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DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

 [Docket No. 150114043-5407-01]

RIN 0648-XD722

Endangered and Threatened Wildlife and Plants: Notice of 12-Month Finding

on a Petition to List the Undulate Ray and the Greenback Parrotfish as Threatened or

Endangered Under the Endangered Species Act (ESA)

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and

Atmospheric Administration (NOAA), Commerce.

ACTION: Status review; notice of finding.

SUMMARY: We, NMFS, have completed comprehensive status reviews under the

Endangered Species Act (ESA) for two foreign marine species in response to a petition to

list those species. These species are the undulate ray (*Raja undulata*) and the greenback

parrotfish (*Scarus trispinosus*). We have determined that, based on the best scientific and

commercial data available, listing the undulate ray under the ESA is not warranted and

listing the greenback parrotfish under the ESA is not warranted. We conclude that the

undulate ray and the greenback parrotfish are not currently in danger of extinction

throughout all or a significant portion of their respective ranges and are not likely to

become so within the foreseeable future.

DATES: The finding announced in this notice was made on [**INSERT DATE OF

PUBLICATION IN THE FEDERAL REGISTER**].

ADDRESSES: You can obtain the petition, status review reports, the 12-month finding, and the list of references electronically on our NMFS website at *http://www.nmfs.noaa.gov/pr/species/petition81.htm*.

FOR FURTHER INFORMATION CONTACT: Ronald Salz, NMFS, Office of Protected Resources (OPR), (301) 427-8171.

SUPPLEMENTARY INFORMATION:

Background

On July 15, 2013, we received a petition from WildEarth Guardians to list 81 marine species or subpopulations as threatened or endangered under the Endangered Species Act (ESA). This petition included species from many different taxonomic groups, and we prepared our 90-day findings in batches by taxonomic group. We found that the petitioned actions may be warranted for 24 of the species and 3 of the subpopulations and announced the initiation of status reviews for each of the 24 species and 3 subpopulations (78 FR 63941, October 25, 2013; 78 FR 66675, November 6, 2013; 78 FR 69376, November 19, 2013; 79 FR 9880, February 21, 2014; and 79 FR 10104, February 24, 2014). This document addresses the 12-month findings for two of these species: undulate ray (*Raja undulata*) and greenback parrotfish (*Scarus trispinosus*). Findings for seven additional species and two subpopulations can be found at 79 FR 74853 (December 16, 2014), 80 FR 11363 (March 3, 2015), and 80 FR 15557 (March 24, 2015). The remaining 15 species and one subpopulation will be addressed in subsequent findings.

We are responsible for determining whether species are threatened or endangered under the ESA (16 U.S.C. 1531 *et seq.*). To make this determination, we consider first

whether a group of organisms constitutes a "species" under the ESA, then whether the status of the species qualifies it for listing as either threatened or endangered. Section 3 of the ESA defines a "species" to include "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." On February 7, 1996, NMFS and the U.S. Fish and Wildlife Service (USFWS; together, the Services) adopted a policy describing what constitutes a distinct population segment (DPS) of a taxonomic species (the DPS Policy; 61 FR 4722). The DPS Policy identified two elements that must be considered when identifying a DPS: (1) the discreteness of the population segment in relation to the remainder of the species (or subspecies) to which it belongs; and (2) the significance of the population segment to the remainder of the species (or subspecies) to which it belongs. As stated in the DPS Policy, Congress expressed its expectation that the Services would exercise authority with regard to DPSs sparingly and only when the biological evidence indicates such action is warranted. Based on the scientific information available, we determined that the undulate ray (*Raja undulata*) and the greenback parrotfish (*Scarus trispinosus*) are both "species" under the ESA. There is nothing in the scientific literature indicating that either of these species should be further divided into subspecies or DPSs.

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." We interpret an "endangered species" to be one that is presently in danger of extinction. A "threatened species," on the other hand, is not presently in danger of extinction, but is likely to become so in the

foreseeable future. In other words, the primary 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).

When we consider whether a species might qualify as threatened under the ESA, we must consider the meaning of the term "foreseeable future." It is appropriate to interpret "foreseeable future" as the horizon over which predictions about the conservation status of the species can be reasonably relied upon. The foreseeable future considers the life history of the species, habitat characteristics, availability of data, particular threats, ability to predict threats, and the reliability to forecast the effects of these threats and future events on the status of the species under consideration. Because a species may be susceptible to a variety of threats for which different data are available, or which operate across different time scales, the foreseeable future is not necessarily reducible to a particular number of years. In determining an appropriate "foreseeable future" timeframe for the undulate ray and the greenback parrotfish, we considered both the life history of the species and whether we could project the impact of threats or risk factors through time. For the undulate ray, we could not define a specific number of years as the "foreseeable future" due to uncertainty regarding life history parameters of, and threats to, the species. For the greenback parrotfish, the foreseeable future was defined as approximately 40 years, based on this species' relatively long life span (estimated at 23 years [Previero, 2014a]), which means threats can have long-lasting impacts.

On July 1, 2014, NMFS and USFWS published a policy to clarify the interpretation of the phrase "significant portion of its range" (SPR) in the ESA definitions of "threatened" and "endangered" (the SPR Policy; 76 FR 37578). Under this policy, the

phrase "significant portion of its range" provides an independent basis for listing a species under the ESA. In other words, a species would qualify for listing if it is determined to be endangered or threatened throughout all of its range or if it is determined to be endangered or threatened throughout a significant portion of its range. The policy consists of the following four components:

(1) If a species is found to be endangered or threatened in only an SPR, the entire species is listed as endangered or threatened, respectively, and the ESA's protections apply across the species' entire range.

(2) A portion of the range of a species is "significant" if its contribution to the viability of the species is so important that, without that portion, the species would be in danger of extinction or likely to become so in the foreseeable future, throughout all of its range.

(3) The range of a species is considered to be the general geographical area within which that species can be found at the time USFWS or NMFS makes any particular status determination. This range includes those areas used throughout all or part of the species' life cycle, even if they are not used regularly (*e.g.,* seasonal habitats). Lost historical range is relevant to the analysis of the status of the species, but it cannot constitute an SPR.

(4) If a species is not endangered or threatened throughout all of its range but is endangered or threatened within an SPR, and the population in that significant portion is a valid DPS, we will list the DPS rather than the entire taxonomic species or subspecies.

We considered this policy in evaluating whether to list the undulate ray and greenback parrotfish as endangered or threatened under the ESA.

Section 4(a)(1) of the ESA requires us to determine whether any species is endangered or threatened due to any one or a combination of the following five threat factors: the present or threatened destruction, modification, or curtailment of its habitat or range; overutilization for commercial, recreational, scientific, or educational purposes; disease or predation; the inadequacy of existing regulatory mechanisms; or other natural or manmade factors affecting its continued existence. We are also required to make listing determinations based solely on the best scientific and commercial data available, after conducting a review of the species' status and after taking into account efforts being made by any state or foreign nation to protect the species.

In assessing extinction risk of these two species, we considered the demographic viability factors developed by McElhany *et al.* (2000) and the risk matrix approach developed by Wainwright and Kope (1999) to organize and summarize extinction risk considerations. The approach of considering demographic risk factors to help frame the consideration of extinction risk has been used in many of our status reviews (see *http://www.nmfs.noaa.gov/pr/species* for links to these reviews). In this approach, the collective condition of individual populations is considered at the species level according to four demographic viability factors: abundance, growth rate/productivity, spatial structure/connectivity, and diversity. These viability factors reflect concepts that are well-founded in conservation biology and that individually and collectively provide strong indicators of extinction risk.

Scientific conclusions about the overall risk of extinction faced by the undulate ray and greenback parrotfish under present conditions and in the foreseeable future are based on our evaluation of the species' demographic risks and section 4(a)(1) threat

factors. Assessment of overall extinction risk considered the likelihood and contribution of each particular factor, synergies among contributing factors, and the cumulative impact of all demographic risks and threats on the species.

Status reviews for the undulate ray and the greenback parrotfish were conducted by NMFS OPR staff. In order to complete the status reviews, we compiled information on the species' biology, ecology, life history, threats, and conservation status from information contained in the petition, our files, a comprehensive literature search, and consultation with experts. We also considered information submitted by the public in response to our petition findings. Draft status review reports were also submitted to independent peer reviewers; comments and information received from peer reviewers were addressed and incorporated as appropriate before finalizing the draft reports. The undulate ray and greenback parrotfish status review reports are available on our website (see **ADDRESSES** section). Below we summarize information from these reports and the status of each species.

Status Reviews

Undulate Ray

The following section describes our analysis of the status of the undulate ray, *Raja undulata*.

Species Description

The undulate ray, *Raja undulata*, is a member of the Family Rajidae whose origin is from the Late Cretaceous period, about 100 to 66 million years ago. Species diversification within the Family Rajidae occurred 15 to 2 million years ago in the northeast Atlantic and Mediterranean, where undulate rays exist today (Valsecchi *et al.*,

2004). The undulate ray is part of the Rajini tribe, which is a taxonomic category above the genus and below the family level. The Rajini tribe is defined by two morphological characteristics: (1) disc free of denticles, and (2) crowns of alar thorns (sharp-pointed, recurved thorns located on the outer aspect of pectoral fins of mature males) with barbs (McEachran and Dunn, 1998).

The undulate ray gets its name from the leading edge of the disc, which undulates from the snout to the wingtips during movement. Its dorsal color ranges from almost black to light yellow-brown interspersed with dark wavy bands lined by a twin row of white spots, which may camouflage them against the seabed. The underbelly is white with dark margins. The dorsal fins are widely spaced, normally with two dorsal spines between them. The undulate ray is relatively large, reaching 114 cm in total length (TL) as an adult (Ellis *et al.*, 2012).

Growth rates, size and age at maturity, and seasonal patterns of reproduction in undulate rays were determined from individuals taken from trammel nets, beach seines, and fish markets in Portugal (Coelho and Erzini, 2002; Coelho and Erzini, 2006; Moura *et al.*, 2007). The undulate ray exhibits rapid growth in the first year, but overall has a slower growth rate compared to most species of *Raja* (n = 187; Von Bertalanffy growth $L\infty = 110.22$ cm, $K = 0.11$ per year and $t_0 = -1.58$ year) (Coelho and Erzini, 2002). Females appear to become sexually mature later in life and at a larger body size than males (Coelho and Erzini, 2006; Moura *et al.*, 2007; Serra-Pereira *et al.*, 2013). In the Algarve estuary along the south coast of Portugal, the mean age and body size at which half of the females became sexually mature was 8.98 years and 76.2 cm TL. Half of the males became sexually mature at 7.66 years and a body size of 73.6 cm TL (Coelho and

Erzini, 2006). This means that half of the females in the Algarve estuary became mature at 86.3 percent of their maximum size and 69.1 percent at their maximum age and half of the males became mature at 88.5 percent of maximum size and 63.8 percent at maximum age. This makes the undulate ray, at least for this study area, a late maturing species (Coelho and Erzini, 2006). Moura *et al.* (2007) found slightly larger values for length at maturity for both females (83.8 cm TL) and males (78.1 cm TL) in the Peniche region on the central coast of Portugal, which may indicate two different populations of the undulate ray exist on the Portuguese continental shelf (Moura *et al.*, 2007). However, low sample sizes and different survey methods may account for the differences found between the study areas (Ellis, CEFAS, 2014 personal communication). Stéphan *et al.* (2013) reported the minimum length at maturity for males captured in the English Channel and Bay of Biscay was 74 cm TL, with 50 percent of the sample (n = 191) reaching maturity at 80 cm TL.

