Billing Code 3510-22-P

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 223

[Docket No. 1206013326-4677-02]

RIN 0648-XA984

Endangered and Threatened Wildlife and Plants: Notice of 12-Month Finding on a Petition to List the Nassau Grouper as Threatened or Endangered Under the Endangered Species Act (ESA)

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Proposed rule; request for comments.

SUMMARY: We, NMFS, announce a 12-month finding and listing determination on a petition to list the Nassau grouper (Epinephelus striatus) as threatened or endangered under the Endangered Species Act (ESA). We have completed a status review of the Nassau grouper in response to a petition submitted by WildEarth Guardians. After reviewing the best scientific and commercial data available, we have determined that the Nassau grouper meets the definition of a threatened species. While the species still occupies its historical range, spawning aggregations have been reduced in size and number due to fishing pressure. The lack of adequate management measures to protect these aggregations increases the extinction risk of Nassau grouper. Based on these considerations, described in more detail in this proposed rule, we conclude that the Nassau grouper is not currently in danger of extinction throughout all or a significant

portion of its range, but is likely to become so within the foreseeable future. We are soliciting information that may be relevant to inform the final listing and designation of critical habitat.

DATES: Information and comments on the subject action must be received by [insert date 120 days after date of publication in the FEDERAL REGISTER].

ADDRESSES: You may submit comments, information, or data on this document, identified by the code NOAA-NMFS-2014-0101, by any of the following methods:

- Electronic Submissions: Submit all electronic comments via the Federal eRulemaking Portal. Go to www.regulations.gov/#!docketDetail;D=NOAA-NMFS-2014-0101, click the "Comment Now!" icon, complete the required fields, and enter or attach your comments.
- Facsimile (fax): 727-824-5309.
- Mail: NMFS, Southeast Regional Office, 263 13th Avenue South, St. Petersburg, FL 33701.
- Hand delivery: You may hand deliver written information to our office during normal business hours at the street address given above.

The Nassau grouper Biological Report and reference list are available by submitting a request to the Species Conservation Branch Chief, Protected Resources Division, NMFS Southeast Regional Office, 263 13th Avenue South, St. Petersburg, FL 33701-5505, Attn: Nassau Grouper 12-month Finding. The report and references are also available electronically at:

http://sero.nmfs.noaa.gov/protected_resources/listing_petitions/index.html

FOR FURTHER INFORMATION CONTACT: Jason Rueter, NMFS, Southeast Regional Office (727) 824-5350; or Lisa Manning, NMFS, Office of Protected Resources (301) 427–8466.

SUPPLEMENTARY INFORMATION:

Background

On September 3, 2010, we received a petition from the WildEarth Guardians to list speckled hind (Epinephelus drummondhayi), goliath grouper (E. itajara), and Nassau grouper (E. striatus) as threatened or endangered under the ESA. Due to the scope of the WildEarth Guardians' petition, as well as the breadth and extent of the required evaluation and response, we provided species-specific 90-day findings in response to the petition. The petition asserted that the present or threatened destruction, modification, or curtailment of habitat or range; overutilization for commercial, recreational, scientific, or educational purposes; inadequacy of existing regulatory mechanisms; and other natural or manmade factors are affecting its continued existence and contributing to the Nassau grouper's imperiled status. The petitioner also requested that critical habitat be designated for this species concurrent with listing under the ESA.

On October 10, 2012, we published a 90-day finding for Nassau grouper with our determination that the petition presented substantial scientific and commercial information indicating that the petitioned action may be warranted (77 FR 61559). We also requested scientific and commercial information from the public to inform a status report of the species including: (1) Status of historical and current spawning aggregation sites; (2) historical and current distribution, abundance, and population trends; (3) biological information (life history, genetics, population connectivity, etc.); (4)

management measures, regulatory mechanisms designed to protect spawning aggregations, and enforcement information; (5) any current or planned activities that may adversely impact the species; and (6) ongoing or planned efforts to protect and restore the species and its habitat. We received information from the public in response to the 90-day finding and incorporated the information in the Biological Report and in this proposed rule.

Listing Determinations under the ESA

We are responsible for determining whether the Nassau grouper is threatened or endangered under the ESA (16 U.S.C. 1531 et seq.). Section 4(b)(1)(A) of the ESA requires us to make listing determinations based solely on the best scientific and commercial data available after conducting a review of the status of the species and after taking into account efforts being made by any state or foreign nation to protect the species. To be considered for listing under the ESA, a group of organisms must constitute a "species," which is defined in section 3 of the ESA to include taxonomic species and "any subspecies of fish, or wildlife, or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." Under section 4(a) of the ESA, we must determine whether any species is endangered or threatened due to any of the following five factors: (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence (sections 4(a)(1)(A) through (E)).

To determine whether the Nassau grouper warrants listing under the ESA, we first completed a Biological Report, which summarizes the taxonomy, distribution, abundance, life history and biology of the species (Hill and Sadovy de Mitcheson 2013). The Biological Report also identifies threats or stressors affecting the status of the species as well as a description of the fisheries, fisheries management, and conservation efforts. The Biological Report incorporates information received in response to our request for information (77 FR 61559, October 10, 2012) and comments from three independent peer reviewers. Information from the Biological Report is summarized below under "Biological Review."

Next, we used the Biological Report to complete a threats evaluation and an extinction risk analysis (ERA) to determine the status of the species. The results of the threats evaluation are discussed below under "Threats Evaluation" and the results of the ERA are discussed below under "Results of Extinction Risk Analysis."

Section 3 of the ESA defines an endangered species as "any species which is in danger of extinction throughout all or a significant portion of its range" and a threatened species as one "which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." Thus, we interpret an "endangered species" to be one that is presently in danger of extinction. A "threatened species," on the other hand, is not currently at risk of extinction but is likely to become so in the foreseeable future. In other words, a key statutory difference between a threatened and endangered species is the timing of when a species may be in danger of extinction, either presently (endangered) or in the foreseeable future (threatened).

In determining whether the species meets the standard of endangered or threatened, we considered the specific life history and ecology of the species, the nature of threats, the species' response to those threats, and population numbers and trends. We considered both the data and information summarized in the Biological Report as well as the results of the extinction risk analysis. We considered each threat identified, both individually and cumulatively. For purposes of our analysis, the mere identification of factors that could impact a species negatively is not sufficient to compel a finding that ESA listing is appropriate. In considering those factors that might constitute threats, we look beyond mere exposure of the species to the factor to determine whether the species responds, either to a single or multiple threats, in a way that causes actual impacts at the species level. In making this finding, we have considered and evaluated the best available scientific and commercial information, including information received in response to our 90-day finding.

Biological Review

This section provides a summary of key biological information presented in the Biological Report (Hill and Sadovy de Mitcheson 2013).

Species Description

The Nassau grouper, Epinephelus striatus (Bloch 1792), is a long-lived, moderate sized Serranid fish with large eyes and a robust body. The range of color is wide, but ground color is generally buff, with 5 dark brown vertical bars and a large black saddle blotch on top of caudal peduncle and a row of black spots below and behind eye. Color pattern can change within minutes from almost white to bicolored to uniformly dark brown, according to the behavioral state of the fish (Longley 1917, Colin 1992, Heemstra and Randall 1993, Carter et al. 1994). A distinctive bicolored pattern is seen when two adults or an adult and large juvenile meet and is frequently observed in spawning aggregations (Heemstra and Randall 1993). There is also a distinctive dark tuning-fork mark beginning at the front of the upper jaw, extending dorsally (on top) along the interorbital region, and then dividing into two branches on top of the head behind the eyes; another dark band from the tip of the snout through the eye and then curving upward to meet its fellow just before the dorsal-fin origin. Juveniles exhibit a color pattern similar to adults (e.g., Silva Lee 1977).

Maximum age has been estimated up to 29 years, based on an ageing study using sagittal otoliths (Bush et al. 2006). Most studies also indicate rapid growth, which has been estimated to be about 10 mm/month (total length (TL)) for small juveniles, and 8.4 to 11.7 mm/month for larger juveniles (30-270 mm TL; Beets and Hixon 1994, Eggleston 1995). Maximum size is about 122 cm TL and maximum weight is about 25 kg (Heemstra and Randall 1993, Humann and Deloach 2002, Froese and Pauly 2010). Generation time (the average age of parents in the population) is estimated as 9-10 years (Sadovy and Colin 1995).

Distribution

The Nassau grouper's confirmed distribution currently includes "Bermuda and Florida (USA), throughout the Bahamas and Caribbean Sea" (e.g., Heemstra and Randall 1993). The occurrence of E. striatus from the Brazilian coast south of the equator as reported in Heemstra and Randall (1993) is "unsubstantiated" (Craig et al. 2011). The Nassau grouper has been documented in the western Gulf of Mexico, at Arrecife Alacranes (north of Progreso) to the west off the Yucatan Peninsula, Mexico, (Hildebrand et al. 1964). Nassau grouper is generally replaced ecologically in the eastern Gulf by red grouper (E. morio) (Smith 1971) in areas north of Key West or the Tortugas. They are considered a rare or transient species off Texas in the northwestern Gulf of Mexico (Gunter and Knapp 1951 in Hoese and Moore 1977). The first confirmed sighting of Nassau grouper in the Flower Garden Banks National Marine Sanctuary, which is located in the northwest Gulf of Mexico approximately 180 km southeast of Galveston, Texas, was reported by Foley et al. (2007). Many earlier reports of Nassau grouper up the Atlantic coast to North Carolina have not been confirmed. The Biological Report (Hill and Sadovy de Mitcheson, 2013) provides a detailed description .

