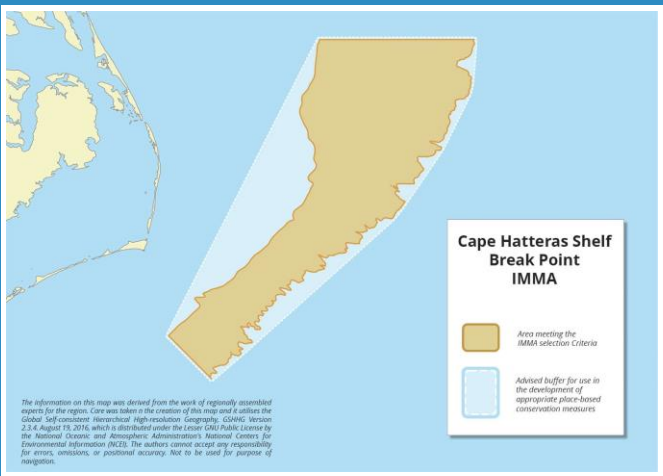

Area Size

6,140 km²

Qualifying Species and Criteria

Fin Whale – *Balaenoptera physalus*

Criterion A

Short-finned Pilot Whale – *Globicephala macrorhynchus*

Criterion B (2); C (2)

Gervais' Beaked Whale – *Mesoplodon europaeus*

Criterion B (2)

Sperm Whale – *Physeter macrocephalus*

Criterion A; B (2); C (2)

Common Bottlenose Dolphin – *Tursiops truncatus*

Criterion C (2)

Goose-beaked Whale – *Ziphius cavirostris*

Criterion B (2); C (2)

Criterion D (2) - Marine Mammal Diversity

Balaenoptera acutorostrata, Balaenoptera physalus, Delphinus delphis, Globicephala macrorhynchus, Grampus griseus, Hyperoodon ampullatus, Lagenodelphis hosei, Megaptera novaeangliae, Mesoplodon europaeus, Peponocephala electra, Physeter macrocephalus, Pseudorca crassidens, Stenella attenuata, Stenella clymene, Stenella coeruleoalba, Stenella frontalis, Stenella longirostris, Steno bredanensis, Tursiops truncatus truncatus, Ziphius cavirostris

Cape Hatteras Shelf Break Point IMMA

Other Marine Mammal Species Documented

Balaenoptera musculus, Eubalaena glacialis, Feresa attenuata, Kogia breviceps, Kogia sima, Orcinus orca

Summary

The Cape Hatteras Shelf Break Point extends from the 200 to the 2,500 m isobaths directly seaward of Cape Hatteras, North Carolina, North America. The area includes continental slope, break, and deep waters. Within the IMMA, the southward-flowing waters of Mid-Atlantic Bight collide with the northward-flowing South Atlantic Bight and Gulf Stream. This confluence of currents and complex bathymetry makes the Cape Hatteras Shelf Break Point IMMA a site of high biodiversity and abundance, supporting dense resident and visiting populations of toothed whales. As many as 26 cetacean species occur in the IMMA throughout the year (20 regularly, and 6 consistently but less frequently). The recorded densities of goose-beaked whales (*Ziphius cavirostris*) are among the highest in the world. The area is also well known for its aggregations of sperm whales (*Physeter macrocephalus*) and for providing important feeding habitat for short-finned pilot whales (*Globicephala macrorhynchus*).

Description:

The waters off the coast of Cape Hatteras are oceanographically dynamic and complex. In this region, the Gulf Stream ceases following the continental shelf edge—as it does from Florida up the southeast coast—and begins to flow northeast into pelagic waters (Andres 2016). Additionally, cool, fresh

