DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 223

[Docket No. 160614518–7999–02]

RIN 0648–XE685

12-Month Finding and Proposed Rule To List the Chambered Nautilus as Threatened Under the Endangered Species Act

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

ACTION: Proposed rule; 12-month petition finding; request for comments.

SUMMARY: We, NMFS, announce a 12-month finding on a petition to list the chambered nautilus (*Nautilus pompilius*) as a threatened species or an endangered species under the Endangered Species Act (ESA). We have completed a comprehensive status review of the species in response to this petition. Based on the best scientific and commercial information available, including the status review report (Miller 2017), and after taking into account efforts being made to protect the species, we have determined that the chambered nautilus is likely to become an endangered species within the foreseeable future throughout its range. Therefore, we propose to list the chambered nautilus as a threatened species under the ESA. Any protective regulations determined to be necessary and advisable for the conservation of the proposed threatened chambered nautilus under ESA section 4(d) will be proposed in a separate **Federal Register** announcement. Should the proposed listing be finalized, we would also designate critical habitat for the species, to the maximum extent prudent and determinable; however, we have determined that critical habitat is not determinable at this time. We solicit information to inform our final listing determination, the development of potential protective regulations, and potential designation of critical habitat in the event the proposed threatened listing for the chambered nautilus is finalized.

DATES: Comments on the proposed rule to list the chambered nautilus must be received by December 22, 2017. Public hearing requests must be made by December 7, 2017.

ADDRESSES: You may submit comments on this document, identified by NOAA–NMFS–2016–0098, by either of the following methods:

- *Electronic Submissions:* Submit all electronic public comments via the Federal eRulemaking Portal. Go to *www.regulations.gov/#&!docketDetail;D=NOAA-NMFS-2016-0098.* Click the ''Comment Now'' icon, complete the required fields, and enter or attach your comments.
- *Mail:* Submit written comments to Maggie Miller, NMFS Office of Protected Resources (F/PR3), 1315 East West Highway, Silver Spring, MD 20910, USA.

Instructions: Comments sent by any other method, to any other address or individual, or received after the end of the comment period, may not be considered by NMFS. All comments received are a part of the public record and will generally be posted for public viewing on *www.regulations.gov* without change. All personally identifying information (*e.g.,* name, address, etc.), confidential business information, or otherwise sensitive information submitted voluntarily by the sender will be publicly accessible. NMFS will accept anonymous comments (enter ''N/A'' in the required fields if you wish to remain anonymous).

The petition, status review report, **Federal Register** notices, and the list of references can be accessed electronically online at: *http://www.fisheries.noaa.gov/pr/species/invertebrates/chambered-nautilus.html.*

FOR FURTHER INFORMATION CONTACT: Maggie Miller, NMFS, Office of Protected Resources, (301) 427–8403.

SUPPLEMENTARY INFORMATION:

Background

On May 31, 2016, we received a petition from the Center for Biological Diversity to list the chambered nautilus (*N. pompilius*) as a threatened species or an endangered species under the ESA. On August 26, 2016, we published a positive 90-day finding (81 FR 58895) announcing that the petition presented substantial scientific or commercial information indicating that the petitioned action may be warranted for the chambered nautilus. 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 this species warrants listing as endangered or threatened under the ESA.

Listing Species Under the Endangered Species Act

We are responsible for determining whether the chambered nautilus is 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 subspecies and, for any vertebrate species, any distinct population segment (DPS) that interbreeds when mature (16 U.S.C. 1532(16)). Because the chambered nautilus is an invertebrate, the ESA does not permit us to consider listing individual populations as DPSs.

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

When we consider whether a species qualifies as threatened under the ESA, we must consider the meaning of the term ''foreseeable future.'' It is appropriate to interpret ''foreseeable future'' as the horizon over which predictions about the conservation status of the species can be reasonably relied upon. What constitutes the foreseeable future for a particular species depends on species-specific factors such as the life history of the species, habitat characteristics, availability of data, particular threats, ability to predict threats, and the reliability to forecast the effects of these threats and future events on the status of the species under consideration. Because a species may be susceptible to a variety of threats for which different data are available, or which operate across different time scales, the foreseeable future is not necessarily reducible to a particular number of years.

The statute requires us to determine whether any species is endangered or threatened throughout all or a significant portion of its range as a result of any one or a combination of any of the following factors: The present or threatened destruction, modification, or curtailment of its habitat or range; overutilization for commercial, recreational, scientific, or educational purposes; disease or predation; the inadequacy of existing regulatory mechanisms; or other natural or manmade factors affecting its continued existence. 16 U.S.C. 1533(a)(1). We are also required to make listing determinations based solely on the best scientific and commercial data available, after conducting a review of the species' status and after taking into account efforts, if any, being made by any state or foreign nation (or subdivision thereof) to protect the species. 16 U.S.C. 1533(b)(1)(A).

Status Review

A NMFS biologist in the Office of Protected Resources conducted the status review for the chambered nautilus (Miller 2017). The status review is a compilation of the best available scientific and commercial information on the species' biology, ecology, life history, threats, and status from information contained in the petition, our files, a comprehensive literature search, and consultation with nautilus experts. We also considered information submitted by the public in response to our petition finding. In assessing the extinction risk of the chambered nautilus, we considered the demographic viability factors developed by McElhany et al. (2000). The approach of considering demographic risk factors to help frame the consideration of extinction risk is well accepted and has been used in many of our status reviews, including for Pacific salmonids, Pacific hake, walleye pollock, Pacific cod, Puget Sound rockfishes, Pacific herring, scalloped, great, and smooth hammerhead sharks, and black abalone (see *http://www.nmfs.noaa.gov/pr/species/* for links to these reviews). In this approach, the collective condition of individual populations is considered at the species level according to four viable population descriptors: abundance, growth rate/productivity, spatial structure/connectivity, and diversity. These viable population descriptors reflect concepts that are well-founded in conservation biology and that individually and collectively provide strong indicators of extinction risk (NMFS 2015).

The draft status review report was subjected to independent peer review as required by the Office of Management and Budget (OMB) Final Information Quality Bulletin for Peer Review (M–05–03; December 16, 2004). The draft status review report was peer reviewed by independent specialists selected from the academic and scientific community, with expertise in nautilus biology, conservation, and management. The peer reviewers were asked to evaluate the adequacy, appropriateness, and application of data used in the status review, including the extinction risk analysis. All peer reviewer comments were addressed prior to dissemination and finalization of the draft status review report and publication of this finding.

We subsequently reviewed the status review report, its cited references, and peer review comments, and believe the status review report, upon which this 12-month finding and proposed rule is based, provides the best available scientific and commercial information on the chambered nautilus. Much of the information discussed below on the species' biology, distribution, abundance, threats, and extinction risk is presented in the status review report. However, in making the 12-month finding determination and proposed rule, we have independently applied the statutory provisions of the ESA, including evaluation of the factors set forth in section 4(a)(1)(A)–(E) and our regulations regarding listing determinations at 50 CFR part 424. The status review report is available on our Web site (see **ADDRESSES** section) and the peer review report is available at *http://www.cio.noaa.gov/services_programs/prplans/PRsummaries.html.* Below is a summary of the information from the status review report and our analysis of the status of the chambered nautilus. Further details can be found in Miller (2017).

Description, Life History, and Ecology of the Petitioned Species

Species Taxonomy and Description

Nautilus taxonomy is controversial. Based on the Integrated Taxonomic Information System (ITIS), which has a disclaimer that states it ''is based on the latest scientific consensus available . . . [but] is not a legal authority for statutory or regulatory purposes,'' two genera are presently recognized within the family of Nautilidae: *Allonautilus* and *Nautilus.* The genus *Allonautilus* has two recognized species: *A. perforatus* and *A. scrobiculatus.* The genus *Nautilus* has five recognized species*: N. belauensis* (Saunders 1981), *N. macromphalus* (Sowerby 1849), *N. pompilius* (Linnaeus 1758), *N. repertus* (Iredale 1944), and *N. stenomphalus* (Sowerby 1849). However, a review and analysis of recent genetic and morphological data suggests that perhaps only two of these five species are valid: *N. pompilius* and *N. macromphalus,* with the other three species more appropriately placed within *N. pompilius* (Vandepas et al. 2016; Ward et al. 2016). Saunders et al. (2017) suggested that consensus may be trending towards treating *N. pompilius* as a ''superspecies'' taxonomically, with *N. stenomphalus, N. belauensis,* and *N. repertus* as subspecies.

However, because the taxonomy of the *Nautilus* genus is not fully resolved, with ongoing debate as to the number of species that exist, we follow the latest scientific consensus of the taxonomy of the *Nautilus* genus as acknowledged by the ITIS, with *N. pompilius* identified as one of five recognized species.

The chambered nautilus is an externally-shelled cephalopod with a distinctive coiled calcium-carbonate shell that is divided into chambers. The shell can range in color from white to orange, and even purple, with unique color patterns (Barord 2015). Its distinctive coiled shell is what makes the chambered nautilus a highly sought after commodity in international trade (Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) 2016). The body of the chambered nautilus is housed in the largest chamber within the shell, and when the animal is attacked, it can seal itself into this chamber, closing the opening with a large, fleshy hood (Jereb 2005). The chambered nautilus also has up to 90 tentacles, without suckers, which they use to dig in substrate and scavenge for food (Barord 2015) and to grab on to reef surfaces for rest (CITES 2016).

Range, Distribution and Habitat Use

The chambered nautilus is found in tropical, coastal reef, deep-water habitats of the Indo-Pacific. Its known range includes waters off American Samoa, Australia, Fiji, India, Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands, and Vanuatu, and it may also potentially occur in waters off China, Myanmar, Western Samoa, Thailand, and Vietnam (CITES 2016). Additionally, Saunders et al. (2017) notes that traps set at *Nautilus* depths in Yap (Caroline Islands), Pohnpei and Majuro (Marshall Islands), Kosrae (Gilbert Islands), Western Samoa, and Tonga failed to catch any chambered nautiluses, providing ''highly suggestive'' evidence that the geographic range of *N. pompilius* may not extend out to these sites.

Within its range, the chambered nautilus has a patchy distribution and is unpredictable in its area of occupancy. Based on multiple research studies, the presence of suitable habitat on coral reefs does not necessarily indicate the likelihood of chambered nautilus occurrence (CITES 2016). Additionally, the chambered nautilus is limited in its horizontal and vertical distribution throughout its range due to physiological constraints. Physiologically, the chambered nautilus cannot tolerate temperatures above approximately 25°C or depths exceeding around 750–800 meters (m) (Ward et al. 1980; Carlson 2010). At depths greater than 800 m, the hydrostatic pressure will cause the shell of the nautilus to implode, thereby killing the animal (Ward et al. 1980). Based on these physiological constraints, the chambered nautilus is considered to be an extreme habitat specialist, found in association with steep-sloped forereefs with sandy, silty, or muddy-bottomed substrates. Within these habitats, the species ranges from around 100 m depths (which may vary depending on the water temperature) to around 500 m depths (CITES 2016). The chambered nautilus does not swim in the open water column (likely due to its vulnerability to predation), but rather remains near the reef slopes and bottom substrate, and thus can be best characterized as a nektobenthic or epibenthic species (Barord (Barord et al. 2014; CITES 2016).

Nautilus pompilius can travel distances of up to 6 kilometers (km) in a day facilitated by currents (Dunstan et al. 2011c). However, at the depths where these animals are generally active (>200 m), currents are weak and movements are primarily accomplished through self-propulsion, with observed *N. pompilius* distances of up to 3.2 km per day and maximum speeds of up to 1.18 km/hour for short periods of time (less than 6 hours) (Dunstan et al. 2011a).

Despite the apparent temperature and depth constraints of the species, larger-scale migrations, although rare, have occurred. For example, an *N. pompilius* specimen was captured off southern Japan in the 1970s and assumed to have drifted 2,000 km in the Kuroshio Current from the Philippines (Saunders 2010). Saunders (2010) notes that these movements across large stretches of either shallow, warm water (< 100 meters (m), > 25° C) or deep water (> 800m) would likely be accomplished only by drifting or rafting (*i.e.,* moving passively with ocean currents) through midwater or surface waters. However, the author notes that these movement events must have occurred ''with sufficient frequency'' to account for the species' distribution across the Indo-Pacific (Saunders 2010).

Diet and Feeding

Chambered nautiluses are described as deep-sea scavenging generalists and opportunistic predators. As previously mentioned, the chambered nautilus uses its 90 retractable tentacles to dig in the substrate and feed on a variety of organisms, including fish, crustaceans, echinoids, nematodes, cephalopods, other marine invertebrates, and detrital matter (Saunders and Ward 2010; Barord 2015). The chambered nautilus also has an acute sense of olfaction and can easily smell odors (such as prey) in turbulent waters from significant distances (of up to 10 m) (Basil et al. 2000).

Growth and Reproduction

The general life history characteristics of the chambered nautilus are that of a rare, long-lived, late-maturing, and slow-growing marine invertebrate species, with likely low reproductive output. Circumferential growth rate for the chambered nautilus is estimated to range from 0.053 mm/day to 0.23 mm/day and slows as the animal approaches maturity (Dunstan et al. 2010; Dunstan et al. 2011b). However, average size at maturity of *N. pompilius* appears to vary among regions, with smaller shell diameters noted around the Philippines, Fiji, and eastern Australia and larger diameters off Indonesia (see Table 1 in Miller 2017). Additionally, the species exhibits sexual dimorphism, with males consistently growing to larger sizes than females (Saunders and Ward 2010).

Chambered nautilus longevity is at least 20 years, with age to maturity between 10 and 17 years (Dunstan et al. 2011b; Ward et al. 2016). Very little is known regarding nautilus reproduction in the wild. Observations of captive animals suggest that nautiluses reproduce sexually and have multiple reproductive cycles over the course of their lifetime. Based on data from captive *N. belauensis* and *N. macromphalus* individuals, female nautiluses may lay up to 10 to 20 eggs per year, which hatch after a lengthy embryonic period of around 10 to 12 months (Uchiyama and Tanabe 1999; Barord and Basil 2014; Carlson 2014). There is no larval phase, with juveniles hatching at sizes of 22 to 23 millimeters (mm) in diameter, and potentially migrating to deeper and cooler waters (Barord and Basil 2014); however, live hatchlings have rarely been observed in the wild.

