

Juvenile Atlantic cod HAPC

Ecological basis for designation

Rocky habitats are critical habitat types for multiple managed fish species, including juvenile Atlantic cod. Rocky habitats are considered the most structurally complex habitats in the northwest Atlantic because they are inherently three-dimensional, providing both height in the water column and crevices between rocks. Rocky habitats include pebble-gravel, cobble, boulder, and ledge substrate types, and are typically found in environments subject to high-energy wave or water currents. Rocky habitats vary in composition from pebble-gravel pavements, to scattered cobbles and boulders, to rocky reefs composed of large piled boulders.

The complexity of rocky habitats provide a number of ecosystem functions for fish and invertebrate species. The three-dimensional characteristic of rocky habitats alters water flows creating areas of both increased water flow, and low-energy “pockets” within these otherwise high-energy environments. This flow alteration allows for increased prey delivery in high-energy flow areas while also creating flow refuge areas and allowing for deposition and accumulation of finer-grained sediments within the low-energy “pockets.” Further, the vertical feature of rocky habitats also provides increased surface area for macroalgae and benthic invertebrate colonization that provide additional structural complexity and increased forage habitat. The structural complexity of rocky habitats, inclusive of both the geological and biological features, provides critical refuge from predation and shelter for multiple species.

Rocky habitat communities are dominated by attached, sessile invertebrates and/or macroalgae in nearshore environments, with infaunal invertebrate species being limited to finer-grained “pockets” and spans between scattered cobbles and boulders or patchy pebble-gravel habitat.

While it may appear logical that rocky habitats would be less vulnerable to disturbances because they are composed of “hard” substrate types with benthic communities adapted to high energy environments, they are in fact highly vulnerable to disturbances and alterations.

To highlight the importance these habitats for juvenile Atlantic cod, in particular, the New England Fishery Management Council has designated a “Habitat Area of Particular Concern” (HACP) along the coast of New England, from Maine through Rhode Island, extending from the mean high water line to a depth of 20 meters. The HACP is, by definition, a subset of the Councils new juvenile Atlantic cod EFH designation that includes not only rocky habitats, but also submerged aquatic vegetation (SAV), and sandy habitats adjacent to rocky and SAV habitats for foraging.

The Councils rationale for designating the juvenile Atlantic cod HACP notes that these habitat types are not “rare” in the Gulf of Maine, but determined these inshore areas were in need of recognition and focused conservation efforts due to: 1) their critical role in providing juvenile Atlantic cod refuge from predation and forage habitat for young of the year (YOY) and age-1 juvenile Atlantic cod; 2) their sensitivity to current and future human stressors and development; and 3) their critical role for multiple other managed fish species.

Juvenile Atlantic cod EFH text description:

Juveniles: Intertidal and sub-tidal benthic habitats in the Gulf of Maine, southern New England, and on Georges Bank, to a maximum depth of 120 meters, including high salinity zones in bays and estuaries in the Gulf of Maine. Structurally-complex habitats, including eelgrass, mixed sand and gravel, and rocky habitats (gravel pavements, cobble, and boulder) with and without attached macroalgae and emergent epifauna, are essential habitats for juvenile cod.

In inshore waters, young-of-the-year juveniles prefer gravel and cobble habitats and eelgrass beds after settlement, but in the absence of predators also utilize adjacent un-vegetated sandy habitats for feeding. Survival rates for young-of-the-year cod are higher in more structured rocky habitats than in flat sand or eelgrass; growth rates are higher in eelgrass. Older juveniles move into deeper water and are associated with gravel, cobble, and boulder habitats, particularly those with attached organisms.

Gravel is a preferred substrate for young-of-the-year juveniles on Georges Bank and they have also been observed along the small boulders and cobble margins of rocky reefs in the Gulf of Maine.

Applicability of juvenile Atlantic cod HAPC

Although the nearshore juvenile Atlantic cod HAPC would appear to include a vast portion of the nearshore habitats throughout its range, the EFH text description for juvenile Atlantic cod and the intent to protect young of the year juveniles, with some overlap of Age-1 juveniles, limits its application along much of the designated inshore area. As described in the EFH text description, YOY cod experience the highest survivorship in the most complex habitats, with higher growth rates in eelgrass, and exhibit a preference for gravel, cobble, and eelgrass habitats.

