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DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

[Docket No. 200716-0193]

RTID 0648-XA496

Endangered and Threatened Wildlife and Plants; Notice of 12-Month Finding on a Petition to List the Dwarf Seahorse as Threatened or Endangered Under the Endangered Species Act

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

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

SUMMARY: We, NMFS, announce a 12-month finding and listing determination on a petition to list the dwarf seahorse (*Hippocampus zosterae*) as threatened or endangered under the Endangered Species Act (ESA). We have completed a status review of the dwarf seahorse in response to a petition submitted by the Center for Biological Diversity. After reviewing the best scientific and commercial data available, including the Status Review Report, we have determined the species does not warrant listing at this time. While the species has declined in abundance, it still occupies its historical range, and population trends indicate subpopulations are stable or increasing in most locations. We conclude that the dwarf seahorse 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.

DATES: This finding was made on [*insert date of publication in the FEDERAL REGISTER*].

ADDRESSES: The dwarf seahorse Status Review Report associated with this determination and its references are available upon request from the Species Conservation Branch Chief, Protected Resources Division, NMFS Southeast Regional Office, 263 13th Avenue South, St. Petersburg, FL 33701, Attn: Dwarf Seahorse 12-month Finding. The report and references are also available electronically at: *https://www.cio.noaa.gov/services_programs/prplans/ID411.html*

FOR FURTHER INFORMATION CONTACT: Adam Brame, NMFS Southeast Regional Office, (727) 209-5958; or Celeste Stout, NMFS Office of Protected Resources, 301-427-8436

SUPPLEMENTARY INFORMATION:

Background

On April 6, 2011, we received a petition from the Center for Biological Diversity to list the dwarf seahorse as threatened or endangered under the ESA. The petition asserted that (1) the present or threatened destruction, modification, or curtailment of habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) inadequacy of existing regulatory mechanisms; and (4) other natural or manmade factors are affecting its continued existence and contributing to the dwarf seahorse's imperiled status. The petitioner also requested that critical habitat be designated for this species concurrent with listing under the ESA.

On May 4, 2012, NMFS published a 90-day finding for dwarf seahorse with our determination that the petition presented substantial scientific and commercial information indicating that the petitioned action may be warranted (77 FR 26478). We also requested scientific and commercial information from the public to inform a status review of the species, as required by section 4(b)(3)(a) of the ESA. Specifically, we requested information pertaining to: (1) historical and current distribution and abundance of this species throughout its range; (2) historical and current population status and trends; (3) life history in marine environments; (4) curio, traditional medicine, and aquarium trade or other trade data; (5) any current or planned activities that may adversely impact the species; (6) historical and current seagrass trends and status; (7) ongoing or planned efforts to protect and restore the species and its seagrass habitats; (8) management, regulatory, and enforcement information; and (9) any biological information on the species. We received information from the public in response to the 90-day finding and incorporated the information into both the Status Review Report (NMFS 2020) and this 12-month finding.

Listing Determinations Under the ESA

We are responsible for determining whether the dwarf seahorse is threatened or endangered under the ESA (16 U.S.C. 1531 *et seq.*). Section 4(b)(1)(A) of the ESA requires us to make listing determinations based solely on the best scientific and commercial data available after conducting a review of the status of the species and after taking into account efforts being made by any state or foreign nation to protect the species. To be considered for listing under the ESA, a group of organisms must constitute a "species," which is defined in section 3 of the ESA to include taxonomic species and "any subspecies of fish, or wildlife, or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." 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 ("DPS Policy," 61 FR 4722). The joint 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 taxon to which it belongs; and (2) the significance of the population segment to the remainder of the taxon to which it belongs.

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

Under section 4(a)(1) of the ESA, we must determine whether any species is endangered or threatened due to any of the following five factors: (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence.

To determine whether the dwarf seahorse warrants listing under the ESA, we formed a Status Review Team (SRT) consisting of biologists and managers to complete a Status Review Report (NMFS 2020), which summarizes the taxonomy, distribution, abundance, life history and biology of the species. The Status Review Report (NMFS 2020) also identifies threats or stressors affecting the status of the species, and provides a description of fisheries, fisheries management, and conservation efforts. The team then assessed the threats affecting dwarf seahorse as part of an extinction risk analysis (ERA). The results of the ERA from the Status Review Report (NMFS 2020) are discussed below. The Status Review Report incorporates information received in response to our request for information (77 FR 26478, May 4, 2012) and comments from three independent peer reviewers. Information from the Status Review Report is summarized below in the **Biological Review** section.

The petition requested that the species be considered for endangered or threatened status as a single entity throughout its range. While the agency has discretion to evaluate a species for potential DPSs, it is our policy, in light of Congressional guidance (S. Rep. 96-151), to list DPSs sparingly. The SRT held discussions as to whether DPSs should be considered, based on the information within the Status Review Report (NMFS 2020), but ultimately decided to evaluate the dwarf seahorse as a singular species throughout its range.

In determining whether the species is endangered or threatened as defined by the ESA, we considered both the data and information summarized in the Status Review Report (NMFS 2020) as well as the results of the ERA. The ERA analyzed demographic and listing factors that could affect the status of the dwarf seahorse. Demographic factors considered included abundance, population growth rate and productivity, spatial structure/connectivity, and diversity. We also identified threats under each of the five listing factors: (A) present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization of the species for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) inadequacy of existing regulatory mechanisms; and (E) other natural or manmade factors affecting its continued existence. For purposes of our analysis, the identification of demographic or listing factors that could impact a species negatively is not sufficient to compel a finding that ESA listing is warranted. In considering those factors that might constitute threats, we look beyond mere exposure of the species to the factors to determine whether the species responds, either to a single threat or multiple threats, in a way that causes impacts at the species level. We considered each threat identified, both individually and cumulatively, evaluating both their nature and the species' response to the threat. In making this 12-month finding, we have considered and evaluated the best available scientific and commercial information, including information received in response to our 90-day finding.

Biological Review

This section provides a summary of key biological information presented in the Status Review Report (NMFS 2020).

Species Description

The dwarf seahorse (*Hippocampus zosterae,* Jordan and Gilbert 1882), is a short-lived, small-sized syngnathid fish. Like all seahorses, the tail of the dwarf seahorse is prehensile (capable of grasping) and used to secure the animal to seagrass or floating marine vegetation in the water (Gill 1905; Walls 1975). The eyes move independently of one another, allowing for better accuracy during feeding (Gill 1905). Dwarf seahorses have a wide range of color patterns from yellow and green to black. Individuals may also have white markings or dark spots which aid in camouflage while inhabiting seagrass (Gill 1905; Lourie *et al.* 2004; Lourie *et al.* 1999; Vari 1982).

Dwarf seahorses are one of the smallest species of seahorses. Aquarium-raised dwarf seahorses have been recorded at 0.27–0.35 inches (0.7–0.9 cm) total length (TL) at birth and growing to 0.7 inches (1.8 cm) TL by day 17 (Koldewey 2005). There is some discussion regarding the maximum size of adults with reports ranging from 1 inch (2.5 cm; Lourie *et al.* 2004) to a single specimen at 2.12 inches (5.4 cm; Masonjones, University of Tampa, pers. comm. to Kelcee Smith, Riverside, Inc., on July 17, 2013). Masonjones *et al.* (2010) indicated body size was highly correlated with season, as individuals born in the Florida wet season (June-September) were larger than those born in the dry season. The species rarely lives longer than 2 years in the wild (Koldewey 2005; Strawn 1958; Vari 1982), though it has been reported to live up to 3 years in captivity (Abbott 2003).

Distribution

Historically, dwarf seahorses have been reported in the southeastern United States, including Texas, Louisiana, Mississippi, Alabama, and Florida (Strawn 1958), Mexico, and the greater Caribbean, including The Bahamas, Bermuda, and Cuba. Data from outside the United States are limited, and reports from the Bahamas, Cuba, and Bermuda have been rare historically and absent recently. Available data from the United States, both historically and presently, indicate the highest abundances of dwarf seahorses are in bay systems south of 29° N (south Florida and south Texas) and the lowest abundances are in Alabama, Louisiana, and Mississippi (NMFS 2020).

Habitat

In general, dwarf seahorse habitat is characterized by shallow, warm, nearshore seagrass beds. These habitats often occur within sheltered lagoons or embayments with reduced exposure to strong currents and heavy wave action (Iverson and Bittaker 1986). Dwarf seahorses are typically found in shallow coastal and lagoon habitats during the summer (Musick *et al.* 2000; Robbins 2005; Strawn 1961; Tipton and Bell 1988; Walls 1975) and deeper waters or tide pools during the winter (Lourie *et al.* 2004). Dwarf seahorses show no particular affinity for a specific seagrass species (Masonjones *et al*. 2010), but are generally found in areas with higher densities of seagrass blades and higher seagrass canopy (*i.e.,* length of seagrass blades) (Lourie *et al.* 2004). This results in a patchy distribution of dwarf seahorses within estuaries.

