Nassau Grouper and Nassau Grouper Critical Habitat Consultation Framework NOAA Fisheries Southeast Regional Office

Revised October 2024

Purpose and Scope

To inform the Region's consultation activities regarding the Nassau grouper and its critical habitat, this document consolidates and interprets information obtained through the listing process and collected through collaboration with state, federal (Southeast Fisheries Science Center [SEFSC]), and university partners. This collection of information provides Section 7 assistance, and identifies conservation/recovery concepts to be considered during consultation. The contents are intended to summarize best available information as well as facilitate integration of conservation/recovery considerations into our routine consultation practices. A large quantity of data was synthesized in the production of this document and as such it should be considered a job aid and used as general guidance only.

Background Information

This section presents information to help familiarize you with the species to understand its basic biology, life history, ecology, and habitat use. This information was used in combination with the listing rule, and the Biological Report, to guide development of this framework.

Listing Information

- Listed as threatened on June 29, 2016 (81 FR 42268).
- Critical habitat designated January 2, 2024 (89 FR 126), effective February 1, 2024.

Species Description

- Adult appearance (Figure 1): Dark band on top of head from upper jaw through each eye and then curving to meet its corresponding band above eye (i.e., tuning fork pattern); 5 dark vertical bars; black saddle on the caudal peduncle; and, numerous black spots below/behind each eye.
- Juveniles exhibit a color pattern similar to adults.
- Maximum weight: 55-lbs (25-kg).
- Maximum length: 4-ft (122-cm).

Figure 1. Adult Nassau grouper on a reef. Photo credit: S.K. Bolden.

Range (based on literature and historical accounts)

- Bermuda and Florida (USA), throughout the Bahamas and Caribbean Sea (Figure 2).
  - Florida Range: Cape Canaveral south through the Florida Keys westward to the Tortugas and Pulley's Ridge. It is fairly uncommon in Florida, with mixed accounts of historical abundance.
  - Considered rare in the Gulf of Mexico
- Primary determinants of distribution for Nassau grouper are not known, although water clarity, habitat, and benthos appear to be important. The mean depth range of the Nassau grouper (0-130m) may be influenced more by the availability of suitable habitat than by food resources, since diet is highly varied and more a function of body size than of water depth.
- Occurs in tropical/subtropical waters (~24°C - 30°C, but can vary); generally shallow water, but may be found in depths to 130-m; can tolerate practical salinity of 15 for a few days, but prefer 30 or greater.
- Patchy abundance throughout the range of a species is common due to variability of habitat quality and quantity and exploitation level.

Distribution (based on life history)

- Within Florida, the Florida Reef Tract is essential for Nassau grouper recruitment.
  - The Florida Reef Tract extends from St. Lucie Inlet in Martin County to the Dry Tortugas with the most prolific reef development seaward of the Florida Keys. It is a near continuous offshore reef structure that stretches in a barrier-like formation for some 360 linear miles.
  - The Florida Reef Tract is a complex progression of continuous reef habitat from inshore (shoreline/intertidal zone to lagoon to back reef to patch reefs to reef flat to reef crest) to offshore built upon older carbonate structures that provides the necessary habitats and topographical complexity for the Nassau grouper to complete its growth from post-settlement to adult.
  - There are no documented spawning aggregations in Florida waters, however, Nassau grouper have been observed among the fishes at an aggregation site at Riley's Hump, in the Dry Tortugas. These individuals have displayed spawning coloration, behaviors, and sound production. In addition, limited surveys at Riley's Hump have documented substantially higher Nassau grouper encounter rates (>66 percent of sample sites) as compared to the rest of the Florida reef tract (<1 percent of sample sites). We have therefore concluded that Riley's Hump contains the spawning habitat essential feature and consequently was designated as critical habitat for the species.

The distribution of Nassau grouper, within the range, varies based on habitat and depth as previously discussed. Some areas within the confirmed range of Nassau grouper do not provide essential nearshore nursery habitats; however, adults may occupy adjacent offshore hard-bottom areas.

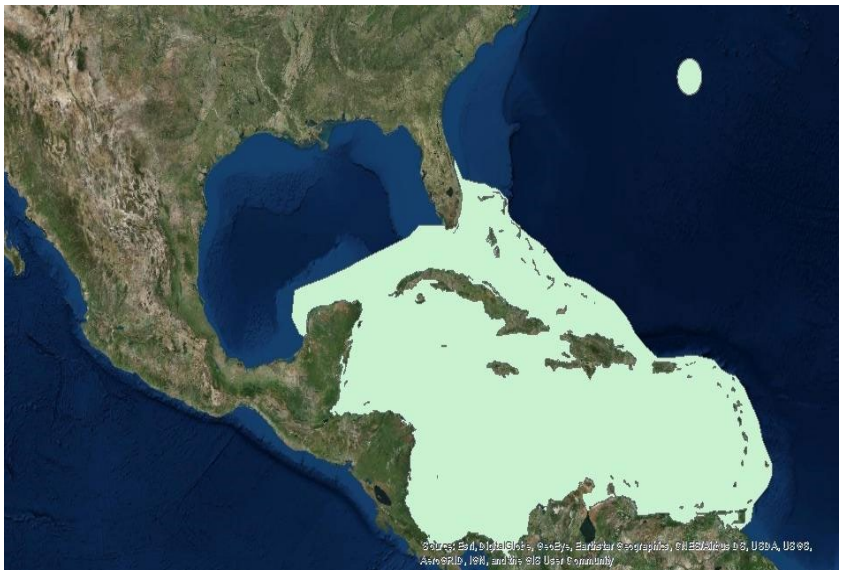

Figure 2. Confirmed range of Nassau grouper currently includes Bermuda, Florida (USA), the Bahamas, and Caribbean Sea (Acero and Garzón-Ferreira 1991; Cervigón 1991; Heemstra and Randall 1993; Smith 1971).

Summary of Survey Results by Area

Continental U.S.

