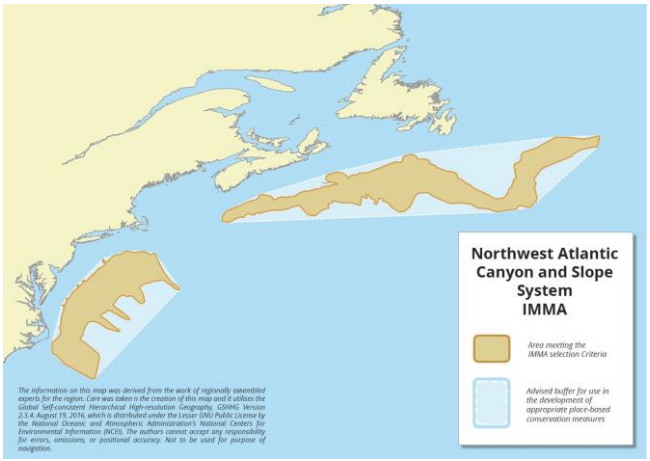
Northwest Atlantic Canyon and Slope System IMMA



Area Size

439,572 km²

Qualifying Species and Criteria

Sei Whale – *Balaenoptera borealis*

Criterion A; C (2)

Blue Whale – *Balaenoptera musculus*

Criterion A; C (2)

Fin Whale – *Balaenoptera physalus*

Criterion A; C (2)

North Atlantic Right Whale – *Eubalaena glacialis*

Criterion A

Short-finned Pilot Whale – *Globicephala macrorhynchus*

Criterion C (2)

Long-finned Pilot Whale – *Globicephala melas*

Criterion C (2)

Northern Bottlenose Whale – *Hyperoodon ampullatus*

Criterion C (2)

Humpback Whale – *Megaptera novaeangliae*

Criterion C (2)

Sowerby's Beaked Whale – *Mesoplodon bidens*

Criterion C (2)

True's Beaked Whale – *Mesoplodon mirus*

Criterion C (2)

Sperm Whale – *Physeter macrocephalus*

Criterion A; C (2)

Goose-beaked Whale – *Ziphius cavirostris*

Criterion C (2)

Criterion D (2) – Marine Mammal Diversity

Balaenoptera borealis, Balaenoptera musculus, Balaenoptera physalus, Delphinus delphis, Eubalaena glacialis, Globicephala macrorhynchus, Globicephala melas, Grampus griseus, Hyperoodon ampullatus, Kogia breviceps, Kogia sima, Leucopleurus acutus, Megaptera novaeangliae, Mesoplodon bidens, Mesoplodon europaeus, Mesoplodon mirus, Physeter macrocephalus, Stenella clymene, Stenella coeruleoalba, Stenella frontalis, Tursiops truncatus, Ziphius cavirostris

Other Marine Mammal Species Documented

Balaenoptera acutorostrata, Mesoplodon densirostris, Orcinus orca

Summary

This IMMA spans slope and canyon waters from immediately south of Cape Hatteras, North Carolina (USA), and extends northeast to the southern flank of the Flemish Cap east of Newfoundland, Canada. This area roughly follows the 150 m isobath and encompasses the deep ends of canyons. The slope waters and canyons are associated with high productivity and zooplankton densities, and oceanographic processes along the steep slope topography accumulate prey and attract a diversity of cetacean species. Within this area there are threatened species (North Atlantic right whale (*Eubalaena glacialis*), blue whale (*Balaenoptera musculus*), sei whale (*Balaenoptera borealis*), fin whale (*Balaenoptera physalus*), and sperm whales (*Physeter macrocephalus*). This area supports important feeding areas for a number of beaked whales and other deep

diving odontocete species as well as several baleen whales, and sustains a high diversity of 22 marine mammal species. This area contains several nationally-defined protected areas in Canada: The Gully Marine Protected Area, parts of the Eastern Canyons Marine Refuge, Critical Habitat designated under the Species at Risk Act for the Scotian Shelf population of northern bottlenose whales; and in the USA: the Northeast Canyons and Seamounts Marine National Monument.

Description:

The area spans the slope and canyon waters from immediately south of Cape Hatteras, North Carolina, extending northeast to the southern flank of the Flemish Cap. The eastern boundary encloses the deep ends of the canyons and the western boundary is defined by the 150 m isobath from the south to Northeast Channel and by the 150 m isobath with a 20 km buffer from the Northeast Channel to the North to capture important blue whale habitat. The slope waters and canyons are associated with high productivity and zooplankton densities, and oceanographic processes along the steep slope topography accumulate cetacean prey and attract a diversity of species, including baleen whales, deep-diving toothed whales, and several dolphin species. This area contains several nationally-defined protected areas. The Gully submarine canyon was established as a Canadian Marine Protected Area in 2004 and protects cetaceans within it from fishing activity, oil and gas development and other threats. Shortland and Haldimand canyons and areas in between along the eastern Scotian Shelf and further offshore are included in the Canadian Eastern Canyons Marine Refuge created in 2022, which provides protection for the seafloor. The Northeast Canyons and Seamounts Marine National Monument is the only Marine Monument on the east coast to the USA. It was established in 2016 on the basis of the area's unique ecological resources that are a subject of scientific interest.

