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DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

[Docket No. 121204680-4789-03]

RIN 0648-XC387

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

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

ACTION: Notice of 12-month finding and availability of a status review report.

SUMMARY: We, NMFS, announce a 12-month finding on a petition to list the humphead wrasse (Cheilinus undulatus) as threatened or endangered under the Endangered Species Act (ESA). We have completed a comprehensive status review of the humphead wrasse in response to this petition. Based on the best scientific and commercial information available, including the status review report (Graham et al., 2014), we have determined that the species does not warrant listing at this time. We conclude that the humphead wrasse is not currently in danger of extinction throughout all or a significant portion of its range and is not likely to become so within the foreseeable future. We also announce the availability of the humphead wrasse status review report.

DATES: This finding was made on [INSERT DATE OF PUBLICATION IN THE FEDERAL REGISTER].

ADDRESSES: The humphead wrasse status review report is available electronically at: http://www.fpir.noaa.gov/PRD/prd_humpheadwrasse.html. You may also receive a copy by submitting a request to the Protected Resources Division, Pacific Islands Regional Office, NMFS, 1845 Wasp Blvd., Building 176, Honolulu, HI 96818, Attention: Humphead Wrasse 12-month Finding.

FOR FURTHER INFORMATION CONTACT: Krista Graham, NMFS, Pacific Islands Regional Office, (808) 725-5152; or Lisa Manning, NMFS, Office of Protected Resources, (301) 427-8466.

SUPPLEMENTARY INFORMATION:

Background

On October 31, 2012, we received a petition from WildEarth Guardians to list the humphead wrasse (Cheilinus undulatus) as threatened or endangered under the ESA throughout its entire range. The petitioners also requested that critical habitat be designated for the humphead wrasse under the ESA. On February 28, 2013, we published a positive 90-day finding (78 FR 13614), announcing that the petition presented substantial scientific or commercial information indicating the petitioned action of listing the species may be warranted and explained the basis for that finding. We also announced the initiation of a status review of the species, as required by section 4(b)(3)(a) of the ESA, and requested information to inform the agency's decision on whether the species warranted listing as endangered or threatened under the ESA.

Listing Species Under the Endangered Species Act

Section 4(b)(3)(B) of the ESA requires us to make a finding within 12-months of the date of receipt of any petition that was found to present substantial information indicating that the petitioned action may be warranted. The 12-month finding must provide a determination of whether the petitioned action is: (a) not warranted; (b) warranted; or (c) warranted but precluded. In this case, we are responsible for determining whether the humphead wrasse warrants listing as threatened or endangered under the ESA (16 U.S.C. 1531 et seq.). To make this determination, we first consider whether a group of organisms constitutes a "species" under section 3 of the ESA, then whether the status of the species qualifies it for listing as either threatened or endangered. Section 3 of the ESA defines 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 (61 FR 4722). The DPS Policy identifies 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.

Section 3 of the ESA further defines an "endangered species" as "any species which is in danger of extinction throughout all or a significant portion of its range" and a "threatened species" as one "which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." Thus, in the context of the ESA, we interpret an "endangered species" to be one that is presently in danger of extinction. A "threatened species" is not presently at risk of extinction, but is likely to become so in the foreseeable future.

The key statutory difference between an endangered and threatened species is the timing of when a species may be in danger of extinction, either presently (endangered) or in the foreseeable future (threatened).

Section 4 of the ESA and implementing regulations at 50 CFR part 424 require us to determine whether any species is endangered or threatened as a result of any one or a combination of the following five factors: (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence (ESA section 4(a)(1)(A)-(E)). Section 4(b)(1)(A) of the ESA requires us to make listing determinations based solely on the best scientific and commercial data available after conducting a review of the status of the species and after taking into account efforts being made by any State or foreign nation or political subdivision thereof to protect the species. We also consider the comments received in response to issuance of the 90-day finding. In evaluating the efficacy of existing protective efforts, we rely on the Services' joint Policy on Evaluation of Conservation Efforts When Making Listing Decisions ("PECE"; 68 FR 15100; March 28, 2003). The PECE provides direction for considering conservation efforts that have not been implemented, or have been implemented but not yet demonstrated effectiveness.

Status Review

We appointed an Endangered Species Biologist in the Protected Resources Division of the NMFS Pacific Islands Regional Office (PIRO) to gather and review the best available data and information on the life history and ecology, distribution, abundance, and threats to the humphead wrasse and to document this review in a status review report. Next, we convened a team of four biologists (hereinafter referred to as the Extinction Risk Analysis (ERA) Team) to conduct an extinction risk analysis for the humphead wrasse, using the information in the status review report. The ERA Team was comprised of three fishery biologists from NMFS' Pacific Island Fisheries Science Center and a fishery biologist with NMFS PIRO's Habitat Conservation Division. The ERA Team had expertise in reef fish biology and ecology, population dynamics, and stock assessment science. The ERA Team documented their evaluation of possible DPSs for the humphead wrasse and their professional judgment of the extinction risk facing the humphead wrasse in the status review report (Graham et al., 2014). The report makes no recommendation as to the listing status of the species. The status review report is available electronically at http://www.fpir.noaa.gov/PRD/prd_humpheadwrasse.html.

The status review report was then subjected to peer review as required by the Office of Management and Budget Final Information Quality Bulletin for Peer Review (M-05-03; December 16, 2004). The status review report was peer reviewed by three independent specialists selected from the academic and scientific community, with expertise in reef fish biology, conservation and management, and knowledge of humphead wrasse. The peer reviewers were asked to evaluate the adequacy, appropriateness, and application of data used in the status review as well as evaluate the findings made in the "Assessment of Extinction Risk" section of the report. All peer reviewer comments were addressed prior to dissemination of the final status review report and publication of this determination.

Life History, Biology, and Status of the Petitioned Species

Below we summarize the key life history and species information from the status review report (Graham et al., 2014). More detailed information is available in the status review report, which is available electronically at http://www.fpir.noaa.gov/PRD/prd_humpheadwrasse.html.

Species Description

The humphead wrasse is the largest member of the family Labridae. Found throughout the Indo-Pacific Ocean, the humphead wrasse is distinguished from other coral reef fishes, including other wrasses, due primarily to its large size along with its fleshy lips in adults (Myers, 1999), prominent bulbous hump that appears on the forehead in larger adults of both sexes, and intricate markings around the eyes (Marshall, 1964; Bagnis et al., 1972; Sadovy et al., 2003a).

The humphead wrasse has a reported maximum length of 229 cm total length (TL) (7.5 ft) and weight of 190.5 kg (420 lbs) (Marshall, 1964; Myers, 1989; Lieske and Myers, 1994; Donaldson and Sadovy, 2001; Westneat, 2001; Sadovy et al., 2003a; Russell, 2004); however, there are no confirmed records of this species greater than 150 cm fork length (FL) (Choat et al., 2006). (TL is measured from the tip of the snout to the tip of the longer lobe of the caudal or tail fin; whereas, FL is measured from the tip of the snout to the end of the middle caudal fin rays (i.e., where the fork of the tail begins). TL is longer than FL). The maximum age of humphead wrasse is estimated to be 30 years for females and 25 years for males (Sadovy et al., 2003a; Choat et al., 2006; Andrews et al., in review).

The development of the cephalic hump is related to body size and is visible at 37 cm TL, with all individuals ≥ 75 cm TL exhibiting a distinctive hump, irrespective of sex (Liu and Sadovy de Mitcheson, 2011). Therefore, C. undulatus does not show obvious sexual dimorphism of the forehead extension, meaning that it is not a reliable criterion for differentiating males and females. The species has 9 dorsal fin spines, 10 dorsal fin rays, 3 anal fin spines, and 8 anal fin rays (Sadovy et al., 2003a). Juveniles are pale gray/green with large dark spots on some of the scales that produce a series of broad dark bands, interspersed with narrower white bands along the length of the body and a pair of distinctive parallel black lines before and after the eye (Sadovy et al., 2003a). Colin (2006) notes that juvenile C. undulatus resemble juvenile C. trilobatus and C. chlorurus, with similar shape, some resemblance in coloration, similar swim fashion, and can all occur in the same habitat. The author notes that the similarities with these two more common species can result in confusion and misidentification of juvenile C. undulatus.

Adults are olive green to blue-green with large scales. A narrow dark bar on each scale breaks into irregular dark lines anteriorly on the body with growth (Randall, 2005). The head is a blue-green to blue with irregularly wavy yellowish lines (Sadovy et al., 2003) with the same two slightly oblique black lines extending posteriorly from the lower half of the eye, often with two more black lines extending from the eye to the rear part of the upper lip (Randall, 2005). These distinctive patterns of lines makes identifying individual fish possible if the head pattern and spots can be seen or photographed. While there is no apparent sexual dichromatism or permanent difference in color between sexes (Sadovy et al., 2003a), temporary color differences between males and females are seen during reproduction (Colin, 2010).