- Florida Keys (south of landmass) and Dry Tortugas
    - During the FWC/ University of Miami Rosenstiel School of Marine, Atmospheric, and Earth Sciences (UM-RSMAS)/NOAA/National Park Service in-water surveys from Biscayne Bay, through the Florida Keys, the mean percentage of occurrence during a survey was 1.8% (meaning a diver had a 1.8% chance of seeing a Nassau grouper during surveys using the random stratified design). The same surveys in the Dry Tortugas produced a percentage of occurrence of 0.8%. The corresponding densities were 0.78 and 0.3 individuals per hectare in the Florida reef tract and the Dry Tortugas respectively. Survey periods were from 1999 – 2021. The Nassau grouper observed ranged in size from 17 to 98-cm FL in depths averaging 1.3 to 29.9-m.
        - Habitat types where Nassau grouper were observed included: continuous reef high relief, continuous reef low relief, isolated patch low relief, isolated patch medium relief, isolated patch high relief, spur and groove low relief, and spur and groove high relief habitats.
        - All surveys were conducted on the south side of the Florida Keys and only in reef habitat.
    - FWC tagged 24 animals in waters off the Florida Keys and Dry Tortugas from 2006 – 2021. The animals ranged in size from 33 to 79-cm TL.
    - The smallest Nassau grouper that FWC has recorded in the Florida Keys was at a site called Coral Gardens; FWC has observed many juvenile Nassau grouper here all at a length in the upper 20-cm range or larger. Coral Gardens is described by FWC as a nearshore site with many patch reefs.
    - FWC has a seining program with monthly survey at ten sites in the middle keys with no

reports of Nassau grouper. This gear type (seine) is not likely to capture Nassau grouper.
    - The FWC collaborator queried several divers in the group and none recall observing Nassau smaller than 19.5-cm in the Florida Keys. Several of these people have thousands of dives each in the Florida Keys.
    - There are limited data for nearshore non-reef areas where action areas may occur.
    - Two extensive surveys were conducted for ichthyoplankton at the western edge of the Florida Current; one survey used light traps and the other used nets. While both surveys collected Serranids, neither collected *E. striatus*.
- Florida Bay - area on the north side of the upper Florida Keys that is encompassed within the Everglades National Park boundary.
    - Surveys by FWC's Fisheries Independent Monitoring program reports only a single Nassau grouper record. The gears used for this survey (otter trawls, 21.3-m haul seines, and purse seines) are not likely to capture Nassau grouper over hardbottom habitat but would be appropriate for catching juveniles in the lagoon area.
    - The FWC Unified Florida Coral Reef Tract Map identifies many areas around the Florida Keys and the Marquesas as hardbottom habitat including large areas immediately north of the Middle Keys.
    - Numerous studies have documented abundant red algae (*Laurencia* spp.) and sponges, corals, and other crevice-structures in these hard bottom areas, which are also near patch reefs and deeper contiguous reef tracts.
    - Available information indicates the species is not common; however, habitat to support each of its ontogenetic stages is prevalent, suggesting the potential of the area for supporting a recovering population.
- Florida Keys to Government Cut (Biscayne Bay)
    - Biscayne Bay – Creel survey (1976 – 1991) of recreational fishers in Biscayne Bay report Nassau grouper in all years except 1977.
- Government Cut (Miami Dade County) Florida to Cape Hatteras, North Carolina
    - No animals have been recorded during in-water, visual diver surveys off the coast of Florida from Government Cut in Miami to St. Lucie Inlet in Martin County. Surveys were conducted from 2012 – 2021, with no individuals recorded.
    - NOAA SEFSC conducts annual fishery independent surveys (including trap, long line, and camera) in the Atlantic from Florida to North Carolina. Since the inception of this program in 1990, only 1 adult Nassau grouper has been observed. This individual was recorded by video on 8/16/13 in 52-m of water off the coast of Jacksonville, FL. Given there is only this one record it is our opinion that this was an extralimital occurrence, and it does not represent a true range expansion.
    - The SEFSC generally surveys hard bottom areas at depths from about 50-ft to 350-ft. The closest to shore the SEFSC surveys is approximately 3.5-mi at depths of 45-ft. While juvenile and adult Nassau grouper could occupy habitat at this depth, the SEFSC has not surveyed near shore sea grass or algae habitats within 3.5-mi of shore.
    - Both commercial and recreational fishers have captured Nassau grouper from reef outcroppings offshore (> 3-mi) between Cape Canaveral and the Florida Keys (NMFS 2016).

- Spawning Locations
  - As noted above, although actual spawning has not been confirmed, evidence suggests that a spawning aggregation occurs at Riley's Hump, next to the Dry Tortugas. While a few larger juvenile-sized Nassau grouper have been observed in Florida waters, no information is available to determine their origin.

U.S. Caribbean (Puerto Rico and the U.S. Virgin Islands)

- NCRMP in-water surveys, whereby divers visually census fish communities, were conducted in Puerto Rico in 2016, 2019, and 2021, while surveys were conducted in the U.S. Virgin Islands (i.e., St Thomas/St John and St Croix) in 2017, 2019, and 2021. The percent occurrence of Nassau grouper on surveys was 0.7%, 2.6%, and 0.3% with corresponding densities of 0.22, 0.89, and 0.1 individuals per hectare for the Puerto Rico, St. Thomas/St. John, and St. Croix platforms respectively. Minimum and maximum sizes for the region were recorded as 20 and 65-cm, while minimum and maximum depths observed were 4.3 and 29.5-m.
- At least two Nassau grouper aggregation sites have disappeared, one near La Parguera, and the other off of Mona Island.
- A small aggregation has been documented near Puerto Rico at Bajo de Sico, which may be a reconstitution of a former aggregation. Additionally, an even smaller aggregation at Abrir la Sierra may be a subdivision of the larger aggregation at Bajo de Sico.
- Multiple aggregations have been documented during the spawning season at the Grammanik Bank, located south of St. Thomas, U.S. Virgin Islands.
- Multiple life stages are assumed to be present throughout the Caribbean based on the presence of these spawning aggregation sites. In addition, anecdotal evidence suggests that juveniles are often present in high densities in nearshore environments during productive years.

Caribbean Foreign Waters

- Bahamas - all life stages present and common, numerous spawning sites are known.
- Cayman Islands – all life stages present and common, numerous spawning sites are known.
- Belize – all life stages present and common, numerous spawning sites are known.
- Mexico – fishing pressure in the 1990's caused many aggregations to collapse and three remaining aggregations are known to remain.
- Bermuda – previously abundant with numerous spawning sites, commercial fishing greatly reduced abundance and aggregation sites no longer form; presence of small individuals has recently increased.
- Cuba – data are few and difficult to validate, numerous spawning sites are reported to occur.

Life History/Ecology/Habitat Use

Biological Characteristics

- Slow-growing.

- Long lived (~29 years).
- Individuals occur at low densities across a large spatial scale, likely due to the predatory nature of adults, which occur within a home range.
- Generation time (the interval between the birth of an individual and the subsequent birth of its first offspring) is estimated at 9 – 10 years.
- Data from scales and otoliths indicate that fish reach sexual maturity in approximately 4 – 7 years. Both male and female Nassau grouper typically mature at 4 – 5 years of age and at lengths between 40 and 45-cm SL (44 and 50-cm TL).
- Reproductive period is brief (days) as fish aggregate to group-spawn at transient, site-specific locations during consecutive full moons in the winter; there are no records of pair-spawning.

Diet

- Larval and pelagic juvenile Nassau grouper feed on a variety of plankton, including pteropods, amphipods, and copepods.
- Demersal juveniles occur in nearshore benthic habitats (i.e. mangroves, seagrasses, and macroalgal clumps) and feed mainly on crustaceans.
- Late juveniles/subadults occur on hard bottom and reefs and feed mainly on benthic invertebrates and fish.
- Adult Nassau grouper are unspecialized, bottom-dwelling, ambush-suction predators. Numerous studies describe adult Nassau grouper as piscivores.
- Piscivores are generally diurnal to coincide with activity period of their prey. There are limited data regarding Nassau grouper foraging period. Nassau grouper may take advantage of the reduced light levels at dawn and dusk combined with the increased number of prey during changeover between diurnal and nocturnal fishes to forage as a means to reduce high energy costs associated with large fish ambushing prey.