Population Demographics and Structure

Isolated Populations

Most of the recent genetic data suggest that *N. pompilius* may actually be comprised of unrecognized sibling species that are genetically distinct and geographically isolated (CITES 2016). For example, in a recent examination of the genetic structure between an *N. pompilius* population off Western Australia and one off the Philippines, Williams et al. (2015) concluded that very little gene flow exists between these two populations. The authors note that the absence of migration between the Philippines and Western Australia indicates that recolonization would not be possible if the Philippines population were to be extirpated (Williams et al. 2015).

On a smaller geographic/population scale, Sinclair et al. (2007) analyzed DNA sequence information from *N. pompilius* collected from the Coral Sea and the outer edges of the Great Barrier Reef in northern Queensland (''Northern GBR'') and found population-specific genetic differentiation. Through use of Random Amplification of Polymorphic DNA (RAPD) analysis and partial sequencing of the *CoxI* gene region, the authors determined that there is genetic divergence between the geographic lineages of ''Northern GBR'' and ''Coral Sea,'' indicating distinct groups of populations and pointing to the potential for larger-scale geographic divergence of the species. In a follow-up study, Sinclair et al. (2011) found an even greater degree of genetic variation between populations on the east coast of Australia (using the ''Northern GBR'' and ''Coral Sea'' populations) and the west coast of Australia (Scott Reef), with phylogenetic analyses suggesting three genetically divergent populations.

In addition to genetics, other studies have looked at morphological differences to examine isolation between *N. pompilius* populations. For example, based on biometric analysis of *N. pompilius* from the Philippines and Fiji, Tanabe and Tsukahara (2010) concluded that the populations are morphologically differentiated, finding statistically significant differences in weight, size at maturity, and slopes of allometric relationships of morphological characters between the two populations.

While it is thought that deep water largely serves as a barrier to movement of *N. pompilius,* explaining the isolation of the above populations, results from Swan and Saunders (2010) suggest it is more likely a combination of both depth and geographic distance. In their study, Swan and Saunders (2010) examined the correlation between morphological differences and distances between populations in Papua New Guinea, including some that were separated by deep water (> 1000 m). Their findings showed that adaptive equilibrium had not yet been attained, indicating that the populations are not completely genetically isolated (Swan and Saunders 2010). As such, the authors surmised that there is at least some degree of contact and gene flow between the Papua New Guinea populations, through potentially rafting or midwater movements, with the amount inversely related to the geographic distance between the populations (Swan and Saunders 2010).

Given the above information, it is reasonable to assume that populations separated by large geographic distances and deep water are genetically differentiated, with very little to no gene flow.

Diversity

In terms of genetic diversity, Williams et al. (2015) estimated large ancestral and current effective population sizes for the Philippines (current median size = 3,190,920) and Ashmore Reef (Western Australia) (current median size = 2,562,800) populations, indicating a low likelihood of the fixation of alleles and no evidence of significant genetic drift impacts in either population. Additionally, the authors found no significant difference in the allelic richness between the sampled locations in the Philippines and Western Australia. In other words, the data tend to suggest that the species may have high genetic diversity. However, Williams et al. (2015) caution that due to the low fecundity and long generation time of the species, genetic responses to current exploitation rates (such as decreases in genetic diversity) may not yet be detectable. In fact, using *CoxI* sequences from *N. pompilius* across its range and Tajima's *D* test to examine departures from population equilibrium, Vandepas et al. (2016) found significant negative Tajima's *D* values for the populations in Western Australia, New Caledonia and Papua New Guinea. These results indicate an excess of rare alleles or high-frequency polymorphisms within the populations, suggesting they may be currently recovering from possible bottleneck events. While not statistically significant, the Tajima's *D* values for the rest of the sampled populations, with the exception of Palau and Eastern Australia (*i.e.,* Fiji, Indonesia, Vanuatu, Philippines and American Samoa), were also negative, suggesting that the species potentially has low genetic diversity across its range.

Overall, given the available and somewhat conflicting information, the level of genetic diversity needed to maintain the survival of the species and the current level of genetic diversity across the entire range of the species remains highly uncertain. Further morphological and genetic tests examining differences within and among populations are needed.

Sex-Ratios and Population Structure

Regarding population structure, the available information indicates chambered nautilus populations are comprised mainly of male and mature individuals. Based on trapping data, including mark-recapture studies, male *N. pompilius* appear to dominate the chambered nautilus catch, with proportions of 75 to 80 percent (CITES 2016). In addition, a large proportion of those captured (around 75 percent) are mature, with juvenile *N. pompilius* individuals rarely caught (CITES 2016). Saunders et al. (2017) state that the male-female sex ratio and composition of mature individuals in nautilus populations provides clues to the current stability of the population. In the authors' study, they compared 16 nautilus populations from ''unfished'' areas (in Papua New Guinea, Australia, Indonesia, Fiji, Palau, American Samoa, New Caledonia, and Vanuatu) to two populations in the Philippines that have been subject to decades of uncontrolled exploitation and provided an estimate of quantitative measures to illustrate demographic disturbance, or ''disequilibrium,'' in a nautilus population. Specifically, Saunders et al. (2017) found that the mean percentage of mature animals in the unfished nautilus populations (n = 16) was 73.9 percent (standard deviation (SD): 21.8, standard error (SE): 5.1) and the mean percentage of males was 75.0 percent (SD: 16.4, SE: 4.1). The authors suggested that these proportions could be used as a baseline for determining whether a population (of $n > 100$ individuals) is at equilibrium (Saunders et al. 2017). In contrast, the intensely fished Philippine population from Tañon Straits (n = 353 individuals) had a male proportion of only 28 percent and mature individuals comprised only 26.6 percent of the population, which the authors suggest are levels that signal pending collapse of the local fishery (Saunders et al. 2017). Ultimately, the authors indicate that the ratios obtained by examining the sex and maturity composition of a nautilus population could be used as a basis for determining whether management and conservation measures are appropriate. However, a caveat to this method is that it is unclear if the male-biased sex ratio reflects the natural equilibrium for chambered nautilus populations. Because these population studies tend to use baited traps to capture chambered nautiluses, there may be an aspect of sampling bias in terms of the size and sex of individuals attracted to the traps. For example, laboratory studies by Basil (2014) suggest that female *N. pompilius* may repel each other. Potentially, this female avoidance of one another may explain why fewer females are found in the baited-trap field studies. In fact, in a study of *N. pompilius* drift shells that were collected between 1984 and 1987 in Papua New Guinea (n = 1,329), 54 percent were male, suggesting a much different sex ratio than those determined from baited studies (Saunders et al. 1991). Given the conflicting information, further research on sex ratios in the wild, as well as a better understanding of the population structure of the species, is needed before definitive conclusions can be drawn on this particular point.

Population Abundance and Trends

The global abundance of *N. pompilius* is unknown, with no available historical baseline population data. In fact, the first study to estimate baseline population size and density for the species in a given area was only recently conducted by Dunstan et al. (2011a). This study examined the *N. pompilius* population at Osprey Reef, an isolated coral seamount off Australia's northeastern coast with no history of nautilus exploitation. Based on data collected from 2000 to 2006, the authors estimated that the population at Osprey Reef consisted of between 844 and 4,467 individuals, with a density estimate of 14.6 to 77.4 individuals per square kilometer (km^2) (Dunstan et al. 2011a). Subsequent research, conducted by Barord et al. (2014), provided abundance estimates of nautiluses (species not identified) from four locations in the Indo-Pacific: The Panglao region of the Bohol Sea, Philippines, with 0.03 individuals per km^2, Taena Bank near Pago Pago Harbor, American Samoa, with 0.16 individuals per km^2, the Beqa Passage in Viti Levu, Fiji, with 0.21 individuals per km^2, and the Great Barrier Reef along a transect from Cairns to Lizard Island, Australia, with 0.34 individuals per km^2 (see Table 2 in Miller 2017). With the exception of the Bohol Sea, these populations are located in areas where fishing for nautiluses does not occur, suggesting that nautiluses may be naturally rare, or that other unknown factors, besides fishing, may be affecting their abundance. The authors also indicate that the population estimates from this study may, in fact, be overestimates as they used baited remote underwater video systems to attract individuals to the observation area (Barord et al. 2014). In either case, these very low population estimates suggest that chambered nautiluses are especially vulnerable to exploitation, with limited capacity to recover from depletion. This theory is further supported by the comparison between the population density in the Panglao region of the Bohol Sea, where nautilus fishing is occurring, and the unfished sites in American Samoa, Fiji, and Australia, with the Bohol Sea density less than 20 percent of the smallest unfished population (Barord et al. 2014).

Recently, Williams et al. (2015) used genetic modelling to estimate median population sizes for *N. pompilius* from locations in Australia and the Philippines. Specifically, the authors examined genetic markers and used Bayesian clustering methods to estimate a median population size for the Australian Ashmore Reef population (which the authors note may possibly contain the entire Australian northwest shelf nautilus population) at 2,562,800 individuals (Williams et al. 2015). Using the same methods, Williams et al. (2015) estimated a median size for the Palawan region, Philippines, population at 3,190,920 individuals. The authors recognize that the use of different methods to generate population density estimates (such as those used by Barord et al. (2014)) will produce ''predictably dissimilar abundance data'' (Williams et al. 2015). Additionally, as mentioned previously, the authors suggest that the large estimates from the genetic methods (with no evidence of population reduction) may indicate that the genetic response to exploitation (*e.g.,* a decrease in allelic richness) has not had enough time to become detectable yet, unlike the trapping data from the above studies (Williams et al. 2015).

Overall, abundance information is extremely spotty and limited to only a select number of locations (see Table 3 in Miller 2017). Based on data from the 1980s, collected from sites off American Samoa, Fiji, Papua New Guinea, and Vanuatu, the average number of *N. pompilius* individuals caught per trap ranged from 1 to 30, depending on the site (see Table 3 in Miller 2017). From 1998 to 2008, an average of 5.7 to 7.9 *N. pompilius* individuals were caught per trap off Osprey Reef in Australia (Dunstan et al. 2011a). However, it is difficult to make comparisons between these locations using the available abundance and catch-per-unit-effort (CPUE) information (*e.g.,* number of individuals caught per trap) because the methods of collecting the data vary greatly by study. For example, most studies examining abundance of nautiluses are based on trapping data where multiple traps can be set and left over multiple nights, or one trap can be set for one night, and the particulars of the trapping methods are generally not available from the anecdotal or study descriptions. As such, the available reported data are hard to standardize across studies. It should also be noted that the majority of the data are over two decades old, with no available recent trapping estimates. Furthermore, although not yet confirmed by research, many nautilus experts hypothesize that chambered nautiluses likely occur in locations where they are not currently observed (NMFS 2014), suggesting abundance may be underestimated. However, these experts agree that current abundance estimates cannot be extrapolated across the species' range without considering suitable habitat and likelihood of nautilus presence (NMFS 2014), which has yet to be done.

Regarding current trends in abundance, *N. pompilius* populations are generally considered stable in areas where fisheries are absent (*e.g.,* Australia) and declining in areas where fisheries exist for the species; however, recent CPUE data from Fiji indicate a decline despite no active fishery (FAO 2016). In the unfished Australian Osprey Reef population discussed above, Dunstan et al. (2010) used mark-recapture methods to examine the trend in CPUE of individuals over a 12-year period. Analysis of the CPUE data showed a slight increase of 28 percent from 1997 to 2008, and while this increase was not statistically significant, the results indicate a stable *N. pompilius* population in this unexploited area (Dunstan et al. 2010).

In locations where fisheries have operated or currently operate, anecdotal declines and observed decreases in catches of nautilus species are reported (see Table 4 in Miller 2017). Citing multiple personal communications, the CITES (2016) proposal (to include all species of nautiluses in Appendix II of CITES) noted declines of *N. pompilius* in Indian waters, where commercial harvest occurred in the past for several decades, and in Indonesian waters, where harvest is suspected to be increasing. In fact, traders in Indonesia have observed a significant decrease (with estimates up to 97 percent) in the number of nautiluses collected over the past 10 years, which may be an indication of a declining and depleted population (Freitas and Krishnasamy 2016). In the Philippines, Dunstan et al. (2010) estimated that the CPUE of *Nautilus* from four main nautilus fishing locations in the Palawan region has decreased by an estimated average of 80 percent in less than 30 years. Anecdotal reports from fishermen that once fished for *N. pompilius* in the Sulu Sea note that the species is near commercial extinction, forcing fishermen to move to new areas in the South China Sea (Freitas and Krishnasamy 2016). Furthermore, in Tawi Tawi, Cayangacillo, and Tañon Strait/Cebu, Philippines, fisheries that once existed for chambered nautiluses have since been discontinued because of the rarity of the species, with Alcala and Russ (2002) noting the likely extirpation of *N. pompilius* from Tañon Strait in the late 1980s. The fact that the species has not yet recovered in the Tañon Strait, despite an absence of nautilus fishing in over two decades, further supports the susceptibility of the species to exploitation and its limited capability to repopulate an area after depletion.

Species Finding

Based on the best available scientific and commercial information described above, we find that the latest scientific consensus is that *N. pompilius* is considered a taxonomically-distinct species and, therefore, meets the definition of ''species'' pursuant to section 3 of the ESA. Below, we evaluate whether this species warrants listing as endangered or threatened under the ESA throughout all or a significant portion of its range.