Habitat and Depth

The Nassau grouper is primarily a shallow-water, insular fish species that has long been valued as a major fishery resource throughout the wider Caribbean, South Florida, Bermuda and the Bahamas (Carter et al. 1994). The Nassau grouper is considered a reef fish, but it transitions through a series of developmental shifts in habitat. As larvae, they are planktonic. After an average of 35-40 days and at an average size of 32 mm TL, larvae recruit from an oceanic environment into demersal habitats (Colin 1992, Eggleston 1995). Following settlement, Nassau grouper juveniles are reported to inhabit macroalgae (primarily Laurencia spp.), coral clumps (Porites spp.), and seagrass beds (Eggleston 1995, Dahlgren 1998). Recently-settled Nassau grouper have also been collected from tilefish (Malacanthus plumieri) and rubble mounds at 18 m depth(Colin et al. 1997). Post-settlement, small Nassau grouper have been reported with discarded queen conch shells (Strombus gigas) and other debris around Thalassia beds (Randall 1983, Eggleston 1995).

Juvenile Nassau grouper (120-150 mm TL) are relatively solitary and remain in specific areas for months (Bardach 1958). Juveniles of this size class are associated with macroalgae, and both natural and artificial reef structure. As juveniles grow, they move progressively to deeper areas and offshore reefs (Tucker et al. 1993, Colin et al. 1997). Schools of 30- 40 juveniles (250-350 mm TL) were observed at 8-10 m depths in the Cayman Islands (Tucker et al. 1993). No clear distinction can be made between types of adult and juvenile habitats, although a general size segregation with depth occurs - with smaller Nassau grouper in shallow inshore waters (2 to 9 fathoms) and larger individuals more common on deeper (10 to 30 fathoms) offshore banks (Bardach et al. 1958, Cervigón 1966, Silva Lee 1974, Radakov et al. 1975, Thompson and Munro 1978).

Recent work by Nemeth and coworkers in the U. S. Virgin Islands (U.S.V.I.; manuscript, in prep) found more overlap in home ranges of smaller juveniles compared to larger juveniles, and adults having larger home ranges with less overlap. Mean home range of adult Nassau grouper in the Bahamas was 18,305m^2 +/- 5,806 (SD) with larger ranges at less structurally complex reefs (Bolden 2001). The availability of habitat and prey was found to significantly influence home range of adults (Bolden 2001).

Adult Nassau grouper tend to be relatively sedentary and are generally associated with high relief coral reefs or rocky substrate in clear waters to depths of 130 m. Generally adults are most common at depths less than 100 m (Hill and Sadovy de Mitcheson, 2013) except when at spawning aggregations where they are known to descend to depths of 255m (Starr et al. 2007).

Diet and Feeding

Adult Nassau grouper are unspecialized, bottom-dwelling, ambush-suction predators (Randall 1965, Thompson and Munro 1978). Numerous studies describe Nassau grouper as piscivorous as adults (Randall and Brock 1960, Randall 1965, Randall 1967, Carter et al. 1994, Eggleston et al. 1998). Feeding takes place throughout the diel cycle although most fresh food is found in stomachs collected in the early morning and at dusk (Randall 1967). Young Nassau grouper (20.2-27.2 mm SL) feed on a variety of plankton, including pteropods, amphipods, and copepods (Greenwood 1991, Grover et al. 1998).

Population Structure and Genetics

Multiple genetic analyses indicate that there is high gene flow throughout the geographic range of the Nassau grouper; however, the relative contributions of populations have yet to be determined (Hinegardner and Rosen 1972, Hateley 2005). A study of genetic population structure in Nassau grouper, using mitochondrial DNA (mtDNA) and nuclear microsatellite DNA, revealed no clearly defined population substructuring based on samples from Belize, Cuba, Bahamas, and Florida (Sedberry et al. 1996). These data indicate that spawning aggregations are not exclusively self-recruiting and that the larval stages can disperse over great distances; however, the relative importance of self-recruitment and larval immigration to local populations is not clear (Sedberry et al. 1996). Samples (n=264) from Belize, Bahamas, Turks and Caicos, and Cayman Islands analyzed through enzyme electrophoresis had low to intermediate levels of genetic variability and provided no evidence for population sub-structuring by sex or small-scale spatial distribution, or for macrogeographic stock separation (Hateley 2005). These results are consistent with a single panmictic population within the northern Caribbean basin with high gene flow through the region. Results of an ongoing PhD dissertation using more fine-scale genetic techniques may provide a more detailed understanding of population structure (Alexis Jackson, PhD. research in progress, University of California, Santa Cruz).

Reproductive Biology

The Nassau grouper was originally considered to be a monandric protogynous hermaphrodite, meaning males derive from adult females that undergo a change in sex (Smith 1971, Claro et al. 1990, Carter et al. 1994). However, juveniles possess both male and female tissue, indicating they can mature directly into either sex (Sadovy and Colin 1995). Other characteristics such as the strong male/female size overlap, the presence of males that develop directly from the juvenile phase and the mating system were found to be inconsistent with protogyny (Colin 1992, Sadovy and Colin 1995). Therefore, while taxonomically similar to other hermaphroditic grouper species, the Nassau grouper is primarily considered a gonochore with separate sexes (Sadovy and Colin 1995).

Male and female Nassau grouper typically mature between 400 and 450 mm SL (440 and 504 mm TL), with most individuals attaining sexual maturity by about 500 mm SL (557 mm TL) and about 4-5 years of age, although the smallest mature fish recorded in Cuba was a male in the 360-390 mm TL size class (Claro et al. 1990). The minimum age at sexual maturity based on otoliths is between 4 and 8 years (Bush et al. 1996, 2006) with most fish spawning by age 7+ years (Bush et al. 2006). Nassau grouper raised from the egg in captivity matured at just over 2 years (400-450 mm SL/440-504 mm TL) (Tucker and Woodward 1994). Size, rather than age, may be the major determinant of sexual maturation (Sadovy and Eklund 1999).

Fecundity estimates indicate an average fecundity between 3 and 5 eggs/mg of ripe ovary. Female Nassau grouper from Belize yielded a mean relative fecundity of 4.1 eggs/mg ovary weight and a mean total number of 4,200,000 oocytes (range = 350,000-6,500,000 for females from 300 to 700 mm SL) (Carter et al. 1994). Estimated number of eggs in the ripe ovary (90.7 g) of a 445 mm SL Nassau grouper from Bermuda was 785,101 (Bardach et al. 1958). In the U.S.V.I., mean fecundity was 4.97 eggs/mg of ovary (s.d. = 2.32) with mean egg production of 4,800,000 eggs (Olsen and LaPlace 1979); however, this may be an overestimate as it included premature eggs that may not develop. Fecundity estimates were also made, based on vitellogenic oocytes only, from Bahamas fish producing a mean relative fecundity of 2.9 eggs/mg ripe ovary (s.d. = 1.09; n = 64) and a mean fecundity of 716,664 (range = 11,724 - 4,327,440 for females, 475-686 mm SL). Estimates of oocyte production from animals induced to spawn in captivity are closer to those based solely on vitellogenic oocyte counts.

Spawning Behavior and Habitat

Nassau grouper form spawning aggregations at predictable locations around the winter full moon, or between full and new moons (Smith 1971, Colin 1992, Tucker et al. 1993, Aguilar-Perera 1994, Carter et al. 1994, Tucker and Woodward 1994). Aggregations consist of hundreds, thousands, or, historically, tens of thousands of individuals. Some aggregations have persisted at known locations for periods of 90 years or more (see references in Hill and Sadovy de Mitcheson 2013). Pair spawning has not been observed.

About 50 individual 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 U.S.V.I.; however, many of these may no longer form (Hill and Sadovy de Mitcheson 2013, Figure 10). Recent evidence suggests that spawning is occurring at what appear to be reconstituted or novel spawning sites in both Puerto Rico and the U.S.V.I. (Hill and Sadovy de Mitcheson 2013). Suspected or anecdotal evidence also identifies spawning aggregations in Los Roques, Venezuela (Boomhower et al. 2010) and Old Providence in Colombia's San Andrés Archipelago (Prada et al. 2004). Neither aggregation nor spawning has been reported from South America although ripe Nassau grouper are frequently caught in certain areas (F. Cervigón, Fundacion Cientifica Los Roques – Venezuela, pers. comm. to Y. Sadovy, NMFS, 1991). Spawning aggregation sites have not been reported in the Lesser Antilles, Central America south of Honduras, or Florida.

"Spawning runs," or movement of adult Nassau grouper from coral reefs to spawning aggregations sites, were first described in Nassau grouper from 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 even 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 with some fish moving only a few kilometers, while others move up to several hundred kilometers (Colin 1992, Carter et al. 1994, Bolden 2000). Ongoing research in the Exuma Sound, Bahamas has tracked migrating Nassau grouper up to 200 km (125 mi), with likely estimates of up to 330 km (205 mi), as they move to aggregation sites (Hill and Sadovy de Mitcheson 2013).