Habitat Use by Size Class

Table 1. Size, habitat, and notes associated with each life stage

Life stage	Size	Habitat	Notes
Egg	N/A	Eggs are planktonic within the oceanic environment	Eggs hatch as larvae 23-40 hours post fertilization
Larvae	<2.5-cm TL	Larvae are planktonic within the oceanic environment	Larvae are planktonic for up to 70 days but typically recruit to demersal habitat around 40 days at an average size of 2.5-cm.
Post-settlement and early juveniles	2.5 to 15-cm TL	Recruit (2 to 3-cm TL) to coral clumps (primarily *Porites* spp.) covered by masses of macroalgae (*Laurencia* spp.) in shallow nearshore waters. With growth (at about 8-cm TL) move from within the macroalgae to outside/adjacent coral/algae clumps. Have also been found in several	Several studies indicate coral clumps with attached macroalgae as being the most important settlement habitat. Usually in coarse calcareous sand areas as the stony corals provide attachment sites for the red algae as direct holdfast attachment is inhibited. Density of

Life stage	Size	Habitat	Notes
		microhabitats including empty queen conch shells, debris adjacent to seagrass, and rubble mounds. Begin shifting to reef habitats including solution holes, ledges, and natural/artificial patch reefs around 12 to 15-cm.	recruits within algae can be up to 8, become more solitary as they move from within algae to adjacent areas. Also a shift towards deeper water as size increases.
Juveniles	15 to 50-cm TL	Inshore patch reefs, both natural and artificial, at smaller length (15 to 30-cm TL) then transitioning to forereef habitat around 30 to 35-cm TL. Transition to progressively deeper water banks and offshore reefs with increased size.	Generally solitary in specific habitats for extended periods.
Adults	>50-cm TL	High relief corals and rocky substrates in clear water from the shore to depths of 130-m. Occupy crevices, caves, solution holes, and ledges in these habitats.	• Relatively sedentary, correlation between size and depth, movements generally diurnal

Reproduction

- Spawning aggregation sites (Figure 3) are transient and site-specific forming between November and February around the full moon when water temperature is around 25°C – 26°C. All known reproductive activity occurs within these aggregations.
- Adults move from resident reefs as spawning time approaches to established spawning areas. Distances traveled are highly variable depending on distance to aggregation site. Some fish move only a few kilometers, but some individuals are known to travel up to several hundred kilometers to the aggregation site. Limited observations indicate: 1) fish move in groups numbering between 25 and 500; 2) movement is parallel to the coast or along the shelf edge; 3) movements are synchronous, and 4) individuals return to their home reef after spawning.
- Spawning aggregation sites have been found to occur near the edge of insular platforms, as little as 50-m from the shore, nearby a drop-off into deeper water across a wide (6 to 60-m) depth range and diversity of substrate types. Sites are characteristically small, highly circumscribed areas, measuring several hundred meters in diameter, with soft corals, sponges, stony coral outcrops, and sandy depressions.
- The general spawning behavior consists of courtship among four distinct color phases concluding with a rapid vertical rush led by a female followed by numerous males releasing eggs and sperm into the water column well above the substrate near sunset.
- Size and number of spawning aggregations have decreased over time (Figure 3). Based on the size and number of current spawning aggregations the Nassau grouper population appears to be just a fraction of its historical size. Recent evidence suggests that spawning is occurring at what may be reconstituted or novel spawning sites in Puerto Rico and U.S. Virgin Islands.
- The following figure (Figure 3) denotes the location of historic and current spawning aggregations.

