

# Determination of the relative contribution of various sources of nitrogen to primary production in Martha's Vineyard ponds

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## Background

Wastewater, fertilizer and atmospheric deposition are the three major external sources of nitrogen to our estuaries and coastal ponds. Nitrogen from these three sources enters estuaries and promotes primary producer growth. Excessive amounts of nitrogen can cause algal overgrowth and eutrophication, resulting in an overall degradation of the natural environment. Quantifying the relative contribution of the various sources of external nitrogen to excessive primary producer growth is key for understanding which of those sources (or combinations of them) are likely causes of eutrophication, and as a first step for developing effective management strategies to remediate its negative effects.

The nitrogen present in wastewater, fertilizers and atmospheric deposition differ greatly in its isotopic composition. Examining the stable isotopic signatures of nitrogen in environmental samples allows us to determine the origin of that nitrogen and the relative importance of its various sources.

Estuarine suspended materials, mostly composed of phytoplankton cells, rapidly incorporate the nitrogen available in estuaries. The captured nitrogen is used by phytoplankton to grow. Due to the rapid and efficient incorporation of nitrogen by plankton, the isotopic signature of the particulate nitrogen (PON) usually reflects the isotopic signature of the mix of the various available nitrogen sources, and it can therefore provide us with information about the relative importance of nitrogen sources in an estuary.

## Methodology

The data and conclusions presented in this brief report resulted from the analysis of stable isotopic signatures of PON present in estuarine waters. Water samples were collected in various ponds in Martha's Vineyard during the period between June and October 2021. A total of 101 particulate samples were analyzed.

To obtain approximate estimates of the relative contributions from the most likely and distinguishable sources (wastewater, fertilizers or atmospheric deposition) we used IsoSource (Phillips et al., 2005), a stable isotope mixing model developed by the U.S. EPA. Stable isotope mixing models are often used to quantify source contributions to a mixture. Examples include pollution source identification, trophic web studies, analysis of water sources for soils, plants or water

**Table 1.** Ranges and midpoints of  $\delta^{15}N$  values in wastewater, fertilizers, and atmospheric deposition. Values averaged from compilations in the literature (Aravena et al., 1993; Bateman and Kelly, 2007; Chen et al., 2011; Heaton, 1986; Jia and Chen, 2010; Kauschal et al., 2011; Kendall, 1998; Kim et al., 2017; Kreitler, 1979; Li et al., 2016; Su et al., 2005; Xue et al., 2009)

Nitrogen sources	$\delta^{15}N$ range (‰)	$\delta^{15}N$ midpoint (‰)
Wastewater	7.3 to 21.0	14.2
Inorganic fertilizers	-3.9 to 3.1	-0.4
Atmospheric deposition	-8.1 to -2.9	-5.5

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# The Impacts of Dredging on the Ecosystem Health of Edgartown Great Pond

After a decade of dredging (2009-2019), the water quality and ecosystem health of Edgartown Great Pond have improved as a result of increased and pond-wide flushing capacity during periodic barrier beach breaches to the Atlantic Ocean.



Flash Report  
April 2020

# The Impacts of Dredging on the Ecosystem Health of Edgartown Great Pond 2020

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Marine Biodiversity Records

RESEARCH

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## Distribution of the highly toxic clinging jellyfish *Gonionemus* sp. around the island of Martha's Vineyard, Massachusetts, USA

Mary R. Carman<sup>1</sup>, David W. Grunden<sup>2</sup>, Emily Reddington<sup>3</sup> and Annette F. Govindarajan<sup>4\*</sup>