Observations suggest that individuals can return to their original home reef following spawning. Bolden (2001) reported two tagged fish (n=22) returning to home reefs in the Bahamas one year following spawning. Sonic tracking studies around Little Cayman Island have demonstrated that spawners may return to the aggregation site in successive months with returns to their residential reefs in between (Semmens et al. 2007). Sixty percent of fish tagged at the west end spawning aggregation site in Little Cayman in January 2005, returned to the aggregation site in February 2005 (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).

It is not known how Nassau grouper select and locate aggregation sites or why they aggregate to spawn. Spawning aggregation sites are typically located near significant geomorphological features, such as projections (promontories) of the reef as little as 50 m from the shore, and close to a drop-off into deep water over a wide (6-60 m) depth range (Craig 1966, Smith 1972, Burnett-Herkes 1975, Olsen and LaPlace 1979, Colin et al. 1987, Carter 1989, Fine 1990, Beets and Friedlander 1998, Colin 1992, Aguilar-Perera 1994). Sites are characteristically small, highly circumscribed areas, measuring several hundred meters in diameter, with soft corals, sponges, stony coral outcrops, and sandy depressions (Craig 1966, Smith 1972, Burnett-Herkes 1975, Olsen and LaPlace 1979, Colin et al. 1987, Carter 1989, Fine 1990, Beets and Friedlander 1998, Colin 1992, Aguilar-Perera 1994). Recent work has identified geomorphological similarities in spawning sites that may be useful in applying remote sensing techniques to discover previously unknown spawning sites (Kobara and Heyman 2010).

The link between spawning sites and settlement sites is also not well understood. Larval sampling adjacent to a spawning aggregation at Mahahual, Mexico (Vásquez-Yeomans et al. 1998) failed to capture a single Nassau grouper larva, perhaps due to methodology or the density of spawning fish. Researchers speculate the location of spawning sites is to assist in offshore transport of fertilized eggs. However, currents nearby aggregation sites do not necessarily favor offshore egg transport, indicating some locations may be at least partially self-recruiting (e.g., Colin 1992). In a similar study around a spawning aggregation site at Little Cayman, surface velocity profile drifters released on the night of peak spawning showed significant eddy formation so that Drifters released nearby an aggregation site at Little Cayman remain near or returned to the spawning reef on the night of spawning compared to those that moved away on nights preceding (Heppell et al. 2011).

Spawning aggregations usually form between December and March (reviewed in Sadovy and Eklund 1999) within the narrow water temperature range of 25-26°C over a wide range of day-lengths (Colin 1992, Tucker et al. 1993, Carter et al. 1994). Temperature is evidently a more important stimulus for spawning than day length (Hill and Sadovy de Mitcheson 2013). In more northerly latitudes (i.e., Bermuda), the reproductive season falls between May and August, peaking in July (La Gorce 1939, Bardach et al. 1958, Smith 1971, Burnett-Herkes 1975). Spawning occurs for up to 1.5 hours around the time of sunset for several days in each of several months (Whaylen et al. 2007).

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 actually takes place (Colin 1992, Kadison et al. 2010, Nemeth 2012). Prior to spawning, individuals milling around over the substrate exhibit one of four distinctive color phases: barred (normal); bicolor; white belly; or dark phase. There are intergradations of these patterns, with rapid changes among patterns possible (Colin 1992). Different color phases have also been associated with specific times or stages of spawning events (Colin 1992).

Courtship is indicated by two behaviors which occur late in the afternoon: "following" and "circling" (Colin 1992). "Following" occurs as one or more fish in the bicolor phase swim closely behind an apparent female while "circling" occurs as a bicolor phase fish circles a barred or dark phase fish. The aggregation then moves into deeper water shortly before spawning (Colin 1992, Tucker et al. 1993, Carter et al. 1994), by which time all individuals are either "dark phase" or "bicolor." Progression from courtship to spawning may depend on aggregation size, but generally fish move up into the water column, with an increasing number exhibiting the bicolor phase (Colin 1992, Carter et al. 1994).

Spawning involves a rapid horizontal swim or a "rush" of bicolor fish following dark fish closely in either a column or cone rising to within 20-25 m of the water surface where group-spawning occurs in sub-groups of 3-25 fish (Olsen and LaPlace 1979, Carter 1986, Aguilar-Perera and Aguilar-Davila 1996). Then there is release of sperm and eggs and a rapid return of the fragmented sub-group to the substrate. Similar accounts of spawning behavior from the U.S.V.I. described the aggregated fish as a cone in the water column rather than being dispersed across the bottom (Olsen and LaPlace 1979). All spawning events have been recorded within 20 minutes of sunset and most within 10 minutes of sunset (Colin 1992).

Repeated spawning occurs at the same site for up to three consecutive months during the correct moon phase. Participation by individual fish across the time periods is unknown. It has been suggested that individual females spawn repeatedly over several different days during one aggregation based on reproductive tissue (Smith 1972, Sadovy, NMFS, pers. obs.). Videotape recording shows a single female in repeated spawning rushes during a single night, indicating repeated release of eggs (Colin 1992). It is unknown whether a single, mature female will spawn across the spawning season or even each year.

Status Assessments

Few formal stock assessments have been conducted for the Nassau grouper. The most recent published assessment, conducted in the Bahamas, indicates fishing effort, and hence fishing mortality (F), in the Bahamas needs to be reduced from the 1998 - 2001 levels, otherwise the stocks are likely to be overexploited relative to biological reference points (Cheung et al. 2013). The population dynamic modeling by Cheung et. al (2013) found: "assuming that the closure of the spawning aggregation season is perfectly implemented and enforced, the median value of *F*SPR (fishing mortality rate that produces a certain spawning potential ratio) = 35% on non-spawning fish would be 50% of the fishing mortality of the 1998 to 2001 level. The 5% and 95% confidence limits are estimated to be less than 20% and more than 100% of the fishing mortality at the 1998 to 2001 level, respectively. In other words, if (1) fishing mortality (F) rates of non-spawning fish are maintained at the 1998 to 2001 level, and (2) fishing on spawning aggregations is negligible, the median spawning potential (spawner biomass relative to the unexploited level) is expected to be around 25% (5 and 95% CI of 20 and 30%, respectively). This level is significantly below the reference limit of 35% of spawning potential, meaning that there is a high chance of recruitment overfishing because of the low spawning stock biomass."

The Nassau grouper was formerly one of the most common and important commercial groupers in the insular tropical western Atlantic and Caribbean (Smith 1978, Randall 1983, Appeldoorn et al. 1987, Sadovy 1997). Declines in landings and catch per unit of effort (CPUE) have been reported throughout its range, and it is now considered to be commercially extinct (the species is extinct for fishery purposes due to low catch per unit effort) in a number of areas, including Jamaica, Dominican Republic, U.S.V.I., and Puerto Rico (Sadovy and Eklund 1999). Information on past and present abundance and density, at coral reefs and aggregation sites, is based on a combination of anecdotal accounts, visual census surveys, and fisheries data. Because grouper species are reported collectively in landings data, there are limited species-specific data to determine catch of Nassau grouper throughout its range.

While fisheries dependent data are generally limited for the species throughout its range, there are some 1970s and 1980s port-sampling data from the U.S.V.I. and Puerto Rico. In the U.S.V.I., Nassau grouper accounted for 22 percent of total grouper landings with 85 percent of the Nassau grouper catch coming from spawning aggregations (D. Olsen, Chief Scientist – St. Thomas Fishermen's Association, pers. comm. to J. Rueter, NMFS, October 2013). The first U.S. survey of the fishery resources of Puerto Rico noted the Nassau grouper was common and a very important food fish, reaching a weight of 22.7 kg (50 lbs.) or more (Evermann 1900). The Nassau grouper was still the fourth-most common shallow-water species landed in Puerto Rico in the 1970's (Thompson

1978), and it was common in the reef fish fishery of the U.S.V.I. (Olsen and LaPlace 1979). By 1981, "the Nassau grouper ha(d) practically disappeared from the local catches and the ones that d(id) appear (were) small compared with previous years" (CFMC 1985), and by 1986, the Nassau grouper was considered commercially extinct in the U.S.V.I./Puerto Rico region (Bohnsack et al. 1986). About 1,000 kg of Nassau grouper were landed from the Puerto Rico Reef Fish Fishery during the latter half of the 1980s , and most of them were less than 500 mm, indicating they were likely sexually immature (Sadovy 1997).

A number of organizations and agencies have conducted surveys to examine the status of coral reefs and reef fish populations throughout the western Atlantic, as well as other parts of the world. Results from these monitoring studies offer some indication of relative abundance in various locations for Nassau grouper, although different methods are often employed and thus results of different studies cannot be directly compared (Kellison et al. 2009). The Atlantic and Gulf Rapid Reef Assessment Program (AGRRA), which samples a broad spectrum of western Atlantic reefs, reports few Nassau groupers with sighting frequency (proportion of all surveys with at least one Nassau present) ranging from less than 1% to less than 10% per survey from 1997 - 2000. Densities of Nassau grouper range from 1 to 15 fish/hectare with a mean of 5.6 fish/hectare across all areas surveyed (AGRRA). NOAA's Coral Reef Ecosystem Monitoring Program (CREMP) has conducted studies on coral reefs in Puerto Rico and the U.S.V.I. since 2000, and sighting frequency has ranged from 0 to 0.5% and density has ranged from 0 to 0.5 fish/hectare. Data from University of the Virgin Islands (UVI Vis. Sur.) Self contained underwater breathing apparatus (SCUBA) surveys report densities of Nassau grouper at 4 fish/hectare per survey across reef habitat types in the U.S.V.I. SCUBA surveys by NOAA in the Florida Keys across reef habitat types have sighting frequencies per survey between 2-10%; with densities at 1 fish/hectare (NOAA's NMFS FRVC). In addition to these surveys, Hodgson and Liebeler (2002) noted that Nassau grouper were absent from 82% of shallow Caribbean reefs (3–10m) during a 5-year period (1997-2001) of underwater surveys in most countries in the range of the species for the ReefCheck project.