Distribution

The humphead wrasse is widely distributed on coral reefs and nearshore habitats throughout much of the tropical Indo-Pacific Ocean. The biogeographic range of the humphead wrasse spans from 30° N to 23° S latitude and includes the Red Sea south to Mozambique in the Indian Ocean, from southern Japan in the northwest Pacific south to New Caledonia in the south

Pacific and into the central Pacific Ocean including French Polynesia. The humphead wrasse has been recorded from many islands of Oceania, but appears to be absent from the Hawaiian Islands, Johnston Island, Easter Island, Pitcairn, Rapa, and Lord Howe Island with the exception of occasional waifs (Randall et al., 1978). In the United States (U.S.), the species is found in the territories of American Samoa, the Commonwealth of the Northern Mariana Islands (CNMI), and Guam. In the U.S. Pacific Remote Island Areas, the species is found in the Line (Palmyra Atoll, Kingman Reef, and Jarvis Island) and Phoenix (Howland and Baker) Islands, and at Wake Atoll.

Habitat

The humphead wrasse is widely distributed in low densities on all types of coral reef environments and nearshore habitats throughout much of the tropical Indo-Pacific. Both coral reefs and seagrass beds have been reported to provide a nursery habitat for post-settlement and juvenile humphead wrasse (Sadovy et al., 2003a; Russell, 2004). Juveniles are also observed in murky outer river areas with patch reefs, shallow sandy areas adjacent to coral reef lagoons, and in mangroves (Randall, 1955; Randall et al., 1978; Myers, 1989; Sadovy et al., 2003a; Myers, 1999).

Unlike juveniles, adults are more commonly observed inhabiting offshore habitats along steep outer reef slopes, reef drop offs, channel slopes, reef passes, reef flats, and lagoonal reefs to depths of up to at least 100 m (Randall, 1978; Myers, 1989; Sadovy et al., 2003a; Zgliczynski et al., 2013). Fish size and abundance are correlated with habitat type, with the largest fish and most dense groups of humphead wrasses observed on barrier reefs and passes. In coastal, middle reefs and lagoon areas, smaller fish (< 50 cm TL) are typically observed among branching staghorn corals (Acropora spp.) (Sadovy et al., 2003a).

Movement and Behavior

The numbers of fish found together can vary. According to Sadovy et al. (2003a), juveniles are typically solitary, wary, and difficult to approach, though they can be found in small groups. Adults are typically observed solitary or paired (Myers, 1989; Sadovy et al., 2003a) but have also been noted in groups of 3-7 individuals (Donaldson, 1995; Sadovy et al., 2003a). Additionally, small social units can be observed moving together in less heavily fished areas, while lone and more wary individuals are more often noted in heavily fished areas (Sadovy et al., 2003a).

Based on mensurative in situ observations, humphead wrasse display site fidelity and predictable home ranges with the same individuals, identifiable by distinct head markings, observed along the same stretches of reef for extended periods, although the lengths of these periods are not defined. Additionally, adults often use a consistent resting place (i.e., cave or crevice) at night or when threatened (Bagnis et al., 1972; Myers, 1989; Thaman, 1998; Myers, 1999; Donaldson and Sadovy, 2001; Sadovy et al., 2003a; Chateau and Wantiez, 2007).

Factors such as sex, age, and size of the fish directly influence the home range size of the humphead wrasse, with smaller fish using a fraction of the area occupied by adults (Sadovy et al., 2003a citing T.J. Donaldson, unpublished data). A single juvenile (45 cm FL) humphead wrasse that had been surgically implanted with an ultrasonic transmitter in New Caledonia moved at least 20-200 m every day and had an estimated home range size of at least 50,000 m^2 (Chateau and Wantiez, 2007). In Palmyra Atoll, 19 acoustically tagged juveniles and adults (ranging in length from 27 to 109 cm TL) had home range sizes of 800 m^2 to 19,000 m^2, with the smallest home ranges occupied by juveniles, intermediate ranges for adult males, and largest ranges occupied for adult females (Weng et al., in press).

Foraging Ecology

The humphead wrasse is a diurnal carnivore, feeding during the day and sleeping at night (Durville et al., 2003; Gillbrand et al., 2007). Much of its prey is found in sand or rubble habitats where it feeds on a variety of molluscs, small fishes such as gobies, moray eels, sea urchins, crustaceans, brittle stars, starfish, and other invertebrates (Randall et al., 1978; Myers, 1989; Randall et al., 1997; Thaman, 1998; Sadovy et al., 2003a; Choat et al., 2006). Similar to other wrasse (Labridae), humphead wrasses forage by turning over or crushing rocks and rubble to reach cryptic organisms (Pogonoski et al., 2002; Sadovy et al., 2003a citing P.S. Lobel, pers. comm.). The thick fleshy lips of the species appear to absorb sea urchin spines, and the pharyngeal teeth easily crush heavy-shelled sea snails in the genera Trochus spp. and Turbo spp. The humphead wrasse is also one of the few predators of toxic animals such as boxfishes (Ostraciidae), sea hares (Aplysiidae), and crown-of-thorns starfish (Acanthaster planci) (Randall, 1978; Myers, 1989; Thaman, 1998; Sadovy et al., 2003a). Consumption of toxic species in certain areas, particularly Tahiti, Tuvalu, New Caledonia, the Tuamotu Archipelago (French Polynesia), Marshall Islands, and the Federated States of Micronesia can cause the humphead wrasse to be ciguatoxic to humans (Randall, 1958; Randall et al., 1978; Randall, 1979; Lewis, 1986; Myers, 1989; Dalzell, 1992; Dalzell, 1994; Sadovy, 1998; Myers, 1999; Sadovy et al., 2003b; Sadovy, 2006).

Reproduction and Growth

Field reports reveal variable humphead wrasse spawning behavior, depending on location

(Sadovy et al., 2003a; Colin, 2010). Spawning can occur between several and all months of the year, coinciding with certain phases of the tidal cycle (usually after high tide) and possibly lunar cycle (Sadovy et al., 2003a; Colin, 2010). Spawning can reportedly occur in small (< 10 individuals) or large (> 100 individuals) groupings, which can take place daily in a variety of reef types (Sadovy et al., 2003a; Sadovy de Mitcheson et al., 2008; Colin, 2010).

Data from captive rearing programs indicates that egg diameter ranges from 0.62-0.67 mm, and newly hatched larvae are 1.5-1.7 mm TL (Slamet and Hutapea, 2005). Eggs are spherical and lack pigment (Sadovy et al., 2003 citing P.L. Colin, unpublished data). Little information is available regarding larval dispersal in the wild (Poh and Fanning, 2012). However, in unpublished work P.L. Colin (pers. comm.) found that eggs of humphead wrasse moved slowly off the western barrier reef of Palau over a few hours in tidal currents, and then stalled before moving laterally along the reef. Some eggs are brought back in over the barrier reef, while others remain at sea, all in the first 12 hours after spawning.

Humphead wrasse larvae settle out of the plankton at a size of 8 to 15 mm TL, with a mode of 12 mm TL (at an unspecified larval duration), and reach 35 mm TL or greater within 2 to 3 weeks post-settlement (Tupper, 2007 citing M. Tupper, unpublished data). Slamet and Hutapea (2005), however, indicate that growth of larvae is actually much slower. The authors report that captive larvae reach 50-60 mm TL in 6 months. Settlement varies among habitat types.

As is common in wrasses, the humphead wrasse is a protogynous hermaphrodite, capable of changing sex from female to male around 9 years of age (Choat et al., 2006; Sadovy de Mitcheson et al., 2010). At around 6 months of age, juveniles are approximately 5-6 cm TL

(Slamet and Hutapea, 2005), reaching 50 cm TL at approximately 7 years of age. As females reach sexual maturity growth slows, with few individuals observed > 100 cm TL. Male growth rates are approximately double those of females, resulting in relatively young but large males (Choat et al., 1996; 2006).

Size at maturity for males and females is difficult to compare across studies because some measurements are reported as TL and others as FL. Sadovy et al. (2003a) estimates that females reach sexual maturity at around 5 years of age and 35-50 cm TL. Other histological studies estimate that sexual maturity is reached around 40-60 cm TL, which is estimated to be about 5-7 years of age (Pogonoski et al., 2002 and Russell, 2004 citing Sadovy, unpublished data; Sadovy et al., 2011). Another study analyzing early gonadal development on 178 humphead wrasse specimens revealed that minimum body sizes for female and male sexual maturation were 65 cm and 84.5 cm TL, respectively (Sadovy de Mitcheson et al., 2010). However, the authors note that despite the results from this study, based on available information, it is suggested that the typical size of female sexual maturation for the humphead wrasse occurs at 40-50 cm TL (Sadovy de Mitcheson et al., 2010). Choat et al. (2006) estimated length at first maturity as 45-50 cm FL for females (6-7 years) and 70 cm FL (9 years) for males. Despite the apparent differences in estimated minimum size of female sexual maturation among the different studies and locations, the age at first maturity is relatively late, representing about 20% of the female life span as opposed to 5-6% of the female life span observed in most other reef fishes with life spans in excess of 30 years (Choat and Robertson, 2002).

