Endangered Species Act Critical Habitat Report

Final Information Basis and Impact Considerations of Critical Habitat Designation for Threatened Nassau grouper

December 2023

Nassau grouper. Credit: Paddy Ryan

U.S. Department of Commerce | National Oceanic and Atmospheric Administration | National Marine Fisheries Service

Contents

List of Tables

List of Figures

1 Introduction

Section 3(5)(A) of the ESA defines critical habitat as (i) the specific areas within the geographical area occupied by the species, at the time it is listed, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed, upon a determination by the Secretary of Commerce (Secretary) that such areas are essential for the conservation of the species. (16 U.S.C. 1532(5)(A)). Conservation is defined in section 3(3) of the ESA as the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary (16 U.S.C.1532(3)). Section 3(5)(C) of the ESA provides that, except in those circumstances determined by the Secretary, critical habitat shall not include the entire geographical area which can be occupied by the threatened or endangered species. Our regulations provide that critical habitat shall not be designated within foreign countries or in other areas outside U.S. jurisdiction (50 CFR 424.12(g)).

Section 4(a)(3)(B)(i) of the ESA prohibits designating as critical habitat any lands or other geographical areas owned or controlled by the Department of Defense (DoD), or designated for its use, that are subject to an Integrated Natural Resources Management Plan (INRMP) prepared under section 101 of the Sikes Act (16 U.S.C. 670a), so long as the Secretary determines in writing that the INRMP plan provides a benefit to the species for which critical habitat is designated. Section 4(b)(2) of the ESA requires the Secretary to designate critical habitat for threatened and endangered species under the jurisdiction of the Secretary on the basis of the best scientific data available and after taking into consideration the economic impact, the impact on national security, and any other relevant impact of specifying any particular area as critical habitat. This section also grants the Secretary discretion to exclude any area from critical habitat if the Secretary determines the benefits of such exclusion outweigh the benefits of specifying such area as part of the critical habitat. However, the Secretary may not exclude areas if such exclusion will result in the extinction of the species (16 U.S.C. 1533(b)(2)).

Once critical habitat is designated, section 7(a)(2) of the ESA requires Federal agencies to ensure that actions they authorize, fund, or carry out are not likely to destroy or adversely modify that habitat (16 U.S.C. 1536(a)(2)). This requirement is in addition to the section 7(a)(2) requirement that Federal agencies ensure their actions are not likely to jeopardize the continued existence of ESA-listed species. Specifying the geographic area identified as critical habitat also facilitates implementation of section 7(a)(1) of the ESA by identifying areas where Federal agencies can focus their conservation programs and use their authorities to further the purposes of the ESA. See 16 U.S.C. 1536(a)(1). The ESA section 7 consultation requirements do not apply to citizens engaged in actions on private land that do not involve a Federal agency; for example, if a private landowner is undertaking an action that does not require a Federal permit or is not federally-funded. However, designating critical habitat can help focus the efforts of other, non-federal, conservation partners (*e.g.*, state and local governments, individuals, and non-governmental organizations).

In the final rule listing the Nassau grouper (81 FR 42268; June 29, 2016), we found the designation of critical habitat was not determinable. We acknowledged gathering information during the status review and public comment period, but not having enough information to determine which of the habitat features are essential to the conservation of the Nassau grouper and may require special management

considerations or protection. We stated that we would, to the maximum extent prudent and determinable, publish a proposed designation of critical habitat for the Nassau grouper in a separate rule. This document is part of that process and contains: (1) the biological information used to determine the specific areas containing the features essential to the conservation of the species requiring special management, and (2) consideration of the national security, economic, and other relevant impacts of designating critical habitat.

2 Background

2.1 Listing History

On June 29, 2016, we published a final rule that listed Nassau grouper as a threatened species (81 FR 42268). The listing rule identified fishing at spawning aggregations and inadequate law enforcement as the most serious threats to this species. No critical habitat was designated for the Nassau grouper at that time.

On October 17, 2022, NMFS proposed to designate critical habitat for Nassau grouper within U.S. jurisdictions throughout the range of the species. We requested public comment on the proposed designations and supporting reports for 60 days following the publication of the proposed rule, until December 15, 2022 (87 FR 62930). The essential features of the Nassau grouper critical habitat consist of (1) nearshore to offshore areas necessary for recruitment, development, and growth of Nassau grouper containing a variety of benthic types that provide cover from predators and habitat for prey, and (2) marine sites used for spawning and adjacent waters that support movement and staging associated with spawning. The proposed rule identified 19 units in waters off the coasts of southeastern Florida, Puerto Rico, Navassa, and the United States Virgin Islands (USVI) that contain the essential features. The area covered by the Naval Air Station Key West (NASKW) Integrated Natural Resource Management Plan (INRMP) was ineligible for designation pursuant to section 4(a)(3)(B)(i) of the ESA due to the conservation benefits it affords the Nassau grouper. Pursuant to section 4(b)(2) of the ESA, no areas were proposed for exclusion from the designation on the basis of economic, national security, and other relevant impacts. We did not propose to designate any unoccupied critical habitat.

As explained in the proposed rule, on July 5, 2022, the United States District Court for the Northern District of California issued an order vacating the ESA section 4 implementing regulations that were revised or added to 50 CFR part 424 in 2019, which included changes made to the definition of physical or biological feature and the designation of unoccupied critical habitat ("2019 regulations"; 84 FR 45020, August 27, 2019). On September 21, 2022, the U.S. Court of Appeals for the Ninth Circuit granted a temporary stay of the district court's July 5 order. As a result, the 2019 regulations are once again in effect, and, as with the proposed critical habitat designation, we are applying the 2019 regulations here. For purposes of this determination, we considered whether the analysis or its conclusions would be any different under the regulations in effect prior 2019. We have determined that while our analysis in some respects would differ, the conclusions ultimately reached and presented here would not be any different.

2.2 Natural History

This section summarizes life history and biological characteristics of threatened Nassau grouper to provide context for the determination of physical or biological features that are essential for the conservation of the species. We provide information on the biology and ecology of Nassau grouper. The information below is largely summarized from listing documents so more detail can be found there (e.g., 81 FR 42268; June 29, 2016), and updated with the best available scientific information to date.

The Nassau grouper, like most large marine reef fishes, demonstrates a bi-partite life cycle with demersal adults and juveniles but pelagic eggs and larvae. It undergoes a series of ontogenetic shifts of both habitat and diet from larval to adult stage. Adults maintain resident home ranges (Randall, 1962 1963; Carter *et al.*, 1994), but may undergo long migrations to spawning aggregation sites (Bolden, 2000). Reproduction is known only to occur during annual aggregations, in which large numbers of Nassau grouper, ranging from dozens to tens of thousands, collectively gather to spawn at predictable times and locations.

In the following sections, we describe the natural history of the Nassau grouper as it relates to habitat needs from the egg and larval stage to settlement into nearshore habitats followed by a progressive offshore movement with increasing size and maturation.

Egg and Larval Planktonic Stage

Fertilized eggs are pelagic, measure about 1 mm in diameter, and have a single oil droplet about 0.22 mm in diameter (Guitart-Manday and Juárez-Fernandez, 1966). Data from eggs produced in an aquarium (Guitart-Manday and Juarez-Fernandez, 1966) and artificially fertilized in the laboratory (Powell and Tucker, 1992; Colin, 1992) indicate that spherical, buoyant eggs hatch 23–40 hours following fertilization. Eggs of groupers that spawn at sea require a salinity of about 30 parts per thousand (ppt) or higher for maximum survivorship and for them to float (Tucker, 1999). Both buoyancy and survivorship decrease as salinity declines below optimum levels, resulting in less than 50% hatching rates at salinities of 24 ppt (Ellis *et al.*, 1997).

The pelagic larvae begin feeding on zooplankton approximately 2–4 days after hatching (Tucker and Woodward, 1994). Newly hatched larvae in the laboratory measured 1.8 mm notochord length and were slightly curved around the yolk sac (Powell and Tucker, 1992). Nassau grouper larvae are rarely reported from offshore waters (Leis, 1987) and little is known of their movements or distribution. The pelagic larval period has been reported to range from 37 to 45 days based on otolith analysis of newly settled juveniles in the Bahamas (Colin *et al.*, 1997) with a mean of 41.6 days calculated from net-caught samples (Colin, 1992; Colin *et al.*, 1997). Collections of pelagic larvae were made 0.8 to 16 km off Lee Stocking Island, Bahamas, at 2 to 50 m depths and from tidal channels leading onto the Exuma Bank (Greenwood, 1991). Larvae were widely dispersed or distributed in patches of various sizes (Greenwood, 1991). Larvae collected 10 days after back-calculated probable spawning date measure 6–10 mm standard length (SL) and attain a maximum size of 30 mm SL (Shenker *et al*., 1993).

Larval Settlement

After spending about 40 days in the plankton, in the Bahamas, Nassau grouper larvae have been found to recruit from the oceanic environment into demersal, bank habitats through tidal channels (Colin, 1992). This recruitment process can be brief and intense, occurring in short pulses during highly limited periods (often several days) each year, and has been found to be associated with prevailing winds, currents, and lunar phase (Shenker *et al*., 1993). These late larvae/early juvenile Nassau grouper (18–30 mm TL) moved inshore from pelagic environments to shallower nursery habitats (Shenker *et al*., 1993).

Most of what is known about the earliest cryptic life stages is known from research in the Bahamas where recently settled Nassau grouper were found to be on average 32 mm TL when they recruit into the nearshore habitat and settle out of the plankton (Eggleston, 1995). Newly settled or post-settlement fish found by Eggleston (1995) ranged in size from 25–35 mm TL and were patchily distributed at 2–3 m depth in substrates characterized by numerous sponges and stony corals with some holes and ledges residing exclusively within coral clumps (e.g., *Porites* spp.) covered by masses of macroalgae (primarily the red alga *Laurencia* spp.). Stony corals provided attachment sites for red algae since direct holdfast

attachment was probably inhibited by heavy layers of coarse calcareous sand. This algal and coral matrix also supported high densities and a diverse group of xanthid crabs, hippolytid shrimp, bivalve, gastropods and other small potential prey items. In the USVI, Beets and Hixon (1994) observed groupers on a series of nearshore artificial reefs constructed of cement blocks with small and large openings and found the smallest Nassau groupers (30–80 mm TL) were closely associated with the substrate, usually in small burrows under the concrete blocks. Growth during this period was about 10 mm/month (Eggleston, 1995).

Juveniles

After settlement, Nassau grouper grow through three juvenile stages, defined by size, as they progressively move from nearshore areas adjacent to the coastline to shallow hardbottom areas and seagrass habitat. The size ranges for the three juvenile stages, which we discuss in more detail below, are approximations and are not always collected the same way between studies. Juvenile Nassau grouper reside within nearshore areas for about 1 to 2 years, where they are found associated with structure in both seagrass (Eggleston, 1995; Camp *et al*., 2013; Claydon and Kroetz, 2008; Claydon *et al*., 2009, 2010; Green, 2017) and hardbottom areas (Bardach, 1958; Beets and Hixon, 1994; Eggleston, 1995; Camp *et al*., 2013; Green, 2017). Juvenile Nassau grouper leave these refuges to forage and when they transition to new habitats (Eggleston, 1995; Eggleston *et al*., 1998).

Newly settled (post-settlement) juveniles (~2.5 – 5 cm TL) Most of what is known about the earliest demersal life stages of Nassau grouper comes from a series of studies conducted from 1987–1994 near Lee Stocking Island in the Exuma Cays, Bahamas as reported by Eggleston (1995). These surveys and experiments in mangrove-lined lagoons and tidal creeks (1–4 m deep), seagrass beds, and sand or patch reef habitats helped identify the Nassau grouper's early life ontogenetic (*i.e.*, developmental) habitat changes. Benthic habitat of newly settled Nassau grouper (31.7 ± 2.9 mm TL (mean ± standard deviation), n=31) was described as exclusively within coral clumps (e.g., *Porites* spp.) covered by masses of macroalgae (primarily the red alga *Laurencia* spp.). These macroalgal clumps were patchily distributed at 2 to 3 m depths in substrate characterized by numerous sponges and stony corals, with some holes and ledges. The stony corals (primarily *Porites* spp.) provided attachment sites for red algae; direct holdfast attachment to the coral by the red algae was probably inhibited by heavy layers of coarse calcareous sand and minor amounts of silt and detritus. The open lattice of the algal-covered coral clumps provided cover and prey and facilitated the movement of individuals within the interstices of the clumps (Eggleston 1995). Post-settlement Nassau grouper were either solitary or aggregated within isolated coral clumps. Density of the post-settlement fish was greatest in areas with both algal cover and physical structure (Eggleston, 1995). A concurrent survey of the adjacent seagrass beds found abundance of nearly settled Nassau grouper was substantially higher in *Laurencia* spp. habitats than in neighboring seagrass (Eggleston, 1995).

Eggleston (1995) found the functional relationship between percent algal cover and post-settlement density of Nassau grouper was linear and positive compared to other habitat characteristics such as algal displacement volume, and the numbers of holes, ledges, and corals. Recently-settled Nassau grouper have also been collected from tilefish (*Malacanthus plumieri*) rubble mounds, with as many as three fish together (Colin *et al.,* 1997). They have been reported as associated with discarded queen conch (*Strombus gigas*) shells and other debris within *Thalassia* beds (Claydon *et al.*, 2009, 2010) in the Turks and Caicos Islands, although the exact fish sizes observed are not clear. Post-settlement survival in macroalgal habitats is higher than in seagrass beds, showing a likely adaptive advantage for the demonstrated habitat selection (Dahlgren and Eggleston, 2000). Nassau grouper remain in the shallow nearshore habitat for about 3 to 5 months following settlement and grow at about 10 mm/month (Randall, 1983; Eggleston, 1995).

Early juveniles (~4.5 – 15cm TL). Band transects performed near Lee Stocking Island, Bahamas, 4–5 months after the settlement period (June 1991–93) showed that early juveniles (8.5 ± 11.7 cm TL, n=65) demonstrated a subtle change in microhabitat; 88 percent were solitary within or adjacent to algal-covered coral clumps (Eggleston, 1991). As the early juveniles grew, reef habitats, including solution holes and ledges, took on comparatively greater importance as habitats (Eggleston, 1991). Low habitat complexity was associated with increased predation rates and lowered the survival of recruits (Dahlgren and Eggleston, 2000).

Early juveniles in the Bahamas have a disproportionately high association with the macroalgae *Laurencia* spp.; whereas other microhabitats (*e.g.*, seagrass, corals) are used in proportion to their availability (Dahlgren and Eggleston, 2001). Reports from Mona Island, Puerto Rico (Aguilar-Perera *et al*., 2006) indicate that early juveniles (60–120 mm TL) were found at the edge of a seagrass patch, under rocks surrounded by seagrass, in a tire, and in a dissolution hole in shallow bedrock.

A conspicuous change in habitat occurs about 4–5 months post-settlement when Nassau grouper move from nearshore macroalgae habitat to adjacent patch reefs located within either seagrass or hardbottom areas, between the nearshore environment and the offshore reefs. In the Bahamas, early juvenile Nassau grouper (12–15 cm TL) exhibited an ontogenetic movement from macroalgal clumps to patch reef habitats in the late summer and early fall after settlement in the winter as demonstrated by a significant decrease in juvenile density within the macroalgal habitat and concomitant increase in the seagrass meadows (Eggleston, 1995). Similarly in the Turks and Caicos, 87 percent of early juvenile Nassau grouper (identified as less than 12 cm TL, n=181) were found in seagrass and 10 percent were found in rock or rubble habitat (Claydon and Kroetz, 2008). Within the Turks and Caicos seagrass habitat, 44 percent of the early juveniles were found in discarded conch shells and 33 percent were found along blowout ledges (Claydon and Kroetz, 2008). Individuals were rarely seen in open areas; instead they were usually seen in close proximity to a structure or sheltering within structure (*i.e.*, discarded conch shell or blowout ledge). Density of Nassau grouper (>12 cm TL) was found to increase when discarded conch shells were placed in seagrass habitat (Claydon *et al.*, 2009), perhaps due to reduced mortality as the structure limited access of larger predators (Claydon *et al*,. 2010). On shallow constructed block reefs off the coast of the USVI, newly settled and early juveniles (3–8 cm TL) occupied small separate burrows beneath the reef while larger juveniles occupied holes in the reefs (Beets and Hixon, 1994).

Juvenile fish are vulnerable to predation (large fish, eels, other groupers and sharks) and utilize refuges to protect themselves (Beets and Hixon, 1994; Eggleston 1995; Claydon and Kroetz, 2008) and to forage for crustaceans using ambush predation techniques (Eggleston *et al.*, 1998; Claydon and Kroetz, 2008). Juveniles often associate with refuges proportional to their body size (Beets and Hixon, 1994) and seek new shelter as they grow (Eggleston, 1995). Suitable refuges provide some protection from predation; however, juveniles may leave their refuges to forage for food and during ontogenetic shifts in habitat (Eggleston, 1995).

Late Juveniles (~15 – 35; 30 – 50cm TL). Camp *et al.* (2013) conducted a broad-scale survey in the shallow nearshore lagoons of Little Cayman and found Nassau grouper (12–26 cm TL) on hardbottom areas more frequently than other more available habitats (sand, seagrass and algae). Eighty-two percent of juvenile Nassau grouper (18.4 ± 3.4 cm TL, n=142) were found at depths from 1.0–2.3 m in hardbottom habitat that provided crevices, holes, ledges and other shelter, with 10–66 percent of the holes with grouper also containing one or more cleaning organisms (*i.e.*, banded coral shrimp; *Elacatinus* gobies; or bluehead wrasse, *Thalasoma bifasciatum*). A small percentage of Nassau grouper (3 percent) were found in other habitat sheltered in holes (*i.e.*, concrete blocks or conch shells). Overall, the vast

majority of juvenile Nassau grouper were associated with some form of shelter, suggesting that shelter represents a primary determinant of microhabitat use (Camp *et al.*, 2013).

As late juveniles, Nassau grouper may occupy seagrass habitats for food and protection from predators (Claydon and Kroetz, 2008); they forage for crustaceans in seagrass beds (Eggleston *et al.*, 1998). In a survey of seagrass bays in waters off of the USVI, Green (2017) found that juvenile Nassau grouper (n=46, 6–30 cm TL) were more abundant in areas with taller canopy and less dense native seagrasses compared to higher density of the same seagrasses and low canopy height. Differences in abundance were attributed to the taller canopy providing better cover from predators (Beets and Hixon, 1994). Tall seagrass also increases hiding places for their prey (Eggleston, 1995), and the less dense seagrass habitats permit better movement by Nassau grouper to forage (Green, 2017).

Juvenile Nassau grouper also rely on hardbottom structure for refuge from predation and ambush of potential prey. Nassau grouper residing on patch reefs use short bursts of speed that allow them to ambush crabs located up to 7 m away from a patch reef and return to a reef within 5 seconds (D. Eggleston pers. comm. as cited in Eggleston *et al.*, 1999). Suitable refuges provide cover for juvenile Nassau grouper with crevices, holes, and ledges proportionate to their body size (Beets and Hixon, 1994).

As juveniles grow, they move progressively to deeper banks and offshore reefs (Tucker *et al.*, 1993; Colin *et al.* 1997). In Bermuda, Bardach (1958) noted that few small Nassau grouper (less than 4 inches or 10 cm TL) were found on outer reefs, and few mature fish were found on inshore reefs. The weights of mature individuals trapped in deep areas were about double that of Nassau grouper captured in the shallow areas. While there can be an overlap of adults and juveniles in hardbottom habitat areas, size segregation generally occurs by depth, with smaller fish typically occurring in shallow inshore waters (3 to 17 m), and larger individuals more commonly occurring on deeper (18 to 55 m), offshore banks (Bardach *et al.*, 1958; Cervigón, 1966; Silva Lee, 1974; Radakov *et al.*, 1975; Thompson and Munro, 1978).

Adults

Both male and female Nassau grouper typically mature between 40 and 45 cm SL (44 and 50 cm TL), with most individuals attaining sexual maturity by about 50 cm SL (55 cm TL) and about 4–5 years of age (see Table 1 and additional details in Hill and Sadovy de Mitchenson, 2013) and with most fish spawning by age 7+ years (Bush *et al.*, 2006).

Adults are found near shallow, high-relief coral reefs and rocky bottoms to a depth of at least 90 m (Bannerot, 1984; Heemstra and Randall, 1993). Reports from fishing activities in the Leeward Islands show that although Nassau grouper were fished to 130 m, the greatest trap catches were from 52–60 m (Brownell and Rainey, 1971). In Venezuela, Nassau grouper were cited as common to 40 m in the Archipelago Los Roques (Cervigón, 1966). Nassau groupers tagged with depth sensors in Belize exhibited marked changes in depth at specific times throughout the year: 15–34 m from May through December, followed by movement to very deep areas averaging 72 m with a maximum of 255 m for a few months during spawning periods, then returning to depths of about 20 m in April (Starr *et al.*, 2007).

Adults lead solitary lives outside of spawning periods and tend to be secretive, often seeking shelter in reef crevices, ledges, and caves; rarely venturing far from cover (Bardach, 1958; Starck and Davis, 1966; Bohlke and Chaplin, 1968; Smith, 1961, 1971; Carter, 1988, 1989). Although they tend to be solitary, individuals will crowd peacefully in caves or fish traps with some proclivity to re-enter fish traps resulting in multiple recaptures (Randall, 1962; Sadovy and Eklund, 1999; Bolden, 2001). Nassau grouper have the ability to home (Bardach *et al.*, 1958; Bolden, 2000) and remain within a highly circumscribed area for

extended periods (Randall, 1962 1963; Carter *et al.*, 1994; Bolden, 2001). In the Florida Keys, adult Nassau grouper (n=12) were found more often in high- and moderate-relief habitats compared to low-relief reefs (Sluka *et al.*, 1998). Habitat complexity has been found to influence home range size of adult Nassau grouper, with larger home ranges at less structurally-complex reefs (Bolden, 2001). Nassau grouper are diurnal or crepuscular in their movements (Collette and Talbot, 1972). Bolden (2001) investigated diel activity patterns via continuous acoustic telemetry and found Nassau groupers are more active diurnally and less active nocturnally, with activity peaks at 1000 and 2000 hours.

Importance of shelter

For many reef fishes, access to multiple, quality habitats and microhabitats represents a critical factor determining settlement rates, post-settlement abundances, mortality rates, and growth rates, because suitably sized refuges provide protection from predators and access to appropriate food (Shulman, 1984; Hixon and Beets, 1989; Eggleston *et al.*, 1997, 1998; Grover *et al.*, 1998; Lindeman *et al*., 2000; Dahlgren and Eggleston, 2000, 2001; Dahlgren and Marr, 2004; Eggleston *et al.*, 2004). Many reef fish and invertebrates use hardbottom areas located between the nearshore environment and the outer reefs as juveniles.

As Nassau grouper move from their nearshore settlement habitat, through hardbottom and seagrass mosaic habitats, to the offshore reefs they occupy as adults, shelter provides an essential life history function by reducing risk of predation and promoting successful ambush hunting. Availability of suitably sized shelters may be a key factor limiting successful settlement and survival for juvenile Nassau grouper and related species that settle and recruit to shallow, off-reef habitats (Hixon and Beets, 1989; Eggleston, 1995; Lindeman *et al.*, 2000; Dahlgren and Eggleston, 2001). In addition, shelters of different sizes may govern the timing and success of ontogenetic movements to adult habitats (Caddy, 1986; Moran and Reaka, 1988; Eggleston, 1995). Camp *et al*. (2013) found juvenile Nassau grouper use shelters of varying sizes and degrees of complexity. Suitably-sized refuge from predators is expected to be a key characteristic supporting the survival and growth of juvenile Nassau grouper and other species, with access to food resources likely representing another key, and sometimes opposing, characteristic (Shulman, 1984; Hixon and Beets, 1989; Eggleston *et al.*, 1997, 1998; Grover *et al.*, 1998; Dahlgren and Eggleston, 2001). The transition to these new habitats, however, heightens predation risk if habitats are far apart (Sogard, 1997; Tupper and Boutilier, 1997; Almany and Webster, 2006) and there is minimal cover between them (Dahlgren and Eggleston, 2000; Caddy, 2008). Nassau grouper rely on shelter to safely move between these interconnected habitats. Benthic juvenile fish rely on complex structure to protect themselves from predation and the simplification of habitats can lead to declines in recruitment (Caddy, 2008). Stock replenishment is threatened by degradation of the habitats of successive life stages. Nassau grouper must often risk predation by crossing seascapes where cover connectivity is limited. Loss of cover therefore increases mortality, reduces foraging success, and affects other life-history activities.

Diet

In the planktonic stage, the yolk and oil in the egg sac nourish the early yolk-sac larva as it develops prior to hatching. The pelagic larvae begin feeding on zooplankton approximately 2–4 days after hatching when a small mouth develops (Tucker and Woodward, 1994). In the laboratory, grouper larvae eat small rotifers, copepods, and other zooplankton, including brine shrimp (Tucker and Woodward, 1994). Diet information for newly settled Nassau grouper is based on visual observations indicating that young fish (20.2–27.2 mm SL) feed on a variety of plankton, including pteropods, ostracods, amphipods, and copepods (Greenwood, 1991; Grover *et al.*, 1998). Similarly, in the Bahamas, recently settled and post-settlement stage (25–35 mm TL) Nassau grouper living within the macroalgae and seagrass blades have

a primarily invertebrate diet of xanthid crabs, hippolytid shrimp, bivalves, and gastropods (Eggleston, 1995).

More detailed diet information is available for juveniles and adults. Stomach contents of juvenile Nassau grouper (5–19 cm TL) collected from seagrass beds near Panama contained primarily porcellanid and xanthid crabs with minor amounts of fish (Heck and Weinstein, 1989). Four dominant prey were ingested by small (< 20 cm TL) Nassau grouper in the Bahamas: stomatopods, palaemonid shrimp, and spider and portunid crabs (Eggleston et al., 1998). Fish and spider crabs made up the bulk of the diet for both mid-size (20.0–29.9 cm TL) and large (>30 cm TL) Nassau grouper in opposite proportion: spider crabs dominated the diet of the mid-size fish, while fish were the most important prey for large Nassau grouper (Eggleston *et al*., 1998). Juveniles generally engulfed their prey whole (Eggleston *et al.* 1998). Smaller juveniles ate greater numbers of prey than larger grouper, but the individual prey items ingested by larger grouper weighed more (Eggleston *et al*., 1998). Similar ontogenetic changes in the Nassau grouper diet were reported by Randall (1965) and Eggleston *et al.* (1998) who analyzed stomach contents and determined that juveniles fed mostly on crustaceans, while adults foraged mainly on fishes.

As adults, Nassau grouper are unspecialized-ambush-suction predators (Randall, 1965; Thompson and Munro, 1978) that lie under shelter, wait for prey, and then quickly expand their gill covers to create a current to engulf prey by suction (Thompson and Munro, 1978; Carter, 1986) and swallow their prey whole (Werner, 1974, 1977). Numerous studies describe adult Nassau groupers as piscivores, with their diet dominated by reef fishes: parrotfish (Scaridae), wrasses (Labridae), damselfishes (Pomacentridae), squirrelfishes (Holocentridae), snappers (Lutjanidae), groupers (Epinephelidae) and grunts (Haemulidae) (Randall and Brock, 1960; Randall, 1965, 1967; Parrish, 1987; Carter *et al*, 1994; Eggleston *et al*., 1998). The propensity for adult Nassau grouper to consume primarily fish (Randall, 1965; Eggleston *et al*., 1998) may be due to increased visual perception and swimming-burst speed with increasing body size (*e.g.*, Kao *et al*., 1985; Ryer, 1988). Large Nassau grouper are probably foraging on reef-fish prey that are either associated with a reef (Eggleston *et al.*, 1997) or adjacent seagrass meadows. In general, groupers have been characterized from gut content studies as generalist opportunistic carnivores that forage throughout the day (Randall, 1965, 1967; Goldman and Talbot, 1976; Parrish, 1987), and perhaps being more active near dawn and dusk (Parrish, 1987; Carter *et al*., 1994). Comparison of Nassau grouper stomach contents from natural and artificial reefs were found to be generally similar (Eggleston *et al*., 1999). While Smith and Tyler (1972) classified Nassau grouper as nocturnally active residents, Randall (1967) investigated Nassau grouper gut contents and determined that although feeding can take place around the clock, most fresh food is found in stomachs collected in the early morning and at dusk. Silva Lee (1974) reported Nassau grouper with empty stomachs throughout daylight hours.

Spawning

The most recognized Nassau grouper habitats are the sites where adult males and females assemble briefly at predictable times during winter full moons for the sole purpose of reproduction. These spawning aggregation sites are occupied by Nassau grouper during winter full moon periods, from about November and extending to May (USVI) (Nemeth *et al.*, 2006). Aggregations consist of hundreds, thousands, or, historically, tens of thousands of individuals. Some aggregations have consistently formed at the same locations for 90 years or more (see references in Hill and Sadovy de Mitcheson 2013). All known reproductive activity for Nassau grouper occurs in aggregations; pair spawning has not been observed. About 50 spawning aggregation sites have been recorded, mostly from insular areas in the Bahamas, Belize, Bermuda, British Virgin Islands, Cayman Islands, Cuba, Honduras, Jamaica, Mexico, Puerto Rico, Turks and Caicos, and the USVI; however, Nassau grouper may no longer form spawning aggregations at many of these sites (Figure 10 in Hill and Sadovy de Mitcheson, 2013). While both the

size and number of spawning aggregations has diminished, spawning is still occurring in some locations (NMFS, 2013).

Spawning aggregation sites typically occur near the edge of insular platforms in a wide (6–50 m) depth range, as close as 350 m to the shore, and close to a drop-off into deep water. These sites are characteristically small, highly circumscribed areas, measuring several hundred meters in diameter, with a diversity of bottom types, including soft corals, sponges, stony coral outcrops, and sandy depressions (Craig, 1966; Smith 1990; Beets and Friedlander, 1992; Colin, 1992; Aguilar-Perera, 1994). Adults are known to travel hundreds of kilometers (Bolden, 2000) to gather at specific spawning aggregation sites. While aggregated, the Nassau grouper are extremely vulnerable to overfishing (Sadovy de Mitcheson *et al.*, 2008).

It is not known how Nassau grouper select and locate aggregation sites or why they aggregate to spawn. Variables that are considered to influence spawning site suitability include geomorphological characteristics of the seabed, hydrodynamics including current speed and prevailing direction of flow to disperse eggs and larvae, seawater temperature, and proximity to suitable benthic habitats for settlement (Kobara and Heyman, 2008). The link between spawning sites and settlement sites is not well understood. The geomorphology of spawning sites has led researchers to assume that offshore transport was a desirable property of selected sites. However, currents in the vicinity of aggregation sites do not necessarily favor offshore egg transport, leaving open the possibility that some stocks are at least partially self-recruiting. Additional research is needed to understand these spatial dynamics.

The biological cues known to be associated with Nassau grouper spawning include photoperiod (*i.e.*, length of day), water temperature, and lunar phase (Colin, 1992). The timing and synchronization of spawning may be to accommodate immigration of widely dispersed adults, facilitate egg dispersal, or reduce predation on adults or eggs.

Movement

"Spawning runs," or movements of adult Nassau grouper from coral reefs to spawning aggregation sites, were first described in Cuba in 1884 by Vilaro Diaz, and later by Guitart-Manday and Juarez-Fernandez (1966). Nassau grouper migrate to aggregation sites in groups numbering between 25 and 500, moving parallel to the coast or along shelf edges or inshore reefs (Colin, 1992; Carter *et al.*, 1994; Aguilar-Perera and Aguilar-Davila, 1996; Nemeth *et al.*, 2009). Distance traveled by Nassau grouper to aggregation sites is highly variable; some fish move only a few kilometers, while others move up to several hundred kilometers (Colin, 1992; Carter *et al.*, 1994; Bolden, 2000). Observations suggest that individuals may return to their original home reef following spawning (Semmens *et al.*, 2007).

Larger fish are more likely to return to aggregation sites and spawn in successive months than smaller fish (Semmens *et al.*, 2007). Nassau grouper have been shown to have high site fidelity to an aggregation site, with 80 percent of tagged Nassau grouper returning to the same aggregation site, Bajo de Sico, each year over the 2014–2016 tracking period off the coast of Puerto Rico (Tuohy *et al.*, 2016). The area occupied during spawning by Nassau grouper is smaller at Bajo de Sico compared to Grammanik Bank off St. Thomas. Acoustic detections of tagged Nassau grouper revealed a southwesterly movement from the Puerto Rican shelf to the Bajo de Sico in a narrow corridor (Tuohy *et al.*, 2017).

Activity/Behavior

Spawning occurs for up to 1.5 hours around sunset for several days (Whaylen *et al.*, 2007). All spawning events have been recorded within 20 minutes of sunset, with most within 10 minutes of sunset (Colin, 1992). At spawning aggregation sites, Nassau grouper tend to mill around for a day or two in a "staging

area" adjacent to the core area where spawning activity later occurs (Colin, 1992; Kadison *et al.*, 2010; Nemeth, 2012). Courtship is indicated by two behaviors that occur late in the afternoon: "following" and "circling" (Colin, 1992). The aggregation then moves into deeper water shortly before spawning (Colin, 1992; Tucker *et al.*, 1993; Carter *et al.*, 1994). Progression from courtship to spawning may depend on aggregation size, but generally fish move up in the water column, with an increasing number of the fish exhibiting the bicolor phase (i.e. when spawning animals change to solid dark and white colors, temporarily losing their characteristic stripes) (Colin, 1992; Carter *et al.*, 1994). Following the release of sperm and eggs, there is a rapid return of the spawning individuals to the bottom.

Repeated spawning occurs at the same site for up to three consecutive months generally around the full moon or between the full and new moons (Smith, 1971; Colin, 1992; Tucker *et al.*, 1993; Aguilar-Perera, 1994; Carter *et al.*, 1994; Tucker and Woodward, 1994). Examination of female reproductive tissue suggests multiple spawning events across several days at a single aggregation (Smith, 1972). A video recording shows a single female in repeated spawning rushes during a single night, repeatedly releasing eggs (Colin, 1992).

Spawning Aggregations in U.S. Waters

The best available information suggests that spawning in U.S. waters occurs at three sites: Bajo de Sico in waters off the coast of Puerto Rico (Scharer et al., 2012), Grammanik Bank in waters off the coast of the USVI (Nemeth et al., 2006), and Riley's Hump within the Tortugas South Ecological Reserve off the coast of Florida (Locascio and Burton 2015; J. McCawley, Pers. comm., December 9, 2022). These three sites are all at least partially protected under existing fishery regulations, as discussed below. For all three sites, it is unclear whether they are reconstituted (i.e., reestablished after depletion) or novel spawning sites. Nassau grouper spawning has been positively confirmed at Bajo de Sico (Scharer et al. 2012; Scharer et al. 2017; Tuohy et al. 2017) and Grammanik Bank (Nemeth et al. 2006; Nemeth et al. 2009; Nemeth et al. 2023). At Riley's Hump, visual and acoustic evidence suggests that spawning is occurring there (Locascio and Burton 2015; J. McCawley, Pers. comm., December 9, 2022). A spawning aggregation site historically existed on the eastern tip of Lang Bank, USVI that was extirpated in the early 1980s; however, we have insufficient information regarding its continued existence or its current value to Nassau grouper spawning.

Bajo de Sico, Puerto Rico

Bajo de Sico, in waters off the coast of Puerto Rico is a submerged offshore seamount located in the Mona Passage off the insular platform of western Puerto Rico approximately 29 km west of Mayaguez (Scharer-Umpierre *et al.*, 2014). Reef bathymetry is characterized by a ridge of highly rugose rock promontories ranging in depths from 25 to 45 m, which rise from a mostly flat, gradually sloping shelf that extends to 100 m deep. Below this depth, the shelf ends in a vertical wall that reaches depths of 200–300 m to the southeast and over 1,000 m to the north (Tuohy *et al.*, 2015). Most of the shallow (<180 m depth) areas of this 11 km^2 seamount are located in the U.S. exclusive economic zone (EEZ). Bajo de Sico is considered a mesophotic coral ecosystem due to the range of depths and coral/algae development. Where water depths are less than 50 m, this area is characterized by a reef top, vertical reef wall and rock promontories, colonized hardbottom with sand channels, uncolonized gravel, and substantial areas of rhodolith reef habitat (Garcia-Sais *et al.*, 2007).

In 1996, NMFS approved a 3-month seasonal fishing closure (December 1 through February 28) in Federal waters at Bajo de Sico to protect spawning aggregations of red hind (61 FR 64485, December 5, 1996); the closure also partially protects Nassau grouper spawning aggregations (Scharer *et al.*, 2012). During the closure period, all fishing was prohibited (61 FR 64485). A later rule prohibited the use of

bottom-tending gear, including traps, pots, gillnets, trammel nets, and bottom longlines, in Bajo de Sico year-round (70 FR 62073, October 28, 2005). In 2010, NMFS approved a modification to the Bajo de Sico seasonal closure, extending the closure period to 6-months (October 1 through March 31), altering the restriction to prohibit fishing for and possessing Caribbean reef fish in or from Federal waters at Bajo de Sico during the closure period, and prohibiting anchoring by fishing vessels year-round in the area (75 FR 67247, November 2, 2010). The 2010 rule is still in place.

In February 2012, a Nassau grouper spawning aggregation was identified at Bajo de Sico when at least 60 individuals were observed via video and audio recordings exhibiting reproductive behaviors (Scharer *et al.*, 2012). While actual spawning was not observed on the 2012 video recordings, all four Nassau grouper spawning coloration patterns and phases (Smith, 1972; Colin, 1992; Archer *et al*., 2012) were observed, including the bi-color phase associated with peak spawning activity (Scharer *et al.*, 2012). Subsequent diver surveys conducted from January 25 to April 5, 2016, indicated between 5–107 individuals at the site, with the greatest number occurring in February (Scharer *et al.*, 2017). The highest detection rate of tagged Nassau grouper (n=29) occurred in February and March, with other detections in January and April, all peaking following the full moon (Scharer *et al.*, 2017). The depth range (40 to 155 m) being used by Nassau grouper at the Bajo de Sico exceeds other locations (Scharer *et al.*, 2017).

Grammanik Bank, U.S. Virgin Islands

Grammanik Bank, USVI is located approximately 4 km east of the Hind Bank Marine Conservation District (MCD), on the southern edge of the Puerto Rican Shelf. Grammanik Bank is a narrow deep coral reef bank (35–40 m) about 1.69 km long and 100 m wide at the widest point located on the shelf edge about 14 miles south of St. Thomas. It is bordered to the north by extensive mesophotic reef and to the south by a steep drop-off and a deep *Agaricea* reef at 200–220 ft (60–70 m) (Nemeth *et al*., 2006; Scharer *et al*., 2012). The benthic habitat is primarily composed of a mesophotic reef at depths between 30–60 m, which includes a combination of *Montastrea and Orbicella* coral and hardbottom interspersed with gorgonians and sponges (Smith *et al*., 2008). Corals are present on Grammanik Bank at depths between 35 and 40 m and the coral bank is bordered to the east and west by shallower (25 to 30 m) hardbottom ridges along the shelf edge, which is sparsely colonized by corals, gorgonians, and sponges (Nemeth *et al*., 2006). When Hind Bank MCD was established in 1999 as the first no-take fishery reserve in waters of the USVI to protect coral reef resources, reef fish stocks, including red hind (*E. guttatus*), and their habitats (64 FR 60132, November 4, 1999), fishing pressure is thought to have moved to the adjacent Grammanik Bank (Nemeth *et al*., 2006). Fishing is prohibited for all species at Hind Bank MCD year-round. At Grammanik Bank, all fishing is prohibited, with an exception for highly migratory species, from February 1 to April 30 of each year. The initial intent of the spatial closure was to protect yellowfin grouper (*Mycteroperca venenosa*) when they aggregate to spawn (70 FR 62073, October 28, 2005; Scharer *et al.*, 2012), but this closure has also proven beneficial for the protection of spawning aggregations of tiger grouper (*M. venenosa*), yellowmouth grouper (*M.interstitialis*), cubera snapper (*Lutjanus cyanopterus*) and Nassau grouper (Nemeth et al. 2006).

Approximately 100 Nassau grouper were observed aggregating at the Grammanik Bank in 2004 between January and March (Nemeth *et al.*, 2006). This discovery marked the first documented appearance of a Nassau grouper spawning aggregation site within U.S. waters since the mid-1970s (Kadison *et al.*, 2009); however, commercial fishers were quick to target this new aggregation site and began to harvest both yellowfin (*Mycteroperca venenosa*) and Nassau groupers (Nemeth *et al.*, 2006). In 2005, NMFS approved a measure developed by the Caribbean Fisheries Management Council (70 FR 62073, October 10, 2005) that closed the Grammanik Bank to fishing for all species, with an exception for highly migratory species, from February 1 through April 30 each year. Diver surveys and collection of fish in traps recorded 668 Nassau grouper at Grammanik Bank between 2004 and 2009 (Kadison *et al.*, 2010). The fish were of

reproductive size and condition and arrived on and around the full moon in February, March, and April and then departed 10 to 12 days after the full moon. The number of Nassau grouper observed in diver visual surveys suggests that Nassau grouper spawning biomass has increased at the aggregation site from a maximum abundance of 30 individuals sighted per day in 2005, to 100 per day in 2009 (Kadison *et al.*, 2009). By 2013, a maximum abundance of 214 individuals was recorded per day (Scharer-Umpierre *et al.*, 2014). Since then the maximum number of Nassau grouper counted per day during spawning periods has continued to increase, reaching over 500 in 2020, 750 in February 2021, and at least 800 in January 2022 (R. S. Nemeth, unpublished data).

The behavior of Nassau grouper in the aggregation has also changed dramatically in the past few years. From 2004 to 2019, Nassau grouper were found aggregating in small groups of 10, 20, or maybe as high as 40 individuals, resting close to the bottom among the coral heads. Nassau grouper were also observed to swim down the slope to 60 to 80 m, presumably to spawn, to an extensive *Agaricia larmarki* reef that Nassau grouper also use for shelter (R. S. Nemeth, unpublished data). These deep movements were later verified with acoustic telemetry data, and Nassau grouper were suspected of spawning near this deep reef area. Since 2020, Nassau grouper have been observed in groups of 100 to 300 fish aggregated 5 to 10 m above the bottom. On January 24, 2022 (7 days after full moon), researchers captured the first ever observation of Nassau grouper spawning at the Grammanik Bank at 17:40 and a second spawning rush at 18:10 (R.S. Nemeth, pers. comm., February 13, 2022). Spawning occurred well above the bottom in 30 to 40 m depth. Vocalization by Nassau grouper has suggested that abundance and spawning of Nassau grouper peaked at Grammanik Bank after the full moons in January through May (Rowell *et al.*, 2013).

Nemeth *et al.* (2009) first reported synchronous movement of Nassau grouper during the spawning period between Hind Bank MCD and Grammanik Bank using acoustic telemetry. Both Nassau and yellowfin groupers primarily used two of three deep (50 m) parallel linear reefs that link Grammanik Bank with the Hind Bank MCD and lie in an east-west orientation parallel to the shelf edge. The linear reef about 300 to 500 m north of the shelf edge was used mostly by Nassau grouper. Acoustic telemetry and bioacoustic recordings were later integrated by Rowell *et al.* (2015) to identify a synchronized pathway taken by pre- and post -spawning Nassau grouper to the Grammanik Bank spawning site from the nearby Hind Bank MCD. While not every Nassau grouper was found to use this spawning route, the majority (64 percent) of the tagged fish followed this specific route on a regular or often daily basis during the week when spawning was occurring at Grammanik Bank. Because 56 percent of the tagged Nassau grouper (n=10) traversed between Hind Bank MCD and Grammanik Bank during spawning, it was suggested by Nemeth *et al.* (2009) and by Nemeth *et al.* (2023), that the boundary of the Grammanik Bank fishing closure area be expanded to the south, north, and west to protect the moving fish.