Summary of Factors Affecting the Chambered Nautilus

As described previously, section 4(a)(1) of the ESA and NMFS' implementing regulations (50 CFR 424.11(c)) state that we must determine whether a species is endangered or threatened because of any one or a combination of the following factors: the present or threatened destruction, modification, or curtailment of its habitat or range; overutilization for commercial, recreational, scientific, or educational purposes; disease or predation; inadequacy of existing regulatory mechanisms; or other natural or man-made factors affecting its continued existence. We evaluated whether and the extent to which each of the foregoing factors contribute to the overall extinction risk of the chambered nautilus. We considered the impact of all factors for which information is available. For each relevant factor, we also considered whether a particular impact is having a minor or significant influence on the species' status. A ''significant'' contribution is defined, for purposes of this evaluation, as increasing the risk to such a degree that the factor affects the species' demographics (*i.e.,* abundance, productivity, spatial structure, diversity) either to the point where the species is strongly influenced by stochastic or depensatory processes or is on a trajectory toward this point. Demographic stochasticity refers to the variability of annual population change arising from random events such as birth and death rates, sex ratios, and dispersal at the individual level. Depensatory processes refers to those density-dependent processes that result in increased mortality as density decreases. For example, decreases in the breeding population can lead to reduced production and survival of offspring. This section briefly summarizes our findings and conclusions regarding threats to the chambered nautilus and their impact on the overall extinction risk of the species. More details can be found in the status review report (Miller 2017).

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

Chambered nautilus habitat, and in particular coral reefs, are impacted by a number of human activities. These activities include the harvest of coral reef species through use of destructive or unselective fishing practices, coastal development and deep-sea mining that can contribute to pollution and sedimentation of habitat, and changes in water temperature and pH caused by climate change. Below we briefly describe these various threats to the habitat of *N. pompilius* and evaluate the likely impact on the status of the species. More details can be found in the status review report (Miller 2017).

Harvest of Coral Reef Species and Destructive and Unselective Fishing Practices

Many coral reef species are harvested for the aquarium trade and to satisfy the high-end Asian food markets (CITES 2016). In addition to directly contributing to the loss of biodiversity on the reefs, some of the techniques used to obtain coral reef species for these industries can cause significant destruction to coral reef communities. For example, blast and poison fishing are two types of destructive and unselective fishing practices that are used to harvest coral reef species throughout much of the range of the chambered nautilus (WRI 2011). Figure 3 in Miller (2017) depicts the extent and severity of observed blast or poison fishing areas, which are primarily concentrated off the Philippines, Indonesia, and Malaysia.

Blast fishing is particularly destructive as it not only destroys coral reefs but also indiscriminately kills their marine inhabitants. A ''typical'' blast will shatter corals and turn them into rubble within a 1 to 1.5 m diameter of the blast site, and can kill marine organisms, including invertebrates, within a 20 m radius (Pet-Soede and Erdmann 1998; Njoroge 2014). Although blast fishing is largely illegal, the use of this destructive practice still continues in many areas. For example, in a September 2016 article in the Jakarta Post, Amnifu (2016) reports that blast fishing, a common occurrence in East Nusa Tenggara waters, and particularly around Sumba Island, has recently expanded to parts of the Sawu Sea National Park's conservation area.

Because blast fishing is generally conducted in shallow reef waters (*e.g.,* 5 to 10 m depths) (Fox and Caldwell 2006), *N. pompilius* is unlikely to experience direct mortality from these destructive practices given that they generally inhabit much deeper waters. However, the indirect impact, such as changes in coral reef community structure and loss of fish biomass (Raymundo et al. 2007), may decrease the availability of food resources for the scavenging chambered nautilus. Also, depending on the extent of the coral reef destruction, *N. pompilius,* because of its physiological constraints, may be incapable of finding and exploiting other suitable habitat with greater prey resources. Additional research is needed as to the potential effects of blast fishing on the deeper-water inhabitants of these impacted coral reefs before definitive conclusions can be drawn regarding this particular factor.

Another primarily illegal fishing practice that destroys coral reefs is the use of cyanide, which is primarily deployed to stun and capture live reef fish. When exposed to cyanide, coral respiration rates decrease and can cease altogether, with corals observed expelling their zooxanthellae, resulting in bleaching and mortality events (Rubec 1986; Jones 1997). The practice of using cyanide to harvest reef fish dates back to the 1960s, where it was developed and commonly used in the Philippines, before spreading to Indonesia (CITES 2016). Similar to blast fishing, cyanide fishing is unlikely to result in direct mortality of *N. pompilius,* given the species' preferred depth range; however, changes in coral reef community structure and loss of fish biomass (Raymundo et al. 2007) might decrease the availability of food resources for the chambered nautilus. Additional research is needed before definitive conclusions can be drawn as to the potential effects of cyanide on the deeper-water reef habitats and inhabitants.

Overall, given the speculative effects of blast and cyanide fishing on nautilus populations, and the patchy and largely unknown distribution of the species and its habitat preferences, the best available information does not indicate that habitat degradation from the harvest of coral reef species and destructive and unselective fishing practices are likely significant threats to the species. Further research is needed before definitive conclusions can be drawn regarding the extent of nautilus habitat degradation and the impacts on the status of the species.

Pollution and Sedimentation

Evidence of the impacts of pollution and sedimentation on chambered nautilus habitat and the effects to the species is speculative or largely unavailable. For example, in their review of the nautilus CITES (2016) proposal, the fifth Food and Agriculture Organization of the United Nations expert advisory panel (FAO panel) hypothesized that an observed 60 percent decline in a local *N. pompilius* population in Fiji was potentially because of pollution of its habitat (FAO 2016). This assumption was largely based on the fact that no known local utilization of the species and no commercial fishery exists in this area. Therefore, the FAO panel speculated that the decline was attributed to local habitat degradation, as they noted the population is in close proximity to a major port (Suva) and its potentially small and fragmented characteristics made it especially vulnerable to habitat destruction (FAO 2016).

Although deep sea mining may also contribute to the pollution of chambered nautilus habitat, it appears that the extent of this pollution, and its subsequent impacts on nautilus populations, may be largely site-specific. For example, in a study comparing bioaccumulation rates of trace elements between nautilus species located in a heavily mined location (*i.e., N. macromphalus* in New Caledonia) versus a location not subject to significant mining (*i.e., N. pompilius* in Vanuatu), Pernice et al. (2009) found no significant difference between the species for trace elements of Ag, Co, Mn, Ni, Pb, Se, V, and Zn. The authors concluded that the geographical origin of the nautilus species was not a major contributor to interspecific differences in trace element concentrations (Pernice et al. 2009). Additionally, the authors noted that, based on the study results, the heavy nickel mining conducted in

New Caledonia does not appear to be a significant source of contamination in the oceanic habitat of the nautilus, suggesting that the lagoons in New Caledonia likely trap the majority of the trace elements from the intense mining activities (Pernice et al. 2009).

The biological impact of potential toxin and heavy metal bioaccumulation in chambered nautilus populations is unknown. Many of the studies that have evaluated metal concentrations in cephalopods examined individuals outside of the range of the chambered nautilus, with results that show that metal concentrations vary greatly depending on geography (Rjeibi et al. 2014; Jereb et al. 2015). As such, to evaluate the degree of the potential threat of bioaccumulation of toxins in chambered nautilus, information on concentrations of these metals from *N. pompilius,* or similar species that share the same life history and inhabit the same depth and geographic range of *N. pompilius,* is necessary. For example, the study by Pernice et al. (2009), mentioned above, examined the bioaccumulation rates of trace elements between two nautilus species in similar depths and geographic ranges. However, the authors found no significant difference between those nautiluses located in areas of intensive mining (and, therefore, high heavy metal pollutants) compared to nautiluses in areas without significant mining (Pernice et al. 2009). With the exception of this one study, we found no other information on the bioaccumulation rates of metals in the chambered nautilus, including the lethal concentration limits of toxins or metals in *N. pompilius* or evidence to suggest that current concentrations of environmental pollutants are causing detrimental physiological effects to the point where the species may be at increased risk of extinction. As such, the best available information does not indicate that present bioaccumulation rates and concentrations of environmental pollutants in *N. pompilius* or their habitat are likely significant threats to the species.

Climate Change and Ocean Acidification

Given the narrow range of temperature tolerance of the chambered nautilus, warming surface water temperatures due to climate change may further restrict the distribution of the species, decreasing the amount of suitable habitat (particularly in shallower depths) available for the species. Perhaps more concerning may be the effects of ocean acidification. In terms of ocean acidification, which will cause a reduction of pH levels and concentration of carbonate ions in the ocean, it is thought that shelled mollusks are likely at elevated risk as they rely on the uptake of calcium and carbonate ions for shell growth and calcification. However, based on available studies, the effects of increased ocean acidification on juvenile and adult mollusk physiology and shell growth are highly variable (Gazeau et al. 2013). For example, after exposure to severe CO_2 levels (pCO_2 = 33,000 µatm) for 96 hours, the deep-sea clam, *Acesta excavata,* exhibited an initial drop in oxygen consumption and intracellular pH but recovered with both levels approaching control levels by the end of the exposure duration (Hammer et al. 2011). No mortality was observed over the course of the study, with the authors concluding that this species may have a higher tolerance to elevated CO2 levels compared to other deep-sea species (Hammer et al. 2011). This is in contrast to intertidal and subtidal mollusk species, such as *Ruditapes decussatus, Mytilus galloprovincialis,* and *M. edulis,* which exhibited reduced standard metabolic rates and protein degradation when exposed to decreases in pH levels (Gazeau et al. 2013).

Regarding the impact of ocean acidification on calcification rates, which is important for the growth of chambered nautiluses, one relevant study looked at cuttlebone development in the cephalopod *Sepia officinalis* (Gutowska et al. 2010). Similar to nautiluses, cuttlefish also have a chambered shell (cuttlebone) that is used for skeletal support and for buoyancy regulation. Results from the study showed that after exposure to 615 Pa CO_2 for 6 weeks, there was a seven-fold *increase* in cuttlebone mass (Gutowska et al. 2010). However, it should be noted that unlike *N. pompilius, Sepia officinalis* is not a deep-sea dwelling species but rather found in 100 m depths, and their cuttlebone is internal (not an external shell).

While the above were only a few examples of the variable impacts of ocean acidification on mollusk species, based on the available studies, such as those described in Gazeau et al. (2013), it is clear that the effects are largely species-dependent (with differences observed even *within* species). To date, we are unaware of any studies that have been conducted on *N. pompilius* and the potential effects of increased water temperatures or acidity on the health of the species. Therefore, given the species-specific sensitivities and responses to climate change impacts, and with no available information on chambered nautiluses, we cannot conclude that the impacts from climate change are currently or will in the foreseeable future be significant threats to the existence of the species in the future.

Overutilization for Commercial, Recreational, Scientific or Educational Purposes

Based on the best available information, the primary threat to the chambered nautilus is overutilization for commercial purposes—mainly, harvest for the international nautilus shell trade. Chambered nautilus shells, which have a distinctive coiled interior, are traded as souvenirs to tourists and shell collectors and also used in jewelry and home décor items (where either the whole shell is sold as a decorative object or parts are used to create shell-inlay designs) (CITES 2016). The trade in the species is largely driven by the international demand for their shells and shell products since fishing for nautiluses has been found to have no cultural or historical relevance (Dunstan et al. 2010; De Angelis 2012; CITES 2016; Freitas and Krishnasamy 2016). Nautilus meat is also not locally in demand (or used for subsistence) but rather sold or consumed as a by-product of fishing for the nautilus shells (De Angelis 2012; CITES 2016). While all nautilus species are found in international trade, *N. pompilius,* being the most widely distributed, is the species most commonly traded (CITES 2016).

Although most of the trade in chambered nautiluses originates from the range countries where fisheries exist or have existed for the species, particularly the Philippines and Indonesia, commodities also come from those areas with no known fisheries (such as Fiji and Solomon Islands). Other countries of origin for *N. pompilius* products include Australia, China, Chinese Taipei, India, Malaysia, New Caledonia, Papua New Guinea, Vanuatu, and Vietnam (Freitas and Krishnasamy 2016). Known consumer markets for chambered nautilus products include the Middle East (United Arab Emirates, Saudi Arabia), Australia, Singapore, Malaysia, Indonesia, Philippines, Hong Kong, Russia, Korea, Japan, China, Chinese Taipei and India, with major consumer markets noted in the European Union (Italy, France, Portugal), the United Kingdom, and the United States (Freitas and Krishnasamy 2016). In fact, between 2005 and 2014, the United States imported more than 900,000 chambered nautilus products (CITES 2016). The vast majority of these U.S. imports originated from the Philippines (85 percent of the traded commodities), followed by Indonesia (12 percent), China (1.4 percent), and India (1.3 percent) (CITES 2016).

Because harvest of the chambered nautilus is primarily demand-driven for the international shell trade, the intensive nautilus fisheries that develop to meet this demand tend to follow a boom-bust cycle that lasts around a decade or two before becoming commercially nonviable (Dunstan et al. 2010; De Angelis 2012; CITES 2016). Fishing for nautiluses is fairly inexpensive and not labor-intensive, requiring a fish trap baited with locally-available meat (*e.g.,* cow, duck, goat, offal, chicken, pufferfish) (Freitas and Krishnasamy 2016). These traps are usually set at 150 to 300 m depths and retrieved after a few hours or left overnight (Freitas and Krishnasamy 2016). Given the fishing gear requirements, and the fact that the chambered nautilus exists as small, isolated populations, harvest of the species may continue for years within a region, with the fisheries serially depleting each population until the species is essentially extirpated from that region (CITES 2016).

Commercial harvest of the species is presently occurring or has occurred in the Philippines, Indonesia, India and Papua New Guinea, and also potentially in China, Thailand and Vanuatu (CITES 2016). However, based on the number of commodities entering the international trade, we find that the best available information supports the conclusion that the Philippines and Indonesia have the largest commercial fisheries for chambered nautilus, with multiple harvesting sites throughout these nations (CITES 2016). Although information on specific harvest levels and the status of chambered nautilus populations within this portion of its range is limited, the best available data, discussed below, provide significant evidence of the negative impact of these fisheries and resulting overutilization of the species.