Estimated generation length (the age at which half of total reproductive output is achieved by an individual) for this species varies from 14.9 to 15.9 years in females and from 14.3 to 15.3 years in males (Coelho *et al.*, 2009). Based on an analysis of vertebral band deposits of 187 undulate rays caught in commercial fisheries in the Algarve estuary, the oldest individuals were estimated to be 13 years old, but overall longevity for this species has been estimated to be around 21-23 years (Coelho *et al.*, 2002).

The undulate ray is a seasonal breeder; however, temporal differences in breeding season were found between nursery areas (Moura *et al.*, 2007). Individuals from the Algarve region in south Portugal were found to breed only in the winter (Coelho and Erzini, 2006), those from Peniche in central Portugal were found to breed from February

through May (Moura *et al.*, 2007; Serra-Pereira *et al.*, 2013), and in Portugal's north central coast, breeding occurred from December through June (Serra-Pereira *et al.*, 2013). Water temperatures in the Peniche region are colder than those in the Algarve, which may explain the longer breeding season observed there (Moura *et al.*, 2007).

The undulate ray is oviparous, in that the fertilized egg, which is encased in an egg capsule, hatches outside of the parental body (Moura *et al.*, 2008). Egg cases measure 70-90 mm long and 45-60 mm wide. Typical reproductive output is unknown; however, one female was observed to lay 88 egg cases over 52 days and the incubation period was 91 days (Shark Trust, 2009). In general, Rajidae exhibit protracted incubation times ranging from 4 to 15 months (Serra-Pereira *et al.*, 2011).

Information on sex ratios in the population is sparse, but appears to indicate a slight female bias in some areas and significant male bias in other areas. In the eastern English Channel, individuals collected in bottom trawl surveys were slightly female-biased at 57 percent female and 43 percent male (Martin *et al.*, 2010). Undulate rays caught in the Bay of Biscay, France, by fishermen, fishing guides, and scientists were generally 48 to 95 cm in total length and the sex ratio was 54 percent female and 46 percent male (Delamare *et al.*, 2013). Other studies have found a preponderance of males. During three gillnet fisheries trips in May 2010 and two trips in February-March 2011 off the Isle of Wight in the English Channel, the ratio of females to males was 1:4.5 and 1:6.0, respectively, and all were mature adults (Ellis *et al.*, 2012).

Undulate ray habitat in the northeastern Atlantic Ocean includes sandy and coarse bottoms from the shoreline to no deeper than 200 m, but undulate rays are generally found in waters less than 50 m deep (Saldnaha, 1997 as cited in Coelho and Erzini, 2006;

Martin *et al.*, 2010; Martin *et al.*, 2012; Ellis *et al.*, 2012). Undulate rays, especially juveniles, inhabit inshore waters, including lagoons, bays, rias (defined as a coastal inlet formed by the partial submergence of a river valley that is not covered in glaciers and remains open to the sea), and outer parts of estuaries (Ellis *et al.*, 2012).

The English Channel provides important habitat for the undulate ray (Martin *et al.*, 2010; Martin *et al.*, 2012). The main predictors of elasmobranch habitat in the English Channel were depth, bed shear stress (an estimate of the pressure exerted across the seabed by tidal forcing), and stability, followed by seabed sediment type and temperature (Martin *et al.*, 2010). The undulate ray was found more frequently in the western area of the English Channel, particularly in the area between the Cherbourg Peninsula and Isle of Wight, where the seabed is hard (pebble) and tidal currents strong. However, the species was also reported in patches of lower density in some shallower coastal waters in the eastern part of the English Channel (Martin *et al.*, 2010; Martin *et al.*, 2012). Based on counts of egg cases recorded on beaches along the south coast of England, areas to the west and east of the Isle of Wight may be important nursery areas for the undulate ray (Dorset Wildlife Trust, 2010).

The Gironde estuary of France provides important sand and mud bottom habitat for the undulate ray (Lobry *et al.*, 2003). Tides are strong within the estuary (average flow volume between 800 and 1,000 m^3/s) and turbidity is high, frequently exceeding 400 mg/L. The undulate ray is one of the most common species found in the coastal waters of the Tagus estuary in the central and west coast of Portugal (Prista *et al.*, 2003). About 60 percent of the estuary is exposed at low tide, revealing soft bottom habitat. However,

specific data are lacking on the undulate ray's distribution and association with specific habitat within the estuary.

In waters off Portugal, the undulate ray diet changed as individuals grew and matured. Smaller individuals had a generalized diet, consuming a variety of semi-pelagic and benthic prey, including shrimps and mysids. However, larger undulate rays began to specialize on the brachyuran crab, *Polybius henslowi*, with the largest undulate rays eating this prey item almost exclusively (Moura *et al.*, 2008). The shift in diet from semi-pelagic and benthic species to primarily benthic crabs occurred at 55 cm TL, and the shift from more generalized to specialized diet occurred at 75 cm TL. The first shift may be due to juveniles migrating from nursery to foraging habitat, and the second shift may be related to the onset of maturity (Moura *et al.*, 2008).

Population Abundance, Distribution, and Structure

The undulate ray occurs on the continental shelf of the northeast Atlantic Ocean, ranging in the north from southwest Ireland and the English Channel, south to northwest Africa, west to the Canary Islands, and east into the Mediterranean Sea (Serena, 2005; Coelho and Erzini, 2006; Ellis *et al.*, 2012). The undulate ray exhibits a patchy distribution throughout its range. According to ICES (2008), the patchy distribution of the undulate ray may have existed as far back as the 1800s. It is locally abundant at sites in the central English Channel, Ireland, France, Spain, and Portugal (Ellis *et al.*, 2012). Within the Mediterranean Sea, occasional records occur off Israel and Turkey, but they are mainly recorded from the western region off southern France and the Tyrrhenian Sea (Serena, 2005; Ellis *et al.* 2012). In 2001, a few specimens were recorded in bottom trawl hauls on the continental shelf of the Balearic Islands off the Iberian Peninsula (western

Mediterranean) (Massutí and Moranta, 2003; Massutí and Reñones, 2005). Specimens have also been reported in the southern North Sea and Bristol Channel, but these areas are outside the normal distribution range (Ellis *et al.*, 2012).

Few data exist regarding undulate ray population structure. Tagging studies were conducted in French waters from 2012 through 2014 to determine population structuring of the undulate ray in the English Channel, central Bay of Biscay, Iroise Sea, South Brittany, and Morocco, North Africa (Delamare *et al.*, 2013). Preliminary data from the Bay of Biscay and western English Channel indicate undulate rays do not migrate great distances. In the central Bay of Biscay, 1,700 undulate rays were tagged from April 2012 through May 2013. Of the rays tagged, 98 were recaptured within 450 days of tagging, mainly within 30 km of the tagging location; about two-thirds were recaptured within 10 km, indicating high site fidelity. The number of days between capture and recapture did not affect the distances between the two points, also supporting high site fidelity (Delamare *et al.*, 2013). The central part of the Bay of Biscay may host a closed population exhibiting a small degree of emigration and immigration (Delamare *et al.*, 2013). Mark and recapture studies in the western English Channel around the Island of Jersey also indicate high site fidelity (Ellis *et al.*, 2011). Discrete populations may also occur in the bays of southwest Ireland (ICES, 2007; ICES, 2013).

The ICES Working Group on Elasmobranch Fishes (2013) recommended the species be managed as five separate stocks: (1) English Channel; (2) southwest Ireland; (3) Bay of Biscay; (4) Cantabrian Sea; and (5) Galicia and Portugal. However, the recommendation was based only on the species' patchy distribution and not direct

evidence of population structure. Data are lacking on population structure based on behavioral, morphological, and genetic characteristics.

Determining population size or trends is difficult due to the patchy distribution of the species, variable survey effort and survey methods over time, inconsistent metrics for reporting abundance, temporally limited (less than 20 years) data sets, and species misidentification. Prior to 2009, the undulate ray was often classified at a higher taxonomic level, i.e. miscellaneous rays and skates (LeBlanc *et al.*, 2013); thus, the species was an unknown percentage of a larger sample and was likely underrepresented in the landings data. Trends based on fisheries landings have limited utility in understanding true population trends. Restrictions and catch limits have been implemented for the undulate ray at least since 2009; thus, any reported decline in recent species-specific landings may be more reflective of changes in fisheries practices, effort, and regulations rather than changes in species abundance (see Ellis *et al.*, 2010).

Fisheries-independent bottom trawl surveys were conducted in the eastern English Channel each October from 1988 through 2008 (Martin *et al.*, 2010; Martin *et al.*, 2012). During this period 1,800 hauls were made and 16 different elasmobranch species were captured. The undulate ray was the eighth most abundant elasmobranch in terms of individuals caught and percent total biomass (Martin *et al.*, 2010). Mean densities of undulate ray fluctuated dramatically from 1988 through 2008, and no trend could be detected. The undulate ray was present in 3.8 percent of the fisheries-independent bottom trawl survey hauls from 1988 – 1996 and 3.8 percent of hauls from 1997 - 2008, indicating stability in presence in the area (Martin *et al.*, 2010).

Fisheries-independent beam trawl surveys have been conducted in the eastern and western English Channel each year since 1989. In the eastern English Channel survey, undulate ray catch rates were generally low and variable, partly due to its patchy distribution. For the period 1993-2013, mean number of individuals caught per hour of survey effort ranged from a low of zero (in 2006 and 2007) to between 0.25 and 0.30 (in 1996, 2009, 2012-2013)(ICES, 2014a). In the western English Channel beam trawl survey, undulate ray catch rates were also generally low and variable from 1989-2011 (Burt *et al.*, 2013), with an apparent decreasing trend after 2004. Mean relative abundance was zero in 6 out of 7 years from 2005-2011. However, preliminary results from surveys conducted in 2012-2013 of fishermen operating in the western English Channel indicate that the undulate ray is a main species caught, representing approximately 75 percent of the ray catch in trawl, dredge, gillnet, and longline gear (LeBlanc *et al.*, 2013). The English Channel undulate ray stock status was considered uncertain and classified by ICES as a "data-limited stock" with a precautionary margin of 20 percent recommended for fishery management (ICES, 2012). The "precautionary margin" is a 20 percent reduction to catch advice that serves as a buffer when reference points for stock size or exploitation (e.g., maximum sustainable yield) are unknown (ICES, 2012).

In the southern region of the North Sea, the undulate ray may be a rare vagrant, but it is absent further north (Ellis *et al.*, 2005). From 1990-1995, beam trawl surveys conducted in coastal waters of the eastern North Sea, English Channel, Bristol Channel, and Irish Sea indicated that the undulate ray was the least common of seven ray species collected (Rogers *et al.*, 1998a). Overall abundance in the British Isles was low (<8

individuals per hour per ICES survey area) (Ellis *et al.*, 2005). The undulate ray was reported in trawl surveys conducted from 1973 to 1997 along the south coasts of England (0.003 individuals per 1000 m^2), but is absent from other parts of the survey grid (Rogers and Millner, 1996; Rogers *et al.*, 1998b). Juveniles were infrequent catches in the surveys (Rogers *et al.*, 1998b). Cooler water temperatures may explain the absence of the undulate ray in sampling stations along the more northern coast of England (Rogers and Millner, 1996).