### Abstract

In recent years, the cryptogenic and often highly toxic hydrozoan *Gonionemus* sp. has appeared in new locations around the globe and has become increasingly abundant in the Northwest Atlantic where it is now associated with severe stings. Several such stings have been documented from the island of Martha's Vineyard, located approximately 8 km south of the Cape Cod, Massachusetts coast. It appears that *Gonionemus* sp. may be expanding its range in this region. Here we surveyed for medusae in the major coastal ponds along the perimeter of Martha's Vineyard, refined our knowledge of *Gonionemus* sp. habitat by recording salinity, water depth, and bottom type from surveyed areas, and obtained a basic population life history assessment by measuring the size and sex ratios of medusae collected in the surveys. We found *Gonionemus* sp. present in five ponds: Farm Pond, Sengstacke Pond, Lake Tahmoos, Stonewall Pond, and Edgartown Great Pond. Medusae were associated with eelgrass meadows in all cases. Salinities for medusa populations ranged from 18 ppt in Edgartown Great Pond to 29 ppt in the other ponds. The Farm Pond and Stonewall Pond medusae were significantly smaller than those from other ponds and were comprised of primarily immature individuals despite sampling relatively later in the season, suggesting factors other than temperature may be affecting medusa growth. For mature medusae, sex ratios were highly biased, suggesting a strong clonal component to population growth. Edgartown Great Pond contained only males and thus may represent an entirely clonal population. These medusae are the first record of *Gonionemus* sp. in Edgartown Great Pond, despite a long history of study. Medusae were most abundant in the portion of the pond near the town landing, which suggests that the medusae could have originated by clonal polyps, larvae, or cysts associated with a boat hull. Given the presence of male and female medusae in other parts of Martha's Vineyard, it seems likely that additional genetic individuals will arrive in the near future, potentially establishing a sexually reproductive population.

**Keywords:** *Gonionemus*, Hydrozoa, Martha's Vineyard, Polyps, Cyst, Asexual reproduction, Clones, Cryptogenic, Eelgrass

### Background

The hydrozoan jellyfish *Gonionemus* sp. (Fig. 1) is an often highly toxic, cryptogenic species that has become increasingly abundant in the Cape Cod region of Massachusetts, USA in recent years. *Gonionemus* was originally known from this region in the 1800s and early 1900s (referred to as *Gonionemus murbachii*), but nearly died out when its eelgrass habitat succumbed to a wasting disease in the 1930s (Govindarajan and Carman 2016). At least one small population on the island of Martha's Vineyard was

able to persist through the twentieth century. However, the jellyfish began a regional resurgence around 1990 and became associated, for the first time, with severe stings similar to those described from Narragansett, Pacific, and Sea of Japan populations, including severe joint and muscle pain, respiratory difficulties, and neurological symptoms (Pignatelli and Michaleff 1960; Yakovlev and Yakovlev 1993). These observations suggested a cryptic invasion of a new, more toxic lineage (Govindarajan and Carman 2016). Similar recent sightings that possibly indicate new invasions have occurred elsewhere around the world, including in Argentina (Rodriguez et al. 2016), the US mid-Atlantic region (Gaynor et al. 2016), the French

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# Distribution of the highly toxic clinging jellyfish *Gonionemus* sp. around the island of Martha's Vineyard, Massachusetts, USA 2019



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## Research Article

### Biogeographical patterns of tunicates utilizing eelgrass as substrate in the western North Atlantic between 39° and 47° north latitude (New Jersey to Newfoundland)

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**Con-Editor:** Near this study was first presented at the 2011 International Science Sea Squares Conference held at Woods Hole, Massachusetts, USA, May 24–26, 2011 (<http://www.whoi.edu/page.do?pid=3537&tid=3538&cid=3539>), since its inception in 2007, the IISSE series has provided a venue for marine biologists and people concerned with invasive species to apply the biology, ecology, impact, management options for control, and other relevant topics.

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# Biogeographical patterns of tunicates utilizing eelgrass as substrate in the western North Atlantic between 39° and 47° north latitude (New Jersey to Newfoundland) 2019

# Data Tells Encouraging Story for Edgartown Great Pond

Positive trends in Edgartown Great Pond water quality affirm pond management practices

February 2018



GREAT  
POND  
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*Data Tells Encouraging Story for  
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