Dwarf seahorses are found within a range of salinities (7–37), temperatures (57–89°F (14–32°C)), and depths, depending on geographic location and time of year (Ryan Moody, Dauphin Island Sea Lab, pers. comm. to Kelcee Smith, Riverside, Inc., on July 17, 2012; Masonjones and Rose 2009; Masonjones *et al.* 2010; Mark Fisher, Texas Parks & Wildlife Dept., pers. comm. to Kelcee Smith, Riverside, Inc., on July 12, 2012; Mike Harden, Louisiana Dept. of Natural Resources, pers. comm. to Kelcee Smith, Riverside, Inc., July 24, 2012). However, within aquarium husbandry the dwarf seahorse is considered a tropical species, and water temperatures of 68–79°F are recommended (20–26°C; Masonjones 2001; Koldewey 2005). In their review paper, Foster and Vincent

(2004) reported the maximum recorded depth for the dwarf seahorse as 6.5 feet (2 meters).

Diet and Feeding

Seahorses are ambush predators, feeding on harpacticoid copepods and amphipods (both very small crustaceans measuring only a few millimeters in length) as they drift along the edges of seagrass beds (Huh and Kitting 1985; Tipton and Bell 1988). No seasonal differences have been reported in the dwarf seahorse diet (Tipton and Bell 1988). Dwarf seahorses produce a stridulatory sound (a "click") from the articulation of the supraoccipital and coronet bones in the skull during feeding, and it has been shown that dwarf seahorses click 93 percent of the time during feeding in a new environment, and during competition for mates (Colson *et al.* 1998).

Reproductive Biology

Dwarf seahorses reach reproductive maturity at approximately 3 months of age (Wilson and Vincent 2000) and exhibit gender-specific roles in reproduction (Masonjones and Lewis 1996; Masonjones and Lewis 2000; Vincent 1994). Dwarf seahorses are generally monogamous (the practice of an individual having one mate) within a breeding season and mates are chosen by similarity in size (Jones *et al.* 2003; Wilson *et al.* 2003). Dwarf seahorses will reject a potential mate if the size difference is too large (Masonjones *et al.* 2010). Once bonded, the mating pair remains together throughout a 3-day courtship ritual. After successful courtship, the female deposits unfertilized eggs into the male's brood pouch. In the brood pouch, eggs are fertilized and the embryos are nourished, osmoregulated (the body fluid balance and concentration of salts is kept stable), oxygenated (by circulating water), and protected (Jones *et al.* 2003;

Vincent 1995a; Wilson *et al*. 2003; Wilson and Vincent 2000). Strawn (1958) reported a maximum number of 69 eggs found in the ovaries of a female and up to 55 young counted in the pouch of a male. Masonjones and Lewis (1996) found that males give birth to an average of 3–16 offspring per brood. Males in captivity usually give birth to fewer individuals compared to males in the wild (Masonjones *et al.* 2010). Throughout the 10-12-day gestation (Masonjones and Lewis 2000) the female greets the male daily and the pair remains in close proximity (Jones *et al.* 2003; Vincent 1995a; Wilson and Vincent 2000).

Dwarf seahorses exhibit iteroparity (multiple reproductive cycles) throughout the breeding season (Masonjones and Lewis 1996; Masonjones and Lewis 2000; Rose *et al.* 2014). Following the transfer of eggs, the female begins developing new eggs for the next clutch (Masonjones and Lewis 1996; Masonjones and Lewis 2000). Egg development is achieved in 2 days but the female is only sexually receptive for a few hours following development and is "essentially incapable of mating before the end of their previous mating partner's gestation period" (Masonjones and Lewis 2000). Under ideal conditions, the male can mate 4-20 hours after giving birth, allowing dwarf seahorse pairs to produce up to two broods per month (Masonjones and Lewis 2000; Strawn 1958; Vari 1982). Masonjones and Lewis (2000) reported the potential number of offspring that male and female dwarf seahorses could produce over the breeding season were 279.5 and 240.5 individuals, respectively. This difference in potential offspring between the two sexes is a result of latency, as males are faster to respond to new potential mates if the pair bond is disrupted (if one dies or is removed). If the female dies or is removed during gestation, the male will give birth to that clutch before finding a new mate. If a pregnant male (a male carrying fertilized eggs) dies or is removed, the female will not mate until the gestation for the interrupted pregnancy would have been complete (Masonjones and Lewis 2000).

Dwarf seahorse breeding season is generally protracted and is influenced by day length and water temperature (Koldewey 2005; Masonjones and Lewis 2000; Strawn 1958; Vari 1982). Breeding occurs year-round at latitudes south of approximately 28ºN (Rose *et al.* 2019). During the summer months, when the day length is longer and water temperature exceeds 86ºF (30ºC), dwarf seahorses reproduce more frequently because gestation is shorter (Fedrizzi *et al.* 2015; Foster and Vincent 2004). For example, in Tampa Bay, Florida, pregnant males are found in all months but are more abundant early summer through fall (Rose *et al.* 2019). Year round reproduction was also observed in the Florida Keys, based on anecdotal reports from commercial collectors (FWC 2016).

Population Structure and Genetics

Fedrizzi *et al.* (2015) investigated dwarf seahorse population genetic structure at eight Florida locations: one in the Panhandle (Pensacola), two adjacent to Tampa Bay, four in the Florida Keys, and one in Indian River Lagoon. The study found significant population structuring with a strongly separated population in the Panhandle, two recognizable subpopulations in the Florida Keys, and a potential fourth subpopulation at Big Pine Key. Dwarf seahorses from the Indian River Lagoon were not delineated as a discrete population, due to small sample size and lack of consistency in relationship to the other populations. Despite overall population structuring, Fedrizzi *et al.* (2015) observed evidence of some gene flow between sampled locations, with the exception of the Florida Panhandle. The results suggest that the subpopulations of Florida's dwarf seahorses that are closest to each other are more genetically similar than those that are further apart. Interestingly, the distance between the sites sampled by Fedrizzi *et al.* (2015) is greater than the distance over which Florida's dwarf seahorses have been shown to actively migrate (Masonjones *et al.* 2010). Thus, genetic connectivity between subpopulations is more likely the result of individuals dispersing to neighboring subpopulations through rafting.

Status Assessments

There have been no formal status assessments conducted for the dwarf seahorse throughout its range. While the species has been documented from Florida to Texas in the United States and Cuba, The Bahamas, Bermuda and Mexico internationally, data are generally lacking outside of Florida. Given the paucity of data outside the United States, we are unsure of the status of dwarf seahorse in these other countries. Studies indicate dwarf seahorse subpopulations have steadily decreased throughout their range since the 1970s due to loss of habitat and are noted as rare in parts of its former range (Koldewey 2005; Musick *et al.* 2000). Our evaluation of available data reviewed during the status review supports this assertion, as the species is rarely collected along the north coast of the Gulf of Mexico and relative abundance has declined since the 1990s in long-term fishery-independent data from Florida (Figure 3 in NMFS 2020). It is unlikely that the dwarf seahorse ever fully occupied the northern Gulf of Mexico due to winter water temperatures below the species' optimal limits and the general lack of available seagrass habitat, as compared to Florida and south Texas (Handley *et al.* 2007). Current data indicate that the species remains common along the south and southwest coasts of Florida, specifically west Florida from Tampa Bay to the Florida Keys.

In Florida, the species appears to be most abundant in five estuaries: Charlotte Harbor, Tampa Bay, Sarasota Bay, Biscayne Bay, and Florida Bay, which the SRT considers to be the core area of abundance critical to the population, based on available seagrass habitat and the species' thermal tolerance. Long-term dwarf seahorse abundance in Charlotte Harbor and Tampa Bay estuaries has declined, but population abundance has remained stable at a lower level since 2009 when the commercial harvest trip limit regulations (see 68B-42, F.A.C.) went into effect (FWC unpublished data). Rose *et al.* (2019) found Tampa Bay dwarf seahorse was a robust subpopulation with stable densities across 3 years and year-round breeding. Additionally, Tampa Bay dwarf seahorse densities in 2008-2009 (Rose *et al.* 2019) were significantly higher than those reported for 2005-2007 (Masonjones *et al.* 2010). The U.S. Geological Survey data from Florida Bay and Biscayne Bay suggest the relative abundance of dwarf seahorse was stable within these systems over the short duration (2005-2009) of their study. Cumulatively, the best available information on the dwarf seahorse's status suggests that Florida Bay has the highest relative abundance of dwarf seahorse.