It remains unknown whether the increasing abundance at the Nassau grouper aggregation at Grammanik Bank is a result of: (1) Remnant adults from the nearby overfished aggregation site (the historical Grouper Bank, now located within the Hind Bank Marine Conservation District) shifting spawning locations to the Grammanik Bank, a distance of about 5 km; (2) Larvae dispersed from distant spawning aggregations elsewhere in the Eastern Caribbean that have settled on the St. Thomas/St. John shelf, matured, and migrated to the Grammanik Bank spawning site; (3) Self-recruitment by local reproduction from the remnant population. Each of these recovery scenarios is supported by various researchers who have observed these same phenomena in separate locations. Scenario (1) is supported by Heppel *et al.* (2013), who found that Nassau grouper visit multiple aggregation sites during the spawning season, yet all fish aggregate and spawn at a single location. Scenario (2) is supported by Jackson *et al.* (2014), who found strong genetic mixing of Nassau grouper populations among Lesser and Greater Antilles, including Turks and Caicos. Bernard *et al.* (2015) also found that external recruitment is

an important driver of the Grammanik Bank spawning aggregation recovery. Scenario (3) relies on self-recruitment, a popular strategy of recruitment among marine species.

Riley's Hump, Florida

Riley's Hump, Florida is located approximately 16 km to the southwest of the Dry Tortugas National Park, and is within the boundaries of the Tortugas South Ecological Reserve. The larger area of the Dry Tortugas, which encompass the Dry Tortugas National Park, the Tortugas Bank, the Tortugas South Ecological Reserve, and the Tortugas North Ecological Reserve, represent a series of carbonate banks and sand shoals located southwest of the Florida continental margin. Riley's Hump is one of these carbonate banks, separated from the Tortugas Bank to the north by a deep trough, which is filled with thick sedimentary deposits. The bank crests at about 30 m, and has a 20 m escarpment at the shelf break on the south side of the bank (Mallinson *et al*., 2003). While coral cover on Riley's Hump is relatively low, fish diversity is high and is characterized by species that are rare in other locations (Dahlgreen *et al*., 2001).

Riley's Hump is located within the boundaries of the Tortugas South Ecological Reserve, which has been closed to fishing since 2001, when both the North and South Ecological Reserves were established, adjacent to the Dry Tortugas National Park. The Tortugas South Ecological Reserve hosts several known annual spawning aggregations, including aggregations of mutton snapper, and likely black grouper, red grouper, red hind, and Nassau grouper (Locascio and Burton, 2015). The location and depth of Riley's Hump make it particularly difficult to conduct annual monitoring projects. However, visual surveys have documented higher densities of Nassau groupers at Riley's Hump than anywhere in Florida state waters, and are estimated at roughly 1 adult per 0.04 acres (D. Morley, Pers. comm., September 6, 2023). Some observations have included individuals displaying colorations and producing sounds associated with spawning (Locascio and Burton, 2015, J. Locascio, Pers. comm., September 6, 2023).

The mechanism behind the spawning aggregation at Riley's Hump remains unclear. The southern Florida reef tract is near the northern extent of the range of Nassau grouper, and the species is extremely rare in this location. However, historical accounts suggest that the species was once more common in the area; this aggregation could be a remnant of a depleted historical aggregation, or a new aggregation that is being formed by individuals which have settled and matured in the area.

Lang Bank, St. Croix U. S. Virgin Islands

A historical Nassau grouper spawning aggregation site occurred on the eastern tip of Lang Bank but was extirpated in the early 1980's (Beets and Friedlander 1992). Exploratory fishing with a commercial fisher was conducted and 7 adult Nassau grouper were caught. Subsequent diver surveys have observed small groups of Nassau (<10) aggregating during spawning season. In 2016, a Nassau grouper was tagged with an acoustic transmitter in Teague Bay reef, St. Croix. This fish eventually migrated to the tip of Lang Bank where the historical Nassau spawning aggregation had occurred or where Nassau have been observed in recent years (R. Nemeth, Pers. Comm., May 14, 2022).

3 Critical Habitat Identification and Designation

Critical habitat is defined by Section 3 of the ESA (and further by 50 CFR 424.02(d)) as ‘‘(i) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the

provisions of Section 4 of this Act, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of Section 4 of this Act, upon a determination by the Secretary that such areas are essential for the conservation of the species.''[1]

[1] Section 3 of the ESA (16 U.S.C. 1532(3)) defines the terms "conserve," "conserving," and "conservation" to mean: "to use, and the use of, all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this chapter are no longer necessary."

4 Geographical Areas Occupied by the Species

The phrase "geographical areas occupied by the species," which appears in the statutory definition of critical habitat (16 U.S.C. 1532(5)(A)(i)), is defined by regulation as "an area that may generally be delineated around species' occurrences, as determined by the Secretary (*i.e.*, range). Such areas may include those areas used throughout all or part of the species' life cycle, even if not used on a regular basis (*e.g.*, migratory corridors, seasonal habitats, and habitats used periodically, but not solely by vagrant individuals) (50 CFR 424.02).

Nassau grouper are found in tropical and subtropical waters of the western North Atlantic. The 2016 listing rule identified the distribution or range of the Nassau grouper as "Bermuda and Florida (USA), throughout the Bahamas and Caribbean Sea" (81 FR 42268, 42271; June 29, 2016) based on existing literature (*e.g.*, Heemstra and Randall, 1993). They generally live among shallow reefs, but can be found in depths to 130 m (426 feet). Many earlier reports of Nassau grouper up the Atlantic coast of Florida to North Carolina have not been confirmed (Hill and Sadovy de Mitcheson, 2013).

We investigated the distribution of Nassau grouper in the Gulf of Mexico. As summarized in the 2016 listing rule, Nassau grouper is generally replaced ecologically in the eastern Gulf of Mexico, in areas north of Key West or the Tortugas, by red grouper (*E. morio*) (Smith, 1971). Nassau grouper are considered a rare or transient species off Texas in the northwestern Gulf of Mexico (Gunter and Knapp, 1951 in Hoese and Moore, 1998). The only confirmed sighting of Nassau grouper in the Flower Garden Banks National Marine Sanctuary (FGBNMS), which is located in the northwest Gulf of Mexico approximately 180 km southeast of Galveston, Texas, was reported by Foley *et al.* (2007). Since then, no additional Nassau grouper have been reported in the FGBNMS despite an extensive survey by remote operated vehicles (E. Hickerson, FGBNMS, personal communication, 2021). There are two records (1996 and 2006) of Nassau grouper in the Gulf of Mexico from the NMFS Southeast Area Monitoring and Assessment Program (SEAMAP) reef fish video (RFV) survey. This RFV survey of hardbottom habitats in the Gulf of Mexico has been conducted annually since 1992 (with the exception of 1998 – 2000 and 2020) at approximately 300 sites and targets snappers and groupers at mesophotic reefs out to the 200 m depth contour between the Florida Keys and Texas. Both sightings were presumed adult Nassau grouper and both occurred off the Florida west coast: one off the panhandle and one west of the Dry Tortugas (K. Rademacher, NMFS, personal communication, 2021). We conclude from the paucity of these reports that the Nassau grouper does not regularly occur in the United States portion of the Gulf of Mexico.

The range of the Nassau grouper spans the wider Caribbean, and specifically the east coast of Florida including the Florida Keys, Puerto Rico, and USVI in the United States (Hill and Sadovy de Mitcheson, 2013). Because we cannot designate critical habitat areas outside of U.S. jurisdiction (50 CFR 424.12(g)), the geographical area under consideration for this designation is limited to areas under the jurisdiction of the United States.

5 Physical or Biological Features Essential for Conservation

Within the geographical area occupied by the species, critical habitat consists of specific areas on which are found physical or biological features essential to the conservation of the species and which may require special management considerations or protection (16 U.S.C. 1532(3)). Features essential to the conservation of the species are defined as features that are essential to support the life-history needs of the species, including but not limited to, water characteristics, soil type, geological features, sites, prey, vegetation, symbiotic species, or other features. A feature may be a single habitat characteristic, or a more complex combination of habitat characteristics. Features may include habitat characteristics that support ephemeral or dynamic habitat conditions. Features may also be expressed in terms relating to principles of conservation biology, such as patch size, distribution distances, and connectivity (50 CFR 424.02).

To assess habitat features that are "essential to the conservation" of Nassau grouper, we considered the physical and biological features that are essential to support the life history needs and are essential to the conservation of Nassau grouper within the areas they occupy within U.S. waters. As noted previously, section 3 of the ESA defines the terms "conserve," "conserving," and "conservation" to mean: "to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary" (16 U.S.C. 1532(3)).

Because the reduction in the number of Nassau grouper through historical harvest and fishing at spawning aggregations was a major factor in the listing determination (81 FR 42286, June 26, 2016), Nassau grouper conservation necessitates increasing the number of individuals, particularly the spawning population. Therefore, we have identified physical and biological features that support reproduction, recruitment, and growth as essential to the species' conservation. For the Nassau grouper, critical habitat includes physical and biological features to support adult reproduction at the spawning aggregations, and settlement of larvae, and subsequent growth to maturity. These features are essential to the conservation of the species because long-term population recovery relies on successful recruitment and the existence of individuals across a broad size range. Nassau grouper populations are dependent on settlement of pelagic larvae to coastal locations and rely on a contiguous reef system to accommodate ontogenetic habitat shifts from inshore locations to nearshore patch reefs and hardbottom areas and subsequent movement into offshore reef habitats as the individuals mature. Both natural and artificial reefs are used. While in nursery habitats, juvenile grouper associate with a variety of microhabitats, including macroalgae, seagrass, empty conch shells, coral patches, sponges, rubble mounds produced by sand tilefish (*Malcanthus plumieri*) (Bloch, 1786), artificial structures, and debris (Eggleston, 1995; Colin *et al*., 1997; Eggleston *et al*., 1998; Aguilar-Perera *et al*., 2006; Claydon and Kroetz, 2008; Claydon *et al*., 2009, 2011). Nassau grouper conservation requires habitat to support ontogenetic growth from larval settlement in the nearshore to maturity, with appropriate inter-habitat connectivity to support ontogenetic movement from nearshore habitat used for larval settlement, to intermediate areas used by juveniles, and finally to offshore areas used by adults. Observations at documented spawning sites indicate that spawning aggregation sites are typically located near the edge of an insular platform, often in areas that are close to shore, yet also close to a deep-water drop-off. These sites are generally small, some measuring several hundred meters in diameter, and can contain a

wide diversity of bottom types (Craig, 1966; Smith, 1990; Beets and Friedlander, 1992; Colin, 1992; Aguilar-Perera, 1994). The designations for spawning habitat sites include the specific area used for spawning (i.e., where the fish aggregate and release gametes into the water column) as well as any documented staging areas (i.e., the areas used by adult Nassau grouper in between spawning events) and known migration corridors between neighboring spawning locations.

Within the habitats used by Nassau grouper as they progress through their life history stages, we have identified the following essential features, which remain unchanged from the proposed rule (87 FR 62930):

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.

6 Specific Areas Containing the Essential Features within the Geographical Areas Occupied by the Species

To determine what areas qualify as critical habitat within the geographical area occupied by the species, we are required to identify "specific areas" within the geographical area occupied by the species that contain the physical or biological features essential to the conservation of the species (50 CFR 424.12(b)(1)(iii)). Delineation of the specific areas is done "at a scale determined by the Secretary [of Commerce] to be appropriate" (50 CFR 424.12(b)(1)). Our regulations also require that each critical habitat area be shown on a map with more-detailed information discussed in the preamble of the rulemaking documents in the **Federal Register**, which will reference each area by the State, county, or other local governmental unit in which it is located (50 CFR 424.12(c)). In determining the appropriate boundaries and mapping the specific areas of critical habitat, we relied on the best available data as further described below, and the Critical Habitat Report. We note that we are not required to, nor was it possible to, determine that each square inch, acre, or even square mile independently meets the definition of "critical habitat." A main goal in determining and mapping the boundaries of the specific areas is to provide a clear description and documentation of the areas containing the identified essential features. This is ultimately crucial to ensuring that Federal action agencies are able to determine whether their particular actions may affect the critical habitat.

Available habitat and bathymetric data layers were examined with the help of databases from Florida Fish and Wildlife Conservation Commission (FWC) Unified Florida Reef Tract, the Nature Conservancy, and NOAA to determine the contiguous areas of appropriate habitat complexity that contain a combination of habitat characteristics relevant to the essential feature supporting Nassau grouper development, refuge, and foraging. For example, we used information from the National Centers for Coastal Ocean Science Benthic Habitat Mapping program that provides data and maps at *http://products.coastalscience.noaa.gov/collections/benthic/default.aspx* and the Unified Florida Reef Tract Map found at *https://myfwc.com/research/gis/regional-projects/unified-reef-map/.*

These resources provide maps and information on the location of seagrass; unconsolidated calcareous sediment of medium to very coarse sediments (not fine sand) including shell and coral fragments interspersed with cobble, boulders, corals, and rubble mounds; continuous and discontinuous areas of seagrass and inshore patch and fore reefs; coral reef; and colonized hardbottom. Areas of these habitat types that were not sufficiently close to satisfy the need for contiguous habitat that could support nearshore to offshore movement of the species from larva to adult were excluded. Species presence or absence was also used to inform the decision making. Expert opinion was important to identifying areas that contain the feature. These experts included a NMFS regional GIS lead, a NMFS Nassau Grouper Recovery Coordinator with 30 years of protected species and Nassau grouper conservation research experience, and other Nassau grouper researchers. NMFS staff jointly reviewed all data prior to delineating proposed units, consulting with these experts.

To map these specific areas we reviewed available species occurrence, bathymetric, substrate, and water quality data. The highest resolution bathymetric data available were used for each geographic location. For areas off the coast of Florida and the FGBNMS, we used contours created from National Ocean Service Hydrographic Survey Data, NOAA ENCDirect bathymetric point data National Park Service

(NPS), and NOAA's Coastal Relief Model. For areas off the coast of Puerto Rico, we used contours derived from the National Geophysical Data Center's (NGDC) 2005 U.S. Coastal Relief Model. For areas in USVI, we used contours derived from NOAA's 2004–2015 Bathymetric Compilation. For areas in Navassa, we used contours derived from NOAA's NGDC 2006 bathymetric data. These bathymetric data were used with other geographic or management boundaries to draw the boundaries of each specific area on the maps in the critical habitat designation.

Within the geographical and depth ranges of the species, certain areas contain the appropriate substrates; however, due to their consistently disturbed nature, these areas do not provide the quality of substrate, structure, and often water quality, essential for the conservation of the threatened Nassau grouper. These disturbances are caused by human activities, such as dredging and high boat traffic. While these areas may provide substrate for recruitment and growth, the periodic nature of direct human disturbance renders them unsuitable habitat to promote recruitment and growth. In some of these areas, the substrate has been persistently disturbed by planned management activities authorized by local, state, or Federal governmental entities at the time of critical habitat designation. For the purpose of this rule, we refer to the areas disturbed by planned management activities as "managed areas." We expect that these areas will continue to be periodically disturbed by such planned management activities. Examples include dredged navigation channels, vessel berths, and active anchorages. These managed areas are not designated as critical habitat.

NMFS is aware that dredging may result in sedimentation impacts beyond the actual dredge channel. To the extent that these impacts are persistent, are expected to recur whenever the channel is dredged, and are of such a level that the areas in question have already been made unsuitable, we consider such areas to be included as part of the managed area and therefore are not designated as critical habitat.

GIS data of the locations of some managed areas were available and extracted from the maps of the specific areas considered for critical habitat designation. These data were not available for every managed area. Regardless of whether the managed area is extracted from the maps depicting the specific areas designated as critical habitat, no "managed areas" as defined above are part of the specific areas within the geographical area occupied by the species that contain the essential feature related to recruitment and development habitat (essential feature 1).

Spawning site locations were identified and mapped based on review of literature, including existing maps used in Caribbean Fishery Management Council management measures, codified in the Code of Federal Regulations (50 CFR 622.439, 50 CFR 622.514), and confirmation with species experts to determine the areas relevant to the Nassau grouper essential feature related to spawning habitat (essential feature 2). The identified marine sites used for spawning and adjacent waters that support movement and staging associated with spawning are: Bajo de Sico (waters encompassed by 100 m isobath bounded in the Bajo de Sico spawning area off the west coast of Puerto Rico); Grammanik Bank and Hind Bank (waters which make up the Grammanik Bank and the Hind Bank, interconnecting waters between these banks, and waters extending out to 366 m directly south from Grammanik Bank, located south of St. Croix); and Riley's Hump (waters encompassing Riley's Hump located southwest of the Dry Tortugas out to the 35 m isobath on the north, west, and east side of the hump and out to the 50 m isobath on the south side of the hump). The species has been known to spawn in the waters of the Grammanik Bank and to use the nearby Hind Bank for staging and movement to and from the spawning area. In addition, continuous monitoring at Riley's Hump, Florida by FWC indicates that Nassau grouper aggregate at the site during winter months and display typical spawning behaviors.

Based on the available data, we identified 20 specific areas that contain the essential feature. The units can generally be grouped as the: (1) Florida units, (2) Puerto Rico units, (3) St. Thomas/St. John units (STT/STJ), (4) St. Croix units, (5) Navassa unit, and (6) Spawning Site units (Shoreline = Mean Low Water (MLW)).

Table 1. UNITS OF CRITICAL HABITAT.

Critical Habitat Unit Name	State/ Territory	Geographic Extent
Navassa Island Unit	Navassa	All waters surrounding Navassa Island, encompassed by the shoreline to the 30 meter isobath. This includes a majority of the offshore coral reef area surrounding the southwest portion of the island and excludes the shallow sandy areas.
Puerto Rico Unit 1 - Mona Island.	Puerto Rico	Isla de Mona and Monito: All waters from the Mona Island shoreline out to the 50m isobath around the entire island. All waters from the Monito shoreline out to the 50m isobath around the entire island.
Puerto Rico Unit 2 - Desecheo Island	Puerto Rico	All waters between the shoreline out to the 50m isobath around Desecheo.
Puerto Rico Unit 3 - Southwest	Puerto Rico	All waters containing benthic habitat which support seagrasses from the southwestern shoreline at 67° 11' 10"W, 18° 08' 12"N, located just south of Mayaguez at Playa 'Tres Tubos' Beach, extending offshore near the 10m isobath following southeast to Magueyes Island (Isla Magueyes), University of Puerto Rico field office following the benthic habitat near the 15m isobath, and then back to where it nears the 10m isobath to the shoreline at Punta Ballena, 66° 51' 49"W, 17° 56' 45"N.
Puerto Rico Unit 4 - Northeast.	Puerto Rico	All waters from the northeastern shoreline at the Cabeza Chiquita Nature Preserve at 65°38'40"W, 18°22'51"N out to the 10m isobath, and then following the isobath southeast to the Punta Lima shoreline at 65° 41' 28"W, 18° 10' 45"N.
Puerto Rico Unit 5 - Vieques Island	Puerto Rico	There are two areas which make up this unit. All waters along the southwestern portion of Vieques shoreline, encompassed from Punta Boca Quebrada at 65°34'39"W, 18°6'9"N out to the inner reef near the 2m isobath at 65°34'40"W, 18°6'9"N, following the inner reef along the 2m isobath to 65°31'55"W, 18°4'46"N, then to shore at Punta Vaca at 65°31'55", 18°4'50". Along the eastern portion of the island, all waters from the Cayo Jalovita shoreline at 65° 21' 17"W, 18° 07' 01"N extending out to the inner reef near the 2m isobath, following the inner reef along the isobath northerly until it intersects with the Punta Mulas shoreline at 65°26' 39"W, 18° 09' 15"N.
Puerto Rico Unit 6 - Culebra/Culebrita Islands	Puerto Rico	There are two areas which make up this unit. For Isla de Culebra, all waters encompassed from the southern tip of Isla de Culebra shoreline at Punta Del Soldado, 65°17'08"W 18°16'38"N, out to the reef ledge near the 15m isobath, and following the reef ledge northeasterly (with some exceptions) until intersecting with the shoreline at 65°14'43"W, 18°18'32"N. The boundary is encompassed between the benthic reef habitat and the shoreline with two bay exclusions: 1) to the north, Puerto del Manglar and 2) to the south, Ensenada Honda. For Culebrita, all southwest waters from the Culebrita shoreline out to the inner coral reef near the 5m isobath, between the shoreline at 65°14'18"W, 18°19'14"N in the north and 65°13'18"W, 18°18'45"N in the east.
United States Virgin Island Unit - St. Croix	USVI	There are two areas which make up this unit, the main island of St. Croix and Buck Island. On the main island of St. Croix, all waters from the Pelican Grove Beach shoreline at 64°44'7"W, 17°45'58"N to the outer coral reef where it nears the 10m isobath following east past Tague Point and around eastern tip of the island following the reef edge south until 64°36'25"W, 17°45'58"N where it nears the 15m isobath. Following the reef edge west, waters are encompassed between the reef edge and the shoreline to Bastiste Point at 64°42'12"W, 17°42'11"N. This unit excludes the waters which make up the maintenance channel on the north side of St. Croix. For Buck Island, all waters on the north side of Buck Island from the shoreline to the fore reef near the 5m isobath, encompassed from the east end at 64°36'40"W, 17°47'14"N, then following the fore reef northerly to waypoint 64°37'35"W, 17°47'51"N, then southwest to waypoint 64°38'03"W, 17°47'30"N, then southerly to 64°37'54"W, 17°47'18"N, to due west of the shoreline at 64°37'39"W, 17°47'18"N encompassing the back reef and reef flat zone.
United States Virgin Island Unit - St Thomas	USVI	There are two areas which make up this unit. On the mainland of St. Thomas, all waters on the southeast portion of St. Thomas from the shoreline to the reef ledge near the 15m isobath, encompassed between the shoreline at 64°52'45"W, 18°18'21"N and 64°50'00"W, 18°19'35"N, following the reef ledge around Dog Island and to Cabrita Point Beach. For the Water Island area which makes up this unit, this includes all waters on the south side of Water Island, just south of the mainland of St. Thomas, from the shoreline out to the coral

		reef near the 5m isobath, encompassed from west of Druif Point at 64°57'38"W, 18°18'58"N, to the point at the end of Sand Bay at 64°56'28"W, 18°19'19"N.
United States Virgin Island Unit - St. John	USVI	All waters on the east end of St. John encompassed from the Leinster Point shoreline at 64°43'13"W, 18°22'04"N out to the inner coral reef near the 2m isobath, following the benthic reef habitat east and then south around the island until it intersects with the White Point shoreline at 64°43'56"W, 18°18'50"N.
Florida Unit 1 - Biscayne/Key Largo	Florida	All Biscayne Bay waters starting on the south side of Rickenbacker Causeway at 80°12'9"W, 25°44'54"N following the shoreline along Virginia Key, Key Biscayne, to COLREGS-72 to 80°9'29"W, 25°37'55"N, extending out to the coral reef (spur and grove) near the 20m isobath and following the coral reef south until 80°24'51"W, 24°58'55"N, and then directly to the shoreline at the Harry Harris Beach Park at 80°29'21"W, 25°1'59"N. From here, following the shoreline northeast along the inside of Biscayne Bay and Card Sound, along County Hwy 905A (Card Sound Rd), until meeting the shoreline of the Rickenbacker Causeway at 80°12'9"W, 25°44'54"N.
Florida Unit 2 - Marathon		All waters encompassed by the shoreline between Knights Key at 81°7'29"W, 24°42'24"N to Grassy Key at 80°55'51"W, 24°46'26"N out to the 15m isobath, excluding only the dredged channel between Boot Key and Knights Key. The dredged channel excluded from this unit are bound between AtoNs 13541.7, 13541.6, 13541.5, 13541.4, 13541.3, and 13541.
Florida Unit 3 - Big Pine Key	Florida	All waters encompassed by shoreline between Geiger Key (Boca Chica) at 81°39'15"W, 24°34'38"N to Big Pine Key at 81°19'41"W, 24°38'43"N out to the 15m isobath. All bay waters are bound by south of US1.
Florida Unit 4 - Key West	Florida	All Lavina Bank waters encompassed by waypoints: 1) 81°59'54"W, 24°30'51"N ; 2) 82°1'26"W, 24°30'51"N; 3) 82°1'26"W, 24°26'26"N; 4) 81°56'25"W, 24°26'13"N; 5) 81°48'11"W, 24°27'50"N; 6) 81°48'11"W, 24°28'46"N; 7) 81°50'36"W, 24°29'35"N; 8) 81°56'25"W, 24°29'7"N; and 9) 81°56'25"W, 24°30'32"N. This area surrounds a shoal between 5m and 30m which contain aggregated patch reef and seagrass habitat.
Florida Unit 5 - New Ground Shoal	Florida	All New Ground Shoal waters located southwest of Marquesas Keys encompassed by waypoints: A) 82°31'45"W, 24°26'30"N; B) 82°34'0"W, 24°27'51"N; C) 82°35'45"W, 24°27'45"N; D) 82°37'15"W, 24°26'45"N; E) 82°36'0"W, 24°25'54"N; and F) 82°32'0"W, 24°24'48"N which contain a dense amount of seagrass and aggregated patch reef habitat.
Florida Unit 6 - Halfmoon Shoal	Florida	All Half Moon Shoal waters located northwest of Marquesas Keys encompassed by waypoints: A) 82°20'0"W, 24°38'15"N; B) 82°22'30"W, 24°38'21"N; C) 82°25'45"W, 24°39'24"N; D) 82°20'15"W, 24°40'0"N; E) 82°20'15"W, 24°40'18"N; F) 82°24'0"W, 24°40'48"N; G) 82°27'15"W, 24°40'0"N; H) 82°23'42"W, 24°37'30"N; and I) 82°20'0"W, 24°37'30"N which contain a dense amount of seagrass and aggregated patch reef habitat.
Florida Unit 7 - Dry Tortugas	Florida	There are three areas which make up this unit, Loggerhead Key, Garden Key, and Bush Key. For Loggerhead Key, waters surrounding Loggerhead Key out to approximately 2m in depth to include seagrass beds and aggregate reef, bisected to the south at 82°55'36"W, 24°37'38"N, then northwesterly to 82°55'39"W, 24°37'53"N. For Garden Key, all waters surrounding Garden Key from south of Fort Jefferson at 82°52'24"W, 24°37'34"N bound between the shoreline and AtoN Light List numbers 15565, 15555, 15545, then following the 3.5m isobath north until reaching to and in between AtoNs 15465, 15480, 15490 to the shoreline on the north side of Garden Key at 82°52'17"W, 24°37'44"N. For Bush Key, all waters surrounding Bush Key from the northern shoreline at 82°52'12"W, 24°37'43"N following the 2m isobath to and in between AtoN Light List numbers 15495, 15485, 15475, and 15470, then following the 5.5m isobath east to AtoN Light List number 15450, following the 5.5m isobath south to 82°52'12"W, 24°37'43"N, following the isobath north to 82°52'2"W, 24°37'22"N, then west to AtoN 15570, to waypoint 82°52'18"W, 24°37'29"N to the southern shoreline at 82°52'13"W, 24°37'40"N, following the shoreline around the entire island until reaching the northern shoreline at 82°52'12"W, 24°37'43"N.
Spawning Site Unit 1 - Bajo de Sico		All waters encompassed by the 100m isobath in the Bajo de Sico 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.
Spawning Site Unit 2 - Grammanik Bank/Hind Bank MCD		All waters which make up the Hind Bank and Grammanik Bank and the interconnecting waters between these banks extending out to the 200 fathom line directly south from Grammanik Bank. Waters between Grammanik Bank and the 200 fathom line include the deep Agaricia reefs.
Spawning Site Unit 3 – Riley’s Hump		All waters encompassing Riley's Hump located southwest of the Dry Tortugas, which is identified as the bank peaking at -30m depth, 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.

7 Unoccupied Areas

ESA section 3(5)(A)(ii) defines critical habitat to include specific areas outside the geographical area occupied by the species at the time of listing if the areas are determined by the Secretary to be essential for the conservation of the species. An area must logically be "habitat" in order for that area to meet the narrower category of "critical habitat" as defined in the ESA. *Weyerhaeuser Co. v. U.S. FWS*, 139 S. Ct. 361, 368 (2018) (explaining that an area cannot be designated as critical habitat unless it is also habitat for the species). Our regulations at 50 CFR 424.12(b)(2) further explain that the Secretary will identify, at a scale determined by the Secretary to be appropriate, specific areas outside the geographical area occupied by the species only upon a determination that such areas are essential for the conservation of the species. As noted previously, we considered these current regulatory requirements, as well as those in effect prior to 2019 and the recently proposed revisions to 50 CFR 424.12(b)(2) (see 88 FR 40764, June 22, 2023). Although our analyses would differ with regard to considering whether any unoccupied areas qualify as critical habitat for Nassau grouper, our conclusions would not differ.

While the most serious threats to Nassau grouper are historical overutilization, fishing at spawning aggregations, and inadequate law enforcement (81 FR 42268, 42280-81, June 29, 2016), loss of the habitats used by groupers during various life stages can influence their distribution, abundance, and survival. For example, alterations or destruction of nearshore nursery areas and degradation of hardbottom habitat can affect Nassau grouper's ability to grow and survive. The designated critical habitat will help conservation of spawning areas within U.S. jurisdiction, but will not address fishing at the spawning aggregations or enforcement of any spawning area protections as that cannot be addressed by this final rule. The critical habitat identified in this final rule identifies key habitat necessary for promoting the recruitment, refuge, forage, and spawning habitat necessary for the conservation of the species. Based on our current understanding of the species' life history, status, and conservation needs, we have not identified any specific areas outside the geographical area occupied by the species that are essential for its conservation. The protection of the specific areas identified in this final rule from destruction and adverse modification stemming from federal actions will help support the species' habitat-based conservation needs.

8 Special Management Considerations

Specific areas within the geographical area occupied by a species at the time of listing may be designated as critical habitat only if they contain essential features that "may require special management considerations or protection" (16 U.S.C. 1532(5)(A)(i)(II)). Special management considerations or protection are defined as any "methods or procedures useful in protecting the physical or biological features essential to the conservation of listed species" (50 CFR 424.02).

The essential feature components that support settlement, development, refuge, and foraging (essential feature 1, components a through d) are particularly susceptible to impacts from human activity because of the relatively shallow water depth range where these features occur as well as their proximity to the coast. As a result, these features may be impacted by activities such as coastal and in-water construction, dredging and disposal activities, beach nourishment, stormwater run-off, wastewater and sewage outflow discharges, point and non-point source pollutant discharges, and fishing activities. Coastal and in-water construction, dredging and disposal, and beach nourishment activities can directly remove the essential feature that supports settlement, development, refuge, and foraging by dredging or by depositing sediments, making habitat unavailable. These same activities can impact the essential feature by creating turbidity during operations. Stormwater run-off, wastewater and sewage outflow discharges, and point and non-point source pollutant discharges can adversely impact the essential feature by allowing nutrients and sediments from point and non-point sources to alter the natural levels of nutrients or sediments in the water column, which could negatively impact the substrate characteristics or health (*e.g.*, seagrass and corals). Further, the global oceans are being impacted by climate change from greenhouse gas emissions. The impacts from all these activities, combined with those from natural factors (*e.g.*, major storm events) affect the habitat, including the components described for this essential feature. We conclude that this essential feature is currently and will likely continue to be negatively impacted by some or all of these factors.

The spawning habitat essential feature (essential feature 2) is affected by activities that may make the sites unsuitable for reproductive activity, such as activities that inhibit fish movement to and from the sites or within the sites during the period the fish are expected to spawn, or create conditions that deter the fish from selecting the site for reproduction. Pollution leading to significant declines in water quality may render spawning locations unusable or reduce adult or egg survival. Acoustic disturbances may also inhibit spawning activity due to the acoustic cues used by the animal during courtship and spawning behaviors. Further, because the spawning aggregation sites are so discrete and rare, and the species' reproduction depends on their use of these sites, the species is highly vulnerable at these locations and loss of an aggregation site could lead to significant population impacts.

Based on the above, we determined that the essential features may require special management considerations or protection.

9 Application of ESA Section 4(a)(3)(B)(i)

Section 4(a)(3)(B)(i) of the ESA prohibits designating as critical habitat any lands or other geographical areas owned or controlled by the Department of Defense (DoD), or designated for its use, that are subject to an Integrated Natural Resources Management Plan (INRMP) prepared under section 101 of the Sikes Act (16 U.S.C. 670a), so long as the Secretary determines in writing that the INRMP plan provides a benefit to the species for which critical habitat is designated. Pursuant to our regulations at 50 CFR 424.12(h), we consider the following when determining whether such a benefit is provided:

1. The extent of the area and features present;

2. The type and frequency of use of the area by the species ;

3. The relevant elements of the INRMP in terms of management objectives, activities covered, and best management practices, and the certainty that the relevant elements will be implemented; and

4. The degree to which the relevant elements of the INRMP will protect the habitat from the types of effects that would be addressed through a destruction-or-adverse-modification analysis.

Naval Air Station Key West (NASKW) in Key West, Florida, is the only installation controlled by the DoD, specifically the Department of the Navy (Navy), that coincides with any of the areas under consideration for critical habitat. On July 14, 2022, the Navy requested in writing that the areas covered by the 2020 INRMP for NASKW not be designated as critical habitat, pursuant to ESA section 4(a)(3)(B)(i).

The NASKW INRMP covers the lands and waters (generally out to 50 yards (45.7 m)) adjacent to NASKW, including several designated restricted areas. The total area of the waters covered by the INRMP that overlaps with areas identified as critical habitat is approximately 800 acres (3.2 sq km). Within this area, the species and the recruitment and developmental habitat essential feature are present, specifically young juvenile fish and nearshore shallow subtidal marine nursery and intermediate hardbottom and seagrass areas in close proximity to the nearshore shallow subtidal marine nursery areas. As detailed in the INRMP, the plan provides benefits to the threatened Nassau grouper and areas included in the designated critical habitat through the following NASKW broad programs and activities: wetlands management; floodplains management; soil conservation and erosion control; stormwater and water quality control; coastal and marine management; threatened species and natural communities management; wetlands protection and shoreline enhancement; federally listed species assessments; community outreach and awareness; fish and wildlife conservation signage; marine resources surveys. These types of best management practices have been ongoing at NASKW since 1983; thus, they are likely to continue into the future. Further, the plan specifically provides assurances that all NASKW staff have the authority and funding (subject to appropriations) to implement the plan. The plan also provides assurances that the conservation efforts will be effective through annual reviews conducted by state and Federal natural resource agencies. These activities address some of the particular conservation and protection needs that critical habitat would afford. These activities are similar to those that we describe for avoiding or reducing effects to the critical habitat. Further, the INRMP includes provisions for monitoring and evaluating conservation effectiveness, which will ensure continued benefits to the species. Therefore, pursuant to section 4(a)(3)(B)(i) of the ESA, we determined that the INRMP provides

a benefit to Nassau grouper, and areas within the boundaries covered by the INRMP are ineligible for designation as critical habitat.

10 Application of ESA Section 4(b)(2)

The foregoing discussion described the specific areas within U.S. jurisdiction that fall within the ESA Section 3(5) definition of critical habitat in that they contain the physical or biological features essential to the Nassau grouper's conservation that may require special management considerations or protection. Section 4(b)(2) of the ESA requires that we consider the economic impact, impact on national security, and any other relevant impact, of designating any particular area as critical habitat. Additionally, the Secretary has the discretion to exclude any area from critical habitat if the Secretary determines the benefits of exclusion (that is, avoiding some or all of the impacts that would result from designation) outweigh the benefits of designation. The Secretary may not exclude an area from designation if the Secretary determines, based upon the best scientific and commercial data available, exclusion will result in the extinction of the species. Because the authority to exclude is discretionary, exclusion is not required for any particular area under any circumstances.

The ESA provides the Secretary broad discretion in how to consider impacts. (See H.R. Rep. No. 95–1625, at 17, reprinted in 1978 U.S.C.C.A.N. 9453, 9467 (1978)). Regulations at 50 CFR 424.19(b) specify that the Secretary will consider the probable impacts of the designation at a scale that the Secretary determines to be appropriate, and that such impacts may be qualitatively or quantitatively described. The Secretary is also required to compare impacts with and without the designation (50 CFR 424.19(b)). In other words, we are required to assess the incremental impacts attributable to the critical habitat designation relative to a baseline that reflects existing regulatory impacts in the absence of the critical habitat. The consideration and weight given to any particular impact is determined by the Secretary. Courts have noted the ESA does not contain requirements for any particular methods or approaches. (See*, e.g., Bldg. Indus. Ass'n of the Bay Area et al.* v *U.S. Dept. of Commerce et al.,* 792 F.3d 1027 (9th Cir. 2015), upholding district court's ruling that the ESA does not require the agency to follow a specific methodology when designating critical habitat under section 4(b)(2)). NMFS and the U.S. Fish and Wildlife Service have adopted a joint policy setting out non-binding guidance explaining generally how we exercise our discretion under section 4(b)(2) of the ESA (see Policy Regarding Implementation of Section 4(b)(2) of the Endangered Species Act ("4(b)(2) Policy," 81 FR 7226, February 11, 2016)). For this final rule, we followed the same basic approach to describing and evaluating impacts as we have for several recent critical habitat rulemakings, as informed by our 4(b)(2) Policy.

The following sub-sections describe the economic, national security, and other relevant impacts that, employing the best data available, NMFS projected would result from including the areas described in section 6 in the final critical habitat designation. These impacts were considered in deciding whether to exercise NMFS' discretion to propose excluding particular areas from the designation. Both positive and negative impacts (these terms are used interchangeably with benefits and costs, respectively) were identified and were considered. Impacts were evaluated in quantitative terms where feasible, but qualitative appraisals were used where more appropriate to particular impacts or available information.

The primary impacts of a critical habitat designation result from the ESA section 7(a)(2) requirement that Federal agencies ensure their actions are not likely to result in the destruction or adverse modification of critical habitat, and that they consult with NMFS in fulfilling this requirement. Determining these impacts is complicated by the fact that section 7(a)(2) also requires that Federal agencies ensure their actions are not likely to jeopardize the species' continued existence. One incremental impact of designation is the extent to which Federal agencies modify their proposed actions

to ensure they are not likely to destroy or adversely modify the critical habitat beyond any modifications the agencies would make because of listing and the requirement to avoid jeopardy to the listed Nassau grouper. When the same modification would be required due to impacts to both the species and critical habitat, there would be no additional or incremental impact attributable to the critical habitat designation beyond the administrative impact associated with conducting the critical habitat analysis.

Relevant, existing regulatory protections are referred to as the "baseline" for the analysis and are discussed in the Critical Habitat Report. In this case, notable baseline protections include the ESA listing of the species (81 FR 42268, June 29, 2016), and other species listings and critical habitat designations (*e.g.*, elkhorn and staghorn coral, 73 FR 72209, November, 26, 2008).

The following impact analyses describe projected future federal activities that would trigger Section 7 consultation requirements because they may affect the essential feature(s) and consequently may result in economic, national security, or other relevant impacts. Additionally, these analyses describe broad categories of project modifications that may reduce impacts to the essential feature(s), and state whether the modifications are likely to be solely a result of the critical habitat designation or co-extensive with another baseline regulation, including the ESA listing of the species.

10.1 Economic Impacts

10.1.1 Summary of Key Findings

Economic impacts of the critical habitat designation result through implementation of Section 7 of the ESA in consultations with federal agencies to ensure their proposed actions are not likely to destroy or adversely modify critical habitat. These economic impacts may include both administrative and project modification costs; economic impacts that may be associated with the conservation benefits of the designation are described later. An analysis of the economic impacts of the final rule to critical habitat units and aggregated impacts to appropriate economic or geopolitical areas (e.g., Florida county, Puerto Rico, USVI islands) was conducted to assist in projecting the extent to which discrete areas may be impacted.

Table 2 summarizes the key conclusions of this analysis for each of the economic activities that NMFS has identified may affect the areas considered for critical habitat. Overall, NMFS has not identified a particular project or activity for which it is likely that section 7 consultation with the critical habitat units for Nassau grouper will result in project modifications different than those required without the critical habitat.[2] Absent the critical habitat designation, NMFS is already required to consult on these types of activities to consider the potential for jeopardy to the ESA-listed Nassau grouper and identifies project modifications accordingly. Additional key baseline protections to the designated critical habitat exist due to:

- The presence of listed coral species, and associated critical habitats (88 FR 54026) in most of the

[2] This analysis refers to "project modifications" as a generic term for recommendations NMFS may make to modify projects or activities for the benefit of the any listed species or their designated critical habitat, or that action agencies or other entities may otherwise undertake to avoid adverse effects of their actions on listed species or their designated critical habitat..

units comprising the Nassau grouper critical habitat; and

- Significant overlap of the Acropora coral critical habitat with the specific areas under consideration, including the areas where the vast majority of potentially affected projects and activities occur.

NMFS anticipates that impacts of future activities that adversely affect an essential feature of Nassau grouper critical habitat, but which will not require modification due to these existing baseline protections, will be sufficiently limited that the functionality of the critical habitat will not be diminished. As a result, incremental project modifications will not need to be implemented specifically due to the Nassau grouper critical habitat. While there is some uncertainty as to the degree of protection that baseline protections will provide the critical habitat, this analysis concludes that project modifications required to address adverse modification of the critical habitat would already be required due to the listing of the Nassau grouper and other baseline protections, including those to listed corals and Acropora critical habitat. As a result, incremental costs of the final rule that can be monetized are limited to the additional administrative effort required for Section 7 consultations to consider effects to the critical habitat. Should NMFS identify project modifications necessary in particular cases to avoid adverse modification to critical habitat separate from modifications necessary to avoid jeopardy determinations, this would result in additional costs not identified in this analysis. However, as summarized in Table 2, NMFS cannot currently foresee any specific, additional conservation efforts that may be required.

This analysis calculates the incremental administrative costs by multiplying the forecast of section 7 consultations by the estimated average administrative cost per consultation over a ten-year timeframe. An additional important conclusion of the economic analysis is that the types, frequencies, and locations of activities that have required Section 7 consultation over the past 11 years is generally reflective of the types, frequency, and location of activities that will require Section 7 consultation in the future. To the extent that we handle consultations differently over the next ten years (e.g., more dealt with on a programmatic basis, or critical habitat results in more formal consultations than would occur absent designation), our analysis could over or underestimate the incremental administrative burden of critical habitat for the Nassau grouper.

As exhibited in Table 3 and Table 4, total present value incremental costs of critical habitat designation for the Nassau grouper are projected to be $440,000 over the next ten years (discounted at 7%), or $62,000 in annualized costs.[3] Consultations on activities occurring within the Florida units are anticipated to drive more than half of incremental costs, or approximately $240,000 over the ten years (discounted at 7%), with the Biscayne/Key Largo, Marathon, and Big Pine Key units together accounting for $200,000 of these costs. Incremental costs of the final rule are projected to total $120,000 across Puerto Rico units and $60,000 across USVI units over the ten years (Table 3).

Future consultations on construction activities are projected to account for $210,000 of incremental costs, or 48% of total incremental costs, of the critical habitat designation over the next ten years (Table 4). Consultations related to water quality management, scientific research and monitoring, and military activities are each projected to drive at least 11% of total costs, with consultations related to commercial fishery management and protected area management accounting for 8% and 6% of total

[3] Cost estimates are expressed in 2023 dollars. Present values are calculated over ten years (2024 – 2033) assuming a 7% discount rate.

costs, respectively. Derelict vessel and marine debris removal (3% of total incremental costs) and aquaculture activities (less than 1% of costs) are expected to be minimally impacted by Nassau grouper critical habitat.

While a degree of uncertainty underlies this analysis, the results provide an indication of the activities that may be affected, as well as the relative costs of critical habitat designation across particular areas and potentially impacted activities.

