Effectiveness of a coral conservation area in the Gulf of Maine: distribution along the boundaries and changes in abundance of two deep-water octocoral species over 13 years

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Summary
To protect deep-water coral aggregations from destructive fishing, the Northeast Channel Coral Conservation Area was established as a Fisheries Closure by the Canadian Government in the Gulf of Maine in 2002. In this study, communities of the octocoral species Primnoa resedaeformis and Paragorgia arborea were monitored inside the conservation area at depths of 400 – 700 m using video from ROV dives to determine the effectiveness of the conservation measures between 2001 and 2014. Coral abundance remained approximately stable at one location and increased at two sites. Size frequency distributions were variable for the two species among locations and sampling years. Small colonies (<20 cm) indicative of successful recruitment were not found at all sites. In additional dives at deeper parts and outside the conservation area at 685 – 1521 m depth different coral taxa were dominant than in shallower parts. The lack of recruits suggests a limited ability to sustain coral communities at some of the sampling locations over the observed time period. This study provides the first data points for long-term monitoring of population dynamics in protected octocoral communities.

Introduction
Over the past 15 years, multiple areas in the North Atlantic have been closed to destructive fishing practices to protect vulnerable deep-water coral ecosystems, known to provide habitat for diverse associated fauna. In the Gulf of Maine, the 424-km² Northeast Channel Coral Conservation Area (NECCCA) was established in 2002 to protect dense aggregations of the two dominant octocoral species in the region, Primnoa resedaeformis and Paragorgia arborea. These corals form gardens or forests where associated organisms are found on the corals themselves and among colonies. Long-term monitoring of these long-lived and slow-growing communities is necessary to determine the effectiveness of protection measures. Here, we present a dataset of octocoral communities inside the NECCCA over 13 years.

Materials and Methods
Communities of P. resedaeformis and P. arborea were monitored using the remotely operated vehicle ROPOS in 2001, 2006, 2010 and 2014 in the NECCCA. Data collected in 2001 were used to establish the NECCCA in 2002 (Mortensen et al. 2005). The published data on abundance in 2001 are considered the baseline for our comparisons. In 2014, size frequency distribution was measured at two locations at 400 – 500 m depth (site 1 and 2) and two at 600 – 700 m depth (site X and Z). Coral abundance was estimated at site 1, 2 and X. Transects at sites 1 and 2 overlapped with transects in 2001 (Mortensen and Buhl-Mortensen 2004). We compare the size estimates from 2014 to measurements we collected from dives in 2001 done in the same area as in 2014. In 2006, published data on abundance and size frequency (Watanabe et al. 2009) were collected in areas overlapping with sites X and Z. Additional dives along the deep boundary of the NECCCA in 2010 and outside the NECCCA in 2014 were used to determine coral distribution and abundance at depths of 685 – 1521 m. Coral abundance was analysed from video transects. Colony length was measured from frame grabs using two laser pointers for scale.
Results and Discussion

In 2014, coral abundance at site 1 was similar to 2001 (Mortensen and Buhl-Mortensen 2004). Average colony size of *P. resedaeformis* did not change significantly over this period. No colonies were observed in the two smallest size classes (< 20 cm) in either year, indicating a lack of recruitment (Figure 1 A). The smallest colony of *P. arboarea* was 72 cm long. Assuming growth rates of ~1.6 cm yr⁻¹ (Sherwood and Edinger 2009), the last recruitment event of *P. arboarea* must have occurred around 45 years ago. At site 2 and site X, coral abundance for both species was higher in 2014 than 2001 (Mortensen and Buhl-Mortensen 2004) and 2006 (Watanabe et al. 2009). The average size of *P. resedaeformis* did not change over time at site 2. The presence of corals < 20 cm in length indicate successful recruitment at this location in 2001 and 2014 (Figure 1 B). Colonies of *P. arboarea* were significantly smaller at this site in 2014 than 2001. The shift to smaller colonies can be explained by recruitment, since multiple colonies were found in the smallest size classes.

While *P. arboarea* was abundant in two of the three dives between 685 – 1521 m depth, *P. resedaeformis* was only found in more shallow depths (686 – 768 m) outside the NECCA. *Anthomastus* sp. and the bamboo coral *Acanella* sp. were among the numerically dominant taxa in all three dives. There was a clear shift in coral communities with depth within the NECCA.

Patterns in abundance and size were variable spatially and temporally for the two dominant octocoral species inside the NECCA, and recent recruitment was only evident in some sites. To date, the patterns and drivers of successful recruitment for these two species are largely unknown. Successful recruitment is crucial for sustaining coral populations. Our results suggest limited recruitment at some locations inside the NECCA, 12 years after the initiation of the conservation measures. Our study provides the first data for long-term monitoring which is needed for the effective management of deep-water coral conservation areas.

References