Fishing Impacts on Spawning Aggregations

Historically, fifty spawning aggregation sites had been identified throughout the Caribbean (Sadovy de Mitcheson et al 2008). Of these 50, less than 20 probably still remain (Sadovy de Mitcheson et al 2008). Furthermore, while numbers of fish at aggregation sites [once] numbered in the tens of thousands (30,000 – 100,000 fish; Smith 1972), they have now been reduced to less than 3,000 at those sites where counts have been made (Sadovy de Mitcheson et al 2008). Because we lack sufficient stock assessments or population estimates, here we use spawning aggregation trends as a proxy for population trends. We believe the status of spawning aggregations is likely to be reflective of the overall population, because adults migrate to spawning aggregations for the only known reproductive events.

In general, slow-growing, long-lived species (such as snappers and groupers) with limited spawning periods and, possibly, with only a narrow recruitment window are susceptible to overexploitation (Bannerot et al. 1987, Polovina and Ralston 1987). The strong appeal of spawning aggregations as targets for fishing, their importance in many seasonal fisheries, and the apparent abundance of fish at aggregations, make spawning aggregations particularly susceptible to over-exploitation. There are reports from across the Caribbean where Nassau grouper spawning aggregations have repeatedly been discovered, fished, and then ceased to exist, or exist at such low densities that spawning fails. Nassau grouper were exclusively fished during aggregation formation during the 1970's in Bermuda. Commercial landings in 1975 were 75,000 tons; by 1981, landings had fallen to 10,000 tons (Sadovy de Mitcheson and Erisman 2012). The four known spawning aggregation sites ceased to form shortly after and have still not recovered (Sadovy de Mitcheson and Erisman 2012). In Mahahual, Quintana Roo, Mexico, aggregations of up to 15,000 fish formed each year at the same site, but due to increased fishing pressure in the 1990's, aggregations have not formed since 1996, and management measures designed to protect spawning aggregations are not enforced (Aguilar-Perera 2007). Nassau grouper were almost exclusively targeted during aggregation formation in Cuba; because of this, 20 of the 21 known aggregations no longer form (Claro et al. 2009). In Belize there has been an eighty percent decline in the last 25 years in size of the Glover's Reef aggregation (15,000 fish to 3,000). Additionally, only 2 of the 9 known aggregations still formed as of 2001, and those had been reduced from 30,000 fish to 1,000-5,000 fish. Recent work has identified 15 spawning aggregation sites in Belize. Seven of these sites were monitored for a ten year period (2003 – 2012). The number of fish counted at all seven sites has remained very low (five sites have less than 170 fish, the other two have 1,050 and 1,350), with no sign of recovery (Belize SPAG workgroup 2012). Similar situations are known to have occurred in in the Bahamas, U.S.V.I., Puerto Rico, and Honduras (Sadovy de Mitcheson and Erisman 2012, see also Hill and Sadovy de Mitcheson 2013).

Further indicators of population decline are the reduced size and/or age of fish in many of the spawning aggregations that remain. It is unusual to obtain individuals of more than 12 years of age in exploited fisheries, with more heavily fished areas yielding much younger fish on average. The maximum age estimate in the heavily exploited U.S.V.I. population is 9 years (Olsen and LaPlace l979), 12 years in northern Cuba, 17 years in southern Cuba (Claro et al. 1990), and 21 years from the Bahamas, (Sadovy and Colin 1995). Most individuals caught from a U.S.V.I. spawning aggregation were between about 500 and 600 mm TL (Olsen and LaPlace 1979). Nemeth et al. (2006) found that adult Nassau grouper at a different spawning aggregation site (Grammanik Bank) in the U.S.V.I. ranged between 480 and 800 mm with average total length for males (603 mm, n = 18) and females (591 mm, n = 44) being similar.

While heavy fishing on spawning aggregations may have been a primary driver of population declines as reflected by the observed declines in spawning aggregations (Sadovy de Mitcheson and Erisman 2012), other factors may affect abundance. For example, heavy fishing of adults away from or during spawning runs, intensive capture of juveniles, either through direct targeting (e.g., spearfishing) or using small mesh traps or nets, are also occurring (Hill and Sadovy de Mitcheson 2013). In addition to the high fishing pressure in some areas, poaching also appears to be affecting some populations (e.g., in the Cayman Islands, Semmens et al. 2012).

Threats Evaluation

The threats evaluation was the second step in the process of making an ESA listing determination for Nassau grouper as described above in “Listing Determinations Under the ESA”. The Extinction Risk Analysis Group (ERAG), which consisted of 12

NOAA Fisheries Science Center and Regional Office personnel, was asked to independently review the Biological Report and assess 4 demographic factors (abundance, growth rate/productivity, spatial structure/connectivity, and diversity) and 13 specific threats (see ERA Threat Table under supporting documents). The group members were asked to provide qualitative scores based on their perceived severity of each factor and threat.

The ERAG members were asked to independently evaluate the severity, scope, and certainty for these threats currently and in the foreseeable future (30 years from now). The foreseeable future was based on our consideration of age at maturity, estimated generation time, and threats. Using a generation time of 10 years and an age at maturity of 8 years (Bush et al. 1996, 2006; Legault and Eklund 1998), we chose 30 years as the foreseeable future time-frame, which would potentially allow three generations of mature individuals to contribute to spawning aggregations. Given the limited information we have to predict the impacts of threats, we felt the 30 year timeframe was the most appropriate to predict impacts from threats in the future.

ERAG members were asked to rank each of four demographic factors and 13 identified threats as "very low risk," "low risk," "moderate risk," "increasing risk," "high risk," or "unknown." "Very low risk" meant that it is unlikely that the demographic factor or threat affects the species' overall status. "Low risk" meant that the demographic factor may affect species' status, but only to a degree that it is unlikely that this factor significantly elevates risk of extinction now or in the future. "Moderate risk" meant that the demographic factor or threat contributes significantly to long term risk of extinction, but does not constitute a danger of extinction in the near future. "Increasing risk" meant that the present demographic risk or threat is low or moderate, but is likely to increase to high risk in the foreseeable future if present conditions continue. Finally, “high risk” meant that the demographic factor or threat indicates danger of extinction in the near future. The ERAG evaluated risk on this scale, and we then interpreted these rankings against the statutory language for threatened or endangered to determine the status of Nassau grouper.

ERAG members were also asked to consider the potential interactions among demographic factors and threats. If the demographic factor or threat was ranked higher due to interactions with other demographic factors or threats, ERAG members were asked to identify those factors or threats that caused them to score the risk higher or lower than it would have been if it were considered independently. We then examined the independent responses from each ERAG member for each demographic factor and threat and used the modal response to determine the level of threat to Nassau grouper.

Climate change and international trade regulations (e.g. CITES, as described in the Biological Report) were categorized as “unknown.” Habitat alteration, U.S. federal regulations, disease/parasites/abnormalities, and aquaculture were ranked as “very low risk” to “low risk.” State/territorial regulations, growth rate/productivity, abundance, spatial structure/connectivity, commercial harvest, foreign regulations, artificial selection, and diversity were ranked as “moderate risk” to “increasing risk.” Historical harvest (the effect of prior harvest on current population status), spawning aggregation fishing, and inadequate law enforcement were classified as “high risk.” The demographic factors and threats are described below by the five listing factors with the corresponding ERAG ranking for each demographic factor or threat.

A. The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range

Spatial structure/connectivity and habitat alteration were considered under Factor A; this included habitat loss or degradation, and the loss of habitat patches, critical source populations, subpopulations, or dispersal among populations.

Nassau grouper use many different habitat types within the coral reef ecosystem. The increase in urban, industrial, and tourist developments throughout the species' range impacts coastal mangroves, seagrass beds, estuaries, and live coral (Mahon 1990). Loss of juvenile habitat, such as macroalgae, seagrass beds, and mangrove channels is likely to negatively affect recruitment rates. Habitat loss or degradation was ranked by the ERAG as a “low risk” threat to Nassau grouper. In conclusion, the use of many different habitat types by Nassau grouper greatly reduces a risk of extinction from habitat loss or degradation (Hill and Sadovy de Mitcheson 2013).

As described in Hill and Sadovy de Mitcheson (2013), a study of genetic population structure in Nassau grouper revealed no clearly defined population substructuring at the geographic locations sampled, i.e. Belize, Cuba, Bahamas, and Florida (Sedberry et al. 1996). Based on ERAG scores, spatial structure/connectivity was characterized as an “increasing” risk for Nassau grouper. We agree with the ERAG ranking and believe this increasing risk is due to the declining number and size of spawning aggregations, which affects population structure.