Commercial Harvest

In the Philippines, the harvesting of chambered nautiluses appears to have no cultural or historical relevance other than as a source of local income for the shell trade, with meat either consumed by the fishermen or sold in local markets (del Norte-Campos 2005; Dunstan et al. 2010). Yet, anecdotal accounts of fishing for *N. pompilius* indicate that trapping of the species has occurred as early as 1900 (Saunders et al. 2017). Specifically, these accounts suggest trapping in 1900 and 1901 would yield anywhere from 4–5 nautiluses per trap to up to 20 animals (depending on the duration of the trap set) (Saunders et al. 2017). In 1971, Haven (1972, cited in Haven (1977)) found that Tañon Strait, Philippines, was still an abundant source of *N. pompilius.* From 1971 to 1972, around 3,200 individuals were captured for study (Haven 1977). Prior to this time, *N. pompilius* was, for the most part, caught as bycatch in fish traps by Filipino fishermen (Saunders et al. 2017). However, Haven (1977) notes that it was during this time when more fishermen began targeting Tañon Strait, specifically for nautilus shells, with the numbers of fishermen tripling during subsequent years. Trap yields in 1972 were similar to those from the early 1900s, with fishermen reporting catches of zero to 19 nautiluses, with an average of 5 animals per trap (Saunders et al. 2017). However, by 1975, the impact of this substantial increase in fishing pressure on the species was already evident (Haven 1977). Fishermen in 1975 reported having to move operations to deeper water as catches were now rare at shallower depths, and the number of individuals per trap had also decreased (Haven 1977). Additionally, although the number of fishermen had tripled in those 3 years, and therefore fishing effort for the species intensified, the catch did not see an associated increase, indicating a likely decrease in the abundance of the species within the area (Haven 1977). By 1979, trap yields had drastically fallen, to around 2 nautiluses per trap, and only a few fishermen remained engaged in the fishery (Saunders et al. 2017). CITES (2016) reports that around 5,000 chambered nautiluses were trapped per year in Tañon Strait in the early 1980s and, by 1987, the population was estimated to have declined by 97 percent from 1971 levels, with the species considered commercially extinct and potentially extirpated from the area (Alcala and Russ 2002). Based on 2014 data from baited remote underwater video station footage in the region, nautilus activity remains low, and the population density still has yet to recover to pre-1970 levels (Saunders et al. 2017).

Similarly, other nautilus fishing sites that were established in the late 1980s, including at Tawi Tawi (an island province in southwestern Philippines), Cagayancillo (an island in the Palawan province) and Cebu Strait (east of Tañon Strait), have also seen harvest crash in recent decades (Dunstan et al. 2010). More recently, in the Central Luzon region, Bulacan and Pampanga Provinces were formerly collection and trade sites for nautilus species; however, collectors and traders noted that the last shipments from these areas were in 2003 and 2007, respectively, indicating they are likely no longer viable harvesting sites (Freitas and Krishnasamy 2016).

The level of historical harvest (5,000 chambered nautilus individuals/year) that appeared to lead to local extirpations in Tañon Strait is being greatly exceeded in a number of other areas throughout the chambered nautilus' range in the Philippines. In Tibiao, Antique Province, in northwestern Panay Island, del Norte-Campos (2005) estimated annual yield of the chambered nautilus at around 12,200 individuals for the entire fishery (data from 2001 to 2002). In the Palawan nautilus fishery, 9,091 nautiluses were harvested in 2013 and 37,341 in 2014 (personal communication cited in CITES (2016)). This level of harvest is particularly concerning given the significant declines already observed in these fisheries. In fact, in four of the five main nautilus fishing areas in this province, Dunstan et al. (2010) estimated a decline in CPUE of the species ranging from 70 percent to 90 percent (depending on the fishing site) over the course of only 6 to 24 years. The one main fishing region in Palawan that did not show a decline was the municipality of Balabac; however, the authors note that this fishery is relatively new (active for less than 8 years), with fewer fishermen, and, as such, may not yet have reached the point where the population crashes or declines become evident in catch rates (Dunstan et al. 2010). Given that the estimated annual catches in the Balabac municipality ranged from 4,000 to 42,000 individuals in 2008 (Dunstan et al. 2010), this level of annual harvest, based on the trends from the other Palawan fishing sites (Dunstan et al. 2010), will likely lead to similar population declines and potential extirpations of chambered nautiluses in the near future.

In addition to the declines in harvest and CPUE of the species from observed fishing sites throughout the Philippines, the overutilization of *N. pompilius* in this area is also evident in the available trade data. In a personal communication cited in CITES (2016), it was stated that over the past 5 years, shell traders in Palawan Province have seen a decline in the number of shells being offered to them by local harvesters. Similarly, harvesters and traders in the Visayan regions have noted increasing difficulty in obtaining shells, with this trend beginning in 2003 (CITES (2016) citing

Schroeder (2003)). Based on U.S. trade data from the last decade, Philippine export and re-export of nautilus commodities to the United States has decreased by 92 percent since 2005 (see Figure 4 in Miller (2017)) (CITES 2016). Despite the extensive evidence of overutilization of the species throughout the Philippines, including the serial depletion and potential extirpation of local populations, harvest and trade in *N. pompilius* continues, with the Philippines still the number one supplier of nautilus commodities to the United States (based on figures from 2014).

Off Indonesia, signs of decline and overutilization of chambered nautilus populations are also apparent. In fact, based on the increasing number of chambered nautilus commodities originating from Indonesia, it is suggested that nautilus fishing has potentially shifted to Indonesian waters because of depletion of the species in the Philippines (CITES 2016). According to trade data reported in De Angelis (2012), the Philippines accounted for 87 percent of the nautilus commodities in U.S. trade from 2005 to 2010, whereas Indonesia accounted for only 9 percent. However, with the significant decline of nautilus exports coming out of the Philippines in recent years (2010 to 2014), Indonesia has become a larger component of the trade, accounting for 42 percent of the nautilus commodities in 2014, while the Philippines has seen a decrease in their proportion, down to 52 percent (CITES 2016).

Similar to the trend observed in the Philippines, a pattern of serial depletion of nautiluses because of harvesting is emerging in Indonesia. Both fishermen and traders note a significant decline in the numbers of chambered nautiluses over the last 10 years, despite a prohibition on the harvest and trade of *N. pompilius* that has been in place since 1999 (CITES 2016; Freitas and Krishnasamy 2016). For example, fishermen in North Lombok note that they historically trapped around 10 to 15 nautiluses in one night, but currently catch only 1 to 3 per night (Freitas and Krishnasamy 2016). Similarly, in Bali, fishermen reported nightly catches of around 10 to 20 nautiluses until 2005, after which yields have been much less (Freitas and Krishnasamy 2016). While fishing for chambered nautiluses has essentially decreased in western Indonesia (likely due to a depletion of the local populations), the main trade centers for nautilus commodities are still located here (*i.e.,* Java, Bali, Sulawesi and Lombok). The sources of nautilus shells for these centers now appear to originate from eastern Indonesian waters (including northeastern Central Java, East Java, and West Nusa Tengarra eastward) where it is thought that nautilus populations may still be abundant enough to support economically viable fisheries, and where enforcement of the current *N. pompilius* prohibition appears weaker (Nijman et al. 2015; Freitas and Krishnasamy 2016). For example, data collected from two large open markets in Indonesia (Pangandaran and Pasir Putih) indicate that chambered nautiluses were still being offered for sale as of 2013. Over the course of three different weekends, Nijman et al. (2015) observed 168 *N. pompilius* shells for sale from 50 different stalls in the markets (average price was $17 USD/shell). In addition to catering to tourists, a wholesaler with a shop in Pangandaran noted that he also exports merchandise to Malaysia and Saudi Arabia on a bimonthly basis (Nijman et al. 2015). In total, Nijman et al. (2015) found evidence of six Indonesian wholesale companies that offered protected marine mollusks (and mostly nautilus shells) for sale on their respective Web sites (with two based in East Java, two in Bali, and one in Sulawesi). The company in Sulawesi even had a minimum order for merchandise of 1 metric ton, and a company in Java noted that they could ship more than one container per month, indicating access to a relatively large supply of nautilus shells (Nijman et al. 2015).

The available U.S. trade data provide additional evidence of the overutilization and potential serial depletion of populations within Indonesia, although not yet as severe as what has been observed in the Philippines. Overall, based on data from the last decade, Indonesian export and re-export of nautilus commodities to the United States has decreased by 23 percent since 2005 (see Figure 5 in Miller (2017)) (CITES 2016); however, large declines were seen between 2006 and 2009 before smaller increases in the following years. As noted above, these trends likely reflect the depletion of nautilus populations in western Indonesian waters and a subsequent shift of fishing effort to eastern Indonesian waters in recent years to support the nautilus trade industry.

In India, CITES (2016) states that the chambered nautilus has been exploited for decades and is also caught as bycatch by deep sea trawlers. A 2007 survey aimed at assessing the status of protected species in the curio trade in Tamil Nadu confirmed the presence of *N. pompilius* shells and found them highly valued in the retail domestic markets (John et al. 2012). Out of 13 major coastal tourist curio markets surveyed, *N. pompilius* shells were found in 20 percent of the markets (n = 40 shops) (John et al. 2012). Based on estimated sales from these markets, *N. pompilius* was the fourth highest valued species (n = 25 total species), accounting for 7 percent of the annual profit from the protected species curio trade (John et al. 2012). During the survey, chambered nautilus shells sold, on average, for approximately 275 INR each (7 USD in 2007 dollars) (John et al. 2012).

Interviews with the curio traders indicate that the Gulf of Mannar and Palk Bay, the island territories of Andaman and Lakshadweep, and Kerala are the main collection areas for the protected species sold in the curio trade (John et al. 2012). While the extent of harvest of *N. pompilius* is unknown, the fact that the nautilus shells sold in markets are nearly half the size of the reported common wild size (90 mm vs 170 mm) (John et al. 2012) suggests that this curio trade may be contributing to overfishing of the population, causing a shift in the local population structure. Compared to observed mature shell sizes elsewhere throughout the range of *N. pompilius* (average mature shell length range: 114 to 200 mm; see Table 1 in Miller (2017)), the Indian market nautilus shells are likely entirely from immature individuals. The removal of these nautilus individuals before they have time to reproduce, particularly for this long-lived and low fecundity species, could have devastating impacts on the viability of the local populations. While the authors note that curio vendors may strategically stock a larger number of undersized shells rather than fewer larger shells to meet the demand of the tourists, given the relative rarity of chambered nautilus shells in Indian waters (with only 9 shells sold during the 2007 survey) and the fact that larger shells generally obtain higher prices, we conclude it is at least equally likely that curio vendors are stocking whatever is available.

Although trend data are not available, the popularity of the species in the curio trade as well as information suggesting that the marketed shells are significantly smaller than wild-caught and, hence, likely belong to immature individuals, indicate that this level of utilization may have already negatively impacted the local populations within India. The continued and essentially unregulated fishing and selling of *N. pompilius* within southern Indian waters will lead to overutilization of the species in the future, as has been observed in other parts of its range, and potential extirpation of these small and isolated populations.

In Papua New Guinea, most of the available information indicates that trade of chambered nautilus shells is primarily supplied from incidental collection of drift shells. CITES (2016) states that the species may be caught as bycatch in some deep-sea fisheries and also notes that new nautilus fishing sites may have recently become established in 2008. The extent of harvest of the species in these waters, however, is unknown.

Possible commercial harvest of the species has also been identified in East Asia (China, Hong Kong, and Chinese Taipei), Thailand, Vanuatu, and Vietnam. In East Asia, minimal numbers of nautilus shells are sold in art markets, home décor shops, small stores, and airport gift shops, with meat found in seafood markets (particularly in the south of China on Hainan Island, the large coastal cities of Fujian and Guangdong Provinces, and Chinese Taipei) (Freitas and Krishnasamy 2016). There is also evidence of a small trade in live specimens for aquaria in Hong Kong; however, the origin of these live specimens is unclear (Freitas and Krishnasamy 2016). While the CITES (2016) proposal suggests that nautilus harvest may occur on Hainan Island, we are aware of no information to confirm that a fishery exists.

In Thailand, nautilus experts note that targeted chambered nautilus fisheries have occurred and are still operating (NMFS 2014), with past observations of shells found in gift shops (CITES 2016); however, we are aware of no published information on the current intensity or duration of such harvest (or confirmation that the fishery is still occurring). Nautilus experts also note that targeted chambered nautilus fisheries have occurred and are occurring in Vanuatu (NMFS 2014), with shells sold to tourists and collectors (Amos 2007). While we are aware of no published information regarding the current intensity or duration of such harvest (or confirmation that the fishery is still occurring), available information suggests the fishery may have begun in the late 1980s. From March to June 1987, the Vanuatu Fisheries Department conducted a deep sea fishing trial, aimed at testing commercial fishing traps on the outer-reef slope of north Efate Island, Vanuatu (Blanc 1988). Results showed the successful capture of *N. pompilius,* with a CPUE of around 2.6 nautilus per trap per day, taken at depths greater than 300 m (Blanc 1988). In total, 94 traps were set and 114 *N. pompilius* were captured (Blanc 1988). Those shells that were in good condition (approximately two-thirds of the total) were sold locally for around 300 to 500 VUV each ($2.89 to $4.81 U.S. dollars based on the 1987 conversion rate) (Blanc 1988). It was noted in the report that the capture of nautiluses can be a good supplementary source of income (Blanc 1988).

In Vietnam, some of the nautilus shells observed for sale may be sourced from local harvest of the animal. For example, an interview with a Vietnamese seller revealed that his nautilus shells come from islands in Vietnam and that 1,000 shells a month are able to be acquired (of 5 to 7 inches in size; 127 to 178 mm) (Freitas and Krishnasamy 2016). However, the species was not identified, nor was it clear whether the origin of the shells was from Vietnam (indicating potential harvest) or if the islands simply serve as transit points for the trade.