Catch of undulate ray was reported by two charter vessels from Tralee Bay, southwestern Ireland, for the years 1981 through 2005 (ICES, 2007). Although effort data were not reported, the overall catch trend suggests a decline in abundance. Undulate ray catch was at a high of 80-100 fish per year in the first 2 years of reporting (1980-1981), declined to 20-30 fish per year by the mid-1990s, increased to about 40-60 fish per year at the turn of the century, and declined again from 2001 through 2005, although catches fluctuated each year (ICES, 2007). Tag and release data collected in the recreational fishery throughout southwestern Ireland, including Tralee Bay, from 1972-2014 indicate a decline since the 1970s, but potential changes in fishing effort were not provided (ICES, 2014b).

The Tagus estuary, in the central and west coast of Portugal, was surveyed between 1979 and 1981 and from 1995 through 1997 to determine fish abundance and diversity (Cabral *et al.*, 2001). The undulate ray was a common species, usually in the top 3 to 5 most common species found in the surveys over time. Mean density was similar or even slightly increased over the sampling period (less than 0.01/1,000 m^2 in 1979 and 1995; 0.01/1,000 m^2 in 1996; 0.03/1,000 m^2 in 1997) (Cabral *et al.*, 2001). More recent

data reflecting the current status of the undulate ray in the Tagus estuary were not available.

French landings data on the undulate ray for the Celtic Sea from 1995-2001 show a declining trend from a high of 12 t in 1995 to a low of 0 t in 2000 and 2001 (ICES, 2007). However, not all French fisheries reported skate landings at the species level. In coastal waters off Spain, based on bycatch data from artisanal fisheries, there is no evidence of a decreasing trend in undulate ray abundance (Bañon *et al.*, 2008 as cited in ICES, 2010). Data on undulate ray abundance and trends in the western Mediterranean Sea and northwest coast of Africa were not available.

Summary of Factors Affecting the Undulate Ray

Available information regarding current, historical, and potential future threats to the undulate ray was thoroughly reviewed (Conant, 2015). We summarize information regarding threats below according to the factors specified in section 4(a)(1) of the ESA. There is very little information available on the impact of "Disease or Predation" or "Other Natural or Manmade Factors" on undulate ray survival. These subjects are data poor, but there are no serious or known concerns raised under these threat categories with respect to undulate ray extinction risk; therefore, we do not discuss these further here. See Conant (2015) for additional discussion of all ESA section 4(a)(1) threat categories.

Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range

Data are limited on the undulate ray's habitat, and a comprehensive review of the habitat characteristics that are important to the undulate ray, and anthropogenic impacts on undulate ray habitat are not available. Thus, the following section summarizes available data by region on any habitat impacts, if known.

The Tagus estuary in Portugal has been subjected to industrial development and urbanization (Cabral *et al.*, 2001). Lisbon, which is on the Tagus River and estuary, has experienced dramatic increases in human population growth since the early 1900s. In 2000, the human population living along the coast of the estuary was estimated at 2 million, which has resulted in high pollution loads in the estuary and poor water quality (Cabral *et al.*, 2001). The Tagus estuary is one of the largest and most contaminated by anthropogenic mercury in Europe. When released to the water column mercury can accumulate in aquatic organisms, causing contamination within the food chain. Accumulation of metals has been documented in other species, such as the European eel (*Anguilla anguilla*), that were collected from the Tagus estuary (Neto *et al.*, 2011). However, data are lacking on specific contaminant loads and effects on the undulate ray. In fact, abundance data in the Tagus estuary reported by Cabral *et al.* (2001) indicate that the undulate ray density slightly increased between 1979 and 1997.

The Gironde estuary is considered somewhat pristine and has relatively fewer phosphates and nitrogen content compared to other estuaries in France, such as the Seine, Loire, and Rhône (Mauvais and Guillaud, 1994 cited in Lobry *et al.*, 2003). However, human impacts have been documented for the estuary, including contamination, nitrogen loads, and hypoxic conditions from upland activities (Dauvin, 2008).

The English Channel, and its local biodiversity, are also subject to numerous anthropogenic impacts, including shipping, aggregate extraction, aquaculture, and eutrophication (Dauvin, 2008; Martin *et al.*, 2010; Martin *et al.*, 2012). Maritime traffic in the English Channel is intense, with up to 600 vessels passing through the Dover

Straits each day. Transportation of oil is a major component of the shipping industry in the English Channel.

Major oil spills have occurred in European seas, including off the Brittany coast of France, Cornwall coast of England, and Galician coast of Spain (Dauvin, 2008). In 2002, a spill of over 50,000 tons of heavy oil occurred 250 miles from Spain's coast (Serrano *et al.*, 2006). The spill occurred during November, and the winter conditions dispersed and sank the oil as tar aggregates along the continental shelf. These tar aggregates were still detected on the continental shelf one month after the spill, and oil was found in zooplankton species. Serrano *et al.* (2006) sampled the area affected by the oil and compared it to pre-spill data to determine if changes in biomass and benthic diversity had occurred due to the oil spill. The undulate ray was one indicator species in the study; however, the data were aggregated across taxa. Although density of several taxa declined significantly in 2003, their density increased to pre-oil spill numbers in 2004—two years after the oil spill (Serrano *et al.*, 2006). Also, the dissimilarity in species abundance between 2002 and 2003 was not due to changes in any ray species, including the undulate ray. The study found no effect on biomass and benthic diversity due to the tar aggregation. Rather, environmental variables such as depth, season, latitude, and sediment characteristics influenced benthic community structure (Serrano *et al.*, 2006).

Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

With respect to commercial fishing, the undulate ray is mainly bycaught in demersal fisheries using trawls, trammel nets, gillnets, and longlines, but has been recorded as landings in other fisheries operating within its range (Coehlo *et al.*, 2009). Landings data are generally reported as a generic "skates and rays" category and are not

species specific. By the early 1900s, the UK reported general skate landings of 25,000–30,000 t per year (Ellis *et al.*, 2010). Since 1958, general skate landings have declined and have been less than 5,000 t per year since 2005 (Ellis *et al.*, 2010). Where landings are identified to the undulate ray level, recent restrictions on fisheries need to be considered in any interpretation on trends (Ellis *et al.*, 2010). In 2009 and 2010, through Council Regulation EC No 43/2009 and Council Regulation EU No 23/2010, respectively, the European Commission (EC) banned the retention of the undulate ray in the European Union (EU) by fishing vessels equipped for commercial exploitation of living aquatic resources (EC 2371/2002). Prior to the retention ban, the species was a relatively common commercial fish caught in the northeast Atlantic and Mediterranean bays and estuaries (Costa *et al.*, 2002). In the two years preceding the 2009 retention ban on undulate rays, 60-100 t per year were landed in the Bay of Biscay off the coast of France (Hennache, 2012 cited in Delamare *et al.*, 2013). French landings data on the undulate ray for the Celtic Seas were 12 t in 1995, 6 t in 1996, 10 t in 1997, after which landings fell to 2 t in 1998, 1 t in 1999, and 0 t in 2000-2006 (ICES, 2007), which may indicate overexploitation in this area. However, it is unknown what percentage of French fisheries reported skate landings to the species level. French landings data of Rajidae from 1996 to 2006 were variable with no detectable trend and ranged from 934 t in 2003 to 2,058 t in 1997 (ICES, 2007).

In Portugal, prior to the 2009 retention ban, over 90 percent of the undulate rays caught in trammel nets were retained for commercial purposes or for personal consumption (Coelho *et al.*, 2002; Coelho *et al.*, 2005; Batista *et al.*, 2009; Baeta *et al.*, 2010). The undulate ray was the most prominent elasmobranch species by weight (8.51

kg per 10 km of net), comprising almost 35 percent of the elasmobranch biomass caught in the Portuguese artisanal trammel net fishery between October 2004 and August 2005 (Baeta *et al.*, 2010). Catch per unit effort (CPUE) was highest in shallow waters (0-25 m) and slightly increased in cooler months. *Raja spp.* landings in Portuguese artisanal fisheries decreased 29.1 percent between 1988 and 2004 (Coelho *et al.*, 2009). However, landings data were not reported by species, so trends in undulate ray landings data for this area are unknown.

In the Gulf of Cadiz off Spain, the undulate ray was the fifth most common species discarded (Gonçalves *et al.*, 2007). The undulate ray is also bycaught in the Spanish demersal trawl fleet operating in the Cantabrian Sea located in the southern Bay of Biscay (ICES, 2007). However, trawling is banned in waters shallower than 100m, so much of the bycatch in the area occurs in small artisanal gillnet fisheries operating in bays or shallow waters (ICES, 2010). The undulate ray is an important species for artisanal fisheries operating in the coastal waters of Galicia, and there is no evidence of a decreasing trend in its abundance in the area (Bañon *et al.*, 2008 as cited in ICES, 2010).

In the western Mediterranean, in 2001, one undulate ray was recorded in a total of 131 bottom trawl hauls (Massutí and Moranta, 2003) and two specimens were recorded in 88 hauls (Massutí and Reñones, 2005) on the continental shelf of the Balearic Islands off the Iberian Peninsula. Landings data are not available for the northwestern coast of Africa, but the undulate ray's preference for shallow waters may render it vulnerable to intensive artisanal coastal fisheries operating in the area (Coelho *et al.*, 2009).

Inclusion of the undulate ray on the EC prohibited species list has increased commercial discarding of this species, especially in areas where it is locally common

(ICES, 2013). Data are lacking on mortality in the undulate ray as a result of discarding. Mortality may be high in skates and rays discarded from fishing gear operating offshore where soak times are relatively long (Ellis *et al.*, 2010); however, skates primarily caught in otter trawls, gillnets, and beam trawls by inshore vessels operating in areas occupied by undulate rays have shown high survival rates (Ellis, CEFAS, personal communication, 2014).

As discussed earlier, recreational catches have declined in Tralee Bay and southwestern Ireland, which may indicate overexploitation in this area, although fishing effort data are not available. The International Game Fish Association (IGFA), which has 15,000 members in over 100 countries, lists the undulate ray as a trophy fish (Shiffman *et al.*, 2014). Trophy fishing may result in catching large and fecund fish. Although the IGFA undulate ray trophy fishery is a catch and release program, some fish may die after being released (Shiffman *et al.*, 2014). Data are lacking on the number of undulate ray caught in the IGFA program and on the recreational post-release mortality of undulate rays.

In addition to commercial and recreational fishing, population abundance research involving the tagging of undulate rays could have an impact on the species. Petersen disk tags were tested for the level of mortality that may result from their use under controlled conditions in holding tanks. Two of 34 tagged rays died, most likely due to the applied tags (Delamare *et al.*, 2013). The authors stated that although the mortality is low, it is not negligible and needs to be accounted for in designing and carrying out future studies involving tags. Mark recapture studies using Petersen disk tags were conducted in 2013 in the western English Channel and Bay of Biscay. A total of 1,700 undulate rays were

tagged and released during 6 sampling trips in the Atlantic, and 224 undulate rays were tagged and released during 4 sampling in the English Channel (Stéphan *et al.*, 2013). Fisheries independent surveys generally result in low mortality of all species of rays caught (Ellis *et al.*, 2012).