Table 2. SUMMARY FINDINGS BY ACTIVITY

ACTIVITY	SUMMARY FINDING
Construction	It is unlikely that the critical habitat will result in additional conservation efforts as part of future section 7 consultations on in-water and coastal construction, dredging and disposal, and beach nourishment activities. As a condition of permitting, USACE generally requires that applicants avoid or minimize impacts to listed species and any critical habitat in which the project is located. As a result, some baseline protections for listed species and critical habitats that overlap with the designated critical habitat may protect the critical habitat contiguous area essential feature. Given baseline protections, and the assumption that at least some components of the contiguity essential feature are present throughout the designated critical habitat areas, NMFS anticipates that impacts from future in-water and coastal construction projects will be sufficiently limited that the functionality of the critical habitat will not be diminished. Therefore, it is unlikely that consultation on construction projects within the critical habitat will result in incremental project modifications as a result of critical habitat designation for the Nassau grouper. This analysis anticipates that maintenance dredging activities will not be impacted by the designation of critical habitat as it excludes navigation channels that are dredged on a recurring basis, as well as areas beyond the channels where sedimentation impacts from the dredging operations are persistent, are expected to recur whenever the channel is dredged, and are of such a level that the areas in question have already been made unsuitable.
Water Quality Management	As part of the process of developing water quality standards, EPA considers levels that would be needed to protect Nassau grouper and any other potentially impacted listed species and critical habitat. Accordingly, the effect of developing water quality standards on Nassau grouper habitat is a consideration even absent critical habitat designation, and the development of more stringent water quality standards in the future would likely occur absent designation. It is therefore unlikely that consultation on projects that could affect water quality within the designated critical habitat will result in incremental project modifications.
Protected Area Management	Consultations related to protected area management over the next ten years are not expected to result in incremental project modifications as these protected areas generally provide specific regulations to protect sedimentary, seagrass, hard-bottom, coral reef, and other components of the contiguous area essential feature; however, some minor adverse effects may be unavoidable.

ACTIVITY	SUMMARY FINDING
Fishery Management	Limited areas of the designated critical habitat are located within federally managed waters. Gears used by fisheries that operate within the Florida units are unlikely to affect the contiguity essential feature in any manner that would appreciably alter the physical or biological features that make them suitable for Nassau grouper. Fishing within the Bajo de Sico and Grammanik units is not expected to adversely affect the conservation value of these areas to Nassau grouper due to existing gear and seasonal restrictions. All fishing is prohibited within the Riley's Hump unit, which is located within the South Area of the Tortugas Ecological Reserve.
Aquaculture	Aquaculture activity is not expected to affect the designated critical habitat due to existing siting requirements and best practices that protect sensitive areas including coral, seagrass, and hard bottom.
Military Activities	Consultations related to military activities over the next ten years are not expected to result in incremental project modifications due to measures developed by the Navy that significantly limit the potential for impacts of training and testing activities and environmental remediation activities to the designated critical habitat.
Scientific Research and Monitoring	NOAA research and monitoring activities may affect the designated critical habitat, but these activities typically have a minor footprint. In addition, strict protocols are observed during fieldwork permitted by NOAA to ensure minimal disturbance to the environment. Restoration activities within the designated critical habitat may cause temporary disturbances to the project areas but eventually improve the functionality of these areas as Nassau grouper habitat. Therefore, scientific research and monitoring and restoration activities are unlikely to adversely modify the designated critical habitat and are therefore unlikely to result in incremental project modifications.
Derelict Vessel and Marine Debris Removal	Consultations related to derelict vessel and marine debris removal activities are unlikely to require incremental project modifications due to the designation of critical habitat for the Nassau grouper because of existing protocols designed to minimize impacts to coral reef and hard bottom habitat.
Oil and Gas and Renewable Energy Development	There are no active oil and gas leases within the Florida units of the designated critical habitat, which are located within the Straits of Florida Planning Area. The area is excluded from consideration for leasing for purposes of exploration, development, or production through June 30, 2032. Oil and gas exploration and development activities on the U.S. Outer Continental Shelf offshore the USVI and Puerto Rico are also not anticipated over the next ten years. Although BOEM plans to assess interest in and feasibility of offshore renewable energy leases in Florida and the U.S. Caribbean territories, there are currently no active offshore renewable energy leases in Florida; no planned lease sites are located offshore of Florida's Atlantic coast; and no renewable energy development is currently planned on the U.S. Outer Continental Shelf offshore Navassa, Puerto Rico, or the USVI over the next ten years.

Table 3. PROJECTED TOTAL PRESENT VALUE AND ANNUALIZED ECONOMIC IMPACTS OF NASSAU GROUPER CRITICAL HABITAT DESIGNATION, BY CRITICAL HABITAT UNIT, 2024 – 2033 (2023 DOLLARS)

UNIT	PRESENT VALUE IMPACTS (7% DISCOUNT RATE)	ANNUALIZED IMPACTS (7% DISCOUNT RATE)	PRESENT VALUE IMPACTS (3% DISCOUNT RATE)
Biscayne/Key Largo	$78,000	$11,000	$94,000
Marathon	$38,000	$5,400	$46,000
Big Pine Key	$84,000	$12,000	$100,000
Key West	$16,000	$2,300	$20,000
New Ground Shoal	$9,000	$1,300	$11,000
Halfmoon Shoal	$9,000	$1,300	$11,000
Dry Tortugas	$9,000	$1,300	$11,000
Florida, All	**$240,000**	**$35,000**	**$290,000**
Mona Island	$15,000	$2,100	$18,000
Desecheo	$9,000	$1,300	$11,000
Southwest	$23,000	$3,300	$28,000
Northeast	$30,000	$4,100	$35,000
Vieques	$33,000	$4,600	$40,000
Isla de Culebra/ Culebrita	$9,000	$1,300	$11,000
Puerto Rico, All	**$120,000**	**$17,000**	**$140,000**
Navassa	**$4,700**	**$660**	**$5,600**
USVI - STT	$27,000	$3,500	$30,000
USVI - STJ	$14,000	$2,000	$17,000
USVI - STX	$21,000	$3,000	$26,000
USVI, All	**$62,000**	**$8,500**	**$73,000**
Bajo de Sico	**$4,700**	**$660**	**$5,600**
Grammanik Bank/ Hind Bank	**$4,700**	**$660**	**$5,600**
Riley's Hump	**$3,100**	**$440**	**$3,800**
TOTAL	**$440,000**	**$62,000**	**$530,000**

Table 4. PROJECTED TOTAL PRESENT VALUE ECONOMIC IMPACTS OF NASSAU GROUPER CRITICAL HABITAT DESIGNATION, BY ACTIVITY TYPE AND UNIT, 2024-2033 (7 PERCENT DISCOUNT RATE; 2023 DOLLARS)

UNIT	CON-STRUCTION	WATER QUALITY MGMT.	PROTECTED AREA MGMT.	FISHERY MGMT.	AQUA-CULTURE	MILITARY	DERELICT VESSEL AND MARINE DEBRIS REMOVAL	SCIENTIFIC RESEARCH AND MONITOR.	TOTAL
Biscayne/Key Largo	$41,000	$900	$27,000	$1,800	$0	$2,100	$2,700	$1,800	$78,000
Marathon	$30,000	$900	$0	$1,800	$0	$2,100	$2,700	$0	$38,000
Big Pine Key	$77,000	$900	$0	$1,800	$0	$2,100	$2,700	$0	$84,000
Key West	$1,500	$900	$0	$1,800	$1,800	$7,500	$2,700	$0	$16,000
New Ground Shoal	$1,500	$900	$0	$1,800	$0	$2,100	$2,700	$0	$9,000
Halfmoon Shoal	$1,500	$900	$0	$1,800	$0	$2,100	$2,700	$0	$9,000
Dry Tortugas	$1,500	$900	$0	$1,800	$0	$2,100	$2,700	$0	$9,000
Florida, All	**$150,000**	**$6,300**	**$27,000**	**$13,000**	**$1,800**	**$20,000**	**$19,000**	**$1,800**	**$240,000**
Mona Island	$1,500	$3,600	$0	$2,500	$0	$0	$1,400	$5,500	$15,000
Desecheo	$1,500	$3,600	$0	$2,500	$0	$0	$1,400	$0	$9,000
Southwest	$6,800	$3,600	$0	$2,500	$0	$0	$6,800	$3,600	$23,000
Northeast	$12,000	$5,400	$0	$2,500	$0	$5,400	$1,400	$1,800	$30,000
Vieques	$1,500	$3,600	$0	$2,500	$0	$22,000	$1,400	$1,800	$33,000
Isla de Culebra/ Culebrita	$1,500	$3,600	$0	$2,500	$0	$0	$1,400	$0	$9,000
Puerto Rico, All	**$25,000**	**$24,000**	**$0**	**$15,000**	**$0**	**$27,000**	**$14,000**	**$13,000**	**$120,000**
Navassa	**$1,500**	**$980**	**$0**	**$770**	**$0**	**$0**	**$1,400**	**$0**	**$4,700**
USVI - STT	$13,000	$6,100	$0	$2,200	$0	$0	$3,000	$0	$27,000
USVI - STJ	$2,700	$6,100	$0	$2,200	$0	$0	$3,000	$0	$14,000
USVI - STX	$8,100	$7,900	$0	$2,200	$0	$0	$3,000	$0	$21,000
USVI, All	**$24,000**	**$20,000**	**$0**	**$6,500**	**$0**	**$0**	**$9,100**	**$0**	**$62,000**
Bajo de Sico	**$1,500**	**$980**	**$0**	**$770**	**$0**	**$0**	**$1,400**	**$0**	**$4,700**
Grammanik Bank/Hind Bank	**$1,500**	**$980**	**$0**	**$770**	**$0**	**$0**	**$1,400**	**$0**	**$4,700**
Riley's Hump	**$1,500**	**$370**	**$0**	**$0**	**$0**	**$0**	**$1,300**	**$0**	**$3,100**
TOTAL	**$210,000**	**$53,000**	**$27,000**	**$37,000**	**$1,800**	**$47,000**	**$48,000**	**$14,000**	**$440,000**

Source: NMFS SERO's Section 7 consultation database.
Note: The estimates may not sum to totals due to rounding.

10.1.2 Introduction

The purpose of the economic analysis is to identify and consider the potential economic impacts associated with the designation of critical habitat areas for the Nassau grouper. These economic impacts provide information on some of the potential "benefits of exclusion." In addition, this information addresses the requirements of Executive Orders 12866 (as affirmed and supplemented by Executive Order 13563), which directs federal agencies to assess the costs and benefits of regulatory actions.

To estimate the economic impacts of critical habitat designation, this analysis compares the state of the world with and without the designation of critical habitat for the Nassau grouper. The "without critical habitat" scenario represents the baseline for the analysis, considering protections already afforded the designated critical habitat as a result of the listing of the Nassau grouper as a threatened species, or as a result of other federal, state, and local regulations or protections, notably the previous listing of 7 Caribbean coral species and the designation of critical habitat for the 2 Caribbean acroporids. The "with critical habitat" scenario describes the incremental impacts associated specifically with this final designation of critical habitat.

To characterize the economic impacts of critical habitat designation for the Nassau grouper, this analysis undertakes the following general steps as detailed in the following sections:

1. Characterize the areas chosen for designation, in terms of economic activities and existing management, as well as the presence of overlapping protections such as existing critical habitat designations or conservation areas.
2. Identify the types of projects or activities that may affect critical habitat and that may be subject to Section 7 consultation pursuant to the ESA, and forecast the expected occurrences of these activities within the boundaries of the designated critical habitat. We used historical data on Section 7 consultations and interviews with federal action agencies to generate these forecasts.
3. Assess the potential need for project modifications for these activities that may be recommended through Section 7 consultation to ensure they are not likely to destroy or adversely modify critical habitat.
4. Project the economic impacts to these economic activities for each particular area of designated critical habitat.
5. Provide information on the distribution of economic impacts across the particular areas chosen for designation.
6. Evaluate the potential economic benefits stemming from the incremental project modifications.

10.1.3 Framework of the economic analysis

The U.S. Office of Management and Budget (OMB) instructs federal agencies to provide an assessment of both the social costs and benefits of proposed regulatory actions. OMB's guidelines for conducting economic analyses of regulations direct federal agencies to measure the impacts of a regulatory action against a baseline, which it defines as the "best assessment of the way the world would look absent the proposed action" (U.S. Office of Management and Budget 2003). In other words, the baseline includes the existing regulatory and socio-economic burden imposed on landowners, managers, or other resource users potentially affected by the designation of critical habitat. Impacts that are incremental to that baseline (i.e., occurring over and above existing constraints) are attributable to the proposed

regulation. NMFS's and the U.S. Fish and Wildlife Service's regulations addressing the content and timing of critical habitat economic analyses require that the economic analyses of critical habitat rules be focused exclusively on the incremental effects of the designation (50 CFR 424.19).

Accordingly, this economic analysis employs "without critical habitat" and "with critical habitat" scenarios:

1. The "**without critical habitat**" scenario represents the baseline for the analysis, considering protections already afforded the critical habitat for the Nassau grouper. The baseline for this analysis is the state of regulation absent designation of new critical habitat.
2. The "**with critical habitat**" scenario describes and where possible monetizes the incremental impacts due specifically to designation of critical habitat for the Nassau grouper. Incremental project modifications and associated impacts are those that are expected to occur solely as a result of critical habitat designation.

10.1.3.1 Identifying Baseline Protections

The baseline for this analysis is the existing state of regulation prior to the designation of critical habitat, including the listing of the Nassau grouper under the ESA, and other federal, state, and local laws and guidelines. The baseline also reflects a wide range of additional factors beyond compliance with existing regulations that provide protection to the habitat to be designated as critical habitat. As recommended by OMB, the baseline incorporates, as appropriate, trends in market conditions, implementation of other regulations and policies by NMFS and other government entities, and trends in other factors that have the potential to affect economic costs and benefits, such as the rate of regional economic growth in potentially affected industries.

Baseline impacts and protections include implementation of sections 7, 9, and 10 of the ESA to the extent that they are expected to occur absent designation of critical habitat for the Nassau grouper. This analysis does not quantify the baseline costs associated with these protections, as the critical habitat designation will not affect these costs.

- Section 7 of the ESA requires federal agencies to consult with NMFS to ensure that any action authorized, funded, or carried out is not likely to jeopardize the continued existence of any endangered or threatened species or destroy or adversely modify critical habitat that has already been designated for listed species. Baseline consultations under the jeopardy and adverse modification standards result in administrative costs, as well as costs of implementing any project modifications resulting from consideration of these standards.
- Section 9 defines the actions that are prohibited by the ESA. In particular, it prohibits "take" of endangered wildlife, where "take" means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (16 USC § 1532). Economic impacts associated with Section 9 that are relevant to this analysis manifest themselves in application of Sections 7 and 10 for listed species. There are no Section 9 prohibitions for critical habitat.
- Under Section 10(a)(1)(B) of the ESA, a non-federal entity (e.g., a landowner or local government) may develop a Habitat Conservation Plan (HCP) for a listed animal species in order to meet the conditions for issuance of an incidental take permit in connection with a land or water use activity or project (U.S. Fish and Wildlife Service 2002). The requirements posed by the HCP may have economic impacts associated with the goal of ensuring that effects of incidental take are adequately avoided or minimized. Development and implementation of HCPs

is considered a baseline protection for the species and habitat unless the HCP is determined to be precipitated by the designation of critical habitat, or the designation influences stipulated conservation efforts under HCPs.

The protection of listed species and critical habitat is not limited to the ESA. Other federal agencies, as well as state and local governments, may also protect the natural resources under their jurisdiction. If compliance with the Clean Water Act (CWA), state environmental quality laws, or best management practices, for example, protects critical habitat for the Nassau grouper, such protective efforts are considered to be baseline protections. Of note, however, such efforts may not be considered baseline in the case that they would not have been triggered absent the designation of critical habitat. In such cases, they are considered incremental impacts.

10.1.3.2 Identifying Incremental Impacts

Incremental impacts of critical habitat rules result from changes in the management of projects and activities, above and beyond those changes resulting from existing required or voluntary conservation efforts undertaken due to other federal, state, and local regulations or guidelines.

When critical habitat is designated, Section 7 requires federal agencies to ensure that their actions are not likely to destroy or adversely modify critical habitat, in addition to ensuring that the actions are not likely to jeopardize the continued existence of the species. The added administrative costs of considering critical habitat in Section 7 consultation and the additional impacts of implementing conservation efforts (i.e., reasonable and prudent alternatives in the case of an adverse modification finding) resulting from the protection of critical habitat are the direct compliance costs of designating critical habitat.

In identifying incremental impacts, it is important to consider both economic efficiency and distributional effects resulting from critical habitat designation for the Nassau grouper. Economic efficiency effects generally reflect “opportunity costs” associated with the commitment of resources required to accomplish species and habitat conservation. At the guidance of OMB and in compliance with Executive Order 12866 “Regulatory Planning and Review,” federal agencies measure changes in economic efficiency in order to understand how society, as a whole, will be affected by a regulatory action. In the context of critical habitat designation, these efficiency effects represent the opportunity costs of resources used or benefits foregone by society as a result of the rule. Economists generally characterize opportunity costs in terms of changes in producer and consumer surpluses in affected markets (Gramlich 1990).

We also consider the distribution of impacts associated with the designation, including an assessment of any local or regional impacts of habitat conservation and the potential effects of conservation efforts on small entities. This information on distributional impacts may be used by decision-makers to assess whether the effects of the designation may unduly burden a particular group or economic sector. For example, while project modifications may have a small impact relative to the national economy, individuals employed in a particular sector of the regional economy may experience relatively greater impacts.

In some instances, compliance costs may provide a reasonable approximation for the efficiency effects associated with a regulatory action. For example, a federal permitting agency may enter into a consultation with NMFS to ensure that a particular project will not adversely modify critical habitat. The effort required for consultation is an economic opportunity cost because the agency and/or project proponent's time and effort would have been spent in an alternative activity had the particular area not

been included in the designation. When compliance activity is not expected to significantly affect markets—that is, not result in a shift in the quantity of a good or service provided at a given price, or in the quantity of a good or service demanded given a change in price—the measurement of compliance costs can provide a reasonable estimate of the change in economic efficiency.

Where habitat protection measures are expected to significantly impact a market, it may be necessary to estimate changes in producer and consumer surpluses. For example, if a given commercial fishery is precluded from fishing across a large area, the price and quantity of fish on the market may be affected. In this case, changes in economic efficiency (i.e., social welfare) can be measured by considering changes in producer and consumer surplus in the market. As noted above, in some cases, compliance costs can provide a reasonable estimate of changes in economic efficiency. However, if the costs of project modifications are expected to significantly impact markets, the analysis will consider potential changes in consumer and/or producer surplus in affected markets. In the case of the designated critical habitat for the Nassau grouper, incremental project modifications are not anticipated to significantly affect activity levels or markets; therefore, this report focuses solely on compliance costs.

Measurements of changes in economic efficiency focus on the net impact of project modifications, without consideration of how certain economic sectors or groups of people are affected. Thus, a discussion of efficiency effects alone may miss important distributional considerations. OMB encourages federal agencies to consider distributional effects separately from efficiency effects (U.S. Office of Management and Budget 2003). This analysis considers the entities expected to bear the costs associated with the designation, including a separate analysis of potential impacts to small entities (see Appendix B).

Regional economic impact analysis can provide an assessment of the potential localized effects of conservation efforts. Specifically, regional economic impact analysis produces a quantitative estimate of the potential magnitude of the initial change in the regional economy resulting from a regulatory action. Regional economic impacts are commonly measured using regional input/output models. These models rely on multipliers that represent the relationship between a change in one sector of the economy (e.g., expenditures by recreators) and the effect of that change on economic output, income, or employment in other local industries (e.g., suppliers of goods and services to recreators). These economic data provide a quantitative estimate of the magnitude of employment and revenue shifts in the local economy. Given the limited nature of incremental impacts likely to result from this designation, measurable regional impacts are not anticipated.

10.1.3.3 Direct Impacts

The 2 categories of direct, incremental impacts of critical habitat designation are:

1. The administrative costs of conducting Section 7 consultation; and
2. Implementation of any project modifications recommended through Section 7 consultation to avoid potential destruction or adverse modification of critical habitat.

Section 7(a)(2) of the ESA requires federal agencies to consult with NMFS whenever activities that they undertake, authorize, or fund may affect a listed species or designated critical habitat. In some cases, consultations will involve NMFS and another federal agency only, such as the U.S. Army Corps of Engineers (USACE). Often, consultations will also include a third party involved in projects, such as the applicant for a CWA Section 404 permit.

During a consultation, NMFS, the federal action agency, and the entity applying for federal funding or

permitting (if applicable) communicate in an effort to minimize potential adverse effects to the species and/or critical habitat. Communication between these parties may occur via written letters, phone calls, in-person meetings, or any combination of these. The duration and complexity of these interactions depends on a number of variables, including the type of consultation, the activity of concern, and the potential effects to the species and designated critical habitat associated with the proposed activity, the federal agency, and whether there is a private applicant involved. Section 7 consultations with NMFS may be either informal or formal, based on the determination of adverse effects to the species or critical habitat.

Informal consultations consist of discussions between NMFS, the action agency, and applicant (if applicable) concerning an action that may affect a listed species or its designated critical habitat, and are designed to identify and resolve potential adverse effects at an early stage in the planning process. Informal consultations are concluded by determining that the action is not likely to adversely affect listed species or designated critical habitat.

By contrast, a ***formal consultation*** is required if the action agency or NMFS determines that a proposed federal action may adversely affect listed species or designated critical habitat. The formal consultation process results in NMFS's determination in its Biological Opinion (BO) of whether the action is likely to jeopardize a listed species or destroy or adversely modify designated critical habitat, and project modification recommendations to avoid or minimize the impacts of those adverse effects. In addition, NMFS may conduct programmatic consultations which address an agency's multiple actions on a program, regional, or other basis.

Programmatic consultations can be used to evaluate the expected effects of groups of related agency actions expected to be implemented in the future, where specifics of individual projects such as project location are not definitively known. Programmatic Consultations allow for streamlined project-specific consultations because much of the effects analysis is completed up front in the Programmatic Opinion. Regardless of the type of consultation or proposed project, Section 7 consultations can require administrative effort on the part of all participants.

As described above, parties involved in Section 7 consultations include NMFS, a federal action agency, and, in some cases, a third-party applicant. While consultations are required for activities that involve a federal nexus and may affect a listed species regardless of whether critical habitat is designated, the additional consideration of critical habitat may increase the effort for consultations if the project or activity in question may affect critical habitat. Administrative efforts for future consultations may therefore include baseline and incremental impacts.

In general, 3 different scenarios associated with the designation of critical habitat may result in incremental administrative consultation costs:

1. **Additional effort to address adverse effects to new critical habitat in a consultation**: Future consultations taking place after critical habitat designation may require additional effort to address critical habitat issues above and beyond addressing effects to listed species or existing designated critical habitat. In this case, only the additional administrative effort required solely to consider effects to the Nassau grouper critical habitat is considered an incremental impact of the designation.
2. **Re-initiation of consultation to address adverse effects to critical habitat**: Consultations that have already been completed on an ongoing project or activity may require re-initiation to

address critical habitat. In this case, costs of re-initiating the consultation, including all associated administrative and conservation effort costs, are considered incremental impacts of the designation.

3. **New consultation resulting entirely from critical habitat designation**: Critical habitat designation may trigger future consultations that may not occur absent the designation (e.g., for an activity for which adverse modification may be an issue, while jeopardy is not). Such consultations, for example, may be triggered in critical habitat areas in which the species are not present, or in areas outside of critical habitat for other listed species. All associated administrative and conservation effort costs of these consultations are considered incremental impacts of the designation.

In addition to administrative costs, Section 7 consultations in designated critical habitat areas may also include additional project modifications recommended specifically to address potential destruction or adverse modification of the new critical habitat. This analysis refers to "project modifications" as a generic term for recommendations NMFS may make to modify projects or activities for the benefit of the any listed species or their designated critical habitat, or that action agencies or other entities may otherwise undertake to avoid adverse effects of their actions on listed species or their designated critical habitat. The ESA Section 7 Consultation Handbook includes more targeted descriptions for other terminology as follows:

- **Conservation measures** are actions to benefit or promote the recovery of listed species that are included by the federal agency as an integral part of the proposed action. These actions will be taken by the federal agency or applicant, and serve to minimize or compensate for project effects on the species under review. These may include actions taken prior to the initiation of the consultation, or actions which the federal agency or applicant have committed to complete in a biological assessment or similar document.
- **Conservation recommendations** are the Services' non-binding suggestions resulting from formal or informal consultation that: (1) identify discretionary measures that a federal agency can take to minimize or avoid the adverse effects of a proposed action on listed or proposed species, or designated or proposed critical habitat; (2) identify studies, monitoring, or research to develop new information on listed or proposed species, or designated or proposed critical habitat; and (3) include suggestions on how an action agency can assist species conservation as part of their action and in furtherance of their authorities under Section 7(a)(1) of the ESA.
- **Reasonable and prudent measures** are actions the Secretary believes necessary or appropriate to minimize the impacts, i.e., amount or extent, of incidental take. These measures are not imposed for effects to critical habitat; however, they may also reduce the impact of adverse effects to the critical habitat.
- **Reasonable and prudent alternatives** are recommended alternative actions identified during formal consultation that can be implemented in a manner consistent with the intended purpose of the action, that can be implemented consistent with the scope of the federal agency's legal authority and jurisdiction, that are economically and technologically feasible, and that the Secretary believes would avoid the likelihood of jeopardizing the continued existence of listed species or the destruction or adverse modification of designated critical habitat (U.S. Fish and Wildlife Service and National Marine Fisheries Service 1998).

For future consultations considering jeopardy and adverse modification, the economic impacts of project modifications undertaken to avoid adverse modification of the designated critical habitat, above

and beyond those that would have been undertaken to avoid jeopardy or adverse modification of existing critical habitat for other listed species, are considered incremental impacts of the critical habitat designation.

In some cases, project modifications that are undertaken in order to avoid jeopardy may also avoid adverse modification of critical habitat. That is, while jeopardy and adverse modification are not the same standard, project modifications undertaken to avoid jeopardy may also result in the project avoiding adverse modification of critical habitat. This finding is often true for aquatic and marine species for which the condition of the habitat is inextricably linked to the health of the species. In other words, while avoidance of adverse modification of critical habitat requires protection of essential features, avoiding jeopardy to the species may require protection of these features even absent critical habitat. Listing protections are relevant to the baseline management of activities wherever the listed species are present.

In some cases, the critical habitat impacts may be more readily apparent than the species level effects. For example, turbidity in the water column at a project site may be a concern for the species as well as the critical habitat. NMFS may recommend modifications to such projects to avoid both of these effects. However, measuring the impacts of turbidity on the species may be more difficult than on the habitat itself and, as such, NMFS may be more likely to examine and tie an activity to potential impacts to critical habitat within the Section 7 consultation than to the species. Although the link to adverse modification may be more readily drawn, the outcome of the Section 7 consultation is not expected to be different with or without critical habitat designation. Nonetheless, where adverse modification provides a simpler means to recommend project modifications, but the outcome of consultation is not expected to change as a result of critical habitat designation, we do not assume impacts of the project modifications are incremental to the designation.

10.1.3.4 Indirect Impacts

The designation of critical habitat may, under certain circumstances, affect actions that do not have a federal nexus and thus are not subject to the provisions of Section 7 under the ESA. Indirect impacts are those sometimes unintended changes in economic behavior that may occur outside of the influence of the ESA, through other federal, state, or local actions, and that are caused by the designation of critical habitat. [4] This section identifies common types of indirect impacts that may be associated with the designation of critical habitat. Importantly, these types of impacts are not always considered incremental. In the case that these types of conservation efforts and economic effects are expected to occur regardless of critical habitat designation, they are appropriately considered baseline impacts in this analysis.

OTHER STATE AND LOCAL LAWS

Under certain circumstances, critical habitat designation may provide new information to a community about the sensitive ecological nature of a geographic region, potentially triggering additional economic impacts under other state or local laws. In cases where these impacts would not have been triggered absent critical habitat designation, they are considered indirect, incremental impacts of the designation.

[4] Indirect impacts considered in this analysis are distinct from indirect impacts estimated in regional economic impact analysis.

ADDITIONAL INDIRECT IMPACTS

In addition to the indirect effects of compliance with other laws or triggered by the designation, project proponents, land managers and landowners may face additional indirect impacts, including the following:

- **Time Delays** - Both public and private entities may experience incremental time delays for projects and other activities due to requirements associated with the need to re-initiate the Section 7 consultation process and/or compliance with other laws triggered by the designation. To the extent that delays result from the designation, they are considered indirect, incremental impacts of the designation.
- **Regulatory Uncertainty or Stigma** - NMFS conducts each Section 7 consultation on a case-by-case basis and issues a biological opinion on formal consultations based on species-specific and site-specific information. As a result, government agencies and affiliated private parties who consult with NMFS under Section 7 may face uncertainty concerning whether project modifications will be recommended by NMFS and the nature of these modifications. This uncertainty may diminish as consultations are completed and additional information becomes available on the effects of critical habitat on specific activities. Where information suggests that this type of regulatory uncertainty stemming from the designation may affect a project or economic behavior, associated impacts are considered indirect, incremental impacts of the designation.

10.1.3.5 Benefits

Under Executive Order 12866, OMB directs federal agencies to provide an assessment of both the social costs and benefits of proposed regulatory actions. OMB's Circular A-4 distinguishes 2 types of economic benefits: direct benefits and ancillary benefits. Ancillary benefits are defined as favorable impacts of a rulemaking that are typically unrelated, or secondary, to the statutory purpose of the rulemaking (U.S. Office of Management and Budget 2003).

In the context of the ESA, the primary purpose of a critical habitat designation (i.e., the direct benefit) is the potential to enhance conservation of the species. The published economics literature has also documented that social welfare benefits can result from the conservation and recovery of endangered and threatened species. In its guidance for implementing Executive Order 12866, OMB acknowledges that it may not be feasible to monetize, or even quantify, the benefits of environmental regulations due to either an absence of defensible, relevant studies or a lack of resources on the implementing agency's part to conduct new research (U.S. Office of Management and Budget 2003).

Critical habitat aids in the conservation of listed species specifically by protecting the essential biological and physical features of critical habitat on which the species' conservation depends. To this end, critical habitat designation can result in maintenance of particular environmental conditions that may generate social benefits aside from the conservation of the species. That is, management actions undertaken to conserve a species or habitat may have coincident, positive social welfare implications, such as increased recreational opportunities in a region. While they are not the primary purpose of critical habitat, these ancillary benefits may result in gains in employment, output, or income that may offset the direct, negative impacts to a region's economy resulting from actions to conserve a species or its habitat. Section 10.3 address the potential benefits of this critical habitat designation.

10.1.3.6 Presentation of Results

Impacts are described in present value and annualized terms applying discount rates of 7% in the body

of the report. Additionally, Appendix A provides the present and annualized value of impacts in each unit applying a 3% discount rate for comparison with values calculated at 7%. Present value and annualized impacts are calculated according to the methods described in Figure 1. Economic impacts of the designation are considered within each of the 19 units being considered for designation and by category of activity.

Ideally, the time frame of this analysis would be based on the expected time period over which the critical habitat regulation is expected to be in place. Specifically, the analysis would forecast impacts of implementing this designation through species recovery (i.e., when critical habitat is no longer required). Recent guidance from OMB indicates that "if a regulation has no predetermined sunset provision, the agency will need to choose the endpoint of its analysis on the basis of a judgment about the foreseeable future" (U.S. Office of Management and Budget 2011). The "foreseeable future" for this analysis includes, but is not limited to, activities that are currently authorized, permitted, or funded, or for which proposed plans are currently available to the public. Accordingly, this analysis forecasts impacts over a ten-year time horizon. OMB supports this time frame stating that "for most agencies, a standard time period of analysis is ten to 20 years, and rarely exceeds 50 years" (U.S. Office of Management and Budget 2011). Therefore, this analysis considers economic impacts to activities over a ten-year period from 2023 through 2032.

Figure 1. PRESENT VALUE AND ANNUALIZED IMPACT CALCULATION METHODS

This analysis compares economic impacts incurred in different time periods in present value terms. The present value represents the value of a payment or stream of payments in common dollar terms. That is, it is the sum of a series of past or future cash flows expressed in today's dollars. Translation of economic impacts of past or future costs to present value terms requires the following: a) past or projected future costs of critical habitat designation; and b) the specific years in which these impacts have been or are expected to be incurred. With these data, the present value of the past or future stream of impacts (PVc) from year t to T is measured in 2022 dollars according to the following standard formula:[a]

$$PV_c = \sum_{t}^{T} \frac{C_t}{(1 + r)^{t-2023}}$$

C_t = cost of incremental impacts in year t

r = discount rate[b]

This analysis also expresses impacts for each activity as annualized values. Annualized values are calculated to provide comparison of impacts across activities with varying forecast periods (T). For this analysis, activities employ a forecast period of ten years, 2024-2033. Annualized future impacts (APVs) are calculated using the following standard formula:

$$APV_c = PV_c \left[\frac{r}{1-(1+r)^{-(N)}} \right]$$

N = number of years in the forecast period (in this analysis, ten years)

[a] To derive the present value of future impacts to development activities, t is 2024 and T is 2033.

[b] To discount and annualize costs, guidance provided by the OMB specifies the use of a real rate of 7%. In addition, OMB recommends sensitivity analysis using other discount rates such as 3%, which some economists believe better reflects the social rate of time preference. (U.S. Office of Management and Budget, Circular A-4, September 17, 2003, and U.S. Office of Management and Budget, "Draft 2003 Report to Congress on the Costs and Benefits of federal Regulations; Notice," 68 Federal Register 5492, February 3, 2003.)

10.1.4 Activities that may be affected

Activities that federal action agencies propose to authorize, fund, or carry out are subject to ESA Section 7 consultation on critical habitat. That is, such proposed actions that federal action agencies believe may affect listed species or designated critical habitat require Section 7 consultation between the action agency and NMFS to ensure the activities: a) are not likely to jeopardize the continued existence of the

species; and b) are not likely to destroy or adversely modify critical habitat.

To identify the types and geographic distribution of activities that may trigger Section 7 consultation for the Nassau grouper' critical habitat, we first reviewed Section 7 consultation records for NMFS' Southeast Region and Office of Protected Resources for activities consulted on from 2011 to 2022 in the areas being designated as critical habitat for the Nassau grouper. Of these, the consultation history includes 13 programmatic, 13 formal, and 137 informal consultations that fall within the boundaries of and may affect the designated critical habitat for the Nassau grouper. In addition, this analysis conducted stakeholder outreach to identify future activities that may affect Nassau grouper critical habitat that may have been omitted by relying on the past Section 7 consultation history. Through this outreach, we did not identify any additional activities that may affect Nassau grouper critical habitat. Stakeholders included the USACE, the U.S. Air Force, Department of the Navy, and the U.S. Coast Guard (USCG).

Based on this information, the types of activities that have the potential to affect the essential features for the Nassau grouper and involve a federal nexus include the following:

- Coastal and In-water Construction (e.g. docks, seawalls, piers, marinas, port expansions, anchorages, pipelines/cables, bridge repairs, aids to navigation, etc.)
- Water Quality Management (revision of national and state water quality standards, issuance of National Pollutant Discharge Elimination System (NPDES) permits and Total Maximum daily load (TMDL) standards, registrations of pesticides)
- Protected Area Management (development of management plans for national parks, marine sanctuaries, wildlife refuges, etc.)
- Fishery Management (development of fishery management plans)
- Aquaculture
- Military Activities (all activities undertaken by the Department of Defense, such as training exercises)
- Scientific Research and Monitoring
- Derelict Vessel and Marine Debris Removal
- Oil & Gas and Renewable Energy Development (development of oil, gas, or renewable energy, such as tidal power, in the marine environment)

Table 5 summarizes historical Section 7 consultation data for each of these activity categories from 2011 to 2022. The vast majority (approximately 84%) of historical consultations occurring within the critical habitat were informal. The limited subset of formal and programmatic consultations (26 actions) was primarily associated with construction activities, scientific research and monitoring activities, and activities related to water quality. As shown in Table 6, consultations were concentrated across Florida, Puerto, and USVI units, with Florida units alone accounting for approximately 64% of total consultations.

Table 5. NMFS SOUTHEAST REGION CONSULTATIONS FOR ACTIVITIES THAT MAY AFFECT NASSAU GROUPER CRITICAL HABITAT AREAS, BY ACTIVITY TYPE AND ACTION AGENCY (2011 – 2022)

ACTIVITY TYPE	ACTION AGENCY	TOTAL NUMBER OF CONSULTATIONS
Coastal & In-water Construction	USACE, USCG	98
Protected Area Management	NPS	11

ACTIVITY TYPE	ACTION AGENCY	TOTAL NUMBER OF CONSULTATIONS
Military Activities	DoD	12
Fishery Management	NMFS	11
Scientific Research and Monitoring	NOAA	13
Water Quality Management	EPA, USACE	10
Derelict Vessel and Marine Debris Removal	USCG, NOAA	7
Aquaculture	USACE	1
Total		**163**
Source: NMFS. Public Consultation Tracking System and Environmental Consultation Organizer.		

Table 6. NMFS SOUTHEAST REGION CONSULTATIONS FOR ACTIVITIES THAT MAY AFFECT NASSAU GROUPER CRITICAL HABITAT AREAS, BY UNIT (2011 – 2022)

UNIT	FORMAL CONSULTATIONS	INFORMAL CONSULTATIONS	PROGRAMMATIC CONSULTATIONS	TOTAL NUMBER OF CONSULTATIONS
Biscayne/Key Largo	2.5	30.7	1.4	34.6
Marathon	1.5	14.7	0.4	16.6
Big Pine Key	1.5	40.7	0.4	42.6
Key West	0.5	4.7	0.4	5.6
New Ground Shoal	0.5	0.7	0.4	1.6
Halfmoon Shoal	0.5	0.7	0.4	1.6
Dry Tortugas	0.5	0.7	0.4	1.6
Florida, All	**7.7**	**92.7**	**3.8**	**104.2**
Mona Island	1.2	2.0	0.7	3.9
Desecheo	0.2	1.0	0.7	1.9
Southwest	0.2	9.0	0.7	9.9
Northeast	0.2	12.0	0.7	12.9
Vieques	0.2	6.0	1.7	7.9
Isla de Culebra/ Culebrita	0.2	1.0	0.7	1.9
Puerto Rico, All	**2.2**	**30.9**	**5.0**	**38.1**
Navassa	**0.1**	**0.3**	**0.3**	**0.7**
USVI - STT	1.0	6.8	1.0	8.8
USVI - STJ	1.0	0.8	1.0	2.8
USVI - STX	1.0	4.8	1.0	6.8
USVI, All	**2.9**	**12.5**	**3.0**	**18.4**
Bajo de Sico	**0.1**	**0.3**	**0.3**	**0.7**
Grammanik Bank/ Hind Bank	**0.1**	**0.3**	**0.3**	**0.7**
Riley's Hump	**0.0**	**0.1**	**0.3**	**0.4**
TOTAL	**13.0**	**137.0**	**13.0**	**163.0**
Source: NMFS. Public Consultation Tracking System and Environmental Consultation Organizer.				

UNIT	FORMAL CONSULTATIONS	INFORMAL CONSULTATIONS	PROGRAMMATIC CONSULTATIONS	TOTAL NUMBER OF CONSULTATIONS
Numbers of consultations on activities affecting multiple units were distributed across relevant units.				

The remainder of this section provides an overview of each of the activities potentially affected by the designated critical habitat, including a description of and how they may affect the essential features of critical habitat for the Nassau grouper, the scope of historical activity within the designated critical habitat, and how they are currently managed under the baseline regulatory environment. Baseline protections exist in large areas of the designation; however, there is uncertainty as to the degree of protection that these baseline provisions may provide relevant to future projects. In particular, the listing status of the Nassau grouper, listing status of Acropora and Caribbean coral species, and significant overlap with coral critical habitat may reduce the potential effects of future activities on the designated critical habitat. Where the Nassau grouper critical habitat overlaps with the presence of coral critical habitat, recommended modifications to avoid adverse modification of the coral reef or hardbottom substrate features of the Nassau grouper critical habitat would likely already be recommended to avoid or minimize adverse impacts to the listed corals and/or Acropora critical habitat. Figure 2 and Figure 3 illustrate where Florida and Caribbean units of the Nassau grouper critical habitat overlap with Acropora critical habitat.

Thus, if a project requires consultation to avoid potential adverse effects to the designated critical habitat and listed corals and/or Acropora critical habitat, and the same project modification would address both types of adverse effects, the costs of project modification are co-extensive, i.e., critical habitat would not add project modification costs. While the areas where the essential features of coral critical habitat are present are uncertain, anywhere the threatened coral species or Acropora critical habitat essential feature are present, project modifications are considered baseline protections which

PROTECTIONS PROVIDED BY KEY BASELINE REGULATIONS

Baseline protections that reduce the potential effects of future activities on the Nassau grouper critical habitat include the following:

-The ESA-listing of the Nassau grouper prohibits "take" of the species.

-Overlap of the presence of other ESA-listed species, including listed corals, and the associated critical habitat designation that protects the essential features of the critical habitat to the extent that projects or activities that may adversely affect the critical habitat also pose a jeopardy threat to the listed species or the threat of adverse modification or destruction of coral critical habitat.

-The primary law governing marine fisheries management in U.S. federal waters, the Magnuson-Stevens Fishery Conservation and Management Act, fosters the long-term biological and economic sustainability of U.S. marine fisheries. Key objectives of the MSFCMA include the prevention of overfishing and protection of habitat that fish need to spawn, breed, feed, and grow to maturity.

-Overlap of the designated Nassau grouper critical habitat with several federal protected areas affords the critical habitat extensive protections against potentially damaging activities.

would occur regardless of the Nassau grouper critical habitat designation. However, that assumption only holds in project areas where the Nassau grouper critical habitat overlaps with areas in which the essential features of the critical habitat of one or more of the listed coral species is present. These baseline protections would not extend to areas of the designated critical habitat that contain essential features other than hard bottom substrate. Listing protections are relevant to the baseline management of activities wherever the coral species are present.