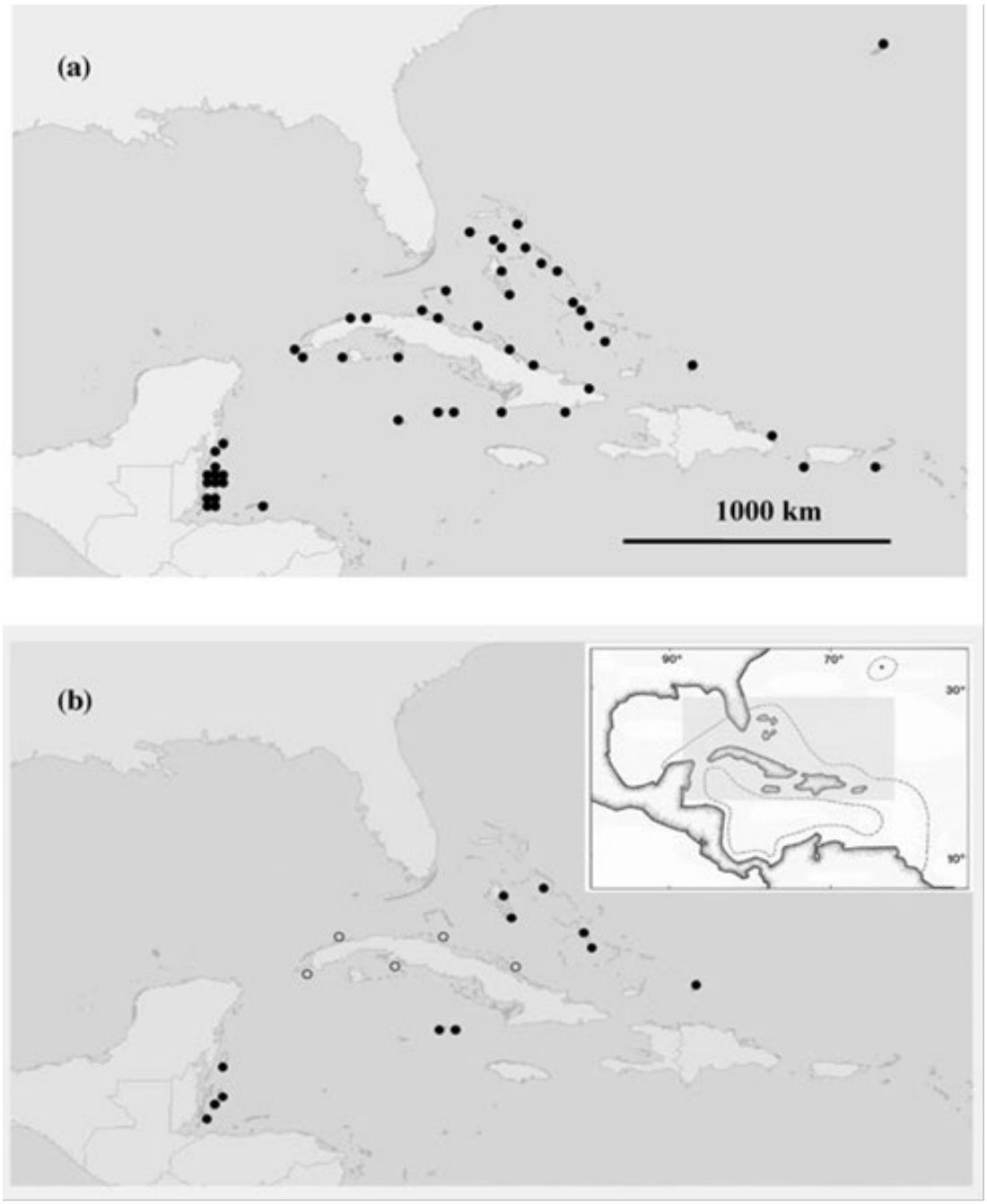

Figure 3. Nassau grouper spawning aggregations locations both (a) historically and (b) as of about 2007 according to available information; not all sites have been validated. Inset shows full geographic range, main concentrations (shaded) and extended areas (dashed lines). Each closed circle represents 1, or occasionally 2, reported site(s). Open circles are "probable" sites. (Sources: (Sadovy and Eklund 1999; Sala et al. 2001; Smith 1972; Whaylen et al. 2004); Belize Spawning Aggregation Working Group, unpublished data; R. Claro, unpublished data; E. Sala, unpublished data, as presented in De Mitcheson et al. (2008).

Summary of Threats

The most serious threats to Nassau grouper are fishing at spawning aggregations and inadequate law enforcement. In addition, a variety of other threats have been identified including: 1) negative pressures on growth rate/productivity; 2) spatial structure/connectivity; 3) effectiveness of foreign regulations; 4) potential impacts from artificial selection; 5) insufficient abundance levels and diversity 6) commercial harvest; and 7) effectiveness of state and territory regulations. Additional detail is provided in the listing rule.

Major loss of any of the habitats utilized by groupers during various life stages is likely to influence their abundance and survival. Perhaps the greatest habitat losses influencing grouper populations arise from alterations or destruction of nearshore nursery areas, including mangroves and seagrasses, and by the declining state of coral reef systems (Dahlgren and Eggleston 2001; Gardner et al. 2003; Semmens et al. 2007).

- Changes in water temperature experienced by early life stages of Nassau grouper may have profound effects on their food consumption, development and growth rate, and these factors may play a significant role in the annual fluctuations in the survival of this species (Ellis et al. 1997). This may be compounded by the fact that these early life stages already experience high mortality rates due primarily to predation (Choat 2012) and disease susceptibility (Harikrishnan et al. 2011).
- Sea temperature may also affect adult grouper directly by affecting metabolism, reproduction, growth and behavior (Asch and Erisman 2018; Colin 1992; Watanabe et al. 1995).
- Other environmental stressors that are likely to affect grouper survival directly include predicted climate related changes in ocean chemistry (e.g. ocean acidification) (Cheung et al. 2013; Semmens et al. 2007; Young et al. 2006).

To date, very little research has been done examining the impacts of environmental stressors on the different life stages of Nassau grouper.

Section 7 Considerations

Following the June 2016 Nassau grouper listing under the Endangered Species Act (ESA; 81 FR 42268), we began considering what types of federal actions could have the potential to affect the species. This analysis considered Nassau grouper distribution and habitat use within its range based on the various life stages of the species. We relied on the 2013 Biological Report and collected additional information from various state, university, and federal agencies, as presented below, to ensure the most recent data available was incorporated (Hill and Sadovy de Mitcheson 2013). Additionally, we integrate considerations for Nassau Grouper Critical Habitat, as designated January 2, 2024 (89 FR 126).

Range for consultation purposes: How common is the species and where is the species found?

All data from our Florida Fish and Wildlife Conservation Commission (FWC), university, and NOAA

partners, to date, suggest that Nassau grouper are absent from the waters surrounding most of the continental United States. The exception is Florida where a small number of larger juveniles and adults (293 individuals) have been recorded in surveys and others reported in fisheries (see supporting data for details), and Texas, where a single individual has been reported at Flower Garden Banks National Marine Sanctuary (Foley et al. 2007). No larval Nassau grouper or juveniles smaller than 19-cm fork length (FL) have been collected or observed in Florida waters. To settle from the plankton and successfully recruit, Nassau grouper require specific nursery habitats coupled with currents to transport larvae; these areas are limited to the Florida Reef Tract. However, it should be noted that sampling along shoreline habitats of the Florida Keys where smaller juveniles might be expected to occur has been limited, to date. Ichthyoplankton surveys have not collected Nassau grouper. Adults have been captured at offshore reef outcroppings north of the Florida Reef Tract; these fish likely moved in as large juveniles or adults. By contrast, all life stages of Nassau grouper may be found throughout the waters surrounding Puerto Rico and the U.S. Virgin Islands (i.e., the U.S. Caribbean).

Based on the information detailed later in this document, we evaluated the range and distribution of Nassau grouper to ensure that our Section 7 consultation practices consistently and accurately consider where the species may be present. Please refer to the SERO Section 7 Mapper for more detailed information on the recommended Nassau grouper consultation areas: ESA Section 7 Mapper web app viewer.

Southeast Florida, North of Government Cut

- General coastal construction projects occurring in the southeastern United States, with the exception of those in the Florida Keys (including the Dry Tortugas and Biscayne Bay to Government Cut), will have no effect on the species due to the absence of Nassau grouper in these nearshore locations. The general absence of Nassau grouper outside of the Florida Keys is well documented by the lack of records in Florida Fish and Wildlife Conservation Commission's, Fisheries Independent Monitoring data as well as various surveys conducted by the National Marine Fisheries Service's SEFSC. Specifically, we do not believe Nassau grouper will be present in waters on the north side of the Florida Keys (north of Hwy 1), the Gulf of Mexico, and nearshore (<3 nautical miles) locations along the Atlantic coast north of Government Cut.
- Adults and large juvenile Nassau grouper may be present at reef outcroppings in offshore waters (> 3 nautical miles) north of Government Cut to Cape Canaveral, FL. Nassau grouper are captured incidentally in the snapper-grouper fishery by both commercial and recreational fishers using handlines (NMFS 2016).
- The general absence of Nassau grouper in nearshore areas outside of the Florida Keys is well documented by the lack of records in Florida Fish and Wildlife Conservation Commission's, Fisheries Independent Monitoring data as well as various surveys conducted by the National Marine Fisheries Service's SEFSC.

Government Cut to Florida Keys and Dry Tortugas

- Adult and large juvenile Nassau grouper may be present in waters surrounding the Dry Tortugas and on the south side (south of U.S. Hwy 1) of the Florida Keys, including Biscayne Bay to

Government Cut. In this area, consultations should carefully evaluate the habitat preferences for these life stages in determining whether Nassau grouper may be present in affected areas. Nassau grouper are not expected to be present on the north side of the Florida Keys (north of U.S. Hwy 1). Please refer to the Section 7 Mapper for more information on the recommended consultation area for Nassau grouper in this area.