Carlson *et al.* (2019) estimated dwarf seahorse population size in five regions of Florida using a population viability model. Initial population size estimates were developed for the following subpopulations; Cedar Key, Tampa Bay, Charlotte Harbor, Florida Bay, and North Indian River Lagoon, based on all known existing survey data. Known density estimates varied from 0.0-0.59 N/m^2 (individuals per square meter) with highest densities in the most southern Bays (*i.e.,* Florida Bay and Biscayne Bay) and lower estimates in Tampa Bay, southwest Florida, and north Florida (Table 2 in Carlson *et al.* 2019). Carlson *et al.* (2019) derived initial estimates of subpopulation size by using all available dwarf seahorse density observations to create 10,000 bootstrapped samples (simulated outcomes). The 5 percent or 10 percent quantiles of seahorse density estimates (0.0009 N/m^2 and 0.003 N/m^2, respectively) from the bootstrapped samples were then multiplied by the available seagrass acreage in nearshore waters (Yarbro and Carlson 2016). Carlson *et al*. (2019) used the 5 percent or 10 percent quantiles to conservatively account for variability in dwarf seahorse distribution within seagrass meadows (greater density of dwarf seahorse in areas with higher density of seagrass blades and higher seagrass canopy (Lourie *et al.* 2004)). As dwarf seahorses are most abundant in bay systems south of 29°N latitude, Carlson *et al.* (2019) applied the density estimate from the 10 percent quantile (0.003 N/m^2) for the Tampa Bay, Charlotte Harbor and Florida Bay subpopulations (those south of 29°N latitude) and the 5 percent quantile (0.0009 N/m^2) for the Cedar Key and north Indian River Lagoon subpopulations (north of 29°N latitude). Retrospective projections from these conservative initial estimates suggested male subpopulation sizes in 2016 ranged from about 15,258 at Cedar Key to 9,910,752 in Florida Bay. Assuming a female biased sex ratio of 58.2/41.8 (Rose *et al.* 2019), the total estimated population across the five modeled subpopulations exceeded 29 million individual dwarf seahorse in 2016.

The population abundance estimates from Carlson *et al.* (2019) are likely conservative for the following reasons: (1) the starting densities derived from the 5 percent or 10 percent quantiles of the bootstrapped samples are expected to be underestimates of the actual densities for each subpopulation; (2) the intrinsic rate of population increase (R_{max}) was conservatively estimated (assumed equal to the dominant eigenvalue (an indicator of variance in the data) of the Leslie matrix (an age-structured model of population growth) at starting conditions prior to density-dependence (Cortes 2016)) and was much lower than estimated R_{max} for other seahorse species (Denney *et al.* 2002, Curtis 2004); (3) the RAMAS model used by Carlson *et al.* (2019) accounted for variability in survivorship of each age class resulting in 98 percent of reproduction generated by the Age-0 class (suggests nearly all reproduction is carried out in the first year so any reproduction after the first year is generally unaccounted for even though it could be occurring); (4) carrying capacity in seagrass habitats was capped at the 25 percent quantile estimate from the bootstrapped data (0.02 N/m^2), which is likely an underestimate; (5) a 30 percent mortality rate was assumed for acute cold exposure although greater thermal tolerance is suggested by Mascaró *et al.* (2016); and (6) a theoretical mortality rate of 100 percent for harmful algal bloom (HAB) exposure was assumed, with HABs assumed to cover 25 percent to 50 percent of available seagrass habitat within a given estuary, despite limited observations of HAB overlap with seagrass beds in coastal bays (NOAA-HABSOS 2018).

Extinction Risk Analysis

The SRT relied on the best information available to conduct an ERA through evaluation of four demographic viability factors and five threats-based listing factors. The SRT, which consisted of three NOAA Fisheries Science Center and Regional Office personnel, was asked to independently evaluate the severity, scope, and certainty for these threats currently and in the foreseeable future. The SRT defined the foreseeable future as the timeframe over which threats that impact the biological status of the species can be reliably predicted.

Several foreseeable future scenarios were considered. The different foreseeable futures were based on the ability to forecast different primary threats and the species response to these threats through time. As outlined in the Status Review Report (NMFS 2020), habitat loss associated with climate change, overutilization in a targeted fishery, and stochastic events such as HABs and cold weather events are the greatest threats to the species. These threats affect dwarf seahorse populations over different time scales. Stochastic events such as HABs and severe cold events are generally restricted in geographic space, duration, and frequency and therefore are likely short-term threats. Directed harvest is a longer-term threat; however, harvest regulations can be dynamically adapted to promote sustainability. Contemporary models forecast climate change effects several decades into the future; thus, climate change is considered a long-term threat.

The response of dwarf seahorses was considered over the timeframes associated with the major threats. Dwarf seahorse subpopulations have demonstrated remarkable resilience to stochastic events, with apparent large population declines followed by large population increases (NMFS 2020). The response of dwarf seahorses to long-term threats was difficult to predict given the species' life history, including longevity and generation time. At approximately 1-3 years (Abbott 2003; Koldewey 2005; Strawn 1958; Vari 1982), dwarf seahorse longevity is very short in comparison to many other teleost fish. Dwarf seahorses reach sexual maturity in about 3 months (Strawn 1953; Strawn 1958; Koldewey 2005) and generation time is 1.24 years. As an early-maturing species, with fast growth rates and high productivity, dwarf seahorse subpopulations are highly dynamic and likely able to respond quickly to conservation actions or short-term threats. However, this brief life history strategy makes it difficult to forecast the response to long-term threats, such as climate change, that extend over several decades. The SRT was unsure how a short-lived species would be able to adapt to slowly changing habitats associated with climate change. The SRT discussed whether the impacts of known threats could be confidently predicted over timeframes of several generations.

The SRT believed the foreseeable future should include several generation times and ultimately decided on approximately 8 generation times, or 10 years, as the SRT felt confident they could predict the impact of threats on the species over a decade. While the selected foreseeable future of 10 years is shorter than that estimated for other species, the brief and highly dynamic life history of the dwarf seahorse must be considered in determining an appropriate foreseeable future because, their rapid turnover and capacity for replacement limits our ability to reasonably predict the impact of longer-term threats on the species.

The ability to determine and assess risk factors to a marine species is often limited when quantitative estimates of abundance and life history information are lacking. Therefore, in assessing threats and subsequent extinction risk of a data-limited species such as the dwarf seahorse, we include both qualitative and quantitative information. In assessing extinction risk to the dwarf seahorse, the SRT 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 *https://www.fisheries.noaa.gov/resources/documents?sort_by=created&title=status+review* 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.

Using these concepts, the SRT evaluated extinction risk by assigning a risk score to each of the four demographic viability factors and five threats-based listing factors. The scoring was as follows: very low risk = 1; low risk = 2; medium risk = 3; high risk = 4; and very high risk = 5.

- Very low risk: It is unlikely that this factor contributes significantly to risk of extinction, either by itself or in combination with other demographic viability factors.
- Low risk: It is unlikely that this factor contributes significantly to current or long-term risk of extinction by itself, but there is some concern that it may, in combination with other demographic viability factors.
- Moderate risk: This factor contributes to the risk of extinction and may contribute to additional risk of extinction in combination with other factors.
- High risk: This factor contributes significantly to short-term or long-term risk of extinction and is likely to be magnified by the combination with other factors.
- Very high risk: This factor by itself indicates danger of extinction in the near future and over the foreseeable future.

SRT members were also asked to consider the potential interactions among demographic and listing factors. If the demographic or listing factor was ranked higher due to interactions with other demographic or listing factors, SRT members were asked to identify those factors that caused them to score the risk higher (or lower) than it would have been if it were considered independently.

Finally, the SRT examined and discussed the independent responses from each team member for each demographic and listing factor to determine the overall risk of extinction (see *Extinction Risk Determination* below).

Demographic Risk Analysis

Abundance

The best available information on dwarf seahorse abundance indicates that the species may still be present along the east coasts of Mexico and Texas and along both coasts of Florida. Lack of data from outside the United States hindered the SRT's ability to analyze abundance trends in foreign locations. Within the United States, dwarf seahorse appears to be most common in Florida, though it is also present at a much lower level of abundance in south Texas. Outside of Florida and Texas, observations and records of the dwarf seahorse are historically uncommon. Seasonally low water temperatures establish geographic range boundaries, which likely contribute to the limited number of records of the dwarf seahorse in waters of the northern Gulf coast (Florida panhandle to north Texas). Additionally, limited seagrass habitat along the northern Gulf coast, both historically and currently, also likely restricts dwarf seahorse in this region. There are three sources that can be used to estimate the species relative abundance: U.S. Geological Survey data, the Florida Fish Wildlife Conservation Commission (FWC) Fisheries Independent Monitoring (FIM) program in Florida, and the Texas Parks and Wildlife Department (TPWD) monitoring program in Texas. Additionally, a population modeling study by Carlson *et al.* (2019) provides insight into the abundance of dwarf seahorse in Florida and the potential changes to this population in the context of ongoing threats.