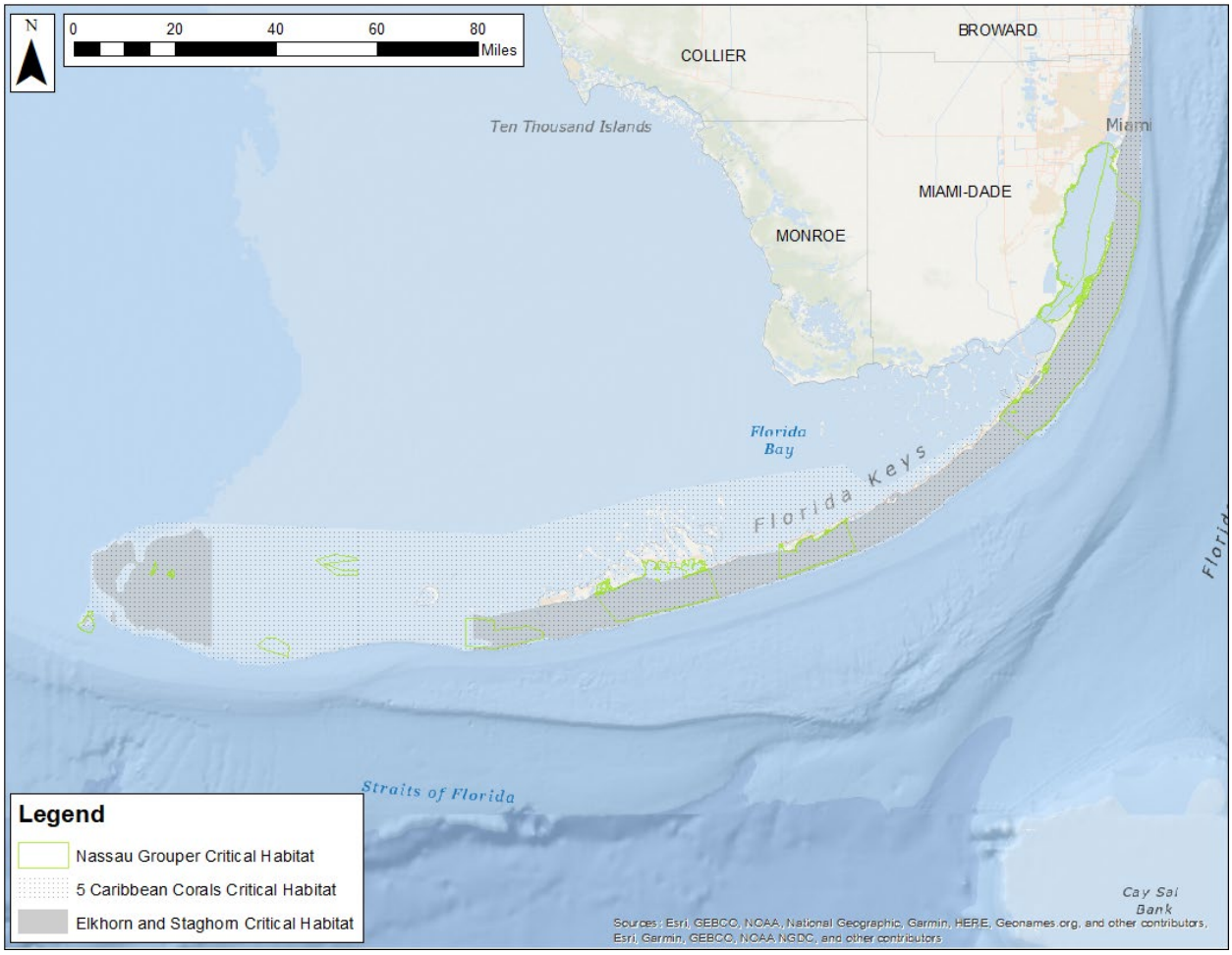

Figure 2. OVERLAP WITH ELKHORN AND STAGHORN CRITICAL HABITAT IN FLORIDA COASTAL WATERS.

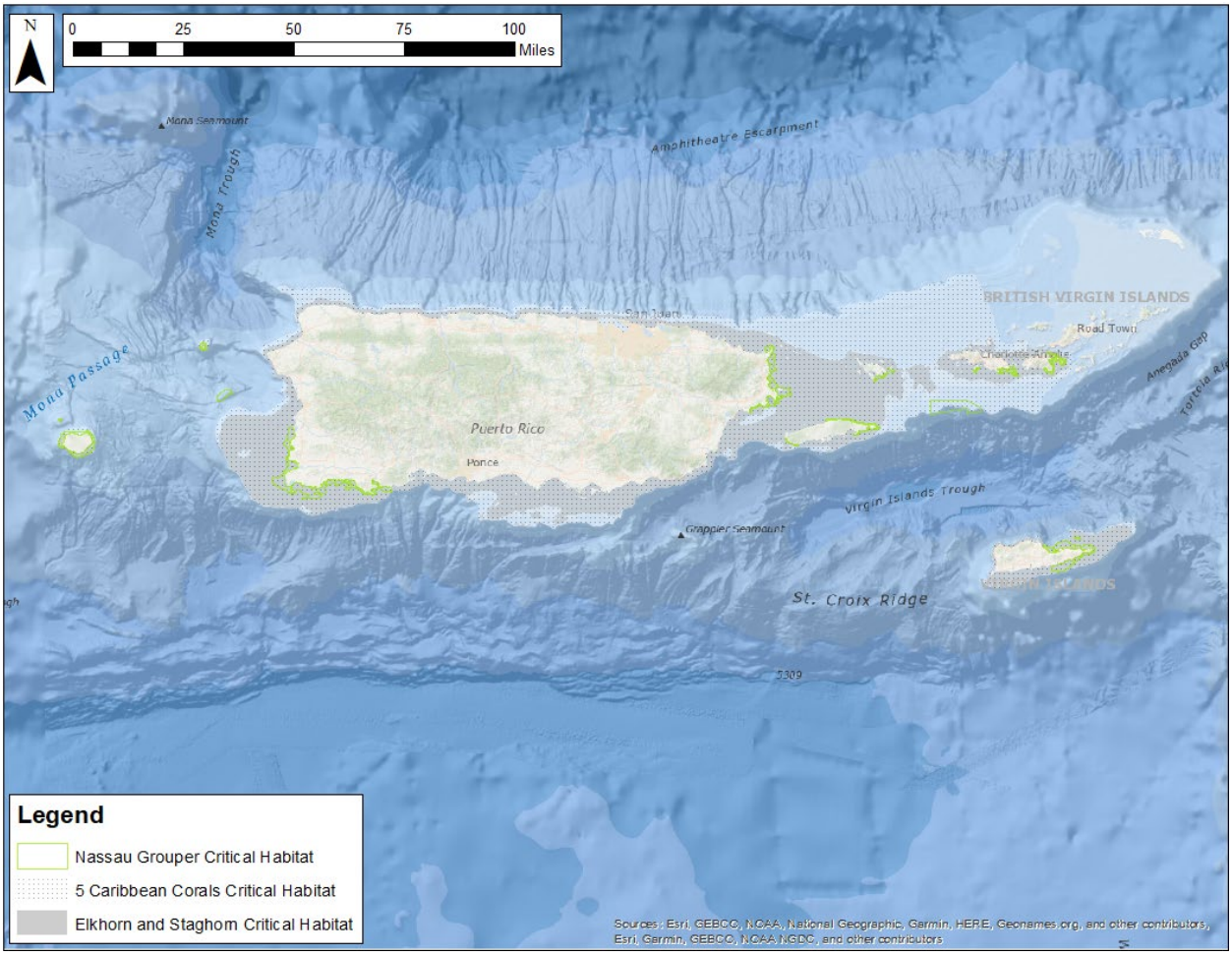

Figure 3. OVERLAP WITH ELKHORN AND STAGHORN CRITICAL HABITAT IN THE CARIBBEAN.

10.1.4.1 In-Water and Coastal Construction – USACE

Construction activities in U.S. waters are generally regulated by the USACE, which administers permits through the CWA and the Rivers and Harbors Act of 1899. Section 404 of the CWA authorizes USACE to regulate and permit the discharge of dredged or fill material into waters of the United States (33 USC § 1344). Sections 9 and 10 of the Rivers and Harbors Act of 1899 authorize USACE to regulate and permit structures and work affecting navigable waters of the United States (33 USC §§ 401 et seq. 1938).

DESCRIPTION OF THREAT

Coastal and in-water construction activities represent the most frequently occurring potential threat to the designated Nassau grouper critical habitat. Construction activities may affect the essential features of the Nassau grouper critical habitat in several different ways. Shoreline projects such as docks, boat ramps, seawalls, and marinas account for the large majority of construction activities. These projects may result in the permanent removal of elements of nearshore shallow subtidal areas, including medium to coarse sediments, shells, and rubble mounds. These projects also have the potential to cause temporary cover of the critical habitat due to sedimentation generated during construction. Mooring buoy installation similarly may result in the permanent removal of small amounts of intermediate and offshore critical habitat and temporary cover of adjacent critical habitat during construction. Maintenance and replacement of fixed aids to navigation (ATONs), conducted by USCG, may cause

sedimentation of the seafloor surrounding piling or other foundation. Use of floating ATONs may result in removal of the elements of the essential feature through chain scouring and placement of the sinker. As of April 2022, USCG maintained 211 fixed ATONs and 21 floating ATONs within the designated critical habitat areas. Importantly, the removal of elements of the feature in-and-of themselves is not necessarily indicative of an impact to the feature, which is a mosaic of elements that serve a function as a whole. The habitat's value to the Nassau grouper derives from the combination of sediment type and habitat complexity caused by interspersed structure, thus the removal of elements of the feature would not adversely affect the feature if its function is not impacted. This has bearing on the estimation of costs of the rule to construction activities, as a consultation would not necessarily be elevated to formal because an area of coarse sand is covered by interspersed structure, if the function of providing habitat for cover and feeding is not impacted.

EXTENT OF ACTIVITY WITHIN CRITICAL HABITAT AREA

This analysis relied upon two sources to determine the historical frequency and location of construction projects with a federal nexus:

- NMFS Public Consultation Tracking System (PCTS) and NMFS Environmental Consultation Organizer (ECO) Section 7 consultation history from 2011 to 2022. The PCTS and ECO were queried to identify consultations on all species in NMFS Southeast Region that involved activities with the potential to affect the essential features of Nassau grouper critical habitat.

- USACE's Jacksonville permit application database from 2011 to 2022 (US Army Corps of Engineers 2022). The USACE permit application database was queried to identify all permit applications located within the critical habitat area. The data were then refined to include only those activities that may affect the designated critical habitat. These records were compared to NMFS' Section 7 consultation records to assess how accurately NMFS' records capture historical construction activities within the areas of the critical habitat designation.

Between 2011 and 2022, NMFS completed 2 programmatic, 4 formal, and 92 informal consultations related to construction activities that likely impacted the designated critical habitat (Table 7). These consultations were concentrated in the Big Pine Key (41 consultations), Biscayne/Key Largo (21), and Marathon (15) units off of Florida. Additional informal consultations were distributed across the Northeast (6 consultations) and Southwest (3) units of Puerto Rico, St. Thomas (6), and St. Croix (3). Projects consulted on through the programmatic consultation on Authorization of Minor In-Water Activities throughout the Geographic Area of Jurisdiction of the U.S. Army Corps of Engineers Jacksonville District, including Florida and the U.S. Caribbean (JAXBO), occurred throughout populated areas of the designated critical habitat. USACE was the lead federal action agency on 90 of the 98 formal and informal consultations on construction activities. The USCG was the lead action agency on a formal consultation on the Miami Beach Corridor Rapid Transit Project. The USCG also completed a formal programmatic consultation with NMFS in 2018 on the continued implementation of its ATON program. The Federal Emergency Management Agency was the lead action agency on two consultations, including a formal consultation on an oceanfront park boardwalk and pier repair project in the City of Marathon which was necessitated by damages sustained during Hurricane Irma in 2017. Coastal and in-water construction consultations accounted for approximately 60% of all consultations from 2011 to 2022 on activities that may affect the designated critical habitat.

Table 7. NMFS SOUTHEAST REGION CONSULTATIONS FOR CONSTRUCTION ACTIVITIES THAT MAY AFFECT NASSAU GROUPER CRITICAL HABITAT AREAS, BY UNIT AND CONSULTATION TYPE (2011 – 2022)

UNIT	NUMBER OF FORMAL CONSULTATIONS	NUMBER OF INFORMAL CONSULTATIONS	NUMBER OF PROGRAMMATIC CONSULTATIONS	TOTAL
Biscayne/Key Largo	1.0	20.0	0.1	21.1
Marathon	1.0	14.0	0.1	15.1
Big Pine Key	1.0	40.0	0.1	41.1
Key West	0.0	0.0	0.1	0.1
New Ground Shoal	0.0	0.0	0.1	0.1
Halfmoon Shoal	0.0	0.0	0.1	0.1
Dry Tortugas	0.0	0.0	0.1	0.1
Florida, All	**3.0**	**74.0**	**0.7**	**77.7**
Mona Island	0.0	0.0	0.1	0.1
Desecheo	0.0	0.0	0.1	0.1
Southwest	0.0	3.0	0.1	3.1
Northeast	0.0	6.0	0.1	6.1
Vieques	0.0	0.0	0.1	0.1
Isla de Culebra/ Culebrita	0.0	0.0	0.1	0.1
Puerto Rico, All	**0.0**	**9.0**	**0.6**	**9.6**
Navassa	**0.0**	**0.0**	**0.1**	**0.1**
USVI - STT	0.3	6.0	0.1	6.4
USVI - STJ	0.3	0.0	0.1	0.4
USVI - STX	0.3	3.0	0.1	3.4
USVI, All	**1.0**	**9.0**	**0.3**	**10.3**
Bajo de Sico	**0.0**	**0.0**	**0.1**	**0.1**
Grammanik Bank/ Hind Bank	**0.0**	**0.0**	**0.1**	**0.1**
Riley's Hump	**0.0**	**0.0**	**0.1**	**0.1**
TOTAL	**4.0**	**92.0**	**2.0**	**98.0**

Source: NMFS SERO's Section 7 consultation database.
Fractions of consultations occurred as a result of assigning some consultations to two or more units.

The construction category encompasses a number of activities, each with varying levels of applicability to the types of adverse effects identified above. Table 8 outlines the various types of construction activities observed in the Section 7 consultation history. While consultations comprised a large number of construction subcategories, consultations on dock/boat ramp projects accounted for 64% of informal and formal consultations on coastal and in-water construction activities from 2011 to 2022 that may affect the designated critical habitat. Consultations on marina/harbor (7.7), seawall (6.0), marina (6), mooring buoy installation (4.1), and shoreline stabilization (3.0) projects together accounted for 21% of consultations on construction activities.

Table 8. SECTION 7 CONSULTATIONS ON CONSTRUCTION ACTIVITIES IN DESIGNATED CRITICAL HABITAT AREAS FOR NASSAU GROUPER BY SUBCATEGORY (2011 – 2022)

CONSTRUCTION SUBCATEGORY	TOTAL NUMBER OF CONSULTATIONS
Dock/Boat ramp	63.1

CONSTRUCTION SUBCATEGORY	TOTAL NUMBER OF CONSULTATIONS
Marina/Harbor	7.7
Seawall	7.0
Mooring buoys	4.1
Shoreline stabilization	3.0
Breakwater	2.1
Dredging/Disposal	2.0
Pipeline/Cable	2.0
Pier	1.6
All other	5.4
TOTAL	**98.0**

Source: NMFS Public Consultation Tracking System and Environmental Consultation Organizer
Fractions of consultations occurred as a result of assigning some consultations to two or more construction subcategories.

REGULATORY BASELINE

As a condition of permitting, USACE often requires applicants to avoid or minimize impacts to listed species and any critical habitat in which the project is located. As a result, some baseline protections for listed species and critical habitats that overlap with the designated critical habitat may protect the critical habitat contiguous area essential feature, even absent the critical habitat designation for the Nassau grouper. Such protections include:

- Monitoring and control of turbidity during construction, often through the use of turbidity curtains. In some instances, the use of turbidity curtains may be waived by the USACE project manager if the project is deemed too minimal to generate turbidity (e.g., certain aids to navigation installation, scientific survey device placement, marine debris removal) or if the current is too strong for the curtains to stay in place.
- Positioning of turbidity barriers in a way that does not block species' entry to or exit from designated critical habitat.
- Maintaining use of turbidity curtains until construction work has been completed and the water quality in the project area has returned to background conditions.
- In the range of ESA-listed corals, mandatory installation of sediment control barriers to prevent any upland sediments from reaching estuarine or marine waters. If turbidity curtains are not feasible in an area based on site conditions such as water current, high wave action, or stormy conditions, the project must undergo individual Section 7 consultation and cannot be covered under JAXBO.
- Avoidance and minimization to the extent practicable of impacts to non-ESA listed native, non-invasive seagrasses.
- Implementation of dock construction guidelines which prevent shading impacts over coral resources (National Marine Fisheries Service 2015a).
- Where the designated critical habitat overlaps with coral critical habitat, project design or modification to minimize or avoid impacts to the hard bottom substrate.

When establishing, maintaining, or discontinuing ATONs, USCG follows project design criteria intended to prevent or minimize adverse effects to ESA-listed species and critical habitat (National Marine Fisheries Service 2018a). These include:

- Use of environmental observers to identify ESA-listed marine species and designated critical habitats.
- Installation of turbidity barriers to minimize sedimentation of adjacent habitats.
- Prohibition against anchoring of vessels on coral habitats and the use of drag hooks were ESA-listed corals are present.
- Maximization of the accuracy of sinker replacements on or near reef and seagrass habitats through utilization of the ship's most accurate navigation and positioning systems and the careful lowering of sinkers.
- Avoidance of impacts to seagrass hardbottom to the maximum extent practicable during ATON operations.
- When practicable, use of smaller diameter pilings for construction in or close to seagrass, oysters, hardbottom, and corals.

Given these baseline protections, as well as the assumption that at least some components of the contiguity essential feature are present throughout the designated critical habitat areas, NMFS anticipates that impacts from future in-water and coastal construction projects will be sufficiently limited that the functionality of the critical habitat will not be diminished. Specifically, construction activities occurring within the designated areas, which result in the removal or temporary cover of small amounts of the essential feature, do not inhibit the progression of Nassau grouper from nearshore to offshore areas, i.e., they do not reduce the functionality of the critical habitat. Consequently, this analysis concludes that incremental costs of the final rule to construction activities will be limited to the additional administrative effort required to consider impacts to the critical habitat through consultations that would occur absent designation.

MAINTENANCE DREDGING OF NAVIGATION CHANNELS

The final critical habitat excludes navigation channels that are dredged on a recurring basis as well as areas beyond the channels where sedimentation impacts from the dredging operations are persistent, are expected to recur whenever the channel is dredged, and are of such a level that the areas in question have already been made unsuitable. While these areas may provide functional habitat over short periods, the periodic nature of direct disturbance renders them poor habitat over time. The navigation channels and surrounding impacted areas are defined areas where the substrate has been persistently disturbed by planned management activities authorized by local, state, or Federal governmental entities at the time of critical habitat designation, and where periodic disturbance by such management activities are expected to continue. As such, this analysis anticipates that maintenance dredging activities will not be impacted by the designation of critical habitat for Nassau grouper.

DISPOSAL OF DREDGED MATERIAL

Provisions of sections 102 and 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA), also known as the Ocean Dumping Act, require that site selection for the disposal of dredged material consider the potential site's location in relation to breeding, spawning, nursery, feeding, and passage areas of living marine resources and amenity areas. These provisions help ensure that the contiguity of Nassau grouper critical habitat not be diminished as a result of dumping of dredged material. The MPRSA further stipulates that impacts to coral reefs should be avoided during the site selection process

by selecting sites that avoid areas with reefs or areas where reefs may be affected by subsequent disposal (United States Environmental Protection Agency 2022). Based on available information, the Ocean Dredged Material Disposal Sites closest to the designated critical habitat areas occur in areas deeper than 90 meters (United States Environmental Protection Agency 2015); thus, this activity is not expected to be affected by the designation of critical habitat.

10.1.4.2 Water Quality Management – EPA

This activity encompasses efforts by the EPA, states, and territories to establish appropriate water quality standards, as well as ocean discharges and onshore activities that have the potential to affect water quality. This activity also includes the registration of pesticides by the Environmental Protection Agency (EPA).

DESCRIPTION OF THREAT

Sewage, industrial effluent, storm water runoff, river discharge, and groundwater are sources of nutrients, sediments, turbidity, and contaminants that may adversely affect seagrasses, corals species, or features essential to coral habitat. Two components of discharges from land are nitrogen and phosphorus (e.g., organic and inorganic nutrients). Nutrification (excess nutrients) from ocean outfall discharges contribute to algal and bacteria blooms that reduce dissolved oxygen and diminish the persistence and distribution of seagrass that provides prey and cover to protect growing fish as they move from the nearshore nursery areas into deeper areas. The algal and bacteria blooms can also smother or shade coral species or reduce the quantity or quality of areas suitable for coral colonization and growth. These contaminants are delivered to the water column via several sources, including wastewater discharge, industrial activities, coastal and in-water construction, and agriculture and urban runoff.

EXTENT OF ACTIVITY WITHIN CRITICAL HABITAT AREAS

A review of the Section 7 consultation history from 2011 to 2022 identified 10 consultations related to water quality management activities, with consultations distributed across Florida, Puerto Rico, and USVI units. These included programmatic consultations on revisions to water quality standards to enhance protections to aquatic life, including ESA-listed coral species (Table 9).

Table 9. NMFS SOUTHEAST REGION CONSULTATIONS FOR WATER QUALITY MANAGEMENT ACTIVITIES THAT MAY AFFECT NASSAU GROUPER CRITICAL HABITAT AREAS, BY UNIT AND CONSULTATION TYPE (2011 – 2022)

UNIT	NUMBER OF FORMAL CONSULTATIONS	NUMBER OF INFORMAL CONSULTATIONS	NUMBER OF PROGRAMMATIC CONSULTATIONS	TOTAL
Biscayne/Key Largo	0.1	0.0	0.1	0.2
Marathon	0.1	0.0	0.1	0.2
Big Pine Key	0.1	0.0	0.1	0.2
Key West	0.1	0.0	0.1	0.2
New Ground Shoal	0.1	0.0	0.1	0.2
Halfmoon Shoal	0.1	0.0	0.1	0.2
Dry Tortugas	0.1	0.0	0.1	0.2
Florida, All	**1.0**	**0.0**	**0.4**	**1.4**
Mona Island	0.0	0.1	0.5	0.6
Desecheo	0.0	0.1	0.5	0.6
Southwest	0.0	0.1	0.5	0.6

UNIT	NUMBER OF FORMAL CONSULTATIONS	NUMBER OF INFORMAL CONSULTATIONS	NUMBER OF PROGRAMMATIC CONSULTATIONS	TOTAL
Northeast	0.0	1.1	0.5	1.6
Vieques	0.0	0.1	0.5	0.6
Isla de Culebra/ Culebrita	0.0	0.1	0.5	0.6
Puerto Rico, All	**0.0**	**1.7**	**2.8**	**4.5**
Navassa	**0.0**	**0.0**	**0.1**	**0.1**
USVI - STT	0.0	0.1	0.8	0.9
USVI - STJ	0.0	0.1	0.8	0.9
USVI - STX	0.0	1.1	0.8	1.9
USVI, All	**0.0**	**1.3**	**2.4**	**3.7**
Bajo de Sico	**0.0**	**0.0**	**0.1**	**0.1**
Grammanik Bank/ Hind Bank	**0.0**	**0.0**	**0.1**	**0.1**
Riley's Hump	**0.0**	**0.0**	**0.1**	**0.1**
TOTAL	**1.0**	**3.0**	**6.0**	**10.0**

Source: NMFS SERO's Section 7 consultation database.
Fractions of consultations occurred as a result of assigning some consultations to two or more units.

NMFS issued a biological and conference opinion in 2019 on the effects of EPA issuance of the 2021 Multi-Sector General Permit (MSGP) on numerous listed species and designated critical habitat in areas where EPA is the National Pollutant Discharge Elimination System permitting authority, including Puerto Rico (NMFS 2019). The biological opinion noted the presence of near-coastal MSGP facilities potentially affecting Nassau grouper. A biological opinion issued in 2017 considered effects to the Nassau grouper of EPA's approval of Florida estuary specific numeric nutrient criteria for total phosphorus, total nitrogen, and chlorophyll-a, but the 42 estuary segments in waters off of Florida did not include any portions of the designated areas (National Marine Fisheries Service 2017a). According to NMFS' Conference and Biological Opinion on EPA's reissuance of the 2021 Pesticide General Permit (PGP) on ESA-listed species and designated critical habitat, the "top five current impairments for Puerto Rico's bays and estuaries (12.6 miles) are fecal coliform, low dissolved oxygen, copper, turbidity, and pH. A total of 442.2 miles of coastal shoreline are impaired by turbidity, low dissolved oxygen, pH, enterococcus bacteria, and temperature. The sources for these impairments are associated with sewage and urban/marina runoff" (National Marine Fisheries Service 2021).

REGULATORY BASELINE

The CWA directs states to adopt water quality standards for their waters subject to the CWA. These standards include water quality criteria expressed as constituent levels representing a quality of water that supports a particular designated use. States are required to review applicable water quality standards at least once every three years and, if appropriate, revise or adopt new water quality standards and submit to EPA for review and approval or disapproval. EPA consults with NMFS on approvals of water quality standard submissions that may affect listed species. The status of water quality standards development in each relevant area is summarized below:

Florida's current water quality standards include thermal surface water criteria for coastal and open waters of 92° F (33.3°C) and 97° F (36.1°C), respectively, turbidity limit of < 29 NTU, and site-specific criteria for chlorophyll a varying from 0.2 to 1.09 µg L-1 for open ocean coastal waters (Florida Department of State 2021). Florida is currently conducting its triennial review of its statewide water quality standards (Florida Department of Environmental Protection 2021). As part of this triennial

review, FLDEP is proposing several revisions to water quality standards, including a narrative turbidity criterion to protect corals and updated cadmium criteria.

According to EPA, the current turbidity standard in Puerto Rico is 10 NTUs (United States Environmental Protection Agency 2022). NMFS' 2019 biological and conference opinion on the effects of EPA issuance of the 2021 MSGP included changes made for the 2021-2026 MSGP permit term, including that permittees:

- Provide a graphical example showing that the action area is not limited to the facility property, but includes all areas affected by stormwater flowing from the site; and
- Consider structural improvements and enhanced pollution prevention measures and other mitigation measures to minimize impacts from stormwater discharges from major storm events that cause extreme flooding conditions.

The biological opinion specifically referenced losses of listed coral and seagrass beds in waters off of Puerto Rico from hurricanes, including Hurricane Maria in 2017, which resulted in contamination of nearshore waters due to flooding of terrestrial areas including wastewater treatment plants. The biological opinion further determined that the EPA's reissuance of the MSGP was likely to adversely affect, but not likely to jeopardize the continued existence of Nassau grouper.

In the USVI, current water quality standards took effect in 2019 include a temperature criterion that areas where coral reef ecosystems are located are not to exceed 25–29° C, nor be greater than 1.0° C above natural conditions as a result of waste discharge (U.S. Virgin Islands Department of Planning and Natural Resources 2019). This maximum temperature standard replaced the prior maximum allowable water temperature standard of 32° C (U.S. Virgin Islands Department of Planning and Natural Resources 2016). The maximum permissible turbidity reading is 1 Nephelometric Turbidity Unit (NTU) in areas where coral reefs are present and 3 NTU elsewhere, and phosphorus levels may not exceed 50 milligrams per liter in marine and coastal waters (U.S. Virgin Islands Department of Planning and Natural Resources 2019).

The NPDES program provides a method of achieving water quality standards by regulating point sources of pollution into U.S. waters. States can be granted primacy by EPA to manage NPDES permits, though EPA retains the right to reject state programs and administer permits according to its own standards. Currently, Florida and the USVI manage their own NPDES programs, while the Puerto Rico program is administered by EPA. Absent a federal nexus associated with issuance of a permit in Florida and the USVI, Section 7 consultation regarding Nassau grouper critical habitat is expected to be limited to the triennial review of water quality standards, which involves EPA oversight. In Puerto Rico, however, to the extent that EPA determines that issuance of individual NPDES permits may affect corals or their critical habitat, Section 7 consultation is required.

As part of the process of developing water quality standards, EPA considers levels that would be needed to protect Nassau grouper and any other potentially impacted listed species and critical habitat. Accordingly, the effect of developing water quality standards on Nassau grouper habitat is a consideration even absent critical habitat designation. Recommendations that result from Section 7 consultation on water quality standards related to multiple species, including the Nassau grouper and listed corals, have the potential to result in more stringent water quality standards in the future. However, this would likely occur regardless of critical habitat designation for Nassau grouper. Consequently, this analysis concludes that incremental costs of the final rule to activities related to

water quality standards will be limited to the additional administrative effort required to consider impacts to the critical habitat through consultations that would occur absent designation.

10.1.4.3 Protected Area Management – NOAA National Ocean Service, Department of Interior National Park Service

A number of protected areas overlap with the specific areas under consideration for Nassau grouper critical habitat. These protected areas include federal marine sanctuaries, parks, monuments, and wildlife refuges. Many of the protected areas overlapping the final critical habitat are popular tourist destinations.

DESCRIPTION OF THREAT

The primary threat to the Nassau grouper associated with protected areas relates to human use of the areas. Activities such as boating, fishing, and diving present the potential for inadvertent damage to nearshore shallow subtidal marine areas, intermediate hard bottom areas, and offshore linear and patch reefs from vessel anchoring or grounding, and certain fishing practices.

EXTENT OF ACTIVITY WITHIN CRITICAL HABITAT AREAS

A review of the Section 7 consultation history from 2011 to 2022 identified 11 consultations related to protected area management activities within the designated areas. All 11 consultations were with the National Park Service on projects or activities occurring in Biscayne National Park. The 9 informal consultations included dock replacement, mooring buoy installation, and aids to navigation installation projects, as well as one seagrass restoration program. The 2 other consultations, both completed in 2011, were a formal consultation on NPS' Fishery Management Plan draft environmental impact statement (EIS) and a programmatic consultation on NPS' Draft General Management Plan EIS.

REGULATORY BASELINE

A number of protected areas overlap with the specific areas under consideration for the Nassau grouper critical habitat. Table 10 lists these protected areas as well as the associated management agency, and where readily available, a list of existing measures that may be protective of Nassau grouper critical habitat. Figure 4, Figure 5, and Figure 6 illustrate the locations of several protected areas that overlap with the final critical habitat across Florida and Caribbean units, respectively. These protected areas are guided by formal management plans implemented by federal agencies. When a federal agency such as NPS is involved, revisions to these management plans may require Section 7 consultation.

Table 10. FEDERAL PROTECTED AREAS WITHIN THE FINAL CRITICAL HABITAT

PROTECTED AREA	MANAGER	PROTECTION LEVEL	KEY BASELINE PROTECTIONS
Florida Keys National Marine Sanctuary	NOAA, National Marine Sanctuaries	Zoned w/No Take Areas	Prohibited: Moving, removing, taking, harvesting, damaging, disturbing, breaking, cutting, or otherwise injuring, or possessing (regardless of where taken from) any living or dead coral or coral formation, or attempting any of these activities, except as permitted; drilling into, dredging, or otherwise altering the seabed of the Sanctuary; and operating a vessel in such a manner as to strike or otherwise injure coral, seagrass, or other immobile organisms attached to the seabed, or cause prop scarring.[1]
Biscayne National Park	National Park Service	Zoned Multiple Use	Several areas are closed year-round to public entry to protect sensitive resources and wildlife. Beaching or anchoring of vessels is prohibited in several areas of the Park. Anchoring of vessels in coral reefs is prohibited.[2]
Dry Tortugas National Park	National Park Service	Zoned w/No Take Areas	Prohibited: Extractive activities in the Research Natural Area, including fishing; commercial fishing within Dry Tortugas National Park; taking, possessing, removing, damaging, touching, handling, harvesting, or otherwise injuring coral, coral formation, seagrass, or other living or dead organisms; striking, injuring, or damaging coral, seagrass, or any other immobile organism as a result of vessel operation; and destroying, removing, defacing, or tampering with wrecked or abandoned vessels.[3]
Buck Island Reef National Monument	National Park Service	No Take	Prohibited: Dredging and filling; boat operation that damages underwater features; anchoring other than in deep sand bottom areas; all forms of fishing; and destruction, removal, displacement, or tampering with wrecked or abandoned waterborne craft.[4]
Virgin Islands National Park	National Park Service	Zoned w/No Take Areas	Prohibited: Dredging and filling; boat operation that damages underwater features; anchoring except in emergency situations; destruction, removal, displacement, or tampering with wrecked or abandoned waterborne craft.[5]
Virgin Islands Coral Reef National Monument	National Park Service	No Take	Prohibited: All boat anchoring, except for emergency or authorized administrative purposes; all fishing or take of any kind, except by permit, when on a designated fishing morring for blue runner, mackerel, tuna, and bonitos.[6]
Sources: [1] 15 CFR 922.163, [2] 16 USC § 410gg, [3] 36 CFR 7.274, [4] 36 CFR 7.73., [5] 36 CFR 7.74., [6] 66 FR 7364.			

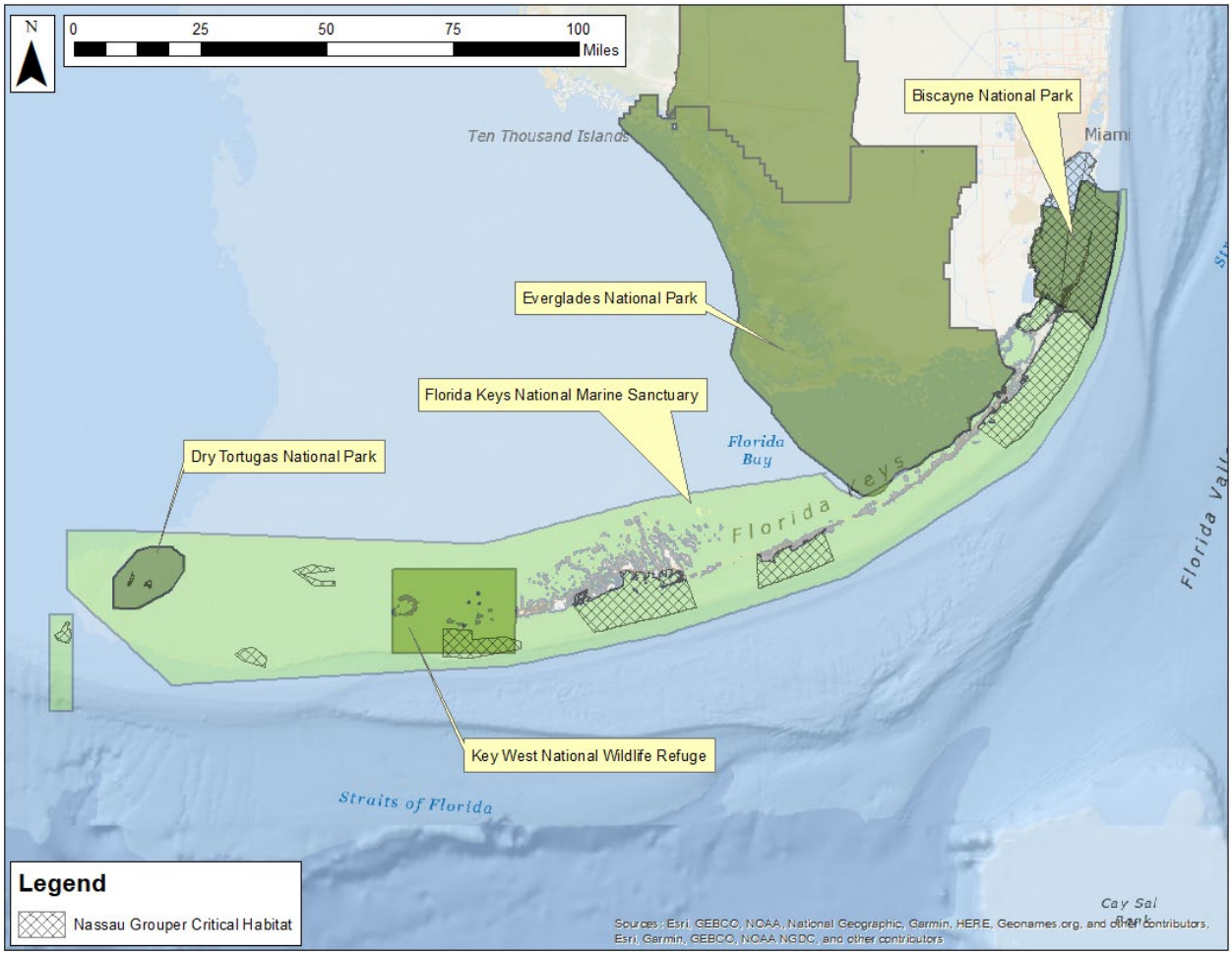

Figure 4. FEDERAL PROTECTED AREAS WITHIN OR NEAR THE FINAL CRITICAL HABITAT OFF THE COAST OF FLORIDA.

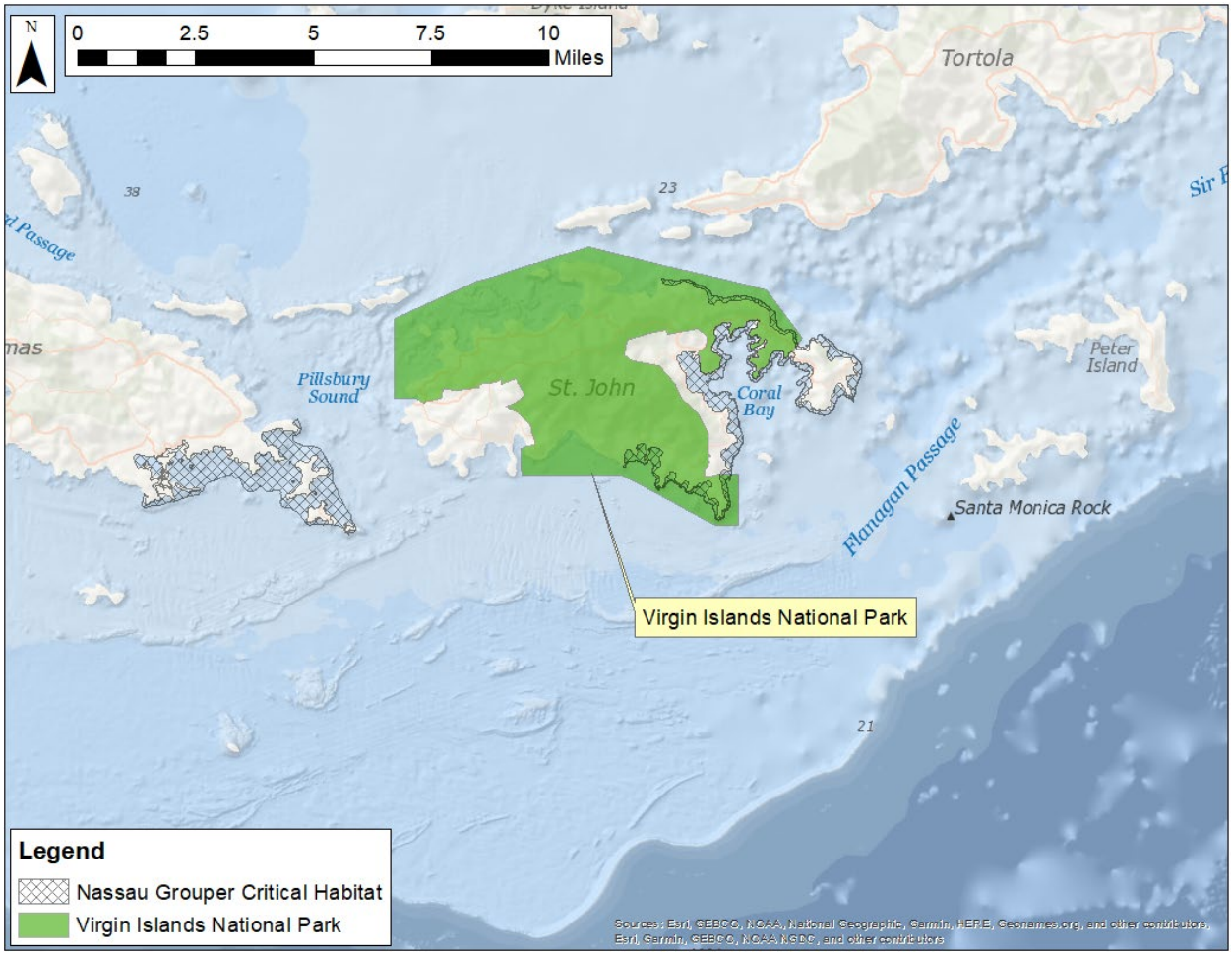

Figure 5. FINAL CRITICAL HABITAT AND VIRGIN ISLANDS NATIONAL PARK.

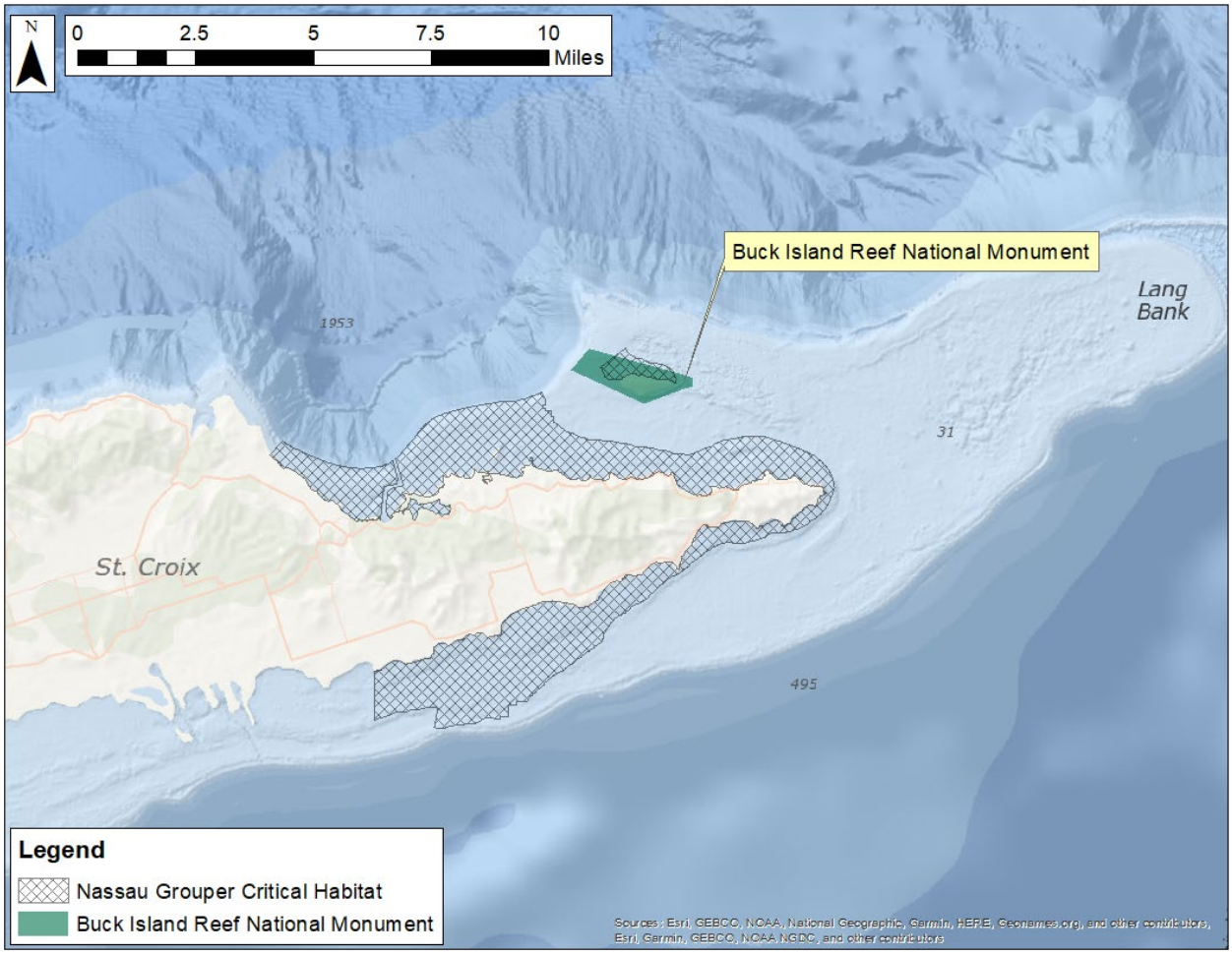

Figure 6. FINAL CRITICAL HABITAT AND BUCK ISLAND REEF NATIONAL MONUMENT.

While human use of protected areas has the potential to adversely impact Nassau grouper critical habitat, many protected areas provide specific regulations to protect sedimentary, seagrass, hard-bottom, coral reef, and other components of the contiguous area essential feature. The level of protection differs between protected areas, as detailed in Table 10, but some examples of regulations include:

- Restrictions on vessel anchoring and requiring use of mooring buoys;
- Prohibiting activities such as mining, drilling and construction of structures on the seabed;
- Prohibiting destroying or removing hard substrate;
- Prohibiting discharges into the waters;
- Prohibiting removal of or tampering with abandoned waterborne craft; and
- Prohibiting fishing with bottom longline, bottom trawl, dredge, pot, or trap.

