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Tide Deck Report 2023

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Purpose

Tide pools are shallow pools above the mean tide line that fill with water when the tide rises and hold the water when the tide recedes (**Fig. 1**). This twice-daily exchange of water carries organisms from microscopic plankton and algae to shellfish, crustaceans, and many others.
Artificial tide pools carved into granite were installed under the raised end of Pier 26 to monitor and track the settlement of epibionts, settling organisms during the pier's construction. During high tide, the Pier 26 Tide Deck becomes completely submerged by the Hudson River, refreshing the water in the tide pools, and allowing sessile species on the Tide Deck to feed on plankton suspended in the river. At low tide, the pools and rocks of the tide deck become accessible to mallards, seagulls, sparrows, and other bird species who feed on the algae, insects, and marine organisms present.

Sampling in 2022 contributed to baseline taxon data for further analysis of epibiont and biodiversity throughout the Park. This year saw additional trialing of microscopic analyses for finer taxonomic identification of settled organisms.

Key Questions

- What is the incidence and abundance of settling organisms within the tide pools?
- How can the addition of microscopy support taxonomic identification of algae?

Fig. 1 | One of the 108 tide pools on the Pier 26 Tide Deck

Fig. 2 | Northwest corner of Pier 26 tide deck, 3.5 hours after low tide

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Methods

- **Set Up & Imaging:** Settlement plates are fastened by zip ties to bolts in the rocks. Plates are first photographed from a wide view out of the water and are then photographed up close. They are then refastened with fresh zip ties to the bolts **(Fig.2)**.

- **Sampling:** Samples of settled organisms on the plate are randomly selected for assessment. Organisms are taken from edge of plate to not to disturb the sampling area.

- **Analysis:** Photos of the pools are analyzed using ImageJ software to calculate percent coverage of settled organisms.

- **Microscopy:** Samples of settled organisms on the plate are analyzed using a compound light microscopic to identify the lowest taxa. **(Fig.3)**

Fig. 2 | Hudson River Park staff cutting a settlement plate out of a tide pool for imaging