Natural Mortality

Natural adult mortality is thought to be low (Sadovy et al., 2003a). As for mortality due to predation, little is known though it is thought there is refuge in size. Although adult humphead wrasses are most vulnerable during spawning, apex predators including sharks are not known to prey on adult humphead during this time (Colin, 2010).

Population Structure

Very little published genetic research is available on the humphead wrasse other than the results of sequencing the mitochondrial genome of the species (Qi et al., 2013). Research is currently underway to analyze 200 humphead wrasse samples collected from the eastern Indian Ocean to Pohnpei and from the Great Barrier Reef to the Marianas Islands. Preliminary analyses of mitochondrial DNA from a subset of samples from across the range suggest no deep genetic differentiation on the scale of ocean basins, though robust conclusions await final analyses of the complete dataset (Michael Dawson, pers. comm.). Additionally, no tagging or tracking studies of a scale sufficient to define population structure have been conducted. Although a number of studies have provided abundance estimates based on in situ surveys, there are no current studies or references describing population structure.

Population Abundance

There are no historical estimates (pre-1970s) of global or local abundance or biomass of humphead wrasse. When limited surveys first began on this species in the early 1970s, the species was generally characterized as being naturally uncommon to rare in places (Bagnis et al., 1972; Galzin et al., 1998; Sadovy et al., 2003a and IUCN, 2008 citing Galzin, 1985; IUCN, 2008 citing Tropical Research and Conservation Centre - Malaysia (TRACC), 2004). For example, in 1972 Taiaro lagoon, a 9 km^2 uplifted lagoon (maximum depth of 27 m dominated by talus sand and small dispersed patch reefs) of Taiaro Atoll in Tuamotu Archipelago, French Polynesia, where this species was not fished and fish diversity was high, abundance was estimated to be 1-2 fish per 10,000 m^2 (Galzin et al., 1998). This abundance remained unchanged during repeat surveys in 1992 and 1994 (Galzin et al., 1998). In the Society Islands of French Polynesia, humphead wrasses were also reported to be uncommon in the early 1970s (Bagnis et al., 1972; IUCN, 2008 citing Galzin, 1985).

Past catch records for some locations, when compared to more current catch records, although the data are sparse, indicate that some populations were at one time greater than present day (i.e., Australia, Fiji, Malaysia, Palau [IUCN, 2008]). However, inferences regarding abundance from fishery dependent data are subject to uncertainty from effects of fishing methods, size selectivity, fishery participation, regulation, and methods of collecting data. Such uncertainty is also true in relation to inferences made from underwater surveys when habitat information and survey methodology are not known.

Efforts to estimate abundance and density of humphead wrasse have been completed in certain regions within the species' range (e.g., U.S. Pacific Islands) using underwater visual census techniques designed to quantify the abundance of these relatively rare/uncommon and wide-ranging fish. Although humphead wrasses are widely distributed, natural densities are typically low, even in locations where habitats are presumably intact. Unfished or lightly fished areas have densities ranging from 2-27 individuals per 10,000 m^2 of reef (Sadovy et al., 2003a). For example, at Wake Atoll where there is zero fishing pressure for the species, surveys that recorded primarily juveniles (< 30 cm TL) reported the naturally low abundance of the species at 13-27 individuals per 10,000 m^2 (Sadovy et al., 2003a and IUCN, 2008 citing P.S. Lobel, pers. comm., and Lobel and Lobel, 2000). This is the highest recorded abundance of any location and one of the most protected areas. Abundance of sub-adult and adult humphead wrasse observed from towed-diver surveys of fore reef habitats (10-15 m depth) at Wake Atoll conducted by NMFS Pacific Islands Fisheries Science Center (PIFSC) Coral Reef Ecosystem Division (CRED) in 2005, 2007, 2009, and 2011 is lower. Four years of biannual surveys from this time period report an average of 1.101 large (> 50 cm TL) individuals per 10,000 m^2 (NMFS PIFSC CRED, unpublished). Palmyra Atoll, also a U.S. Pacific Remote Island Area where the species is completely protected, had similarly naturally low abundance levels despite decades of complete protection. Abundance of large (> 50 cm TL) humphead wrasse observed from towed-diver surveys of fore reef habitats (10-15 m depth) of Palmyra Atoll conducted biannually from 2001-2012 is 0.641 individuals per 10,000 m^2 (NMFS PIFSC CRED, unpublished).

At sites near human population centers or at fished areas, densities are typically lower by tenfold or more and in some locations humphead wrasse are rarely observed (Sadovy et al., 2003a; Colin, 2006; Sadovy, 2006b; Unsworth et al., 2007). However, in some areas, such as the previously mentioned Tuamotu Archipelago, French Polynesia, abundance of humphead wrasse is low to non-existent, even when fisheries exploitation is known to be low or non-existent (Galzin et al., 1998). Another example is the northernmost uninhabited islands of the Marianas Archipelago (Uracus, Maug, and Asuncion), which are part of the Marianas Trench Marine National Monument. Here, where commercial fishing is prohibited and recreational or subsistence fishing is very rare given the distance from most of the southern inhabited areas of the island chain, humphead wrasses were not observed. However, in the southern inhabited part of the chain where some protections for the species exist, large (> 50 cm TL) humphead wrasses are present though abundance levels are low (i.e., biannual towed-diver surveys of fore reef habitats (10-15 m depth) from 2003-2011 of the entire Marianas Archipelago reports an average of 0.059 individuals per 10,000 m^2 (Brainard et al., 2012; NMFS PIFSC CRED, unpublished data)).

Status of the Species

Other than activities associated with the live reef food fish trade (LRFFT), there are few "directed" fisheries for the humphead wrasse due to its natural rarity and the inherent difficulty of capturing the fish (Gillett, 2010). In most countries where the fish occurs, most of the catch of this species is for domestic use. Commercially, the humphead wrasse is caught in low volume fisheries in different ways according to its size and whether it is needed alive or dead (Sadovy et al., 2003a). The species is sold for domestic consumption, exported for food for the LRFFT, exported for mariculture until the fish is large enough for consumption, or exported for aquaria.

The LRFFT is a highly lucrative industry that involves the capture of reef fish that are kept alive for sale and consumption. For about three decades, the humphead wrasse has been a small but significant component of the commercial LRFFT as one of the highest-valued luxury food items (Sadovy et al., 2003a; Sadovy et al., 2003b; Gillett, 2010). Indonesia, Malaysia, and the Philippines are the top three exporters of humphead wrasse for the LRFFT, respectively. The major importing countries for the species are China (especially Hong Kong), Taiwan, and Singapore (Sadovy et al., 2003a).

In 1996, the humphead wrasse was listed as "vulnerable" on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species due to concerns over rapidly declining numbers in many areas. In 2004, the species was reclassified to "endangered" on the IUCN Red List. Also in 2004, the species was included in Appendix II in the Convention on

International Trade in Endangered Species of Wild Fauna and Flora (CITES). Appendix II includes species that are vulnerable to overexploitation, but not at risk of extinction under CITES criteria; trade must be regulated to avoid exploitation rates incompatible with species survival.

Distinct Population Segment Analysis

As described earlier, the ESA's definition of "species" includes "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." The petitioners did not request that NOAA consider listing a DPS; however, the ERA Team was asked to evaluate whether any populations of the species might qualify as DPSs based on the elements of discreteness and significance as defined in the DPS Policy. The ERA Team found support for discreteness of the humphead wrasse population within the "core-Coral Triangle" area of Indonesia, Malaysia, and the Philippines solely on the basis that the population is delimited by international governmental boundaries within which regulation and governance of threats are different from other portions of the species' range. There was no support to conclusively subdivide the species into discrete population segments on the basis of genetics, morphology, behavior, physical factors, or other biological characteristics.

When evaluating whether the core-Coral Triangle DPS met the significance criteria, the team found some support for the "persistence of the discrete population segment in an ecological setting unusual or unique for the taxon." According to the Team (see Appendix 1 of the Status Review Report), this support was largely based on the fact that the three countries within the core-Coral Triangle area contain approximately 50 percent of mangroves and 30 percent of coral reefs within the species range, both of which provide important habitat for various humphead wrasse life stages. However, the team acknowledged that because coral reef and mangrove habitats also occur outside the range of the proposed DPS, neither of those habitat types is unique to the core-Coral Triangle area, nor did they identify any other unique habitat features of this area. The ERA Team did consider that the humphead wrasse plays a relatively unique ecosystem role in the core-Coral Triangle area due to its co-occurrence with two significant prey species that likely have interdependent ecological roles. However, the humphead wrasse also overlaps with the two significant prey species outside the range of the proposed DPS, and although the overlap may not be as widespread, the team acknowledged that this ecological structure is not truly unique to the core-Coral Triangle area. Thus, overall, the significance criterion of the DPS Policy is not well supported.