Due to these existing protections, NMFS anticipates that impacts from protected area management activities are unlikely to reduce the functionality of the critical habitat. As a result, incremental costs of critical habitat designation associated with protected area management activities are expected to be limited to the costs of additional administrative effort required to address Nassau grouper critical habitat in consultations that would occur absent designation.

10.1.4.4 Fishery Management – NMFS

There are a number of fisheries within the final critical habitat which are regulated through Fishery Management Plans (FMPs) developed under the Magnuson-Stevens Fishery Conservation and Management Act. The FMPs are designed and implemented by NMFS through regional Fisheries Management Councils. The South Atlantic Fishery Management Council manages FMPs for fisheries in federal waters off the east coast of Florida. The Gulf of Mexico Fishery Management Council manages FMPs for fisheries in federal waters off the west coast of Florida. The Caribbean Fishery Management Council manages fisheries in federal waters off Puerto Rico and the USVI. Island-based FMPs for Puerto Rico, St. Croix, and St. Thomas and St. John were recently approved and now govern the fisheries as individual island-based units (87 FR 56204).

DESCRIPTION OF THREAT

Fishing activities with a federal nexus have limited potential to affect Nassau grouper critical habitat largely because most of the areas are in state or territorial waters. The shoreward boundary of the Exclusive Economic Zone (EEZ), where federal fisheries operate, is three nautical miles (nm) offshore of Florida and the USVI and nine nm offshore of Puerto Rico. As exhibited in Figure 7, the majority of the areas of the critical habitat designation off Florida comprise state waters. The only Caribbean units that are in federal waters occur in the BDS, Hind Bank Marine Conservation District (Hind Bank), and GB management areas, shown in Figure 8 and Figure 9. Limited fishing occurs in both areas; gear and seasonal restrictions offer protections to the spawning habitat.

Fishing activities in federal waters off Florida may affect the coral reef and colonized hard bottom component of the essential feature. The federally managed fisheries with the greatest potential to adversely affect the Nassau grouper critical habitat are those that target reef fish species and spiny lobster due to these fisheries' use of trap gear. These fisheries exist off southeast Florida and the U.S. Caribbean islands (the Caribbean fisheries previously managed under the Reef Fish FMP and the Spiny Lobster FMP, which were formally Caribbean-wide FMPs, are now managed under the new island-based FMPs). Fishermen may use the following gear types that may affect critical habitat: hook-and-line gear, including handlines and vertical bottom lines;[5] SCUBA diving methods, including spear fishing for reef fish; hand and snare collection of spiny lobster; and traps. Fishing vessel anchoring can also affect habitat.

Standard vertical line fishing practices have the potential to impact features that have structure through hooks snagging and damaging habitat. However, fishermen are expected to deploy hook-and-line gear in the water column above reef areas that compose Nassau critical habitat, so that the gear is not placed on the coral (i.e., where coral is part of the Nassau grouper habitat). To the extent any non-coral element of habitat is damaged/hooked, this could have negative impacts on the final critical habitat. However, these impacts are not expected to be significant.

Traps placed on the consolidated hard bottom can temporarily preclude new settlement of planulae (free-swimming coral larvae), affecting the recruitment of coral. Traps and anchoring can also damage hard-bottom and rubble habitat and coral reef and colonized hard bottom habitat. Traps are deployed within the designated areas of critical habitat offshore of Florida but are prohibited in coral protection areas. In addition, trap fishermen try to set traps in sandy areas and avoid hard bottom. However,

[5] Vertical bottom longlines are deployed vertically in the water column and are not considered bottom longline gear, which is deployed horizontally along the sea floor.

unforeseen circumstances, such as hard currents from storms, can move traps onto hard bottom.

The Caribbean fisheries that target reef fish and spiny lobster, which are managed under the reef fish and spiny lobster FMPs, also use potentially damaging fishing practices, such as traps, and present an additional threat to the final critical habitat through the harvest of herbivorous fishes that remove macroalgae from potential coral settlement substrate. The harvest of reef fish reduces herbivory, leading to increased populations of macroalgae, which can put competitive pressure on corals (National Marine Fisheries Service 2011). However, a 2020 biological opinion completed in conjunction with the consultation recommending the shift to the island-based FMPs states that "the available information on the growth and spread of macroalgae in the U.S. Caribbean indicates that herbivorous fish harvest is contributing very minimally to its growth" (National Marine Fisheries Service 2020a).

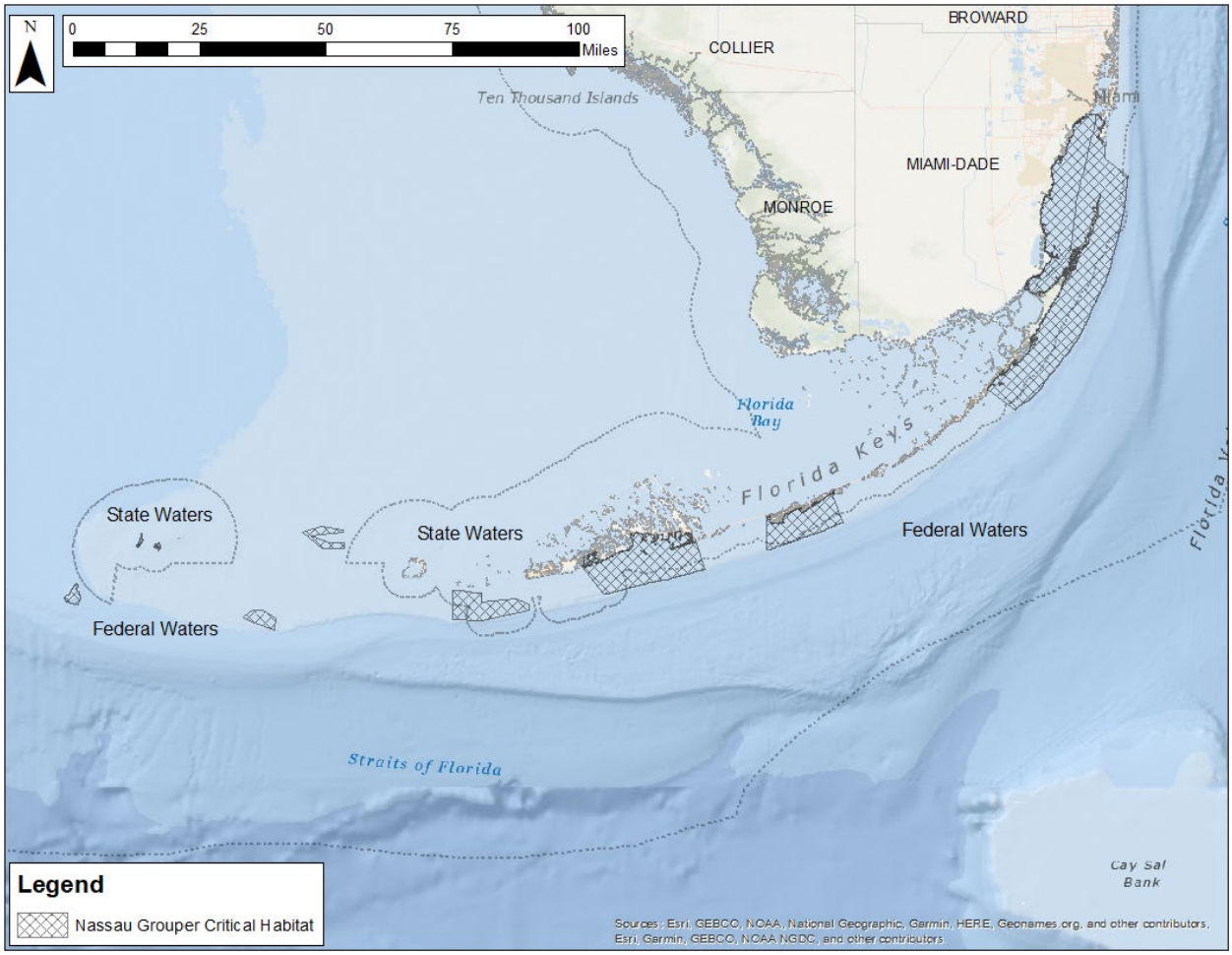

Figure 7. OVERLAP OF FINAL CRITICAL HABITAT WITH FEDERALLY MANAGED WATERS OFF THE COAST OF FLORIDA.

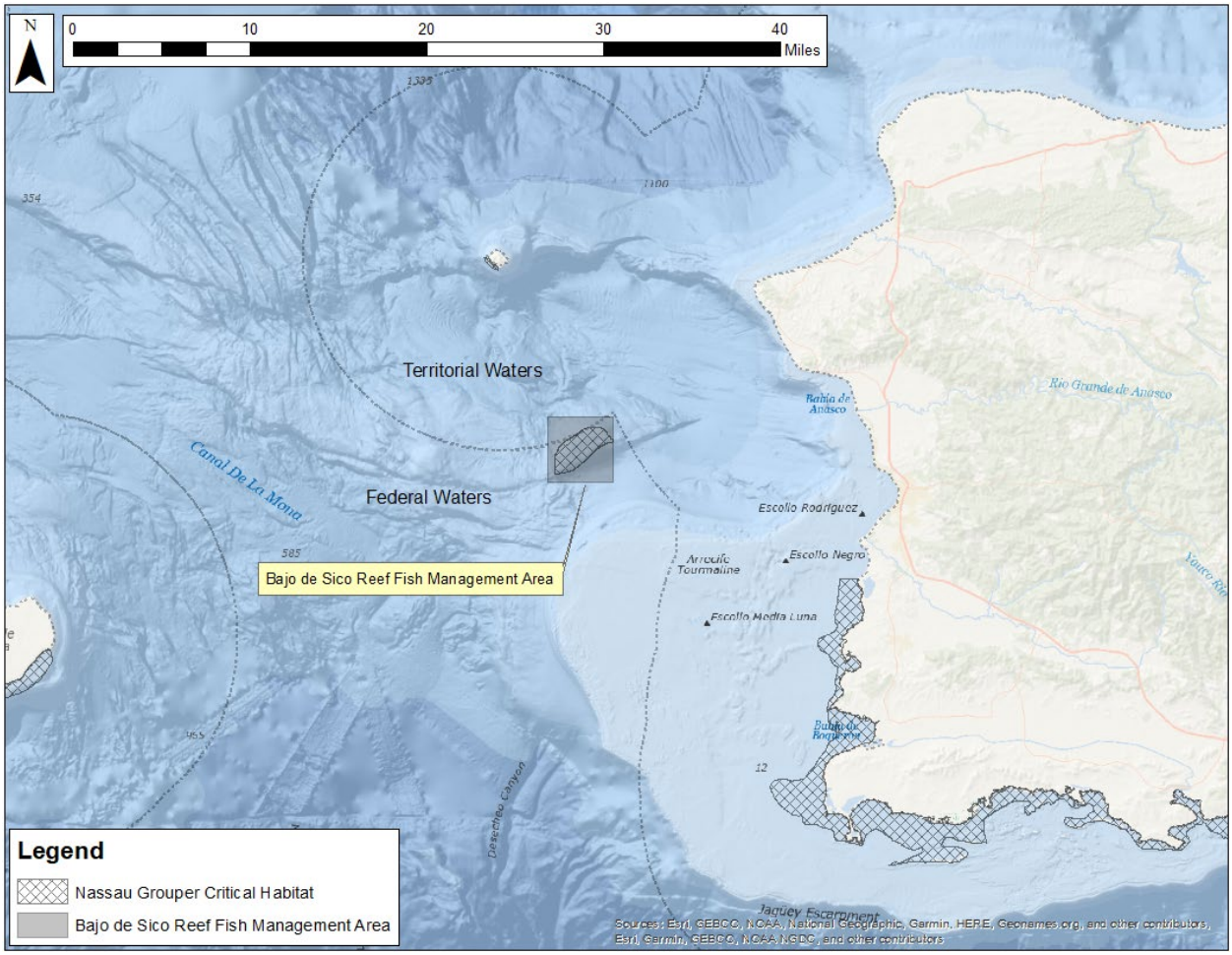

Figure 8. OVERLAP OF FINAL CRITICAL HABITAT AND FEDERALLY MANAGED WATERS AROUND PUERTO RICO.

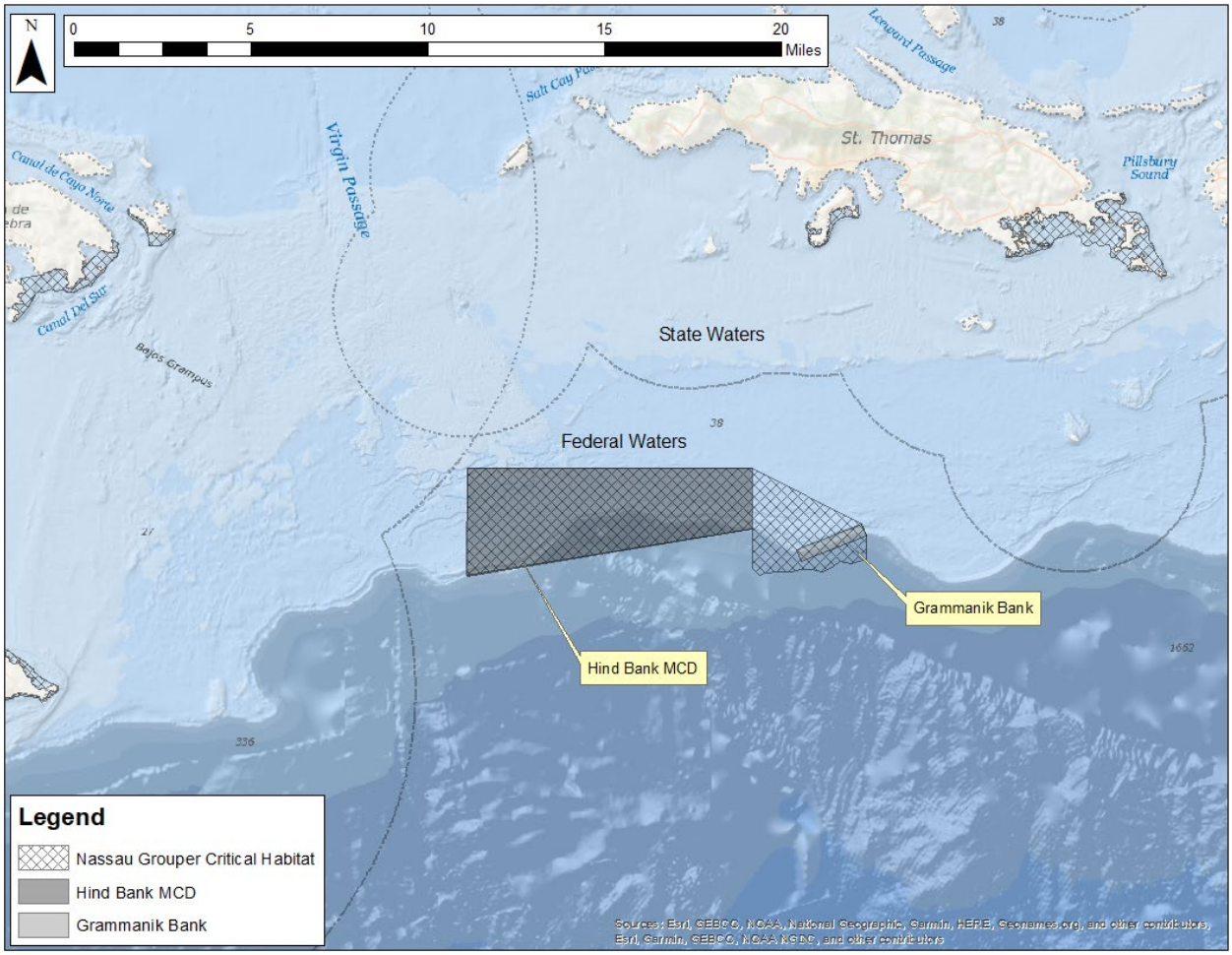

Figure 9. OVERLAP OF FINAL CRITICAL HABITAT AND FEDERALLY MANAGED WATERS AROUND THE USVI.

EXTENT OF ACTIVITY WITHIN CRITICAL HABITAT AREAS

With the exception of the Halfmoon Shoal unit and Riley's Hump spawning area unit, where fisheries operate under the management of the Gulf of Mexico Fishery Management Council, the South Atlantic Fishery Management Council manages fisheries that operate within the final critical habitat off Florida. These are the coastal migratory pelagics (CMP), which includes king mackerel, Spanish mackerel and Gulf of Mexico cobia; dolphin and wahoo; snapper-grouper; and spiny lobster fisheries. The Gulf of Mexico Fishery Management Council manages fisheries that operate within the Halfmoon Shoal unit, including the reef fish, CMP, shrimp, and spiny lobster fisheries. The FMPs for CMP and spiny lobster are shared by the South Atlantic Fishery Management Council and Gulf of Mexico Fishery Management Council. In the Caribbean, the Puerto Rico reef fish and deepwater snapper fisheries, which employ hook-and-line gear, operate within the BDS unit of the final critical habitat. The reef fish fishery operates in this area from April 1 through September 30 each year, but fishing for or possession of Caribbean Fishery Management Council-managed reef fish is prohibited from October 1 through March 31. The reef fish and and spiny lobster fisheries also occur in the GB unit of the final critical habitat, with restrictions that are described below.

In order to provide context for the analysis, including the benefits discussed in Section 10.3.1, Table 11 and Table 12 display the annual landings and economic value of the reef fish and spiny lobster fisheries.

As illustrated in these tables, the fishery with the highest value is Florida's spiny lobster fishery, totaling over $46 million in 2021 (2023 dollars). Total landings in the 2019 Puerto Rico spiny lobster fishery and the 2021 USVI spiny lobster fishery were valued at approximately $2.5 million and $1.3 million, respectively (2023 dollars). Total landings in the 2019 Puerto Rico reef fish fishery and 2021 USVI reef fish fishery were valued at approximately $4.4 million and $1.2 million, respectively (2023 dollars).

Table 11. ANNUAL LANDINGS AND VALUE OF THE COMMERCIAL SPINY LOBSTER FISHERIES

LOCATION	LANDINGS (POUNDS)	VALUE (2023 DOLLARS)
Florida East Coast	509,387	
Florida West Coast	4,196,517	
Florida Total (2021)	**4,705,904**	
Puerto Rico (2019)		
USVI (2021)		
Source: NOAA Fisheries 2022.		

Table 12. LANDINGS AND VALUE OF THE PUERTO RICO AND USVI COMMERCIAL REEF FISH FISHERIES

REEF FISH	PUERTO RICO (2019)		USVI (2021)	
	LANDINGS (POUNDS)	VALUE (2023 DOLLARS)	LANDINGS (POUNDS)	VALUE (2023 DOLLARS)
Goatfish			213	
Groupers	13,547		10,890	
Grunts	17,509		15,439	
Hogfish	39,505		3,197	
Jacks	42,642		2,790	
Parrotfish	24,586		34,903	
Scup or porgy	11,227		4,919	
Snappers	596,717		51,771	
Squirrelfish	1,781		5,171	
Surgeonfish	-	-	408	
Triggerfish	38,663		47,536	
Trunkfish (boxfish)	29,559		-	-
Total				
Source: NOAA Fisheries 2022.				

REGULATORY BASELINE

The regional Fishery Management Councils are responsible for delineating Essential Fish Habitat (EFH) for federally managed fisheries. Similar to ESA Section 7 consultation for listed species and critical habitats, an EFH consultation with NMFS is required whenever an activity with a federal nexus has the potential to adversely affect EFH. The existence of EFH for Nassau grouper and other species provides some level of baseline protection against damages to habitat from fishing activity. However, EFH alone is not likely to provide sufficient protection to the Nassau grouper habitat because the conservation

recommendations that result from EFH consultations are not compulsory (National Marine Fisheries Service 2015b). Information is not readily available to estimate how frequently EFH recommendations are implemented, because this information is not tracked.

Additionally, there are several protected areas within the final critical habitat that provide baseline levels of protection against potentially damaging fishing activities. Some protected areas, such as the Florida Keys National Marine Sanctuary and the Buck Island Reef National Monument, do not allow fishing within certain special restriction zones. Prohibited activities within the Riley's Hump spawning site, which is located within the South Area of the Tortugas Ecological Reserve, include all fishing; removing, harvesting, or possessing any marine life; touching or standing on living or dead coral; and anchoring on living or dead coral, or any attached organism (66 FR 4267). Regulations for other protected areas allow fishing, but prohibit potentially ecologically damaging techniques such as bottom longline, bottom trawl, dredge, pot, or trap. For example, the federal regulations concerning the Gulf of Mexico shrimp FMP prohibit the use of trawls year-round within waters containing the Halfmoon Shoal unit but allows the use of butterfly nets and cast nets, which have minimal or no impact to the seafloor. Additionally, a 2015 biological opinion concluded that the South Atlantic and Gulf of Mexico CMP fisheries are not likely to adversely affect any listed coral species, with the same determination made with respect to impacts to elkhorn and staghorn critical habitat. The opinion noted that physical contact by fishing vessels or gear on coral or the substrate essential feature of elkhorn and staghorn critical habitat is unlikely because of the pelagic nature of CMP species and the use of hook-and-line gear in the water column or at the surface (National Marine Fisheries Service 2015c). Federal regulations for several South Atlantic FMPs constitute baseline protections to the essential feature of the final critical habitat:

- The South Atlantic snapper grouper fishery allows the use of vertical line gear and spearfishing gear but prohibits the use of longline gear.
- Allowable gear in the dolphin wahoo fishery includes hook-and-line gear, bandit gear, handlines, and spearfishing. Longlines are allowed in certain portions of the fishery but not in federal waters within the final critical habitat.
- The South Atlantic spiny lobster fishery allows the use of traps in certain areas but has several regulations designed to protect corals and that otherwise limit the potential for damage to the final critical habitat. For example, traps may be no larger in dimension that 3 feet by 2 feet by 2 feet, or the volume equivalent. In addition, several areas in the Florida Keys are closed to help protect corals (South Atlantic Fishery Management Council 2022).

As noted above, the BDS and GB units are the only Caribbean units within federal waters. Limited fishing occurs in both areas, and gear and seasonal restrictions offer protections to the spawning habitat. In the Bajo de Sico unit, which is fully contained within the Bajo de Sico Reef Fish Management Area, no reef fish fishing is permitted from October 1 through March 31. The closure does not apply to Caribbean spiny lobster or other species that can be legally harvested from the Puerto Rico EEZ, such as highly migratory species. From February 1 through April 30 each year, no person may fish for or possess any species of fish, except highly migratory species, in or from the Grammanik Bank management area. All fishing and anchoring is prohibited year-round in the Hind Bank management area. In both Bajo de Sico and Grammanik Bank, fishing with pots, traps, bottom longlines, gillnets, and trammel nets is prohibited year-round. Anchoring by fishing vessels in the portion of Bajo de Sico in the Puerto Rico EEZ is also prohibited year-round. Fishing is allowed year-round in the portion of the Grammanik Bank unit between Hind Bank and Grammanik Bank, which is shown in Figure 9. However, most of the fishing in the Caribbean is conducted within the 100-fathom depth line, which occurs shoreward of the Bajo de Sico unit and which generally coincides with the southern (seaward) boundary of the portion of the

Grammanik Bank unit to the east of Hind Bank.

NMFS believes that the FMPs will need to assess the potential impact of their activities on the final Nassau grouper critical habitat, resulting in re-initiation of ESA Section 7 consultations at some level. Previous consultations for the FMP fisheries assess their impacts on coral and coral critical habitat that are components of the designated Nassau grouper critical habitat. However, the FMPs will need to address to what extent the fisheries may affect the essential features of the final critical habitat. NMFS believes hook-and-line gear used by fishermen in the South Atlantic fisheries that operate within the Florida units would not affect essential feature in any manner that would appreciably alter the physical or biological features that make them suitable for Nassau grouper. Similarly, the extent of potential impacts of permissible fishing activities to the portions of the Bajo de Sico and Grammanik Bank management area is uncertain, but these impacts are not anticipated to adversely affect the conservation value of these areas to Nassau grouper. As a result, NMFS anticipates that incremental impacts of the final critical habitat to FMPs will be limited to the incremental administrative costs of consultation.

10.1.4.5 Aquaculture – NMFS

Under section 10 of the Rivers and Harbors Act, marine aquaculture projects require a permit from the USACE for the creation of any obstruction to navigation. NMFS is responsible for considering and preventing and/or mitigating the potential adverse environmental impacts of planned and existing marine aquaculture facilities in federal waters through the development of FMPs, sanctuary management plans, permit actions, proper siting, and consultations with other regulatory agencies at the federal, state, and local levels (National Oceanic and Atmospheric Administration 2011).

DESCRIPTION OF THREAT

Aquaculture infrastructure, such as net pens and fixed structures, has the potential to physically damage corals and substrate and result in the permanent removal of other features that provide cover to the Nassau grouper. Additionally, aquaculture facilities have the potential to increase sedimentation of nearby areas.

EXTENT OF ACTIVITY WITHIN CRITICAL HABITAT AREAS

The query of NMFS SERO's Section 7 consultation database for the years 2011–2022 yielded 1 informal consultation related to aquaculture within the final critical habitat. USACE consulted with NMFS on an application for a 20-year permit to create an in-water staghorn coral nursery to actively propagate staghorn coral year-round for restoration. The proposed project consisted of coral nursery modules and trees within a 50m x 50m area large enough to propagate up to 10,000 fragments of staghorn coral to support ongoing transplantation activities to restore nearby degraded reefs. This activity could cause temporary disturbances to the project area but would eventually improve the functionality of the area by increasing the abundance and distribution of healthy coral reefs.

REGULATORY BASELINE

Neither the South Atlantic Fishery Management Council nor the Caribbean Fisheries Management Council has any plans to develop aquaculture FMPs. In the areas where aquaculture activity is contemplated, impacts to the final critical habitat are considered unlikely due to existing best management practices. Specifically, offshore aquaculture facilities are sited to avoid sensitive areas including coral, seagrass, and hard bottom areas. Thus, the final critical habitat is not expected to result in incremental impacts to aquaculture activities beyond the additional administrative effort required to

address Nassau grouper critical habitat in consultations that would occur absent designation.

10.1.4.6 Military Activities – DoD

Military activities encompass all activities conducted by the Department of Defense. Three sites operated by the U.S. Navy are adjacent to areas designated as critical habitat. These include Naval Air Station Key West and two sites that have been inoperational since the early 2000s, Naval Activity Puerto Rico (NAPR) and Atlantic Fleet Weapons Training Area (AFWTA). Training and testing activities conducted by the Atlantic Fleet and remediation activities conducted at NAPR and Vieques Naval Training Range (VNTR) have the potential to damage critical habitat.

DESCRIPTION OF THREAT

Training activities conducted by the Navy's Atlantic Fleet, including Key West Range Complex (KWRC), present one of the two primary threats to the final critical habitat. For example, activities involving the use of mines or demolition charges detonated on the ocean bottom could damage the essential feature. Coral habitat could be directly impacted by detonations or experience some level of structural degradation depending on the size and location of the blast radius of the explosion in relation to critical habitat (National Marine Fisheries Service 2018b). Activities that may result in attaching cables or pipelines to the seafloor, ships dragging anchors, or ammunition landing on the ocean floor have the potential to physically damage the critical habitat. Ammunition training may also reduce water quality by generating turbidity, or lead to sedimentation.

The Navy purchased portions of Vieques Island in the early 1940s in order to conduct activities related to military training. The AFWTA was divided into the Naval Air Support Detachment (NASD), located on the western end of Vieques, and the VNTR, located on the eastern end of Vieques. Site operations in the NASD consisted mainly of ammunition loading and storage, vehicle and facility maintenance, and open burn/open detonation. In the VNTR, various naval gunfire training activities were conducted, including air-to-ground ordnance delivery and amphibious landings. The former NASD was apportioned and transferred to the Department of Interior (DOI), the Municipality of Vieques, and the Puerto Rico Conservation Trust in 2001, and, in 2003, the former VNTR was transferred to DOI to be operated by the USFWS as part of the Vieques National Wildlife Refuge (National Marine Fisheries Service 2020b). Waters in which some of these operations were conducted overlap with areas of the critical habitat designation on both the western and eastern ends of Vieques. Under the Comprehensive Environmental Response, Compensation, and Liability Act, the Navy has proposed the removal of suspected Munitions and Explosives of Concern (MEC) and Material Potentially Presenting an Explosive Hazard and explosives from underwater areas surrounding the former NASD and former VNTR. Proposed activities that could disturb, damage, or remove portions of Nassau grouper critical habitat include:

- Location and removal of underwater munitions items from on or beneath the seafloor
- Collection of aquatic samples such as sediment, water, and biota
- Installation and maintenance of structures, such as anchor systems, marker buoys, and floating barriers
- Underwater investigations using remote sensing and testing of new detection technologies
- General boating operation
- Transplantation of coral and seagrass

NAPR, formerly U.S. Naval Station Roosevelt Roads, is located on the east coast of the island of Puerto Rico, approximately 33 miles southeast of San Juan. As an operating base, NAPR served as one of the

largest Atlantic naval ports in the U.S. Navy. Subsequent to the site's closure in 2004, various areas or Solid Waste Management Units (SWMUs) required investigation for releases of hazardous waste and hazardous substances to the environment. A total of 76 SWMUs and 6 Areas of Concern have been identified at NAPR, which require assessments and/or investigations under the corrective action authorities of the Resource Conservation and Recovery Act. These sites are being cleaned up under Federal authority, with EPA the lead agency. However, the Puerto Rico Environmental Quality Board (EQB) participates with EPA in cleanup decision making and oversight. The most significant current environmental threats posed by these sites are adverse environmental impacts to the surface waters of Ensenada Honda and other marine bays and mangrove areas bordering the facility (U.S. Environmental Protection Agency 2019). The potential effects of these activities to the final critical habitat are discussed in Section 10.1.3.2. An additional threat posed to the designated Nassau grouper critical habitat is posed by the investigation and removal of underwater MEC from areas offshore of NAPR that overlap with the final critical habitat.

EXTENT OF ACTIVITY WITHIN CRITICAL HABITAT AREAS

Between 2011 and 2022, NMFS conducted 10 informal consultations and 2 programmatic consultations related to Navy activities in the final critical habitat areas (Table 13). Four informal consultations and a programmatic consultation in Puerto Rico were on remediation activities in the waters surrounding the former VNTR. The other 3 informal consultations in Puerto Rico were related to water quality activities and an investigation of underwater munitions and explosives on or around NAPR. A biological assessment completed in 2010 as part of the latter consultation determined that impacts related to underwater investigation, removal of MEC, and vessel traffic would be discountable because of avoidance and mitigation measures employed by the Navy, including avoidance of listed corals and anchoring in unvegetated, sandy bottom (CH2MHill 2011). The 3 informal consultations in Florida were on activities conducted on and around Naval Air Station Key West. The remaining programmatic consultation, completed in 2018, was on Atlantic Fleet Training and Testing (AFTT) activities and the permitting of take of marine mammals incidental to AFTT activities.

Table 13. NMFS SOUTHEAST REGION CONSULTATIONS FOR MILITARY ACTIVITIES THAT MAY AFFECT NASSAU GROUPER CRITICAL HABITAT AREAS, BY UNIT AND CONSULTATION TYPE (2011 – 2022)

UNIT	NUMBER OF FORMAL CONSULTATIONS	NUMBER OF INFORMAL CONSULTATIONS	NUMBER OF PROGRAMMATIC CONSULTATIONS	TOTAL
Biscayne/Key Largo	0.0	0.0	0.1	0.1
Marathon	0.0	0.0	0.1	0.1
Big Pine Key	0.0	0.0	0.1	0.1
Key West	0.0	3.0	0.1	3.1
New Ground Shoal	0.0	0.0	0.1	0.1
Halfmoon Shoal	0.0	0.0	0.1	0.1
Dry Tortugas	0.0	0.0	0.1	0.1
Florida, All	**0.0**	**3.0**	**1.0**	**4.0**
Mona Island	0.0	0.0	0.0	0.0
Desecheo	0.0	0.0	0.0	0.0
Southwest	0.0	0.0	0.0	0.0
Northeast	0.0	3.0	0.0	3.0
Vieques	0.0	4.0	1.0	5.0
Isla de Culebra/ Culebrita	0.0	0.0	0.0	0.0

UNIT	NUMBER OF FORMAL CONSULTATIONS	NUMBER OF INFORMAL CONSULTATIONS	NUMBER OF PROGRAMMATIC CONSULTATIONS	TOTAL
Puerto Rico, All	**0.0**	**7.0**	**1.0**	**8.0**
Navassa	**0.0**	**0.0**	**0.0**	**0.0**
USVI - STT	0.0	0.0	0.0	0.0
USVI - STJ	0.0	0.0	0.0	0.0
USVI - STX	0.0	0.0	0.0	0.0
USVI, All	**0.0**	**0.0**	**0.0**	**0.0**
Bajo de Sico	**0.0**	**0.0**	**0.0**	**0.0**
Grammanik Bank/ Hind Bank	**0.0**	**0.0**	**0.0**	**0.0**
Riley's Hump	**0.0**	**0.0**	**0.0**	**0.0**
TOTAL	**0.0**	**10.0**	**2.0**	**12.0**

Source: NMFS SERO's Section 7 consultation database.
Fractions of consultations occurred as a result of assigning some consultations to two or more units.

REGULATORY BASELINE

The 2018 Biological and Conference Opinion on Navy Fleet Training and Testing Activities identifies several protections to listed corals and Acropora critical habitat that constitute baseline protections to the final critical habitat. The Navy does not conduct explosives testing in any areas where Nassau grouper are thought to be present. In addition, areas containing or close to coral reefs are protected due to mitigation measures the Navy implements to prevent explosives from being discharged on mapped coral reefs. Moreover, the vast majority of explosives proposed for use at KWRC, including all torpedoes and missiles with the larger net explosive weight, would occur in waters deeper than the depth range of all ESA-listed corals (i.e., > 90 m). Some explosives with less than 0.5 pound net explosive weight could be used in waters less than 60 m, and some explosives with less than 5 pound net explosive weight could be used in waters less than 90 m, but greater than 60 m. The only underwater explosions that would occur on or near the bottom in the KWRC would result from use of 5, 10, and 20-pound charges during mine warfare training and testing activities. These activities occur within the depth range of all ESA-listed corals (up to 90 m for some species) and elkhorn and staghorn coral critical habitat (up to 30 m), but in designated, soft bottom locations that have been used for this purpose for decades (National Marine Fisheries Service 2018b).

NMFS' Programmatic Biological Opinion on the Underwater Investigation and Removal/Remedial Activities in UXO 16, Vieques, Puerto Rico, issued in 2020, identifies potential threats to Nassau grouper habitat but concludes that proposed actions in the areas surrounding the former NASD and former VNTR are likely to result in discountable and insignificant effects. For example, the Navy has developed standard operating procedures in coordination with NMFS that minimize the effects to seagrass from propeller scarring and to benthic habitat from anchoring and excavation in seagrass and unconsolidated bottom required to remove munitions and explosives. As part of the proposed action, divers are to check areas where vessels will anchor to verify that no co coral habitats are present. As a result of these measures, NMFS believes the effects to Nassau grouper habitat from the Navy's propsed remediation activities around Vieques will be insignificant (National Marine Fisheries Service 2020b).

The Sikes Act Improvement Act of 1997 also provides baseline protection for critical habitat located in or near military installations. The Act requires military installations to work with the USFWS and NMFS to prepare and implement an INRMP. INRMPs are designed to promote:

- Conservation and rehabilitation of natural resources on military installations;
- Sustainable multipurpose use of the resources, which shall include hunting, fishing, trapping, and non-consumptive uses; and
- Subject to safety requirements and military security, public access to military installations to facilitate the use of the resources.

There is an INRMP in place for Naval Air Station Key West. One of the four goals of the INRMP is to "protect, maintain, and restore native vegetation communities, threatened and/or endangered species, including resident and migratory animal populations while supporting the military mission." The INRMP further identifies as one of its 19 objectives the protection and management of "critically important habitats of resident and migratory threatened and endangered species, and species of special concern" (U.S. Navy 2014).

10.1.4.7 Derelict Vessel and Marine Debris Removal – USCG, NOAA

Under section 19 of the Rivers and Harbors Appropriations Act, USACE has the authority to undertake projects to remove and dispose of derelict objects such as sunken vessels and waterfront debris if they are determined to be obstructions to navigation. USACE's Nationwide Permit 22 authorizes temporary structures or minor discharges of dredged or fill material required for the removal of wrecked, abandoned, or disabled vessels, or the removal of manmade obstructions to navigation. The permittee must submit a pre-construction notification to the district engineer prior to commencing the activity if the activity is conducted in a special aquatic site, including coral reefs and wetlands. In addition, the USCG is responsible for implementing the Oil Pollution Act by responding to vessel groundings that present the risk of an oil spill. Prior to responding to an incident, the USCG typically conducts an emergency consultation with NMFS to reduce impacts to listed species.

DESCRIPTION OF THREAT

The removal of a grounded vessel could adversely affect the development and growth essential feature of the critical habitat if the vessel acts as habitat to support Nassau grouper by providing cover and prey or if critical habitat surrounding the vessel suffers additional damage during removal. The method of removal of the oil from a grounded vessel could be more or less detrimental depending on the properties of the oil and the hydrodynamics of the system.

Marine debris, including lost or abandoned fishing gear, building materials, plastics, and other trash may be snagged in coral reefs, and break, dislodge, or scar coral branches. Marine debris removal efforts are regularly initiated in Florida and throughout the Caribbean to alleviate these threats. These efforts could adversely affect the critical habitat if the debris are removed in a manner causes additional damage. However, given the assumption that the essential feature is present throughout the designated areas, damage to or removal of small amounts of the essential feature is unlikely to diminish the functionality of the area as critical habitat for Nassau grouper.

EXTENT OF ACTIVITY WITHIN CRITICAL HABITAT AREAS

The query of NMFS SERO's Section 7 consultation database yielded 6 informal consultations and 1 formal consultation related to derelict vessel and marine debris removal activities (Table 14). NOAA was the lead federal action agency on an informal consultation on a derelict vessel and marine debris removal initiative in northeast Puerto Rico and an informal consultation on the salvage of a vessel that had grounded on Cannon Patch Reef, approximately 2.5 miles offshore of Key Largo. The USCG was the lead action agency on 4 vessel salvage operations, all of which occurred within Puerto Rico units of the

critical habitat, as well as the retrieval of an Aids to Navigation Buoy offshore of southwest Puerto Rico.

Table 14. NMFS SOUTHEAST REGION CONSULTATIONS FOR DERELICT VESSEL AND MARINE DEBRIS REMOVAL ACTIVITIES THAT MAY AFFECT NASSAU GROUPER CRITICAL HABITAT AREAS, BY UNIT AND CONSULTATION TYPE (2011 – 2022)

UNIT	NUMBER OF FORMAL CONSULTATIONS	NUMBER OF INFORMAL CONSULTATIONS	NUMBER OF PROGRAMMATIC CONSULTATIONS	TOTAL
Biscayne/Key Largo	0.0	1.0	0.0	1.0
Marathon	0.0	0.0	0.0	0.0
Big Pine Key	0.0	0.0	0.0	0.0
Key West	0.0	0.0	0.0	0.0
New Ground Shoal	0.0	0.0	0.0	0.0
Halfmoon Shoal	0.0	0.0	0.0	0.0
Dry Tortugas	0.0	0.0	0.0	0.0
Florida, All	**0.0**	**1.0**	**0.0**	**1.0**
Mona Island	1.0	1.0	0.0	2.0
Desecheo	0.0	0.0	0.0	0.0
Southwest	0.0	2.0	0.0	2.0
Northeast	0.0	1.0	0.0	1.0
Vieques	0.0	1.0	0.0	1.0
Isla de Culebra/ Culebrita	0.0	0.0	0.0	0.0
Puerto Rico, All	**1.0**	**5.0**	**0.0**	**6.0**
Navassa	0.0	0.0	0.0	**0.0**
USVI - STT	0.0	0.0	0.0	0.0
USVI - STJ	0.0	0.0	0.0	0.0
USVI - STX	0.0	0.0	0.0	0.0
USVI, All	**0.0**	**0.0**	**0.0**	**0.0**
Bajo de Sico	**0.0**	**0.0**	**0.0**	**0.0**
Grammanik Bank/ Hind Bank	**0.0**	**0.0**	**0.0**	**0.0**
Riley's Hump	**0.0**	**0.0**	**0.0**	**0.0**
TOTAL	**1.0**	**6.0**	**0.0**	**7.0**

Source: NMFS SERO's Section 7 consultation database.

REGULATORY BASELINE

Some baseline protection for critical habitat is provided by the National Response Team's guidance for federal On-Scene Coordinators and Area Committees that develop solutions for the abatement of pollution from abandoned vessels and examine options applicable to the removal and disposition of abandoned vessels (U.S. Environmental Protection Agency 2020). In addition, the Coral Reef Task Force and Injury Resource Tools Working Group, through NOAA Office of Response and Restoration (OR&R), funded the development of Rapid Assessment Protocols for Small Vessel Groundings. These grounding protocols include the Live Coral Triage protocol, which describes how to salvage and stabilize live coral and associated resources in a coral reef or hard bottom habitat that have been physically fractured, dislodged, or overturned (Michel et al. 2008).

OR&R has funded research on assistance with vessel removals, focusing on coral habitats in both the Pacific and Caribbean. OR&R's abandoned and derelict vessel removal efforts are designed to avoid the

physical destruction of sensitive marine and coastal habitats due to the dispersal of oil and toxic chemicals still on board, the generation of marine debris, and the spread of derelict nets and fishing gear that entangle and endanger marine life (NOAA Office of Response and Restoration 2019). OR&R similarly emphasizes minimization of environmental impacts of debris removal in debris removal programs that it leads and funds (NOAA Office of Response and Restoration 2021). Given these baseline protections, the critical habitat designation is not expected to result in incremental impacts to derelict vessel and marine debris removal activities beyond the additional administrative effort required to address Nassau grouper critical habitat in consultations that would occur absent designation.

10.1.4.8 Scientific Research and Monitoring – NOAA, USACE

NOAA conducts scientific research and issues permits for various research and monitoring activities in the coastal waters of south Florida, Puerto Rico, and the USVI. NOAA issues permits for restoration projects undertaken by NMFS, while the USACE issues permits for restoration projects undertaken by other entities.

DESCRIPTION OF THREAT

NOAA conducts research and monitoring activities that may affect the final critical habitat, including installation of scientific instrumentation; deployment of nets and other marine resource collection devices; and research, restoration, and relocation of threatened coral species. However, these activities usually have a minor footprint. For example, NOAA collects continuous measurements of environmental conditions influencing coral reefs from platforms such as pylons, moored buoys, and underwater instruments. Divers and underwater researchers directly observe the biological, physical, and chemical conditions of coral reef ecosystems (NOAA 2022), with little or no disturbance to coral reefs. Additionally, strict protocols are typically observed during field work permitted by NOAA to ensure minimal disturbance to the environment. Research on smalltooth sawfish in Florida coastal waters involves the anchoring of gillnets where listed coral species and the substrate essential feature of Acropora critical habitat are present; however, NMFS has concluded that it is extremely unlikely that these activities would damage either the corals or the substrate (National Marine Fisheries Service 2017b).

Restoration activities that have occurred within the final critical habitat include seaweed cultivation projects in the waters off southwest Puerto Rico and the outplanting of listed corals in the Florida Keys National Marine Sanctuary, Puerto Rico, and the USVI. These activities may cause temporary disturbances to the project areas but eventually improve the functionality of these areas by increasing the abundance of the seagrass and coral components of the essential feature. Therefore, scientific research and monitoring and restoration activities are unlikely to adversely modify the final critical habitat, and we anticipate that incremental impacts to scientific research and monitoring activities will be limited to the additional administrative effort required to address Nassau grouper critical habitat in consultations that would occur absent designation.