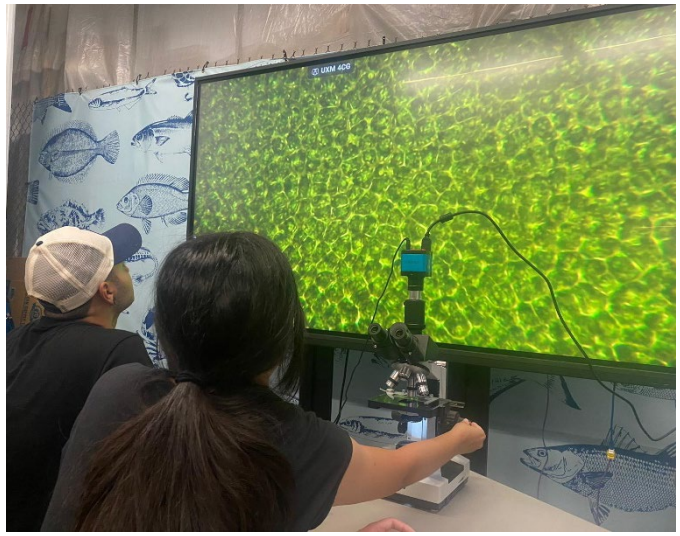

Fig. 3 | Hudson River Park staff assessing a tide pool sample under a microscope

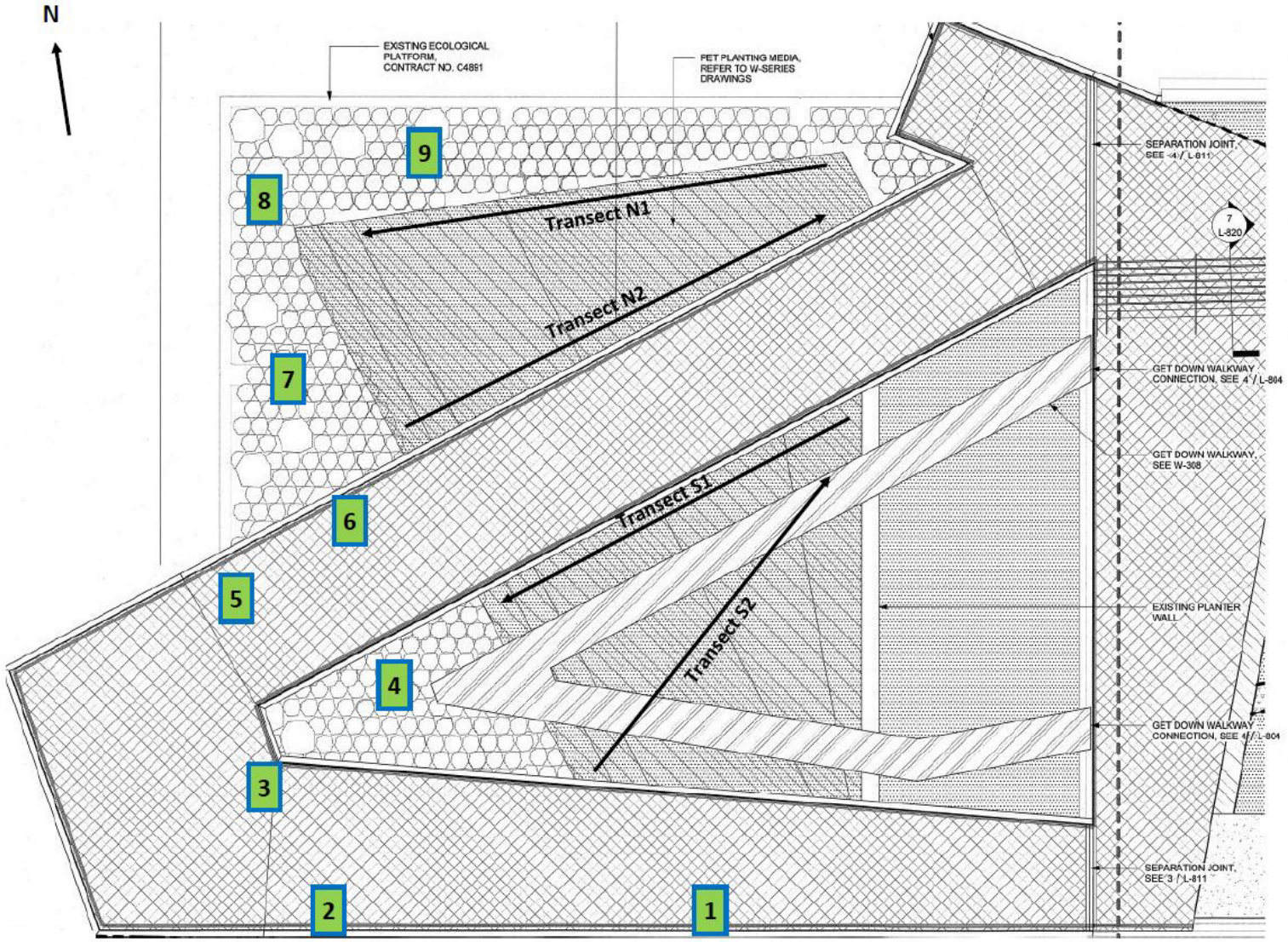

Fig. 4 | Top-down view of the Pier 26 tide deck. Green squares indicate approximate location of monitored tide pools.