In our review of the available information, we also found no evidence of known local utilization or commercial harvest of the chambered nautilus in the following portions of the species' range: American Samoa, Australia, Fiji, or the Solomon Islands. While products that incorporate nautilus shells, such as jewelry and wood inlays, are sold to tourists in these locations, the nautilus parts appear to be obtained solely from the incidental collection of drift shells. In these areas, where the species is not subject to commercial harvest, populations appear stable (with the exception of Fiji; however, the threat in this case was not identified as overutilization—see *Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range* section). Given that the species exists as geographically isolated populations, we conclude it is unlikely that these local, unfished populations will see significant declines as a result of overutilization in other portions of its range.

Overall, out of the 10 nations in which *N. pompilius* is known to occur, potentially half historically or currently have targeted nautilus fisheries. Given that this harvest is largely unregulated, and has led to the serial depletion and extirpation of local *N. pompilius* populations, with no evidence of a decline in fishing effort or demand for the species, the best available information indicates that overutilization of *N. pompilius* is the most significant threat to the species throughout its range.

Trade

As mentioned previously, the commercial harvest of the chambered nautilus is primarily demand-driven for the international shell trade. The Philippines and Indonesia appear to supply the majority of the nautilus products in the trade. In Indonesia, most of the networks that aid in the illegal trade of marine mollusks originate in Java and Bali, with the United States, China, and New Caledonia as main destinations (Nijman et al. 2015). While the extent of export from the Philippines and Indonesia is unknown, data collected from Indonesia over the past 10 years suggest the amounts are likely substantial. For example, based on seizure data from 2005 to 2013, over 42,000 marine mollusk shells protected under Indonesian law, including over 3,000 chambered nautiluses, were confiscated by Indonesian authorities (Nijman et al. 2015). At least two-thirds of the shells were meant to enter the international trade, with the largest volumes destined for China and the United States (Nijman et al. 2015). Between 2007 and 2010, De Angelis (2012), citing a personal communication, estimated that around 25,000 nautilus specimens were exported from Indonesia to China for the Asian meat market.

In addition to the United States and China, other major consumer destinations for nautilus commodities include Europe, the Middle East, and Australia, with suspected markets in South Africa, South America (Argentina), and Israel (Freitas and Krishnasamy 2016). Freitas and Krishnasamy (2016) indicate that, in Europe, the trade and sale of nautiluses occur at fairly low levels and mainly involve whole nautilus shells. Their internet research and consultations indicate that the majority of Web sites selling nautilus products are located in France, Germany and the United Kingdom; however, details regarding the product, including species and origin of the nautilus, are often not provided (Freitas and Krishnasamy 2016). Based on interviews with trade experts and online sellers, it appears that the Philippines is the main source of nautilus shells for the European trade (Freitas and Krishnasamy 2016). Some German online sellers indicate that the wholesalers also receive imports from Thailand (Freitas and Krishnasamy 2016).

In the United States, the most recent 5 years of available trade data (2010 to 2014) reveal that around 6 percent of the imported commodities were whole shells (n = 9,076) and less than 1 percent were live animals, with the remaining products primarily comprised of jewelry, shell products, and trim pieces (CITES 2016). Based on trade data from 2010–2013 and using rough approximations of individual nautilus counts for different commodity labels, Freitas and Krishnasamy (2016) estimated that between 20,000 and 100,000 nautilus individuals comprised the commodities being imported into the United States, representing between 6,000 and 33,000 individuals annually. However, it is important to note that even these figures likely underestimate the actual trade volumes in the United States, as additional nautilus imports could have also been lumped under a more general category, such as ''mollusks'' (De Angelis 2012). This is likely true for other countries as well, because specific custom codes are lacking for nautilus products (with nautilus commodities frequently lumped as ''coral and similar materials'' and worked or unworked shell products) (Freitas and Krishnasamy 2016). Therefore, estimating the number of nautilus individuals traded annually around the globe remains extremely challenging. Despite these unknowns, based on the available trade data from the United States, and data garnered from seizures and research, it is clear that nautilus commodities are in high demand and nautilus products are globally traded likely in the hundreds of thousands (De Angelis 2012). This market demand is a significant threat driving the commercial harvest and overutilization of *N. pompilius* throughout most of its range.

Disease or Predation

We are aware of no information to indicate that disease is a factor that is significantly and negatively affecting the status of the chambered nautilus. Diseases in nautiluses are not well known, nor is there information to indicate that disease is contributing to population declines of the species. However, shells of *N. pompilius,* like other mollusks, are subject to marine fouling from a variety of epizoans and may also be hosts to parasites. In an examination of 631 *N. pompilius* shells from the Philippines and Papua New Guinea, Landman et al. (2010) found the incidence of encrustation by epizoans varied by site. In the *N. pompilius* shells from the Philippines, 12 percent were encrusted whereas 49 percent of the shells from the Papua New Guinea sample showed signs of encrustation. However, the encrusted area only averaged around 0.5 percent of the shell surface, with the maximum encrustation at 2.2 percent (Landman et al. 2010). Additionally, the authors note that the encrusted surface comprised less than 1 percent of the total shell weight in air, which they deemed ''a negligible factor in the overall buoyancy of the animal'' (Landman et al. 2010). As such, it is likely that the species has some other defense against epizoan settlement, with encrustation not a significant threat to the survival of *N. pompilius* individuals.

Regarding parasites, Carlson (2010) notes that newly collected nautilus individuals are usually heavily infested with the copepod *Anchicaligus nautili;* however, no information on the effect of these infestations on the nautilus animal is available. Therefore, based on the available data, marine fouling and parasitism do not appear to be significant threats to the species.

Chambered nautiluses may serve as prey to a number of teleost fish (such as triggerfish), octopuses, and sharks; however, predation rates appear to vary across the species' range (CITES 2016). For example, octopod predation rates on live nautiluses have been estimated at 1.1 percent in the Philippines, 4.5 to 11 percent in Indonesia, 2 to 8 percent in Papua New Guinea, 5 percent in American Samoa, and 3.2 percent on Australia's Great Barrier Reef, indicating that predation by octopuses likely occurs throughout the entire species' range (Saunders et al. 1991).

Recently, Ward (2014) analyzed the prevalence of shell breaks in nautiluses as an indicator of predation and found that those nautilus populations subject to fishing had a statistically significant higher number of major shell breaks compared to unfished populations. Specifically, Ward (2014) found that over 80 percent of mature *N. pompilius* shells had major shell breaks in the fished Bohol, Philippines population (in 2012 and 2013) and calculated an over 40 percent rate in the fished New Caledonia *N. macromphalus* population in 1984. In contrast, only 30 percent of mature shells had major shell breaks in the unfished nautilus populations on the Great Barrier Reef (based on 2012 data) (Ward 2014). In the unfished Osprey Reef population, this rate was around 20 percent (based on 2002 to 2006 data), and in Papua New Guinea and Vanuatu in the 1980s, this rate was less than 20 percent (Ward 2014).

Predation is clearly evident in all sampled nautilus populations. It appears that predation rates may be substantially higher in those populations compromised from other threats (such as overutilization). This, in turn, exacerbates the risk that predation poses to those already vulnerable chambered nautilus populations, contributing significantly to their likelihood of decline and to the species' overall risk of extinction.

The Inadequacy of Existing Regulatory Mechanisms

Based on the available data, *N. pompilius* appears most at risk from overutilization in those range states supplying the large majority of nautilus shells for the international trade. Substantial commercial harvest of the species in Indonesia, Philippines, and India has led to observed declines in the local *N. pompilius* populations. As we discuss below, although there are some national and international legal protections, including a recent listing under CITES, poor enforcement of these laws and continued illegal fishing demonstrate that the existing regulatory mechanisms are inadequate to achieve their purpose of protecting the chambered nautilus from harvest and trade. It is too early to conclude that the CITES listing will be effective at ameliorating the threat of overutilization.

In Indonesia, *N. pompilius* was provided full protection in the nation's waters in 1999 (Government Regulation 7/1999). While the species was first added to Indonesia's protected species list in 1987 (SK MenHut No 12 Kptd/II/1987), the implementing legislation in 1999 made it illegal to harvest, transport, kill, or trade live or dead specimens of *N. pompilius* (CITES 2016). Despite this prohibition, the commercial harvest and trade in the species continues (see *Overutilization for commercial, recreational, scientific, or educational purposes*). For example, in a survey of 343 shops within 6 Provinces in Indonesia, Freitas and Krishnasamy (2016) found that 10 percent were selling nautilus products, with the majority located in East Java. Interviews with local suppliers of nautilus shells revealed that many are aware of the prohibition and therefore have found ways to conduct business covertly, such as selling more products online and purposely mislabeling *N. pompilius* shells as *A. perforatus* (which are not protected) (Freitas and Krishnasamy 2016). Nijman et al. (2015) observed the sale of chambered nautilus shells in two of Indonesia's largest open markets (Pangandaran and Pasir Putih, both on Java) and remarked that the shells were prominently displayed. In interviews with the traders, none mentioned the protected status of the species (Nijman et al. 2015). Additionally, nautilus shells and products (such as furniture) are often on display by government officials and offered for sale in airports (Freitas and

Krishnasamy 2016), indicating that enforcement of the Indonesian regulation protecting the species is very weak. Therefore, given the apparent disregard of the prohibition, with substantial evidence of illegal harvest and trade in the species, and issues with enforcement, we conclude that existing regulatory mechanisms are inadequate to protect the species from further declines in Indonesia from overutilization.

In the Philippines, shelled mollusks are protected from collection without a permit under Fisheries Administrative Order no. 168; however, it is unclear how this is implemented or enforced for particular species (CITES 2016). In Palawan Province, a permit is also required to harvest or trade the chambered nautilus, as it is listed as ''Vulnerable'' under Palawan Council for Sustainable Development Resolution No. 15–521 (CITES 2016). Freitas and Krishnasamy (2016) report that some municipalities in Cebu Province and the Panay Islands have local ordinances that prohibit the harvest of *N. pompilius;* however, even in these Provinces, there is evidence of harvest and trade in the species. For example, in a survey of 66 shops in Cebu, the Western Visayas region, and Palawan, 83 percent of the shops sold nautilus products. For the most part, the harvest and trade of nautilus is largely allowed and essentially unregulated throughout the Philippines (Freitas and Krishnasamy 2016). Given the significant declines in the *N. pompilius* populations throughout this portion of the species' range, existing regulations to protect *N. pompilius* from overutilization throughout the Philippines are clearly inadequate.

In India, *N. pompilius* has been protected from harvest and trade since 2000 when it was listed under Schedule I of the Indian Wildlife (Protection) Act of 1972 (John et al. 2012). However, as noted in the *Overutilization for commercial, recreational, scientific, or educational purposes* section, *N. pompilius* shells were being collected in Indian waters and sold in major coastal tourist curio markets as recently as 2007. Interviews with retail vendors (n = 180) indicated that a large majority were aware of the Indian Wildlife Protection Act and legal ramifications of selling protected species yet continued to sell large quantities of protected marine mollusks and corals in the curio shops (John et al. 2012). Because there is no official licensing system for these shops, the annual quantities sold remain largely unrecorded and unknown (John et al. 2012). The high demand for nautilus shells and profits from this illegal curio trade, coupled with the lack of enforcement of existing laws, indicates that overutilization of *N. pompilius* will continue to threaten populations within Indian waters.

In China, *N. pompilius* is listed as a ''Class I'' species under the national Law of the People's Republic of China on the Protection of Wildlife, which means that harvest is allowed (under Article 16) but only with special permission (*i.e.,* for purposes of scientific research, ranching, breeding, exhibition, or ''other''). Unfortunately, enforcement of this law has proven difficult, as many nautilus products for sale have unknown origin or claim origin from the Philippines (Freitas and Krishnasamy 2016). While the extent of harvest in East Asia remains unclear based on the available data, the fact that trade is allowed, and the difficulties associated with enforcement and identifying *N. pompilius* products and origin in the trade, indicate that existing regulatory measures are likely inadequate to prevent the harvest of the species within Chinese waters.

In areas where trade of *N. pompilius* is prohibited, available data suggest smugglers are using other locations as transit points for the trafficking and trade of the species to circumvent prohibitions and evade customs (Freitas and Krishnasamy 2016). For example, New Caledonia, where only *N. macromphalus* is protected, has become a stop-over destination for smuggling nautilus shells to Europe (CITES 2016; Freitas and Krishnasamy 2016). In 2008, officials confiscated at least 213 *N. pompilius* shells that were being smuggled into New Caledonia from Bali, Indonesia (Freitas and Krishnasamy 2016). At this time, the extent of the illegal trade, including transit points for smugglers, remains largely unknown; however, the impact of this illegal trade on the species only contributes further to its overutilization.

Overall, given the ongoing demand for chambered nautilus products, the apparent disregard of current prohibition regulations by collectors and traders, lack of enforcement, and the observed declining trends in *N. pompilius* populations and crashing of associated fisheries, the best available information strongly suggests that existing regulatory mechanisms are inadequate to control the harvest and overutilization of *N. pompilius* throughout most of its range, significantly contributing to the species' risk of extinction.

Recognizing that the international trade is the clear driving force of the intense exploitation of nautiluses, in October 2016, the member nations to CITES agreed to add all nautilus species to Appendix II of CITES (effective January 2017). This listing means increased protection for *N. pompilius* and the other nautilus species, but still allows legal and sustainable trade. Export of nautilus products now requires CITES permits or re-export certificates that ensure the products were legally acquired and that the Scientific Authority of the State of export has advised that such export will not be detrimental to the survival of that species in the wild (*i.e.,* a ''non-detriment finding''). Given that the international trade is the main driver of the threat to the species (*i.e.,* overutilization), the CITES listing should provide *N. pompilius* with some safeguards against future depletion of populations and potential extinction of the species. However, given the limited information on the present abundance of the species throughout its range, it may prove difficult for State Authorities to determine what level of trade is sustainable. As the FAO panel notes, based on previous cases for species listed under Appendix II with similar circumstances where the State Authorities' abilities to make non-detriment findings are limited due to an absence of information, the following outcomes are likely to occur: (1) International trade in products from that country ceases; (2) international trade continues but without proper CITES documentation (''illegal trade''); and/or (3) international trade continues with inadequate non-detriment findings (FAO 2016). Because this listing only recently went into effect (January 2017), it is too soon to know which outcome(s) will dominate in the various nautilus-exporting countries. There is thus not yet a body of information on which to evaluate the adequacy of the CITES listing to reduce the threat of overutilization.