Inadequacy of Existing Regulatory Mechanisms

As described above, in 2009, through Council Regulation (EC No 43/2009), and in 2010, through Council Regulation (EU No 23/2010), the EC designated the undulate ray as a prohibited species that could not be fished, retained, transshipped or landed in the EU. Member countries of the EU include France, Spain, Portugal, UK, and Ireland--all countries where the undulate ray occurs. The justification for the ban was based largely on ICES's findings that the state of conservation in the Celtic Sea was "uncertain but with cause for concern" and recommendation of no targeted fishing for this species (ICES, 2014b). The prohibited species designations have been controversial and some EU countries have questioned the rationale behind them (ICES, 2013; ICES, 2014). In 2010, the EC asked ICES to comment on the listing of the undulate ray as a prohibited species. ICES (2010) stated that the undulate ray would be better managed under local management measures and "should not appear on the prohibited species list in either the Celtic Seas or the Biscay/Iberia ecoregion." ICES classified the undulate ray as a "data-limited stock" and recommended a precautionary approach to the exploitation of this species (ICES, 2012). In 2014, the undulate ray was removed from the prohibited species list in ICES Sub-Area VII, which includes Ireland and the English Channel (ICES, 2014b), although it remains as a species that should be returned to the water unharmed to the maximum extent practicable and cannot be landed in this area.

In England and Wales, the undulate ray is designated as a species of principal importance in conserving biodiversity under sections 41 and 42 of the Natural Environment and Rural Communities Act of 2006. Thus, England and Wales must take into consideration the undulate ray in conserving biodiversity when performing government functions such as providing funds for development.

Other fishing regulations apply generally to skates and rays. Local English and Welsh minimum landing sizes are in effect in some inshore areas (Ellis *et al.*, 2010). In 1999, a total allowable catch (TAC) set at 6,060 t was established for skates and rays in the North Sea (ICES Division IIa and sub-area IV). The TAC was reduced by 20 percent (to 4,848 t) for the period 2001–2002, and has been further reduced by between 8 percent and 25 percent in subsequent years. In 2010, the TAC was at a record low of 1,397 t (Ellis *et al.*, 2010). Other measures include bycatch quotas for skates and rays, whereby skates and rays may not exceed 25 percent live weight of the catch retained on board larger vessels. In Portugal, a maximum of 5 percent bycatch, in weight, of any skate species belonging to the Rajidae family is allowed per fishing trip (ICES, 2013). In 2011, Portugal adopted a law (Portaria No. 315/2011) that prohibits landing any Rajidae species during May within the nation's exclusive economic zone. In 1998, mesh size restrictions were implemented for fisheries targeting skates and rays (Ellis *et al.*, 2010). Other technical measures have been implemented that may benefit skate and ray populations, including height of static nets, delimitation of fishing grounds and depths, and duration of soak time (e.g., European Council Regulations EC No 3071/95, 894/97, 850/98) (Gonçalves *et al.*, 2007). Portuguese legislation limits trammel net soak times to 24

hours, unless nets are set deeper than 300m, for which the soak time can be 72 hours (Baeta *et al.*, 2010).

Information on regulatory mechanisms is lacking for the non-EU Mediterranean Sea and northwest Africa, which represents a large part of the undulate ray's overall range.

Extinction Risk Assessment

Several demographic characteristics of the undulate ray, which are intrinsic to elasmobranchs, may increase the species' vulnerability to extinction (Dulvy *et al.*, 2014; Musick, 2014, Virginia Institute of Marine Science, personal communication). The undulate ray is a large-bodied skate that exhibits the following life-history characteristics: delayed age to sexual maturity; long generation length; and long life span. For these reasons, we conclude that demographic characteristics related to growth rate and productivity have a moderate to high likelihood of contributing to the extinction of the undulate ray.

Historical abundance data are lacking for the undulate ray. Prior to the ban on retention, fisheries landings data indicate that it was a common species caught in the Celtic Seas off west Ireland, Portugal, and the English Channel, but was uncommon elsewhere. Fisheries dependent data from France showed a decline in undulate ray catch over the period of 1995 through 2001. In the Tagus estuary, Portugal, the undulate ray mean density was stable or slightly increasing from 1979 through 1997. In coastal waters off Spain there is no evidence of a decreasing trend in the abundance of the undulate ray in the area. Thus, in some areas population abundance may be declining, while in other areas the population appears to be stable or increasing. For these reasons, we conclude

that demographic characteristics related to population abundance have a low likelihood of contributing to the extinction of the undulate ray.

The distribution of the undulate ray is patchy, and few data exist on the undulate ray population structure. Preliminary data indicate undulate rays do not migrate great distances and exhibit high site fidelity. Similar to other large skates, these life-history characteristics may increase the undulate ray's vulnerability to exploitation, reduce their rate of recovery, and increase their risk of extinction (ICES, 2007; Rogers *et al.*, 1999). However, localized declines of this species are not widespread. Based on the limited information available, we conclude spatial structure and connectivity characteristics have a low likelihood of contributing to the extinction of the undulate ray.

Because there is insufficient information on genetic diversity, we conclude this characteristic presents an unknown likelihood of contributing to the extinction of the undulate ray.

Information on specific threat factors contributing to the undulate ray extinction risk is limited. Regarding habitat related threats, several estuaries inhabited by the undulate ray have been degraded by human activities, yet others appear somewhat pristine (e.g., Gironde estuary). However, systematic data are lacking on impacts to habitat features specific to the undulate ray and/or threats that result in curtailment of the undulate ray's range. For these reasons, we conclude habitat destruction, modification, and curtailment of habitat or range has an unknown to low likelihood (given some undulate ray habitat areas are not highly impacted by human activities) of contributing to the extinction of the undulate ray. Predictions of how threats to habitat may impact the undulate ray in the foreseeable future would be largely speculative.

Overexploitation of the undulate ray by commercial fishing has occurred in some areas, but does not appear widespread. Fisheries independent data indicate undulate ray populations are uncommon in some areas, and stable or possibly increasing in other areas over time. Some mortality may also occur as a result of tags used in scientific research activities, although the number of rays tagged is relatively low and unlikely to represent a large portion of the overall population. For these reasons, we conclude that overutilization for commercial, recreational, or scientific purposes has a low likelihood of contributing to the extinction of the undulate ray. Predictions of how the threat of overutilization may impact the undulate ray in the foreseeable future would be largely speculative.

With respect to the inadequacy of existing regulatory mechanisms, retention of the undulate ray is banned in most areas of the EU. Although the ban on retention of the undulate ray is being re-examined, a precautionary approach to fisheries management is still advised for the undulate ray and is likely to continue into the foreseeable future. Other fisheries regulations for skates and rays in general will reduce the impact of fishing on the undulate ray population and are also likely to continue into the foreseeable future. In conclusion, there is a low likelihood that the inadequacy of existing regulatory mechanisms contributes or will contribute in the foreseeable future to the extinction of the undulate ray.

Conant (2015) concluded that the undulate ray is presently at a low risk of extinction, with no information to indicate that this will change in the foreseeable future. Although one of the demographic characteristics (growth rate/productivity) of the undulate ray has a moderate to high likelihood of contributing to extinction, the species

does not appear to be negatively impacted by threats now, and information does not indicate the species' response to threats will change in the future. In addition, known threats pose a very low to low likelihood of contributing to the extinction of the undulate ray. After reviewing the best available scientific data and the extinction risk assessment, we agree with Conant (2015) and conclude that the undulate ray's risk of extinction is low both now and in the foreseeable future.

Significant Portion of Its Range

Though we find that the undulate ray is not in danger of extinction now or in the foreseeable future throughout its range, under the SPR Policy, we must go on to evaluate whether the species is in danger of extinction, or likely to become so in the foreseeable future, in a "significant portion of its range" (79 FR 37578; July 1, 2014).

The SPR Policy explains that it is necessary to fully evaluate a particular portion for potential listing under the "significant portion of its range" authority only if substantial information indicates that the members of the species in a particular area are likely <u>both</u> to meet the test for biological significance <u>and</u> to be currently endangered or threatened in that area. Making this preliminary determination triggers a need for further review, but does not prejudge whether the portion actually meets these standards such that the species should be listed. To identify only those portions that warrant further consideration, we will determine whether there is substantial information indicating that (1) the portions may be significant and (2) the species may be in danger of extinction in those portions or likely to become so within the foreseeable future. We emphasize that answering these questions in the affirmative is not a determination that the species is endangered or threatened throughout a significant portion of its range -- rather, it is a step

in determining whether a more detailed analysis of the issue is required (79 FR 37578, at 37586; July 1, 2014).

Thus, the preliminary determination that a portion may be both significant and endangered or threatened merely requires NMFS to engage in a more detailed analysis to determine whether the standards are actually met (79 FR 37578, at 37587). Unless both are met, listing is not warranted. The policy further explains that, depending on the particular facts of each situation, NMFS may find it is more efficient to address the significance issue first, but in other cases it will make more sense to examine the status of the species in the potentially significant portions first. Whichever question is asked first, an affirmative answer is required to proceed to the second question. Id. ("[I]f we determine that a portion of the range is not 'significant,' we will not need to determine whether the species is endangered or threatened there; if we determine that the species is not endangered or threatened in a portion of its range, we will not need to determine if that portion was 'significant'" (79 FR 37578, at 37587). Thus, if the answer to the first question is negative -- whether that regards the significance question or the status question -- then the analysis concludes and listing is not warranted.

Applying the policy to the undulate ray, we first evaluated whether there is substantial information indicating that any particular portion of the species' range is "significant." The undulate ray exhibits a patchy distribution throughout its range and may have been patchily distributed since at least the 1800s (ICES, 2008). It is locally abundant at sites in the central English Channel, Ireland, France, Spain, and Portugal (Ellis *et al.*, 2012). Within the Mediterranean Sea, occasional records occur off Israel and Turkey, but undulate rays are mainly recorded from the western region off southern

France and the Tyrrhenian Sea (Ellis *et al.* 2012; Serena 2005). Few data exist on the undulate ray population structure and studies have just begun that would improve our understanding of whether the species migrates and mixes/interbreeds among populations. Studies to date indicate that this species does not migrate great distances and that it exhibits high site fidelity (ICES 2007; Ellis *et al.*, 2011; ICES, 2013; Delamare *et al.*, 2013).

The undulate ray is broadly distributed, with locally abundant populations in five countries, indicating a level of representation that would increase resiliency against environmental catastrophes or random variations in environmental conditions. Limited data indicate discrete populations may exist (e.g., Bay of Biscay, Tralee Bay), but no data support that any particular population's contribution to the viability of the species is so important that, without the members in that portion of the range, the spatial structure of the entire species could be disrupted, resulting in fragmentation that could preclude individuals from moving and repopulating other areas. The preliminary data on possible discrete populations in some areas are too limited to support a conclusion that undulate ray populations would become isolated and fragmented, and demographic and population-dynamic processes within the species would be disrupted to the extent that the entire species would be at higher risk of extinction. Data on genetic diversity are lacking; thus, it is unknown how this characteristic would affect the species' resiliency against extinction should any particular population be extirpated. While historical abundance data are lacking, limited fishery-independent and fishery-dependent data indicate that in some areas population abundance may be declining, but in other areas the population appears to be stable or increasing. And as noted above, we have no reason to conclude

that the extirpation of any particular portion of the range would cause the entire species to be in danger of extinction now or in the foreseeable future.