EXTENT OF ACTIVITY WITHIN CRITICAL HABITAT AREAS

The query of NMFS SERO's Section 7 consultation database for the years 2011–2022 yielded 8 consultations related to scientific research and monitoring and 5 consultations related to environmental restoration. Of these, 8 were informal consultations, 3 were formal consultations, and 2 were programmatic consultations (Table 15). The consultations occurred throughout the designated areas, with the exceptions of the Bajo de Sico and Grammanik Bank units. The 2 programmatic consultations, conducted in 2011 and 2016, respectively, were both on coral reef research and restoration activities for

threatened Caribbean corals.

Table 15. NMFS SOUTHEAST REGION CONSULTATIONS FOR SCIENTIFIC RESEARCH ND MONITORING ACTIVITIES THAT MAY AFFECT NASSAU GROUPER CRITICAL HABITAT AREAS, BY UNIT AND CONSULTATION TYPE (2011 – 2022)

UNIT	NUMBER OF FORMAL CONSULTATIONS	NUMBER OF INFORMAL CONSULTATIONS	NUMBER OF PROGRAMMATIC CONSULTATIONS	TOTAL
Biscayne/Key Largo	0.2	0.4	0.1	0.7
Marathon	0.2	0.4	0.1	0.7
Big Pine Key	0.2	0.4	0.1	0.7
Key West	0.2	0.4	0.1	0.7
New Ground Shoal	0.2	0.4	0.1	0.7
Halfmoon Shoal	0.2	0.4	0.1	0.7
Dry Tortugas	0.2	0.4	0.1	0.7
Florida, All	**1.7**	**2.7**	**0.7**	**5.1**
Mona Island	0.0	0.2	0.1	0.3
Desecheo	0.0	0.2	0.1	0.3
Southwest	0.0	3.2	0.1	3.3
Northeast	0.0	0.2	0.1	0.3
Vieques	0.0	0.2	0.1	0.3
Isla de Culebra/ Culebrita	0.0	0.2	0.1	0.3
Puerto Rico, All	**0.0**	**4.1**	**0.6**	**4.7**
Navassa	**0.0**	**0.2**	**0.1**	**0.3**
USVI - STT	0.4	0.2	0.1	0.7
USVI - STJ	0.4	0.2	0.1	0.7
USVI - STX	0.4	0.2	0.1	0.7
USVI, All	**1.3**	**0.6**	**0.3**	**2.2**
Bajo de Sico	**0.0**	**0.2**	**0.1**	**0.3**
Grammanik Bank/ Hind Bank	**0.0**	**0.2**	**0.1**	**0.3**
Riley's Hump	**0.0**	**0.1**	**0.1**	**0.2**
TOTAL	**3.0**	**8.0**	**2.0**	**13.0**

Source: NMFS SERO's Section 7 consultation database.
Fractions of consultations occurred as a result of assigning some consultations to two or more units.

10.1.4.9 Oil and Gas and Renewable Energy Development – BOEM

The leasing and development of offshore oil, natural gas, and renewable energy resources is regulated by the Bureau of Ocean Energy Management (BOEM) and the Bureau of Safety and Environmental Enforcement. As discussed in the following subsections, based on our review of the consultation history and discussions with state and federal agencies, there is substantial uncertainty whether oil and gas or renewable energy activity within or affecting the final critical habitat is anticipated over the next ten years. Recent communications with BOEM suggest that the development of renewable offshore energy may be imminent in the U.S. Caribbean. However, given the uncertainty in the timeline for these new projects, they were not considered in the development of this report.

OIL AND GAS EXPLORATION AND DEVELOPMENT

Development of oil and gas resources has the potential to damage the final critical habitat through several pathways. Oil and gas platforms and ships have the potential to physically damage coral reef and colonized hardbottom, and may reduce water quality through increased sedimentation and turbidity.

Additionally, an oil spill from a wellhead or transport vessel could damage the final critical habitat.

The Florida units of the final critical habitat are located within the Straits of Florida Planning Area. There are no active oil and gas leases within this planning area, and the area is excluded from consideration for leasing for purposes of exploration, development, or production through June 30, 2032. It is unlikely that the Straits of Florida planning area will be included in future programs, as there have been no commercial discoveries along the east coast of Florida, and the area has not been included in a lease program since 1987–1992 (Bureau of Ocean Energy Management 2022a).

Development on the U.S. Outer Continental Shelf offshore the USVI and Puerto Rico is also unlikely as BOEM's founding document, the Outer Continental Shelf Lands Act, does not provide authority to lease oil and gas offshore of U.S. Territories. While a 2013 U.S. Geological Survey assessment identified potential undiscovered crude oil resources in a subsea formation south of Puerto Rico and the USVI, neither territory has any crude oil production, refining, or proved reserves (U.S. Energy Information Administration 2021, U.S. Energy Information Administration 2022).

RENEWABLE ENERGY PROJECTS

BOEM also grants leases for renewable energy projects in the offshore environment. BOEM currently has no active offshore renewable energy leases in Florida, and the Section 7 consultation record revealed no historical consultations related to renewable energy projects in Puerto Rico or the USVI. The current Administration has announced a goal to deploy 30 gigawatts of offshore wind energy in the U.S. Outer Continental Shelf by 2030. At the time of the March 2021 announcement, there were 17 Atlantic renewable energy lease areas, although the southernmost of these was offshore of North Carolina. The DOI announced plans in October 2021 to hold up to seven new offshore lease sales by 2025; however, none of the potential lease sites is offshore of Florida's Atlantic coast, nor off the coasts of Puerto Rico or the USVI (NOAA Fisheries and BOEM 2022b).

Under the 2007 BOEM Interim Policy for authorization of the installation of offshore data collection and technology testing facilities on the Outer Continental Shelf, BOEM identified four proposed lease areas offshore Florida. BOEM granted a limited ocean power lease to Florida Atlantic University in 2014 to allow for testing of the technology; however, Florida Atlantic University relinquished the lease in 2016 (Bureau of Ocean Energy Management 2022).

In August 2022, the Inflation Reduction Act (IRA) expanded the Department of the Interior's authority over potential renewable energy leasing on the Outer Continental Shelf offshore the territories of Puerto Rico and the USVI in the Caribbean, as well as the Northern Mariana Islands, Guam, and American Samoa. That IRA requires BOEM to assess interest and feasibility of leasing, and BOEM is planning outreach to ensure that it can act before the statutory deadline for publishing a Call for Information and Nominations in September 2025. BOEM expects that any commercial scale offshore wind projects would include fixed and/or floating foundations for all project structures, including offshore wind turbine generators and any associated electrical service platforms/offshore substations. Projects would also include interarray and export cables, which may be buried or surface laid.

Offshore wind installations are of interest in the U.S. Caribbean as they have the potential to drastically lower the cost of energy for Puerto Rico and the USVI. A study published in 2022 noted that the potential exists for over 41 gigawatts of energy production through offshore wind facitlities, either fixed or floating, that would potentially lower the cost of energy in Puerto Rico. The study did not include areas that were proposed for critical habitat at the time, including the Nassau grouper critical habitat.

The study also noted that the timing of development of any offshore wind facilities in the U.S. Caribbean remains uncertain. Thus, while offshore wind energy development will likely necessitate section 7 consultations, actions requiring consultation for proposed Nassau grouper critical habitat are uncertain to occur within the next ten years (Duffy *et al*., 2022).

10.1.5 Projection of Future Section 7 Consultations

This section discusses the methods applied to forecast the quantity and distribution of future Section 7 consultations that will consider the Nassau grouper critical habitat. While significant uncertainty exists with respect to the levels and locations of future projects and activities that may require Section 7 consultation considering critical habitat for Nassau grouper, absent better information, our analysis bases forecasts of future Section 7 consultations on historical information. This may overstate impacts to the extent NMFS handles more consultations on a programmatic basis, or it may understate impacts if more formal consultations are required as a result of critical habitat designation. However, this analysis provides a signal of costs likely to occur in a given area. This analysis relies on the best available information to forecast future projects and activities, including:

1. Targeted interviews with key federal action agencies and relevant local government agencies to identify anticipated future projects that may affect critical habitat for the Nassau grouper; and
2. Information on the historical frequency and location of projects with a federal nexus as indicated by the following key sources:
    a. NMFS PCTS and NMFS Environmental Consultation Organizer (ECO) Section 7 consultation history from 2011 to 2022. The PCTS and ECO were queried to identify consultations on all species in NMFS Southeast Region that involved activities with the potential to affect the essential features of Nassau grouper critical habitat.
    b. USACE's Jacksonville permit application database from 2011 to 2022 (USACE Jacksonville District 2022). The USACE permit application database was queried to identify all permit applications located within the final critical habitat area. These data were then refined to only include those activities that may affect the final critical habitat.

Our forecast assumes that trends in the location and frequency of consultations over the next ten years will be similar to the past approximately ten years. To verify that this was a reasonable approach for estimating future Section 7 consultation efforts that would need to consider impacts to Nassau grouper critical habitat, we undertook the following steps:

- **Compared the numbers of known upcoming Section 7 consultations and re-initiations to the forecasts** based on discussions with:
    - USACE personnel regarding anticipated re-initiations as well as temporal trends in the volume of projects permitted by USACE's Jacksonville District Regulatory Division
    - NMFS SERO personnel regarding anticipated re-initiations and the extent to which critical habitat designation may incrementally affect Section 7 consultations that would occur absent designation.
- **Reviewed historical Section 7 consultation history from NMFS and both permit data and Section 7 consultation data from USACE to identify any potential trends** in levels or locations of consultations that should be considered in the forecast. NMFS did not identify any discernable trends in consultation activity and find that applying an average annual rate of consultations based on the recent past is most representative of the likely future activity levels.

This analysis assumes that the Section 7 consultation history, combined with the USACE permit data, provide a complete view of historical activities within the designated Nassau grouper critical habitat which would trigger Section 7 consultation if they are implemented in the Nassau grouper critical habitat in the future. The Section 7 consultation history represents past activity only in areas with existing listed species or critical habitat. Existing critical habitat, including habitat designated for acroporid corals, smalltooth sawfish, loggerhead sea turtle, green sea turtle, hawksbill sea turtle, and leatherback sea turtle, overlaps all areas of the designated Nassau grouper critical habitat except the Bajo de Sico and Grammanik Bank spawning site units. However, projects that may trigger Section 7 consultations are unlikely to occur solely in these areas.

While the historical consultation rate is likely an imperfect predictor of the number of future actions, the designation of critical habitat for Nassau grouper is not expected to result in any new Section 7 consultations that would not have already been expected to occur absent designation (*i.e.*, triggered solely by the designation of critical habitat). This is because, given the listing of the Nassau grouper and its presence throughout the final critical habitat, as well as the fact that the final critical habitat overlaps with the presence of other listed species (*e.g.*, listed corals; smalltooth sawfish; green, hawksbill, leatherback, and loggerhead sea turtles) and critical habitats where most activities are occurring, Section 7 consultations are already likely to occur for activities with a federal nexus throughout the final critical habitat. However, the need to evaluate impacts to the final critical habitat in future consultations will add an incremental administrative burden to Section 7 consultations.

Importantly, designation of critical habitat for the Nassau grouper is not expected to result in project modifications for any of the activities that may affect the critical habitat. Rationale for this assumption is provided in Section 10.1.3 and summarized below.

- **Construction**. As a condition of permitting, USACE generally requires that applicants avoid or minimize impacts to listed species and any critical habitat in which the project is located. As a result, some baseline protections for listed species and critical habitats that overlap with the final critical habitat may protect the critical habitat contiguous area essential feature. Given baseline protections, and the assumption that at least some components of the contiguity essential feature are present throughout the final critical habitat areas, NMFS anticipates that impacts from future in-water and coastal construction projects will be sufficiently limited that the functionality of the critical habitat will not be diminished. Therefore, it is unlikely that consultation on construction projects within the final critical habitat will result in incremental project modifications as a result of critical habitat designation for the Nassau grouper.
- **Water quality**. As part of the process of developing water quality standards, EPA considers levels that would be needed to protect Nassau grouper and any other potentially impacted listed species and critical habitat. Accordingly, the effect of developing water quality standards on Nassau grouper habitat is a consideration even absent critical habitat designation, and the development of more stringent water quality standards in the future would likely occur absent designation. It is therefore unlikely that consultation on projects that could affect water quality within the final critical habitat will result in incremental project modifications.
- **Protected Area Management**. Consultations related to protected area management over the next ten years are not expected to result in incremental project modifications as these protected areas generally provide specific regulations to protect sedimentary, seagrass, hard-bottom, coral reef, and other components of the contiguous area essential feature; however, some minor adverse effects may be unavoidable.

- **Fishery Management**. Limited areas of the final critical habitat are located within federally managed waters. Gear used by fisheries that operate within the Florida units is unlikely to affect the essential feature in any manner that would appreciably alter the physical or biological features that make them suitable for Nassau grouper. Fishing within the Bajo de Sico and Grammanik units is not expected to adversely affect the conservation value of these areas to Nassau grouper due to existing gear and seasonal restrictions.
- **Aquaculture**. Aquaculture activity is not expected to affect the final critical habitat due to existing siting requirements and best practices that protect sensitive areas including coral, seagrass, and hard bottom.
- **Military Activities**. Consultations related to military activities over the next ten years are not expected to result in incremental project modifications due to measures developed by the Navy that significantly limit the potential for impacts of training and testing activities and environmental remediation activities to the final critical habitat.
- **Derelict Vessel and Marine Debris Removal**. Consultations related to derelict vessel and marine debris removal activities are unlikely to require incremental project modifications due to the designation of critical habitat for the Nassau grouper because of existing protocols designed to minimize impacts to coral reef and hard bottom habitat.
- **Scientific Research and Monitoring.** NOAA-permitted research and monitoring activities may affect the final critical habitat, but these activities typically have a minor footprint. In addition, strict protocols are observed during fieldwork permitted by NOAA to ensure minimal disturbance to the environment. Restoration activities within the final critical habitat may cause temporary disturbances to the project areas but eventually improve the functionality of these areas as Nassau grouper habitat. Therefore, scientific research and monitoring and restoration activities are unlikely to adversely modify the final critical habitat and are therefore unlikely to result in incremental project modifications.

10.1.5.1 Projected Consultations

Between 2011 and 2022, NMFS completed 13 formal consultations, 13 programmatic consultations, and 137 informal consultations on activities occurring within the areas being considered for the Nassau grouper critical habitat designation. The formal consultations primarily involved construction activities, fishery management plans, and scientific research and monitoring activities. Six of the 13 programmatic consultations involved water quality regulations, with the remainder covering military, scientific research and monitoring, construction, and protected area management activities. Construction activities accounted for 92 of the 137 informal consultations, with most of the remaining informal consultations distributed across military (10 consultations), protected area management (9), fishery management (8), scientific research and monitoring (8), and derelict vessel and marine debris removal (6) activities.

To forecast the location of future consultations, the critical habitat unit(s) associated with each historical formal or programmatic consultation was identified. Next, the future number of consultations expected to occur in each critical habitat unit was projected, based on the patterns established in the consultation history and information on likely future activity gathered through conversations with NMFS personnel and federal action agencies. Fractions of consultations were assigned to all units anticipated to be impacted by activities falling under those consultations. As discussed previously, known upcoming Section 7 consultations were compared to the forecasts based on historical information. This comparison indicated that the currently planned projects are likely to be captured in the forecasts based on the historical frequency of programmatic and formal Section 7 consultations. The projections reflect

the assumption that there will be neither an increase nor decrease in the rate at which future activities are handled under programmatic consultations, i.e. that the types of activities that historically have been consulted on through programmatic consultations will continue to be handled under programmatic consultations.

Future informal consultations were projected based on the frequency and distribution of informal Section 7 consultations conducted from 2011 to 2022 as well as a review of USACE permit applications over the same time frame (USACE Jacksonville District 2023) and discussions with NMFS personnel and federal action agencies. Review of USACE permit application data is particularly useful because the database encompasses activities that may not have been consulted on in the past if they were outside of previously designated critical habitats or areas containing species protected under the ESA. As a result, for these areas, the USACE permit application data can be compared to the Section 7 consultation history to assess the latter's completeness. Comparison of the NMFS consultation history and USACE permit history confirmed that the relative distributions of consultation activity across critical habitat units were comparable between the two data sources, thereby validating use of the NMFS consultation database to project future informal consultations on USACE projects. Projections of informal consultations with action agencies other than the USACE were also based on information from the NMFS consultation database. Finally, this analysis evaluated the historical Section 7 consultation database to identify any potential statistically significant temporal trends in the rate of consultations. As no such trends were identified, the projected rate of future consultations on activities occurring within the areas being considered for Nassau grouper critical habitat is equivalent to that observed from 2011 to 2022.

We project that approximately 11 formal consultations, 11 programmatic consultations, and 114 informal consultations will be conducted in the next ten years on activities that may affect the Nassau grouper critical habitat (Table 16). We anticipate that each of these approximately 136 consultations will generate incremental impacts due specifically to the additional administrative effort required to consider impacts to Nassau grouper critical habitat. Where a project is expected to overlap multiple critical habitat units, we divide the expected number of future consultations across the relevant units. In some areas, the consultation forecast in this table is presented as a fraction (e.g., 0.5). This does not imply that we anticipate a fraction of a consultation will occur in this area. Rather, these fractions result from apportioning a single consultation to a particular unit when it may cover multiple geographic areas. In these instances, the consultation (and associated cost) is divided across the relevant units. This is particularly relevant in the case of programmatic or formal consultations that cover a larger geographic scope than a project-specific consultation.

Previous locations of Section 7 consultations suggest that more than 60% of consultations are likely to occur in Florida, with the Biscayne/Key Largo, Big Pine Key, and Marathon units together accounting for more than half of total consultations. As shown in Table 16, Florida units are also projected to account for 6.4 out of 11 formal consultations and 3.1 programmatic consultations. It should be noted, however, that there is uncertainty with respect to both the volume and geographic scope of future programmatic consultations that would result in incremental costs.

It is further projected that approximately 1.8 formal consultations, 4.2 programmatic consultations, and 25.8 informal consultations will occur across Puerto Rico units over the next ten years. The Northeast and Southwest units of Puerto Rico are expected to account for 10.7 and 8.2 informal consultations, respectively, with another 6.5 informal consultations occurring in Vieques. We anticipate that 2.4 formal consultations and 2.5 programmatic consultations will be distributed equally across the St. Thomas, St.

John, and St. Croix units of the USVI, with higher numbers of informal consultations occurring in St. Thomas (5.7) and St. Croix (4.0) than St. John (0.7).

Table 16. PROJECTED QUANTITY AND DISTRIBUTION OF SECTION 7 CONSULTATIONS ON ACTIVITIES THAT MAY AFFECT NASSAU GROUPER CRITICAL HABITAT, BY UNIT AND TYPE (2024- 2033)

UNIT	NUMBER OF FORMAL CONSULTATIONS	NUMBER OF INFORMAL CONSULTATIONS	NUMBER OF PROGRAMMATIC CONSULTATIONS	TOTAL
Biscayne/Key Largo	2.1	25.6	1.2	28.8
Marathon	1.3	12.2	0.3	13.8
Big Pine Key	1.3	33.9	0.3	35.5
Key West	0.4	3.9	0.3	4.7
New Ground Shoal	0.4	0.6	0.3	1.3
Halfmoon Shoal	0.4	0.6	0.3	1.3
Dry Tortugas	0.4	0.6	0.3	1.3
Florida, All	**6.4**	**77.3**	**3.1**	**86.8**
Mona Island	1.0	1.7	0.6	3.2
Desecheo	0.2	0.8	0.6	1.5
Southwest	0.2	7.5	0.6	8.2
Northeast	0.2	10.0	0.6	10.7
Vieques	0.2	5.0	1.4	6.5
Isla de Culebra/ Culebrita	0.2	0.8	0.6	1.5
Puerto Rico, All	**1.8**	**25.8**	**4.2**	**31.8**
Navassa	**0.1**	**0.2**	**0.3**	**0.6**
USVI - STT	0.8	5.7	0.8	7.3
USVI - STJ	0.8	0.7	0.8	2.3
USVI - STX	0.8	4.0	0.8	5.7
USVI, All	**2.4**	**10.4**	**2.5**	**15.3**
Bajo de Sico	**0.1**	**0.2**	**0.3**	**0.6**
Grammanik Bank/ Hind Bank	**0.1**	**0.2**	**0.3**	**0.6**
Riley's Hump	**0.0**	**0.1**	**0.2**	**0.3**
TOTAL	**10.8**	**114.2**	**10.8**	**135.8**

Source: NMFS SERO's Section 7 consultation database.
Fractions of consultations occurred as a result of assigning some consultations to two or more units.

Table 17. PROJECTED QUANTITY AND DISTRIBUTION OF SECTION 7 CONSULTATIONS ON ACTIVITIES THAT MAY AFFECT NASSAU GROUPER CRITICAL HABITAT, BY ACTIVITY AND TYPE (2024 2033)

UNIT	CON-STRUCTION	WATER QUALITY MGMT.	PROTECTED AREA MGMT.	FISHERY MGMT.	AQUA-CULTURE	MILITARY	SCIENTIFIC RESEARCH AND MONITOR.	DERELICT VESSEL AND MARINE DEBRIS REMOVAL	TOTAL
Biscayne/Key Largo	17.6	0.2	9.2	0.4	-	0.1	0.6	0.8	28.8
Marathon	12.6	0.2	-	0.4	-	0.1	0.6	-	13.8
Big Pine Key	34.3	0.2	-	0.4	-	0.1	0.6	-	35.5
Key West	0.1	0.2	-	0.4	0.8	2.6	0.6	-	4.7
New Ground Shoal	0.1	0.2	-	0.4	-	0.1	0.6	-	1.3
Halfmoon Shoal	0.1	0.2	-	0.4	-	0.1	0.6	-	1.3
Dry Tortugas	0.1	0.2	-	0.4	-	0.1	0.6	-	1.3
Florida, All	**64.8**	**1.1**	**9.2**	**2.5**	**0.8**	**3.3**	**4.3**	**0.8**	**86.8**
Mona Island	0.1	0.5	-	0.7	-	-	0.2	1.7	3.2
Desecheo	0.1	0.5	-	0.7	-	-	0.2	-	1.5
Southwest	2.6	0.5	-	0.7	-	-	2.7	1.7	8.2
Northeast	5.1	1.3	-	0.7	-	2.5	0.2	0.8	10.7
Vieques	0.1	0.5	-	0.7	-	4.2	0.2	0.8	6.5
Isla de Culebra/ Culebrita	0.1	0.5	-	0.7	-	-	0.2	-	1.5
Puerto Rico, All	**8.0**	**3.7**	**-**	**4.4**	**-**	**6.7**	**3.9**	**5.0**	**31.8**
Navassa	**0.1**	**0.1**	**-**	**0.1**	**-**	**-**	**0.2**	**-**	**0.6**
USVI - STT	5.4	0.8	-	0.6	-	-	0.6	-	7.3
USVI - STJ	0.4	0.8	-	0.6	-	-	0.6	-	2.3
USVI - STX	2.9	1.6	-	0.6	-	-	0.6	-	5.7
USVI, All	**8.6**	**3.1**	**-**	**1.8**	**-**	**-**	**1.8**	**-**	**15.3**
Bajo de Sico	**0.1**	**0.1**	**-**	**0.1**	**-**	**-**	**0.2**	**-**	**0.6**
Grammanik Bank/Hind Bank	**0.1**	**0.1**	**-**	**0.1**	**-**	**-**	**0.2**	**-**	**0.6**
Riley's Hump	**0.1**	**0.0**	**-**	**-**	**-**	**-**	**0.2**	**-**	**0.3**
TOTAL	**81.7**	**8.3**	**9.2**	**9.2**	**0.8**	**10.0**	**10.8**	**5.8**	**135.8**

Source: NMFS SERO's Section 7 consultation database.
Fractions of consultations occurred as a result of assigning some consultations to two or more units.

10.1.6 Estimated Incremental Costs

As discussed previously, this analysis considers both direct and indirect impacts of the critical habitat designation. Direct impacts include the costs associated with additional administrative effort required to conduct Section 7 consultations as well as the direct costs associated with project modifications that would not have been required under the baseline "world without critical habitat for Nassau grouper" scenario.

Indirect impacts are those changes in economic behavior that may occur due to critical habitat designation for reasons other than direct ESA requirements, i.e., those impacts which are "triggered" by critical habitat designation through other federal, state, or local actions, or which are otherwise unintended. Some common types of indirect impacts include time delays, regulatory uncertainty, and stigma effects.

To calculate present value and annualized impacts, guidance provided by OMB specifies the use of a real annual discount rate of 7%. In addition, OMB recommends sensitivity analysis using other discount rates, such as 3%, which some economists believe better reflects the social rate of time preference (i.e., the willingness of society to exchange the consumption of goods and services now for the consumption of goods and services in the future). Accordingly, this section presents results at 7% and a sensitivity analysis is included in Appendix A that presents impacts assuming a discount rate of 3%.

10.1.6.1 Administrative Section 7 Costs

The effort required to address adverse effects to the final critical habitat is assumed to be the same, on average, across categories of activities. Informal consultations are expected to require comparatively low levels of administrative effort, while formal and programmatic consultations are expected to require comparatively higher levels of administrative effort. For all formal and informal consultations, it is anticipated that incremental administrative costs will be incurred by NMFS, a federal action agency, and, potentially, a third party. For programmatic consultations, it is anticipated that costs will be incurred by NMFS and a federal action agency. Incremental administrative costs per consultation effort are expected on average to be $13,000 for programmatic, $6,400 for formal consultations, and $3,100 for informal consultations (see Table 18).

Table 18. INCREMENTAL COSTS PER CONSULTATION RESULTING FROM THE ADDITIONAL ADMINISTRATIVE EFFORTTO ADDRESS ADVERSE MODIFICATION FOR ACTIVITIES IN NASSAU GROUPER CRITICAL HABITAT (2023 DOLLARS)

CONSULTATION TYPE	NMFS	FEDERAL ACTION AGENCY[(1)]	THIRTY PARTY	BIOLOGICAL ASSESSMENT COST	TOTAL COST
Informal	$900	$1,100	$510	$500	$3,100
Formal	$2,000	$2,300	$880	$1,200	$6,400
Programmatic	$6,100	$5,100	N/A	$1,400	$13,000

Source: Industrial Economics analysis of full administrative costs which was based on data from the federal Government Schedule Rates, and a review of consultation records from several Service field offices across the country conducted in 2002; revised by NMFS to reflect current federal Government Schedule Rates for the Locality Pay Area of Miami-Ft. Lauderdale-St. Lucie, FL (U.S. Office of Personnel Management 2023).

It is estimated the incremental administrative costs of Section 7 consultation by applying these per

consultation costs to the projected number of consultations (presented earlier in Section 10.1.5); the resulting annualized costs, by unit and activity type, are presented in Table 19. Table 20 presents total projected costs over the ten years, 2024-2033. It is anticipated that there will be approximately 11 programmatic consultations, 11 formal consultations, and 114 informal consultations which will require incremental administrative effort. Incremental costs are expected to total approximately $440,000 over the next ten years (discounted at 7%), at an annualized cost of $62,000. We conservatively assume that there will be approximately eight re-initiations of existing consultations to consider effects to Nassau grouper critical habitat, with the re-initiations on consultations related to fishery management, military, construction, and scientific research and monitoring activities.

By activity, future consultations on construction activities are projected to account for the largest share (48%) of incremental costs of critical habitat designation for the Nassau grouper. However, consultations related to water quality management, scientific research and monitoring, military, fishery management, and protected area management activities are each projected to account for at least 6% of incremental costs. Consultations on activities occurring within the Florida units are anticipated to drive more than half of incremental costs, or approximately $240,000 over the ten years (discounted at 7%). Incremental costs of the final rule are projected to total $120,000 across Puerto Rico units and $60,000 across USVI units over the ten years.

Table 19. PROJECTED ANNUALIZED INCREMENTAL COSTS OF NASSAU GROUPER CRITICAL HABITAT DESIGNATION, BY ACTIVITY TYPE AND UNIT, 2024-2033 (2023 DOLLARS)

UNIT	CON-STRUCTION	WATER QUALITY MGMT.	PROTECTED AREA MGMT.	FISHERY MGMT.	AQUA-CULTURE	MILITARY	SCIENTIFIC RESEARCH AND MONITOR.	DERELICT VESSEL AND MARINE DEBRIS REMOVAL	TOTAL
Biscayne/Key Largo	$5,800	$130	$3,900	$260	$0	$300	$380	$250	$11,000
Marathon	$4,300	$130	$0	$260	$0	$300	$380	$0	$5,400
Big Pine Key	$11,000	$130	$0	$260	$0	$300	$380	$0	$12,000
Key West	$210	$130	$0	$260	$250	$1,100	$380	$0	$2,300
New Ground Shoal	$210	$130	$0	$260	$0	$300	$380	$0	$1,300
Halfmoon Shoal	$210	$130	$0	$260	$0	$300	$380	$0	$1,300
Dry Tortugas	$210	$130	$0	$260	$0	$300	$380	$0	$1,300
Florida, All	**$22,000**	**$900**	**$3,900**	**$1,800**	**$250**	**$2,900**	**$2,700**	**$250**	**$35,000**
Mona Island	$210	$520	$0	$350	$0	$0	$200	$790	$2,100
Desecheo	$210	$520	$0	$350	$0	$0	$200	$0	$1,300
Southwest	$970	$520	$0	$350	$0	$0	$970	$510	$3,300
Northeast	$1,700	$770	$0	$350	$0	$760	$200	$250	$4,100
Vieques	$210	$520	$0	$350	$0	$3,100	$200	$250	$4,600
Isla de Culebra/ Culebrita	$210	$520	$0	$350	$0	$0	$200	$0	$1,300
Puerto Rico, All	**$3,500**	**$3,400**	**$0**	**$2,100**	**$0**	**$3,900**	**$2,000**	**$1,800**	**$17,000**
Navassa	**$210**	**$140**	**$0**	**$110**	**$0**	**$0**	**$200**	**$0**	**$660**
USVI - STT	$1,900	$870	$0	$310	$0	$0	$430	$0	$3,500
USVI - STJ	$390	$870	$0	$310	$0	$0	$430	$0	$2,000
USVI - STX	$1,200	$1,100	$0	$310	$0	$0	$430	$0	$3,000
USVI, All	**$3,500**	**$2,900**	**$0**	**$930**	**$0**	**$0**	**$1,300**	**$0**	**$8,500**
Bajo de Sico	**$210**	**$140**	**$0**	**$110**	**$0**	**$0**	**$200**	**$0**	**$660**
Grammanik Bank/Hind Bank	**$210**	**$140**	**$0**	**$110**	**$0**	**$0**	**$200**	**$0**	**$660**
Riley's Hump	**$210**	**$52**	**$0**	**$0**	**$0**	**$0**	**$180**	**$0**	**$440**
TOTAL	**$30,000**	**$7,600**	**$3,900**	**$5,200**	**$250**	**$6,700**	**$6,800**	**$2,100**	**$62,000**

Source: NMFS SERO's Section 7 consultation database.
Note: The estimates may not sum to totals due to rounding.

Table 20. PROJECTED TOTAL PRESENT VALUE INCREMENTAL COSTS OF NASSAU GROUPER CRITICAL HABITAT DESIGNATION, BY ACTIVITY TYPE AND UNIT, 2024-2033 (7 PERCENT DISCOUNT RATE; 2023 DOLLARS)

UNIT	CON-STRUCTION	WATER QUALITY MGMT.	PROTECTED AREA MGMT.	FISHERY MGMT.	AQUA-CULTURE	MILITARY	SCIENTIFIC RESEARCH AND MONITOR.	DERELICT VESSEL AND MARINE DEBRIS REMOVAL	TOTAL
Biscayne/Key Largo	$41,000	$900	$27,000	$1,800	$0	$2,100	$2,700	$1,800	$78,000
Marathon	$30,000	$900	$0	$1,800	$0	$2,100	$2,700	$0	$38,000
Big Pine Key	$77,000	$900	$0	$1,800	$0	$2,100	$2,700	$0	$84,000
Key West	$1,500	$900	$0	$1,800	$1,800	$7,500	$2,700	$0	$16,000
New Ground Shoal	$1,500	$900	$0	$1,800	$0	$2,100	$2,700	$0	$9,000
Halfmoon Shoal	$1,500	$900	$0	$1,800	$0	$2,100	$2,700	$0	$9,000
Dry Tortugas	$1,500	$900	$0	$1,800	$0	$2,100	$2,700	$0	$9,000
Florida, All	**$150,000**	**$6,300**	**$27,000**	**$13,000**	**$1,800**	**$20,000**	**$19,000**	**$1,800**	**$240,000**
Mona Island	$1,500	$3,600	$0	$2,500	$0	$0	$1,400	$5,500	$15,000
Desecheo	$1,500	$3,600	$0	$2,500	$0	$0	$1,400	$0	$9,000
Southwest	$6,800	$3,600	$0	$2,500	$0	$0	$6,800	$3,600	$23,000
Northeast	$12,000	$5,400	$0	$2,500	$0	$5,400	$1,400	$1,800	$29,000
Vieques	$1,500	$3,600	$0	$2,500	$0	$22,000	$1,400	$1,800	$33,000
Isla de Culebra/ Culebrita	$1,500	$3,600	$0	$2,500	$0	$0	$1,400	$0	$9,000
Puerto Rico, All	**$25,000**	**$24,000**	**$0**	**$15,000**	**$0**	**$27,000**	**$14,000**	**$13,000**	**$120,000**
Navassa	**$1,500**	**$980**	**$0**	**$770**	**$0**	**$0**	**$1,400**	**$0**	**$4,700**
USVI - STT	$13,000	$6,100	$0	$2,200	$0	$0	$3,000	$0	$25,000
USVI - STJ	$2,700	$6,100	$0	$2,200	$0	$0	$3,000	$0	$14,000
USVI - STX	$8,100	$7,900	$0	$2,200	$0	$0	$3,000	$0	$21,000
USVI, All	**$24,000**	**$20,000**	**$0**	**$6,500**	**$0**	**$0**	**$9,100**	**$0**	**$60,000**
Bajo de Sico	**$1,500**	**$980**	**$0**	**$770**	**$0**	**$0**	**$1,400**	**$0**	**$4,700**
Grammanik Bank/Hind Bank	**$1,500**	**$980**	**$0**	**$770**	**$0**	**$0**	**$1,400**	**$0**	**$4,700**
Riley's Hump	**$1,500**	**$370**	**$0**	**$0**	**$0**	**$0**	**$1,300**	**$0**	**$3,100**
TOTAL	**$210,000**	**$53,000**	**$27,000**	**$37,000**	**$1,800**	**$47,000**	**$48,000**	**$14,000**	**$440,000**

Source: NMFS SERO's Section 7 consultation database.
Note: The estimates may not sum to totals due to rounding.

10.1.6.2 Indirect Impacts

The designation of critical habitat may, under certain circumstances, affect actions that do not have a federal nexus and thus are not subject to the provisions of Section 7 under the ESA. Indirect impacts are those sometimes unintended changes in economic behavior that may occur outside of the influence of the ESA, through other federal, state, or local actions, and that are caused by the designation of critical habitat. This section identifies common types of indirect impacts that may be associated with the designation of critical habitat. Importantly, these types of impacts are not always considered incremental. In the case that these types of conservation efforts and economic effects are expected to occur regardless of critical habitat designation, they are appropriately considered baseline impacts in this analysis.

OTHER STATE AND LOCAL LAWS

Under certain circumstances, critical habitat designation may provide new information to a community about the sensitive ecological nature of a geographic region, potentially triggering additional economic impacts under other state or local laws. In cases where these impacts would not have been triggered absent critical habitat designation, they are considered indirect, incremental impacts of the designation.

ADDITIONAL INDIRECT IMPACTS

In addition to the indirect effects of compliance with other laws or triggered by the designation, project proponents, land managers and landowners may face additional indirect impacts, including the following:

- **Time Delays** - Both public and private entities may experience incremental time delays for projects and other activities due to requirements associated with the need to re-initiate the Section 7 consultation process and/or compliance with other laws triggered by the designation. To the extent that delays result from the designation, they are considered indirect, incremental impacts of the designation.
- **Regulatory Uncertainty or Stigma** - NMFS conducts each Section 7 consultation on a case-by-case basis and issues a biological opinion on formal consultations based on species-specific and site-specific information. As a result, government agencies and affiliated private parties who consult with NMFS under Section 7 may face uncertainty concerning whether project modifications will be recommended by NMFS and the nature of these modifications. This uncertainty may diminish as consultations are completed and additional information becomes available on the effects of critical habitat on specific activities. Where information suggests that this type of regulatory uncertainty stemming from the designation may affect a project or economic behavior, associated impacts are considered indirect, incremental impacts of the designation.

Forecasting the costs associated with the regulatory uncertainty and potential project delays resulting from the designation of critical habitat for the Nassau grouper is too speculative to be quantified in this analysis. However, for most projects, delays attributable to the additional time to consider the Nassau grouper critical habitat as part of future Section 7 consultations are anticipated to be minor given that, due to existing baseline protections, the final critical habitat is not expected to result in incremental project modifications.

10.1.6.3 Caveats and Uncertainties

There are several important uncertainties underlying the calculation of incremental costs that could result from the designation of critical habitat for the Nassau grouper. These uncertainties, and their significance with respect to the results, are summarized in Table 21. In general, the potential for these uncertainties to alter the results of the analysis is considered minor.

Table 21. SUMMARY OF UNCERTAINTIES

Assumption/Source of Uncertainty	Direction of Potential Bias	Likely Significance with Respect to Estimated Impacts
This analysis relies on patterns of Section 7 consultation and USACE permit applications within the past 11 years to forecast future rates and locations of consultation activity. The analysis assumes that past consultation rates provide a good indication of future activity levels and distribution of activities.	**Unknown.** May overestimate or underestimate incremental impacts.	**Likely minor.** Data are not available to determine whether the rates or locations of activities subject to consultation are likely to change over time. To the extent that activities increase over the next ten years, our analysis may underestimate incremental costs. If designation of critical habitat for the Nassau grouper leads NMFS to determine that activities which previously were handled on a programmatic basis now require informal or formal consultation, or activities which previously required informal consultation now require formal consultation, our analysis may understate the number of future formal consultations and overstate future informal consultation efforts. To the extent NMFS handles more consultations on a programmatic basis our forecast of consultations may lead us to overestimate formal and informal consultation levels, thus overstating administrative impacts. The estimated incremental impacts per consultation are, however, relatively minor, and we accordingly do not anticipate variations in consulting rates or locations to significantly change the finding of our analysis.

Assumption/Source of Uncertainty	Direction of Potential Bias	Likely Significance with Respect to Estimated Impacts
The analysis assumes that baseline protections to Nassau grouper and other ESA-listed species, as well as designated critical habitat that overlaps with the final critical habitat, will provide sufficient protection to avoid adverse modification of the Nassau grouper critical habitat, thus making additional project modifications unnecessary.	May result in an **underestimate** of costs.	**Potentially major.** NMFS anticipates that it is unlikely that critical habitat designation will generate additional or different recommendations for project modifications due to baseline protections and because forecast activities are not expected to result in adverse modification of the critical habitat. Absent the suite of baseline protections considered in this analysis (other than the listing of the Nassau grouper, without which critical habitat would not be designated), potentially costly project modifications and conservation measures could be required incrementally to the critical habitat designation to avoid adverse modification of the critical habitat. Examples of such project modifications include conditions monitoring, deployment of sediment and turbidity control barriers, surveying, and fishing gear restrictions. However, NMFS will review each individual project or activity at the time of consultation to determine whether additional project modifications may be needed to avoid adverse modification of critical habitat.
The analysis considers potential future changes to water quality standards, and the ultimate impacts of changing those standards, to be baseline impacts.	May result in an **underestimate** of costs.	**Likely minor.** Recommendations that result from Section 7 consultation on water quality standards may result in more stringent water quality standards; however, this would likely occur regardless of critical habitat designation due to baseline protections to ESA-listed species, coral critical habitat, and seagrasses. NMFS believes that the recommendations would likely remain the same. However, if this critical habitat designation generates additional or more stringent recommendations to avoid adverse modification of the final critical habitat, impacts of the critical habitat designation may be understated.

Assumption/Source of Uncertainty	Direction of Potential Bias	Likely Significance with Respect to Estimated Impacts
This analysis makes assumptions regarding distribution of certain types of past consultations across units.	**Unknown**. May overestimate or underestimate incremental impacts in a given area.	**Likely minor**. Because fisheries, water quality, scientific research and monitoring, and protected area management activities are not confined to a specific geographic location, this analysis makes assumptions regarding the critical habitat units included in historical consultations, and how those costs are distributed across relevant units. Variations in the locations of future consultations from the past or in how past consultations are assigned to critical habitat units are unlikely to significantly change the overall findings of our analysis, but may over or underestimate the costs assigned to any given habitat unit.
This analysis does not quantify potential indirect impacts associated with time delay.	May result in an **underestimate** of costs.	**Likely minor**. For new projects, the USACE will be required to consult with NMFS due to the presence of Nassau grouper or other listed species or critical habitat. Therefore, the indirect incremental impact associated with time delay on new projects would be limited to any costs (*e.g.*, additional cost of renting equipment) incurred specifically during the additional time necessary to complete the analysis of adverse modification of the final critical habitat. The bulk of any time delays would be expected to occur regardless of the final critical habitat.
The analysis assumes that no wind energy projects will occur over the next ten years inside the Nassau grouper critical habitat.	May result in an **underestimate** of costs.	**Likely minor**. No consultations are anticipated over the next 10 years on future wind energy projects within the final critical habitat. This could lead to an underestimate of costs if BOEM grants leases for wind energy development in areas that would result in impacts to the critical habitat. Section 7 consultations considering effects of wind energy projects on Nassau grouper critical habitat would likely already occur because of the presence of Nassau grouper or other listed species or existing critical habitat, and any project modifications required to avoid adverse modification of Nassau grouper critical habitat would already be required due to baseline

Assumption/Source of Uncertainty	Direction of Potential Bias	Likely Significance with Respect to Estimated Impacts
		protections to Nassau grouper and other ESA-listed species, as well as designated critical habitat that overlaps with the final critical habitat.

10.1.7 Economic Impacts Summary

In summary, there are significant baseline protections that exist in the designated areas of the Nassau grouper critical habitat. The incremental impacts for the designation are projected to reflect the incremental administrative effort required for Section 7 consultations to consider the critical habitat. Taking into consideration several assumptions and uncertainties, total projected incremental costs are approximately $440,000 over the next ten years ($62,000 annualized), applying a discount rate of 7%. Notwithstanding the uncertainty underlying the projection of incremental costs, the results provide an indication of the potential activities that may be affected and a reasonable projection of future costs.

10.2 National Security Impacts

Impacts to national security could occur if a designation triggers future ESA section 7 consultations because a proposed military activity "may affect" the physical or biological feature(s) essential to the listed species' conservation. Interference with mission-essential training or testing or unit readiness could result if the DoD or USCG were required to modify or delay their actions to prevent adverse modification of critical habitat or implement Reasonable and Prudent Alternatives. Whether national security impacts result from the designation also depends on whether future consultations and associated project modifications and/or implementation of Reasonable and Prudent Measures and Terms and Conditions would otherwise be required due to potential effects to Nassau grouper or other ESA-listed species or designated critical habitat, regardless of the Nassau grouper critical habitat designation, and whether the Nassau grouper designation would add costs beyond those related to the consultation on effects to Nassau grouper or other species or critical habitat.