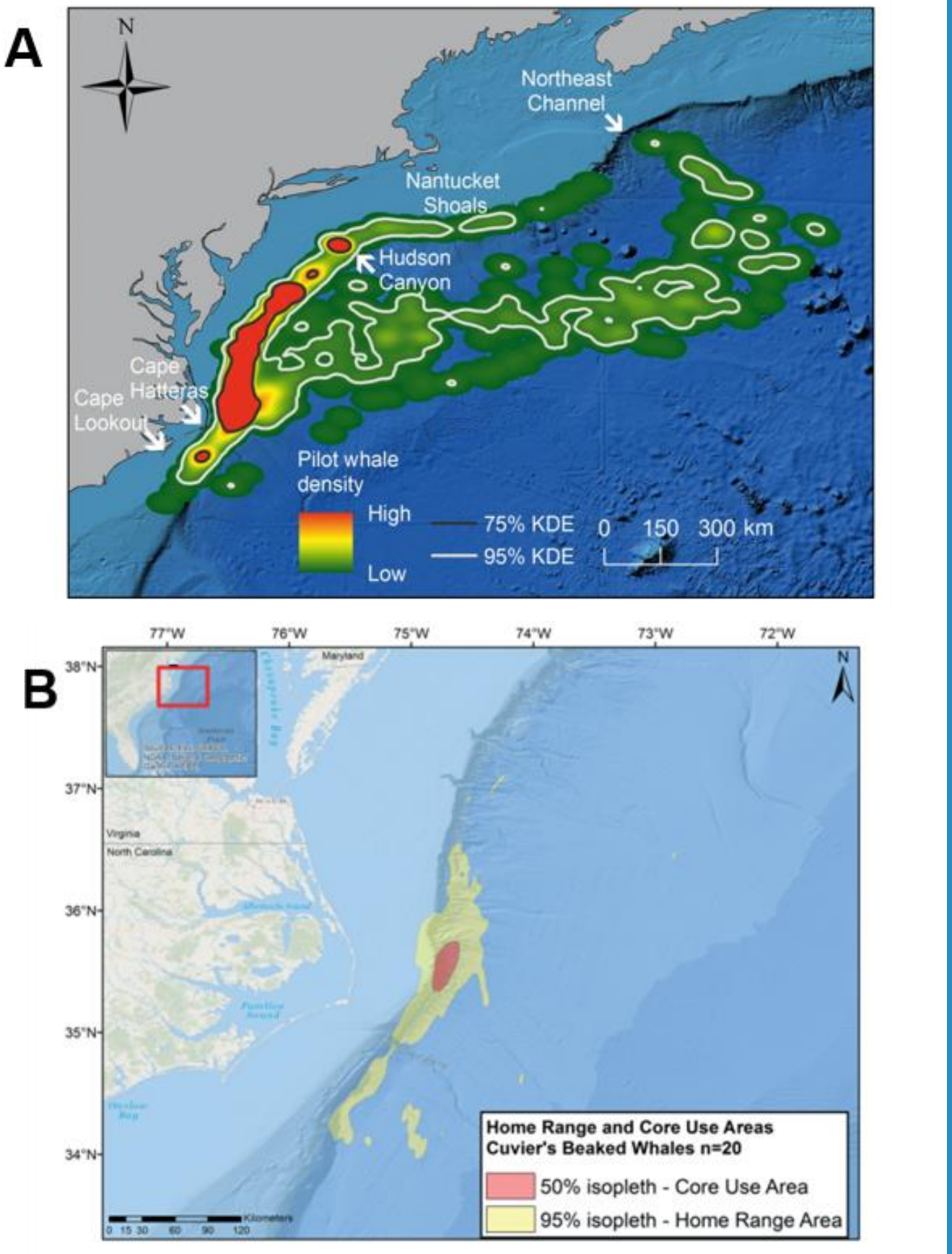

Figure 1: Habitat use areas of satellite tagged (A) Short-finned pilot whale (*Globicephala macrorhynchus*) (n=33) and (B) Goose-beaked whale (*Ziphius cavirostris*) (n=20). The core use area for both species overlaps with the Cape Hatteras Shelf Break Point IMMA. Credit: (A) Thorne, L. H., et al. (2017). Marine Ecology Progress Series, 584, 245-257. https://doi.org/10.3354/meps12371; (B) Foley, H.J., et al. (2021). *Marine Ecology Progress Series*, 660, 203-216. https://doi.org/10.3354/meps13593.