Finally, threats occur throughout the species' range and there is no one particular geographic area where the species appears to be exposed to heightened threats. This, coupled with the lack of data on the undulate ray population structure and diversity, precludes us from identifying any particular portion of the species' range where the loss of individuals within that portion would adversely affect the viability of the species to such a degree as to render it in danger of extinction, or likely to be in the foreseeable future, throughout all of its range.

After a review of the best available information, we could identify no particular portion of the undulate ray range where its contribution to the viability of the species is so important that, without the members in that portion, the species would be at risk of extinction, or likely to become so in the foreseeable future, throughout all of its range. Therefore, we find that there is no portion of the undulate ray range that qualifies as "significant" under the SPR Policy, and thus our SPR analysis ends.

Determination

Based on our consideration of the best available data, as summarized here and in Conant (2015), we determine that the undulate ray, *Raja undulata*, faces a low risk of extinction throughout its range both now and in the foreseeable future, and that there is no portion of the undulate ray's range that qualifies as "significant" under the SPR Policy. We therefore conclude that listing this species as threatened or endangered under the ESA is not warranted. This is a final action, and, therefore, we do not solicit comments on it.

Greenback Parrotfish

The following section describes our analysis of the status of the greenback parrotfish, *Scarus trispinosus*.

Species Description

The greenback parrotfish, *Scarus trispinosus*, is a valid taxonomic species within the parrotfish family Scaridae. Parrotfishes are considered a monophyletic group but are often classified as a subfamily or tribe (Scarinae) of the wrasse family (Labridae). Currently, there are 100 species of parrotfish (family Scaridae) in 10 genera (Parenti and Randall, 2011; Rocha *et al.*, 2012). Parrotfishes are distinguished from other labroid fishes based upon their unique dentition (dental plates derived from fusion of teeth), loss of predorsal bones, lack of a true stomach, and extended length of intestine (Randall, 2005). The greenback parrotfish is one of the largest Brazilian parrotfish species, with maximum sizes reported around 90 cm (Previero, 2014a). The greenback parrotfish has six predorsal scales, two scales on the third cheek row, and roughly homogeneously-colored scales on flanks (Moura *et al.*, 2001). Juveniles are similarly colored to adults, but bear a yellowish area on the nape (Moura *et al.*, 2001).

Greenback parrotfish are endemic to Brazil and range from Manuel Luiz Reefs off the northern Brazilian coast to Santa Catarina on the southeastern Brazilian coast (Moura *et al.*, 2001; Ferreira *et al.*, 2010). Greenback parrotfish are widely distributed in reef environments throughout their range (Bender *et al*., 2012). Their range includes the Abrolhos reef complex, located in southern Bahia state (southeastern Brazil), which is considered the largest and richest coral reef system in the South Atlantic (Francini-Filho

et al., 2008). This reef complex encompasses an area of approximately 6,000 km^2 on the inner and middle continental shelf of the Abrolhos Bank (Kikuchi *et al.*, 2003).

The majority of parrotfishes inhabit coral reefs, but many can also be found in a variety of other habitats, including subtidal rock and rocky reefs, submerged seagrass, and macroalgal and kelp beds (Comeros-Raynal, 2012). There is little evidence that scarids have strict habitat requirements (Feitosa and Ferreira, 2014). Instead, they appear to be habitat "generalists" and their biomass is weakly related to the cover of particular reef feeding substrata (Gust, 2002). Greenback parrotfish have been recorded dwelling in coral reefs, algal reefs, seagrass beds, and rocky reefs at depths ranging from 1 m to at least 30 m (Moura *et al.* 2001).

The following von Bertalanffy growth parameters were estimated for greenback parrotfish: L∞ = 84.48 cm, K = 0.17 and t_0 = 1.09 (Previero, 2014a). Previero (2014a) estimated a maximum life span for this species of 23 years. Based on a similar "sister" species *Scarus guacamaia*, a generation length of 7 to 10 years has been inferred for the greenback parrotfish (Padovani-Ferreira *et al.*, 2012). Previero (2014b) assessed greenback parrotfish productivity using an index designed for data deficient and small scale fisheries (from Hobday *et al.*, 2007). Productivity was measured based on the following seven attributes: average age at maturity, average maximum age, fecundity, average size at maturity, average maximum size, reproductive strategy, and trophic level. Each attribute was given a score from 1 (high productivity) to 3 (low productivity). Data for this analysis were obtained from greenback parrotfish sampled from Abrolhos Bank artisanal fishery landings from 2010 to 2011. Productivity scores for greenback parrotfish

ranged from 1 to 2 with a mean score across all seven attributes of 1.71. This overall score reflects a species with average productivity.

Parrotfish typically exhibit the following reproductive characteristics: sexual change, divergent sexual dimorphism, breeding territories, and harems (Streelman *et al.*, 2002). Territories of larger male parrotfish have been shown to contain more females, suggesting that male size is an important factor in reproductive success (Hawkins and Roberts, 2003). Although parrotfish are usually identified as protogynous hermaphrodites (Choat and Robertson, 1975; Choat and Randall, 1986), evidence of gonochromism has been reported for three species within the parrotfish family (Hamilton *et al.*, 2007).

Freitas *et al.* (2012) studied reproduction of greenback parrotfish on Abrolhos Bank. From 2006-2013 they sampled a total of 1,182 fish, of which they collected gonads and prepared histological sections for 304. Based on a strong female biased sex ratio (282 females; 22 males), histological evidence, and the distribution of males only in the largest size classes, Freitas *et al.* (2012) concluded that the greenback parrotfish is a protogynous hermaphrodite (changing from female to male). Greenback parrotfish size at first maturity (i.e., 50 percent mature) is estimated at 39.1 cm, with 100 percent maturity achieved at 48.0 cm (Freitas *et al.*, 2012). Spawning season for greenback parrotfish is thought to occur between December and March (Freitas *et al.*, 2013).

Most parrotfish species are considered "generalists" in feeding behavior – they can rely on food types other than algae, such as detritus, crustaceans, sponges, gorgonians, and dead or live coral (Feitosa and Ferreira, 2014). Greenback parrotfish are classified as either detritivores or roving herbivores but do occasionally graze on live coral (Francini-Filho *et al.*, 2008c; Comeros-Raynal, 2012). The foraging plasticity of

greenback parrotfish acting either as scraper, excavator, or browser suggests that, depending on environmental heterogeneity, this species has the capacity to exercise some level of selectivity over their primary food, and are thus adapted to foraging in different modes (Ferreira and Goncalves, 2006; Francini-Filho *et al.*, 2008c). Larger males will establish feeding territories which both attract harems and are grazed continuously over a period of time (Francini-Filho *et al.*, 2008c).

Population Abundance, Distribution, and Structure

There are no historical or current abundance estimates for greenback parrotfish. Several studies have reported average densities and relative abundance of greenback parrotfish at specific reef locations in Brazil using underwater visual census (UVC) techniques. Previero (2014b) reported average densities of greenback parrotfish by size class from 2001-2009 at five Abrolhos Bank sites. Average densities fluctuate considerably during this time series, with no strong trends detected for any of the size classes. For the largest size class (40-100 cm), that would be most targeted by fishing, the years 2006-2009 represent four out of the five largest mean densities of greenback parrotfish in the nine year time series. Ferreira (2005) conducted a baseline study of reef fish abundance at six different sites within the Abrolhos Reef complex in 2005. The mean density of greenback parrotfish ranged from 0.80 (Southern Reefs) to 6.04 (Timbebas Reefs) fish per 100 m^2 across the six sites. The relative abundance of greenback parrotfish among all fishery targeted species ranged from 3.05 percent (Southern Reefs) to 15.25 percent (Timbebas Reefs) (Ferreira, 2005). Francini-Filho and Moura (2008b) found that greenback parrotfish accounted for 28.3 percent of the total fish biomass across a diverse range of Brazilian reefs surveyed from 2001-2005. On the Itacolomis

Reef alone, greenback parrotfish accounted for 37.4 percent of the total fish biomass and 45.6 percent of the total target fish biomass (Francini-Filho and Moura, 2008a). Kikucki *et al.* (2012) conducted a rapid assessment of Abrolhos reef fish communities within the Abrolhos National Marine Park and on the fringing reef off Santa Bárbara Island. Average mean density recorded for greenback parrotfish was 11.8 individuals per 100 m^2 and this species was ranked 8th in mean density among all species recorded.

Two studies reported mean densities of greenback parrotfish on northeastern Brazilian reefs. In 2006, Medeiros *et al.* (2007) evaluated reef fish assemblage structure on two shallow reefs located 1.5 km off the coast of João Pessoa in Paraíba state. Greenback parrotfish densities were lower on the recreationally exploited reefs (0.15 fish per 100 m^2) than on unexploited reefs (0.85 fish per 100 m^2). In this study, greenback parrotfish accounted for 0.04 percent of all fish recorded on the exploited reefs and 0.56 percent of all fish recorded on the unexploited reefs. Feitosa and Ferreira (2014) studied reef fish distribution on the shallow, fringing reef complex at Tamandare (northeastern coast) between December 2010 and May 2012. Four visually different habitats were selected for sampling: macroalgal beds; back reef; reef flat; and fore reef. Greenback parrotfish were only observed on the fore reef, where the mean density was 2.0 fish (standard error +/- 0.55) per 100 m².

Results indicate that the greenback parrotfish is not only the most abundant species of parrotfish on Abrolhos Bank, but is also one of the dominant reef species overall in terms of fish biomass at some sites within this reef complex (Ferreira, 2005; Francini-Filho and Moura, 2008b; Kikucki *et al.* 2012). Based on limited data, mean densities and relative abundance of greenback parrotfish reported from studies on

northeastern Brazilian reefs were generally lower that those reported on Abrolhos reefs (Medeiros *et al.*, 2007; Feitosa and Ferreira, 2014). It is unclear whether differences in greenback parrotfish mean densities across study sites are due primarily to different levels of fishery exploitation or to the natural distribution of this species.

Time series datasets for detecting trends in greenback parrotfish abundance over time are limited. Three studies (Francini-Filho and Moura, 2008b; Bender *et al.*, 2014; Previero, 2014b) reported mean densities at particular reef sites over multiple years. Only one of these studies indicated a declining trend in greenback parrotfish abundance over time (Bender *et al.*, 2014). UVC surveys, combined with interviews with local fishermen, suggest that the greenback parrotfish was once abundant at Arraial do Cabo (Rio de Janeiro state) and are now thought to be locally extirpated from this area (Floeter *et al.*, 2007; Bender *et al.*, 2014). Arraial do Cabo is a relatively small (1,000 m^2) marine extractive reserve with heavy exploitation due to its proximity to a traditional fishing village and general lack of enforcement of fishing regulations (Floeter *et al.*, 2006; Bender *et al.*, 2014).