As described previously, we identified DoD military operations as a category of activity that has the potential to affect the essential features of the designated critical habitat. However, for the actions that may affect Nassau grouper critical habitat, designating critical habitat for Nassau grouper would not result in incremental impacts beyond administrative costs because the consultations would otherwise be required to address effects to either the Nassau grouper or other listed species or the substrate feature of designated critical habitat for corals. In 2022, we requested descriptions and locations of any geographical areas owned or controlled by the DoD or the USCG that may overlap with the areas under consideration for critical habitat that they would like considered for exclusion due to impacts to national security. The USCG responded that maintenance and replacement of fixed Aids to Navigation (AToNs) may affect the proposed habitat by generating sedimentation of the seafloor surrounding piling or other foundations. USCG further indicated that use of floating AToNs may result in removal of the essential feature related to development, refuge, and foraging through chain scouring and placement of the sinker. However, USCG already implements measures to mitigate the impacts of AToN operations to corals, hardbottom, and seagrass, per the programmatic biological opinion on USCG's AToN program (NMFS, 2018a). While we do not anticipate that the critical habitat designation would result in incremental modifications to USCG's AToN operations or affect national security matters, we expect USCG would be required to re-initiate consultation on the programmatic biological opinion to address impacts to the Nassau grouper critical habitat. This would represent an incremental administrative impact of the final rule, which is considered in the economic analysis, but would not affect national security.

The Navy requested that NMFS exclude areas around Naval Air Station Key West from the critical habitat designation under ESA section 4(b)(2). However, the Navy's concerns have been addressed through the previously described INRMP exclusion. No areas managed by other DoD branches were identified as potentially of concern.

10.3 Other Relevant Impacts

Previous sections of this report evaluate the potential impacts that may be generated by the designation of critical habitat for the Nassau grouper. This section considers the potential economic benefits resulting from the designation. First, we introduce economic methods employed to quantify benefits of species and habitat conservation, and discuss the availability of existing literature to support valuation in the context of this rulemaking. We then provide a qualitative description of the potential categories of ancillary benefits that may result from Nassau grouper conservation activities.

The primary intended benefit of critical habitat is to support the conservation of threatened and endangered species, such as the Nassau grouper.[6] As discussed previously, the primary regulatory benefit of critical habitat designations stem from the ESA Section 7(a)(2) requirement that all Federal agencies ensure their actions are not likely to destroy or adversely modify the designated habitat. Critical habitat rules contribute to conservation and recovery by focusing on protecting the physical and biological features of habitat that are essential to the conservation of the species.

Beyond the potential for critical habitat to trigger additional conservation efforts as part of Section 7 consultations, critical habitat may indirectly affect conservation behaviors in ways that generate both opportunity costs and conservation benefits. For example, critical habitat provides notice to other Federal agencies of areas and features important to species conservation; provides information about the types of activities that may reduce the conservation value of the habitat; and may stimulate research, voluntary conservation actions, and outreach and education activities. To the extent that this information causes agencies, organizations, or individuals to change their behavior for the benefit of the Nassau grouper, these changes would be considered benefits of this rulemaking. These changes in behavior could also trigger opportunity costs, for example due to the time or money spent to reduce the risk of negatively affecting the species or its habitat. Thus, additional impacts considered in this section include educational and awareness benefits and impacts on governmental or private entities that are implementing existing management plans that provide benefits to the listed species.

10.3.1 Conservation Benefits

For some listed species, critical habitat designation contributes directly to conservation and recovery of the species due to additional conservation efforts implemented as a result of the Section 7 consultation process to avoid adverse modification of critical habitat. Section 10.1.6 of this report evaluate the expected economic costs that may be generated by the critical habitat designation for the Nassau grouper. This analysis concludes that, based on the best available information at this time, it is unlikely that the need to avoid adverse modification would trigger additional conservation efforts above and beyond those that would be undertaken to avoid jeopardy to the Nassau grouper or other listed species, or to avoid adverse modification of designated critical habitat for other listed species. However, this analysis acknowledges the uncertainty associated with that finding. Following the designation of critical habitat, each consultation will be subject to analysis of potential for jeopardy and adverse modification based on the specific circumstances of the planned project or activity. If, for a given future project, NMFS makes a conservation recommendation to avoid adverse modification that would not have been made but for the critical habitat designation (i.e., would not have been made to avoid jeopardy to the Nassau grouper or other listed species, or to avoid adverse modification of existing critical habitat), the associated costs and benefits would be considered economic effects of this rulemaking. In addition, given the additional requirement to consider effects to the Nassau grouper critical habitat, federal agencies may modify the design of their action prior to entering into formal consultation. As these modifications are decided upon prior to entering into formal consultation, such decisions cannot be forecasted.

Given these uncertainties, this analysis is unable to quantify the economic benefits of this rulemaking.

---

[6] The term "conservation" means "the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary" (16 U.S.C. 1532).

This section therefore discusses the economic literature on the benefits of conservation of the Nassau grouper and the essential features of the final critical habitat but does not estimate the extent to which this rule contributes to that conservation. The economics literature demonstrates that, in general, conservation and recovery of the Nassau grouper generates economic benefits associated both with potential use values people hold for the fish (e.g., for wildlife viewing), as well as non-use values (i.e., people's preference for the continued existence of the Nassau grouper regardless of any direct or indirect). Moreover, protection of the essential features of the Nassau grouper critical habitat is associated with considerable ecosystem services benefits.

ESTIMATING ECONOMIC BENEFITS OF SPECIES AND HABITAT CONSERVATION

Economic benefits should be measured in terms of the value people hold for the conservation benefits to the Nassau grouper resulting from the rule. As discussed above, the conservation benefits of this rule cannot be quantified. This section provides a discussion on the value of conservation of the Nassau grouper in general but should not be interpreted as an estimation of benefits for this rule.

From an economic perspective, the "value" of an animal or species reflects the full range of contributions the species makes to people's well-being. In the context of welfare economics, value is most frequently measured in terms of people's "willingness-to-pay" (WTP) for a good or service, where WTP is the maximum amount (typically in monetary terms) that an individual would be willing to pay rather than do without a particular benefit. OMB recognizes WTP as the appropriate measure for valuing costs and benefits in the context of regulatory analysis (U.S. Office of Management and Budget 2003). WTP is inclusive of all use and non-use services and includes the following:

a) **Market value**: This is relevant to species, such as shrimp, that are bought and sold in commercial markets. This type of value is generally quantifiable based on market data but is irrelevant to the Nassau grouper.

b) **Non-market use value**: Non-market use values are associated with uses of a given resource outside of markets, including for recreational purposes such as hunting or fishing. For example, SCUBA diving and snorkeling near coral reefs provide a non-market value. The value people hold for these activities is measured by the utility they derive from the activity above and beyond what they pay for it.

c) **Non-use value**: The concept of non-use values recognizes that people may have a positive preference for a good or service beyond any current or even expected future use. Non-use values are thought to reflect an environmental ethic and are a measure of the utility that people derive from indicators of improved ecological heath or functioning. Economists generally see these values as motivated by three key factors:

    - Existence value, defined as the benefit gained simply from knowing the resource exists;
    - Option value, allowing for potential use of the resource in the future; and/or
    - Bequest value, reflecting a desire to ensure continued existence of the resource for future generations.

d) **Ecological value**: Ecological value may contribute to people's WTP for the species, for example as a predator or prey species, or in supporting a healthy, stable, resilient ecosystem. The ecological function of a species may contribute to the total economic value of other resources (e.g., species interconnected by the food chain) or to the broader ecosystem.

SUMMARY OF BENEFITS DISCUSSION

- Given the uncertainty regarding conservation efforts that may be triggered by this rule, we are unable to quantify the benefits. This section therefore provides an overview of economic literature on the benefits of the overall conservation of the Nassau grouper. The economic benefits described are not benefits specifically of this rulemaking.
- The primary goal of critical habitat designation is to support long-term conservation and recovery of the Nassau grouper. Conservation efforts potentially triggered by this rule would result in benefits, including use benefits (e.g., wildlife-viewing), non-use benefits (e.g., existence values), and ancillary ecosystem service benefits (e.g., enhanced habitat conditions for other marine species).
- Ancillary ecosystem services benefits associated with the conservation of the coral reefs and coastal seagrasses, to which the final rule affords protections, include shoreline protection, provision of essential habitat and nursery functions for recreationally and commercially valuable fish species, increased quality or quantity of reef-related recreational opportunities, sedimentation control, and carbon sequestration.
- Absent information on the incremental change in Nassau grouper populations or recovery potential associated with the designation of critical habitat, this analysis is unable to apply the available literature to quantify or monetize associated incremental use and non-use economic benefits. This literature suggests, however, that the Nassau grouper has value to people nationally.

Quantification and monetization of conservation benefits for listed species requires two primary pieces of information: (1) data on the incremental change in the species population or in the probability of species recovery that is expected to result from the designation; and (2) data on the public's willingness to pay for this incremental change.

Determining the incremental effect of the critical habitat designation on Nassau grouper conservation and recovery is not feasible at this time as we are unable to predict any conservation efforts triggered by this rule. Moreover, this analysis has not identified any activities for which it is likely that Section 7 consultation with the critical habitat for the Nassau grouper will result in different conservation efforts than Section 7 consultation without the critical habitat. This is because protection of the essential features of the Nassau grouper critical habitat is generally important to the conservation and recovery of the Nassau grouper itself as well as other listed species, even outside of the need to consider adverse modification of critical habitat.

Although the critical habitat is not expected to change NMFS' identification of conservation efforts for the Nassau grouper, the adverse modification analysis conducted as part of Section 7 consultations provides useful scientific information to build upon NMFS' and other Federal agencies' understanding of the biological needs of, and threats to, the species. This scientific information is an ancillary benefit of the consultations.

In the remainder of this section, we provide a more detailed description of the economic techniques that economists employ to monetize the benefits of species and habitat conservation and provide an overview of the existing literature specifically related to reef fish, coral reefs, and coastal seagrasses. These studies provide evidence that regulatory and other efforts to increase the recovery probability of Nassau grouper — including critical habitat designation — benefit societal well-being.

ECONOMIC METHODS APPLIED TO ESTIMATE USE AND NON-USE VALUES OF SPECIES AND HABITAT CONSERVATION

Various economic benefits, measured in terms of social welfare (i.e., people's well-being as measured in terms of producer and consumer surplus) or regional economic performance (e.g., regional income or employment), may result from conservation efforts for listed species. Economists apply a variety of methodological approaches to estimate use and non-use values for species and for habitat improvements. Stated preference techniques include such tools as the contingent valuation method, conjoint analysis, or contingent ranking methods. In simplest terms, these methods employ survey techniques, asking respondents questions that provide insight into what they would be willing to pay for a resource or for programs designed to protect a resource. A substantial body of literature has been developed that describes the application of this technique to the valuation of natural resource assets.

More specific to use values for species or habitats, revealed preference techniques examine individuals' behavior in markets in response to changes in environmental or other amenities (i.e., people "reveal" their value through their behavior). For example, travel cost models are frequently applied to value access to recreational opportunities, as well as to value changes in the quality and characteristics of these opportunities. Basic travel cost models are rooted in the idea that the value of a recreational resource can be estimated by analyzing the travel and time costs incurred by individuals visiting the site. Another revealed preference technique is hedonic analysis, which is often employed to determine the effect of site-specific characteristics on property values.

An ideal study to apply in valuing the use and non-use values that may derive from critical habitat designation for Nassau grouper would: (1) be specific to the species; (2) be specific to the policy question at hand (implementation of the particular project modifications associated with critical habitat designation); and (3) provide insight into the relevant population holding such values (e.g., citizens of the coastal counties and regions abutting the final critical habitat or of the United States as a whole). No such study has been undertaken to date for Nassau grouper.

Absent primary research specific to the policy question (benefits of critical habitat designation for Nassau grouper), resource management decisions can often be informed by applying the results of existing valuation research to a new policy question – a process known to economists as benefit transfer. Benefit transfer involves the application of unit value estimates, functions, data, and/or models from existing studies to estimate the benefits associated with the resource under consideration.

OMB has written guidelines for conducting credible benefit transfers. The important steps in the OMB guidance are: (1) specify the value to be estimated for the rulemaking; and (2) identify appropriate studies to conduct benefits transfer based on the following criteria:

- The selected studies should be based on adequate data, sound and defensible empirical methods and techniques;

- The selected studies should document parameter estimates of the valuation function;
- The study and policy contexts should have similar populations (e.g., demographic characteristics). The market size (e.g., target population) between the study site and the policy site should be similar;
- The good, and the magnitude of change in that good, should be similar in the study and policy contexts;
- The relevant characteristics of the study and policy contexts should be similar;
- The distribution of property rights should be similar so that the analysis uses the same welfare measure (i.e., if the property rights in the study context support the use of willingness-to-accept measures while the rights in the rulemaking context support the use of willingness-to-pay measures, benefits transfer is not appropriate); and
- The availability of substitutes across study and policy contexts should be similar.

Use and Non-Use Valuation Studies

Numerous published studies estimate individuals' willingness-to-pay to protect endangered species.[7] The economic values reported in these studies reflect various groupings of benefit categories (including both use and non-use values). For example, these studies assess public willingness to pay for wildlife-viewing opportunities, for the option of seeing or experiencing the species in the future, to assure that the species will exist for future generations and simply knowing a species exists, among other values.

Available Literature Valuing Nassau Grouper and Other Large Reef Fish

Few studies have investigated the non-market use value or non-use value of Nassau grouper, specifically. A notable exception is Rudd and Tupper's (2002) assessment of SCUBA diver preferences for viewing Nassau grouper and the marginal tradeoffs that divers exhibited between fish size and abundance in the Turks and Caicos Islands. Using a paired comparison conjoint survey to develop market share simulations of dive site choice, the study found that market shares increased significantly for sites with increased Nassau grouper abundance and mean size. This revealed that, in the context of the study parameters, Nassau grouper provide nonextractive economic value to divers.

Gill et al. (2015) quantified the potential effects of changes in Caribbean reef fish populations on recreational divers' consumer surplus. The study applied survey data from more than 500 tourist SCUBA divers at seven sites across the Caribbean to conduct a choice experiment to assess willingness to pay as a function of the abundance and size of reef fishes, the presence of fishing activity/gear, and dive price. Results indicate that future declines in the abundance of reef fishes, and particularly in the number of large fishes observed on recreational dives, will result in significant reductions in diver consumer surplus. The study further found that improvements in fish populations and reduced fishing gear encounters are likely to result in significant economic gains.

Shidler and Pierce (2016) used a survey instrument with choice experiments to measure diver WTP for a dive trip encounter with a single goliath grouper and, separately, WTP to observe 40 goliath grouper at a spawning aggregation site. The study found that, on average, divers off eastern Florida would be willing to pay $127 (2023 dollars) for a single encounter and $249 (2023 dollars) if there are 40 goliath grouper present. WTP among the subset of survey respondents coming from outside of Florida was

[7] See, for example, the summary in Richardson, L., and J. Loomis. 2009. The total economic value of threatened, endangered and rare species: An updated meta-analysis. Ecological Economics 68(5):1535-1548.

approximately $414 (2023 dollars) for a single dive at a goliath grouper aggregation site.

Available Literature Valuing Coral Reefs and Seagrass

While the existing economics literature on values for listed species reflects a relatively narrow subset of species and species types, a significant body of research is devoted to evaluating the benefits of coral reefs, including specifically in the United States and its territories and, to a lesser extent, coastal seagrasses. The final critical habitat designation is not expected to result in protections to the essential features, including coral reefs and seagrasses, beyond those that would already be required due to existing ESA species listings and designated critical habitat. However, the inclusion of coral reefs and seagrass as a component of Nassau grouper critical habitat could generate indirect benefits to coral reef and coastal seagrass conservation and restoration by increasing awareness of their importance to promoting marine biodiversity.

A 2013 literature review and synthesis (Brander and van Beukering 2013) by the NOAA Coral Reef Conservation Program summarized existing economic studies focused on values of U.S. coral reefs. The review identifies valuation studies for all states and territories that contain coral reefs. The overarching objective of the study was to estimate an aggregate total economic value of coral reefs in the U.S., and to use the literature to estimate a value function that may be used to value a reef at a particular site. The literature summary estimates the total economic value of reefs in the U.S. at approximately $4.7 billion per year (2023 dollars).[8] The study asserts that this should be considered a lower bound on the total value as it does not cover all known coral reef sites and not all studies were inclusive of both use and non-use values. Table 22 summarizes the findings of valuation studies relevant to regions that overlap Acropora critical habitat and critical habitat for 5 additional listed coral species.

A number of additional studies have likewise evaluated social welfare values of coral reef ecosystems. For example, Table 27 of NMFS' Section 4(b)(2) Report for Acropora corals summarizes economic valuation literature related to coral reefs (National Marine Fisheries Service 2008). In addition to these social welfare values, a number of studies have estimated the regional economic contribution of the recreational and commercial uses of coral reefs. Johns et al. (2003), for example, calculated the impact of visitor spending on reef-related recreational activities on the regional economy. The study estimates that visitors to natural reefs in Miami-Dade County, Florida between June 2000 and May 2001 generated $1.13 billion in sales and $641 million in income (2023 dollars) across the County and supported over 11,000 full time and part time jobs.[9] Overall, these numbers evidence the significant value of reef-related tourism in Southeast Florida.

---

[8] The literature summary presented results in 2007 dollars. For consistency with the critical habitat cost analysis, we have adjusted these estimates to 2023 dollars using the Bureau of Economic Analysis' Gross Domestic Product Price Deflator.

[9] The study results are presented in 2000 dollars. For consistency with the critical habitat cost analysis, we have adjusted these estimates to 2023 dollars using the Bureau of Economic Analysis' Gross Domestic Product Price Deflator.

Table 22. RELEVANT ECONOMIC VALUE ESTIMATES FOR CORAL REEFS (AS REPORTED IN NOAA CORAL REEF CONSERVATION PROGRAM, 2013)

Region	Economic Value of coral reefs (2023 $/year)	Types of Values Included
Southeast Florida (Broward, Palm Beach, Miami-Dade, and Monroe Counties)	$239 million	Contingent valuation study estimated only the direct recreational use of reefs for fishing, diving, snorkeling, and viewing from glass-bottomed boats. Value reflects willingness-to-pay of residents and visitors to maintain natural reefs. Value does not consider existence values or other ecosystem service values of reefs, including support for commercial fisheries or coastal protection.
Eastern Puerto Rico (Fajardo, the Cordillera reef system, Culebra, and Vieques)	$1.51 billion	Study references market data, and applies travel cost and contingent valuation methods to estimate a total economic value inclusive of small scale fishing, recreation and tourism, coastal protection, education and research, biodiversity, and non-use values. The non-use portion of the value may not be additive with the other services and reflects non-use values held by the Puerto Rican population.
U.S. Virgin Islands	$258 million	Study applied a variety of methods to estimate coral reef values related to tourism, recreation, amenity values, coastal protection, and commercial fisheries.

Source: Brander and van Beukering (2013) describes the specific studies relied upon to estimate the use and non-use values of coral reefs.

Note: While we have summarized the information from these studies in order to provide general information on previous research regarding economic values of corals, we do not promote a particular estimate, nor offer judgments regarding the quality of the underlying valuation studies. This study presented results in 2007 dollars. For consistency with the critical habitat cost analysis, we have adjusted these estimates to 2023 dollars using the Bureau of Economic Analysis' Gross Domestic Product Price Deflator.

Ecological and economic benefits derive from coastal seagrasses in the form of nursery habitat for juvenile fish species (Jackson et al. 2015), direct harvest of marine species from seagrass beds, increased wave attenuation leading to reduced coastal erosion, reduced sedimentation benefiting adjacent coral reef ecosystems (Dewsbury et al., 2016), pollution control (Barbier 2017, Asciotti et al. 2022). While not specific to Nassau grouper or the designated areas of critical habitat, and considerably more limited in scope than the body of studies considering the economic value of coral reefs, these studies signal that the benefits of coastal seagrasses within the designated habitat areas extend well beyond their function as habitat for growing Nassau grouper. For example, Jackson et al. (2015) developed a seagrass residency index to estimate the proportion of Mediterranean commercial fishery landings and value and the total expenditure on recreational fisheries that can be attributed to seagrasses. The study estimated that seagrass-associated species, i.e., species that predominantly rely on seagrass to survive juvenile stages, contribute 30–40% of the value of Mediterranean commercial fishery landings and

approximately 29% of recreational fishery expenditures. The study further estimated that seagrass beds had an estimated direct annual contribution of $77–122 million (2023 dollars) (4% of commercial landing values) and $150 million (6% of recreation expenditure) to commercial and recreational fisheries, respectively, despite covering <2% of the area.

Vassallo et al. (2013) employed emergy analysis to estimate the value of ecosystem services provided by the seagrass species *Posidonia oceanica*, a fragile Mediterranean seagrass ecosystem. The study estimated a total ecosystem services value of $166 million (2023 dollars), driven primarily by the value of the seagrass species' sedimentation retention properties. Ascioti et al. (2022) considered the health benefits of coastal seagrasses specific to the avoidance of gastroenteritis cases worldwide. The study estimated that the sanitation properties of seagrasses located in coastal waters are responsible for the avoidance of 24 million gastroenteritis cases globally each year, which equates to $426 million in avoided costs annually (2023 dollars).

ECOSYSTEM SERVICE BENEFITS RELATED TO CRITICAL HABITAT DESIGNATION FOR THE NASSAU GROUPER

The economic valuation studies described provide insight into why reef fish, healthy coral reefs, and coastal seagrasses benefit people. In particular, coral reefs and seagrasses are associated with the following ecosystem service benefits:

- **Shoreline protection**: Reefs help protect both natural and developed shoreline from wave action and reduce beach erosion (Burke and Maidens 2004, Gracia et al. 2018).
- **Provide essential habitat and nursery functions for recreationally and commercially valuable fish species**: Reefs in the designated critical habitat area support valuable fish and shellfish populations. For example, Table 11 and Table 12 highlight the landings values for some of these species. In addition, the regional commercial fishing industry, as well as tourists engaged in recreational fishing, purchase goods and services to support their activities, contributing to robust regional economies.
- **Increased quality or quantity of reef-related recreational opportunities**: Reefs provide sources of enjoyment for residents and tourists, for example, diving and snorkeling. Entertainment and tourism-related sectors are key sources of income and employment in Florida, Puerto Rico, and the USVI.
- **Property value**: In reducing potential damage to properties from wave action, storm surge, and coastal erosion, benefits of healthy reef ecosystems may be realized as a premium on property values (as compared with areas with degraded or no reefs).
- **Carbon sequestration/climate mitigation**: Coral reefs remove carbon from the atmosphere, mitigating damaging effects of climate change (Conservation International 2008; Ganguly et al. 2018).

The benefits of coral reefs to the protection or shorelines and shoreline property, in particular, has gained increasing attention in recent years. Reguero et al. (2021) combined engineering, ecologic, social, and economic models to provide a quantitative valuation of the coastal protection benefits of coral reefs off populated coastlines of the U.S. and its Trust territories. The study's probabilistic risk-modelling framework used high-resolution data on bathymetry, topography, coral distribution and cover, and socioeconomics together with physics-based hydrodynamic models to quantify flood hazard zones, the role of coral reefs in reducing flooding, and the averted economic and social consequences. Risk reduction benefits were calculated as the averted impacts between present-day coral reefs and a

scenario assuming a 1 meter reduction in reef height. The study estimates that the flood hazard risk reduction benefits of U.S. coral reefs exceed $2.0 billion annually (2023 dollars), including $909 million in avoided direct damages to buildings and approximately $1 billion in additional avoided economic impacts. The study estimates that average annual flood risk reduction benefits of coral reefs to Florida, Puerto Rico, and USVI total $742 million, $200 million, and $52 million, respectively.

As previously noted, the primary benefit of the final critical habitat designation is its contribution to conservation and recovery of the Nassau grouper. Our analysis finds that the final rule is not anticipated to result in incremental project modifications. However, the protections afforded reefs and seagrasses could increase awareness of the importance of these elements of the essential features, which in turn could lead to additional conservation efforts. In the case that incremental project modifications are implemented due to the Nassau grouper critical habitat, the designation would provide protections to the types of ecosystem service benefits described, above the baseline. However, implementation of incremental project modifications would incur incremental costs beyond those projected in this analysis.

10.3.2 Educational and Awareness Benefits

The critical habitat designation could potentially have benefits associated with education and awareness. The potential for such benefits stems from three sources: (1) entities that engage in section 7 consultation, including Federal action agencies and, in some cases, third party applicants; (2) members of the general public interested in conservation; and (3) state and local governments that take action to complement the critical habitat designation. Certain entities, such as applicants for particular permits, may alter their activities to benefit the essential features of the critical habitat because they were made aware of the critical habitat designation through the section 7 consultation process. Similarly, Federal action agencies that undertake activities that affect the critical habitat may alter their activities to benefit the critical habitat. Members of the public interested in conservation also may adjust their behavior to benefit critical habitat because they learned of the critical habitat designation through outreach materials or the regulatory process. In our experience, designation raises the public's awareness that there are special considerations to be taken within the area identified as critical habitat. Similarly, state and local governments may be prompted to enact laws or rules to complement the critical habitat designations and benefit the listed species. Those laws would likely result in additional impacts of the designations. However, it is not possible to quantify the beneficial effects of the awareness gained through, or the impacts from state and local regulations resulting from, the critical habitat designation.

10.3.3 Impacts to Governmental and Private Entities

State and local governments may be prompted to enact laws or rules to complement the critical habitat designation and benefit the listed species. Those laws would likely result in additional impacts of the designation. However, it is impossible to quantify the beneficial effects of the awareness gained through or the secondary impacts from state and local regulations resulting from the critical habitat designation.

Many previous critical habitat impact analyses evaluated the impacts of the designation on relationships with, or the efforts of, private and public entities that are involved in management or conservation efforts benefiting listed species. These analyses found that the additional regulatory layer of a designation could negatively impact the conservation benefits provided to the listed species by existing or proposed management or conservation plans.

Impacts on entities responsible for natural resource management, conservation plans, or the functioning of those plans depend on the type and number of Section 7 consultations that may result from the designation in the areas covered by those plans, as well as any potential project modifications recommended by these consultations. Negative impacts to these entities could result if the designation interferes with these agencies' ability to provide for the conservation of the species, or otherwise hampers management of these areas. However, existing management plans and associated regulations include significant protections to the essential features of the designated Nassau grouper critical habitat. As a result of these protections, consultations related to protected area management over the next ten years are not expected to result in incremental project modifications. Any incremental Section 7 impacts of the final critical habitat designation will likely be limited to administrative costs. Thus, it is not anticipated that negative impacts to agencies' ability to provide for the conservation of the Nassau grouper would result from designation.

Appendix A. Incremental Cost Sensitivity Results

Exhibit A 1. PROJECTED INCREMENTAL COSTS OF NASSAU GROUPER CRITICAL HABITAT DESIGNATION, BY ACTIVITY TYPE AND UNIT 2024-2033 (2023 DOLLARS; 3% DISCOUNT RATE)

UNIT	CON-STRUCTION	WATER QUALITY MGMT.	PROTECTED AREA MGMT.	FISHERY MGMT.	AQUA-CULTURE	MILITARY	DERELICT VESSEL AND MARINE DEBRIS REMOVAL	SCIENTIFIC RESEARCH AND MONITOR.	TOTAL
Biscayne/Key Largo	$50,000	$1,100	$33,000	$2,200	$0	$2,600	$3,300	$2,200	$94,000
Marathon	$37,000	$1,100	$0	$2,200	$0	$2,600	$3,300	$0	$46,000
Big Pine Key	$93,000	$1,100	$0	$2,200	$0	$2,600	$3,300	$0	$100,000
Key West	$1,800	$1,100	$0	$2,200	$2,200	$9,100	$3,300	$0	$20,000
New Ground Shoal	$1,800	$1,100	$0	$2,200	$0	$2,600	$3,300	$0	$11,000
Halfmoon Shoal	$1,800	$1,100	$0	$2,200	$0	$2,600	$3,300	$0	$11,000
Dry Tortugas	$1,800	$1,100	$0	$2,200	$0	$2,600	$3,300	$0	$11,000
Florida, All	**$190,000**	**$7,700**	**$33,000**	**$16,000**	**$2,200**	**$24,000**	**$23,000**	**$2,200**	**$290,000**
Mona Island	$1,800	$4,400	$0	$3,000	$0	$0	$1,700	$6,700	$18,000
Desecheo	$1,800	$4,400	$0	$3,000	$0	$0	$1,700	$0	$11,000
Southwest	$8,300	$4,400	$0	$3,000	$0	$0	$8,300	$4,300	$28,000
Northeast	$15,000	$6,600	$0	$3,000	$0	$6,500	$1,700	$2,200	$35,000
Vieques	$1,800	$4,400	$0	$3,000	$0	$27,000	$1,700	$2,200	$40,000
Isla de Culebra/ Culebrita	$1,800	$4,400	$0	$3,000	$0	$0	$1,700	$0	$11,000
Puerto Rico, All	**$30,000**	**$29,000**	**$0**	**$18,000**	**$0**	**$33,000**	**$17,000**	**$15,000**	**$140,000**
Navassa	**$1,800**	**$1,200**	**$0**	**$940**	**$0**	**$0**	**$1,700**	**$0**	**$5,600**
USVI - STT	$16,000	$7,400	$0	$2,600	$0	$0	$3,700	$0	$30,000
USVI - STJ	$3,300	$7,400	$0	$2,600	$0	$0	$3,700	$0	$17,000
USVI - STX	$9,800	$9,600	$0	$2,600	$0	$0	$3,700	$0	$26,000
USVI, All	**$29,000**	**$24,000**	**$0**	**$7,900**	**$0**	**$0**	**$11,000**	**$0**	**$73,000**
Bajo de Sico	**$1,800**	**$1,200**	**$0**	**$940**	**$0**	**$0**	**$1,700**	**$0**	**$5,600**
Grammanik Bank/Hind Bank	**$1,800**	**$1,200**	**$0**	**$940**	**$0**	**$0**	**$1,700**	**$0**	**$5,600**
Riley's Hump	**$1,800**	**$450**	**$0**	**$0**	**$0**	**$0**	**$1,600**	**$0**	**$3,800**
TOTAL	**$250,000**	**$65,000**	**$33,000**	**$44,000**	**$2,200**	**$57,000**	**$58,000**	**$18,000**	**$530,000**

Source: NMFS SERO's Section 7 consultation database.
Note: The estimates may not sum to totals due to rounding.

Appendix B. Impacts on Small Businesses

The Regulatory Flexibility Act (RFA) establishes a principle that agencies shall endeavor, consistent with the objectives of a rule and applicable statutes, to fit regulatory and informational requirements to the scale of businesses, organizations, and governmental jurisdictions subject to regulation. To achieve this principle, agencies are required to solicit and consider flexible regulatory proposals and to explain the rationale for their actions to assure that such proposals are given serious consideration. A draft Initial Regulatory Flexibility Analysis (IRFA) was prepared for this final rule pursuant to Sec. 603 of the RFA. An IRFA does not contain any decision criteria; instead, the purpose of an IRFA is to inform the agency, as well as the public, of the expected economic impacts of the action and to ensure that the agency considers alternatives that minimize the expected impacts while meeting the goals and objectives of the action and applicable statutes.

This final regulatory flexibility analysis (FRFA) considers the extent to which the potential economic impacts associated with the designation of critical habitat for the Nassau grouper could be borne by small businesses. The FRFA presented is conducted pursuant to the Regulatory Flexibility Act (RFA) as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996. Information for this analysis was gathered from the Small Business Administration (SBA) and the Dun and Bradstreet Hoovers Database.

The analysis of impacts to small entities relies on the estimated incremental impacts resulting from the critical habitat designation. Incremental impacts are detailed in Section 10.1.6 of this analysis.

This FRFA uses the best available information to identify the potential impacts of critical habitat designation on small entities. However, there are uncertainties that complicate quantification of these impacts, particularly with respect to the extent to which the quantified impacts may be borne by small entities. As a result, this FRFA employs a conservative approach (i.e., more likely to overestimate than underestimate impacts to small entities) in assuming that the quantified costs that are not borne by the Federal Government are generally borne by small entities.

Summary of Findings

Exhibit B-1 presents a summary of estimated impacts to small entities. The maximum total annualized impacts to small entities are estimated to be $4,221, which represents approximately 7% of the total quantified incremental impacts forecasted to result from the final rule. This assumes that in-water and coastal construction is the only activity category for which small entities will be third parties and that all of the third party entities involved in future in-water and coastal construction projects will be small entities. These impacts are anticipated to be borne by the small entities in the construction industry that obtain funds or permits from federal agencies that consult with NMFS regarding Nassau grouper critical habitat in the next ten years. Given the uncertainty regarding which small entities in a given industry will need to consult with NMFS, this analysis estimates impacts to small entities under two different scenarios. These scenarios are intended to reflect the range of uncertainty regarding the number of small entities that may be affected by the designation and the potential impacts of critical habitat designation on their annual revenues. Under both scenarios, this IRFA assumes that entities conducting in-water and coastal construction activities in the Florida units are limited to those entities located in Miami-Dade and Monroe Counties, entities conducting in-water and coastal

construction activities in the Puerto Rico units are limited to those entities located in Puerto Rico, and entities conducting in-water and coastal construction activities in the USVI units are limited to those entities located in the USVI.

Under Scenario 1, this analysis assumes that all third parties participating in future consultations are small, and that incremental impacts are distributed evenly across all of these entities. For the Florida units, where we estimate hundreds of small entities participate in the in-water and coastal construction industry, Scenario 1 accordingly reflects a high estimate of the number of potentially affected small entities (six) and a low estimate of the potential effect in terms of percent of revenue. The assumption under Scenario 1 that 6.4 small entities will be subject to consultation annually reflects the forecast that 6.4 consultations will occur annually on in-water and coastal construction activities involving third parties. This assumes that each consultation within the in-water and coastal construction industry involves a unique small entity. This scenario therefore may overstate the number of small entities based in Miami-Dade and Monroe counties that are likely to be affected by the rule and potentially understates the revenue effect. Scenario 1 also assumes that each consultation within the in-water and coastal construction industry in the Puerto Rico and USVI units involves a unique small entity. For the Puerto Rico and the USVI units, because Section 7 consultation on construction activities is anticipated to occur at a rate of 0.8 per year, or eight consultations over 10 years, we assume that 0.8 small entities will be impacted per year. Therefore, Scenario 1 does not yield the same overstatement of the number of small entities likely to be affected (unless the third party entities involved in the construction activities in Puerto Rico and USVI are not small entities) or understatement of the revenue effect for these jurisdictions. This analysis anticipates that, across the three jurisdictions, approximately 8 small entities will incur $4,221 in annualized costs under Scenario 1, including $527 in costs to Florida-based small entities, $513 in costs to Puerto Rico-based small entities, and $549 in costs to USVI-based small entities. Annualized impacts of the rule are estimated to make up less than 1 percent of average annual revenues of approximately $1.31 million for each affected small entity.[10]

Under Scenario 2, this analysis assumes that all third parties participating in future consultations are small and that costs associated with each consultation action are borne each year by a single small entity within an industry. This method likely understates the number of small entities affected and overstates the likely impacts on an entity for the Florida units. As such, this method arrives at a low estimate of potentially affected entities in Florida units and a high estimate of potential effects on revenue, assuming that quantified costs represent a complete accounting of the costs likely to be borne by private entities. Under Scenario 2, $3,379 in annualized impacts would be borne by a single small entity in Florida. For Puerto Rico and USVI, we maintain the assumption in Scenario 1 that 0.8 small entities per year bear the third party costs of consultation. This assumption reflects our forecast of eight consultations on construction projects over 10 years in both Puerto Rico and USVI. This scenario forecasts that annualized impacts to single entities in Puerto Rico and USVI would be $513 and $549, respectively. Though this scenario almost certainly overstates the costs borne by a single small entity in Florida, the impact is nonetheless expected to represent less than 1 percent of the average annual revenues for the single entity. Impacts to single small entities in Puerto Rico and USVI are also anticipated to be less than 1 percent of average annual revenues.

[10] Average annual revenues were calculated based on company-specific revenue data sourced from the Dun & Bradstreet Hoovers database.

EXHIBIT B-1. SUMMARY OF ESTIMATED IMPACTS TO SMALL ENTITIES BY JURISDICTION

Metric	Florida	Puerto Rico	USVI	Total or Weighted Average
Total annualized impacts of the Rule to small entities[1]	$3,379	$384	$457	$4,221
Estimated average annual revenues for small entities[2]	$1,330,791	$1,151,648	$2,744,931	$1,313,004[4]
Estimated number of small entities conducting activities in critical habitat areas being considered	406	98	6	510
Scenario 1: Assumes that all small entities bear an equal share of costs				
Estimated maximum number of small entities subject to consultation annually[3]	6.4	0.8	0.8	8.0
Percent of small businesses potentially subject to incremental costs	1.6%	0.8%	13.9%	1.6%[4]
Estimated impact per small entity	$527	$513	$549	$528[4]
Estimated impact per small entity as a percentage of revenues	0.04%	0.04%	0.02%	0.04%[4]
Scenario 2: Assumes that one small entity bears all costs				
Estimated impact per small entity	$3,379	$384	$457	$2,794[4]
Estimated impact per small entity as a percentage of revenues	0.25%	0.03%	0.02%	0.21%[4]

Notes:
1. These values represent total administrative costs expected to be borne by third parties in affected industries.
2. The quantity and revenues for small entities were estimated through queries of the Dun and Bradstreet Hoovers Database. Small entities were identified based on the industry-specific criteria outlined in Exhibit B-2.
3. The estimated maximum number of small entities subject to consultation annually reflects the total number of consultations forecasted to occur annually within each industry. This assumes that each consultation within an industry is conducted by a unique small entity.
4. This value represents a weighted average across jurisdictions.

While these scenarios present a range of potentially affected entities and the associated revenue effects in Florida, we expect the actual number of small entities affected and revenue effects will be somewhere in the middle. In other words, some subset of the small entities in Florida greater than 1 and less than 7 will participate in Section 7 consultations on Nassau grouper critical habitat and bear associated impacts annually. Regardless, our analysis demonstrates that the greatest potential revenue effect is less than 1% across scenarios and jurisdictions.

FRFA Requirements

The Regulatory Flexibility Act, passed in 1980, requires Federal agencies to consider the impacts of regulations on small entities. When a final regulation is published in the *Federal Register*, it must be accompanied by a final regulatory flexibility analysis (FRFA). As described in 5 U.S. Code § 604, each FRFA is required to contain:

1. a succinct statement of the need for, and objectives of, the rule;
2. a summary of the significant issues raised by the public comments in response to the initial regulatory flexibility analysis, a summary of the assessment of the agency of such issues, and a statement of any changes made in the final rule as a result of such comments;
3. the response of the agency to any comments filed by the Chief Counsel for Advocacy of the Small Business Administration in response to the proposed rule, and a detailed statement of any change made to the proposed rule in the final rule as a result of the comments;
4. a description of and an estimate of the number of small entities to which the final rule will apply or an explanation of why no such estimate is available;
5. a description of the projected reporting, recordkeeping, and other compliance requirements of the final rule, including an estimate of the classes of small entities which will be subject to the requirement and the type of professional skills necessary for preparation of the report or record; and
6. a description of the steps the agency has taken to minimize the significant economic impact on small entities consistent with the stated objectives of applicable statutes, including a statement of the factual, policy, and legal reasons for selecting the alternative adopted in the final rule and why each one of the other significant alternatives to the rule considered by the agency which affect the impact on small entities was rejected. (5 USC § 604)

Need for, and Objectives of, the Rule

In 2016, Nassau grouper was listed as threatened under the ESA (81 FR 42268; June 29, 2016). As a requirement of the ESA, critical habitat must be designated for all species listed as threatened or endangered, "to the maximum extent prudent and determinable" (50 CFR 424.12). Designation of critical habitat is being designated in order to fulfill this legal requirement of the ESA.

The objective of this critical habitat rule is to use the best scientific data available to designate critical habitat for the Nassau grouper, which is listed as threatened under the ESA. The designation is designed to meet the conservation needs of the Nassau grouper and ultimately aid in species recovery. The ESA defines critical habitat as:

1. "The specific areas within the geographical area currently occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features (i) essential to the conservation of the species and (ii) that may require special management considerations or protection, and;
2. Specific areas outside the geographical area occupied by a species at the time it is listed upon a determination by the Secretary that such areas are essential for the conservation of the species." (50 CFR 424.02)

Summary of Significant Issues Raised in Public Comment in Response to the IRFA

No public comments on the IRFA were received during the public comment period.

Description and Estimate of the Number of Small Entities to which the Final Rule Will Apply

The RFA defines three types of small entities:

- **Small Business**. Section 601(3) of the RFA defines a small business according to the definition of a small business concern provided in section 3 of the Small Business Act (SBA). The SBA broadly defines a small business concern as a business which is "independently owned and operated and which is not dominant in its field of operation." (15 USC § 632) The SBA provides industry-specific criteria based on either revenues or number of employees that delineate which businesses meet this definition.
- **Small Organization**. Section 601(4) of the RFA defines a small organization as a non-profit enterprise that is independently owned and operated and not dominant in its field.
- **Small Governmental Jurisdiction**. Section 601(5) of the RFA defines a small government jurisdiction as a government of a county, city, town, township, village, school district, or special district, with a population less than 50,000.

The RFA requires consideration of direct impacts to small entities that may result from the final rule. For critical habitat designation, all potential direct impacts are incurred through the Section 7 consultation process. Though section 7 of the ESA only applies to activities with a federal nexus, small entities may be involved through projects that are funded or permitted through federal agencies.

Indirect impacts of critical habitat are unintended changes in economic behavior that may occur outside of the ESA, through other federal or non-federal actions, and that are caused by the designation of critical habitat. Economic effects expected to occur regardless of critical habitat designation are considered baseline impacts. While it is possible that indirect impacts to small entities may occur as a result of the final rule, these impacts are not quantified in this IRFA.

The regulatory mechanism through which critical habitat protections are enforced is section 7 of the ESA, which directly regulates only those activities carried out, funded, or authorized by a federal agency. By definition, federal agencies are not considered small entities, although the activities they may fund or permit may be proposed or carried out by small entities. Given the SBA guidance described above, this analysis considers the extent to which this designation could potentially affect small entities, regardless of whether these entities would be directly regulated by the final rule or by a delegation of impact from the directly regulated entity.

This FRFA focuses on identifying small entities that may bear the incremental impacts of this rulemaking. In addition to the administrative costs of participating in consultations, section 10.1.3 of the economic impact analysis report identifies the following economic activities as potentially requiring ESA Section 7 consultation because they may affect the essential features of Nassau grouper critical habitat. These activities are:

- Coastal and In-water Construction
- Water Quality Management
- Protected Area Management
- Fishery Management
- Aquaculture
- Military Activities
- Scientific Research and Monitoring
- Derelict Vessel and Marine Debris Removal

Though there is significant uncertainty regarding which future section 7 consultations will involve third parties, the activity categories described in Section 10.1.3 of the report provide some indication of the probability of third party involvement. Based on the relevant consultation history and forecast of future activities that may affect the designated critical habitat, only in-water and coastal construction activities, which for purposes of this FRFA are defined to include dredging and disposal and beach nourishment/shoreline protection, are anticipated to involve third parties that qualify as small entities. Given the uncertainty regarding the proportion of consultations on construction activities that will involve third parties, this analysis conservatively assumes that all future consultations on these activities will involve third parties and that all of these third parties will be small entities.

Exhibit B-2 lists potentially affected industries by NAICS code and SBA size standard. Consultation can result in two primary costs:

- **Administrative Costs**. Section 7 consultations are likely to involve written and verbal communication with NMFS and other Federal action agencies. The cost associated with these administrative efforts is estimated separately for informal, formal, and programmatic consultations.
- **Project Modifications**. As explained throughout the economic report, no incremental project modifications are expected to result from this designation due to the considerable baseline protections existing for Nassau grouper and the essential features of the designated critical habitat.