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Based on ERAG rankings, historical harvest and spawning aggregation fishing are two of the three most severe threats (the third being lack of law enforcement) to

Nassau grouper. Historical harvest and fishing spawning aggregations were both classified as "high" risk threats to Nassau grouper. Curiously, the ERAG rankings for commercial harvest, which often includes the fishing on spawning aggregations, were lower and indicated current commercial harvest was a "moderate" threat for Nassau grouper. Current abundance was similarly classified as a "moderate" risk for Nassau grouper.

Two different aspects of fishing affect Nassau grouper abundance: fishing effort throughout the non-spawning months and directed fishing at spawning aggregations or migrating adults. Nassau grouper are fished commercially and recreationally throughout the year by handline, longline, fish traps, spear guns, and gillnets (NMFS General Canvas Landing System). Fishing at aggregations is mainly conducted by handlines or by fish traps, although gillnets were being used in Mexico in the early to mid-1990s (Aguilar-Perera 2004). Declines in landings, catch per unit effort (CPUE) and, by implication, abundance in the late 1980's and early 1990's occurred throughout its range, which has led Nassau grouper to now be considered commercially extinct in a number of areas (Sadovy and Eklund 1999). Population declines and loss of aggregations continue throughout the Nassau grouper's range (Sadovy de Mitcheson 2012).

These predictable spawning aggregations make Nassau grouper a vulnerable fishing target. In many places, annual landings for Nassau grouper were mostly from aggregation-fishing (e.g., Claro et al. 1990, Bush et al. 2006). Because Nassau grouper are only known to reproduce in spawning aggregations, removing ripe individuals from the spawning aggregations greatly influences population dynamics and future fishery yields (Shapiro 1987). Harvesting a species during its reproductive period increases adult mortality and diminishes juvenile recruitment rates. The loss of adults and the lack of recruitment greatly increase a species' extinction risk. The collapse of aggregations in many countries (Sadovy de Mitcheson 2012) may be due to the fact that much of the catch in many countries historically came from spawning aggregations (Olsen and LePlace 1978, Aguilar-Perera 1994, Sadovy and Eklund 1999). As Semmens et al. (2012) noted from the results of a mark-recapture study on Cayman Brac, Cayman Island fishermen appear to catch sufficient adult grouper outside the spawning season to seriously impact populations. It appears that aggregation fishing has led to such depressed populations that fishing operations away from the aggregations are impacting the status of the populations.

The final threat analyzed for Factor B was artificial selection. The ERAG scores indicated artificial selection was a "moderate" threat; however, ranking of this threat was widely distributed amongst ERAG members, indicating a high level of uncertainty about the effects of artificial selection on Nassau grouper.

C. Disease and Predation

There is very little information on the impacts of disease, parasites, and abnormalities on Nassau grouper, but Nassau grouper are not known to be affected by any specific disease or parasite. Additionally, Nassau grouper are not known to be at an increased risk of extinction due to predation. The ERAG ranking indicated a "very low risk" threat from disease, parasites, and predation.

D. Inadequacy of Existing Regulatory Mechanisms

The inadequacy of existing regulatory mechanisms, including inadequate law enforcement, international trade regulations, foreign nations' domestic laws, U.S. federal laws, and U.S. state and territorial laws were considered under Factor D. The lack of law enforcement was noted by members of the ERAG as influencing their scoring for abundance, fishing spawning aggregations, commercial harvest, and historical harvest. The lack of law enforcement lead to higher risk scores for these threats. Inadequate law enforcement was ranked as a "high risk" to Nassau grouper. Rankings for the other categories of regulatory mechanisms were widely distributed, with only one considered an "increasing" risk (foreign regulations). The remaining two categories of regulations (U.S. federal and State of Florida and U.S. territory regulations) were considered "low risk" to "moderate risk." While the ERAG ranking for regulatory mechanisms were generally low, the concern about fishing spawning aggregations ("high risk") may be in part due to regulatory mechanisms.

Summary of Existing Regulatory Mechanisms

As discussed in detail in the Biological Report (Hill and Sadovy de Mitcheson 2013)), a wide array of regulatory mechanisms exists throughout the range of Nassau grouper that are intended to limit harvest. Existing regulatory mechanisms include minimum sizes restrictions, seasonal closures, spatial closures, and gear and access restrictions. We summarize some of these regulatory mechanisms below by country.

In the 1980's, the Bahamas introduced a minimum size of 3 lbs. (1.36 kg) for Nassau grouper. This was followed in 1998 with a 10-day seasonal closure at several spawning aggregations. An annual "two-month" fishery closure was added in December 2003 to coincide with the spawning period and was extended to three months in 2005 to encompass the December through February spawning period. The 3-month closure implementation is determined annually and could be shortened or otherwise influenced by such factors as the economy (Sadovy and Eklund 1999). During the 3-month closure there is a national ban on Nassau grouper catches; however, the Bahamas Reef Educational Foundation (BREEF; unpub. data), has reported large numbers of fish being taken according to fisher accounts with photo-documentation and confirming reports of poaching of the species during the aggregation season.

There are marine parks in the Bahamas that are closed to fishing and therefore protect Nassau grouper. The Exuma Cays Land and Sea Park, first established in 1959, has been closed to fishing since 1986, thus protecting both nursery and adult habitat for Nassau grouper and other depleted marine species. Other sites, including the South Berry Islands Marine Reserve (established on December 29, 2008), Southwest New Providence National Park, and North Exumas Study Site have also been established and closed to fishing. Several gear restrictions are protective of Nassau grouper. Fishing with SCUBA and the use of explosives, poisons, and spearguns is prohibited in the Bahamas, although snorkeling with sling spears is allowed. The use of bleach or other noxious or poisonous substances for fishing, or possession of such substances on board a fishing vessel, without written approval of the Minister, is prohibited. Commercial fishing in the Bahamas is restricted to only the native population and, as a consequence, all vessels fishing within the Bahamas Exclusive Fishery Zone must be fully owned by a Bahamian citizen residing in the Bahamas.

In Belize, the first measure to protect Nassau grouper was a seasonal closure within the Glover’s Reef Marine Reserve in 1993; the area was closed from December 1 to March 1 to protect spawning aggregations. A seasonal closure zone to protect Nassau grouper spawning aggregations was included when the Bacalar Chico marine reserve was established in 1996 (Paz and Truly 2007). Minimum and maximum capture sizes were introduced a decade ago (see Hill and Sadovy de Mitcheson 2013, Sala et al. 2001, Carter et al. 1994, Heyman and Requena 2002, Sadovy de Mitcheson et al. 2008; J. Gibson, Wildlife Conservation Society - Belize City, Belize, pers. comm. to Y. Sadovy, University Hong Kong, 2010).

In 2001 the Belize National Spawning Aggregation Working Group established protective legislation for 11 of the known Nassau grouper spawning sites. Seven of those 11 sites are monitored as regularly as possible. The Working Group meets regularly to share data and develop management strategies (www.spagbelize.org; retrieved on 15 April 2012) and monitoring continues at several sites. In 2003, Belize introduced a four-month closed season to protect spawning fish (O'Connor 2002, Gibson 2008). However, the legislation introduced in 2003 allowed for exemptions to the closures by special license granted by the Fisheries Administrator. These special licenses made it difficult to enforce the national prohibition and in 2010, Belize stopped issuing fishers permits to fish for Nassau grouper during the 4-month spawning period, except at Maugre Caye and Northern Two Caye.

Belize issued additional protective measures in early April 2009 to help manage and protect the Nassau grouper. These include minimum and maximum size limits of 510 mm (20 inches) and 760 mm (30 inches), respectively, and a planned ban on all spear fishing within all marine reserves (yet to be implemented). Furthermore, as a large proportion of finfish are landed as fillets, the new regulations require that all Nassau grouper be landed whole, and if filleted must have a 1-2 inch (25-50 mm) skin patch (The Belize Spawning Aggregation Working Group 2009). Other gear restrictions are in place for reef fishes generally to aid in their management, such as no spearfishing on compressed air.

Although Bermuda closed red hind aggregation sites in 1974, Nassau grouper aggregation sites located seaward of these sites were not protected and continued to be fished. In 1990, a two-fish bag limit and minimum size restriction (356 mm FL) were enacted in Bermuda (Luckhurst 1996). Since 1996, Nassau grouper has been completely protected through a prohibition on take and possession and likely benefits from numerous no-take marine reserves (Hill and Sadovy de Mitcheson 2013).

In the late 1970's (Hill and Sadovy de Mitcheson 2013), the three main ("traditional") grouper "holes" in the Cayman Islands were officially protected and only residents were allowed to fish by lines during spawning season. In 1986, increasing complaints from fishermen of a decline in both numbers and size of Nassau grouper taken from the fishery prompted the implementation of a monitoring program by the Department of the Environment (Bush et al. 2006).