- Small juveniles and larval Nassau grouper are not typically observed in the nearshore areas of the Florida Keys including Biscayne Bay to Government Cut. While benthic surveys may identify appropriate habitat for larvae to settle in the nearshore/lagoon area, no Nassau grouper smaller than 19-cm FL has been collected or observed in Florida waters. Across the range of the species, recruitment is episodic due to a phenomenon known as the storage effect, typical among grouper species. Florida waters occur in the northern most part of the range of Nassau grouper, and as a result, recruitment is even more varied and likely occurs in infrequent pulse events. The critical habitat designated across Florida, therefore represents recruitment habitat that can support larval settlement, and consequent ontogenetic migrations.

U.S. Caribbean

- All life stages of Nassau grouper may be present throughout Puerto Rico and the U.S. Virgin Islands (i.e., the U.S. Caribbean). Again, habitat associations for the various life stages should be considered in determining whether the species may be present in the area affected by proposed actions.

Considerations for Projects Located in Florida Keys

Projects (e.g., general construction) occurring in all waters on the south side of the Florida Keys to Government Cut may have the potential to affect the species, with the following clarification and limitations:

- Adult Nassau grouper along the east coast of Florida are likely a result of infrequent larval immigration from the Caribbean via the Florida Current. Nassau grouper larvae (2 to 3-cm TL) settle in the lagoon area with coarse calcareous substrate, numerous sponges, and stony corals (primarily *Porites* spp.) affixed with macroalgae (*Laurencia* spp.). These small fish lived within the coral/macroalgae clumps patchily distributed at 2 to 3-m depths. This habitat provides both cover and prey for these very small fish. To reduce the risk of mortality, these post-settlement fish, like most coral reef fish, do not emigrate from settlement habitat except during ontogenetic habitat shifts. After 4 to 5 months of living within the macroalgae clumps, the early juveniles emerge and are found adjacent to these alga-covered coral clumps within the lagoon area. Early juveniles are not expected to be in seagrass habitats. To settle from the plankton and successfully recruit, Nassau grouper require specific nursery habitats coupled with currents to transport larvae. While Nassau grouper nursery habitat occurs in the Florida Keys, NMFS is not aware of any record of a Nassau grouper smaller than 19-cm FL despite numerous surveys including those for ichthyoplankton near the western boundary of the Florida Current and in the passes between the Keys. It is possible that the Florida Current is carrying Nassau grouper into the Florida Reef Tract and the larvae are settling in the lagoon area on the windward side of the Florida Keys. However small individuals have not been observed despite survey and

coupled with the large area of the Florida Reef Tract, NMFS has determined that adverse effects on post-settlement and early juveniles would be extremely unlikely to occur and a NLAA determination is appropriate.

- While larger juveniles (19-cm FL and larger) do occur off the Florida Keys, NMFS does not expect any Nassau grouper of this size to be present on soft habitat (mud/sand areas with no coral or rock). "No effect" determinations by the action agency are appropriate for projects occurring over soft bottom habitat.
- Nassau grouper (19-cm FL and larger) could occur over corals, reefs, and other hardbottom habitat, including channels and canals cut through the limestone hardbottom found throughout the Florida Keys. In this instance, a "no effect" determination would not be supported as the species may be present and a "may affect" determination will be made; subsequent analysis to analyze the potential effects of the project based on its stressor(s) is necessary. Additional information to assist with that analysis is provided below.
- Nassau grouper, like other grouper species, are closely associated with structure and utilize these areas for cover. Therefore, they may be found in areas with docks and seawalls even if hardbottom is absent. Again, additional information to assist with the analysis is provided below.

<u>Common Routes of Effect to Consider for Projects Occurring in Waters on the South Side (South of Hwy 1) in the Florida Keys and in Waters Surrounding the Dry Tortugas</u>

If a project will occur near corals, reefs, hard bottom, or shoreline structures, the biologist should consider the following list of potential stressors and their effects. For many projects, especially small-scale projects, spatially and temporally, a determination that effects are extremely unlikely to occur or insignificant may be appropriate. The biologist should consider the rationales presented below and include them in support of determinations, when appropriate. Examples of projects types for which these rationales may not be appropriate could include: large scale projects such as marinas that have a longer construction duration, fishing piers that could result in the incidental capture of Nassau grouper, port expansion projects that may require significant impacts to hard-bottom habitat, consultation on fishery management plans that could result in the incidental bycatch of Nassau grouper in otherwise legal federal fisheries, and activities that could result in significant impacts to hard bottom habitats used by Nassau grouper.

- PHYSICAL INJURY FROM EQUIPMENT - Nassau grouper have the potential to be physically injured or killed by interactions with construction equipment and pile installation. However, we believe this is extremely unlikely to occur because this species is mobile and expected to move away from active construction equipment.
- TEMPORARY LOSS OF FORAGE OR REFUGE HABITAT - Nassau grouper may temporarily be unable to use the project area as forage or refuge habitat due to avoidance related to construction noise and/or physical exclusion from the area via turbidity curtains or disturbance. We believe these types of effects would be insignificant, based on the typical small footprint and short duration associated with most projects. Additionally, Nassau grouper (at the sizes that would be found in the action areas) are mobile organisms and provided similar habitat is

nearby, we expect these adjacent sites could provide similar short-term refuge or forage habitat.

- LONG TERM HABITAT ALTERATIONS - Larger juvenile and adult Nassau grouper (>19-cm FL) use a variety of hardbottom habitats. While the listing rule characterized habitat loss as a low risk to species survival and distribution, habitat loss may affect species recovery. Projects resulting in the removal or modification of reef or hardbottom habitat may affect Nassau grouper by displacing them from these specific habitats. However, we believe any effects from most small scale removals or modifications of reef or hardbottom habitat will be insignificant provided there is other habitat in close proximity to the project site that can serve a similar habitat function for Nassau grouper. Projects removing or altering larger areas of habitat will require further considerations and analyses. Activities that have significant or large scale direct or indirect impacts to reef or hard bottom habitat may result in adverse effects to the species through the modification or loss of habitat. Long term/permanent impacts to reef or hardbottom habitat should be considered in assessing potential for adverse effects to the species.
- NOISE - Effects to ESA-listed animals as a result of noise created by construction activities can physically injure animals in the affected areas or change animal behavior in the affected areas. Injurious effects can occur in two ways. First, immediate adverse effects can occur to listed species if a single noise event exceeds the threshold for direct physical injury. Second, effects can result from prolonged exposure to noise levels that exceed the daily cumulative exposure threshold for the animals, and these can constitute adverse effects if animals are exposed to the noise levels for sufficient periods. Behavioral effects can be adverse if such effects interfere with the animal movement, feeding, resting, or reproduction, for example. The biologist should conduct a noise analysis (noise calculator) to evaluate effects to ESA-listed fish identified by NMFS and whether the effects are NLAA or LAA.
- TURBIDITY - Project construction could increase turbidity that may adversely affect Nassau grouper. To control and reduce turbidity, the applicant will generally be required to use turbidity curtains, which will be installed prior to and remain in place throughout all in-water construction. Turbidity curtains will remain in place post-construction until turbidity and siltation subsides. Given the short duration and this best management practice associated with typical projects it is likely there will be no effect from turbidity. No effect determinations do not need to be discussed in consultations drafted by NMFS.
- VESSEL TRAFFIC – Vessel traffic/boat strikes are not a concern for Nassau grouper as they are demersal (bottom-dwelling) fish[1] that associate with hardbottom. We believe that their association with rocky bottoms and coral reefs coupled with their demersal life history lead to a "No Effect" determination. No effect determinations do not need to be discussed in consultations drafted by NMFS.