As stated in the DPS Policy, Congress instructed the Services to exercise their authority with regard to DPSs "…sparingly and only when the biological evidence indicates that such action is warranted." Given this direction from Congress and the weak support for the significance of the core-Coral Triangle DPS, we declined to consider this DPS further and asked the ERA Team to conduct the extinction risk analysis on the entire global population of the humphead wrasse.

Assessment of Extinction Risk

When evaluating whether the humphead wrasse meets the definition of threatened or endangered, we considered the best available information and applied professional judgment in evaluating the level of risk faced by a species. We qualitatively evaluated demographic risks, such as low abundance and productivity, along with other threats to the species. A quantitative viability analysis (i.e., population modeling) was not conducted for the humphead wrasse because of the limited or inadequate data on population size, definitive trends in population size or apparent abundance, intrinsic rate of increase, mortality rates, or size structure. Lastly, as required under section 4(b)(1)(A), we also took into account conservation efforts being made to protect the species.

Methods

The term "foreseeable future" was defined as the future timeframe over which demographic risks and threats can be reliably predicted to impact the biological status of the humphead wrasse. The Team took into account the life history of the species, including the longevity of the species (25-30 years), and assumed 6-7 years for generation time (which is defined as the time it takes, on average, for a sexually mature female humphead wrasse to be replaced by offspring with the same spawning capacity). Considering all of this, the Team agreed that it would likely take several generation times for any conservative management action to be realized and reflected in population abundance. Therefore, the ERA Team chose to project threats in the "foreseeable future" out to eight generations, or about 50 years.

Previous NMFS status reviews have involved use of a risk matrix method to organize and summarize the professional judgment of a panel of knowledgeable scientists. This approach is described in detail by Wainright and Kope (1999) and has been used in Pacific salmonid status reviews as well as in the status reviews of many other species (see http://www.nmfs.noaa.gov/pr/species for links to these reviews). In the risk matrix approach, the collective condition of individual populations is summarized at the species level according to four demographic risk criteria: abundance, growth rate and productivity, spatial structure and connectivity, and diversity. These viability criteria, outlined in McElhany et al. (2000), reflect concepts that are well founded in conservation biology and that individually and collectively provide strong indicators of extinction risk. Using these concepts, the ERA Team estimated demographic risks by assigning a risk score to each of the four demographic criteria. The scoring for the demographic risk criteria correspond to the following values: 1 – no risk, 2 – low risk, 3 – moderate risk, 4 – high risk, and 5 – very high risk. The Team members also expressed their certainty regarding evidence of demographic risk using a ranking of low, medium, and high. Detailed definitions of the risk scores can be found in the status review report.

The ERA Team then performed a threats assessment for the humphead wrasse by ranking the effect that each threat was having on the extinction risk of the species, both now and in the foreseeable future. The four threat effect levels ranged from "no effect," "small effect," "moderate effect," and "significant effect" on the extinction risk to the humphead wrasse. To allow individuals to express a distribution of risk scores in assessing the impacts of the threats to the species, the ERA Team adopted the "likelihood point" (FEMAT) method using 8 "likelihood points" per Team member for the four threat effect levels. A similar approach has been used in previous NMFS status reviews (e.g., Pacific salmon, Puget Sound rockfish, Pacific herring, black abalone, great hammerhead shark) to structure the Team's thinking and express levels of risk as a distribution in assigning threat risk categories. The scores were then tallied (frequency, range, mode, and median) and summarized for each threat, and considered in making the overall risk determination. The Team members also expressed their certainty regarding evidence of potential threats using a ranking of low, medium, and high.

Guided by the results from the demographics risk analysis as well as the threats assessment, the ERA Team members used their informed professional judgment to make an overall extinction risk determination for the humphead wrasse now and in the foreseeable future (up to 50 years). For these analyses, the ERA Team defined five levels of overall extinction risk: 1 – no risk, 2 – low risk, 3 – moderate risk, 4 – high risk, and 5 – very high risk. Detailed definitions of these risk levels can be found in the status review report. Again, the ERA Team adopted the FEMAT method, distributing 10 "likelihood points" per Team member among the five levels of extinction risk. The scores were then tallied (frequency, mode, and median for likelihood points, and mean and range for certainty) and summarized. The Team members again expressed their certainty in a ranking of low, medium, and high.

Finally, the ERA Team drew scientific conclusions about the overall risk of extinction faced by the humphead wrasse under present conditions and in the foreseeable future based on an evaluation of the species' demographic risks and assessment of threats. The Team did not make recommendations as to whether the species should be listed as threatened or endangered, or if it did not warrant listing.

Evaluation of Demographic Risks

Abundance

Currently, there are no formal estimates of population size throughout most of the humphead wrasse's range. It is known that this species is uncommon to rare throughout most of its range, in some cases exhibiting low abundance in areas where no anthropogenic stressors are evident. In the CNMI, for example, humphead wrasses appear to be more prevalent in the southern populated islands, as compared to the mostly uninhabited or lightly populated islands north of Saipan. In this case, several factors may influence humphead wrasse abundance such as total habitat availability, fishing access to humphead wrasse due to island size and/or orientation, and restrictions on fishing effort.

Declines in abundance appear to be restricted to particular areas where the LRFFT has been active for several decades. In some areas where no apparent harvest occurs, the species has not demonstrated any notable changes between surveys. One aspect lacking in many fishery-independent surveys is meaningful time series of observations incorporating standardized methodological protocols. Without such time series, drawing firm conclusions based on temporally and/or spatially distinct observations is simply not possible. In addition, surveyed locations (i.e., exact locations, habitat type, water depth) and methods (i.e., stationary point count, towed-diver surveys) are an important descriptor in survey work, as not all areas where the humphead wrasse exists are equally accessible for underwater visual census surveys. In other words, it is difficult to draw conclusions on abundance from survey results across different locations and time frames.

Existing information suggests that humphead wrasse populations are most abundant and stable in the Indian Ocean. However, populations in the core-Coral Triangle area, where harvest has been significant near population centers, appear to remain depressed to a degree that is not quantifiable.

There are "pockets" of abundance in Malaysia (e.g., Pulau Layang Layang, West of Sabah, and Pulau Sipadan, as well as Hoga Island in Wakatobi Marine National Park) where either military or management protection exists (IUCN, 2008 citing TRACC, 2004). These pockets of abundance in the core-Coral Triangle area should be considered crucial as important potential source populations to other core-Coral Triangle populations. However, density estimates from these protected locations are at least a decade old, and no recent information is available to indicate that these densities have remained stable, although there is no reason to expect otherwise, especially in designated military bases, where access is assumed to be extremely limited.

There are many other foreign and domestic areas where the species has been protected by fishing regulations or reserves, and the species continues to be observed throughout the Pacific wherever surveyed. Recent relative abundance data suggest that many populations, especially those in U.S. waters, are either stable, show no clear trend, or may be increasing (Graham et al 2014).

Based on the very limited abundance information available and its natural rarity, along with depressed population sizes in the center of the species' range due to overharvest, the ERA Team concluded that the demographic factor of abundance had a low-to-moderate likelihood of contributing to the humphead wrasse's risk of extinction now, and a moderate-to-high likelihood of contributing to the risk of extinction in the foreseeable future. The ERA Team was concerned that the species' low abundance levels, whether natural or manmade, may pose a risk to its continued existence if faced with other demographic risks or threats, such as overutilization, because a species that is already at naturally low levels may not be able to withstand heavy fishing pressure. Of the four demographic factors, abundance was considered by the ERA Team to pose the highest demographic risk to the species. Risk was found to be higher in the foreseeable future than now simply because the increased chance that declines in abundance may become more serious with the passage of time, unless regulations are effective and enforced. Certainty of abundance affecting the risk of extinction to the humphead wrasse now was deemed medium; certainty of abundance affecting the risk of extinction to the humphead wrasse in the foreseeable future was deemed low.

Growth Rate and Productivity

Regarding the effect of the humphead wrasses' growth rate and productivity on its risk of extinction, the ERA Team expressed less concern compared to their concern for abundance. The intrinsic rate of increase, or productivity, is a complex function of fecundity, survival rates, age at maturity, and longevity of a species. Productivity determines a species' ability to recover from low numbers, if extrinsic factors are not limiting, as well as the level of harvest that can be taken from a population sustainably (Hudson and Bräutigam, 2007). For the humphead wrasse, productivity is estimated to be 0.72 per year (Fishbase.org). This places the humphead wrasse towards the slow end of the slow-to-fast growth continuum of reef fishes. While the humphead wrasse may be more productive than other reef fish that are highly exploited in the LRFFT, such as the giant grouper (Epinephelus lanceolatus), it is not as productive as the leopard coral grouper (Plectropomus leopardus) or the mangrove red snapper (Lutjanus argentimaculatus), two species which are also highly exploited in the LRFFT. The Team recognized that being towards the slow end of the continuum creates some extinction risk compared with fish that grow faster. As such, the ERA Team concluded that the demographic risks of growth rate and productivity pose a low risk to the humphead wrasse's continued existence now and a moderate risk in the foreseeable future. Certainty of growth rate and productivity affecting the risk of extinction to the humphead wrasse now was deemed medium; certainty in the foreseeable future was deemed low.