The FWC FIM program provided survey data for several estuarine areas in Florida including Apalachicola Bay (1998-2016), Cedar Key (1996-2016), Tampa Bay (1996-2016), Sarasota Bay (2009-2016), Charlotte Harbor (1996-2016), Florida Bay (2006-2009), and Indian River Lagoon (1996-2016). FIM program data indicate that dwarf seahorses are not abundant in northern Florida and have not been encountered in the Florida Keys National Marine Sanctuary. Surveys conducted within estuaries of northern Florida found that the species is rare in Apalachicola Bay and Cedar Key, and has never been recorded in Choctawhatchee Bay or Northeast Florida. In the Indian River Lagoon, on Florida's east coast, relative abundance was low throughout the survey period (1996-2016), with no individuals recorded from 2011-2013. The decline of the dwarf seahorse in the Indian River Lagoon could be the direct result of recent HABs in the estuary (SJRWMD, 2012; FWC, 2014). During the late 1980s and early 1990s, significant HABs in Florida Bay resulted in massive seagrass die-offs and reductions in dwarf seahorse abundance (Matheson Jr. *et al.* 1999). However, survey data from 2006-2009 suggest that the dwarf seahorse was relatively abundant in Florida Bay when compared to other species and locations (FWC FIM unpublished data).

In Florida, the species appears to be most abundant in five estuaries: Charlotte Harbor, Tampa Bay, Sarasota Bay, Biscayne Bay, and Florida Bay (Figures 3 and 4 in NMFS 2020). The SRT believes these five estuaries comprise the core area of abundance critical to the population. Although long-term dwarf seahorse abundance has declined from historical levels, abundance has remained stable at a lower level since 2009 when the trip limit regulations went into effect (FWC FIM unpublished data). The best available information on the dwarf seahorse's status suggests that Florida Bay has the highest relative abundance of the dwarf seahorse.

Retrospective population projections provided in the Carlson *et al.* (2019) population viability assessment (PVA) of dwarf seahorses estimated male subpopulation sizes over the past 15-20 years using the empirical trends in seagrass coverage and occurrences of major stochastic events. Carlson *et al.* (2019) estimated subpopulations in 2016 ranging from 15,258 in Cedar Key to 9,910,752 in Florida Bay. We compared the Carlson *et al.* (2019) estimated annual subpopulation sizes to the relative abundance indices from the FWC FIM small seine surveys for Cedar Key, Charlotte Harbor, Tampa Bay and Indian River Lagoon (Figure 18 in NMFS 2020). Modeled subpopulation sizes from the PVA did not track the trends in relative abundance reported by FWC early in the time series. The poor fit between modeled and reported data early in the time series was likely a result of the conservative initial population estimates in Carlson *et al.* (2019). However, the modeled data appeared to equilibrate and become more representative mid-way through the time series as indicated by similar patterns in trends between the modeled and reported data.

The general agreement in recent trends suggests the PVA model captured the primary drivers of dwarf seahorse abundance. Additionally, the PVA results suggest that even with conservative assumptions regarding initial population sizes for the different subpopulations, carrying capacity, sex ratio, and age at maturity, the dwarf seahorse population numbers in the tens of millions in Florida waters (Carlson *et al.* 2019). Dwarf seahorse subpopulation densities (N/m^2), which were derived by dividing Carlson *et al.* (2019) subpopulation estimates by total subregion seagrass habitat areas, are significantly lower than those empirically observed, suggesting the Carlson *et al.* (2019) PVA is conservative in its assessment of total population size (see Table 2 in Carlson *et al.* 2019; Rose *et al.* 2019, Figures 3 & 4 in NMFS 2020). Similarly, multiplication of recent density estimates for Tampa Bay (0.139 N/m^2 – Rose *et al.* 2019; 0.095 N/m^2 – Masonjones *et al.* 2019) and Florida Bay (0.00392 N/m^2 in seines and 0.00462 N/m^2 in trawls – FWC FIM unpublished data) by the most recent estimates of seagrass habitat area in Tampa Bay (2014) and Florida Bay (2010-2011), respectively, provided estimates in the range of 15.5 - 22.6 million dwarf seahorses in Tampa Bay and between 6.0 - 7.1 million dwarf seahorses in Florida Bay. This analytical approach could overestimate seahorse abundance if the density estimates were generated from areas of localized dwarf seahorse abundance. However, density estimates are influenced by catchability, which varies between sampling gears. Dwarf seahorse densities derived from FIM catch-per-unit effort (CPUE) in Tampa Bay for 2009 were orders of magnitude smaller for bag seine and otter trawl, respectively (0.000402 N/m^2 and 0.0000125 N/m^2) than those derived by Rose *et al.* (2019). These nominal CPUEs are 2.9 percent and 0.1 percent of the densities reported by Rose *et al.* (2019) for the same time period using specialized gears for sampling dwarf seahorse. Thus, population sizes of dwarf seahorse based on expanding nominal FIM CPUE to seagrass area could be underestimates if animals are uniformly distributed within seagrass habitats across the FIM sampling domain. The difference in estimated abundance between Tampa Bay and Florida Bay presented above is likely attributable to sampling design; the Tampa Bay studies by Masonjones *et al.* (2019) and Rose *et al.* (2019) were actively targeting dwarf seahorses using specialized gears in an area believed to contain high densities, whereas the Florida Bay study was a general nekton survey using less efficient gears (trawls and seines) for collecting dwarf seahorse. Importantly, this approach does suggest that field estimates of abundance, when expanded for the full range of dwarf seahorse habitats, can greatly exceed the estimates generated by the Carlson *et al.* (2019) modeling approach.

In Texas, dwarf seahorse abundance is low and restricted to the central and southern coastal systems including Aransas Bay, Corpus Christi Bay, San Antonio Bay, and the Upper and Lower Laguna Madre. The species has not been recorded in TPWD surveys conducted in Galveston, Matagorda, and East Matagorda Bay systems. Of the bays where dwarf seahorses have been recorded, relative abundance is highest in Upper Laguna Madre, though abundance is still very low within this system compared to the Florida estuaries. Data series for the other bays (Aransas, Corpus Christi, San Antonio, and Lower Laguna Madre) have fewer than 10 records each, and therefore the SRT was unable to discern population trends. The SRT believes that Upper Laguna Madre is likely the core area of abundance for the southwestern portion of the species range within U.S. waters.

Populations with very low abundance that occur over a limited geographic scale are more likely to be impacted by stochastic events such as HABs or extreme cold weather events. Recolonization and recovery is dependent on the ability of surrounding populations to provide recruits to the depleted area. In some cases, a population may have suffered a stochastic event and not been encountered in surveys for several years before eventually returning to the area. Periodic HABs continue to occur in Texas lagoons, but some bays, like Laguna Madre, have consistently recorded dwarf seahorses in surveys indicating that subpopulations can tolerate stochasticity in their environment. Regardless, it is not prudent to base an assessment of risk to species abundance on such few observations as reported from Texas.

Commercial harvest and bycatch of the dwarf seahorse in Florida is a factor that impacts species abundance. The dwarf seahorse is targeted by the commercial ornamental fishery to be sold for aquarium markets. According to dealer reports, harvest appears to be focused from Tampa Bay to Fort Myers and from Florida Bay to Miami (FWC, 2012). However, commercial harvest is prohibited within the Everglades National Park, which encompasses a significant portion of Florida Bay. The dwarf seahorse is also among those species likely captured by non-selective trawl fishing gear targeting bait shrimp, because this trawling often occurs in seagrass habitat. The subpopulations in Charlotte Harbor and Tampa Bay have been variable since surveys began in 1996, but have stabilized since new regulations limiting harvest were adopted in 2009. Because few, if any, reported large-scale stochastic events have occurred over the past two decades within these systems, it is reasonable to infer that high levels of commercial harvest prior to the 2009 trip limit likely caused at least a portion of the observed historical declines in Charlotte Harbor and Tampa Bay (Figures 12 & 13 in NMFS 2020).

The best available information indicates that habitat loss and degradation, stochastic events (HABs and extreme cold weather events), and commercial harvest are factors that impact dwarf seahorse abundance. However, the species appears to be at risk of local extirpation only where populations have very low abundance or are isolated due to the distance between habitat patches or estuary systems.