Summary of Factors Affecting the Greenback Parrotfish

Available information regarding current, historical, and potential future threats to the greenback parrotfish was thoroughly reviewed (Salz, 2015). We summarize information regarding threats below according to the factors specified in section 4(a)(1) of the ESA. There is very little information available on the impact of "Disease or Predation" or "Other Natural or Manmade Factors" on greenback parrotfish survival. These subjects are data poor, but there are no serious or known concerns raised under these threat categories with respect to greenback parrotfish extinction risk; therefore, we

do not discuss these further here. See Salz (2015) for additional discussion of all ESA section 4(a)(1) threat categories.

Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range

The adverse effects of global coral loss and habitat degradation (including declines in species abundance and diversity, reduced physiological condition, decreased settlement, change in community structure, etc.) on species dependent upon coral reefs for food and habitat have been well documented (Comeros-Raynal *et al.*, 2012). Anthropogenic threats to Brazil's coastal zone include industrial pollution, urban development, agricultural runoff, and shrimp farming (Diegues, 1998; Leão and Dominguez, 2000; Cordell, 2006).

In 2008, as part of the International Coral Reef Initiative, coral reef experts worldwide were asked to assess the threat status of reefs in their regions due to human pressures and global climate change (Wilkinson, 2008). For purposes of this assessment, reefs were categorized into one of three groups: 1) Not threatened - reefs at very low risk of decline in the short term (5-10 years); 2) Threatened - reefs under high risk of decline in the mid-long term (> 10 years); or 3) Critical - reefs under high risk of decline in the short term (5-10 years). In the Atlantic Eastern Brazil Region, experts classified 40 percent of the reefs as "Not Threatened," 50 percent as "Threatened," and 10 percent as "Critical" (Wilkinson, 2008).

The Brazilian National Coral Reef Monitoring Program, which includes all major reef areas in Brazil, conducts annual surveys at 90 different sites within 12 reef systems (Wilkinson, 2008). Reef Check (*www.reefcheck.org*) compatible methodology was used to monitor eight locations in northeastern and eastern Brazil from 2003 to 2008

(Wilkinson, 2008). Results showed that due to chronic land-based stresses, the nearshore, shallow reefs, less than 1 km from the coast, were in poor condition, with less than 5 percent mean coral cover; reefs further than 5 km from the coast, or deeper than 6 m, showed an increase in algal cover but also some local coral recovery (Wilkinson, 2008). Atlantic and Gulf Rapid Reef Assessment (AGRRA; *www.agrra.org*) monitoring methods have been used at five eastern Brazilian reefs since 1999. Monitoring via the AGRRA methodology showed that reefs less than 5 km from the coast were in poor condition, with a mean of less than 4 percent coral cover and more than 40 percent cover of macroalgae (Wilkinson, 2008). The poor condition of nearshore reefs was attributed to damage from sewage pollution, increased sedimentation and water turbidity, as well as damage by tourists and over-exploitation (Wilkinson, 2008). Reefs more than 5 km offshore and in no-take reserves had more than 10 percent coral cover and less than 10 percent algal cover (Wilkinson, 2008). Francini-Filho and Moura (2008b) found up to 30 times greater biomass of target fish on deep reefs (25–35 m) on the Abrolhos Bank compared to reefs in shallow coastal areas.

The Itacolomis reef, the largest reef complex within the Corumbau Marine Extractive Reserve on Abrolhos Bank, has a rich coral fauna as well as relatively high cover, particularly of *Orbicella cavernosa*, *M. brazilensis*, and *Siderastrea stellata*, which are biologically representative of the range of Abrolhos corals (Cordell, 2006). Biological surveys of species diversity, coralline cover, and condition of colonies, carried out before and after the creation of the reserve in 2000 indicated that the Itacolomis reefs were still in a good state of conservation as of 2006 (Conservation International – Brazil, 2000; Conservation International – Brazil, 2006).

Coral reef area loss and decline is widespread globally, including many reef areas along the Brazilian coastline. However, there is considerable variation in the reliance of different species on coral reefs based on species' feeding and habitat preferences - i.e., some species spend the majority of their life stages on coral reef habitat, while others primarily utilize seagrass beds, mangroves, algal beds, and rocky reefs. The greenback parrotfish is considered a "mixed habitat" species, found on rocky reefs, algal beds, seagrass beds, and coral reefs (Comeros-Raynal *et al.*, 2012; Freitas *et al.*, 2012), that feeds mainly on detritus and algae and only occasionally grazes on live coral (Francini-Filho *et al.* 2008c).

Impacts of ocean acidification to coral abundance and/or diversity are arguably significant; however, the direct linkages between ocean acidification and greenback parrotfish extinction risk remain tenuous. As discussed above, the ability of greenback parrotfish to occupy multiple habitat types should make this species less vulnerable to climate change and ocean acidification compared to other reef species that are more dependent on coral for food and shelter. Similarly, there is no evidence directly linking increased ocean temperatures or sea level rise with greenback parrotfish survival.

Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Several studies suggest that overutilization of fish populations is leading to significant changes in the community structure and balance of Brazilian reef ecosystems (Costa *et al.*, 2003; Gasparini *et al.*, 2005; Ferreira and Maida, 2006; Previero, 2014b). An estimated 20,000 fishermen currently use the natural resources of Brazil's Abrolhos Region as their main source of income (Dutra *et al.*, 2011). Their activity is predominantly artisanal, performed with small and medium-sized boats. Small-scale

artisanal fisheries account for an estimated 70 percent of total fish landings on the eastern Brazilian coast (Cordell, 2006), where coral reefs are concentrated (Leãˉo *et al.*, 2003). A growing number of larger and industrial fishing boats have moved into this region in the last few years, increasing the pressure on target species and competing with artisanal fishing (Francini-Filho and Moura, 2008b; Dutra *et al.*, 2011).

Greenback parrotfish were not considered a traditional fishery resource by most fishermen in Brazil as recently as 20 years ago (Francini-Filho and Moura, 2008b). Although fishermen from some localities have reported landing greenback parrotfish as far back as the late 1970s (Bender *et al.*, 2014; Previero, 2014b), the importance of this species to Brazil's artisanal fisheries has increased greatly only in the past two decades or so. Since about the mid-1990s, parrotfish have increasingly contributed to fishery yields in Brazil, as other traditional resources such as snappers, groupers, and sea basses are becoming more scarce (Costa *et al.*, 2005; Previero, 2014b). This is part of a global phenomenon described by Pauly *et al.* (1998) as "fishing down the food web." As populations of top oceanic predators collapse due to overfishing, other large-bodied species at lower trophic levels become new targets. Some boats now exclusively target these non-traditional reef fishes, whereas others target them only during periods of low productivity or during closed seasons of higher priority target species (Cunha *et al.*, 2012). Greenback parrotfish are now considered an important fishery resource that is sold to regional markets in nearby large cities (e.g., Vitoria and Porto Seguro) and even to overseas markets (Francini-Filho and Moura, 2008b; Cunha *et al.*, 2012; Previero, 2014b). In general, parrotfishes may be highly susceptible to harvest due to their conspicuous nature, relatively shallow depth distributions, small home ranges, and

vulnerability at night (Taylor *et al.*, 2014). Primary fishing methods used in Brazil to capture parrotfish are spearfishing and seine nets (Ferreira, 2005; Araujo and Previero, 2013).

Previero (2014b) conducted a quantitative assessment of the greenback parrotfish commercial fishery on Abrolhos Bank. Fishery dependent data were collected over 13 months between 2010 and 2011 from the main fishing ports that exploit reef fish: Caravelas; Prado; Corumbau Marine Extractive Reserve (MERC); and Alcobaca. The Alcobaca fleet was characterized by relatively large vessels (some over 12 m) equipped with freezer space for the preservation of fish over long periods. These vessels targeted parrotfish on more distant fishing grounds during extended fishing trips (average duration 11.7 days). By comparison, fishermen from Caravelas mainly took day trips targeting greenback parrotfish closer to shore and from smaller vessels. Prado fishing vessels also traveled longer distances, but greenback parrotfish were considered a less important target species by fishermen at this port (compared to either Alcobaca or Caravelas) and landings were considerably lower as a result. Alcobaca fishermen caught greenback parrotfish only with harpoons, often with air compressors to increase bottom time at greater depths; Caravelas fishermen used a combination of harpoons and nets. Greenback parrotfish landings ranged in size from 28 cm to 91 cm TL and the fishery was dominated by 8 and 9 year-old fish. The oldest fish sampled was 11 years old – less than half the estimated maximum life span of 23 years for this species (Previero, 2014a). Significantly larger specimens were landed at Alcobaca compared to Caravelas (Previero, 2014b). Length frequency data suggest that a relatively large portion of the greenback parrotfish landings, particularly from the near-shore Caravelas fleet, were fish that had not yet

reached maturity (Freitas *et al.*, 2012; Previero, 2014b). Total landings of greenback

parrotfish recorded for 13 months at Caravelas was 24.80 metric tons (average 1.90 tons

per month). Total landings for 7 months of monitoring at the MERC and Alcobaca were

1.93 and 9.21 metric tons, respectively (average 0.27 tons per month at MERC and 1.31

tons per month at Alcobaca). The CPUE for Caravelas ranged from 0.911 to 1.92 kg per

fisherman/hour/day and for the MERC from 0.65 to 1.25 kg per fisherman/hour/day. The

following parameters were estimated for the Abrolhos Bank greenback parrotfish fishery:

fishing mortality = 0.68; natural mortality = 0.19; total mortality = 0.87; and survival rate

= 0.42 (Previero, 2014b).

The potential vulnerability of the greenback parrotfish population to commercial

fishery exploitation was evaluated by Previero (2014b) using a Productivity and

Susceptibility Analysis (PSA) index designed for data deficient and small scale fisheries

(Hobday *et al.*, 2007). The PSA is a semi-quantitative approach based on the assumption

that the vulnerability to a species will depend on two characteristics: (1) the species'

productivity, which will determine the rate at which the population can sustain fishing

pressure or recover from depletion due to the fishery; and (2) the susceptibility of the

population to fishing activities (Hobday *et al.*, 2007). Seven productivity attributes

(described in "Species Description" section above) and the following four susceptibility

attributes were evaluated: 1) Availability - overlap of fishing effort with the species'

distribution, 2) Encounterability - the likelihood that the species will encounter fishing

gear that is deployed within its geographic range, 3) Selectivity - the potential of the gear

to capture or retain the species and the desirability (value) of the fishery, and 4) Post

Capture Mortality - the condition and subsequent survival of a species that is captured

and released (or discarded) (Hobday *et al.*, 2007). Susceptibility attributes were derived mainly from sampling data obtained at major ports and from interviews with fishermen. The productivity and susceptibility rankings determine relative vulnerability and are each given a score: 1 to 3 for high to low productivity, respectively; and 1 to 3 for low to high susceptibility, respectively. The average productivity score of greenback parrotfish on Abrolhos Bank across seven different attributes was 1.71 and the average susceptibility score across four attributes was 3.00. This combination of very high susceptibility and average productivity places the greenback parrotfish in the PSA zone of "high potential risk" of overfishing. The PSA results, in combination with an estimated high fishing mortality, strongly suggest that greenback parrotfish are heavily exploited by artisanal fishing on Abrolhos Bank (Previero, 2014b).