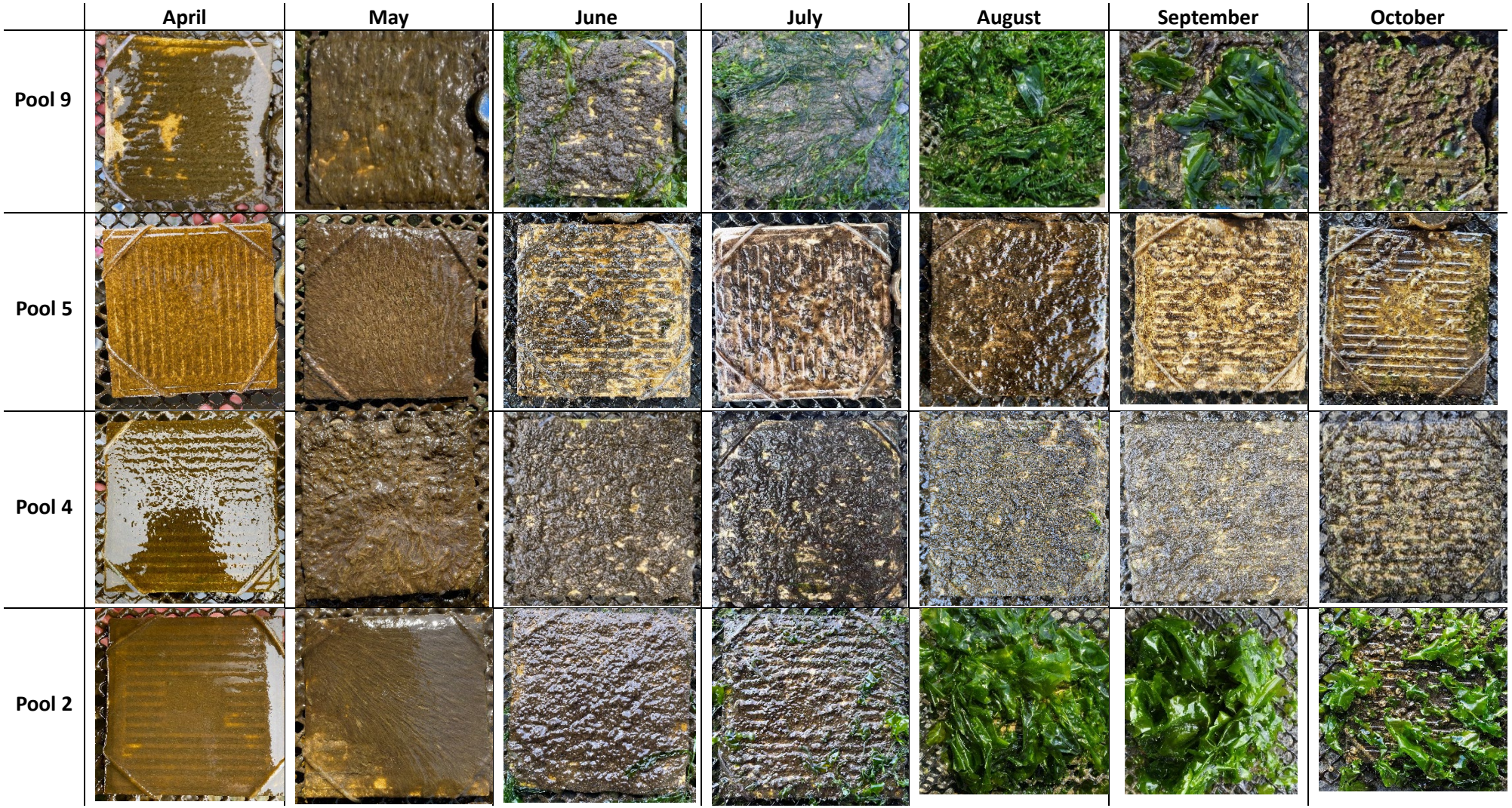

Fig. 5 | Settling organism growth in four tide pools from April to October 2023, arranged North to South (**Fig. 4**).

Major Findings

Settled Organisms

2023 saw a similar incidence of settled organisms as in 2022. Settlement plates had rapid and intense algal and plant growth(**Fig. 5**) reaching nearly 100% coverage within the first few weeks of deployment. Phytoplankton mats (chiefly diatoms but also cyanobacteria at times, often mixed) were ubiquitous, being both the pioneers and last remaining organisms as the waters cooled. These mats were found covering most other dominant species as well, if present. Sea lettuce (*Ulva sp.*) and filamentous green algae (also possibly genus *Ulva*) began sprouting in June on the plates that received the most direct sunlight along the north and south edges of Pier 26 (**Fig. 5**, Pool 9 and 2). *Ulva* growth was rapid, covering plates entirely by August and only declining by October as the waters cooled.