Based on the above information, the SRT members scored the present risk of dwarf seahorse extinction based on abundance from 2 to 3, with a mean of 2.3 and a mode of 2. The team concluded that, based on the population estimate resulting from the population viability model, which shows stable or increasing subpopulations in most areas, the abundance of dwarf seahorse presents a low risk of extinction and the population is robust enough to withstand threats currently facing the species. This result is similar to the International Union for Conservation of Nature (IUCN) Red List assessment, which identified dwarf seahorse as a species of "least concern" in terms of its threat status (Masonjones *et al.* 2017). Although most subpopulations showed stable or increasing abundance and the team expected these patterns to continue into the foreseeable future based on the predictive modeling in Carlson *et al.* (2019), an increase in the frequency, duration, or scale of stochastic events into the future may increase extinction risk. It was unclear to the SRT whether HABs and cold weather events would increase in frequency and magnitude over the 10-year foreseeable future, because the events are stochastic in nature and their causes are poorly understood. Several conservative 10-year forecasts were modeled to encompass the extinction risk associated with the possibility of an increasing frequency and magnitude of these stochastic events. When considering the contribution of abundance to the risk of extinction over the foreseeable future, the team scored abundance as a moderate risk (3), given the uncertainty associated with increased potential for stochastic events.

Population Growth Rate and Productivity

The life history characteristics of the dwarf seahorse (*i.e.,* early age at maturity, rapid growth, high fecundity, and parental care) suggest that this species has a relatively high intrinsic rate of population increase (more births than deaths per generation time; R_{max}=1.49 yr^{-1}) and high compensatory capacity (ability of a population to positively respond to changes in its density) (Kindsvater *et al.* 2016). The dwarf seahorse has relatively high fecundity compared to other seahorse species, though fecundity is much lower than other teleosts. Current demographic analysis suggest that healthy subpopulations have high intrinsic rates of population increase and would be able to tolerate high levels of direct and indirect mortality. However, the species also has complex courtship behaviors and is constrained by its habitat specificity and small home range. With the dwarf seahorse's complex reproductive behaviors, many factors (*e.g.,* stochastic events, directed fishing, bycatch) could disrupt courtship and mating and consequently reduce productivity.

The SRT believes that the dwarf seahorse subpopulations in Charlotte Harbor, Sarasota Bay, Tampa Bay, Florida Bay, and Biscayne Bay are more productive than those of other estuaries and bays within the species' range. The best available information suggests that several other estuaries and bay systems in Florida and Texas have subpopulations which may be at risk of an Allee effect (*i.e.,* inability to find a mate and subsequently low levels of population growth from future recruitment), though these are all systems along the fringe of the dwarf seahorse range and therefore may have naturally low abundance.

The SRT considered scenarios developed by Carlson *et al.* (2019) for dwarf seahorse abundance in five bay systems: Cedar Key, Tampa Bay, Charlotte Harbor, Florida Bay and northern Indian River Lagoon (Figure 5 in NMFS 2020). Scenarios were initiated at the earliest time data were available on the coverage of the seagrass canopy from Yarbro and Carlson (2016) taking into account changes in seagrass density, commercial harvest, bycatch and mortality related to HABs and cold temperature events.

Three of the five subpopulations (Tampa Bay, Charlotte Harbor, Florida Bay) slightly increased in abundance (3–8 percent), whereas the Cedar Key and northern Indian River Lagoon subpopulations did not increase in abundance.

Carlson *et al.* (2019) also explored future scenarios to test the effect of the most likely threats to dwarf seahorse (Figure 20 in NMFS 2020). As the harvest of dwarf seahorse by the Marine Life fishery has been limited, the greatest threats to future seahorse subpopulations include the loss of seagrass habitat, and increased harmful algal blooms, which can cause acute mortality. Carlson *et al.* (2019) explored optimistic scenarios (increased seagrass coverage and current levels) and pessimistic scenarios (increased rates of mortality, loss of seagrass habitat and likelihood of HABs increasing from historically observed levels). The population was projected forward 10 years. Starting conditions for these projections were conservatively assumed at the lower 5 or 10 percent quantiles from bootstrapped empirical estimates of abundance (see Table 2 in Carlson *et al.* 2019). Projected stock trajectories under potential future conditions were mostly stable in Cedar Key, declining in Northern Indian River Lagoon, and generally increasing under the vast majority of scenarios for the other three locations (Figure 13 in NMFS 2020). Only the most pessimistic scenario for Indian River Lagoon resulted in extirpation of any subpopulation within 10 years.

Scenarios testing the effects of HABs accompanied by reduced seagrass habitat affected all subpopulations' abilities to grow. The subpopulation to be most affected was the Indian River Lagoon, which experienced significant declines in abundance. Abundance of dwarf seahorse in Indian River Lagoon declined from a starting size of about 86,000 males to less than 6,000 in 10 years. Other subpopulations were able to maintain their baseline levels of abundance despite losses of habitat.

The SRT determined that population growth rate and productivity of dwarf seahorse present a low risk of extinction to the species. Each member of the team scored this demographic variable as a level 2 risk, both currently and over the foreseeable future.

Spatial Structure/Connectivity

The dwarf seahorse has low mobility, occupying a limited activity space and small home range within a specific habitat (seagrasses). These life history traits suggest that the species is not likely to disperse actively. However, movement by passive dispersal occurs as seahorses use their prehensile tail to hold on to seagrass or macroalgae which are carried by currents (Foster and Vincent 2004; Masonjones *et al.* 2010; Fedrizzi *et al.* 2015). A population genetics study on *Hippocampus kuda* in the Philippines suggested colonization of distant habitats by a small number of founding individuals may be common in seahorses associated with the *H. kuda* complex (Teske *et al.* 2005).

The species' short lifespan, narrow habitat preference, and low mobility increase extinction vulnerability as the dwarf seahorse is susceptible to population fragmentation and loss of population connectivity. Successful repopulation or colonization may depend on a sufficient number of individuals emigrating to a habitat containing seagrass to establish themselves. It is essential that seagrass habitat patches exist between subpopulations as dispersal capabilities are restricted by the availability of seagrass habitat. Historically, the dwarf seahorse has shown that it can recover from stochastic events (HABs and extreme cold weather events) where subpopulations have been impacted or even temporarily extirpated, but low relative abundance in some areas may limit repopulation.

Based on the best available information on the spatial structure/connectivity of dwarf seahorse subpopulations, the SRT believes this demographic variable presents a moderate extinction risk both now and in the foreseeable future. Team scores ranged from 2 to 3, with a mean of 2.7 and a mode of 3. Differences in scores were largely a reflection of personal thoughts on how far dwarf seahorses may disperse via rafting, and thus how connected the populations could be.

Diversity

The loss of diversity can reduce a species' reproductive fitness, fecundity, and survival, thereby contributing to declines in abundance and population growth rate and increasing species extinction risk (Gilpin and Soule, 1986). There is no indication that the dwarf seahorse is at risk due to a significant change or loss of variation in life history characteristics, population demography, morphology, behavior, or genetics.

However, the SRT considered diversity to present a moderate extinction risk to dwarf seahorses both now (range 2-3, mode = 3) and in the foreseeable future (range 2-3, mode 3). The team considered this a moderate risk given the lack of genetic information, particularly from Texas, and how that population may relate to the Florida population. Similarly, Fedrizzi *et al.* (2015) indicated population structuring in which the Panhandle represents a separate population from other areas of Florida. Given the large distance between the subpopulations in the Florida panhandle and other parts of Florida the team also expressed concern over the transfer of genetic material. Expanding the research of Fedrizzi *et al.* (2015) to include dwarf seahorses from Texas and Mexico could provide additional information on the diversity of dwarf seahorse, the relationship among those outside of Florida, and whether additional regulatory measures may be necessary.

Summary of Demographic Risk Analysis

The SRT found that threats such as habitat loss or degradation and overutilization may interact with the dwarf seahorse's life history traits to increase the species' extinction risk. The dwarf seahorse's habitat preference and low mobility could increase the species' ecological vulnerability, as the species may be slow to recolonize depleted areas. Similarly, patchy spatial distributions in combination with low relative population abundance (relative to historical levels) make the species susceptible to habitat degradation and overexploitation. Life history traits, such as complex reproductive behavior and monogamous mating, may also increase the species' vulnerability. However, the species' ability to mature early and reproduce multiple times throughout a prolonged breeding season offsets much of the vulnerability.