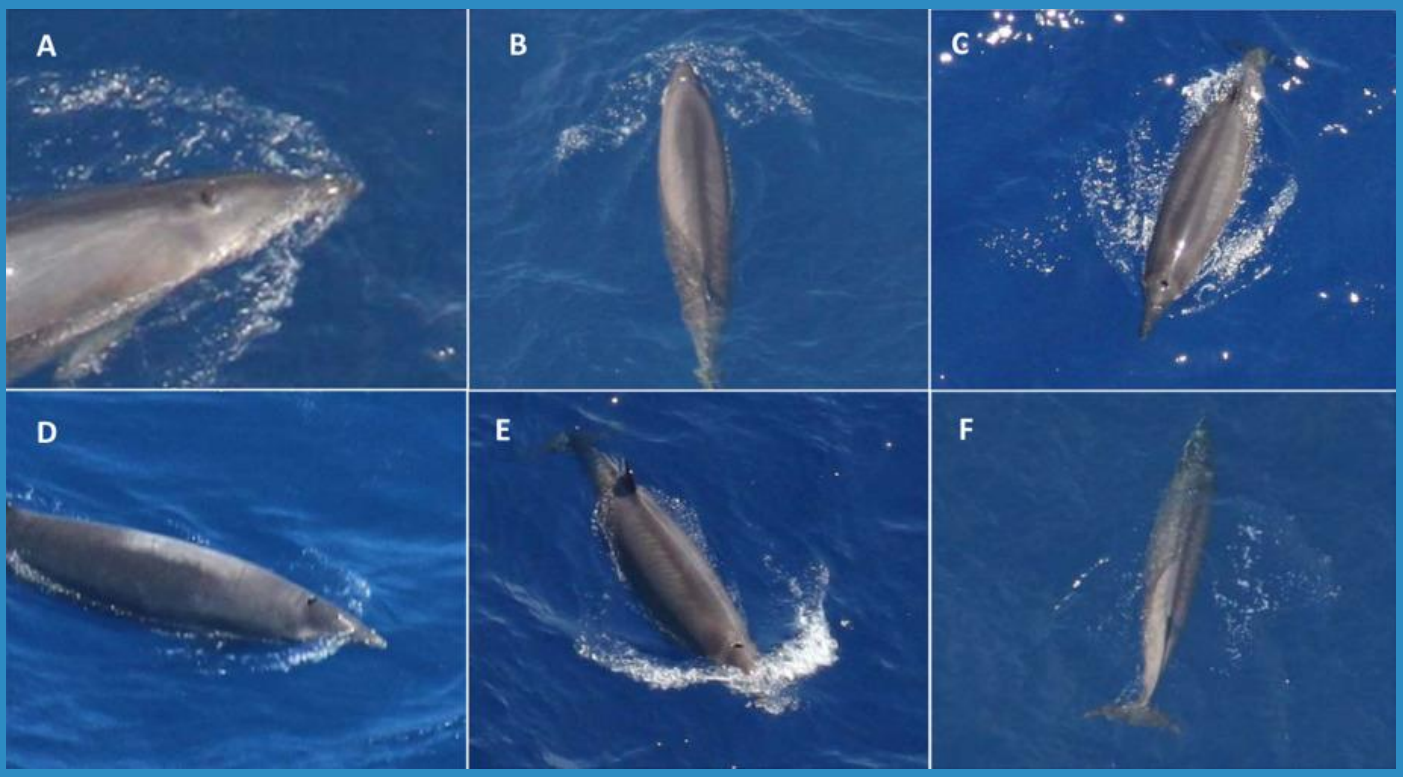

Figure 2: Six Gervais's beaked whale (*Mesoplodon europaeus*) individuals encountered at the shelf break off Cape Hatteras, North Carolina, between May 2011 and November 2015. Excerpt from McClellan, W. A., et al. (2018). *Marine Mammal Science*, 34(4), 997-1017. https://doi.org/10.1111/mms.12500.

Figure 3: The Cape Hatteras Shelf Break Point IMMA is an important seasonal habitat for sperm whales (*Physeter macrocephalus*). Photo credit: NOAA Fisheries/Tim Cole.

shelf waters flowing southward in the Mid-Atlantic Bight, to meet the warm, salty shelf waters of the South Atlantic Bight (SAB) (Churchill & Gawarkiewicz, 2012). As these two water masses meet and the continental shelf narrows, there is a net export of shelf water offshore (Todd et al., 2020). The Hatteras Front is marked by sharp gradients in temperature and salinity as well as a more gradual density gradient (Savidge & Austin, 2007; Savidge & Savidge, 2014).