Other Natural or Man-Made Factors Affecting Its Continued Existence

Ecotourism

While the status review (Miller 2017) discusses ecotourism operations as a possible threat to nautilus species, the examples of these activities come entirely from Palau, where *N. pompilius* does not occur. These ecotourism activities tend to involve bringing nautiluses to the surface for photographic opportunities with customers and subsequently releasing them into shallow waters (CITES 2016). In the daytime, nautiluses are especially vulnerable to predation in shallow waters, and observations of triggerfish feeding on nautiluses as they are released suggest that consistent release of these animals in a certain location may create feeding stations for nautilus predators (Carlson 2015). Additionally, nautiluses may suffer negative physiological effects if released into shallow water, including overheating and the development of air bubbles that can inhibit quick escape movements (CITES 2016). We acknowledge the potential risks that these ecotourism operations may pose to nautilus species; however, at this time, there is no substantial evidence to indicate that there are dive tour operators within the *N. pompilius* range who practice this same behavior (*i.e.,* taking photographs and releasing the species in shallow waters). As such, the best available information does not indicate that ecotourism is presently a significant threat to the species.

Natural Behavior

Because of their keen sense of smell (Basil et al. 2000), chambered nautiluses are easily attracted to baited traps. Additionally, field studies indicate that nautiluses may also habituate to baited sites. For example, in a tag and release study conducted in Palau, the proportion of previously tagged animals over the trapping period increased in the baited traps, reaching around 58 percent in the last trap deployed (Saunders et al. in press). Given this behavior, nautilus populations, including *N. pompilius,* are likely highly susceptible to being caught by fisheries. For isolated and small populations, this could result in rapid depletions of these populations in a short amount of time, potentially just months (Saunders et al. in press). However, Saunders et al. (in press) note that this vulnerability to depletion from overfishing is likely lower in those populations where barriers to movement do not exist, such as Papua New Guinea and Indonesia. These sites both have large swaths of habitat (thousands of km) within the optimal nautilus depth range that are parallel to coastal areas and could serve as natural refugia but also allow for the restocking of depleted populations (Saunders et al. in press). Therefore, the best available information suggests that these aspects of the species' natural behavior (*i.e.,* attraction and habituation to baited trap sites) are likely significant threats to those *N. pompilius* populations that are already subject to other threats (*e.g.,* overutilization) or demographic risks (*e.g.,* spatially isolated, small populations).

Assessment of Extinction Risk

The ESA (section 3) defines an endangered species as ''any species which is in danger of extinction throughout all or a significant portion of its range.'' A threatened species is defined as ''any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.'' We define ''foreseeable future'' generally as the time frame over which identified threats can be reliably predicted to impact the biological status of the species. As mentioned previously, because a species may be susceptible to a variety of threats for which different data are available, or which operate across different time scales, the foreseeable future is not necessarily reducible to a particular number of years.

For the assessment of extinction risk for the chambered nautilus, the ''foreseeable future'' was considered to extend out several decades (> 40 years). Given the species' life history traits, with longevity estimated to be at least 20 years, maturity ranges from 10 to 17 years, with very low fecundity (potentially 10–20 eggs per year with a 1-year incubation period), it would likely take more than a few decades (*i.e.,* multiple generations) for any recent management actions to be realized and reflected in population abundance indices. Similarly, the impact of present threats to the species could be realized in the form of noticeable population declines within this time frame, as demonstrated in the available survey and fisheries data (see Table 4 in Miller 2017). As the main potential operative threat to the species is overutilization, this time frame would allow for reliable predictions regarding the impact of current levels of fishery-related mortality on the biological status of the species. Additionally, this time frame allows for consideration of the previously discussed impacts on chambered nautilus habitat from climate change and the potential effects on the status of this species.

In determining the extinction risk of a species, it is important to consider both the demographic risks facing the species as well as current and potential impacts of external threats that may affect the species' status. To this end, a demographic analysis was conducted for the chambered nautilus. A demographic risk analysis is essentially an assessment of the manifestation of past threats that have contributed to the species' current status and informs the consideration of the biological response of the species to present and future threats. This analysis evaluated the population viability characteristics and trends data available for the chambered nautilus, such as abundance, growth rate/productivity, spatial structure and connectivity, and diversity, to determine the potential risks these demographic factors pose to the species. The information from this demographic risk analysis was considered alongside the information previously presented on threats to the species, including those related to the factors specified by the ESA section 4(a)(1)(A)–(E) (and summarized in a separate Threats Assessment section below) and used to determine an overall risk of extinction for *N. pompilius.*

Because the available data are insufficient to conduct a reliable quantitative population viability assessment (because there is, for example, sporadic abundance data, and uncertain demographic characteristics), the qualitative reference levels of ''low risk,'' ''moderate risk'' and ''high risk'' were used to describe the overall assessment of extinction risk in the Status Review. A species at a ''low risk'' of extinction was defined as one that is not at a moderate or high level of extinction risk. 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. A species is at a ''moderate risk'' of extinction when it is on a trajectory that puts it at a high level of extinction risk in the foreseeable future. A species may be at moderate risk of extinction because of projected threats or declining trends in abundance, productivity, spatial structure, or diversity. 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.

Although the conclusions in the status review report do not constitute findings as to whether the species should be listed under the ESA (because that determination must be made by the agency after considering all relevant information and after evaluating ongoing conservation efforts of any state, foreign nation, or political subdivision thereof. 16 U.S.C. 1533(b)(1)(A)), a finding of ''moderate risk'' generally indicates that a species may qualify for listing as a ''threatened species'' and a finding of ''high risk'' generally indicates that a species may be an ''endangered species.''

Demographic Risk Analysis

Abundance

The global abundance of the chambered nautilus is unknown, with no available historical baseline population data. The species likely exists as small, isolated populations distributed throughout its range. However, abundance estimates of these fragmented populations are largely unavailable, as the species is difficult to survey. Currently, population size has been estimated for *N. pompilius* off Osprey Reef in Australia using baited trap techniques (n = 844 to 4,467 individuals) and for the Palawan region, Philippines and Western Australia populations using genetic markers (median population size for Western Australia = 2.6 million individuals; for Philippines = 3.2 million individuals). Population density estimates (individuals/km^2) are also available from Osprey Reef (13.6 to 77.4), the Great Barrier Reef (0.34), American Samoa (0.16), Fiji (0.21) and the Panglao region, Philippines (0.03). While there may be some sampling bias in the baited trap technique, we find that the population size and density estimates from these studies provide a useful representation of the current abundance of the species because they rely on the best available field data.

If a population is critically small in size, chance variations in the annual number of births and deaths can put the population at added risk of extinction. Additionally, when populations are very small, chance demographic events can have a large impact on the population. However, the threshold for depensation in the chambered nautilus is unknown.

Populations of *N. pompilius* are assumed to be naturally small, and, when not faced with outside threats, appear stable (*e.g.,* Osprey Reef population increased by 28 percent over the course of a decade). However, those populations in areas where nautilus fishing occurs have experienced significant declines in less than a generation time for the species, indicating a greater risk of extirpation because of depensatory processes. Saunders et al. (in press) suggest that trapping data that result in < 1 to 2 nautiluses per trap likely reflect a minimally viable population level. In other words, further removal of individuals from those populations would likely result in population crashes and potential extirpation. Based on the available abundance trend data (see Table 4 in Miller (2017)), many of the populations surveyed in Indonesia and the Philippines currently reflect this minimally viable level, indicating that abundance of these particular populations may be close to levels that place them at immediate risk of inbreeding depression and demographic stochasticity, particularly given their reproductive isolation. Extirpations of these populations would increase the risk of extinction for the entire species to some degree.

While overall abundance is highly uncertain, the evidence indicates that the species exists as small and isolated populations throughout its range, making them inherently vulnerable to exploitation and depletion. Data suggest that many of these populations are in decline and may be extirpated in the next several decades. Taken together, this information indicates that *N. pompilius* is not currently at risk of extinction throughout its range but will likely be at risk of extinction from environmental variation or human-caused threats throughout its range within the foreseeable future.

Growth Rate/Productivity

The current net productivity of *N. pompilius* is unknown because of the imprecision or lack of available abundance estimates or indices. Fecundity, however, is assumed to be low (but note that no egg-laying has been observed in the wild). Based on estimates from other captive Nautilus species (*i.e., N. macromphalus* and *N. belauensis*), the chambered nautilus may lay up to 10 to 20 eggs per year, with a long incubation period (10 to 12 months). Given that the chambered nautilus is a slow-growing and late-maturing species (with maturity estimated between 10 and 17 years, and longevity at least 20 years), it likely has very low productivity and, thus, is extremely susceptible to decreases in its abundance.

In terms of demographic traits, Saunders et al. (in press) suggest that a nautilus population at equilibrium would have a higher percentage of male (75 percent) and mature (74 percent) animals. Ratios that are significantly lower than these estimates suggest the population is in ''disequilibrium'' and likely portend declines in per capita growth rate. Saunders et al. (in press) further provides evidence that fished nautilus populations tend to show significant demographic differences in relative age class (*i.e.,* predominance of immature individuals) and sex ratios (i.e,, no longer male-biased) compared to unfished populations. Under the current assumption that males are the critical sex for population growth, the significant change in the population demographics for these fished populations may portend further declines and potential extirpations of these populations, inherently increasing the risk of extinction for the entire species in the foreseeable future. However, with the exception of the Osprey Reef (Australia), Lizard Island (Great Barrier Reef; Australia), and Sumbawa Island (Indonesia) populations, which showed male percentages of 82 to 91 percent and mature percentages of 58 to 91 percent based on data from the past decade (Saunders et al. in press), we have no available recent data to assess the demographic traits of current *N. pompilius* populations throughout the species' range.

Spatial Structure/Connectivity

Chambered nautilus populations are extreme habitat specialists. The species is closely associated with steeply-sloped forereefs and muddy bottoms and is found in depths typically between 200 m and 500 m. Both temperature and depth are barriers to movement for *N. pompilius,* which cannot physiologically withstand temperatures above around 25 °C or depths greater than 800 m. Chambered nautiluses are bottom-dwelling scavengers and do not swim in the open water column. While larger-scale migrations have occurred (across shallow, warm waters and/or depths > 1000 m), these events are believed to be extremely rare, with gene flow thought to be inversely related to the geographic distance between populations (Swan and Saunders 2010). As such, current chambered nautilus populations, particularly those separated by large geographic distances, are believed to be largely isolated, with a limited ability to find or exploit available resources in the case of habitat destruction. Collectively, this information suggests that gene flow is likely limited among populations of *N. pompilius,* with available data specifically indicating the isolation between populations in Fiji and Western Australia and those in the Philippines.

Regarding destruction of habitat patches, while anthropogenic threats, such as climate change and destructive fishing practices, have been identified as potential sources that could contribute to habitat modification for the chambered nautilus, there is no evidence that habitat patches used by *N. pompilius* are being destroyed faster than they are naturally created such that the species is at an increased risk of extinction. Additionally, there is no information to indicate that *N. pompilius* is composed of conspicuous source-sink populations where loss of one critical population or subpopulation would pose a risk of extinction to the entire species.

Diversity

As noted above, *N. pompilius* appears to exist as isolated populations with low rates of dispersal and little gene flow among populations, particularly those that are separated by large geographic distances and deep ocean expanses. Given the physiological constraints and limited mobility of the species, coupled with the selective targeting of mature males in the fisheries, connectivity among breeding populations may be disrupted. Additionally, while it is unknown whether genetic variability within the species is sufficient to permit adaptation to environmental changes, the best available information suggests that genetic variability has likely been reduced due to bottleneck events and genetic drift in the small and isolated *N. pompilius* populations throughout its range. Because higher levels of genetic diversity increase the likelihood of a species' persistence, the current, presumably reduced level among chambered nautiluses appears to pose a risk to the species.

Threats Assessment

As discussed above, the most significant and certain threat to the chambered nautilus is overutilization through commercial harvest to meet the demand for the international nautilus shell trade. Out of the 10 nations where *N. pompilius* is known to occur, potentially half have targeted nautilus fisheries either historically or currently. These waters comprise roughly three-quarters of the species' known range, with only the most eastern portion (*e.g.,* eastern Australia, American Samoa, Fiji) afforded protection from harvest. Fishing for nautiluses is fairly inexpensive and easy, and the attraction of *N. pompilius* to baited traps further increases the likely success of these fisheries (compounding the severity of this threat on the species). The estimated level of harvest from many of these nautilus fisheries in the Philippines (where harvest data are available) has historically led to extirpations of local *N. pompilius* populations. Given the evidence of declines (of 70 to 94 percent) in the CPUE from these Philippine nautilus fisheries, and the fact that fished populations tend to experience higher predation rates (another compounding factor that further increases the negative impact of fishing on the species), these populations are likely on the same trend toward local extinction. Serial depletion of populations based on anecdotal trapping reports is also evident throughout nautilus fishing sites in Indonesia, with reported declines of 70 to 97 percent. In India, the predominance of immature shells for sale in the curio markets suggests potential overfishing of these local populations as well. Commercial harvest of the species is also thought to occur in Papua New Guinea, East Asia, Thailand, Vanuatu, and Vietnam. Efforts to address overutilization of the species through regulatory measures appear inadequate, with evidence of targeted fishing of and trade in the species, particularly in Indonesia, Philippines, and China, despite prohibitions.