Threats-Based Analysis

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

The SRT considered the destruction or modification of habitat to be the largest threat facing dwarf seahorse both now and into the foreseeable future. As discussed in the Status Review Report (NMFS 2020), there are a number of threats impacting seagrass habitats upon which dwarf seahorse rely, including water quality, damage from vessels and trawling, and climate change. Regulations and educational programs have and continue to be implemented in an attempt to reduce impacts from water quality, vessels, and trawling. In light of the long-term HAB in the Indian River Lagoon resulting in large-scale losses of seagrasses and the collapse of the dwarf seahorse subpopulation there, the SRT was particularly concerned with HABs, their interaction with water quality, and their potential to negatively affect dwarf seahorse. One of the most severe HABs on the west coast of Florida occurred in 2005, with substantial spread of red tide into Tampa Bay (see Figure 1b in Flaherty & Landsberg 2011). FIM data showed a substantial (-71 percent) but statistically insignificant decline in relative abundance in 2005, with a substantial (+110 percent) recovery in 2006. Another HAB was present along the west coast of Florida between Charlotte Harbor and Tampa Bay during the summer and fall of 2018. HAB monitoring data indicate *Karenia brevis* (red tide) did not enter Tampa Bay or Charlotte Harbor (Figure 21 in NFMS 2020), which may have spared dwarf seahorses inhabiting these estuaries. Subsequent dwarf seahorse sampling in Tampa Bay during 2019 indicates a robust dwarf seahorse population in Old Tampa Bay and Ft. DeSoto areas (H. Masonjones, University of Tampa, pers. comm. to Adam Brame, NOAA Fisheries, on October 13, 2019). The 2018 HAB did not affect Florida Bay, where surveys and model simulations suggest dwarf seahorses are found in the highest abundance.

The SRT was also concerned about the impact of climate change affecting seagrass habitat into the future. Climate change is expected to impact seagrass habitat, though the temporal rate and degree to which this occurs is not known with certainty. The Status Review indicates that thermal tolerance of seagrasses and rising sea levels may affect future distribution and meadow health, while warming seawater temperatures could increase the available habitat for dwarf seahorses along the northern Gulf of Mexico. Based on the above information, the team scored the present destruction or modification of habitat as a moderate risk for dwarf seahorse, with all team members giving it a score of 3. Considering the uncertainty associated with climate change and HABs in the future, the team scored this threat slightly higher when considering it over the foreseeable future, with two members giving it a score of 4 and one team member giving it a score of 3.

Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

The commercial harvest of the dwarf seahorse is restricted to Florida, but is considered by the SRT to be the second greatest threat to the species after habitat loss and degradation. The dwarf seahorse is harvested largely for the aquarium markets and removals have resulted in declines in local subpopulation abundance since the early 1990s. In general, seahorses are one of the most popular and heavily exploited marine ornamentals harvested in Florida. Dwarf seahorse landings are significantly higher than other seahorse species; landings data shows that seahorse harvest consists almost solely of dwarf seahorse.

Data indicate that over a 25-year timeframe, dwarf seahorse landings have fluctuated with tens of thousands being harvested annually. Historical declines in abundance observed in Charlotte Harbor and Tampa Bay suggest that harvest may be impacting these core subpopulations. A 2009 trip limit regulation has reduced the harvest of dwarf seahorses and the population appears to have stabilized as a result (Figures 3 and 5 in NMFS 2020). Additionally, a significant portion of Florida Bay is protected by the prohibition on commercial fishing within Everglades National Park boundaries. The protection against commercial harvest and bycatch within this system likely played a significant role in the species' ability to recover from the HABs that impacted Florida Bay during the late 1980s and early 1990s.

While the use of any net with a mesh area exceeding 500 square feet (46.5 square meters) is prohibited in nearshore and inshore waters of Florida (Florida 68B-4.0081(3)(e)), a bait-shrimp fishery operates within these boundaries. This fishery relies upon small trawls to collect shrimp for bait, and, given this fishery operates in seagrass habitat, it is reasonable to infer that dwarf seahorse are removed as bycatch. Seahorses may be more vulnerable to injuries, mortality, and disruption of reproduction in habitats that are disturbed by heavy trawls deployed for longer periods and over greater areas (Baum *et al.* 2003). Baum *et al.* (2003) analyzed bycatch of the lined seahorse (*Hippocampus erectus*) in the bait-shrimp trawl fishery and estimated about 72,000 seahorses were incidentally caught per year. However, this study reported only two dwarf seahorses were captured during the study period. In developing bycatch estimates for use in their population viability model, Carlson *et al.* (2019) used the ratio of dwarf seahorse caught to lined seahorse caught and estimated that 157 dwarf seahorses are incidentally caught per year.

The SRT assumes that demand for the dwarf seahorse in the marine ornamental fishery and aquarium markets will continue. The extent to which heavy commercial harvest is impacting dwarf seahorse populations in Florida is largely unknown, although there are some indications that overharvest may be impacting populations in Charlotte Harbor and Tampa Bay. In response to the listing petition and the subsequent data request by NMFS, the State of Florida considered new regulations, which included time-area closures and a 200 seahorses per trip limit. NMFS analyzed the potential effects of the proposed regulations and determined the area closure, the 200 seahorses per trip limit, and an April-June closed season could, cumulatively, reduce harvest by 40-48 percent

(NMFS 2015). Despite the results of the analysis, the State of Florida did not adopt the new regulations, as the state believed the current trip limit of 400 seahorses per day was sufficient for sustainably managing the wild populations of seahorses. While the SRT believes that the dwarf seahorse population is likely still being negatively impacted by harvest under the current regulations, removals since 2009 have declined by 55 percent, and the relative abundance trend information since 2009 is stable (as an indirect indicator of status) in areas where dwarf seahorses are significantly harvested (*e.g.,* southwest Florida and southeast Florida, including the Florida Keys). Dwarf seahorses are characterized by rapid growth, early age at maturity, and short generation time, all of which collectively indicate that the species has high intrinsic rates of population increase. This suggests that populations can recover from declines following a reduction in fishing effort (Curtis *et al.* 2008).

The SRT concluded that the species is currently at a low to moderate risk due to overexploitation from commercial harvest, with scores that ranged between 2 and 3, with a mean of 2.3 and a mode of 2. Given that the team considered similar rates of utilization in the future, scores were the same when considering the threat over the foreseeable future. The scores also remained the same when considered in combination with other threats, such as lack of adequate existing regulatory mechanisms.

Disease and Predation

The SRT determined that disease and predation present a very low extinction risk to dwarf seahorse. The team was not able to find documentation of disease affecting wild subpopulations of dwarf seahorse. With respect to predation, the team assumed mortality rates from predation are likely higher for juvenile seahorses than adults. The dwarf seahorse is presumed to have few predators and is likely only opportunistically predated upon by fishes, crabs, and wading birds. The dwarf seahorse's excellent camouflage is well-adapted for the species' ecological niche and likely reduces the level of predation on the species.

All members of the SRT scored disease and predation as a 1, both now and over the foreseeable future, which indicates a very low risk in the ERA.

Inadequacy of Existing Regulatory Mechanisms

With respect to inadequacy of existing regulatory mechanisms, there are only three regulations that relate to *Hippocampus* species in the United States. Internationally, only Bermuda has a regulation pertaining to seahorses, and it focuses only on lined and longsnout seahorses, as the dwarf seahorse has been extirpated there. The SRT was not aware of any seahorse regulations in The Bahamas or Cuba.

Within the state of Florida, the FWC regulates fishing effort in both the commercial marine life fishery, which includes marine ornamentals like the dwarf seahorse (68B-42, F.A.C.) and the recreational fishery. The commercial regulations include requirements for specific fishing licenses and tiered endorsements, as well as a commercial trip limit of 400 dwarf seahorses per person or vessel per day, whichever is less (68B-42.006, F.A.C.). There is no cap on the total annual take of dwarf seahorses, and there are no seasonal restrictions or closures. However, entry is limited into the commercial marine life fishery for ornamentals. From 2010-2014, on average, 19 permit holders have reported Florida dwarf seahorse harvest. Enforcement of the trip limit regulation has been problematic as at least one commercial harvester has continued to exceed the 400 dwarf seahorses limit since its inception. This harvester exceeded the trip limit 26 trips out of 80 between 2010 and 2015 (NMFS 2015). The State of Florida also regulates recreational harvest of dwarf seahorse (daily bag limit of up to five per person per day) and bycatch of dwarf seahorses associated with the inshore bait shrimp fishery (also limited by the recreational bag limit). Because there is no reporting associated with recreational limits, the SRT is unsure of the impact these regulations have on the dwarf seahorse population.

The assessment of individual species and fishing effort are necessary to determine whether existing regulations are likely to be effective at maintaining the sustainability of the resources. To date, however, the commercial removal of dwarf seahorses and its impact on the population has not been assessed. The SRT was unable to determine exactly how the daily bag limit (400 dwarf seahorses per person per day) was established, its ability to prevent overharvest, or how effective it will be at achieving long-term sustainability. However, the 2009 bag limit regulation seems to have stabilized the population since implementation.