Criterion A: Species or Population Vulnerability

Five cetacean species that regularly occur in this area are considered threatened with extinction according to the global IUCN Red List of Threatened Species. The North Atlantic right whale (*Eubalaena glacialis*) is listed as Critically Endangered (Cooke, 2020). Blue whales (*Balaenoptera musculus*; Cooke, 2018a) and sei whales (*Balaenoptera borealis*; Cooke, 2018b) whales are listed as Endangered, and fin whales (*Balaenoptera physalus*; Cooke, 2018c) and sperm whales (*Physeter macrocephalus*; Taylor et al., 2008) whales are listed as Vulnerable.

Criterion C: Key Life Cycle Activities Sub-criterion C2: Feeding Areas

Deep slope waters of the Scotian Shelf and Grand Banks are associated with high productivity and high densities of zooplankton (e.g., Breeze et al., 2002; Plourde et al., 2016). A number of submarine canyons also occur in these waters, which often have higher densities of marine mammal prey as a result of unusual oceanographic processes that occur within these bathymetric features (Moors-Murphy, 2014). The processes driving high productivity in the canyons off eastern Canada are similar throughout the full extent of the IMMA. This high productivity associated with the canyon system makes this an important foraging area for many species.

Canyon and slope waters are where the majority of beaked whale sightings and acoustic detections occur off eastern Canada and USA. In the northern part of this IMMA, Slope waters of the Scotian Shelf off Nova Scotia and of the Grand Banks off Newfoundland have been identified as important

habitat that supports foraging for both northern bottlenose whales (*Hyperoodon ampullatus*) and Sowerby's beaked whales (*Mesoplodon bidens*), as evidenced by sightings, acoustic detections, and habitat suitability modelling outputs (Feyrer et al., 2024). Foraging activity of northern bottlenose whales, Sowerby's beaked whales, True's beaked whales (*Mesoplodon mirus*), and Cuvier's beaked whales (*Ziphius cavirostris*) is evidenced by recordings of their deep-water echolocation clicks during passive acoustic monitoring studies that have occurred throughout the IMMA (Cholewiak et al., 2017; Stanistreet et al., 2017, 2021; Cohen et al., 2023; Delarue et al., 2024; Feyrer et al., 2024), supporting the characterization of deep slope and offshore waters as important feeding habitats for these species. Additionally, Foley et al. (2021) found that 20 Cuvier's beaked whales equipped with satellite-linked tags off Cape Hatteras, North Carolina, between 2014 and 2017, allocated much of their time to foraging within the boundaries of the IMMA.

Sperm whales commonly occur in the deep slope waters that define this IMMA, for example, sperm whales have been reported all along deep slope waters of the Scotian Shelf off Nova Scotia and around the Grand Banks off Newfoundland (Gomez et al., 2020), and off the New York Bight, sperm whale sighting rates were the highest in slope waters (3.07 whales/1,000 km; Zoidis et al., 2021). Roberts et al (2016) show that the predicted mean densities of deep-diving beaked and sperm whales is highest in canyon and slope waters all along eastern Canada and the USA. Sperm whale deep-water echolocation clicks are also commonly recorded in the slope and offshore areas that are included in this IMMA (Whitehead et al., 1992; Moors, 2012; Delarue et al., 2018; Westell et al., 2022). Towed hydrophone array data from this region has been used to examine foraging and diving behaviour of sperm whales (e.g., Westell et al., 2022) and found that they exhibited multiple foraging strategies, including foraging at depths ranging from 400 to > 1200 within waters that are included in this IMMA.

Foraging blue whales have been regularly observed in at least the eastern Scotian Shelf canyons, presumably because the canyon-dependent oceanographic processes aggregate zooplankton in sufficient quantities (Whitehead, 2013). The entirety of the slope of the Scotian Shelf and Grand Banks has been identified as an important blue whale feeding habitat (DFO, 2018; Lesage et al., 2018), which is supported by krill modelling studies (Plourde et al., 2016) as well as visual observations and acoustic detections (Moors-Murphy et al., 2019). In the southern portion of the IMMA, a blue whale was also seen feeding among at least 15 fin whales in February 2019 approximately 135 km east-southeast of Virginia Beach (Engelhaupt et al., 2020).