Moving southward in the Mid-Atlantic Bight, the continental shelf narrows to approximately 30 km at Cape Hatteras (Rulifson et al., 2020). In this area, the slope is also steep: the depth increases from 200 m to greater than 1,500 m in less than 10 km. Offshore of Cape Hatteras, there are three main submarine canyons—Pamlico, Hatteras, and Keller (Keller Canyon may sometimes also be called Albermarle Canyon; see Gardner et al., 2016). However, little is known about these habitats; past research on east coast canyons has focused predominantly on those between Virginia and New England (Morrison, 2018). In addition to marine mammals, the high productivity and dense prey aggregations of the Cape Hatteras Shelf Break Point supports high relative diversity and abundance of sharks and sturgeons, recreational and commercially important fish species, sea turtles, and seabirds.

Criterion A: Species or Population Vulnerability

The Cape Hatteras Shelf Break Point IMMA represents important foraging habitat for sperm whales (*Physeter macrocephalus*), and fin whales (*Balaenoptera physalus*) are predicted to be present in relatively high densities year-round (Roberts et al., 2016, 2023; Stanistreet et al., 2018). Both of these species are designated as "Vulnerable" by the IUCN Red List (Taylor et al., 2019; Cooke, 2018) and in the United States, are listed as "Endangered" under the Endangered Species Act and "Depleted" under the Marine Mammal Protection Act.

Criterion B: Distribution and Abundance Sub-criterion B2: Aggregations

The Cape Hatteras Shelf Break Point is an important habitat for beaked whales, particularly goose-beaked whales (*Ziphius cavirostris* – formerly referred to as Cuvier's beaked whales). Studies using satellite-linked tags to track goose- beaked whales near Cape Hatteras found that, while the tagged individuals' ranges stretched from Onslow Bay to the Virginia/Maryland border along the shelf break and slope, the whales spent most of their time in a small, defined core use area just off the shelfbreak east of Cape Hatteras, within the IMMA boundaries (Shearer et al., 2019; Foley et al., 2021). Photographic surveys spotted goose-beaked whales, as well as other beaked whale species (*Mesoplodon* spp.), just offshore of the 1,000 m isobath in this same region in higher densities than have been recorded almost anywhere in the world (McLellan et al., 2018). The Cape Hatteras Shelf Break Point is used year-round by goose-beaked whales and other beaked whale species, including Gervais's beaked whales (*Mesoplodon europaeus*); whales have been recorded and photographed year-round (Stanistreet et al., 2017; McLellan et al., 2018), and individual animals have been re-sighted across seasons and years (Foley et al., 2021). These research findings align with modelled beaked whale density in the Hatteras area (Roberts et al., 2016, 2023).

The region is also an important foraging habitat for short-finned pilot whales (*Globicephala macrorhynchus*; see, also, Criterion C2), and extremely high densities of this species occur just off the shelfbreak east of within the Cape Hatteras Shelf Break Point (Roberts et al., 2016). Tagged individuals

repeatedly return to this area (Thorne et al., 2017) and sightings have occurred during shipboard sightings across multiple years (NMFS, 2021, 2022, 2023, 2024).

Although the distribution of sperm whales (*Physeter macrocephalus*) is still poorly understood, the Cape Hatteras Shelf Break Point has been recognized as a key habitat for this species since the late 1800s, and it is still a seasonally important sperm whale environment (Stanistreet et al., 2018; NMFS, 2021, 2024). In a study that used passive acoustic monitoring (PAM) to record sperm whales along the U.S. east coast, a site located within the Cape Hatteras Shelf Break Point had the highest daily presence of sperm whales of any recording site, with sperm whale clicks present on 65% of the 734 recording days (Stanistreet et al., 2018). Sperm whale vocalizations also displayed a seasonal pattern: significantly more clicks were present during winter than other seasons, although clicks were also present at intermediate levels during the spring and summer (Stanistreet et al., 2018). Presence was lowest in the fall. These trends were evident across multiple years of recording (Stanistreet et al., 2018).

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

The significant aggregations of beaked whales at Cape Hatteras Shelf Break Point may be tied to the bathymetric features (submarine canyons, steep continental slopes) and oceanographic features (confluence of currents, presence of fronts and eddies) of this site that concentrate prey (Foley et al., 2021). Goose-beaked whales (*Ziphius cavirostris*) predominantly exhibited movement patterns that suggested foraging in this area (rather than behaviours that indicated transit, for example) (Foley et al., 2021).

