



Assessing the impacts of the Oyster Creek Nuclear Generating Station and its closure on gelatinous zooplankton and planktonic community structure

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What was the purpose of the study?

The operation of Oyster Creek Nuclear Generating Station (OCNGS), located along Oyster Creek, NJ, exerted significant stresses on the ecological and biological communities of Barnegat Bay during its 50 years of operation. OCNGS negatively impacted these resources through direct destruction of planktonic organisms, redirection of water flow used in cooling the plant, and chronic thermal stress. Subsequently, closure of the plant in September of 2018 provided an opportunity to investigate ecosystem and biotic community response pre- and post-closure. This study looked at determining the changes associated with the closure of the plant on the zooplankton community to assess whether the closure resulted in improved ecological conditions and supported the recovery of Barnegat Bay after this chronic stress.

What was the general approach to the study (methods)?

A sampling protocol was established to assess the spatial and temporal distribution of gelatinous zooplankton in Barnegat Bay to determine the potential impact of OCNGS closure. A BACI (Before-After Control Impact) design was used to compare reference and baseline sites (sites investigated as part of the comprehensive Barnegat Bay research: [Barnegat Bay Studies \(2011-2013\)](#)) to the same sites just prior to and after the closing of OCNGS. Collection methodology and sampling site selection were closely paired with those used in previous studies (see [Assessment of Sea Nettles \(2011-2013\)](#)). Sampling occurred between May and September of 2018, 2019, and 2021. A combination of plankton tows, lift net sampling, molecular sample analysis, and water quality sampling were used to

ascertain type, abundance, and density of species differences between years, seasons, and time periods.

Overall, what did the studies show?

The primary conclusion that can be drawn from comparing pre- and post-closure data sets is that the closure of OCNGS resulted in improved environmental and ecological conditions for Barnegat Bay. The operation of OCNGS was a huge driver of planktonic organism (e.g., copepods, fish larvae, juveniles, eggs, etc.) loss/destruction. During the plant's 50-year operation, the most significant negative impact on the Forked River/Oyster Creek complex, including the immediate waters of Barnegat Bay, was the removal of small planktonic biota due to the excessive volume of intake water needed for cooling the plant's once flow-through reactor. As a result, this biota became impinged on intake screens and or entrained through the cooling system, thus modifying planktonic community structure in the vicinity of the plant. OCNGS also discharged high volumes of heated effluent, creating a thermal plume that increased adjacent water temperatures by as much as 10 C above ambient levels. Thus, the greatest positive impacts of closure were the near elimination of this loss due to entrainment and impingement, along with the removal of chronic thermal stress.

Results from 2021 clearly indicate an improvement in the recovery of the zooplankton community post-closure and a dramatic change in population patterns over the comparison among years (Figure 1). Calanoid copepods, for example, saw a five-fold increase in densities by 2021 when compared to 2018. Other trophic changes were also observed, such as the order of magnitude increase in fish egg density and the two orders of magnitude increase in density of the Atlantic Silverside (*Menidia menidia*). These massive increases come despite the increases in their predators (i.e., *C. chesapeakei* and *M. leidy*), indicating that during the timeframe of this work, substantial improvements in the health of Barnegat Bay are occurring. Continuing efforts to monitor and evaluate the changes are warranted to ensure that the health of Barnegat Bay continues to improve despite other stressors occurring in the region.