The second regulatory mechanism that may affect seahorses (*Hippocampus* spp.) is the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)—an international agreement between governments established with the aim of ensuring that international trade in specimens of wild animals and plants does not threaten their survival. Seahorses are listed under Appendix II of CITES. Appendix II includes species that are not necessarily threatened with extinction, but for which trade must be controlled in order to avoid utilization incompatible with their survival. International trade of Appendix II species is permitted when export permits are granted from the country of origin. In order to issue an export permit, the exporting country must find that the animals were legally obtained and their export will not be detrimental to the survival of the species in the wild (referred to as a ‘‘non-detriment finding’’). Millions of seahorses are traded internationally each year, although only a small percentage of these are dwarf seahorses, and the CITES listing has not curbed this trade (Foster *et al.* 2014). Almost all the dwarf seahorses harvested from the wild populations in the United States remain in U.S. markets and therefore are not subject to the CITES regulation of trade under Appendix II. Dwarf seahorses represent approximately 0.01 percent of international trade, and over a 10-year period only 2,190 dwarf seahorses were exported from the United States, with 1,500 of those being captive-bred (USFWS 2014).

The third regulatory factor that provides protections for seahorses is the listing of dwarf seahorse as a species subject to “Special Protection” under Mexican law. This limits any removal of the species to what is allowed under the rules of the Mexican General Law of Wildlife (Diaz 2013), which establishes the conditions for capture, and transport permits, and authorizations (Bruckner *et al.* 2005). The SRT is unsure of the adequacy of this regulation at this time.

The SRT expects that demand for the dwarf seahorse in the marine ornamental fishery and aquarium markets will continue into the future. The extent to which current regulations are adequate at protecting the dwarf seahorse population was difficult to evaluate. The SRT concluded that the lack of regulatory mechanisms intended to control harvest, particularly commercial harvest, is likely having detrimental effects on population abundance and productivity. However, the 2009 regulation limiting commercial harvest to 400 seahorses per person or per vessel per day, whichever is less, seems to have stabilized the population. In combination with time-area closures associated with the marine life fishery, the limited entry into the fishery, and export regulations associated with CITES, the team concluded that inadequacy of regulatory mechanisms presents a low extinction risk (mode = 2). Given the team's belief that these regulations will remain in place and that they will continue to affect harvest in a similar manner into the future, the scores remained unchanged when considering this threat over the foreseeable future.

Other Natural or Manmade Factors Affecting its Continued Existence

The Status Review Report (NMFS 2020) identified several potential natural or man-made factors that could serve as potential threats to the dwarf seahorse. These included the species' life history strategy, anthropogenic noise, oil spills, and high-impact storm events. The SRT evaluated the potential impact of these threats on the dwarf seahorse, but did not find that any of these other threats are likely to be a source of high extinction risk to the dwarf seahorse. The dwarf seahorse life history strategy is well suited to respond to periodic declines associated with stochastic events. The Deepwater Horizon oil spill occurred far from the core dwarf seahorse population in south and southwest Florida and was not known to affect seagrass habitat outside of the area around the Chandeleur Islands where dwarf seahorses are rare. While future oil spills could impact dwarf seahorses or their habitat, the majority of oil and gas exploration occurs in the central and western portions of the Gulf of Mexico, and oil would need to be transported great distances to reach the nearshore waters of Florida where dwarf seahorses are most abundant. Data are insufficient to determine how anthropogenic noise affects dwarf seahorses, and life history and future studies may be necessary to address this potential threat. Lastly, weather events have the potential to impact dwarf seahorses, but these are expected to be short-term perturbations that the species is capable of quickly responding to. The SRT ranked this category of threats as a very low risk both currently and in the foreseeable future, with all team members scoring this factor a 1.

Extinction Risk Determination

Guided by the results from the demographics risk analysis as well as the threats-based analysis, the SRT members used their informed professional judgment to make an overall extinction risk determination for the species. For these analyses, the SRT defined three levels of extinction risk:

- High risk: A species with a high risk of extinction is at or near a level of abundance, productivity, spatial structure, and/or diversity that places its continued persistence in question. The demographics of a species at such a high level of risk may be highly uncertain and strongly influenced by stochastic or depensatory processes. Similarly, a species may be at high risk of extinction if it faces clear and present threats (*e.g.,* confinement to a small geographic area; imminent destruction, modification, or curtailment of its habitat; or disease epidemic) that are likely to create imminent and substantial demographic risks;
- Moderate risk: A species is at moderate risk of extinction if it is on a trajectory that puts it at a high level of extinction risk in the foreseeable future (see description of "High risk" above). A species may be at moderate risk of extinction due to projected threats or declining trends in abundance, productivity, spatial structure, or diversity. The appropriate time horizon for evaluating whether a species will be at high risk in the foreseeable future depends on various case-specific and species-specific factors. For example, the time horizon may reflect certain life history characteristics (*e.g.,*

long generation time or late age at maturity) and may also reflect the timeframe or rate over which identified threats are likely to impact the biological status of the species (*e.g.,* the rate of disease spread); and

- Low risk: A species is at low risk of extinction if it is not at a moderate or high level of extinction risk (see "Moderate risk" and "High risk" above). A species may be at low risk of extinction if it is not facing threats that result in declining trends in abundance, productivity, spatial structure, or diversity. A species at low risk of extinction is likely to show stable or increasing trends in abundance and productivity with connected, diverse populations.

To allow individuals to express uncertainty in determining the overall level of extinction risk facing the dwarf seahorse, the SRT adopted the "likelihood point" method, which has been used in previous status reviews (*e.g.,* Pacific salmon, Southern Resident Killer Whale, Puget Sound Rockfish, Pacific herring, and black abalone) to structure the team's thinking and express levels of uncertainty in assigning threat risk categories. For this approach, each team member distributed 10 "likelihood points" among the three extinction risk levels. After scores were provided, the team discussed the range of risk level perspectives for the species, and the supporting data on which the perspectives were based, and each member was given the opportunity to revise scores if desired after the discussion. The scores were then tallied (mode, median, range), discussed, and summarized for the species.

Finally, the SRT did not make recommendations as to whether the dwarf seahorse should be listed as threatened or endangered. Rather, the SRT drew scientific conclusions about the overall risk of extinction faced by this species under present conditions and in the foreseeable future, based on an evaluation of the species' demographic viability factors and assessment of threats.

The best available information indicates that within the United States dwarf seahorses occur in Florida and to a lesser extent in south Texas, but do not appear to extend into the northern Gulf of Mexico (*i.e.,* Alabama, Mississippi, and Louisiana), as previously believed. The SRT acknowledged that there is a lack of abundance data in the northern Gulf of Mexico, but found that, because the species is temperature-limited, and due to the seasonal cold water temperatures in that region (Figure 8 of NMFS 2020), it is unlikely that dwarf seahorse was ever common in the northern Gulf of Mexico. The SRT determined that there is evidence of a historical decrease in abundance, especially in areas where dwarf seahorses are naturally abundant. However, over the past decade the most productive subpopulations appear stable or appear to be increasing in their abundance, despite the threats they face. Current regulations and the rebuilding of seagrass habitat have stabilized the populations. The team acknowledged that uncertainty in the frequency, duration, and scale of stochastic events (HABs and extreme cold weather events) could affect the population trend into the foreseeable future and increase extinction risk, but ultimately, based on the predictive analyses provided in Carlson *et al.* (2019), the team believed that the population is robust enough to handle this threat.

Outside of the United States, data on abundance and population trends are lacking. Evidence suggests the species is present along the east coast of Mexico, but without abundance data the SRT was unable to make further conclusions. Therefore, the team made conclusions based solely on the best available data from within the United States.

The SRT had concerns regarding the level of commercial harvest, bycatch, and lack of regulatory mechanisms, and determined that these threats are likely having effects on the species—especially on those local subpopulations that occur in some of the most heavily exploited areas. In addition, overutilization will serve to exacerbate the demographic risks currently faced by the species. However, the SRT determined that habitat degradation (*i.e.,* HABs and coastal construction), projected habitat losses due to sea level rise, and ocean warming resulting from climate change were the most significant threats to the species. The predicted losses of seagrass habitat due to climate change combined with the prolonged commercial harvest may increase the species demographic risks, as impacted populations may be limited in their abilities to recolonize depleted areas based on the dwarf seahorse's low mobility and narrow habitat preference. However, the team concluded that overall the species is at a low risk of extinction (19out of a possible 30 likelihood points), as it is highly productive and faces only one high risk threat. The other remaining 11 likelihood points were all assigned to the moderate risk category. We agree with the assessment provided by the SRT that the dwarf seahorse is at a low risk of extinction.

Significant Portion of Its Range

As noted in the introduction above, the definitions of both "threatened" and "endangered" under the ESA contain the term "significant portion of its range" (SPR), and define SPR as an area smaller than the entire range of the species that must be considered when evaluating a species' risk of extinction. Under the final SPR Policy announced in July 2014, should we find that the species is of low extinction risk throughout its range (*i.e.,* not warranted for listing), we must go on to consider whether the species may have a higher risk of extinction in a significant portion of its range (79 FR 37577; July 1, 2014).