Consideration for Projects within the U.S. Caribbean

Based on the assumption stated above that all life stages of Nassau grouper are likely present in the

[1] Some demersal fish are susceptible to vessel traffic; for example, Atlantic sturgeon that inhabit navigation channels.

U.S. Caribbean, action agencies, and subsequently NMFS, must consider possible impacts to multiple life stages of Nassau grouper from a variety of in-water projects that are likely to occur in the Caribbean. UNLIKE THE FLORIDA KEYS, all size classes may occur in project areas of the U.S. Caribbean. This becomes especially important in considering noise analyses for which there are different thresholds for smaller fish (those <2g) versus larger fish (>2g). NMFS is uncertain about how individual projects may affect the species and therefore effects will need to be considered on a project-by-project basis. Considerations should include time of year (to determine life stages that may be present), habitat types in the vicinity of the project, scale of the project, and then potential routes of effects.

These routes of effects may include but are not limited to:

- Physical injury from equipment.
- Loss of forage or refuge habitat – Habitats used by small Nassau grouper include a variety of microhabitats (Laurencia spp. mats, queen conch shells, tilefish mounds) and more traditional habitats (coral, mangroves, hard bottom) (Hill and Sadovy de Mitcheson 2013). However large-scale projects that have direct or indirect impacts to reef or harbottom habitat can have potential effects to adults. In locations where small juveniles may occur, loss of seagrass and mangroves may also have potential effects to the species' nursery areas. In the U.S. Caribbean, activities with permanent impacts to the nearshore seagrass and mangrove habitat should be assessed for potential adverse effects to newly settled and juvenile life stages.
- Behavioral or physical injury from noise.
- Accidental bycatch.

Potential Work Window to Avoid Effects of Noise to Small (<2g) Recent Recruits

- Construction open windows to avoid impacts to newly recruited juveniles - proposed actions should occur between September 5 – February 11 to avoid noise impacts to small (<2g) Nassau grouper. While applicants are not required to conduct work within this window, projects conducted outside of this period should consider potential impacts of noise to small (<2g) juvenile Nassau grouper.
- This work window is based on the following;
    - Assuming (1) aggregations form at the same sites every year from January – April, (2) eggs hatch as larvae 23 to 40 hours post fertilization, and (3) larvae are planktonic for up to 70 days but typically recruit to demersal habitat around 40 days at an average size of 2.5-cm (25-mm), then the latest that a young 2.5-cm (25-mm) new recruit would show up in the action area would be April 30th + 2 days (to hatch) + 70 days planktonic then recruit = July 11.
    - Estimated growth rate is 0.57-mm/d (this assumes the growth rate for slightly larger fish applies to this size class),
    - A 2-g fish is approximately 57-mm, therefore the recruit at 25-mm needs to grow 32-mm in order to reach a TL of 57-mm (size at recruitment to 57-mm to reach a weight of 2-g; or a total of 32-mm (57-mm – 25-mm = 32-mm).
    - With a growth rate of 0.57-mm/day it would take 56.2 days for the recruit to grow 32-mm (32-mm/0.57-mm/d = 56.2).

- Therefore with a spawn date of April 30th + 2 days (to hatch) + 70 days planktonic then recruit + 56.2 days for the recruit to grow to 2g = September 5th.
- Next, the date a new recruit from the next year class could enter the action area would be February 11 (earliest recruit would be January 1 + 1 day to hatch + 40 days to recruit = February 11).
- So between September 5 - February 11 (roughly 5 months) Nassau grouper less than 2g should not be present in the nearshore habitat.

Conservation and Recovery Considerations

One of the goals of PRD is to promote conservation and recovery of ESA listed species. As such, recovery plans, or outlines, are developed on a species-by-species basis. The recovery outline for Nassau grouper can be found here. Section 7 consultations and the related engagement with action agencies (and applicants) provide an opportunity to help achieve these goals. While the most serious threats to Nassau grouper are removal by fishing at spawning aggregations and inadequate law enforcement, other threats contribute to the threatened status of this species. Possible issues to consider during consultation include, but are not limited to:

- Loss of any of the habitats utilized by groupers during various life stages may influence their distribution, abundance, and survival, including alterations or destruction of nearshore nursery areas, including mangroves and seagrasses, and degradation of hardbottom habitat. Therefore, consulting biologists should not only work to avoid and minimize potential project impacts to Nassau grouper habitat during consultation with action agencies, but encourage proactive conservation actions that could help improve or protect habitat through conservation recommendations whenever possible.
- Where applicable and practicable, staff should seek the cooperation and assistance of action agencies and applicants in helping with public outreach concerning the plight of the species. This may include, but is not limited to, helping communicate (e.g., signage) the importance of minimizing human impacts to habitats used by the Nassau grouper (and other protected species), compliance with existing regulations including no take and seasonal/area closures, and promoting responsible fishing practices (e.g., use of circle hooks when fishing in areas where this species may be captured and safely returning this species to the water if captured).

Critical Habitat

NMFS designated critical habitat within the U.S. jurisdiction of the range of Nassau grouper (published January 2, 2024; 89 FR 126). In the rule, NMFS identified essential features of Nassau grouper habitat that, when present, denote critical habitat for the species. Essential features include recruitment and development habitat and spawning habitat as follows:

1. Recruitment and developmental habitat. Areas from nearshore to offshore necessary for recruitment, development, and growth of Nassau grouper containing a variety of benthic types that provide cover from predators and habitat for prey, consisting of the following:
    a. Nearshore shallow subtidal marine nursery areas with substrate that consists of

unconsolidated calcareous medium to very coarse sediments (not fine sand) and shell and coral fragments and may also include cobble, boulders, whole corals and shells, or rubble mounds, to support larval settlement and provide shelter from predators during growth and habitat for prey.

b. Intermediate hardbottom and seagrass areas in close proximity to the nearshore shallow subtidal marine nursery areas that provide refuge and prey resources for juvenile fish. The areas include seagrass interspersed with areas of rubble, boulders, shell fragments, or other forms of cover; inshore patch and fore reefs that provide crevices and holes; or substrates interspersed with scattered sponges, octocorals, rock and macroalgal patches, or stony corals.

c. Offshore Linear and Patch Reefs in close proximity to intermediate hardbottom and seagrass areas that contain multiple benthic types, for example, coral reef, colonized hardbottom, sponge habitat, coral rubble, rocky outcrops, or ledges, to provide shelter from predation during maturation and habitat for prey.

d. Structures between the subtidal nearshore area and the intermediate hardbottom and seagrass area and the offshore reef area including overhangs, crevices, depressions, blowout ledges, holes, and other types of formations of varying sizes and complexity to support juveniles and adults as movement corridors that include temporary refuge that reduces predation risk as Nassau grouper move from nearshore to offshore habitats.