In 1998, these three main grouper holes at the eastern ends of the islands were formally designated as "Restricted Marine Areas" for which access required licensing by the Marine Conservation Board (the statutory authority responsible for the administration of the Marine Conservation Law) (Bush et al. 2006). In the early 1990s, legislation prohibited spearfishing at spawning aggregation sites. In February 2002, protective legislation defined a spawning season as November 1 to March 31, and an "Alternate Year Fishing" rule was passed. This law allowed fishing of the spawning aggregations to occur every other year with the first non-fishing year starting in 2003, and also set a catch limit of 12 Nassau grouper per boat per day during fishing years. The law defined the one nautical mile (nm) “no trapping” zones around each spawning site, and set a minimum size limit of 12 inches for Nassau grouper in 2002 in response to juveniles being taken by fish traps inside the sounds (Whaylen et al. 2004, Bush et al. 2006). In 2003, spearguns were restricted from use within 1 nautical mile of any designated grouper spawning area from November through March. In 2008, it was prohibited to take any Nassau grouper by speargun anywhere in Cayman waters. Effective December 29, 2003, the Marine Conservation Board, closed fishing at all designated Nassau grouper spawning sites for a period of 8 years. The conservation measure was renewed for a further 8 years in 2011.

In Cuba, there is a minimum size of 32cm TL (or 570g) for Nassau grouper. This is not protective because the size of maturity is 48cm TL. Of some benefit to Nassau grouper are bag limits for recreational fishing, regulations to increase selectivity of fishing gears to avoid the catch of juveniles, limits of net use during spawning aggregation time, and controls of speargun use, both commercially and recreationally. Marine protected areas have been introduced throughout the country. In 2002, the total number of recreational licenses was limited to 3,500 for the whole country hoping to reduce directed fishing pressure.

In Mexico, following scientific documentation of declines of Nassau grouper at Mahahual (Aguilar-Perera 1994), two regulations were enacted: 1) spear-fishing was banned at any spawning aggregation sites in southern Quintana Roo in 1993; and 2) in 1997 the fishing of any grouper species was banned during December and January (Aguilar-Perera 2006). In 2003, a closed season for all grouper was implemented from February 15 to March 15 in all waters of the Mexican Exclusive Economic Zone.

Although aimed at protecting red grouper, E. morio, this closure protects Nassau grouper during a part of its spawning season (Aguilar-Perera et al. 2008). A management plan was to have gone into effect in 2012 to protect all commercially exploited groupers in Mexico's southern Gulf of Mexico and Caribbean Sea; the plan has not been implemented.

In the Turks and Caicos Islands, the only documented spawning aggregation site is protected from fishing in Northwest Point Marine National Park, Providenciales (DECR 2004; National Parks Ordinance and Subsidiary Legislation CAP. 80 of 1988). Similar to situations in other countries, full protection of Nassau grouper habitat as well as important spawning migration corridors on the very narrow fringe of Caicos Bank is problematic/yields unintended consequences. It would impose economic hardship on local fishers who depend on those areas for retrieving commercial species (e.g., spiny lobsters) and subsistence fishing (Rudd 2004).

Take and possession of Nassau grouper have been prohibited since 1990 in U.S. federal waters, including federal waters around Puerto Rico and the U.S.V.I. Since 1993, a ban on fishing/possessing Nassau grouper was implemented for the state of Florida and has been enacted in all U.S. state waters. The species was fully protected in both state and federal waters in Puerto Rico by 2004. The Caribbean Fishery Management Council, with support of local fishermen, established a no-take marine protected area off the southwest coast of St. Thomas, U.S.V.I. in 1990. This area, known as the Hind Bank Marine Conservation District (HBMCD) (Brown 2007), was intended to protect red hind and their spawning aggregations, as well as a former Nassau grouper spawning site. The HBMCD was first subject to a seasonal closure, beginning in 1990 (Beets and

Friedlander 1999, Nemeth 2005, Nemeth et al. 2006) to protect spawning aggregations of red hind, and was later closed to fishing year-round in 1998 (DPNR 2005). Additional fishing restrictions in the U.S.V.I. such as gear restrictions, rules on the sale of fish, and protected areas such as the Virgin Islands Coral Reef National Monument and Buck Island Reef National Monument where all take is prohibited, Virgin Islands National Park (commercial fishing prohibited), and several U.S.V.I. marine reserves offer additional protection to Nassau grouper. In 2006, the U.S.V.I. instituted regulations to prohibit Harvest and possession of Nassau grouper in territorial waters and fileting at sea was prohibited (García-Moliner and Sadovy 2007).

We are not aware of special conservation or management regulations for Nassau grouper in Anguilla. In Antigua-Barbuda, while Nassau grouper is not specifically managed or protected, closed seasons were considered in 2008 for Nassau grouper and red hind, the status of these closed seasons is not known. In the British Virgin Islands, there is a closed season for landing Nassau grouper between March 1 and May 31 (Munro and Blok 2005). In Colombia, the San Andrés Archipelago has a number of areas that are designated as no-take fishing zones, and in 2000 the entire archipelago was declared by UNESCO as the Seaflower Biosphere Reserve. In 2004, large portions of the archipelago were declared as a system of marine protected areas with varying zones of fisheries management; however, enforcement is largely lacking (M. Prada, Coralina, San Andres, Colombia, pers. comm. R. Hill, NMFS, 2010). Right-to-fish laws in Colombia also require that fishermen be allowed to fish at a subsistence level even within the no-take zones (M. Prada, Coralina, San Andres, Colombia, pers. comm. R. Hill, NMFS, 2010).

The catch and sale of ripe female Nassau grouper during the spawning season is not allowed in the Dominican Republic (Bohnsack 1989, Sadovy and Eklund 1999, Box and Bonilla Mejia 2008) and at least one marine park has been established with fishing regulations. In Guadeloupe and Martinique, there are plans to protect the species (F Gourdin, Regional Activity Center for Specially Protected Areas and Wildlife – UNEP, pers. comm. to Y. Sadovy, University of Hong Kong, 2011) although no details are available at this time. There is no legislation that controls fishing in the snapper/grouper fishery in Honduras although traps and spear are illegal in the Bay Islands. There are no special regulations for Nassau grouper in Jamaica specifically; however, some marine protected areas were designated in 2011.

Conclusions and Effectiveness Regarding Inadequacy of Existing Regulatory Mechanisms

Overall, existing regulatory mechanisms throughout the species' range vary in effectiveness in addressing the most serious threat to Nassau grouper, fishing of spawning aggregations. In some countries, an array of national regulatory mechanisms, increase in MPAs, and customary management may be effective at addressing fishing of spawning aggregations. For example, the Exuma Cays Land and Sea Park (Bahamas), has been closed to fishing for over 25 years and protects both nursery and adult habitat for Nassau grouper and other marine species, such as queen conch, spiny lobster and marine turtles. There is a clear difference in the number, biomass, and size of all large grouper species between fished and non-fished areas (Sluka et al. 1996).

We note, however, that many relevant countries have few, if any, Nassau grouper-specific regulations. Instead they rely on general fisheries regulations (e.g., Anguilla, Antigua-Barbuda, Colombia, and Cuba all rely on size limits as their only regulations and they are inadequate, while Guadeloupe and Martinique, Honduras, Jamaica, Mexico, St. Lucia, and the Turks and Caicos rely on a variety of general fishing regulations). Additionally, where regulations do exist, the ERAG indicated that law enforcement was insufficient, thus rendering the regulations ineffective.

Further, the regulations may be ephemeral, unprotective of migrating adults, or inadequate to conserve the biological status of a species. For example, the Bahamas closed season is reconsidered annually and sometimes not implemented (we are aware of only one year the closed season has not been implemented, 2008). Regulations also do not protect all the known spawning aggregations (e.g., Belize, where 2 spawning aggregations are fished by license). No protections were found in any country for the species as they migrate to and from the spawning aggregation sites. There are exemptions for "historical," "local," or artisanal fishermen (e.g., Colombia). Finally, there are other regulations that are insufficient to protect the species (e.g., size limit in the Bahamas is 3 cm shorter than the size-at-maturity, in Cuba it is 16 cm shorter than size-at-maturity).

In some places (e.g., Bermuda), no recovery has been documented after 20 years of regulations (B. Luckhurst, Bermuda Department of Agriculture, Fisheries, and Parks, pers. comm. to Y. Sadovy, University of Hong Kong, September, 2012). In other places (e.g. Cayman Islands) there are indications of recovery at spawning aggregation sites, but fishing continues to keep the population depressed (Semmens et al. 2012). Additionally, larval recruitment is highly variable due to currents in the Caribbean basin. Some populations may receive larval input from neighboring spawning aggregations, while local circulation patterns may entrain larvae (Colin et al. 1987) making the population entirely self-recruiting.

In conclusion, the trends in the number and size of spawning aggregations indicate inadequate existing regulatory mechanisms and a lack of law enforcement leading to an increased risk of extinction for Nassau grouper.

E. Other Natural or Manmade Factors Affecting its Continued Existence

We considered climate change threats to Nassau grouper including global warming, sea level rise, and ocean acidification for Factor E. Although Nassau grouper occur across a range of temperatures, spawning occurs when sea surface temperatures range between 25°C - 26°C. Because Nassau grouper only spawn in a very narrow window of temperatures, a rise in sea surface temperature above the correct range could cause spawning to cease or force the species to shift its geographic range to find the correct temperature range. A potential effect of climate change could also be the loss of structural habitat in the coral reef ecosystems where ocean acidification is anticipated to affect the integrity of coral reefs (Munday et al. 2008). If sea level changed rapidly, coral reef depth regime may be modified with such rapidity that coral and coral reefs will be affected (Munday et al. 2008). Increased sea surface temperatures have been responsible for coral loss through bleaching and disease. Bioerosion may reduce 3-dimensional structure in affected areas (Alvarez-Filip et al. 2009), reducing adult habitat for Nassau grouper (Coleman and Koenig 2010, Rogers and Beets 2001). Increased global temperatures are also predicted to change parasite-host relationships and may present unknown concerns (Harvell et al. 2002, Marcogliese 2001). The ERAG ranking indicated that climate change was an “unknown risk” to Nassau grouper.