Humpback whales (*Megaptera novaeangliae*) and fin whales typically feed in areas with high bathymetric relief, including the shelf break (Roberts et al., 2023), and are present along deep slope waters included in this IMMA at the peak of feeding season, sometimes in large numbers. Palka (2020) estimated that there were 996 (CV 0.59) humpback whales and 1,581 (CV=0.39) fin whales in deep slope waters off the east coast of the USA in 2016. These line-transect surveys also estimated that the number of humpback whales in U.S. shelf break waters at that time was only 27% less than the number in the U.S. portion of the primary Gulf of Maine feeding ground plus the adjacent shelf waters of the New York Bight (Palka, 2020). Those survey results also suggested that there were nearly twice as many fin whales at the shelf break in the peak feeding season (late June through late September) of that year as there were in shelf waters (Palka, 2020). No similar estimates exist for Canadian waters, although sightings and acoustic detections of these species are common along deep

slope and canyon waters off eastern Canada (e.g., Whitehead, 2013; Kowarski et al., 2017; Delarue et al., 2018, 2024). Two of 79 humpback whales tagged in the Gulf of Maine between 2011 and 2018 travelled to the shelf break east of Nova Scotia and south of Newfoundland during July and/or August (CCS unpublished data). Hierarchical state space modelling indicated predominantly transit, but there were some area-restricted search movements suggestive of foraging (CCS unpublished data). Aerial surveys conducted by NOAA Fisheries between May 2023 to May 2024 documented foraging activity or defecation (an indicator of foraging) by fin, humpback, and sei whales on 5 separate flights near Block Canyon (NOAA Fisheries, unpublished data).

Steep bathymetric features, including slope waters, are also known to be important forging areas for short-finned pilot whales (*Globicephala macrorhynchus*) and long-finned pilot whales (*Globicephala melas*). Thorne et al. (2017) examined movement and foraging behaviour of short-finned pilot whales using satellite telemetry data collected from 33 satellite tags deployed in 2014 and 2015, and the results demonstrated the importance of canyons and steep bathymetric features to the pilot whale foraging habitat in the IMMA. More recently, Shearer et al. (2022) showed that pilot whales off Cape Hatteras frequently exploit bathymetric features for foraging and that benthic dives resulted in higher prey capture attempts than pelagic dives. Overholtz & Waring (1991) assessed stomach contents from five pilot whales (species not specified) captured during fishing operations for mackerel in 1989 in the IMMA region, and found that they fed primarily on mackerel and long-finned squid.

Criterion D: Special Attributes
Sub-criterion D2: Diversity

High species diversity in the northern region of the Northwest Atlantic canyon and slope system is supported by sightings data (e.g., Lawson & Gosselin, 2009; Whitehead, 2013; Gomez et al., 2020), as well as long-term passive acoustic monitoring studies that provide evidence of the regular presence of beaked whales throughout the year, including northern bottlenose whales, Sowerby's beaked whales, and Cuvier's beaked whales (Stanistreet et al., 2017, 2021; Delarue et al., 2024; Feyrer et al., 2024); sperm whales (Delarue et al., 2018); as well as the seasonal occurrence of baleen whales including blue whales, fin whales, sei whales and humpback whales (Kowarski et al., 2017; Moors-Murphy et al., 2018; Davis et al., 2020; Delarue et al., 2022; Macklin, 2022; Wingfield et al., 2022).

Species density modelling estimated that 22 cetacean species were present year-round or seasonally in the southern region of the Northwest Atlantic canyon and slope system, including several beaked whale species: northern bottlenose, Sowerby's, Cuvier's, True's beaked whales, Gervais' beaked whales (*Mesoplodon europaeus*), and Blainville's beaked whales (*Mesoplodon densirostris*); sperm whales, dwarf sperm whales (*Kogia sima*) and pygmy sperm whales (*Kogia breviceps*); baleen whales species: blue, fin, sei, and humpback whales; short-finned pilot whales and long-finned pilot whales; and a number of smaller delphinid species: Risso's dolphins (*Grampus griseus*), bottlenose dolphins (*Tursiops truncatus*), Short-beaked common dolphin (*Delphinus delphis*), Atlantic white-sided dolphins (*Lagenorhynchus acutus*), Atlantic spotted dolphins (*Stenella frontalis*), striped dolphins (*Stenella coeruleoalba*), and Clymene dolphins (*Stenella clymene*) (Roberts et al., 2023). Two studies have evaluated marine mammal species diversity along

the entire east coast of the USA (Hodge et al., 2022; Roberts et al., 2023). There is substantial overlap in the datasets used by both studies, but the studies used different methods to derive estimates of species diversity. Both studies found high species diversity in the Northwest Atlantic canyon and slope system.

Figure 1: Multiple beaked whale species commonly occur in the Northwest Atlantic canyon and slope system area, and this IMMA includes identified important habitat for northern bottlenose whales (*Hyperoodon ampullatus;* left panel, photo credit: H. Moors-Murphy) and Sowerby's beaked whales (*Mesoplodon bidens;* right panel, photo credit: C. Gomez).

Figure 2: This IMMA includes identified important habitat for Endangered (EN) blue whales (*Balaenoptera musculus*).
Photo credit: Whitehead Lab, Dalhousie University.

Figure 3: A fin whale (*Balaenoptera physalus*). Photo credit: New England Aquarium.

Figure 4: Dolphins swimming in front of a humpback whale (*Megaptera novaeangliae*). Photo credit: New England Aquarium.

Supporting Information

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