Amphipods & their burrows were a common sight on the plates and in the pools and were joined by other invertebrates such as limpets, anemones, isopods, mud crabs (**Fig. 6**), pacific shore crabs, polychaetes, comb jellies, and oysters. Barnacles were highly prevalent on the surrounding granite, and covered many plates by June (**Fig. 7**).

Fig. 6 | Mud crab and sea lettuce on settlement plate

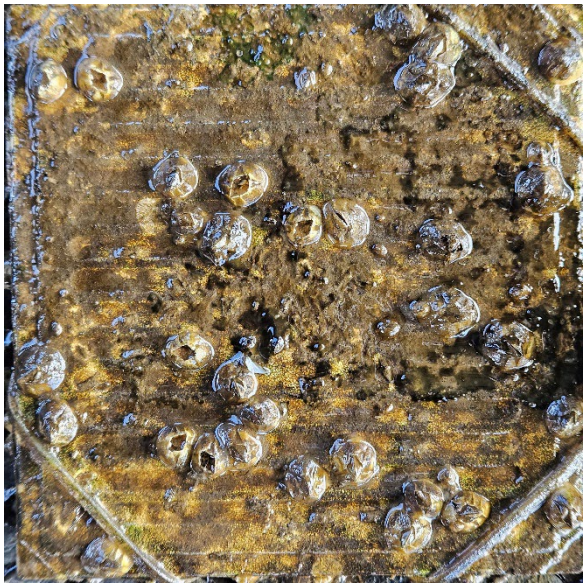

Fig. 7 | Barnacles on settlement plate

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Taxonomic identification

Microscopy was performed every few sampling weeks. **Fig. 6** displays a macroscopic image of a phytoplankton mat on plate 4 and a microscopic image of a sample taken from the same plate at 400x magnification. We can see the phytoplankton mat is predominantly composed of two different diatoms that appear to belong to different order.

Diatoms are critical in aquatic ecosystems as they produce much of the world's oxygen through photosynthesis and make up the foundation of most aquatic food webs as some of the smallest primary producers, providing energy to other plankton, nekton, crustaceans, and filter feeders of all sizes.

Many phytoplankton increase in frequency during the warmer, but more importantly brighter months, but are also observed in the winter during what's known as a "Plankton bloom".
Diatoms and other benthic microalgae exhibited dominance on all settlement plates in both high and low light locations in April-August and saw a slight decline in prevalence by September (**Fig. 5**, Pool 4 September).

