Benthos and Plankton within Waukegan Area of Concern: Potential for Further Local Restoration

Paul Sokoloff[1] and Bill Bolen[2] [1]Battelle, Duxbury, MA [2]U.S. EPA Great Lakes National Program Office, Chicago, IL

ABSTRACT

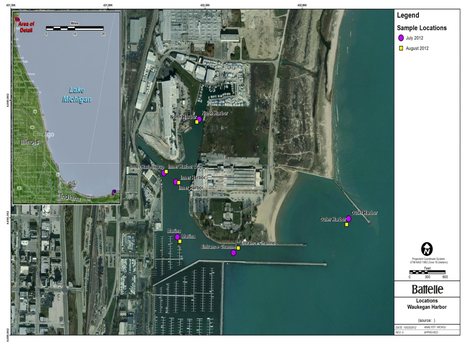
The Great Lakes Areas of Concern (AOCs; http://www.epa.gov/greatlakes/aoc/) are severely degraded areas within the Great Lakes Basin where beneficial uses of water or biota have been listed as impaired or where environmental criteria have been exceeded and impairment is likely. Waukegan Harbor AOC is located in extreme northeast Illinois, within the City of Waukegan, on the western shore of Lake Michigan. In 1975, polychlorinated biphenyls (PCBs) were discovered in Waukegan Harbor sediments. In 1990 remediation efforts began in Waukegan Harbor, this effort led to the removal of approximately 1 million pounds of PCB contaminated sediments. Remediation efforts in Waukegan Harbor have continued in an effort to have the harbor delisted as an AOC. The Waukegan Harbor AOC has a list of beneficial use impairments (BUIs) that must be addressed to improve overall water quality. The BUIs include degradation of benthos, zooplankton, and plankton populations. To address the BUIs, Battelle collected, analyzed and characterized the benthic and the plankton communities of the Waukegan Harbor AOC.

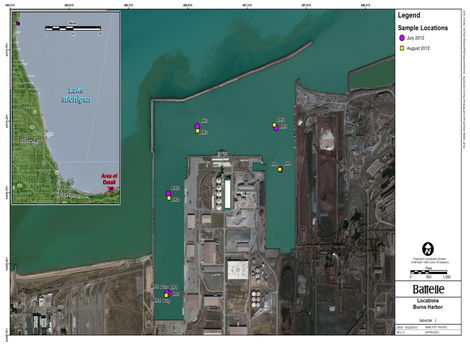
In addition, in order to assess whether these communities were degraded in comparison to river and harbor areas that are not considered AOCs, a non-AOC reference site was established in Burns Harbor. The Shannon-Weaver Diversity Index was used to calculate the plankton community in both harbors. The Waukegan Harbor AOC demonstrated a plankton community consisting of large-cell zooplankton, rotifers, soft-algae phytoplankton, and diatoms with significantly greater diversity than similar communities sampled in Burns Harbor. The Shannon-Weaver Diversity Index calculated for Waukegan Harbor suggests that not only is the community diverse, having a large number of species, but that it has a high evenness value, indicating the relative abundance of rare and common species. The Shannon-Weaver Diversity Index for the infaunal benthic community calculated for Waukegan and Burns Harbors did not differ significantly, suggesting that no significant difference exists between the infaunal benthic communities of the two sites. The results suggest that the restoration efforts in Waukegan Harbor have improved the water and habitat quality, moving the harbor closer to the goal of being delisted.

BACKGROUND AND OBJECTIVES

- 1975: Polychlorinated biphenyls (PCBs) discovered in Waukegan Harbor sediments
- 1981: Waukegan Harbor identified as Area of Concern (AOC); 14 beneficial-use impairments identified (this study focused on two)
  - Degradation of benthos
  - Degradation of phytoplankton and zooplankton populations
- 1990: Restoration efforts begin with removal of contaminated sediments
- 1999: Delisting goals established
- Overall aim is to assess the health of the benthic and plankton communities in the Waukegan Harbor AOC
- Compare Waukegan Harbor benthic and plankton communities to unimpacted harbor, Port of Indiana, determine if communities significantly differ in structure and diversity

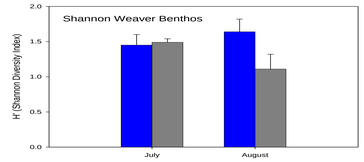
SITE AND METHODS

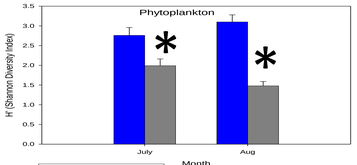


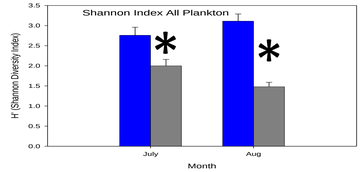


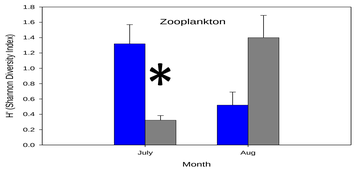
Location (sampling site)		Duplicate	Plankton Tow	Plankton Depth Profile	Van Veen Grab
Waukegan Harbor	Outer Harbor		X	X	X
	Entrance Channel				X
	Inner Harbor and Private Slip	X	X	X	X
	Marina				X
	North Harbor		X	X	X
Burns Harbor	BH1	X	X	X	X
	BH2		X	X	X
	BH3		X	X	X
	BH4				X
	BH5				X

RESULTS









Bars marked with an * are significantly different ($p<0.05$)

CONCLUSIONS

- Shannon-Weaver diversity index calculated for the Waukegan Harbor AOC demonstrated a plankton community with significantly greater diversity than communities sampled in Burns Harbor. The diversity index calculated for Waukegan Harbor suggests that not only is the community diverse, having a large number of species, but that it has a high evenness value, indicating the relative abundance of rare and common.
- The Shannon-Weaver diversity index calculated for phytoplankton was significantly greater in Waukegan Harbor AOC than in Burns Harbor in July and August
- A comparison of the zooplankton communities in Waukegan and Burns Harbors demonstrated that the community in Waukegan Harbor was significantly more diverse than the community sampled in Burns Harbor in July. During sampling in August, the communities did not differ in the diversity.
- The Shannon-Weaver diversity index for the infaunal benthic community calculated for Waukegan and Burns Harbors did not differ significantly, suggesting no significant difference exists between the infaunal benthic communities of the two sites.
- In July and August, in conjunction with characterizing the biologic community of Waukegan and Burns Harbors, the PSD of the benthic sediment was investigated. Both sites were dominated by the smallest fraction of benthic sediments, silt and clay. The comparisons of the individual components of the benthic sediments revealed that while both sites had similar sediment composition overall, Burns Harbor was found to be significantly sandier than Waukegan Harbor; by comparison, Waukegan Harbor was significantly siltier than Burns Harbor.
- The differences in the benthic community could potentially be attributed to differences in the habitat present at Waukegan and Burns Harbors, as both sites were dominated by small-grained particles. The difference in the dominant particle size (sand vs. silt) potentially explains some of the differences in the infaunal benthic community.