2. Spawning Habitat. Marine sites used for spawning and adjacent waters that support movement and staging associated with spawning.

Thus, recruitment and development habitats were identified as nearshore subtidal marine nursery areas, intermediate hardbottom and seagrass areas, offshore linear and patch reefs, and structures between these habitats. Spawning habitat was identified based on the documented presence of a spawning aggregation. These essential features are central to the life history of the Nassau grouper, whereby spawning adults aggregate in known locations to spawn. Once settled, the juveniles use specific habitats for food security and shelter. As the juveniles develop into adults, the ontogeny of the species is predictable such that known habitats are used as they broaden their food sources while maintaining an affinity for structure. The critical habitat units were assigned to specific areas within the range of Nassau grouper that included the essential features as follows:

1. Navassa Island Unit.
    a. All waters surrounding Navassa Island encompassed by the shoreline to the 30m isobaths. Area = 2.468 sq. km.
2. Puerto Rico Unit 1—Mona Island.
    a. All waters between the shoreline out to the 50m isobaths around Mona Island and Monito. Area = 30.65 sq. km.
3. Puerto Rico Unit 2—Desecheo Island.
    a. All waters between the shoreline out to the 50m isobaths around Desecheo. Area = 4.28 sq. km.

4. Puerto Rico Unit 3—Southwest.
    a. Waters off the southwest coast of the Puerto Rico main island. Area = 112.393 sq. km.
5. Puerto Rico Unit 4—Northeast.
    a. Waters off the northeast coast of the Puerto Rico main island. Area = 48.754 sq. km.
6. Puerto Rico Unit 5—Vieques Island.
    a. Waters off the west and northeast, east, and southeast coasts of the island.

    Area = 9.488 sq. km.
7. Puerto Rico Unit 6—Culebra/Culebrita Islands.
    a. The Culebra area consists of waters off the southeastern Culebra coastline. The Culebrita area consists of waters off the western and southern coasts of the island.

    Area = 4.149 sq. km.
8. United States Virgin Island Unit 1—St Thomas.
    a. Waters off the east coast of St. Thomas Island and waters off the southwest, south, and southeast coast of the Water Island. Area = 9.183 sq. km.
9. United States Virgin Island Unit 2—St. John.
    a. Waters off the east coast of the island. Area = 6.552 sq. km.
10. United States Virgin Island Unit 3—St. Croix.
    a. Waters off the east end of St. Croix Island and waters off the north coast of Buck Island. Area = 50.35 sq. km.
11. Florida Unit 1—Biscayne Bay/Key Largo.
    a. Waters south of Rickenbacker Causeway, including portions of waters from the coastline into Biscayne Bay, and waters off the eastern coastline to 80°29’21” W, 25°01’59” N. Area = 1279.696 sq. km.
12. Florida Unit 2—Marathon.
    a. Waters off the southern shoreline approximately between Knights Key to 80°55’51”W, 24°46’26” N. Area = 172.379 sq. km.
13. Florida Unit 3—Big Pine Key to Geiger Key.
    a. Waters off the south side of coastline and US 1 from approximately Geiger Key to Big Pine Key. Area = 372.369 sq. km.
14. Florida Unit 4—Key West.
    a. Shoal waters south of Woman Key. Area = 127.078 sq. km.
15. Florida Unit 5—New Ground Shoal.
    a. New Ground Shoal waters. Area = 31.042 sq. km.
16. Florida Unit 6—Halfmoon Shoal.
    a. Halfmoon Shoal waters. Area = 33.615 sq. km.
17. Florida Unit 7—Dry Tortugas.

a. Waters encompassing Loggerhead Key and waters surrounding Garden Key and Bush Key. Area = 4.437 sq. km.

18. Spawning Site Unit 1—Bajo de Sico.
    a. All waters encompassed by 100m isobath bounded in the Bajo de Sico spawning area bound within the following coordinates: (A) 67°26’13” W, 18°15’23” N, (B) 67°23’08” W, 18°15’26” N, (C) 67°26’06” W, 18°12’55” N, and (D) 67°26’13” W, 18°12’56” N. Area = 10.738 sq. km.
19. Spawning Site Unit 2—Grammanik Bank/Hind Bank.
    a. All waters which make up the Hind Bank and the Grammanik Bank, interconnecting waters between these banks, and waters extending out to the 200 fathom line directly south from Grammanik Bank. Area = 58.77 sq. km.
20. Spawning Site Unit 3 – Riley’s Hump
    a. All waters encompassing Riley’s Hump at 83°6’30.8” W, 24°29’41.6” N out to the 35m isobath on the north, west, and east side of the hump, extending out to the 50m isobath on the south side of the hump to include the escarpment on the southern face of the bank. Area = 15.35 sq. km.