Greenback parrotfish may be particularly vulnerable to spearfishing, due to their size and reproductive traits. Spearfishing is a highly size-selective, efficient gear - fishermen target individual fish, typically the largest, most valuable individuals. For protogynous hermaphrodites, the largest individuals are (in order) terminal males, individuals undergoing sexual transition, and the largest females. Continued removal of terminal males, individuals undergoing sexual transition, and the largest females at high rates can lead to decreased productivity and increased risk of extinction over time. Thus, protogynous hermaphrodites, such as the greenback parrotfish, may be particularly susceptible to over-fishing (Francis, 1992; Hawkins and Roberts, 2003). With continued heavy exploitation from fishing, it is plausible that the proportion of male greenback parrotfish could fall below some critical threshold needed for successful reproduction in some localities. If sex change is governed by social (exogenous) mechanisms, then

transition would be expected to occur earlier in the life cycle when larger individuals are selectively removed by fishing (Armsworth, 2001; Hawkins and Roberts, 2003). This would cause the mean size and age of females to decrease for protogynous species and could result in a reduction in egg production (Armsworth, 2001). Sexual transition takes time and energy, including energy expended on social interactions and competition among females vying for dominance. Since removal of terminal males by fishing will result in more sexual transitions, overall population fitness may be negatively impacted.

Greenback parrotfish are also targeted by recreational spearfishermen in Brazil, but the impact of this activity on the resource is largely unknown (Costa Nunes *et al.*, 2012). Medeiros *et al.* (2007) studied the effects of other recreational activities (i.e., snorkeling, SCUBA, and fish feeding) on a tropical shallow reef off the northeastern coast of Brazil by comparing its fish assemblage structure to a nearby similar control reef where tourism does not occur. Greenback parrotfish were found to be less abundant on the recreationally exploited reef compared to the control reef (0.15 versus 0.85 individuals per 100 m^2), although the relative abundance of this species was very low on both reefs (0.04 percent versus 0.56 percent of all fish individuals recorded) and results were based on very small sample sizes of fish observed.

Several studies have linked localized declines of greenback parrotfish populations to increased fishing effort (Floeter *et al.*, 2007; Pinheiro *et al.*, 2010; Costa Nunes *et al.*, 2012; Bender *et al.*, 2014). As previously discussed (see above in "Population Abundance, Distribution, and Structure"), studies suggest that the greenback parrotfish was once abundant at Arraial do Cabo and are now thought to be locally extirpated from this small area due to fishing pressure (Floeter *et al.*, 2007; Bender *et al.*, 2014). Pinheiro

et al. (2010) studied the relationships between reef fish frequency of capture (rarely, occasionally, or regularly), intensity at which species are targeted by fisheries (highly targeted, average, or non-targeted), and UVC counts off Franceses island (central coast of Brazil) between 2005 and 2006. Greenback parrotfish were one of 19 species classified as both "highly targeted" (by spearfishing) and "rarely caught." The authors attributed these results to the overexploitation by fishing of the Franceses island reef fish community. Similarly, Feitosa and Ferreira (2014) attributed low observed abundance of greenback parrotfish outside of no-take areas on Tamandare reefs (northeastern coast of Brazil) to heavy fishing pressure in this region.

Artisanal and commercial fishing pressure on greenback parrotfish will likely increase in the future as the country's coastal population grows and more traditional target species become less available due to overfishing. As easily accessible nearshore and shallower reefs become more depleted, fishing effort will likely shift to currently less-utilized, more remote, and deeper reefs. This is already evident in landings for the fishing port of Alcobaca, where a fleet of larger, freezer-equipped vessels return from long duration trips (up to several weeks) specifically targeting large greenback parrotfish on offshore reefs (Previero, 2014b). This level of fishing capacity and sophistication suggests that, over time, greenback parrotfish may become over-exploited throughout their range, including in more remote areas that were at one time considered inaccessible to local fishermen. This is supported by the PSA results, which rated greenback parrotfish as "highly susceptible" to overfishing on all four susceptibility criteria: availability, encounterability, selectivity, and post capture mortality (Previero, 2014b).

It is likely that greenback parrotfish are being overfished (Previero, 2014b) and that overfishing will continue into the future unless additional regulatory mechanisms are implemented and adequately enforced. In one very small area (Arraial do Cabo), fishing has led to the local extirpation of this species, although the contribution of this area to the population as a whole is likely minimal. As a protogynous hermaphrodite, the greenback parrotfish may be more susceptible to fishing methods that selectively target the largest individuals in the population. In addition, as one of the largest parrotfish species and with relatively late maturation, greenback parrotfish may be more vulnerable to overexploitation than smaller, faster-maturing parrotfish species (Taylor *et al.*, 2014). However, the lack of baseline information and a time series of fishery dependent data, combined with limitations of the available studies, make it difficult to estimate the magnitude of this threat or to quantitatively assess its impact on greenback parrotfish abundance.

Inadequacy of Existing Regulatory Mechanisms

Several marine protected areas (MPAs) have been established in Brazil on reefs inhabited by greenback parrotfish. Brazil's MPAs vary considerably in terms of size, ecosystem type, zoning regulations, management structure, fishing pressure, and level of compliance and enforcement. The Abrolhos National Marine Park was established by the Brazilian government in 1983 as a "no-take" protected area with limited use allowed by non-extractive activities (Cordell, 2006). Effective conservation policy was not implemented in the national park until the mid-1990s (Ferreira, 2005). The park, which covers an area of approximately 88,000 hectares, is divided into two discontinuous portions: 1) the coastal Timbebas Reef, which is considered poorly enforced, and 2) the

offshore reefs of Parcel dos Abrolhos and fringing reefs of the Abrolhos Archipelago,

which are more intensively enforced (Ferreira and Goncalves, 1999; Francini-Filho *et al.*,

2013). The Corumbau Marine Extractive Reserve (MERC), located in the northern

portion of Abrolhos Bank in eastern Brazil, was established in 2000 and covers 89,500

hectares (930 km^2) of nearshore habitats and coralline reefs (Francini-Filho *et al.*, 2013).

Extractive reserves are co-managed, multi-use areas in Brazil established by the initiative

of local communities with support from the Federal Protected Areas Agency (ICMBio)

and non-governmental organizations (Francini-Filho and Moura, 2008a). Exploitation of

marine resources within the MERC is only allowed for locals, with use rules (e.g., zoning

and gear restrictions) defined by a deliberative council made up of more than 50 percent

fishermen (Francini-Filho and Moura, 2008a). Handlining, spearfishing, and various

types of nets are allowed, while destructive fishing practices (e.g., drive-nets above reefs

and collections for aquarium trade) are prohibited (Francini-Filho and Moura, 2008a).

The MERC management plan, approved in November 2001, created several no-take

zones; the main one (~ 10 km^2) covering about 20 percent of the largest reef complex

within the MERC - Itacolomis Reef (Francini-Filho and Moura, 2008a). Besides those on

Abrolhos Bank, there are a few other no-take reserves with reef habitat within the

greenback parrotfish range. Laje de Santos State Marine Park on the southeastern coast of

Brazil (São Paulo state) is a no-take reserve consisting mainly of rocky reefs (Wilkinson,

2008; Luiz *et al.*, 2008). Established in 1993, Laje de Santos was initially considered a

"paper park" with inadequate (or non-existent) enforcement to eradicate poaching in this

heavily populated region (Luiz *et al.*, 2008). In the past 10 years, significant efforts have

been made to protect the park from illegal and extractive activities (Luiz *et al.*, 2008).

Costa dos Corais, located in Northern Brazil (Pernambuco state), was established in 1997 as a sustainable multi-use MPA. This area includes coral reef habitat and is used for tourism, fisheries, and coral reef conservation (Gerhardinger *et al.*, 2011).

Several studies have evaluated the effectiveness of Brazil's MPAs in protecting and restoring populations of overexploited reef species. Francini-Filho and Moura (2008a) estimated fish biomass and body size within the Itacolomis Reef no-take zone and at unprotected sites on the reef before (2001) and after initiation of protection (2002–2005). Greenback parrotfish was the dominant species found on the Itacolomis Reef in terms of biomass (37.4 percent of total biomass), and considered a major fishery resource in the study area. Biomass of this species increased significantly inside the reserve and also in unprotected reefs close (0–400 m) to its boundary (i.e., "spillover effect") between 2001 and 2002, soon after the reserve establishment and banning of the parrotfish fishery from the entire MERC (Francini-Filho and Moura, 2008a). The initial greenback parrotfish biomass increase on the unprotected reefs was followed by a statistically significant decrease from 2002 to 2003 after local fishermen decided to re-open the parrotfish fishery. Greenback parrotfish biomass inside the no-take reserve also decreased starting in 2004, although this decline was not statistically significant. The authors attributed this decline to increased poaching by some local spearfishermen who were strongly resistant to regulatory controls despite the apparent positive effects on fish biomass in the first few years after the reserve was established.

Francini-Filho and Moura (2008b) compared fish biomass from 2001-2005 across several reef areas with different levels of protection. Their results varied depending on species considered and were sometimes confounded by year effects. For the greenback

parrotfish, biomass was statistically higher within the newly established Itacolomis

Reef's no-take reserve than in any of the following areas: Itacolomis Reef multi-use area,

no-take reserves within Abrolhos National Marine Park, and other open access areas.

Greenback parrotfish biomass within the Abrolhos National Marine Park no-take areas

was not statistically different than biomass found at either the multi-use or open access

sites surveyed. This may be partially due to the lack of enforcement at the Timbebas Reef

no-take area (located within the national park) for many years after it was established in

1983 (Floeter *et al.*, 2006).

Floeter *et al.* (2006) compared abundances of reef fishes across areas with varying

levels of protection and enforcement along the Brazilian coastline. They found that

heavily fished species, including greenback parrotfish, were significantly more abundant

in areas with greater protection. Study sites with full protection (i.e., no-take areas with

adequate enforcement and/or little fishing pressure) also produced significantly more

large parrotfish (>21 cm) than did sites with only partial protection from fishing (Floeter

et al., 2006). Similarly, Ferreira (2005) found that reefs within the fully protected and

enforced areas of the Abrolhos National Marine Park contained greater numbers of large-

sized parrotfish compared to unprotected reefs on Abrolhos Bank.

The studies cited above provide ample evidence that, when fully protected and

enforced, no-take reserves can have positive effects on greenback parrotfish abundance

and size within the reserve boundaries, and possibly outside due to "spillover" effects.

For MPAs to work as a fishery management tool, fully protected (no-take) areas must be

sufficiently large in area and include a variety of habitats critical to the various life

history stages of the target species (Dugan and Davis, 1993). MPAs cover an estimated

3.85 percent of the greenback parrotfish total range (Comeros-Raynal *et al.*, 2012). UVC data indicate that within this range, the reefs with the greatest abundance of greenback parrotfish are located within Abrolhos Bank (Ferreira, 2005; Francini-Filho and Moura, 2008a). At present, about 2 percent of the Abrolhos Bank is designated as a "no-take" marine reserve (Francini-Filho and Moura, 2008a). Afonso *et al.* (2008) found that for the parrotfish *Sparisoma cretense* in the Azore Islands, haremic adults displayed very high site fidelity with minimal dispersion from established male territories that could last for several years. This study suggests that a network of small to medium sized, well-enforced no-take marine reserves can effectively protect "core" populations of reef fish (Afonso *et al.*, 2008) and possibly serve as a buffer from extinction risk.