We also considered threats from aquaculture to Nassau grouper under Factor E. Experiments to determine the success rate of larval Nassau grouper culture (Watanabe et al. 1995a, 1995b) and survival of released hatchery-reared juveniles (Roberts et al. 1994) have been conducted and feasibility of restocking reefs has been tested (Roberts et al. 1995) in St. Thomas, U.S.V.I. The potential of Nassau grouper stock enhancement, as with any other grouper species, has yet to be determined (Roberts et al. 1995). Serious concerns about the genetic consequences of introductions and about possible problems of juvenile habitat availability, introduction of maladapted individuals, or inability to locate traditional spawning aggregations, continue to be raised. The ERAG ranking indicated that aquaculture was a "very low risk" to Nassau grouper.

The demographic factors of growth rate/productivity and diversity were also considered under Factor E. To assess these demographic factors, ERAG members considered whether the species' average population growth rate is likely to be above the population loss (either natural or anthropogenic) such that an appropriate abundance is maintained. They also considered whether the species is at risk due to a loss in the breeding population, which leads to a reduction in survival and production of eggs and offspring. The ERAG also considered whether the species exhibits trends or shifts in demographic or reproductive traits that point to a decline in population growth rate. The ERAG ranking indicated that growth rate/productivity of Nassau grouper was an "increasing risk" for the species and that diversity was a "moderate risk." We agree with these rankings and believe they are supported by the declining number and size of spawning aggregations, which affects growth rate/productivity and diversity.

Protective Efforts

Section 4(b)(1)(A) of the ESA requires the Secretary, when making a listing determination for a species, to take into consideration those efforts, if any, being made by any State or foreign nation to protect the species. In judging the efficacy of not yet implemented efforts or efforts that have been implemented, but have not yet demonstrated whether they are effective, we rely on the Services' joint "Policy for Evaluation of Conservation Efforts When Making Listing Decisions" ("PECE"; 68 FR 15100; March 28, 2003). The PECE is designed to ensure consistent and adequate evaluation on whether any conservation efforts that have been recently adopted or implemented, but not yet proven to be successful, will result in recovering the species to the point at which listing is not warranted or contribute to forming the basis for listing a species as threatened rather than endangered. The PECE is expected to facilitate the development of conservation efforts by states and other entities that sufficiently improve a species' status so as to make listing the species as threatened or endangered unnecessary.

The PECE establishes two basic criteria to use in evaluating efforts identified in conservations plans, conservation agreements, management plans or similar documents: (1) the certainty that the conservation efforts will be implemented; and (2) the certainty that the efforts will be effective. We evaluated conservation efforts to protect and recover Nassau grouper that are either underway but not yet fully implemented, or are only planned.

Conservation efforts with the potential to address threats to Nassau grouper include, but are not limited to fisheries management plans, education about overfishing and fishing of spawning aggregations, and projects addressing the health of coral reef ecosystems. These conservation efforts may be conducted by countries, states, local governments, individuals, NGOs, academic institutions, private companies, individuals, or other entities. They also include global conservation organizations that conduct coral reef and/or marine environment conservation projects, global coral reef monitoring networks and research projects, regional or global conventions, and education and outreach projects throughout the range of Nassau grouper. The Biological Report summarizes all known conservation efforts, including those that have yet to be fully implemented or have yet to demonstrate effectiveness. Conservation efforts that have yet to be fully implemented included Mexico's 2012 proposed management plan, Antigua-Barbuda's 2008 closed season proposal, and Guadeloupe and Martinique's plans to protect the species. Because these proposed plans are two to six years old with no updates or known implementation, we find that they fail to meet the PECE criterion regarding certainty of implementation. Based on Jamaica's historic overfishing and difficulty in enforcing existing regulations, we find that the marine protected areas implemented in 2011 fail to meet the second PECE criterion regarding certainty of effectiveness. All other known conservation efforts have been implemented for extended periods of time and have failed to satisfy the criteria of the PECE as evidenced by the continued decline in size and number of spawning aggregations. After taking into account these conservation efforts, our evaluation of the section 4(a)(1) factors is that the conservation efforts identified cannot be considered effective measures in reducing the current extinction risk.

Significant Portion of Range

There are two situations under which a species is eligible for listing under ESA: a species may be endangered or threatened throughout all of its range or a species may be endangered or threatened throughout only a "significant portion of its range" (SPOIR). Although the ESA does not define "SPOIR," NMFS and the U.S. Fish and Wildlife Service (USFWS) published a final policy clarifying their interpretation of this phrase (79 FR 37577; July 7, 2014). Under the policy, if a species is found to be endangered or threatened throughout only a significant portion of its range, the entire species is subject to listing and must be protected everywhere. A portion of a species' range is "significant" if "… the species is not currently endangered or threatened throughout its range, but the portion's contribution to the viability of the species is so important that, without the members in that portion, the species would be in danger of extinction, or likely to become so in the foreseeable future, throughout all of its range." Thus, if the species is found to be threatened or endangered throughout its range, we do not separately evaluate portions of the species' range.

Although the SPOIR Policy had yet to go into effect during our status review of Nassau grouper, we considered the interpretations and principles contained in the Draft Policy with regards to the Nassau grouper and completed and assessment of potential "SPOIR," which is documented in the ERAG responses. However, given our conclusion that the Nassau grouper is threatened throughout its range, under our final policy, there is no portion of the range that can be considered "significant."

Results of Extinction Risk Analysis

Based on the rankings by the ERAG, the greatest threats to Nassau grouper are historical harvest, inadequate law enforcement, and fishing of spawning aggregations, all of which were ranked as are "high risk" threats. Growth rate/productivity, spatial structure/connectivity, and foreign regulations were rated as "increasing risks," meaning they are likely to be posing only low to moderate risk to the species now but are expected to pose a high risk in the foreseeable future. Abundance, diversity, commercial harvest, artificial selection, and state and territory regulations, were rates as “moderate risks,” and thus may not contribute significantly to the extinction risk of the species now but are likely pose long term risks to the species. Habitat alteration, aquaculture, U.S. federal regulations, disease, parasites, and abnormalities were rated as “very low” to “low” risks and thus are unlikely to be affecting the species extinction risk or status.

We concur with these overall results and conclude that the “high risk” threats are driving the extinction risk for Nassau grouper. Based on the information in the Biological Report and the results from the ERAG, we conclude that the ESA Factor D, inadequacy of regulatory mechanisms, particularly in regards to fishing spawning aggregations, is contributing to an increased risk of extinction for Nassau grouper. Fishing on spawning aggregations and lack of regulatory control and law enforcement greatly reduce reproductive output, which reduces recruitment. If growth and sexual recruitment rates cannot balance the loss from mortality, populations become more vulnerable to extinction (Primack 1993).

Key Conclusions from Biological Review

The species is made up of a single population over its entire geographic range. As discussed in detail in the Biological Report and summarized above, there is no evidence to suggest the existence of genetic differences between Nassau grouper in different portions of the range. Multiple genetic analyses indicate that there is high gene flow throughout the geographic range of the Nassau grouper, and no clearly defined population substructuring has been observed. Accordingly, we conclude that the species is comprised of a single panmictic population.

The species has patchy abundance, being depleted or absent in many areas. This conclusion is based on the Biological Report, which describes the reduction in size and number of spawning aggregations throughout the range. Patchy abundance throughout the range of a species is common and due to differences in habitat quality/quantity or exploitation levels at different locations. However, for Nassau grouper, dramatic, consistent declines have been noted throughout the species range. In many areas throughout the Caribbean, the species is now commercially extinct or spawning aggregations have been extirpated with no signs of recovery.

The species possesses life history characteristics that increase vulnerability to harvest, including slow growth with late maturation, large size, formation of large spawning aggregations, and occur in shallow habitat. This conclusion is based on the Description of the Species in the Biological Report (Hill and Sadovy de Mitcheson 2013). Slow growth leading to late maturation exposes sub-adults to harvest prior to reproduction. Sub-adult and adult Nassau grouper form large conspicuous spawning aggregations. These aggregations are often in shallow habitat areas that are easily accessible to fishermen and are heavily exploited. There are existing spawning aggregations, that while reduced in size and number, still function and provide recruits to the population.

The species is broadly distributed, and its current range is similar to its historical range. This conclusion is based on the Range Wide Distribution section of the Biological Report (Hill and Sadovy de Mitcheson 2013), which concluded that available information suggests that the current range is equivalent to the historical range though abundance has been severely depleted.