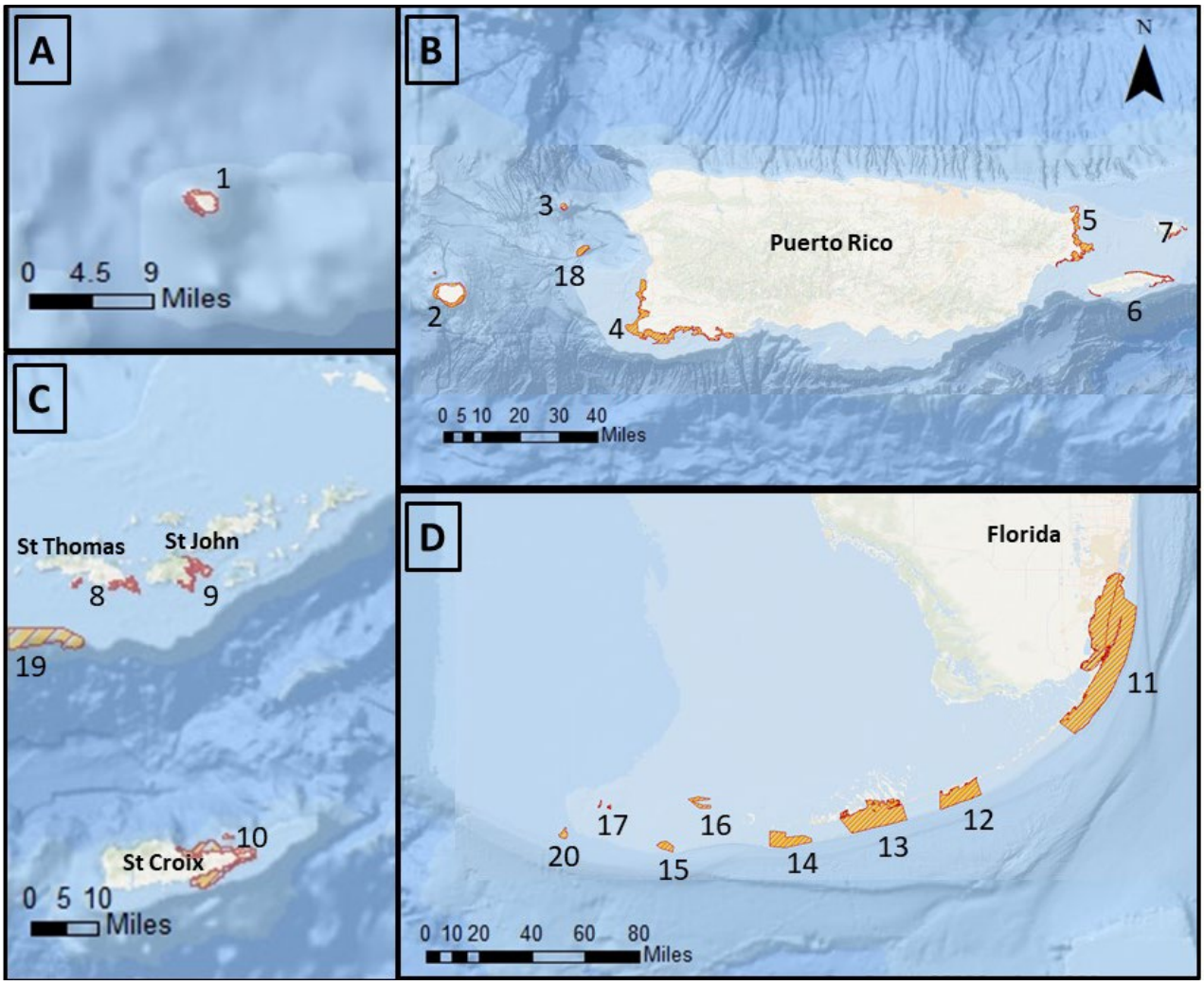

Figure 4. Nassau grouper critical habitat units as identified in the final critical habitat rule (89 FR 126). Sub-figures are broken down further into A) Navassa unit; B) Puerto Rico units (including spawning site 1); C) United States Virgin Islands units (including spawning site 2); D) Florida units (including spawning site 3). Numbers on the map correspond to the numbered units listed in the text above.

Routes of Effect

Table 2. Activity, Essential Feature Potentially Affected, Route of Effect, and Considerations for Nassau grouper critical habitat.

Activity	Essential Feature Affected	Potential Impact to Essential Feature	Considerations
Dredging	• Recruitment habitat (shallow rubble, hard-bottom) • Development and Adult habitat (coral reefs)	• Removal of essential features • Turbidity and Sedimentation • Direct burial of habitat	Distance from critical habitat, use of turbidity controls, turbidity and sedimentation monitoring to ensure turbidity does not exceed 7 NTU (due to correlation between turbidity and sediment deposition) and sedimentation does not exceed 0.5 cm. Use of environmental windows.
Fill/Beach Nourishment	• Recruitment and development habitat (rubble, hard-bottom)	• Turbidity and Sedimentation • Direct burial of habitat	Distance from critical habitat, use of turbidity controls, turbidity and sedimentation monitoring to ensure turbidity does not exceed 7 NTU (due to correlation between turbidity and sediment deposition) and sedimentation does not exceed 0.5 cm. Use of environmental windows.
Cables, Gas lines, Pipelines	• Recruitment habitat (shallow rubble, hard-bottom) • Development and adult habitat (coral reefs)	• Removal of essential features • Turbidity and Sedimentation • Damage to essential features via direct contact	Distance from critical habitat, use of turbidity controls, turbidity and sedimentation monitoring to ensure turbidity does not exceed 7 NTU (due to correlation between turbidity and sediment deposition) and sedimentation does not exceed 0.5 cm. Use of environmental windows.
Shoreline development (seawalls, docks, boat ramps, groins)	• Recruitment and development habitats (rubble, hard-bottom, mangroves)	• Removal of essential features • Sedimentation • Damage to essential features via direct contact	Distance from critical habitat, use of turbidity controls, turbidity and sedimentation monitoring to ensure turbidity does not exceed 7 NTU (due to correlation between turbidity and sediment deposition) and sedimentation does not exceed 0.5 cm. Use of environmental windows.
ATONs	• Recruitment habitat (shallow rubble, hard-bottom)	• Removal of essential features • Damage to essential features via direct contact	Distance from critical habitat, bottom type at ATON installation site

Activity	Essential Feature Affected	Potential Impact to Essential Feature	Considerations
	• Development and adult habitat (coral reefs)		
Outfalls	• Recruitment habitat (shallow rubble, hard-bottom, mangroves) • Development and adult habitat (coral reefs)	• Sedimentation • Direct burial of habitat • Nutrification leading to coral stress and algae growth	Distance from critical habitat, use of turbidity controls to ensure sediment does not deposit onto the critical habitat
Anchoring	• Recruitment habitat (shallow rubble, hard-bottom, mangroves) • Development and adult habitat (coral reefs)	• Removal of essential features • Damage to essential features via direct contact	Distance from critical habitat, or alternatives to anchoring in sensitive habitats, such as mooring balls
Docks / Marinas	• Recruitment habitat (shallow rubble, hard-bottom, mangroves) • Development and adult habitat (coral reefs)	• Removal of essential features • Sedimentation • Damage to essential features via direct contact	Distance from critical habitat, use of turbidity controls to ensure sediment does not deposit onto the critical habitat
Artificial Reef	• Development and adult habitats (coral reefs)	• Removal of essential features • Damage to essential features via direct contact	Adequacy of controls to avoid deployment of reefs on benthic habitat that contains essential features
Fishing Activities	• Recruitment habitat (shallow rubble, hard-bottom, mangroves) • Development and adult habitat (coral reefs)	• Damage to essential features via direct contact of destructive fishing gear types, such as bottom gear including traps, trawls, and nets.	Avoid use of destructive fishing practices in any critical habitat areas
Activities occurring at any of the offshore spawning aggregation sites	• Spawning habitat: ○ All offshore spawning aggregation sites	• Potential damage to all essential features	Avoid all spawning aggregation sites to the extent possible

Supporting Materials

For more information, visit NOAA Fisheries webpage for Nassau grouper

The Recovery Outline and Biological Report are available for download.

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