The region is also an important foraging habitat for short-finned pilot whales (*Globicephala macrorhynchus*), with high densities of whales located just off the shelf break within the Cape Hatteras Shelf Break Point IMMA and tagged individuals repeatedly returning to this area (Thorne et al., 2017). Density here is predicted to be especially high during winter and early spring, when cool water temperatures in Mid-Atlantic Bight waters further north discourage foraging by this species (Thorne et al., 2019; Adamczak et al., 2020). Short-finned pilot whales often forage at depths of 200–1,000 m, concentrating their efforts close to the shelf break and within submarine canyons (Thorne et al., 2017; Stepanuk et al., 2018). Both habitats likely provide enhanced foraging opportunities: ocean currents interacting with the steep continental slope of the Mid-Atlantic Bight may aggregate prey, and canyon upwellings can advect prey into shallower waters (Thorne et al., 2017).

The Cape Hatteras Shelf Break Point also serves as a foraging habitat for small delphinoids, particularly the Western North Atlantic Offshore stock of bottlenose dolphins (*Tursiops truncatus truncatus*) (Schick et al., 2011; Stepanuk et al., 2018).

Criterion D: Special Attributes Sub-criterion D2: Diversity

The exceptional oceanographic features present at the Cape Hatteras Shelf Break Point, along with the convergence of the distinct biogeographic zones of the Mid-Atlantic Bight to the north, and the South Atlantic Bight to the south, support abundant populations of marine mammals and high biodiversity.

Sightings data collected during shipboard surveys conducted by the United States National Marine Fisheries Service (NMFS) and results of habitat-based density models developed by scientists at Duke

University in 2016 and updated in 2023 using survey data collected in 2022, 20 species of cetaceans expected to occur regularly within this relatively small area (NMFS, 2021, 2022, 2023, 2024; Roberts et al., 2016, 2023). The Duke University habitat-based density models combine multiple sources of systematic survey data and are considered among the best available scientific information available on cetacean density in the United States. The models are particularly informative in the case of the Cape Hatteras Shelf Break Point as it is a relatively under-surveyed offshore area.

These 20 species are: minke whales (*Balaenoptera acutorostrata*), fin whales, short-beaked common dolphins *(Delphinus delphis*), short-finned pilot whales, Risso's dolphins *(Grampus griseus*), Northern bottlenose whales *(Hyperoodon ampullatus*), Frasier's dolphins *(Lagenodelphis hosei*), Humpback whales (*Megaptera novaeangliae*; sightings only, NMFS, 2024), Gervais's beaked whales, melon-headed whales *(Peponocephala electra*), sperm whales, false killer whales *(Pseudorca crassidens*), pantropical spotted dolphins *(Stenella attenuata*), clymene dolphins *(Stenella clymene*), striped dolphins *(Stenella coeruleoalba*), Atlantic spotted dolphins *(Stenella frontalis*), spinner dolphins *(Stenella longirostris*), rough-toothed dolphins *(Steno bredanensis*), common bottlenose dolphins, and goose-beaked whales.

Six other species have been less frequently documented in the area and/or are predicted to occur at lower relative densities by the Roberts et al. habitat-based density model. These species are blue whales (*Balaenoptera musculus*), North Atlantic right whales (*Eubalaena glacialis*), pygmy killer whales (*Feresa attenuata*), pygmy sperm whales (*Kogia breviceps*), dwarf sperm whales (*Kogia sima*), and killer whales (*Orcinus orca*).

Additional evidence of the region's outstanding marine mammal diversity is provided by strandings data. During systematic monitoring and analysis of strandings data from 1997 through 2008, 1,847 strandings of marine mammals from nine families and 34 species were reported along 537 km of coastline adjacent to this IMMA (Byrd et al., 2014). This number of species was larger than that documented for strandings in other areas of the world such as northwest Spain, San Diego, southeastern Canada, and Cape Cod (Byrd et al., 2014). In western Australia, the same number of species was found, but the research area included 12,889 km of coastline (Byrd et al., 2014). While the geographic origin of these strandings is not known and cannot be definitively linked to this relatively small, offshore IMMA, these findings provide general support to the richness of marine mammal species in the area, a fact that is also supported by relatively high diversity of the area compared to other parts of the Mid-Atlantic Bight and South Atlantic Bight (excluding the more productive Northeast region; Hodge et al., 2022).

Supporting Information

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