Key Conclusions from Threats Evaluation

The three most important threats to Nassau grouper are spawning aggregation fishing, historical harvest, and lack of law enforcement. These three threats were rated as "high risk" threats to the species by the ERAG. Growth rate/productivity, spatial structure/connectivity, and foreign regulations are "increasing risks." Abundance, diversity, commercial harvest, artificial selection, and state and territory regulations are "moderate risks." Habitat alteration, aquaculture, U.S. federal regulations, and disease, parasites, and abnormalities are "very low" to "low" risk.

Existing regulatory mechanisms are insufficient in addressing the most serious threat to Nassau grouper. As discussed above in the "Overall Conclusions Regarding Inadequacy of Existing Regulatory Mechanisms," national and/or local laws and regulations are not addressing the most important threat, fishing spawning aggregations, to an acceptable extent. Because of the inadequacy of regulatory mechanisms (Factor D), Nassau grouper are at an increased risk of extinction.

Conclusion

Based on the key conclusions from the Biological Report and the Extinction Risk Analysis, we summarize the results of our comprehensive status review as follows: (1) The species is made up of a single population over a broad geographic range, and its current range is indistinguishable from its historical range; (2) the species possesses life history characteristics that increase vulnerability to harvest; (3) spawning aggregations are declining in size and number across the species' range; (4) existing regulatory mechanisms and a lack of law enforcement throughout the species' range are not effective in addressing fishing spawning aggregations; and (5) the combination of life history characteristics and existing regulatory mechanisms indicate that the species is not currently in danger of extinction, but it is likely to become in danger of extinction in the foreseeable future.

Based on these results, we conclude that the Nassau grouper is not currently in danger of extinction throughout its range, but is likely to become in danger of extinction throughout its range within the foreseeable future. Accordingly, we find that the species meets the definition of threatened and propose to list it as threatened under the ESA.

Effects of Listing

Conservation measures provided for species listed as endangered or threatened under the ESA include recovery plans (16 U.S.C. 1553(f)), critical habitat designations, Federal agency consultation requirements (16 U.S.C. 1536), and prohibitions on taking (16 U.S.C. 1538). Recognition of the species' status through listing promotes conservation actions by Federal and state agencies, private groups, and individuals, as well as the international community. Should the proposed listing be made final, a recovery program could be implemented, and critical habitat will be designated to the maximum extent prudent and determinable. We anticipate that protective regulations for Nassau grouper may need to be developed in the context of conserving aquatic ecosystem health. Federal, state, and the private sectors will need to cooperate to conserve listed Nassau grouper and the ecosystems upon which they depend.

Identifying ESA Section 7 Consultation Requirements

Section 7(a)(4) of the ESA and NMFS/USFWS regulations require Federal agencies to confer with us on actions likely to jeopardize the continued existence of species proposed for listing, or likely to result in the destruction or adverse modification of proposed critical habitat. If a proposed species is ultimately listed, Federal agencies must consult under section 7 on any action they authorize, fund, or carry out if those actions may affect the listed species or designated critical habitat. Based on currently available information, we can conclude that examples of Federal actions that may affect Nassau grouper include, but are not limited to: artificial reef creation, dredging, pile-driving, military activities, and fisheries management practices.

Critical Habitat

Critical habitat is defined in section 3 of the ESA (16 U.S.C. 1532(5)) as: (1) the specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the ESA, on which are found those physical or biological features (a) essential to the conservation of the species and (b) 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 that such areas are essential for the conservation of the species. "Conservation" means the use of all methods and procedures needed to bring the species to the point at which listing under the ESA is no longer necessary. Regulations require that we shall designate critical habitat in areas outside the geographical area presently occupied by a species only when a designation limited to its present range would be inadequate to ensure the conservation of the species (50 CFR 424.12 (e)). Critical habitat cannot be designated within foreign countries or in other areas outside of United States jurisdiction (50 CFR 424.12(h)).

Section 4(a)(3)(A) of the ESA (16 U.S.C. 1533(a)(3)(A)) requires that, to the extent prudent and determinable, critical habitat be designated concurrently with the listing of a species. To the maximum extent prudent and determinable, we will publish a proposed designation of critical habitat for Nassau grouper in a separate rule. Designations of critical habitat must be based on the best scientific data available and must take into consideration the economic, national security, and other relevant impacts of specifying any particular area as critical habitat. Once critical habitat is designated, section 7 of the ESA requires Federal agencies to ensure that they do not fund, authorize, or carry out any actions that are likely to destroy or adversely modify that habitat. This requirement is in addition to the section 7 requirement that Federal agencies ensure that their actions do not jeopardize the continued existence of listed species.

Identification of Those Activities That Would Constitute a Violation of Section 9 of the ESA

Because we are proposing to list Nassau grouper as threatened, the ESA section 9 prohibitions do not automatically apply. Therefore, pursuant to ESA section 4(d), we will evaluate whether there are protective regulations we deem necessary and advisable for the conservation of Nassau grouper, including application of some or all of the take prohibitions. If protective regulations are deemed necessary, a proposed 4(d) rule would be subject to public comment.

Peer Review

In December 2004, the Office of Management and Budget (OMB) issued a Final Information Quality Bulletin for Peer Review establishing minimum peer review standards, a transparent process for public disclosure of peer review planning, and opportunities for public participation. The OMB Bulletin, implemented under the Information Quality Act (Public Law 106-554) is intended to enhance the quality and credibility of the Federal government's scientific information, and applies to influential or highly influential scientific information disseminated on or after June 16, 2005. To satisfy our requirements under the OMB Bulletin, we obtained independent peer review of the Biological Report. Five independent specialists were selected from the academic and scientific community, Federal and state agencies, and the private sector for this review (with three respondents). All peer reviewer comments were addressed prior to dissemination of the final Biological Report and publication of this proposed rule.

References

A complete list of the references used in this proposed rule is available upon request (see ADDRESSES).

Classifications

National Environmental Policy Act

The 1982 amendments to the ESA, in section 4(b)(1)(A), restrict the information that may be considered when assessing species for listing. Based on this limitation of criteria for a listing decision and the opinion in Pacific Legal Foundation v. Andrus, 675 F. 2d 825 (6th Cir. 1981), NMFS has concluded that ESA listing actions are not subject to the environmental assessment requirements of the National Environmental Policy Act (See NOAA Administrative Order 216-6).

Executive Order 12866, Regulatory Flexibility Act and Paperwork Reduction Act

As noted in the Conference Report on the 1982 amendments to the ESA, economic impacts cannot be considered when assessing the status of a species.

Therefore, the economic analysis requirements of the Regulatory Flexibility Act are not applicable to the listing process. In addition, this proposed rule is exempt from review under Executive Order 12866. This proposed rule does not contain a collection-of-information requirement for the purposes of the Paperwork Reduction Act.

Federalism

In keeping with the intent of the Administration and Congress to provide continuing and meaningful dialogue on issues of mutual state and Federal interest, this proposed rule will be given to the relevant governmental agencies in the countries in which the species occurs, and they will be invited to comment. NMFS will confer with U.S. Department of State to ensure appropriate notice is given to foreign nations within the range of the species. As the process continues, NMFS intends to continue engaging in informal and formal contacts with the U.S. State Department, giving careful consideration to all written and oral comments received.

Public Comments Solicited

NMFS intends that any final action resulting from this proposal will be as accurate as possible and informed by the best available scientific and commercial information. Therefore, NMFS request comments or information from the public, other concerned governmental agencies, the scientific community, industry, or any other interested party concerning this proposed rule. NMFS particularly seek comments containing:

(1) Information concerning the location(s) and status of any spawning aggregations of the species; and
(2) Information concerning the threats to the species; and

(3) Efforts being made to protect the species throughout its current range.

Public hearing requests must be requested by [insert date 45 days after publication in the FEDERAL REGISTER].

List of Subjects in 50 CFR Part 224

Administrative practice and procedure, Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

Dated: August 22, 2014.

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Samuel D. Rauch III,
Deputy Assistant Administrator for Regulatory Programs,
National Marine Fisheries Service.

For the reasons set out in the preamble, we propose to amend 50 CFR Chapter II part 223 as follows:

PART 223—THREATENED MARINE AND ANADROMOUS SPECIES

1. The authority citation for part 223 continues to read as follows:

Authority: 16 U.S.C. 1531-1543; subpart B, § 223.201-202 also issued under 16 U.S.C. 1361 et seq.; 16 U.S.C. 5503(d) for § 223.206(d)(9).

2. In § 223.102, amend the table in paragraph (e) by adding new entry "Grouper, Nassau" in alphabetical order under the "Fishes" table subheading to read as follows:

§ 223.102 Enumeration of threatened marine and anadromous species.

* * * * *

(e) The threatened species under the jurisdiction of the Secretary of Commerce are:

Species[1]			Citation(s) for listing determination(s)	Critical habitat	ESA rules
Common name	Scientific name	Description of listed entity			
* * * * * * *					
Fishes					
* * * * * * *					
Grouper, Nassau	Epinephelus striatus	Entire species	[Insert FEDERAL REGISTER citation and date when published as a final rule]	NA	NA
		* * * * * * *			

[1]Species includes taxonomic species, subspecies, distinct population segments (DPSs) (for a policy statement, see 61 FR 4722, February 7, 1996), and evolutionarily significant units (ESUs) (for a policy statement, see 56 FR 58612, November 20, 1991).

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[FR Doc. 2014-20811 Filed 08/29/2014 at 8:45 am; Publication Date: 09/02/2014]