitat characteristics, may play a key role in driving these differences. Ongoing research aims to explore these potential drivers to better understand patterns of zebra mussel proliferation and inform management strategies.

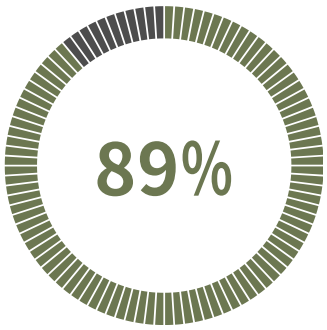
Survey Highlights

Motivations for participation:



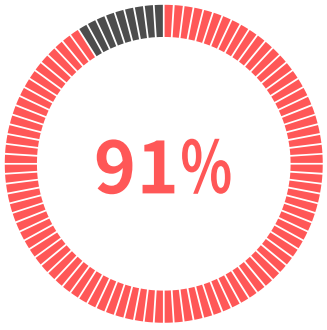
Of participates reported participating because they want to support aquatic invasive species research

Photo taking Experience:



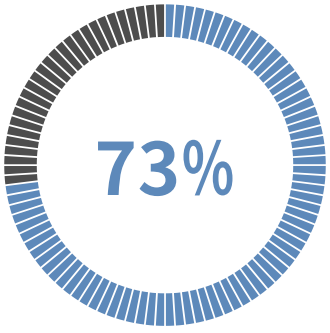
Of participates reported the photo taking being extremely- somewhat easy

Program Difficulty:



Of participates reported participating in the program was “somewhat to extremly easy”

Educational Resources:



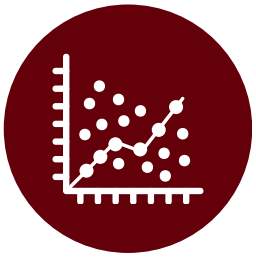
Watched the provided YouTube video tutorials and found them useful for program participation.

WHAT'S NEXT?

Our commitment to conserving Minnesota's lakes does not end with this report. The future of the Zebra Mussel Safari will involve:

No. 01 — **Continuation & Expansion**

Continuing annual zebra mussel surveys in 2025 while expanding our program to encompass more Minnesota lakes.



No. 02 — ***Zebracast***

Using all the data to build Zebracast- a predictive model that uses the Zebra Mussel Safari data to predict local zebra mussel abundance.

No. 03 — **Collaboration & Communication**

Collaborating with local agencies, lake associations, and community members to develop and implement targeted management strategies while educating locals on the importance of zebra mussel monitoring.

Thank You!

The 2024 Zebra Mussel Safari was a collaborative effort, and it would have been impossible without all of our volunteers. We also would like to give an extra thank you to all the lake association leaders for spearheading the organization at each lake!

For an questions, comments, or inquiries for future participation, please email maisrc@umn.edu!

Minnesota Aquatic Invasive Species Research Center
University of Minnesota
Driven to Discover℠