Magris *et al.* (2013) conducted a gap analysis to evaluate how well MPAs in Brazil meet conservation objectives. Coral reef ecosystems were subdivided into four ecoregions: Eastern Brazil, Northeastern Brazil, Amazon, and Fernando de Noronha and Atoll das Rocas islands (note: greenback parrotfish are not found in the latter two ecoregions). No-take areas exceeded 20 percent coverage in three out of the four coral reef ecoregions, but accounted for less than 2 percent of coral reef areas in Northeastern Brazil. While a large portion of coral reef ecosystems in Brazil are designated as no-take, only a few of these areas are greater than 10 km^2 (Magris *et al.*, 2013). Pressey *et al.* (2014) followed up on the Magris *et al.* (2013) study by more finely delineating coral reef ecosystems based on reef type (nearshore bank, bank off the coast, fringing, patch, mushroom reef, and atoll), depth (deep and shallow), and tidal zone (subtidal and intertidal). They found that protection of coral reef ecosystems by no-take areas was very uneven across the 23 ecosystems delineated. Coverage ranged from 0 percent to 99

percent with a mean of 28 percent, with 13 of 23 ecosystems having no coverage (mostly nearshore banks and patch reefs located in the Northeastern ecoregion). Vila-Nova *et al.* (2014) developed a spatial dataset that overlays Brazil's reef fish hotspots with MPA coverage and protection levels. Hotspots were identified as areas with either high species richness, endemism, or number of threatened species. Results showed a mismatch between no-take coverage and reef hotspots in the Northeast region from Paraíba state to central Bahia state. Reef fish hotspots for total richness, endemics, and targeted species were found in this region which does not have any designated no-take areas (only multi-use MPAs). The state of Espírito Santo was also identified as a hotspot for endemic, threatened, and targeted reef fish species despite being the least protected region along the Brazilian coast.

Several researchers have noted the prevalence of high levels of poaching and inadequate enforcement within Brazilian "no-take" reserves (Ferreira and Goncalves, 1999; Cordell, 2006; Floeter *et al.*, 2006; Wilkinson, 2008; Francini-Filho and Moura, 2008a; Luiz *et al.*, 2008; Francini-Filho *et al.*, 2013). Although these reports are based largely on anecdotal information, and quantitative data are lacking, illegal fishing activity is consistently cited as a factor that could undermine the effectiveness of "no-take" marine reserves in Brazil. Management and enforcement of at least some Brazilian no-take areas has been reported as improving within the past decade (Luiz *et al.*, 2008; Floeter *et al.*, 2006). The success of a national MPA system in Brazil will depend on the capacity to overcome pervasive lack of enforcement, frequent re-structuring and re-organization of government environmental agencies, and difficulties with the practicality of implementing management plans (Wilkinson, 2008).

Aside from establishing no-take protected areas, few actions have been taken by the Brazilian government to manage reef fisheries. Traditional fishery management controls (e.g., annual quotas, daily catch limits, limited entry, seasonal closures, and size limits) on coastal fisheries are typically not implemented either at the state or national level (Cordell, 2006; Wilkinson, 2008). For years, the only marine management practices that limited access to fishing grounds were unofficial, informal ones: local sea tenure systems based on artisanal fishers' knowledge, kinship and social networks, contracts, and a collective sense of "use rights" (Begossi, 2006; Cordell, 2006). While local sea tenure systems and informal agreements, such as the short-lived ban on parrotfish harvest within the MERC (Francini-Filho and Moura, 2008a), could reduce the threat of overexploitation, without legal authority and regulatory backing, such arrangements may be viewed as tenuous or unstable.

Extinction Risk Assessment

Studies indicating a declining trend in greenback parrotfish abundance over time are lacking. Increased fishing pressure on this species in the past two decades has likely reduced overall abundance (Previero, 2014b), but available data are insufficient to assess the magnitude of this decline. Despite the likely negative impact of fishing on abundance, mean densities recorded for greenback parrotfish are very high when compared to mean densities recorded for similar sized species in the north-western tropical Atlantic (Debrot *et al.*, 2007). In parts of their range, greenback parrotfish are still a commonly occurring species and represent a large proportion of the total fish biomass on some reefs. UVC time series data indicate that greenback parrotfish have been locally extirpated from a relatively small reef near the species' southern range (Rio de Janeiro state). However, the

impact of this localized decline on the greenback parrotfish population as a whole may be small. Based on the available scientific and commercial information, we conclude that it is unlikely that demographic factors related to abundance contribute significantly to the current extinction risk of this species.

As a large-bodied, protogynous hermaphrodite with relatively late maturation, greenback parrotfish may be particularly susceptible to the effects of fishing on population growth rate or productivity. However, information indicating a significant decline in greenback parrotfish productivity is lacking. Greenback parrotfish productivity scores based on a Productivity and Susceptibility Analysis (PSA) are indicative of a species with average productivity (Previero, 2014b). Therefore, we conclude that it is unlikely that demographic factors related to growth rate/productivity contribute significantly to the current extinction risk of this species. Based on the limited available information, we find no evidence to suggest that demographic factors related to spatial structure/connectivity pose an extinction risk to the greenback parrotfish. This species is widely distributed throughout its range, can recruit to a variety of habitats, and shows little evidence of population fragmentation. We conclude that it is very unlikely that demographic factors related to spatial structure/connectivity contribute significantly to the current extinction risk of this species. Because there is insufficient information on genetic diversity, we conclude that this factor presents an unknown likelihood of contributing to the extinction of the greenback parrotfish.

Although there is evidence that some portion of greenback parrotfish habitat has been modified and degraded, studies indicating that habitat associated changes are contributing significantly to the extinction risk of this species are lacking. Therefore,

based on the available scientific and commercial information, we conclude that it is unlikely that the threat of destruction, modification, or curtailment of greenback parrotfish habitat or range contributes or will contribute significantly to the extinction risk of this species either now or in the foreseeable future.

The cumulative research indicates that greenback parrotfish are heavily exploited by fishing throughout much of their range, fishing pressure has reduced the abundance of greenback parrotfish, and in some localities the reduction has been significant. Based on the information available, and taking into account the scientific uncertainty associated with this threat, we conclude that the threat of overutilization from artisanal and commercial fishing is somewhat likely to contribute to the extinction risk of this species both now and in the foreseeable future. Given the systemic problems associated with enforcement of no-take MPAs in Brazil and the general lack of traditional fishing regulations designed to limit catch and effort of reef fishes, we also conclude that the threat of inadequate existing regulatory mechanisms is somewhat likely to contribute to the extinction risk of this species both now and in the foreseeable future.

The extinction risk analysis of Salz (2015) found that the greenback parrotfish currently faces a low risk of extinction throughout its range. Fishing overutilization and the inadequacy of existing fishing regulations were identified as threats that are somewhat likely to contribute to the risk of greenback parrotfish extinction. However, while fishing has resulted in a decline in abundance, greenback parrotfish are still a commonly occurring species on many Brazilian reefs, and represent a relatively large proportion of the total fish biomass on some reefs. All of the demographic factors evaluated were categorized as either unlikely or very unlikely to contribute significantly

to the current extinction risk. There are no indications that the greenback parrotfish is currently at risk of extinction based on demographic viability criteria. After reviewing the best available scientific data and the extinction risk evaluation, we agree with Salz (2015) and conclude that the present risk of extinction for the greenback parrotfish is low.

Salz (2015) found that the greenback parrotfish's risk of extinction in the foreseeable future is between low and moderate. It is likely that fishing overutilization will further reduce greenback parrotfish abundance in the future, thus increasing the overall risk of extinction. However, as mentioned above, there are no indications that the greenback parrotfish is at risk of extinction based on demographic viability criteria. This species is still relatively abundant in parts of its range, and the available information does not indicate that fishing overutilization will reduce abundance to the point at which the greenback parrotfish would be in danger of extinction in the foreseeable future. Based on the best available scientific data and the extinction risk evaluation, we agree with Salz (2015) and conclude that the greenback parrotfish's risk of extinction in the foreseeable future is between low and moderate – i.e., greater than low but less than moderate.

Significant Portion of Its Range

Though we find that the greenback parrotfish is not in danger of extinction now or in the foreseeable future throughout its range, under the SPR Policy, we must go on to evaluate whether the species is in danger of extinction, or likely to become so in the foreseeable future, in a significant portion of its range (79 FR 37578; July 1, 2014). To make this determination, we followed the SPR Policy, as described above in the "Significant Portion of Its Range" section for the undulate ray, and first evaluated whether substantial information indicates that the members of the species in a particular

area are likely both to meet the test for biological significance and to be currently endangered or threatened in that area.

Applying the policy to the greenback parrotfish, we first evaluated whether there is substantial information indicating that any particular portion of the species' range is "significant." Greenback parrotfish are found only in Brazilian waters and are considered widely distributed throughout their range from the Manuel Luiz Reefs off the northern coast to Santa Catarina on the southeastern coast (Moura *et al.*, 2001; Ferreira *et al.*, 2010; Bender *et al.*, 2012). Although studies on greenback parrotfish spatial structure and connectivity are lacking, there is no information indicating that the loss of any particular portion of its range would isolate the species to the point where the remaining portions would be at risk of extinction from demographic processes. Similarly, we did not find any information suggesting that loss of any particular portion would severely fragment and isolate this species to the point that vulnerability to threats would increase as a result. The ability of greenback parrotfish to recruit to a variety of habitats (Moura *et al.*, 2001; Comeros-Raynal, 2012) may improve spatial connectivity among local reef populations. Parrotfish in general exhibit broad larval dispersal capabilities which should aid in the repopulation of reefs where they have been eliminated due to fishing. There is no information indicating that the loss of genetic diversity from one portion of the greenback parrotfish range would result in the remaining population lacking enough genetic diversity to allow for adaptations to changing environmental conditions. There is also no evidence of a particular portion of the greenback parrotfish range that is critically important to specific life history events (e.g., spawning, breeding, feeding) such that the

loss of that portion would severely impact the growth, reproduction, or survival of the entire species.

After a review of the best available information, we could identify no particular portion of the greenback parrotfish range where its contribution to the viability of the species is so important that, without the members in that portion, the species would be at risk of extinction, or likely to become so in the foreseeable future, throughout all of its range. Therefore, we find that there is no portion of the greenback parrotfish range that qualifies as "significant" under the SPR Policy, and thus our SPR analysis ends.

Determination

Based on our consideration of the best available data, as summarized here and in Salz (2015), we determine that the present risk of extinction for the greenback parrotfish is low, and that the greenback parrotfish's risk of extinction in the foreseeable future is between low and moderate – i.e., greater than low but less than moderate, and that there is no portion of the greenback parrotfish's range that qualifies as "significant" under the SPR Policy. We therefore conclude that listing this species as threatened or endangered under the ESA is not warranted. This is a final action, and, therefore, we do not solicit comments on it.

References

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

Classification

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 (NEPA) (See NOAA Administrative Order 216-6).

Authority

The authority for this action is the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.).

Dated: May 5, 2015.

Samuel D. Rauch III,

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