As an initial step, we identified portions of the range that warranted further consideration based on analyses within the Status Review Report (NMFS 2020). The range of a species can theoretically be divided into portions in an infinite number of ways. However, as noted in the policy, there is no purpose to analyzing portions of the range that are not reasonably likely to be significant or in which a species is not likely to be endangered or threatened. To identify only those portions that warrant further consideration, we consider 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 is 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 SPR; rather, it is a step in determining whether a more detailed analysis of the issue is required (79 FR 37578; July 1, 2014). 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. If this preliminary determination identifies a particular portion or portions that may be both significant and may be threatened or endangered, those portions are then fully evaluated under the SPR authority to determine whether the members of the species in the portion in question are biologically significant to the species and whether the species is endangered or threatened in that portion of the range.

The definition of ‘‘significant’’ in the SPR Policy was invalidated in two recent District Court cases that addressed listing decisions made by the USFWS. The SPR

Policy set out a biologically based definition that examined the contributions of the members in the portion to the species as a whole, and established a specific threshold (*i.e.,* when the loss of the members in the portion would cause the overall species to become threatened or endangered). The courts invalidated the threshold component of the definition because it set too high a standard. Specifically, the courts held that, under the threshold in the policy, a species would never be listed based on the status of the portion, because in order for a portion to meet the threshold, the species would be threatened or endangered rangewide. *Center for Biological Diversity, et al.* v. *Jewell,* 248 F. Supp. 3d 946, 958 (D. Ariz. 2017); *Desert Survivors* v. *DOI* 321 F. Supp. 3d. 1011 (N.D. Cal., 2018). Accordingly, while the SRT used the threshold identified in the policy, which was effective at the time the SRT met, NMFS did not rely on the definition of "significant" in the policy when making this 12-month finding. This is consistent with the second *Desert Survivors* case (336 F. Supp. 3d 1131, 1134–1136; N.D. CA August, 2018), which vacated this definition without geographic limitation. As such, our analysis independently analyzed the biological significance of the members of the portion, drawing from the record developed by the SRT with respect to viability characteristics (*i.e.,* abundance, productivity, spatial distribution, and genetic diversity) of the members of the portions, in determining if a portion was a significant portion of the species' range. We considered the contribution of the members in each portion to the viability of the taxon as a whole, given the current available information on abundance levels. We also considered how the contribution of the members in each portion affects the spatial distribution of the species (*i.e.,* would there be a loss of connectivity, would there be a loss of genetic diversity, or would there be an impact on the population growth rate of the remainder of the species).

Within the range of the dwarf seahorse we considered multiple population portions including: (1) south and southwest Florida, (2) east coast of Florida, (3) northwest Florida, (4) Texas, and (5) eastern Mexico. After a review of the best available information, we concluded that only the east coast of Florida and northwest Florida portions may have elevated risk of extinction relative to the species' status range-wide. The other portions considered were either not at risk of extinction (*e.g.,* south and southwest Florida where abundance is high, subpopulations are stable, and seagrass communities are either stable or increasing) or there was insufficient data available to develop an opinion on extinction risk (Texas and eastern Mexico). Therefore, we proceeded to consider the biological significance of only the two portions with elevated extinction risk.

The subpopulation of dwarf seahorses along the east coast of Florida, especially in Indian River Lagoon, appears to be at an elevated risk of extinction relative to the species' range-wide status. Under conservative starting conditions, the retrospective analysis showed this subpopulation has varied in abundance through time and persists at a stable but very low abundance as of 2016 (Carlson *et al.* 2019). The projected PVA runs indicate the population is stable or slightly increasing under optimistic scenarios, but decreasing under all pessimistic scenarios, with the most pessimistic run leading to localized extinction (Carlson *et al.* 2019). The ongoing threat of poor water quality and HABs has drastically reduced seagrass coverage and in turn dwarf seahorse abundance in this portion of its range. If this subpopulation was lost, there would be a reduction in the geographic extent of the dwarf seahorse. However, this portion does not currently have the abundance or habitat capacity to buffer surrounding stocks against environmental threats and is not responsible for connecting other portions. The east coast of Florida subpopulation has been in decline for several years but we have not seen this result in a decline in the adjacent south and southwest Florida subpopulation, suggesting the contribution of the east coast is limited. While Fedrizzi *et al.* (2015) showed there is some gene flow between this portion and others via passive dispersal, the genetic contributions of the east coast portion to the rest of the population's range is limited by ocean currents and winds that dictate passive dispersal. Therefore we would not expect the loss of this portion to contribute significantly to a loss of genetic diversity, and the remaining population would contain enough diversity to allow for adaptations to changing environmental conditions. In conclusion, we determined that the east coast of Florida portion's contribution to the population in terms of abundance, spatial distribution, and diversity is of low biological importance and overall does not appear significant to the viability of the species. Thus we find the east coast of Florida does not represent a significant portion of the dwarf seahorse range.

Dwarf seahorses in northwest Florida (including Apalachicola, Big Bend, Cedar Key, and St. Andrew's Bay) appear to be at a low risk of extinction despite low abundance and the threats facing the species within this portion of its range. Historically, this subpopulation has been far less abundant than other subpopulations, based on the retrospective analysis and fisheries surveys. Overall we find that the contribution that this stock makes to the species' abundance is low. This subpopulation is found on the northern periphery of the species range based on thermal tolerances and thus is most susceptible to mortality from cold weather events. A recent genetic analysis indicates the western-most portion of this subpopulation (Pensacola, Florida) is a separate population from the rest of the Florida population (Fedrizzi *et al.* 2015), but we are unsure of mixing along the boundary further to the south of this portion. If the northwest Florida portion was lost, dwarf seahorses rangewide would lose some potential genetic adaptation. However, this subpopulation is small in size and has limited genetic connectivity to the overall taxon. The remaining subpopulations would continue to provide genetic diversity to the species as whole. There is no evidence to indicate that the loss of genetic diversity from the northwest Florida portion of the dwarf seahorse range would result in the remaining portions lacking enough genetic diversity to allow for adaptations to changing environmental conditions. While it is possible that the unique genetic signature of the northwest Florida portion conveys some type of adaptive potential to the species rangewide, we do not currently have evidence of this. In particular, it is unclear if this subpopulation is uniquely adapted genetically to tolerate colder conditions. The projected PVA runs indicate the subpopulation is generally stable (Carlson *et al.* 2019). Pessimistic PVA scenarios resulted in decreased abundance for this portion of the population, but not extinction (Carlson *et al.* 2019). Although this portion has some extinction risk, its low abundance and limited connectivity suggest it is not significant to the viability of the species overall.

In summary, we find that there is no portion of the dwarf seahorse's range that is both significant to the species as a whole and endangered or threatened. After considering all the portions we believe that some portions (east coast of Florida and northwest Florida) carry an elevated risk of extinction relative to the status of the species range-wide; however, these portions are not biologically significant to the species. In contrast, the south and southwest Florida subpopulation appears to be biologically important to the continued viability of the overall species in terms of abundance, connectivity, and productivity, but this subpopulation is robust and not at risk of extinction now or in the foreseeable future. Thus, we find no reason to list this species, based on an analysis within a significant portion of its range.

Final Listing 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 petitions, public comments submitted on the 90-day finding (77 FR 26478; May 4, 2012), the Status Review Report (NMFS 2020), and other published and unpublished information. We considered each of the statutory factors to determine whether each contributed significantly to the extinction risk of the species. As previously explained, we could not identify a significant portion of the species' range that is threatened or endangered. Therefore, our determination 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 dwarf seahorse is not presently in danger of extinction, nor is it likely to become so in the foreseeable future throughout all or a significant portion of its range. Therefore, the dwarf seahorse does not meet the definition of a threatened species or an endangered species and does not warrant listing as threatened or endangered at this time.

References

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

Peer Review

In December 2004, the Office of Management and Budget (OMB) issued a Final Information Quality Bulletin for Peer Review establishing minimum peer review standards, a transparent process for public disclosure of peer review planning, and opportunities for public participation. The OMB Bulletin, implemented under the Information Quality Act (Pub. L. 106-554) is intended to enhance the quality and credibility of the Federal government's scientific information, and applies to influential or highly influential scientific information disseminated on or after June 16, 2005. To satisfy our requirements under the OMB Bulletin, we obtained independent peer review of the Status Review Report. Three independent specialists were selected from the academic and scientific community for this review. All peer reviewer comments were addressed prior to dissemination of the final Status Review Report and publication of this proposed rule. Both the Status Review Report and the Peer Review Report can be found here: *https://www.cio.noaa.gov/services_programs/prplans/ID411.html*

Authority

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

Dated: July 22, 2020.

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Samuel D. Rauch, III,

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National Marine Fisheries Service.

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