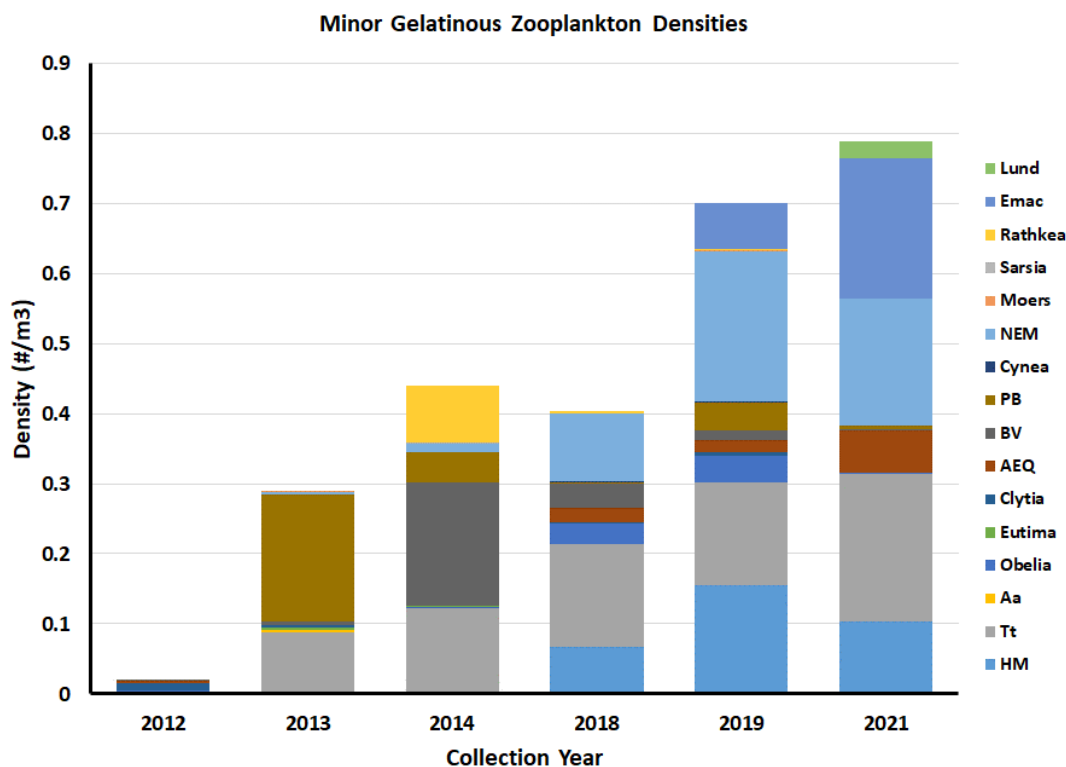


Figure 1. Densities of minor gelatinous zooplankton taxa from plankton sampling across 2012 to 2021 from all bay stations (Note: OCNGS closure occurred in September 2018). Taxa Abbreviations: Lund = *Laodicea undulata*, Emac = *Eucheilota maculata*, Rathkea = *Rathkea* sp., Sarsia = *Sarsia tubulosa*, Moers = *Moerisia* spp., NEM = *Nemopsis bachei*, Cynea = *Cyanea capillata*, PB = *Pleurobrachia pileus*, BV = *Bougainvillia carolinensis*, AEQ = *Aequora* sp., Clytia = *Clytia* spp., Eutima = *Eutima* sp., Obelia = *Obelia* spp., Aa = *Aurelia* spp., Tt = *Turritopsis dohrnii*, HM = *Hydromedusa* unknown.

How will DEP use the data?

The data collected and resulting analyses will be used to better understand the unique planktonic communities that support the trophic fitness of Barnegat Bay. This research, along with other studies conducted concurrently to examine the ecological and biological effects of OCNGS and its closure, are the first of their kind looking at pre- vs. post-closure impacts of a nuclear power plant on a coastal/estuarine system. Techniques employed in this study (i.e., metagenomic analysis) will also provide new information on species composition, including potential invasive species not previously reported in this system. Additionally, this information can assist in the development of guidance to inform future management decisions for invasive species and water quality improvement actions for the bay.

Please review the full report for more detailed information at <https://dspace.njstatelib.org/xmlui/handle/10929/113052>

Who to contact with further questions:

For more information on this study, contact Joseph Bilinski (Joseph.Bilinski@dep.nj.gov).

References:

Bologna, Paul; Gaynor, John; Meredith, Robert (2016). Impacts of Invasive Sea Nettles (*Chrysaora quinquecirrha*) and Ctenophores on Planktonic Community Structure and Bloom Prediction of Sea Nettles Using Molecular Techniques: Final Project Report. Available at [Assessment of Jellyfish \(Barnegat Bay 2011-2013\)](#).

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