Spatial Structure/Connectivity and Diversity

The species' population depends on dispersal dynamics of individuals as well as habitat quality and existing spatial structure. Connectivity is through spawning and planktonic larval dispersal processes. Spatial structure and genetic diversity are important as they affect the species' ability to survive in diverse environments and enable the population to respond to and survive long-term environmental changes.

The humphead wrasse is known to occur in waters around 48 countries, from the Red Sea, east through the tropical Indian and Pacific Oceans, to French Polynesia. This geography includes tens-of-thousands of islands with diverse and varying bathymetry (e.g., shallow coral reefs) along mainland coasts, most within close proximity and presumed easy dispersal reach of pelagic larvae of this species.

Essentially very little is known regarding the spatial structure and genetic diversity of the humphead wrasse. It is not known if there are any manmade or ecological factors that could significantly alter gene flow in the species, nor is it known if the humphead wrasse consists of more than one population throughout its range or if any genetically distinct populations exist. Without definitive genetic information, the Team assumed that the species does not appear to be at risk of a genetic bottleneck, meaning that the humphead wrasse is likely able to adapt overtime to changing environments.

Although data are either completely lacking or inadequate, it can be reasonably presumed that, across its entire range, the characteristics of spatial structure/connectivity and genetic diversity, by themselves, are unlikely to contribute to an extinction risk for the humphead wrasse. Therefore, the ERA Team concluded that the demographic factor of spatial structure and connectivity posed no-to-low risk to the humphead wrasse's continued existence both now and in the foreseeable future, with certainty deemed low for both timeframes. The Team also concluded that diversity posed a low risk to the humphead wrasse's continued existence both now and in the foreseeable future, with certainty deemed low for both timeframes.

Summary of Factors Affecting the Humphead Wrasse

As described above, section 4(a)(1) of the ESA and NMFS implementing regulations (50 CFR part 424) state that we must determine whether a species is endangered or threatened because of any one or a combination of the following five ESA factors: (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) inadequacy of existing regulatory mechanisms; or (E) other natural or man-made factors affecting its continued existence. The ERA Team evaluated whether and the extent to which each of the foregoing factors contributed to the overall extinction risk of the global humphead wrasse population. This section briefly summarizes the ERA Team's findings and our conclusions regarding threats to the humphead wrasse. More details can be found in the status review report (Graham <u>et al.</u>, 2014).

<u>(A) The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range</u>

The ERA Team evaluated habitat destruction as a potential threat to the humphead wrasse and found this threat may have a small effect on the extinction risk of the humphead wrasse now, meaning that it is unlikely that it is presently increasing the species' risk of extinction. In the foreseeable future, the Team found that it is moderately likely that this threat is increasing the species' extinction risk. Certainty of the potential effects of habitat destruction on the extinction risk of the species was deemed medium for both now and in the foreseeable future.

With regard to destructive fishing practices, cyanide fishing is the major practice that is used to target this wrasse, although a relatively small number of mostly small-sized fish of this species might occasionally be killed incidentally during blast fishing for other reef fishes in open-reef environments. The intent in using cyanide is to stun juvenile wrasse and capture them alive for subsequent grow-out for sale in the LRFFT; however, some and perhaps a substantial proportion of cyanide-fished wrasse die prior to actually contributing product to the industry. Cyanide fishing is still a major fishing method in Southeast Asia, but cyanide fishing is presently much less of a concern throughout the rest of the Indo-Pacific region (Sadovy de Mitcheson and Yin, in press), and thus of less concern to the species throughout its range. In addition to its deleterious effects on humphead wrasse, the cyanide released into and near the reef substrate has substantial acute mortality and delayed health effects on other fishes in and near the reef and on the non-fish motile, sessile, and other biota including corals.

Regarding the loss and modification of juvenile nursery areas, burgeoning coastal development and poor land management (e.g., sedimentation) in developing tropical countries appears to be the major threat to the seagrass and branching coral and macroalgal habitats that provide juvenile nursery habitat. The cutting of mangroves for firewood used to fuel open-fire cooking stoves is another increasing problem reflecting exponential human population growth in many of these developing countries. Approximately one-third of all mangroves worldwide have been lost in the past 50 years.

Regarding the loss and modification of adult habitat, the major threat to the primary habitat of forereef and open-lagoons appears to be climate change-induced coral bleaching and acidification, both of which are impacting corals and other organisms with carbonate skeletons, although at varying degrees according to susceptibility. Although adult humphead wrasses use caves and other structures in rock and dead coral limestone substrates to a great extent and are not directly dependent on living corals, humphead wrasses are most numerous near abundant live coral. Moreover, in geological time even consolidated dead coral limestone substrates will decline because of weathering if the replenishment rates of stony corals decline. Concern over this factor and coastal development over a longer term was influential in the conclusion that habitat loss could have moderate effects on extinction risk in the foreseeable future.

Based on the best available information, we do not find that habitat destruction, modification, or curtailment are threats that are presently, or in the foreseeable future, placing the species at an increased risk of extinction. Cyanide has recently been banned in a number of countries throughout the species' range, and illegal use appears to be waning and is much less of a concern outside of the Coral Triangle region. The magnitude of direct and indirect threats to juvenile and adult habitats is variable with no evidence of substantial or widespread habitat loss or destruction.

(B) Overutilization for Commercial, Recreational, Scientific or Educational Purposes

The ERA Team identified overutilization as a threat with a small-to-moderate effect on the extinction risk of the humphead wrasse now, and a moderate effect on the extinction risk to the species in the foreseeable future. Certainty of the potential effects of overutilization on the extinction risk of the species was deemed medium for now and low for the foreseeable future.

Estimates of overutilization have been hampered by a dearth of information regarding landings data and illegal, unregulated, and unreported fishing. Fisheries that land humphead wrasse appear to lack detailed temporal information pertaining to fishing effort, fishing power, harvest location, seasonal changes in landings, as well as the institution of management protocols. For example, IUCN (2008) notes a 10-fold decrease in market landings from Palau from the mid 1980s to mid-1990s, though fails to note that scuba spearfishing was banned in the early 1990s and may be directly linked to that stated decline. Although declines in landings were noted in some jurisdictions, information indicating no changes in landings is either not noted or not available. This may be a result of humphead wrasse representing a minor component of most coral reef fisheries throughout its range because of its natural rarity.

Anecdotal evidence, in particular from within LRFFT participating countries, indicates that areas where at some past time period humphead wrasses were observed to have been present in naturally low densities are no longer found since the start of the LRFFT.

Although overutilization appears to be an issue in some jurisdictions and locales (e.g., core-Coral Triangle area) (Sadovy et al., 2003a; IUCN, 2008), amounting to moderate effects on extinction risk now and in the foreseeable future, it cannot be considered a significant or overriding impact on the species throughout its entire range in either time frame. In jurisdictions where scuba spearfishing has been banned (Fiji, Palau, the U.S. jurisdictions of American Samoa and CNMI), there is reasonable expectation that older and larger fish benefit from depth refugia. In the CNMI, scuba spearfishing is banned; it is still permitted in Guam. As a result, there exists considerable disparity in the size frequency distributions of landed humphead wrasse between the jurisdictions, which falls in line with the conclusions of Lindley et al. (2014) that the banning of scuba spearfishing results in depth refugia for many coral reef fish species.

While there is some concern for overutilization of the species, particularly for commercial purposes resulting in population declines in some areas such as the Coral Triangle region, the current evidence indicates that many populations are either stable, show no clear trend, or may be increasing. The current global population size is likely sufficient to maintain population viability into the foreseeable future. Based on the best available information, we do not find that overutilization of the species is presently, or in the foreseeable future, placing the species at an increased risk of extinction.

(C) Disease or Predation

The ERA Team evaluated disease and predation as potential threats to the humphead wrasse, but noted that available information on either threat is sparse. The ERA Team found that the little information available indicates that this threat may have a small effect on the extinction risk of the species, meaning that it is unlikely that disease or predation are increasing the extinction risk to the species, either now or in the foreseeable future. Certainty of the potential effects of disease or predation on the extinction risk of the species was deemed medium for both time frames.

