Environmental Studies Program: Ongoing Study

Title	Zooplankton Ecology of the Gulf of Maine (AT 18-x01)
Administered by	Office of Renewable Energy Programs
BOEM Contact(s)	Ian Slayton, ian.slayton@boem.gov
Principal Investigators(s)	Jeffrey Runge
Conducting Organizations(s)	University of Maine
Total BOEM Cost	$210,000
Performance Period	FY 2019–2022
Final Report Due	September 22, 2021
Date Revised	February 6, 2020
PICOC Summary	
Problem	There are stakeholder concerns that offshore renewable energy development and oil and gas exploration will put additional pressures on the highly threatened and endangered North Atlantic right whale population by potentially affecting the distribution and or availability of their prey in the NE Atlantic.
Intervention	Long term monitoring at 2 sampling stations in the Gulf of Maine.
Comparison	This study will build upon the multiple years of baseline data collected previously by the Canadian Atlantic Zone Monitoring Program and the University of Maine/University of New Hampshire.
Outcome	To understand the long-term variability of Calanus finmarchicus in the Gulf of Maine and how that influences the NARW feeding grounds in the NE Atlantic.
Context	Gulf of Maine

BOEM Information Need(s): In anticipation of future offshore renewable energy development and potential oil and gas exploration in the NE Atlantic, BOEM must evaluate the cumulative effects of offshore wind on marine species including the highly endangered North Atlantic right whale (NARW). As part of this analysis, variation in food availability is one stressor that must be taken into consideration, particularly in a rapidly changing environment.

Background: Since June 2017 until present 19 NARW deaths have been recorded, resulting in NOAA declaring an Unusual Mortality Event (https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2018-north-atlantic-right-whale-unusual-mortality-event). Eleven necropsies concluded that entanglement in fishing gear or vessel strikes caused these mortalities. The NARW population is currently declining (Pace et al., 2017) with approximately 432 individuals left (https://www.narwc.org/uploads/1/1/6/6/116623219/2017_report_cardfinal.pdf). In addition, during the winter of 2017-2018, no calves were recorded.

Like all mammals, NARWs need sufficient food available in order to fulfil the energetic requirements of gestation and lactation. NARWs feed primarily on copepods, specifically, *Calanus finmarchicus* (Baumgartner and Mate, 2003). There are stakeholder concerns that offshore renewable energy development (currently planned to start construction offshore MA in 2020) will put additional pressures on this highly threatened and endangered population by potentially affecting the distribution and or availability of their prey in the NE Atlantic. In addition, McCauley et al. (2017) found that seismic air gun operations negatively impact zooplankton.

A recent workshop co-hosted by the Massachusetts Clean Energy Center and BOEM in May 2018 determined that impacts to zooplankton communities are currently not possible to detect in the short term and that long-term sampling efforts should be supported (Kraus and Thomas, in prep).

Calanus finmarchicus has key functional significance in the GoMa ecosystem (Bigelow, 1924; Johnson et al., 2011). The lipid-rich stage CV are a primary prey for planktivorous fish, such as herring and sand lance (e.g. Payne et al., 1990; Collette and Klein-MacPhee, 2002) that are fundamental trophic links in regional fisheries. Since there is no apparent functional redundancy for *C. finmarchicus* in the GoMa ecosystem, significant shifts in abundance of *C. finmarchicus* may have substantial impacts on the region's metazoan energy budget and consequently affect local distribution and abundance of planktivores and higher trophic-level predators (Johnson et al., 2011). Wilkinson Basin plays a particularly important role in the western GoMa because it serves as a primary source of supply of *C. finmarchicus* to fishing and NARW feeding grounds in waters off southern New England, including the Great South Channel and Georges Bank (Wishner et al., 1995; Miller et al., 1998; Pendleton et al., 2009).

Through long term monitoring by the Canadian Atlantic Zone Monitoring Program and the University of Maine/University of New Hampshire, time series data within the Gulf of St Lawrence and the GoMa have resulted in data showing *C. finmarchicus* persistence in the GoMa during recent extreme warming events (Runge et al., 2015), and more recently showed interdecadal variability of *C. finmarchicus* in the eastern and western GoMa in relation to NARW distribution (Record et al., in prep). This same time series has provided insight on the mechanisms controlling *C. finmarchicus* abundance in the GoMa and in turn how it influences the NARW feeding grounds in southern New England (Ji et al., 2017). Due to a lack of funding, the US data collection stations in Wilkinson Bay and in the Maine Coastal Current has ended (2017). Moving forward it is imperative to continue this long term data collection in order to detect any climatological or other effects on this ecosystem that may be happening with or without the influence of BOEM-related activities.

Objectives: To understand the long term variability of *C. finmarchicus* in the GoMa and how that influences the NARW feeding grounds in the NE Atlantic.

Methods: The plankton data will be collected following standard protocols used during previous sampling efforts conducted at these stations. Ideally monthly sampling in WBTS, starting in September or October 2018, would provide an estimate of overwintering abundance in the western Gulf of Maine. If not possible, monthly sampling starting in March 2019 will be undertaken. For the CMTS, monthly sampling would start in May 2019. Sampling will be undertaken 10 times during the year at both sites. Data will be analyzed using appropriate analytical techniques.

Specific Research Question(s):

1. What is the trend in zooplankton composition in the Gulf of Maine?
2. What is the trend in zooplankton distribution, specifically *C. finmarchicus*, in the Gulf of Maine?
3. If there are any changes in species distribution, can they be attributed to any specific factors?
4. How does the zooplankton community in the Gulf of Maine affect the zooplankton community in the NE Atlantic, specifically NARW feeding grounds?
5. Does *C. finmarchicus* abundance/distribution in the Gulf of Maine affect the zooplankton community off Long Island?

Current Status: The cooperative agreement was awarded in September 2019. A kick-off meeting was held October 2019. The first quarterly progress report was completed January 30, 2020.

Publications Completed: None.

Affiliated WWW Sites: None.

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