As fishing for the species has no cultural or historical relevance, trade appears to be the sole driving force behind the commercial harvest and subsequent decline in *N. pompilius* populations, with significant consumer markets in the United States, China, Europe (Italy, France, Portugal, United Kingdom), the Middle East, and Australia. If international trade were to be successfully managed to ensure sustainable harvest of *N. pompilius,* then the serial decline of local populations could be halted and partially depleted populations could have time to recover. The CITES Appendix II listing aims to achieve these conservation outcomes; however, given that the listing only recently went into effect (i.e, January 2017), it is too soon to evaluate the ability and capacity of the affected countries (who are parties to CITES) to implement the required measures and ensure the sustainability of their trade. Of concern is the illegal selling and trade of the species that already exists despite domestic prohibitions. Therefore, it is unclear whether and how the new CITES requirements will be adequately implemented and enforced in those countries that are presently unable to prevent the overutilization of the species despite prohibitions (*e.g.,* Indonesia, Philippines, China). We note that the United States appears to be a significant importer of nautilus products and, therefore, this CITES listing could potentially cut-off a large market (and associated demand) for the species if adequate non-detriment findings are not issued by the exporting countries. However, the evidence of illegal trade routes (see Figure 7 in Miller (2017)) and difficulty with tracking the amount and origin of nautilus products suggests that it may take some time before the extent of the ''ins and outs'' of the nautilus trade are fully understood. Therefore, we find that the adequacy of the CITES Appendix II listing in reducing the threat of overutilization (through ensuring sustainable trade) is highly uncertain at this time.

Additional threats to *N. pompilius* that were identified as potentially contributing to long-term risk of the species include unselective and destructive fishing techniques (*e.g.,* blast fishing and cyanide poisoning) and ocean warming and acidification as a result of climate change effects; however, because of the significant data gaps (such as the effects on nautilus habitat and the species' physiological responses), the impact of these threats on the status of the species is highly uncertain.

Overall Extinction Risk Summary

Given the species' low reproductive output and overall productivity and existence as small and isolated populations, it is inherently vulnerable to threats that would deplete its abundance, with a very low likelihood of recovery or repopulation. While there is considerable uncertainty regarding the species' overall current abundance, the best available information indicates that *N. pompilius* has experienced population declines of significant magnitude, including evidence of extirpations, throughout most of its range, primarily because of fisheries-related mortality (i.e.*,* overutilization). While stable populations of the species likely exist in those waters not subject to nautilus fishing (*e.g.,* Osprey Reef, Australia and American Samoa), only a few populations have actually been found and studied. These populations appear small (particularly when compared to trade figures) and genetically and geographically isolated, and, therefore, if subject to environmental variation or anthropogenic perturbations in the foreseeable future (such as through illegal fishing or climate change), will likely be unable to recover.

Currently, the best available information, though not free from uncertainties, does not indicate that the species is currently at risk of extinction throughout its range. The species is still traded in considerable amounts (upwards of thousands to hundreds of thousands annually), with evidence of new sites being established for nautilus fishing (*e.g.,* in Indonesia, Philippines, Papua New Guinea), and areas of stable, unfished populations (*e.g.,* eastern Australia, American Samoa). Although this continued trading presents a moderate threat as has been discussed, current overall abundance throughout its range is not so low that the species' viability is presently at risk. However, the continued harvesting of the species for the international nautilus shell trade and the subsequent serial depletion of populations throughout its range are placing the species on a trajectory to be in danger of extinction within the foreseeable future, likely within the next couple of decades. The species' current demographic risks, including small and isolated populations, low productivity, habitat specificity, and physiological limitations that restrict large-scale migrations, mean that as populations are depleted and extirpated, recovery of those populations and/or repopulation is unlikely. Many of the observed populations of the species are already on this path, with data indicating significant declines in abundance and even local extinctions. Further exacerbating these declines is the evidence of increased predation on fished nautilus populations and the disruption of population demographics (through the attraction of predominantly males and mature individuals to baited traps). As the unsustainable harvesting of nautiluses continues, with fisheries that follow a boom-bust cycle, and fishing efforts that serially exploit populations and then move on to new sites as the populations become depleted (particularly evident in the Philippines and Indonesia), this trend is unlikely to reverse in the foreseeable future. In fact, despite current domestic prohibitions on the harvest and trade of the species throughout most of the species' range (and particularly in the large exporting range states), these regulatory measures are ineffective because they are largely ignored or circumvented through illegal trade networks. Further, although the species was recently listed on CITES Appendix II, there is as of yet no basis to conclude whether that listing will be effective at decreasing the threat of overutilization to the species through the foreseeable future.

Given the best available information, we find that *N. pompilius* is at a moderate risk of extinction throughout its range. Although the species is not currently at risk of extinction throughout its range, it will likely become so within the foreseeable future. Without adequate measures controlling the overutilization of the species, *N. pompilius* is on a trajectory where its overall abundance will likely see significant declines within the foreseeable future eventually reaching the point where the species' continued persistence will be in jeopardy. We therefore propose to list the species as a ''threatened species.''

Protective Efforts

Having found that the chambered nautilus is likely to become in danger of extinction throughout its range within the foreseeable future, we next considered protective efforts as required under Section 4(b)(1)(A) of the ESA. The focus of this evaluation is to determine whether these efforts are effective in ameliorating the threats we have identified to the species and thus potentially avert the need for listing.

As we already considered the effectiveness of existing regulatory protective efforts, discussed above in connection with the evaluation of the adequacy of existing regulatory mechanisms, we consider other, less formal conservation efforts in this section. We identified a non-profit Web site devoted to raising the awareness of threats to the chambered nautilus (*e.g., http://savethenautilus.com/about-us/*), including raising funds to support research on the species. Additionally, we note that chambered nautiluses are found in a number of aquariums worldwide where additional research is being conducted on the reproductive activity of the species. However, survival of the species in captivity is relatively low compared to its natural longevity. Based on a 2014 survey of 102 U.S. aquariums with nautilus species (with 52 responses), Carlson (2014) reported that survival rates for captive *N. pompilius* of more than 5 years was only 20 percent. The rates of survival for less than 5 years were as follows: 0 to 1 year = 33.3 percent, 1–2 years 6.7 percent; 2 to 3 years = 20.0 percent, 3 to 5 years = 20.0 percent. While some of these aquariums have successfully bred nautilus species (*e.g.,* Waikiki Aquarium (U.S.), Birch Aquarium at Scripps (U.S.), Toba Aquarium (Japan), Farglory Ocean Park (Chinese Taipei) (Tai-lang 2012; Blazenhoff 2013; Carlson 2014)), based on the results from these efforts, it is unlikely that aquaculture or artificial propagation programs could substantially improve the conservation status of the species. On average, survival rate after hatching is less than 1 in 1,000 (Tai-lang 2012) and, to date, none of the captive-bred nautiluses have obtained sexual maturity (NMFS 2014). The process is also costly and time-consuming (given the year-long incubation period of eggs). Therefore, captive breeding would not be a feasible alternative to help satisfy the trade industry or restore wild populations (NMFS 2014). Additionally, it should be noted that the shells of nautiluses in captivity tend to be smaller and irregular, with black lines that mar the outside of the shells (Moini et al. 2014). Therefore, those shells would likely not be acceptable as suitable alternatives to wild-caught shells in the trade, given the preference for large, unblemished nautilus shells in the market.

While we find that these protective efforts will help increase the scientific knowledge about *N. pompilius* and potentially promote public awareness regarding declines in the species, none has significantly altered the extinction risk for the chambered nautilus to the point where it would not be in danger of extinction in the foreseeable future. However, we seek additional information on these and other conservation efforts in our public comment process (see below).

Determination

Section 4(b)(1)(A) 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 (81 FR 58895; August 26, 2016), the status review report (Miller 2017), and other published and unpublished information, and have consulted with species experts and individuals familiar with the chambered nautilus.

As summarized above and in Miller (2017), we assessed the ESA section 4(a)(1) factors both individually and collectively and conclude that the species faces ongoing threats from overutilization and that existing regulatory mechanisms are inadequate to ameliorate that threat. Evidence of the continued substantial trade in the species, establishment of new *N. pompilius* fishing sites, and areas of unfished populations indicate that the species has not yet declined to abundance levels that would trigger the onset of depensatory processes. However, the species' demographic risks (including small and isolated populations, with substantial reductions of 70 to 97 percent and extirpations of local chambered nautilus populations from waters comprising roughly three-quarters of the species' known range, low productivity, habitat specificity, and physiological limitations that restrict large-scale migration), coupled with the ongoing serial exploitation of *N. pompilius* to supply the international trade, and evidence of illegal harvest, trade, and poorly enforced domestic regulatory measures, significantly increase the species' vulnerability to depletion and subsequent extinction from environmental variation or anthropogenic perturbations, placing it on a trajectory indicating that it will likely be in danger of extinction within the foreseeable future throughout its range.

We found no evidence of protective efforts for the conservation of the chambered nautilus that would eliminate or adequately reduce threats to the species to the point where it would no longer be in danger of extinction in the foreseeable future. Therefore, we conclude that the chambered nautilus is not currently in danger of extinction, but likely to become so in the foreseeable future throughout its range from threats of overutilization and the inadequacy of existing regulatory mechanisms. As such, we have determined that the chambered nautilus meets the definition of a threatened species and propose to list it is as such throughout its range under the ESA.

Because we find that the chambered nautilus is likely to become an endangered species within the foreseeable future throughout its range, we find it unnecessary to consider whether the species might be in danger of extinction in a significant portion of its range. We believe Congress intended that, where the best available information allows the Services to determine a status for the species rangewide, such listing determination should be given conclusive weight. A rangewide determination of status more accurately reflects the species' degree of imperilment, and assigning such status to the species (rather than potentially assigning a different status based on a review of only a portion of the range) best implements the statutory distinction between threatened and endangered species. Maintaining this fundamental distinction is important for ensuring that conservation resources are allocated toward species according to their actual level of risk. We also note that Congress placed the ''all'' language before the ''significant portion of its range'' phrase in the definitions of ''endangered species'' and ''threatened species.'' This suggests that Congress intended that an analysis based on consideration of the entire range should receive primary focus, and thus that the agencies should do a ''significant portion of its range'' analysis as an alternative to a rangewide analysis only if necessary. Under this reading, we should first consider whether listing is appropriate based on a rangewide analysis and proceed to conduct a ''significant portion of its range'' analysis if (and only if) a species does not qualify for listing as either endangered or threatened according to the ''all'' language. We note that this interpretation is also consistent with the 2014 Final Policy on Interpretation of the Phrase ''Significant Portion of its Range'' (79 FR 37578 (July 1, 2014)). That policy is the subject of pending litigation, including litigation against the United States Fish and Wildlife Service in the United States District Court for the District of Arizona, which ordered the policy vacated and is currently considering a motion for reconsideration. *See Center for Biological Diversity* v. *Jewell,* No. CV–14–02506–TUC–RM, 2017 WL 2438327 (D. Ariz. March 29, 2017). Our approach in this proposed rule, explained above, has been reached and applied independently of the Final Policy.

Effects of Listing

Measures provided for species of fish or wildlife listed as endangered or threatened under the ESA include development of recovery plans (16 U.S.C. 1533(f)); designation of critical habitat, to the maximum extent prudent and determinable (16 U.S.C. 1533(a)(3)(A)); the requirement that Federal agencies consult with NMFS under section 7 of the ESA to ensure their actions are not likely to jeopardize the species or result in adverse modification or destruction of critical habitat should it be designated (16 U.S.C. 1536(a)(2)). Certain prohibitions, including prohibitions against ''taking'' and import, also apply with respect to endangered species under Section 9 (16 U.S.C. 1538); at the discretion of the Secretary, some or all of these prohibitions may be applied with respect to threatened species under the authority of Section 4(d) (16 U.S.C. 1533(d)). Recognition of the species' plight through listing also promotes voluntary conservation actions by Federal and state agencies, foreign entities, private groups, and individuals.

Identifying Section 7 Conference and Consultation Requirements

Section 7(a)(4) (16 U.S.C. 1536(a)(4)) of the ESA and NMFS/USFWS regulations require Federal agencies to confer with us on actions likely to jeopardize the continued existence of species proposed for listing, or that result in the destruction or adverse modification of proposed critical habitat. If a proposed species is ultimately listed, Federal agencies must consult under Section 7(a)(2) (16 U.S.C. 1536(a)(2)) on any action they authorize, fund, or carry out if those actions may affect the listed species or its critical habitat and ensure that such actions are not likely to jeopardize the species or result in destruction or adverse modification of critical habitat should it be designated. At this time, based on the currently available information, we determine that examples of Federal actions that may affect the chambered nautilus include, but are not limited to: alternative energy projects, discharge of pollution from point and non-point sources, deep-sea mining, contaminated waste and plastic disposal, dredging, pile-driving, development of water quality standards, military activities, and fisheries management practices.

Critical Habitat

Critical habitat is defined in section 3 of the ESA (16 U.S.C. 1532(5)) as: (1) The specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the ESA, on which are found those physical or biological features (a) essential to the conservation of the species and (b) that may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by a species at the time it is listed upon a determination that such areas are essential for the conservation of the species. ''Conservation'' means the use of all methods and procedures needed to bring the species to the point at which listing under the ESA is no longer necessary. 16 U.S.C. 1532(3). Section 4(a)(3)(A) of the ESA (16 U.S.C. 1533(a)(3)(A)) requires that, to the maximum extent prudent and determinable, critical habitat be designated concurrently with the listing of a species. Designations of critical habitat must be based on the best scientific data available and must take into consideration the economic, national security, and other relevant impacts of specifying any particular area as critical habitat. At this time, we find that critical habitat for the chambered nautilus is not determinable because data sufficient to perform the required analyses are lacking. Therefore, public input on features and areas in U.S. waters that may meet the definition of critical habitat for the chambered nautilus is invited. If we determine that designation of critical habitat is prudent and determinable, we will publish a proposed designation of critical habitat for the chambered nautilus in a separate rule. Such designation must be limited to areas under United States jurisdiction. 50 CFR 424.12(g).