Ideally, this FRFA would directly identify the number of small entities which may be affected by authorizing or funding federal agencies' consultation with NMFS regarding potential effects of projects and activities on Nassau grouper critical habitat. However, significant uncertainty exists regarding what future projects may involve which small entities. Absent specific knowledge regarding which small entities may engage in consultation with NMFS over the next ten years, this analysis relies on industry and location-specific information on small businesses available through the Dun and Bradstreet Hoovers database. Exhibit B-2 summarizes the NAICS codes that were identified as relevant to the major activity categories discussed above. The Dun and Bradstreet database was used to identify small businesses classified with these NAICS codes that are based in counties or territories that share a coastline with the designated critical habitat. All of the counties and territories that share a coastline with the designated critical habitat have populations of more than 50,000, so no impacts to small governmental jurisdictions are expected as a result of the critical habitat designation.

EXHIBIT B-2. INDUSTRIES MOST AFFECTED BY THE FINAL RULE AND A DESCRIPTION OF THE INDUSTRY SECTORS ENGAGED IN THOSE ACTIVITIES

Major Relevant Activity	Description of Included Industry Sectors	NAICS Code	SBA Size Standard
Coastal & In-Water Construction	County Governments (to the extent that they undertake bridge-building or other construction activities)	N/A	Population of 50,000
	Highway, Street, and Bridge Construction— This industry comprises establishments primarily engaged in the construction of highways (including elevated), streets, roads, airport runways, public sidewalks, or bridges.	237310	$45,000,000

Major Relevant Activity	Description of Included Industry Sectors	NAICS Code	SBA Size Standard
	Other Heavy and Civil Engineering Construction— This industry comprises establishments primarily engaged in heavy and engineering construction projects (excluding highway, street, bridge, and distribution line construction).	237990	$45,000,000
	Dredging and Surface Cleanup Activities		$37,000,000
Source: (U.S. Small Business Administration 2022).			

Description of Reporting and Recordkeeping Efforts

The critical habitat rule will not require "reporting" or "recordkeeping" efforts as defined by the Paperwork Reduction Act. However, designation of critical habitat will require that federal agencies engage in section 7 consultation with NMFS regarding any potential impacts to critical habitat from federal actions. This process is likely to involve communication with NMFS and federal funding or authorizing agencies through letters, phone calls, or in-person meetings. Third party costs may include administrative work, such as cost of time and materials to prepare for letters, calls, or meetings. Factors such as the type of consultation, project location, impacted essential feature, and activity of concern may dictate the complexity of these interactions.

Description of Alternatives to the Final Rule Which Accomplish the Objectives and Which Minimize Impacts on Small Entities

The RFA requires consideration of alternative rules that would minimize impacts to small entities. We considered the following alternatives when developing the final critical habitat rule.

ALTERNATIVE 1: NO ACTION ALTERNATIVE

No action (status quo): We would not designate critical habitat for the Nassau grouper. Under this alternative, conservation and recovery of the listed species would depend exclusively upon the protection provided under the "jeopardy" provisions of Section 7 of the ESA. Under the status quo, there would be no increase in the number or complexity of ESA consultations in the future that would not otherwise be required due to the listing of the Nassau grouper. However, we have determined that the physical features forming the basis for our critical habitat designation are essential to the Nassau grouper's conservation, and conservation of the species will not succeed without these features being available. Thus, the lack of protection of the critical habitat features from adverse modification could result in continued declines in abundance of Nassau grouper, and loss of associated economic and other values the grouper provide to society, such as commercial diving services. Small entities engaged in industries that depend on the presence of Nassau grouper or elements of the species' critical habitat, particularly coral reefs, could be adversely affected by continued declines in the Nassau grouper. Thus, the no action alternative is not necessarily a "no cost" alternative for small entities.

ALTERNATIVE 2: PREFERRED ALTERNATIVE

Under this alternative, the areas designated are waters from the shoreline to depths ranging from 2 m to 30 m in four units in Florida, six units in Puerto Rico, and three units in USVI; waters of New Ground Shoal and Halfmoon Shoal in the Gulf of Mexico; Navassa Island; and waters of the Bajo de Sico, Grammanik Bank, and

Riley's Hump spawning sites. An analysis of the costs and benefits of the preferred alternative designation is presented in Section 10.1. Relative to the no action alternative, this alternative will likely result in an increase in administrative costs of Section 7 consultations that would already occur absent designation. We have determined that no categories of activities would require consultation, and no project modifications would be required, in the future solely due to this rule and the need to prevent adverse modification of the designated critical habitat. However, due to the protections afforded the essential features of the designated critical habitat under this alternative, it is likely that consultations on future Federal actions within those categories of activities will require additional administrative effort to address specific impacts to Nassau grouper critical habitat. This additional administrative effort would be an incremental impact of this rule. Consultation costs associated with those projects with larger or more diffuse action areas, i.e., projects that may affect a wider range of listed species or critical habitats, would likely be largely coextensive with listings or other regulatory requirements.

The preferred alternative was selected because it best implements the critical habitat provisions of the ESA by including the well-defined environmental features we can clearly state are essential to the species' conservation, and because this alternative would reduce the economic impacts on entities relative to an alternative that encompasses a larger geographical area.

ALTERNATIVE 3: DIFFERENT GEOGRAPHIC BOUNDARIES

We considered a third alternative that would have delineated the designation for all nearshore units containing the development, refuge, and foraging essential feature based a single depth contour of 30 m. We evaluated this alternative based on our experience with the 2008 Acropora critical habitat designation, which created a single designation for both acroporid corals species from 0 to 30 m depth, generally, and to ensure inclusion across units of areas where the growth and development essential feature is abundant. However, the areas in these units in which the development, refuge, and foraging essential feature is sufficiently abundant to appreciably promote conversation of the species comprise variable depth swaths across units. Under this alternative, a larger number of future activities would need to consider potential impacts to the Nassau grouper critical habitat through Section 7 consultations, resulting in higher incremental administrative costs compared to the preferred alternative. Thus, we rejected this alternative because, relative to the preferred alternative, it would likely increase incremental costs of the final rule without incrementally promoting conservation of the species.

Appendix C. Data and Assumptions for Estimating Administrative Costs of Section 7 Consultations

This analysis projected administrative costs of Section 7 consultations based on a model developed by Industrial Economics, Incorporated (IEc) in 2002 to inform economic analyses of critical habitat rules. Considered by NMFS to represent the best available information on administrative costs for its critical habitat rulemakings, the model's development relied on interviews with Federal agency staff with significant experience implementing Section 7 consultations and has been adjusted over the course of dozens of rulemakings, as appropriate, by NMFS biologists and Federal agency staff.

The estimated level of effort for time spent in consultations reflects Federal agency staff estimates of hours or days spent by task and consultation type, as well as the staff level (in terms of the Federal General Schedule (GS) level) typically assigned to these tasks. To account for variable complexity across consultations, the interviewees described time estimates and GS level assignments at low and high levels of effort for each consultation type. Separately, the model considers the number of hours and hourly rate to conduct Biological Assessments.

Wages for Federal agency employees reflect the midpoint between Step 1 and Step 10 within each GS level using the GS Hourly Rates and assume an overhead multiplier of 2.5.

Exhibit C.1 describes the resulting key assumptions related to total hours and wage level for consultations that consider both the listing of the species (jeopardy) and critical habitat (adverse modification). Costs to consider adverse modification alone are assumed 25 percent of total consultation costs. The consultation costs in Table 18 of this analysis reflect the average of the low and high levels of effort by consultation type and entity.

Exhibit C-1. SUMMARY OF ESTIMATED IMPACTS TO SMALL ENTITIES BY ACTIVITY TYPE

Consultation Type	Effort Level	FWS/NMFS		Federal Action Agency		Third Party		Biological Assessments	
		Total Hours	GS Level	Total Hours	GS Level	Total Hours	GS Level	Total Hours	GS Level
Technical Assistance	Low	5	GS-10			6	$100		
	High	13	GS-10			15	$100		
Informal Consultation	Low	19	GS-10			12	$100	0	$100
	High	45	GS-12	56	GS-12	29	$100	40	$100
Formal Consultation	Low	45	GS-12	56	GS-12	29	$100	56	$100
	High	74	GS-13	94	GS-12	41	$100	56	$100
Programmatic Consultation	Low	200	GS-11	160	GS-11			56	$100
	High	280	GS-11	240	GS-11			56	$100

Source: Industrial Economics, Incorporated. Final Economic Analysis of Critical Habitat Designation for Humpback Whales. 2020.

References

5 USC § 603. Initial regulatory flexibility analysis.

5 USC § 604. Final regulatory flexibility analysis.

15 CFR 922.163. Prohibited activites – Sanctuary-wide.

15 USC § 632. Definitions in: Title 15 - Commerce and Trade 14A - Aid to Small Business Sec. 632 - Small-business concern.

16 USC § 410gg. Establishment; description of boundary; minor boundary revisions; publication in Federal Register.

16 USC § 670a. Cooperative plan for conservation and rehabilitation.

16 USC § 1532. Definitions in: Title 16 Chapter 35 - EndangeredSpecies.

16 USC § 1533. Determination of endangered species and threatened species.

16 USC § 1536. Interagency cooperation.

33 USC § 1344. Permits for Dredged or Fill Material.

33 USC § 401 et seq. 1938. Protection of Navigable Waters and of Harbor and River Improvements Generally.

36 CFR 7. Special regulations, areas of the National Park System.

50 CFR 424.02. Definitions: Designating critical habitat.

50 CFR 424.12. Criteria for designating critical habitat. U.S. Government Publishing Office.

50 CFR 424.19. Impact Analysis and Exclusion from Critical Habitat. U.S. Government Publishing Office.

61 FR 64485. Endangered and threatened wildlife and plants: Notice of final decision on identification of candiates for listing as endangered or threatened. Federal Register 61:64485-64485.

64 FR 60132. Fisheries of the Caribbean, Gulf of Mexico, and South Atlantic; Coral reef resources of Puerto Rico and the U.S. Virgin Islands; Amendment 1. Federal Register 64:60132-60133.

66 FR 4267. Florida Keys National Marine Sanctuary Regulations.

66 FR 7364. Establishment of the Virgin Islands Coral Reef National Monument. Federal Register 66:7364-7367.

70 FR 62073. Fisheries of the Caribbean, Gulf of Mexico, and South Atlantic; Comprehensive amendment to the fishery management plans of the U.S. Caribbean. Federal Register 70:62073-62084.

75 FR 67247. Fisheries of the Caribbean, Gulf of Mexico, and South Atlantic; Regulatory amendment to the fishery management plan for the reef fish fishery of Puerto Rico and the U.S. Virgin Islands. Federal Register 75:67247-67251.

81 FR 42268. Endangered and threatened wildlife and plants: final listing determination on the proposal to list the Nassau grouper as threatened under the Endangered Species Act. Federal Register 81:42268-42285.

84 FR 45020. Endangered and threatened wildlife and plants: Regulations for listing species and designating critical habitat. Federal Register 84:45020-45053.

87 FR 56204. Fisheries of the Caribbean, Gulf of Mexico, and South Atlantic; Comprehensive fishery management plans for Puerto Rico, St. Croix, and St. Thomas and St. John. Federal Register 87:56204-56237.

87 FR 62930. Endangered and threatened wildlife and plants: Proposed designation of critical habitat for the Nassau grouper. Federal Register 87:62930-62971.

88 FR 54026. Endangered and threatened species; critical habitat for the threatened Caribbean corals. Federal Register 88:54026-54083.

Aguilar-Perera A., and Aguilar-Davila W. 1996. A spawning aggregation of Nassau grouper *Epinephelus striatus* (Pisces: Serranidae) in the Mexican Caribbean. Environmental Biology of Fishes 45:351-361.

Aguilar-Perera, A., M. Schärer, and M. Nemeth. 2006. Occurrence of juvenile Nassau grouper, Epinephelus striatus (Teleostei: Serranidae), off Mona Island, Puerto Rico: considerations of recruitment potential. Caribbean Journal of Science, 42(2): 261-265.

Aguilar-Perera, A. 1994. Preliminary observations of the spawning aggregation of Nassau grouper, Epinephelus striatus, at Majahual, Quintana Roo, Mexico. Proceedings of the Gulf and Caribbean Fisheries Institute, 43:112-122.

Almany, G., and M.S. Webster. 2006. The predation gauntlet: Early post-settlement mortality in reef fishes. Coral Reefs 25(1):19-22

Archer, S.K., S.A. Heppell, B.X. Semmens, C.V. Pattengell-Semmens, P.G. Bush, C. McCoy, and B.C. Johnson. 2012. Patterns of color phase indicate spawn timing at a Nassau grouper *Epinephelus striatus* spawning aggregation. *Current Zoology* 58 (1): 73–83.

Asciotti, F. A., and authors. 2022. The sanitation service of seagrasses – dependencies and implications for the estimation of avoided costs. Ecosystem services 54:101418.

Bannerot, S.P. 1984. The dynamics of exploited groupers (Serranidae): an investigation of the protogynous hermaphroditic reproductive strategy. University of Miami.

Barbier, E. B. 2017. Marine ecosystem services. Current Biology 27(11):R507-R510.

Bardach, J.E. 1958. On the movements of certain Bermuda reef fishes. Ecology 39(1):139-146.

Beets, J., and A. Friedlander. 1992. Stock analysis and management strategies for Red Hind, *Epinephelus guttatus* in the U.S. Virgin Islands.

Beets, J., and M.A. Hixon. 1994. Distribution, persistence, and growth of groupers (Pisces: Serranidae) on artificial and natural patch reefs in the Virgin Islands. Bulletin of Marine Science, 55:470- 483.

Bernard, A., K. Feldheim, R.S. Nemeth, and E. Kadison. 2015. The ups and downs of coral reef fishes: the genetic characteristics of a formerly severely overfished but currently recovering Nassau grouper fish spawning aggregation. Coral Reefs 35(1)

Böhlke, J.E., and C.G. Chaplin. 1968. Fishes of the Bahamas and Adjacent Tropical Waters. Livingston Publ. Co., Wynnewood, PA, 771 pp.

Bolden, S. 2000. Long-distance movement of a Nassau grouper (Epinephelus striatus) to a spawning aggregation in the central Bahamas Fish. Bull. 98:642-645

Bolden, S.K. 2001. Using Ultrasonic Telemetry to Determine Home Range of a Coral-Reef Fish. in: J.R. Sibert and J.L. Nielsen (eds.), Proceedings of the Symposium on Tagging and Tracking Marine Fish with Electronic Devices, February 2000, Hawaii, (Springer Publishing). Reviews: Methods and Technologies in Fish Biology and Fisheries 1:167-188.

Brander, L., and P. van Beukering. 2013. The Total Economic Value of U.S. Coral Reefs: A Review of the Literature. NOAA Coral Reef Conservation Program.

Brownell, W.N., and W.E. Rainey. 1971. Research and development of deep water commercial and sport fisheries around the Virgin Islands plateau. Virgin Islands Ecological Research Station Contrib. No. 3, 88 pp.

Bureau of Ocean Energy Management. 2022a. 2023-2028 Outer Continental Shelf Oil and Gas Leasing Proposed Program.

Bureau of Ocean Energy Management. 2022b. Florida Renewable Energy Activities.

Burke, L., and J. Maidens. 2004. *Reefs at Risk in the Caribbean*. Pages 80 *in*. World Resources Institute, Washington, D.C.

Bush, P.G., D.E. Lane, G.C. Ebanks-Petrie, K. Luke, B. Johnson, C. McCoy, J. Bothwell, and, E. Parsons. 2006. The Nassau grouper spawning aggregation fishery of the Cayman Islands – an historical and management perspective. Proceedings of the Gulf and Caribbean Fisheries Institute, 57:515-524.

CH2MHill. 2011. Addendum No. 2— Underwater Intrusive Investigation Work Plan to Conduct Phase I RCRA Facility Investigation. Prepared for Department of the Navy.

Caddy, J. F. 1986. Size frequency analysis in stock assessment - some petspeclives, approaches and

problems. Proc. Gulf and Caribb. Fish. Insi 39:212-238.

Caddy, J.F. 2008. The importance of 'cover" in the life histories of demersal and benthic marine resources: A neglected issue in fisheries assessment and management. Bulletin of Maine Science 83(1): 7-52.

Camp, E.R., K.E. Lohr, S.C Barry, P.G. Bush, C.A. Jacoby and C. Manfrio. 2013. Microhabitat associations of late juvenile Nassau groper (*Epinephelus striatus*) off Little Cayman, BWI. Bulletin of Marine Science 89: 571-581.

Carter, J. 1986. Moonlight mating of the multitudes. Animal Kingdom Magazine 89(6):63-71.

Carter, J. 1988. Grouper mating ritual on a Caribbean reef. Underwater Naturalist 17:8-11.

Carter, J. 1989. Grouper sex in Belize. Natural History, Oct: 60- 69.

Carter, J., G.J. Marrow, and V. Pryor. 1994. Aspects of the ecology and reproduction of Nassau grouper, Epinephelus striatus, off the coast of Belize, Central America. Proceedings of the Gulf and Caribbean Fisheries Institute, 43:65–111.

Cervigón, F. 1966. Los Peces Marinas de Venezuela. Vols. I and II. Fund. La Salle Cienc. Nat., 951 p.

Claydon, J.A.B., and A.M. Kroetz. 2007. The distribution of early juvenile groupers around South Caicos, Turks and Caicos Islands. Proceedings of the Gulf and Caribbean Fisheries Institute, 60:345-350.

Claydon, J.A.B., M.C. Calosso, and S.E. Jacob. 2010. Large-scale deployment of discarded conch shells enhances juvenile habitat for spiny lobster, Nassau grouper and red hind. Proceedings of the Gulf and Caribbean Fisheries Institute, 63:457-461.

Colin P.L. 1992. Reproduction of the Nassau grouper, Epinephelus striatus (Pisces: Serranidae) and its relationship to environmental conditions. Environmental Biology of Fishes, 34:357-377.

Colin, P.L., W.A. Laroche, and E.B. Brothers. 1997. Ingress and settlement in the Nassau grouper, Epinephelus striatus (Pisces: Serranidae), with relationship to spawning occurrence. Bulletin of Marine Science, 60(3):656-667.

Collette, B. B., and F. H. Talbot. 1972. Activity patterns of coral reef fishes with emphasis on nocturnal-diurnal changeover p. 98-124, in B. B. Collette and S. A. Earle (eds.), Results of the Tektite Program: ecology of coral reef fishes. Bulletin of Natural History of the Museum of Los Angeles County 14.

Conservation International. 2008. Economic Values of Coral Reefs, Mangroves, and Seagrasses: A Global Compilation. Center for Applied Biodiversity Science, Arlington, VA, US.

Craig, A.K. 1966. Geography of fishing in British Honduras and adjacent coastal areas. Technical Report no. 28 Coastal Studies Institute Louisiana State University, Louisiana. Cont. No. 66-2. 143 pp.

Dahlgren C.P., and D.B. Eggleston. 2000. Ecological Processes Underlying Ontogenetic Habitat Shifts in a Coral Reef Fish. Ecology 81(8):2227-2240.

Dahlgren C.P., and D.B. Eggleston. 2001. Spatio-temporal variability in abundance, size and microhabitat associations of early juvenile Nassau grouper Epinephelus striatus in an off-reef nursery system. Marine Ecology Progress Series, 217:145-156

Dahlgren C.P., and Marr. 2004. Back Reef Systems: Important But Overlooked Components of Tropical Marine Ecosystems. Bulletin of Marine Science, 75(2): 145-152

Dahlgren, C.P., J.A. Sobel, and D.E. Harper. 2001. Assessment of the reef fish community, habitat, and potential larval dispersal from the proposed Tortugas South Ecological Reserve.

Dewsbury, B. M., M. Bhat, and J. W. Fourqurean. 2016. A review of seagrass economic valuations: gaps and progress in valuation approaches. Ecosystem services 18:68-77.

Duffy, P., and authors. 2022. Wind energy costs in Puerto Rico through 2035. Golden, CO: National Renewable Energy Laboratory. NREL/TP-5000-83434.

Eggleston, D.B. 1991. Stock enhancement of Caribbean Spiny Lobster, *Panulirus argus Latrielle*, using artificial shelters: Patters of survival and dynamics of shelter selection. The College of William and Mary.

Eggleston D.B. 1995. Recruitment in Nassau grouper Epinephelus striatus: post-settlement abundance, microhabitat features and ontogenetic habitat shifts. Marine Ecology Progress Series, 124:9-22.

Eggleston, D.B., C.P. Dahlgren, and E.G. Johnson. 2004. Fish density, diversity, and size structure within multiple back reef habitats of Key West National Wildlife Refuge. Bulletin of Marine Science, Volume 75, Number 2. Pp. 175-204.

Eggleston D.B., J.J. Grover, and R.N. Lipcius. 1998. Ontogenetic diet shifts in Nassau groper: trophic linkages and predatory impact. Bulletin of Marine Science 63: 111-126.

Eggleston, D.B., R.N. Lipcius, and J.J. Grover. 1997. Predator and shelter size effects on coral reef fish and spiny lobster prey. Marine Ecology Progress Series, 149:43-59.

Florida Department of Environmental Protection. 2023. Surface Water Quality Standards website.

Florida Department of State. 2021. Florida Administrative Code: Surface Water Quality Standards.

Florida Department of State, editor. Florida Administrative Code.

Foley, K.A., C. Caldow, E. Hickerson. 2007. First confirmed record of Nassau grouper *Epinephelus striatus* (Pisces: Serranidae) in the Flower Garden Banks National Marine Sanctuary. Gulf of Mexico Science. 162-165.

Ganguly, D., and coauthors. 2018. Valuing the carbon sequestration regulation service provided by seagrass ecosystems of Palk Bay and Chilika, India. Ocean & Coastal Management 159:26-33.

García-Sais, J.R., R.L. Castro-Gomez, J. Sabater-Clavell, M. Carlo and R. Esteves. 2007 Characterization of benthic habitats and associated reef communities at Bajo de Sico Seamount, Mona Passage, Puerto Rico. Final Report submitted to Caribbean Fishery Management Council, 98 pp.

Gill, D. A., P. W. Schuhmann, and H. A. Oxenford. 2015. Recreational diver preferences for reef fish attributes: Economic implications of future change. Ecological Economics 111:48-57.

Goldman, B., F.H. Talbot, O.A. Jones, and R. Endean. 1976. Aspects of the ecology of coral reef fishes. Biology and Geology of Coral Reefs, 3:125-154.

Gracia, A., and authors. 2018. Use of ecosystems in coastal erosion management. Ocean & Coastal Management 156:277-289.

Gramlich, E. M. 1990. A Guide to Benefit-Cost Analysis, 2nd edition. Waveland Press, Inc., Prospect Heights, Illinois.

Green, D.B. 2017. The effects of invasive seagrass *Halophila stipulacea* on the habitat persistence and condition of juvenile Nassau grouper *Epinephilus striatus*. Doctoral Dissertation. University of the Virgin Islands.

Greenwood, C.B. 1991. Distribution and feeding habits of larval Epinepheline groupers in Exuma Sound, Bahamas. MS thesis, Florida Institute of Technology, Melbourne, FL, 61 pp.

Grover, J.J., D.B. Eggleston, and J.M. Shenker. 1998. Transition from pelagic to demersal phase in early-juvenile Nassau grouper, Epinephelus striatus: Pigmentation, squamation, and ontogeny of diet. Bulletin of Marine Science, 62(1):97-113.

Guitart-Manday, D., and F. Juárez-Fernandez. 1966. Desarrollo embrionario y primeros estudios larvales de la cherna criolla, Epinephelus striatus (Bloch) (Perciformes: Serranidae). Academia Ciencias de Cuba, Instituto de Oceanologica. La Habana 1:35-45.

Heck, K.L, Jr., and M.P. Weinstein. 1989. Feeding Habits of Juvenile Reef Fishes Associated with Panamanian Seagrass Meadows. Bulletin of Marine Science -Miami- 45(3):629-636

Hill, R., and Y. Sadovy de Mitcheson. 2013. Nassau grouper, *Epinephelus striatus* (Bloch 1792) Biological Report. US Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, St. Petersburg, FL.

Heemstra, P.C., and J.E. Randall. 1993. FAO species catalogue. Vol. 16. Groupers of the world (Family Serranidae, Subfamily Epinephelinae). An annotated and illustrated catalogue of the grouper, rockcod, hind, coral grouper and lyretail species known to date. FAO Fisheries Synopsis. No. 125, Vol. 16. Rome, FAO.

Hixon, M.A., and J. Beets. 1989. Shelter characteristics and Caribbean fish assemblages: experiments with artificial reefs. Bulletin or Marine Science, 44(2)666-680.

Hoese, H.D., and R.H. Moore. 1998. Fishes of the Gulf of Mexico. Texas, Louisiana and adjacent waters, 422 pp. Texas A&M University Press, College Station.

Jackson, A.M., R.X. Semmens, Y. Sadovy de Mitcheson, R.S. Nemeth, S.A. Heppell, P.G. Bush, A. Aguilar-Perera, J.A. Claydon, M.C. Calosso, K.S. Sealey, and M.T. Scharer. 2014. Population structure and phylogeneography in Nassau grouper (*Epinephelus striatus*), a mass-aggregating marine fish. PloS one, 9(5):e97508.

Jackson, E. L., and authors. 2015. Seagrass contributions to fishery value. Conservation Biology 29(3):899-909.

Johns, G. M., V. R. Leeworthy, F. W. Bell, and M. A. Bonn. 2003. Socioeconomic study of reefs in southeast Florida October 19, 2001 as revised April 18, 2003. NOAA, Silver Spring, Maryland.

Kadison, E., R.S. Nemeth, and J. Blondeau. 2009. Assessment of an unprotected red hind (*Epinephelus guttatus*) spawning aggregation on Saba Bank in the Netherlands Antilles. Bulletin of Marine Science, 85(1):101-118.

Kadison, E., R.S. Nemeth, J. Blondeau, T. Smith, and J. Calnan. 2010. Nassau Grouper (Epinephelus striatus) in St. Thomas, US Virgin Islands, with Evidence for a Spawning Aggregation Site Recovery Proceedings of the 62nd Gulf and Caribbean Fisheries Institute November 2 - 6, 2009 Cumana, Venezuela

Kao, T., T. K. Wetterer and N. G. Hairston Jr. 1985. Fish size, visual resolution and prey selectivity. Ecology 66: 1729–1735.

Kobara, S., and W.D. Heyman. 2008. Geomorphometric patterns of Nassau grouper (*Epinephelus striatus*) spawning aggregation sites in the Cayman Islands. Marine Geodesy, 31(4):231-245.

Leis, J.M.1987. Review of the early life history of tropical groupers (Serranidae) and snappers (Lutjanidae), p. 189- 238, in: J.J. Polivina and S. Ralston (eds.), Tropical Snappers and Groupers: Biology and Fisheries Management. Westview Press. Boulder.

Lindeman KC, Pugliese R, Waugh GT, Ault JS. 2000. Developmental patterns within a multispecies reef fishery: management applications for essential fish habitats and protected areas. Bull Mar Sci. 66:929–956.

Locascio, J.V., and M.L. Burton. 2015. A passive acoustic survey of fish sound production at Riley's Hump within Tortugas South Ecological Reserve: Implications regarding spawning and habitat use. Fish Bull 114:103-116.

Mallinson, D., A. Hine, P. Hallock, S. Locker, E. Shinn, D. Naar, B. Donahue, and D. Weaver. 2003. Developoment of small carbonate banks on the south Florida platform margin: response to sea level and climate change. Marine Geology, 199(1-2)45-63.

Michel, J., C. Boring, and C. Locke. 2008. Rapid assessment protocols for small vessel groundings. International Oil Spill Conference, American Patroleum Institute, 1:381-386.

Moran, D.P., and M. Reaka. 1988. Bioerosion and availability of shelter for benthic reef organisms. Marine Ecology Progress Series. 44(3):249-263.

National Marine Fisheries Service. 2008. Final Endangered Species Act Section 4(b)(2) Report Impact Analysis for Critical Habitat Designation for Threatened Elkhorn & Staghorn Corals.

National Marine Fisheries Service. 2011. Continued Authorization of Reef Fish Fishing Managed under the Reef Fish Fishery Management Plan (FMP) of Puerto Rico and the U.S. Virgin Islands (CRFFMP), Consultation Number F/SERI2O1O/06680.

National Marine Fisheries Service. 2015a. Authorization of Minor In-Water Activities throughout the Geographic Area ofJurisdiction of the U.S. Army Corps of Engineers Jacksonville District, including Florida and the U.S. Caribbean.

National Marine Fisheries Service. 2015b. Essential fish habitat and Critical habitat: A comparison.

National Marine Fisheries Service. 2015c. Reinitiation of Endangered Species Act (ESA) Section 7 Consultation on the Continued Authorization of the Fishery Management Plan (FMP) for Coastal Migratory Pelagic (CMP) Resources in the Atlantic and Gulf of Mexico under the Magnuson-Stevens Fishery Management and Conservation Act (MSFMCA).

National Marine Fisheries Service. 2017a. Biological Opinion on the Approval of Florida Estuary Specific Numeric Nutrient Criteria under section 303(c) of the Clean Water Act for Total Phosphorus, Total Nitrogen, and Chlorophyll-a in 42 Estuary Segments.

National Marine Fisheries Service. 2017b. Biological and Conference Opinion on the Issuance of Scientific Research Permit No. 21043 to Florida Fish and Wildlife Conservation Commission for research on smalltooth sawfish.

National Marine Fisheries Service. 2018a. Endangered Species Act Section 7 Biological and Conference Opinion and Magnsuon-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation on United States Coast Guard Federal Aids to Navigation Program.

National Marine Fisheries Service. 2018b. Biological and Conference Opinion on U.S. Navy Atlantic Fleet Training and Testing and the National Marine Fisheries Service's Promulgation of Regulations Pursuant to the Marine Mammal Protection Act for the Navy to "Take" Marine Mammals Incidental to Atlantic Fleet Training and Testing.

National Marine Fisheries Service. 2019. Biological and Conference Opinion for the Issuance of the 5-Year MultiSector General Permit for Stormwater Discharges Associated with Industrial Activity, Pursuant to the National Pollution Discharge Elimination System.

National Marine Fisheries Service. 2020a. Endangered Species Act (ESA) Section 7 Consultation on the authorization and management of the Puerto Rico fishery under the Puerto Rico Fishery Management Plan (FMP), the St. Thomas/St. John fishery under the St. Thomas/St. John FMP, and the St. Croix fishery under the St. Croix FMP. Consultation number SERO-2019-04047.

National Marine Fisheries Service. 2020b. Programmatic Biological Opinion on the Underwater Investigation and Removal/Remedial Activities in UXO 16, Vieques, Puerto Rico.

National Marine Fisheries Service. 2021. Reissuance of the Pesticide General Permit for Discharge of Pesticide Pollutants into Waters of the United States.

National Oceanic and Atmospheric Administration. 2011. Marine Aquaculture Policy. Silver Spring, MD.

Nemeth, R.S., E. Kadison, S. Herzlieb, J. Blondeau, and E.A. Whiteman. 2006. Status of a yellowfin (Mycteroperca venenosa) grouper spawning aggregation in the US Virgin Islands with notes on other species. Proceedings of the Gulf and Caribbean Fisheries Institute, 57:543-558.

Nemeth, R.S., E. Kadison, J. Josart, M. Shivji, B.M. Wetherbee, and J.K. Matley. 2023. Acoustic telemetry provides insights for improving conservation and management at a spawning aggregation site of the endangered Nassau grouper (*Epinephelus striatus*). Frontiers in Marine Science. 10:1154689.

Nemeth, R.S., N.J. Blondeau and E. Kadison. 2009. Defining marine protected areas for yellowfin and Nassau grouper spawning aggregation sites. Proceedings 61st GCFI 329 –

NOAA Fisheries. 2022. Annual commercial landings statistics.

NOAA Fisheries and BOEM. 2022. Draft Federal Survey Mitigation Implementation Strategy – Northeast U.S. Region.

NOAA Office of Response and Restoration. 2019. Abandoned and Derelict Vessels.

NOAA Office of Response and Restoration. 2021. 2021-2025 Strategic Plan NOAA Marine Debris Program.U.S.

NOAA Office of Response and Restoration, Marine Debris Program. 2019. 2021-2026 U.S. Virgin Islands (USVI) Marine Debris Action Plan.

Parrish, J. D. 1989. Fish communities of interacting shallow-water habitats in tropical oceanic regions.Mar. Ecol. Prog. Ser. 58: 143–160.

Powell, A.B., and J.W. Tucker Jr. 1992. Egg and larval development of laboratory-reared Nassau grouper, Epinephelus striatus (Pisces: Serranidae). Bulletin of Marine Science, 50(1):171-185.

Radakov, D. V., A.D. Motchek, Y.N. Sbikin, R. Claro Madruga, and A. Silva Lee. 1975. Acerca de la longitud de los peces comerciales en capturas de la zona noroccidental de Cuba. Serie Oceanologica. No. 28. Academia de Ciencias de Cuba. Instituto de Oceanologia. Habana. Cuba, 9 pp.

Randall, J.E., and V.E. Brock. 1960. Observations on the ecology of epinepheline and lutjanid fishes of the Society Islands with emphasis on food habits. Transactions of the American Fisheries Society 89(1):9-16.

Randall, J.E. 1962. Tagging reef fishes in the Virgin Islands. Proceedings of the Gulf and Caribbean Fisheries Institute 14:201–241.

Randall, J.E. 1963. Additional recoveries of tagged reef fishes from the Virgin Islands. Proceedings of the Gulf and Caribbean Fisheries Institute 15:155-157.

Randall, J. E. 1965. Food habits of the Nassau grouper (Epinephelus striatus). Assoc. Island Mar.Lab. Caribbean. 6: 13–16.

Randall, J.E. 1983. Caribbean Reef Fishes. Second edition. T.F.H. Publications, Neptune City. NJ. 350 p

Randall, J.E. 1967. Food habits of reef fishes of the West Indies. Studies in Tropical Oceanography, Miami 5:665– 847.

Reguero B.G., C.D. Storlazzi, A.E. Gibbs, J.B. Shope, A.D. Cole, K.A. Cumming, and M.W. Beck. 2021. The value of US coral reefs for flood risk reduction. Nature Sustainability, 4(8):688-698.

Rowell, T.J., R.S. Appeldoorn, and M.T. Scharer-Umpierre. 2013. Passive acoustics record grouper spawning activity at multi-species aggregations. University of Puerto Rico at Mayaguez.

Rowell, T.J., M.T. Scharer, R.S. Nemeth, and R.S. Appeldoorn. 2015. Fish sound production and acoustic telemetry reveal behaviors and spatial patterns associated with spawning aggregations of two Caribbean groupers. Mareine Ecology Pgorgress Series 518:239-254.

Rudd, M. A., and M. H. Tupper. 2002. The impact of Nassau grouper size and abundance on scuba diver site selection and MPA economics. Coastal Management 30(2):133-151.

Ryer, C. H. 1988. Pipefish foraging: effects of fish size, prey size and altered habitat complexity. J.Exp. Mar. Biol. Ecol. 48: 37–45.

Sadovy, Y. and Eklund, A.-M. 1999. Synopsis of biological information on the Nassau Grouper, Epinephelus striatus (Bloch, 1792), and the Jewfish, E. itajara (Lichtenstein, 1822). NOAA Technical Report NMFS 146. Technical Report of the Fishery Bulletin. FAO Fisheries Synopsis 157. US Department of Commerce, Seattle, WA USA, 65 pp

Sadovy de Mitcheson, Y., A. Cornish, M. Domeier, P. Colin, M. Russell, and K. Lindeman. 2008. A Global Baseline for Spawning Aggregations of Reef Fishes. Conservation Biology 22(5):1233-1244.

Semmens, B.X., K.E. Luke, P.G. Bush, C. Pattengill-Semmens, B. Johnson, C. McCoy, and S. Heppell. 2007. Investigating the reproductive migration and spatial ecology of Nassau grouper (Epinephelus striatus) onLittle Cayman Island using acoustic tags – an overview. Proceedings of the Gulf and Caribbean FisheriesInstitute, 58:191-198.

Scharer, M.T., T.J. Rowell, M.I. Nemeth, and R.S. Appeldoorn. 2012. Sound production associated with reproductive behavior of Nassau grouper, *Epinephelus striatus,* at spawning aggregations. Endangered Species Research, 19(1)29-38.

Scharer M, E Tuohy, R Nemeth and R Appeldoorn. 2017. Nassau grouper (Epinephelus striatus) spawning aggregation research at Bajo de Sico and Grammanik Bank. Final report, 19 pp.

Scharer-Umpierre, M.T., D. Mateos-Molina, R.S. Appeldoorn, I. Bejarano, E.A. Hernandez-Delgado, R.S. Nemeth, M.I. Nemeth, M. Valdes-Pizzini, and T.B. Smith. 2014. Marine managed areas and associated fisheries in the US Caribbean. Advances in Marine Biology, 69:129-152.

Shenker, J.M., E.D. Maddox, E. Wishinski, A. Pearl, S.R. Thorrold, and N. Smith. 1993. Onshore transport of settlement-stage Nassau grouper (Epinephelus striatus) and other fishes in Exuma Sound, Bahamas. Marine Ecology Progress Series, 98:31-43.

Shideler, G. S., and B. Pierce. 2016. Recreational diver willingness to pay for goliath grouper encounters during the months of their spawning aggregation off eastern Florida, USA. Ocean & Coastal Management 129:36-43.

Shulman, M.J. 1984. Resource limitation and recruitment patterns in a coral reef fish assemblage.

Journal of Experimental Marine Biology and Ecology, 74(1):85-109.

Silva Lee, A.F. 1974. Hábitos alimentarios de la cherna criolla Epinephelus striatus Bloch y algunos datos sobre su biologia. Serie Oceanologica Academia de Ciencias de Cuba 25:3-14.

Sluka, R., M. Chiappone, K.M. Sullivan, T. Potts, J.M. Levy, E.F. Schmitt, and G. Meester. 1998. Density, species and size distribution of groupers (Serranidae) in three habitats at Elbow Reef, Florida Keys. Bulletin Marine Science, 62:219-228.

Smith, C.L. 1961. Synopsis of biological data on groupers (Epinephelus and allied genera) of the western North Atlantic. FAO Fish. Biol. Synop. No. 23, 61 pp.

Smith, C.L. 1971. A revision of the American groupers: Epinephelus and allied genera. Bulletin of the American Museum of Natural History. 146:69-241.

Smith, C. L. 1972. A spawning aggregation of Nassau grouper, Epinephelus striatus (Bloch). Transactions of theAmerican Fisheries Society, 101:257-261

Smith, C.L., and J.C. Tyler. 1973. Population ecology of a Bahamian suprabenthic shore fish assemblage. American Museum Novitates, no. 2528.

Smith, T.B., R.S. Nemeth, J. Blondeau, J.M. Calnan, E. Kadison, and S. Herzlieb. 2008. Assessing coral reef health across onshore to offshore stress gradients in the US Virgin Islands. Marine Pollution Bulletin 56:1983-1991.

Sogard, S.M. 1997. Size selective mortality in the juvenile stage of teleost fishes: a review. Bulletin of Marine Science 60:1129-1157.

South Atlantic Fishery Management Council. 2018. Socio-Economic Profile of the Snapper Grouper Commercial Fishery in the South Atlantic Region.

South Atlantic Fishery Management Council. 2022. Spiny lobster regulations.

Starck, W.A., II, and W.P. Davis. 1966. Night habits of fishes at Alligator Reef, Florida. Ichthyologica 38(4):313- 356.

Starr, R.M., E. Sala, E. Ballesteros, and M. Zabala. 2007. Spatial dynamics of the Nassau grouper *Epinephelus striatus* in a Caribbean atoll. Marine Ecology Progress Series, 343:239-249.

Thompson, R., and J.L. Munro. 1978. Aspects of the biology and ecology of Caribbean reef fishes: Serranidae (hinds and groupers). Journal of Fish Biology, 12:115-146.

Tucker, J.W., Jr. 1999. Grouper Aquaculture. Southern Regional Aquaculture Center Publication, 721:1-11.

Tucker, J.W., Jr., and P.N. Woodward. 1994. Growth and development of domestic juvenile Nassau groupers. Proceedings of the Gulf and Caribbean Fisheries Institute, 43:389-391.

Tucker, J.W., Jr., and P.N. Woodward. 1993. Nassau grouper aquaculture, p. 363-377, in: F. Arreguin-

Sanchez, J. L. Munro, M.C. Balgos, and D. Pauly (eds.), Biology, Fisheries, and Culture of Tropical Groupers and Snappers, ICLARM Conf. Proc. 48, 449 p.

Tuohy, E., M. Nemeth, I. Bejarano, M.T. Scharer, and R.S. Appeldoorn. 2015. In situ tagging of Nassau grouper *Epinephelus striatus*, using closed circuit rebreathers at a spawning aggregation in Puerto Rico. Marine Technology Society Journal, 49(1):115-123.

Tuohy, E., Schärer-Umpierre, M. & Appeldoorn, R. 2017. Spatio-temporal Dynamics of a Nassau Grouper Spawning Aggregation in Puerto Rico. Proceedings of the Gulf and Caribbean Fisheries Institute 69: 319-321.

Tupper M., and R.G. Boutilier. 1997. Effects of habitat on settlement, growth, predation risk and survival of a temperate reef fish. Marine Ecology Progress Series 151:225-236

U.S. Army Corps of Engineers. USACE Jurisdictional Determinations and Permit Decisions. 2022.

U.S. Energy Information Administration. 2021. Puerto Rico Territory Profile and Energy Estimates.

U.S. Energy Information Administration. 2022. U.S. Virgin Islands Territory Profile and Energy Estimates.

U.S. Environmental Protection Agency. 2019. Hazardous Waste Cleanup: Naval Activity Puerto Rico in Ceiba, Puerto Rico.

U.S. Environmental Protection Agency. 2020. Abandoned vessel authorities and best practices guidance.

U.S. Environmental Protection Agency. 2022. Puerto Rico Water Quality Standards Regulation.

U.S. Navy. 2014. Integrated Natural Resources Management Plan for Naval Air Station Key West Florida.

U.S. Office of Management and Budget. 2003. Circular A-4.

U.S. Office of Management and Budget. 2011. Circular A-4.

U.S. Office of Personnel Management. 2023. Federal Government Schedule Rates: 2023.

U.S. Small Business Administration. 2022. Table of Small Business Size Standards Matched to North American Classification System Codes.

U.S. Virgin Islands Department of Planning and Natural Resources. 2016. Revisions to U.S. Virgin Islands Water Quality Standards.

U.S. Virgin Islands Department of Planning and Natural Resources. 2019. Amended Water Quality Standards.

United States Environmental Protection Agency. 2015. Dredged Material Management Program website for Puerto Rico and U.S. Virgin Islands.

United States Environmental Protection Agency. 2019. Puerto Rico Water Quality Standards

Regulations.

Vassallo, P., and authors. 2013. The value of the seagrass *Posidonia oceanica:* a natural capital assessment. Marine Pollution Bulletin 75(1-2):157-167.

Werner, E.E. 1974. The fish size, prey size, handling time relation in several sunfishes and some implications. Journal of the Fisheries Board of Canada. 31(9):1531-1536.

Werner, E.E. 1977. Competition and habitat shift in two sunfishes (Centrarchidae). Ecology, 58(4):869-876.

Whaylen, L., P. Bush, B. Johnson, K. Luke, C. McCroy, S. Heppell, B. Semmens, M.R. Boardman. 2007. Aggregation dynamics and lessons learned from five years of monitoring at a Nassau grouper (Epinephelus striatus) spawning aggregation in Little Cayman, Cayman Islands, BWI. Proceedings of the Gulf and Caribbean Fisheries Institute, 59:413–421