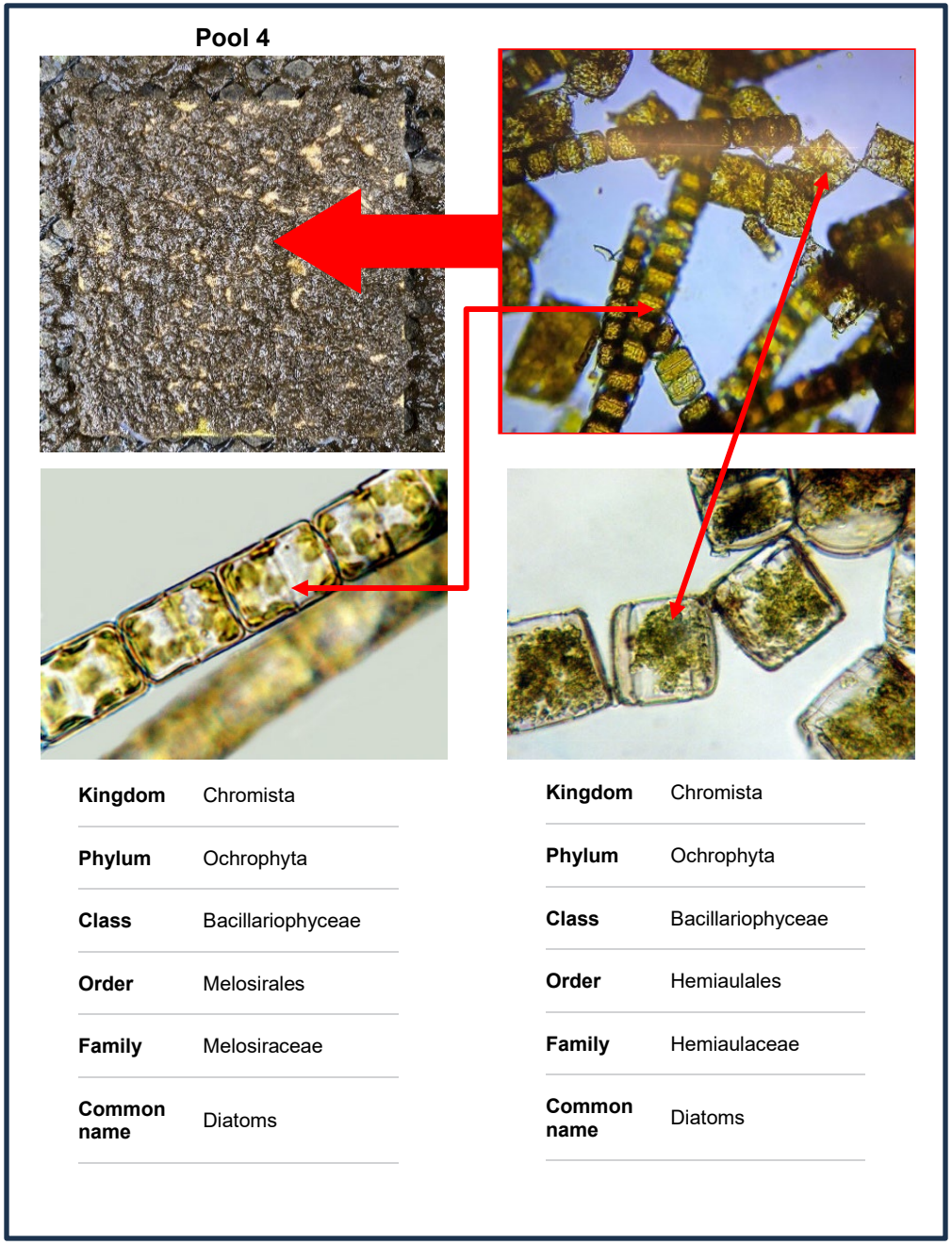

Fig. 6 | 400x magnification of sample taken from Pool 4 and two possible taxonomic identifications. Identified using the Manaaki Whenua Landcare Research Algae Diagnostic Tool

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Future Directions

The addition of microscopy allows for further identification of epibiotic taxa than previously sampled. Development of a more robust protocol for sampling and microscopic analysis in 2024 could lead to a greater understanding of micro- and macroscopic algae in the tidal pools and on hard substrate in the Park. These primary producers are the building blocks of the food chain in the Hudson River and understanding their incidence within tide pools and their relationship to other sessile and motile organisms can lead to greater sustainability of the Hudson Rivers estuarine ecosystem.

The Park is working with contracted experts to assess epibiota on habitat enhancement structures such as those in Tribeca & Gansevoort.

The 2023 tide deck research did not monitor the growth of spartina due to vegetation loss since 2022. The Park hopes to revisit this project and possibly assess the factors for success in the Gansevoort salt marsh.

References

Freshwater Algae Identification Guide. Manaaki Whenua Landcare Research., https://www.landcareresearch.co.nz/tools-and-resources/identification/freshwater-algae/identifications-guide/

Tall, Laure, et al. "*Bioassessment of Benthic Macroinvertebrates in Wetland Habitats of Lake Saint-Pierre (St. Lawrence River)*." Journal of Great Lakes Research, vol. 34, no. 4, 2008, pp. 599–614., https://doi.org/10.1016/s0380-1330(08)71605-8\

"*Indicators: Sediment Diatoms*". United States Environmental Protection Agency., https://www.epa.gov/national-aquatic-resource-surveys/indicators-sediment-diatoms