Very little is known about diseases of the humphead wrasse other than fish leech infestation (Hirundinea spp.), parasitic infestations (protozoa, worms, etc.), and bacterial infections that have been documented. Parasitic infestations have been reported as occurring in the fins, gill operculum, body surface, eyes, and mouth cavity (Koesharyani et al., 2005; Zafran et al., 2005). Zafran et al. (2005) report that cryptocaryoniosis, or white spot disease because it causes numerous white spots on the body surface, is the most dangerous parasitic disease in many marine fishes in aquaria or mariculture facilities. This disease, which can spread rapidly to other healthy fish and lead to a high mortality, has been documented at the Gondol Research Station in Indonesia. The Gondol Research Station has also reported the presence of the parasitic disease oodiniasis (Amyloodinium ocellatum, a dinoflagellate protozoan) infecting captive humphead wrasse at their facility (Zafran et al., 2005), as well as capsalid monogenean, or so-called skin flukes, which are the most common external parasites in mariculture finfish (Koesharyani et al., 2005). Vibriosis, the most common bacterial disease in marine finfish, has also been documented in broodstock and young humphead wrasse at the Gondol Research Station. The infected fish were those that were captured with cage traps and transported to the station; mortality occurred within a week after the transportation (Zafran et al., 2005).

Wada et al. (1993) documented the first known report of a simultaneous infection with an acid-fast bacterium (Mycobacterium sp.) and an imperfect fungus in a humphead wrasse that was captured in Indonesia and reared in a commercial fish dealer's concrete aquarium in Japan. They speculate that the male fish became infected while in captivity. No other information has been found to indicate that disease, particularly in the wild, is a factor influencing mortality of humphead wrasse.

There are no known major predators of adult humphead wrasse, even in vulnerable locations such as at spawning aggregations. Colin (2010) reports that no instances of predation on spawning adults were observed despite the presence of grey reef (Carcharhinus amblyrhynchos) and white tip (Trianodon obesus) reef sharks. Additionally, few other piscivorous reef fishes are capable of taking even a moderate-sized humphead wrasse (Colin, 2010). The predators of juvenile humphead wrasse are unknown but likely to be sharks and other large-bodied piscivorous species such as grouper (Serranidae), Jacks (Carangidae), and snapper (Lutjanidae) that are commonly found on Indo-Pacific coral reefs.

Based on the best available information, we agree that neither disease nor predation is increasing the species' extinction risk presently, or in the foreseeable future.

(D) The Inadequacy of Existing Regulatory Mechanisms

The ERA Team evaluated existing regulatory mechanisms to determine whether they may be inadequate to address threats to the humphead wrasse. Existing regulatory mechanisms may include Federal, state, and international regulations. Below is a brief description and evaluation of current and relevant domestic and international management measures that affect the humphead wrasse. More information on these domestic and international management measures can be found in the status review report (Graham et al., 2014).

Across the wide Indo-Pacific range of the humphead wrasse, there exists a diversity of regulations. In U.S. waters, most jurisdictions have regulations that afford partial to complete protection for the species, and these are, in general, reliably enforced. These include Federal annual catch limits based on what little is known of abundance, prohibitions on non-selective and destructive fishing gear (e.g., American Samoa and CNMI both ban scuba spearfishing, while Guam presently does not but is considering such a ban), an assortment of no-take marine protected areas (MPAs) around CNMI and Guam, and full prohibition on take around American Samoa and the Pacific Remote Island Areas.

Internationally, of the 48 countries where humphead wrasses occur, only about 18 have implemented regulations. This lack of consistent regulation may be due to abundance data being unknown, undocumented, or not attended to (e.g., Cambodia, Egypt, Kenya, Saudi Arabia, Somalia, Sudan, etc.), or the country does not participate in the legal international trade (e.g., Djibouti, Eritrea, Israel, Madagascar, Mayotte, Myanmar). Of countries that have regulations, most prohibit non-selective and destructive gear types, regulate minimum size limits, significantly reduce or ban export quotas, and/or have tightened enforcement loopholes—all within the last few years (Gillett, 2010; Sadovy, 2010; IUCN, 2013; Sadovy, unpublished). Only 12 countries are known to participate (or have participated) in the legal trade of the species, while the number of countries participating in the illegal trade is unquantified. International regulation and effectiveness was the primary concern in finding that inadequate existing regulations have a moderate effect on extinction risk of the species.

Other international regulatory authorities include CITES, which lists the humphead wrasse under Appendix II with the following provisions: Legal trade is regulated, an export permit is required to show fish were legally acquired and harvesting is not detrimental to survival of the species, and the exporting country must have a functional management plan and associated monitoring. In addition, the importing country must closely monitor its imports. Sanctions or complete bans on exports provide strong incentive to comply. Additionally, the IUCN lists the humphead wrasse as "endangered" while affording no regulatory protection; the hope is to promote awareness of the status of the species.

As previously mentioned, 12 countries report legally trading the species, ranging from live humphead wrasse to bodies, derivatives, and meat; of these 12 countries, only 10 countries report exporting live humphead wrasse. According to CITES (2014) trade data, from 2005-2011, 81,848 live humphead wrasse were legally traded by 10 countries, whereas in 2012, only 1,691 live humphead wrasse were legally traded, and only by 5 of the countries. Zero bodies, meat, or derivatives of the species were traded in 2012 (CITES, 2014).

Legal trade has significantly decreased due to reduced or zero export quotas, especially from the main exporting countries of Indonesia, Malaysia, and the Philippines. For example, Indonesia decreased their export quota of humphead wrasse from 8,000 in 2005 to 1,800 in 2012

(IUCN, 2013), and legally traded only 1,653 in 2012 (CITES, 2014). In 2010, Malaysia reached and has maintained a zero export quota of the species (Sadovy, 2010; IUCN, 2013; CITES, 2014). This is significant since Malaysia legally exported ~53,000 live humphead wrasse from 2007-2009 (CITES, 2014). Moreover, Hong Kong is now believed to be better controlling trade where it checks imports and re-exports, and coordinates verification of permits with Malaysia and Indonesia (Sadovy, 2010). Additionally, countries that formerly exported for the LRFFT have now banned the export of the species (e.g., Australia, Federated States of Micronesia, New Caledonia, Niue, and Palau) (Gillett, 2010). In other countries, national regulations have been tightened (e.g., Palau and Fiji), helping to close enforcement loopholes (Sadovy, 2010). In Indonesia, recent field surveys at seven "baseline" sites found increased densities of humphead wrasse at four sites 4-5 years later. Most fish were juveniles, but the increase in numbers is encouraging and has occurred in areas where fishing pressure has evidently declined (IUCN, 2013). At least a decade is believed to be a conservative time scale for these heavily exploited populations to begin recovery from fishing pressure following adequate protection (Colin, 2010).

In the geographic center of the species' range—the Coral Triangle Region—the humphead wrasse is one of the most valuable species in the LRFFT, and has been for the past few decades. Countries within the Coral Triangle region are characterized by large and growing populations, particularly in coastal areas, where many consider fishing an occupation of last resort. Many nearshore fish stocks are heavily harvested, and recent declines in humphead wrasse landings probably reflect this fact more so than effectiveness of new regulations. In areas of this region where the LRFFT is not currently operating, any catch of this species would bring a good price at local markets. Local regulations to manage the trade that are contradictory to national regulations also exist in the area and where illegal export is reportedly rampant (e.g., Philippines).

Misreporting continues to be an illegal, unregulated, and unreported fishing issue for the LRFFT in Southeast Asia, including mislabeled fish or fish hidden in exports (CITES, 2010a; CITES, 2010b; Sadovy et al., 2011). Undocumented shipments continue through Singapore. However, Hong Kong, the largest importer, has recently committed to controlling imports, re-exports, and possession within the territory, thus enabling a more secure system of trade (CITES, 2010a). Additionally, most countries ban the use of cyanide, though it does continue in areas due to lack of enforcement and corruption (Erdman and Pet-Soede, 1997; Pet and Pet-Soede, 1999; Yan, 2011).

Numerous MPAs exist throughout the range of the humphead wrasse. If adequately enforced, these sufficiently large MPAs might help reduce threats from the loss and modification of adult or juvenile habitat, destructive fishing practices, and overutilization. For example, in areas including Australia, Maldives, and Wake Atoll where some degree of protection for the species is afforded (e.g., take and possession prohibited, ban on exports, etc.) and adequately enforced, the risk of local "stock" depletion has been reduced and abundance of humphead wrasse in the area is stable or increasing (Sadovy et al., 2003 citing Sluka, 2000; NMFS PIFSC CRED, unpublished data).