Protective Regulations Under Section 4(d) of the ESA

We are proposing to list the chambered nautilus as a threatened species. In the case of threatened species, ESA section 4(d) gives the Secretary discretion to determine whether, and to what extent, to extend the prohibitions of Section 9 to the species, and authorizes us to issue regulations necessary and advisable for the conservation of the species. Thus, we have flexibility under section 4(d) to tailor protective regulations, taking into account the effectiveness of available conservation measures. The 4(d) protective regulations may prohibit, with respect to threatened species, some or all of the acts which section 9(a) of the ESA prohibits with respect to endangered species. We are not proposing such regulations at this time, but may consider potential protective regulations pursuant to section 4(d) for the chambered nautilus in a future rulemaking. In order to inform our consideration of appropriate protective regulations for the species, we seek information from the public on the threats to the chambered nautilus and possible measures for their conservation.

Role of Peer Review

The intent of peer review is to ensure that listings are based on the best scientific and commercial data available. In December 2004, the Office of Management and Budget (OMB) issued a Final Information Quality Bulletin for Peer Review establishing minimum peer review standards, a transparent process for public disclosure of peer review planning, and opportunities for public participation. The OMB Bulletin, implemented under the Information Quality Act (Public Law 106–554), is intended to enhance the quality and credibility of the Federal government's scientific information, and applies to influential or highly influential scientific information disseminated on or after June 16, 2005. To satisfy our requirements under the OMB Bulletin, we obtained independent peer review of the status review report. Independent specialists were selected from the academic and scientific community for this review. All peer reviewer comments were addressed prior to dissemination of the status review report and publication of this proposed rule.

Public Comments Solicited on Listing

To ensure that the final action resulting from this proposal will be as accurate and effective as possible, we solicit comments and suggestions from the public, other governmental agencies, the scientific community, industry, environmental groups, and any other interested parties. Comments are encouraged on all aspects of this proposal (See **DATES** and **ADDRESSES**).We are particularly interested in: (1) New or updated information regarding the range, distribution, and abundance of the chambered nautilus; (2) new or updated information regarding the genetics and population structure of the chambered nautilus; (3) habitat within the range of the chambered nautilus that was present in the past but may have been lost over time; (4) new or updated biological or other relevant data concerning any threats to the chambered nautilus (*e.g.,* landings of the species, illegal taking of the species); (5) information on the commercial trade of the chambered nautilus; (6) recent observations or sampling of the chambered nautilus; (7) current or planned activities within the range of the chambered nautilus and their possible impact on the species; and (8) efforts being made to protect the chambered nautilus.

Public Comments Solicited on Critical Habitat

As noted above, we have determined that critical habitat is not currently determinable for the chambered nautilus. To facilitate our ongoing review, we request information describing the quality and extent of habitat for the chambered nautilus, as well as information on areas that may qualify as critical habitat for the species in waters under U.S. jurisdiction. We note that based on the best available scientific information regarding the range of the chambered nautilus, waters of American Samoa may contain the only potential habitat for the species that is currently under U.S. jurisdiction. We request that specific areas that include the physical and biological features essential to the conservation of the species, where such features may require special management considerations or protection, be identified. Areas outside the occupied geographical area should also be identified, if such areas themselves are essential to the conservation of the species and under U.S. jurisdiction. ESA implementing regulations at 50 CFR 424.12(g) specify that critical habitat shall not be designated within foreign countries or in other areas outside of U.S. jurisdiction. Therefore, we request information only on potential areas of critical habitat within waters under U.S. jurisdiction.

Section 4(b)(2) of the ESA requires the Secretary to consider the ''economic impact, impact on national security, and any other relevant impact'' of designating a particular area as critical habitat. 16 U.S.C. 1533(b)(2). Section 4(b)(2) also authorizes the Secretary to exclude from a critical habitat designation any particular area where the Secretary finds that the benefits of exclusion outweigh the benefits of designation, unless excluding that area will result in extinction of the species. To facilitate our consideration under Section 4(b)(2), we also request for any area that may potentially qualify as critical habitat information describing: (1) Activities or other threats to the essential features of occupied habitat or activities that could be affected by designating a particular area as critical habitat; and (2) the positive and negative economic, national security and other relevant impacts, including benefits to the recovery of the species, likely to result if particular areas are designated as critical habitat. We seek information regarding the conservation benefits of designating areas within waters under U.S. jurisdiction as critical habitat. *See* 50 CFR 424.12(g). In keeping with the guidance provided by OMB (2000; 2003), we seek information that would allow the quantification of these effects to the extent possible, as well as information on qualitative impacts to economic values.

Data reviewed may include, but are not limited to: (1) Scientific or commercial publications; (2) administrative reports, maps or other graphic materials; (3) information received from experts; and (4) comments from interested parties.

Comments and data particularly are sought concerning: (1) Maps and specific information describing the amount, distribution, and use type (*e.g.,* foraging) by the chambered nautilus, as well as any additional information on occupied and unoccupied habitat areas; (2) the reasons why any specific area of habitat should or should not be determined to be critical habitat as provided by sections 3(5)(A) and 4(b)(2) of the ESA; (3) information regarding the benefits of designating particular areas as critical habitat; (4) current or planned activities in the areas that might qualify for designation and their possible impacts; (5) any foreseeable economic or other potential impacts resulting from designation, and in particular, any impacts on small entities; (6) whether specific unoccupied areas may be essential for the conservation of the species; and (7) individuals who could serve as peer reviewers in connection with a proposed critical habitat designation, including persons with biological and economic expertise relevant to the species, region, and designation of critical habitat.

References

A complete list of the references used in this proposed rule is available within the docket folder under ''Supporting Documents'' (*www.regulations.gov/#!docketDetail;D=NOAA-NMFS-2016-0098*) and upon request (see **ADDRESSES**).

Classification

National Environmental Policy Act

The 1982 amendments to the ESA, in section 4(b)(1)(A), restrict the information that may be considered when assessing species for listing. Based on this limitation of criteria for a listing decision and the opinion in *Pacific Legal Foundation* v. *Andrus,* 657 F. 2d 829 (6th Cir. 1981), NMFS has concluded that ESA listing actions are not subject to the environmental assessment requirements of the National Environmental Policy Act (NEPA).

Executive Order 12866, Regulatory Flexibility Act, and Paperwork Reduction Act

As noted in the Conference Report on the 1982 amendments to the ESA, economic impacts cannot be considered when assessing the status of a species. Therefore, the economic analysis requirements of the Regulatory Flexibility Act are not applicable to the listing process. In addition, this proposed rule is exempt from review under Executive Order 12866. This proposed rule does not contain a collection-of-information requirement for the purposes of the Paperwork Reduction Act.

Executive Order 13132, Federalism

In accordance with E.O. 13132, we determined that this proposed rule does not have significant federalism effects and that a federalism assessment is not required. In keeping with the intent of the Administration and Congress to provide continuing and meaningful dialogue on issues of mutual state and Federal interest, this proposed rule will be given to the relevant governmental agencies in the countries in which the species occurs, and they will be invited to comment. As we proceed, we intend to continue engaging in informal and formal contacts with the states, and other affected local, regional, or foreign entities, giving careful consideration to all written and oral comments received.

List of Subjects in 50 CFR Part 223

Endangered and threatened species.

Dated: October 16, 2017.

Samuel D. Rauch, III,

Deputy Assistant Administrator for Regulatory Programs, National Marine Fisheries Service.

For the reasons set out in the preamble, 50 CFR part 223 is proposed to be amended as follows:

PART 223—THREATENED MARINE AND ANADROMOUS SPECIES

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

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

■ 2. In § 223.102, paragraph (e), add a new table subheading for ''Molluscs'' before the ''Corals'' subheading and adding a new entry for ''nautilus, chambered'' under the ''Molluscs'' table subheading to read as follows:

§ 223.102 Enumeration of threatened marine and anadromous species.

* * * * *

(e) * * *

Species [1]			Citation(s) for listing determination(s)	Critical habitat	ESA rules
Common name	Scientific name	Description of listed entity			
*	*	*	*	*	*
Molluscs					
Nautilus, chambered	*Nautilus pompilius*	Entire species	[Insert **Federal Register** citation and date when published as a final rule].	NA	NA
Corals					
*	*	*	*	*	*

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

[FR Doc. 2017–22771 Filed 10–20–17; 8:45 am]
BILLING CODE 3510–22–P

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 648

[Docket No. 160229159–7990–01]

RIN 0648–BF85

Fisheries of the Northeastern United States; Framework 2 to the Tilefish Fishery Management Plan

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

ACTION: Proposed rule; request for comments.

SUMMARY: NMFS proposes regulations to implement Framework Adjustment 2 to the Tilefish Fishery Management Plan. Framework Adjustment 2 was developed by the Mid-Atlantic Fishery Management Council to improve and simplify the administration of the golden tilefish fishery. These changes include removing an outdated reporting requirement, proscribing allowed gear for the recreational fishery, modifying the commercial incidental possession limit, requiring commercial golden tilefish be landed with the head and fins attached, and revising how assumed discards are accounted for when setting harvest limits.

DATES: Comments must be received on or before November 7, 2017.

ADDRESSES: You may submit comments, identified by NOAA–NMFS–2016–0024, by either of the following methods:

- *Electronic Submissions:* Submit all electronic public comments via the Federal e-Rulemaking Portal. Go to *www.regulations.gov/#!docketDetail;D=NOAA-NMFS-2016-0024,* click the ''Comment Now!'' icon, complete the required fields, and enter or attach your comments.
- *Mail:* John K. Bullard, Regional Administrator, NMFS, Greater Atlantic Regional Fisheries Office, 55 Great Republic Drive, Gloucester, MA 01930. Mark the outside of the envelope: ''Comments on Tilefish Framework 2.''

Instructions: Comments sent by any other method, to any other address or individual, or received after the end of the comment period, may not be considered by NMFS. All comments received are part of the public record and will generally be posted to *www.regulations.gov* without change. All personal identifying information (*e.g.,* name, address, etc.) voluntarily submitted by the commenter may be publicly accessible. Do not submit confidential business information or otherwise sensitive or protected information. NMFS will accept anonymous comments. Attachments to electronic comments will be accepted via Microsoft Word, Microsoft Excel, WordPerfect, or Adobe PDF file formats only.

Written comments regarding the burden-hour estimates or other aspects of the collection-of-information requirements contained in this proposed rule may be submitted to the Greater Atlantic Regional Fisheries Office and by email to *OIRA_Submission@omb.eop.gov,* or fax to (202) 395–7285.

Copies of Framework 2, and of the draft Environmental Assessment and preliminary Regulatory Impact Review (EA/RIR), are available from the Mid-Atlantic Fishery Management Council, 800 North State Street, Suite 201, Dover, DE 19901. The EA/RIR is also accessible via the Internet at: *www.greateratlantic.fisheries.noaa.gov.*

FOR FURTHER INFORMATION CONTACT: Douglas Potts, Fishery Policy Analyst, 978–281–9341, *Douglas.Potts@noaa.gov.*

SUPPLEMENTARY INFORMATION:

Background

This action proposes regulations to implement Framework Adjustment 2 to the Tilefish Fishery Management Plan (FMP). The Mid-Atlantic Fishery Management Council developed this framework to improve and simplify management measures for the golden tilefish fishery in Federal waters north of the Virginia/North Carolina border, consistent with the requirements of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). The proposed management measures contained in Framework 2 are summarized below, with additional information and analysis are provided in the EA (see **ADDRESSES**).

The Council's original FMP for the golden tilefish fishery became effective in 2001 (66 FR 49136; September 26, 2001). The FMP established Total Allowable Landings (TAL) as the primary control on fishing mortality, and implemented a limited entry program with a tiered commercial quota allocation of the TAL. Amendment 1 to the FMP replaced the previous management system with an individual fishing quota (IFQ) system that allocated the TAL to individual quota shareholders rather than different permit categories (74 FR 42580; August 24, 2009). The Council developed this action to address several minor issues and inefficiencies that have been identified since the implementation of the IFQ system.

Proposed Framework Adjustment 2 Measures

Interactive Voice Response System (IVR) Reporting Requirement Removal

Commercial fishing vessels that land golden tilefish under the IFQ system are currently required to report each trip within 48 hours of landing through our IVR system. The Council originally created this reporting requirement when the fishery was managed under three permit categories, each with a sector-specific annual landings limit. The IVR system provided timely landing reports to track quota use and allowed managers to close a permit category if the annual landings cap was reached. When the Council changed the management of the fishery to an IFQ system, it retained the IVR system to allow additional monitoring of landings. Improvements in electronic dealer-reported landings and other data streams have rendered this IVR report redundant, and the data are no longer used to monitor quotas. We propose to eliminate this unnecessary reporting requirement.

Recreational Fishing Gear Limit

In recent years, there have been reports of recreational fishermen using ''mini-longline'' gear with a large number of hooks to target tilefish. The Council is concerned the use of this gear could result in dead discards if fishermen catch more than the eight-fish per person bag limit using this type of gear setup. The Magnuson-Stevens Act list of authorized gear types at 50 CFR 600.75(v) already restricts the recreational fishery to rod and reel and spear gear. However, to avoid any potential confusion and clarify the amount of gear allowed, the Council has recommended and we propose that rod and reel with a maximum of five hooks per rod should be the only authorized recreational tilefish gear for use in the Mid-Atlantic. Anglers could use either a manual or electric reel.

Commercial Golden Tilefish Landing Condition

The commercial tilefish fishery typically lands fish in a head-on, gutted condition. However, quotas and possession limits are in whole (round) weight. This requires the fishing industry to use a conversion factor to change landed weight to whole weight to comply with incidental possession limits and IFQ allocations. We proposed