Juvenile Atlantic cod utilize shelter habitats corresponding to their size. Young of the year cod are typically only a few centimeters at settlement and generally less than 15 cm in total length by the end of the growing season. Without additional structural complexity provided by attached invertebrates or macroalgae, large scattered cobbles or boulders would not likely provide the appropriate level of complexity for YOY Atlantic cod. Similarly, areas of rip-rap fill would not typically provide the structural complexity necessary to be considered as part of the juvenile Atlantic cod HAPC.

Alterations and disturbances in juvenile Atlantic cod HAPC

Alterations and disturbances in habitats consistent with the juvenile Atlantic cod HAPC may result in a loss of the physical and/or biological components of the habitat. For example, in rocky habitats composed of piled cobbles and boulders, direct disturbance of the substrate may level the rocks resulting in a loss of structural complexity. Activities that cause sedimentation, turbidity, shading, water quality degradation, or directly contact rocky substrate may adversely affect these habitats through a loss of physical and biological components. Disturbances that create acute sedimentation can smother the attached organisms and fill crevices between rocks adversely affecting the properties of the habitat that are critical for juvenile Atlantic cod.

Activities that create turbidity, shading, and/or degrade water quality may adversely affect attached organisms resulting in a loss of important biogenic

structure. Direct disturbance of the rocky substrate may scrape off attached fauna and macroalgae from the rock surface, or roll rocks burying attached organisms in the bottom sediments.

Recovery of biological components in rocky habitats is slow, typically on the order of decades or more. Disturbances and alterations that may result in a loss of biogenic features within the juvenile cod HAPC s should be fully considered and evaluated.

Determining extent of rocky habitats within action area

Working definition

Natural rocky habitats are intertidal and subtidal substrates composed of pebble-gravel, cobble, boulder, or rock ledge and outcrops. Manufactured stone (e.g. cut or engineered rip-rap) is not considered a natural rocky habitat. Natural rocky habitats are either found as pavement (consolidated pebble-gravel, cobble, or boulder areas) or as a mixture with fines (i.e. clay and sand) and other substrates.

Rocky habitats as EFH are defined as follows:

- 1) All pebble-gravel, cobble or boulder pavements
- 2) Pebble-gravel mixed with fines: Mixed substrate of pebble-gravel and fines where pebble-gravel is an evident component of the substrate (either through visual observation or within sediment samples). Sediment samples with a content of 10% or more of pebble-gravel in the top layer (6-12 inches) should be delineated.
- 3) Scattered cobble, Scattered boulder, Scattered cobble/boulder: Mixed substrate of cobble and/or boulder and other substrates. The aerial extent of cobbles and/or boulders should be delineated.
- 4) All rock ledge/outcrops: Area should be delineated along the edge of the ledge/outcrop.

Applicability of Juvenile Atlantic cod HAPC:

In order to determine if a rocky habitat is consistent with the juvenile Atlantic cod HAPC, natural rocky habitats should be defined and delineated as described above. In addition, the presence or absence of attached epifauna and macroalgae is also necessary. Eelgrass habitats should be delineated throughout the project area.

Photographic examples

Pebble-gravel pavement (left) and cobble/boulder pavement with macroalgae (right).



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Cobble/boulder pavement (not including groin).



Cobble/boulder pavement (borderline “scattered”).



“Scattered” cobble/boulders.



Pebble-gravel pavement. “scattered” cobble/boulder left, sand & pebble-gravel (top).



Pebble-gravel pavement.



“Scattered” boulders/cobble, but underlying pebble-gravel pavement.



“Scattered” boulders, but underlying pebble-gravel pavement.



Scattered boulders/cobble and pebble-gravel patches.



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**Pebble-gravel pavement (middle, mixed gravel right-top and left-bottom,
pavement unless sample are less than 10% pebble-gravel content.**



Pebble-gravel and cobble pavement area.



Define as sand, low percent pebble-gravel content.