In summary, when considered across the entire range of the species, it is reasonably likely that the various existing regulatory measures will continue to benefit the humphead wrasse globally by appreciably reducing the threats to the species, presuming they are adequately enforced. The greatest threat—the LRFFT—appears to have decreased substantially, according to recent CITES trade data available through 2012 (CITES, 2014). This reduction in legal trade may be due to either reduced or zero export quotas, or reduced population sizes of humphead wrasse stocks within the three main exporting countries of Indonesia, Malaysia, and Philippines. It can be hoped that with time more countries will follow suit, implement, and effectively enforce regulatory mechanisms to prevent the decline of the species and allow any overexploited populations to rebuild. However, it is believed that much illegal and unreported trade still continues, particularly in the several countries of the Coral Triangle region. In spite of local pockets of questionable regulatory compliance, we agree that based on the best available information, it is unlikely that inadequate existing regulatory mechanisms alone contribute more than moderately to the extinction risk for the humphead wrasse across its wide Indo-Pacific range either now, or in the foreseeable future. The recent implementation of, increased adherence to, and enforcement of existing regulatory mechanisms throughout the species' range appear effective in addressing the most important threat to the species, which is overharvest. Certainty of the potential effects of inadequate existing regulatory mechanisms on the extinction risk of the species was deemed medium for now and low in the foreseeable future. Accordingly, we do not find that inadequacy of existing regulatory mechanisms is presently, or in the foreseeable future, placing the species at an increased risk of extinction.

(E.) Other Natural or Manmade Factors Affecting Its Continued Existence

The Status Review Report describes the life history characteristics, information on competition, and substantial concerns with regard to climate change and pollution considered by the ERA Team. The Team concluded that other natural or manmade threats would likely have some small effects on the extinction risk of the species now and moderate effects over the foreseeable future, the latter due to concerns of increased climate change and pollution-related impacts on the species. Certainty of the potential effects of other natural or manmade factors on the extinction risk of the species was deemed medium for now and low in the foreseeable future.

The humphead wrasse may be susceptible to natural and human perturbations due to particular life history characteristics that include slow growing, long-lived, and delayed reproductive development (Choat et al., 2006; Tupper, 2007; Sadovy de Mitcheson et al., 2008; Colin, 2010). Additionally, adults often occupy consistent home ranges, have predictable sleeping sites, have discrete spawning locations, and may form mass aggregations during spawning (Sadovy et al., 2003a).

As for competition with other species for prey, humphead wrasses are opportunistic diurnal carnivores with a wide-ranging diet. As previously mentioned, much of its prey is found in sand or rubble habitats where it feeds on a variety of molluscs, small fishes such as gobies, moray eels, sea urchins, crustaceans, brittle stars, starfish, and other invertebrates (Randall et al., 1978; Myers, 1989; Randall et al., 1997; Thaman, 1998; Sadovy et al., 2003a; Choat et al., 2006). As generalists, the humphead wrasse is less susceptible to competition for prey from other predators or fisheries with more specialized diets.

Large-scale impacts such as global climate change may pose a threat to the humphead wrasse because the species uses inshore habitats and coral reefs out to depths of up to at least 100 m (Randall, 1978; Sadovy et al., 2003a; Russell, 2004; Zgliczynski et al., 2013). The Status Review Report describes the potential threats, including ocean acidification, increased ocean temperatures, sea level rise, and extreme weather, in detail. These threats are summarized below.

Although the impacts of ocean acidification specifically to humphead wrasse are unknown, the threat is anticipated to be greatest to marine taxa that build skeletons, shells, and tests of biogenic calcium carbonate such as coral (e.g., Fabry et al., 2008; Guinotte and Fabry, 2008; Pandolfi et al., 2011). In a meta-analysis, abundances of species reliant on live coral for food or shelter consistently declined (e.g., Wilson et al., 2006; Pratchett et al., 2008), while abundance of some species that feed on invertebrates, algae and/or detritus increased (e.g., Wilson et al., 2006). As previously discussed, branching corals are one of several important habitats to various stages of the humphead wrasse life cycle. Vulnerability of a coral species to a threat is a function of susceptibility and exposure, considered at the appropriate spatial and temporal scales. With regard to localized variability, recent papers identify various mechanisms that can offset or buffer changes in seawater pH around coral reefs from ocean acidification, such as photosynthetic uptake of CO_2 by sea grasses and macroalgae in adjacent areas (Palacios and Zimmerman, 2007; Manzello et al., 2012; Anthony et al., 2013), and biogeochemical processes within coral reef communities (Andersson et al., 2013). Other papers identify mechanisms that can exacerbate changes in seawater pH around coral reefs from ocean acidification, such as diurnal variability, that can amplify CO_2 in seawater around coral reefs (Shaw et al., 2013). Ultimately, the future effects of ocean acidification on coral reefs will be highly variable across coral taxa, space, and time.

Other direct and indirect linkages of ocean acidification effects to the humphead wrasse remain tenuous. The adult humphead wrasse does not appear to be food limited or space limited in any portions of its range. The species also appears to be adaptable to a variety of biotic and abiotic conditions given its wide geographic range and observations of it residing (foraging, sleeping) in both shallow and deep water. Additionally, some researchers have pointed out that increased CO_2 (lower pH) leading to ocean acidification could enhance seagrass productivity (Palacios and Zimmerman, 2007; Guinotte and Fabry, 2008; Poloczanska et al., 2009), which may benefit juvenile humphead wrasse that rely on seagrass beds as nursery areas.

Increased ocean temperatures on large spatial and temporal scales could generally impact current flow, productivity, physiological performance and behavior of coral reef fishes and survival of corals. For example, larval production and survival rates could be negatively impacted (e.g., Lo-Yat et al., 2010). However, small temperature increases might accelerate larval development and competency to settle, though larger temperature increases may be detrimental (Munday et al., 2008).

Brainard et al. (2011) discusses how coral adaptation and acclimatization to increased ocean temperatures is possible; that there is intra-genus variation in susceptibility of coral to bleaching, ocean acidification, and sedimentation; that at least some coral species have already expanded their range in response to climate change; and that not all coral species are seriously affected by ocean acidification. Such adaptation and acclimation could reduce the impact of warming temperatures and allow populations to persist across their current range (Donelson et al., 2011; Logan et al., 2013). The exceptional complexity, extent, and diversity of coral reef habitat defy simplistic modeling of reef responses to climate change threats. Likewise, many aspects of the biology of reef-building corals contribute to complex responses to ocean warming. This includes capacity for acclimatization and adaptation to ocean warming, range expansion in response to ocean warming (Yamano et al., 2011; Yara et al., 2011), and contrasting ecological interactions resulting from ocean warming (Hughes et al., 2012; Cahill et al., 2013). All of these contribute to highly variable, complex and uncertain responses of reef-building coral species and in turn, coral reefs to climate change threats like ocean warming.

The impacts of sea level rise to coral reef ecosystems also remains uncertain. Theoretically, a rise in sea level could potentially provide additional habitat for corals living near the sea surface. There are now studies documenting that during periods of higher water levels, coral cover increases on reef flats (Brown et al., 2011; Scopélitis et al., 2011). On the other hand, if coral growth is unable to keep pace with sea level rise, there will most likely be negative consequences.

As for the effects of climate change to prey species of the humphead wrasse, direct and indirect effects are again variable and complex. Climate change can affect marine organisms both directly via physiological stress and indirectly via changing relationships among species (Harley, 2011). Shifts in distribution and abundance of prey can potentially be driven by changes in temperature and ocean chemistry (Harley et al., 2006). Although humphead wrasses do not feed directly on corals, many of their prey do rely on corals, sea grass beds, or mangroves for their own food or shelter. The wide variety of humphead wrasse prey is found in various habitats and across a vast depth range of a few meters to at least 100 m. Coral communities found at greater depths have shown thermal refuge from increased temperatures while those found in more shallow areas are more impacted (e.g., Graham et al., 2008; Bridge et al., 2014). For example, sea urchin fertilization may be compromised by warmer temperatures (Byrne et al., 2009). While urchins found in more shallow areas may have reduced or compromised fertilization and development, urchins found at deeper depths may be less impacted. Urchins are also less susceptible to increased ocean acidification (Byrne et al., 2009). In another example of variable impacts, Harley (2011) conducted an experiment and found that prey species were able to occupy a hot, extralimital site if predation pressure was experimentally reduced. As a result, local species richness more than doubled, suggesting that anthropogenic climate change can alter interspecific interactions and produce unexpected changes in species distribution, community structure, and diversity (Harley, 2011). Overall, some humphead wrasse prey may likely be negatively impacted by climate change; however, not all prey will be impacted equally. Given that humphead wrasse are foraging generalists and feed on a wide variety of prey found in various habitats and depths, impacts are likely to be less than if they were foraging specialists like other reef fish species (i.e., bumphead parrotfish) that feed primarily on corals.

In summary, the extent of potential direct and indirect effects of climate change on the humphead wrasse are unknown or speculative as the threats described in the literature are broad and general, and typically use another species as a proxy to infer vulnerability.

Lastly, contaminants such as fuel and crude oil from spills, land-based pollution from agriculture, etc. that find its way into the marine environment, sewage effluent from areas with insufficient sanitation systems, and marine debris from discarded or lost fishing gear are all potential sources of pollution that could directly and indirectly affect the humphead wrasse. However, such events including oil and sewage spills are typically episodic and localized. Other types of pollution such as land-based contaminants and marine debris may also impact the humphead wrasse, but the direct extent of the effects to the humphead wrasse and its habitat are speculative at this time. As such, the Team determined that these other natural and manmade factors collectively would likely have some small effects on the extinction risk of the species now and moderate effects over the foreseeable future.

Therefore, based on the best available information, although the Team identified the threat of other natural or manmade factors, such as climate change and pollution, as having a small-to-moderate effect on the species' risk of extinction, we do not find that other natural or manmade factors are presently, or in the foreseeable future, placing the species at an increased risk of extinction.

Significant Portion of Its Range

The definitions of both "threatened" and "endangered" under the ESA contain the term "significant portion of its range" (SPOIR) as an area smaller than the entire range of the species that must be considered when evaluating a species' risk of extinction. With regard to SPOIR, the Services proposed a "Draft Policy on Interpretation of the Phrase 'Significant Portion of Its Range' in the Endangered Species Act's Definitions of 'Endangered Species' and 'Threatened Species'" (76 FR 76987; December 9, 2011), which is consistent with our past practice as well as our understanding of the statutory framework and language. The Draft Policy was recently finalized on July 1, 2014, (79 FR 37578), and the Services are now to consider the interpretations and principles contained in the Final Policy as binding guidance in making individual listing determinations, while taking into account the unique circumstances of the species under consideration. However, the policy remained in the draft form when the ERA Team discussed whether the data indicated if any portion of the humphead wrasse's range is more significant than another portion.

The ERA Team considered whether a portion of the species' range is more important than any other portion, and that without that portion, the species would be in danger of extinction. With this in mind, the ERA Team agreed that of the entire range of the species, the primary region that has exhibited a decline of the humphead wrasse, which comprises the three countries in the core-Coral Triangle area, might meet the definition of a SPOIR. These countries are Indonesia, Malaysia, and the Philippines, and have large and growing human populations with coincident agricultural expansion and coastal development impacts on humphead wrasse habitat. As this area is the center of the species' range, the Team also discussed physical, ecological, and behavioral factors in relation to recruitment between the potential SPOIR area and the rest of the species' range. The Team concluded that local extinction of humphead wrasse in these three countries would not cause the remainder of the species to become in danger of extinction. Islands and archipelagoes outside the core-Coral Triangle area (i.e., Papua New Guinea and the Solomon Islands in the east or Australia to the south) are comparatively healthy with fewer impacts to the species. Humphead wrasse in these other areas are not dependent on aggregations in Indonesia, Malaysia, or the Philippines for larval recruitment or other aspects of survival; in fact, the ERA Team concluded that these nearby areas could provide recruits to recolonize the core-Coral Triangle portion of the range in the event that local extirpations were to occur inside that area. Thus, the status of the rest of the species was not considered to be dependent on the continued existence of the population in these three countries of Indonesia, Malaysia, and the Philippines. The main purpose for improved conservation in this core area of the species' range would be the recovery of the populations located there, and not the status of the rest of the population. Therefore, after a review of the best available information, the ERA Team concluded, and we agree, that data do not indicate any portion of the humphead wrasse's range meets the definition of a SPOIR. As such, when considering the overall extinction risk of the species, we considered it throughout the species' entire range.

Under the Final SPOIR Policy, the definition of “significant” has been revised to a lower threshold and now states “A portion of the range of a species is ‘significant’ if the species is not currently endangered or threatened throughout its range, but the portion’s contribution to the viability of the species is so important that, without the members in that portion, the species would be in danger of extinction <u>or likely to become so in the foreseeable future, throughout all of its range</u>” (emphasis added). Despite this revision, we continue to find that the data do not indicate any portion of the humphead wrasse’s range meets the definition of a SPOIR. Thus, the overall extinction risk of the species is considered throughout the species’ entire range.

Overall Risk Summary

As a final step in their analysis, the ERA Team voted on the overall risk of extinction to the humphead wrasse based on the information the Team reviewed in its demographic risk analysis, as modified by the information reviewed in the threats assessment. Likelihood points attributed to the current level of extinction risk categories were as follows, with the first number representing the total votes by Team members and the second number representing the total possible votes, which was 40: No Risk (25/40), Low Risk (13/40), Moderate Risk (2/40). None of the Team members placed a likelihood point in either the “High Risk” or “Very High Risk” categories, indicating their strong consensus that the species is not currently at a high or very high risk of extinction. Thus, the Team found, and we agree, that the species is not presently at risk of extinction. The Team expressed this view with a high relative certainty with regard to the available information.

For the level of extinction risk of the humphead wrasse in the foreseeable future, the ERA Team found, and we agree, that the species would be at low overall risk of extinction.

Likelihood points attributed to each risk category in the foreseeable future were as follows: No Risk (15/40), Low Risk (18/40), Moderate Risk (7/40). Again, none of the Team members placed a likelihood point in either the "High Risk" or "Very High Risk" categories, indicating their strong consensus that the species will not be at a high or very high risk of extinction in the foreseeable future. The Team viewed the certainty of information for the foreseeable future as being low.

Overall, there was a high degree of consensus among the members of the Team, and we agree, that the humphead wrasse's risk of extinction presently and in the foreseeable future is no-to-low risk. Although the humphead wrasse is naturally rare throughout its range and in some places abundance has declined, this no-to-low risk of extinction is based primarily on the species' sustained widespread distribution throughout most of its known range, and its recent effective protection from exploitation at a variety of localities under both U.S. and foreign jurisdiction.

Final Determination

Section 4(b)(1) of the ESA requires that NMFS make listing determinations based solely on the best scientific and commercial data available after conducting a review of the status of the species and taking into account those efforts, if any, being made by any state or foreign nation, or political subdivisions thereof, to protect and conserve the species. We have independently reviewed the best available scientific and commercial information including the petition, public comments submitted on the 90-day finding (78 FR 13614; February 28, 2013), the status review report (Graham et al., 2014), and other published and unpublished information, and have consulted with species experts and individuals familiar with humphead wrasse. We considered each of the five ESA statutory factors to determine whether it presented an extinction risk to the species on its own. Additionally, we do not find that the combination of factors poses an extinction risk. As required by the ESA, section 4(b)(1)(a), we also took into account efforts to protect humphead wrasse by territories, foreign nations, and others and evaluated whether those efforts provide a conservation benefit to the species. As previously explained, no portion of the species' range is considered significant and we did not find biological evidence that would indicate that any population segment of the humphead wrasse would qualify as a DPS under the DPS Policy. Therefore, our determination set forth below is based on a synthesis and integration of the foregoing information, factors and considerations, and their effects on the status of the species throughout its entire range.

We conclude that the humphead wrasse is not presently in danger of extinction, nor is it likely to become so in the foreseeable future throughout all of its range. We summarize the factors supporting this conclusion as follows: (1) the species is made up of a single population over a broad geographic range, with no barrier to dispersal; (2) its current range is unaltered from the range identified by surveys since the 1970s and although there are some concerns related to the species' habitat, there is no evidence of substantial or widespread habitat loss or destruction; (3) although the species has predictable home ranges and sleeping sites, and possesses life history characteristics that may increase its vulnerability to impacts of fishing in reef fish assemblages, its risk of extinction due to low productivity is not of significant concern; (4) the best available information indicates that abundance is naturally low across the species' range, and although populations have declined in some areas because of fishing mortality, many populations, especially those in U.S. waters, are either stable, show no clear trend, or may be increasing; (5) although there is no formal estimate on the current global population size, it is likely sufficient to maintain population viability into the foreseeable future; (6) the main threat to the species is overutilization in the live reef food fish trade; however, legal trade of the species has decreased substantially over recent years due to reduced or zero export quotas, especially from the three main exporting countries within the Coral Triangle region; (7) there is no evidence that disease or predation is contributing to increasing the risk of extinction of the species; (8) recent implementation of, increased adherence to, and enforcement of existing regulatory mechanisms throughout the species' range appear effective in addressing the most important threat to the species (overharvest); and (9) although there is some concern with regard to effects from other natural or manmade factors, such as climate change and pollution, the evidence does not suggest that the species is at risk of extinction from these factors.

Based on these findings, we conclude that the humphead wrasse is not presently in danger of extinction throughout all or a significant portion of its range nor is it likely to become so within the foreseeable future. Accordingly, the humphead wrasse does not meet the definition of a threatened or endangered species and therefore the humphead wrasse does not warrant listing as threatened or endangered at this time. However, it will remain on our Species of Concern list and we will encourage research on the status of the species for use in future status reviews.

References

A complete list of all references cited herein is available upon request (see FOR FURTHER INFORMATION CONTACT).

Authority

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

Dated: September 22, 2014.

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