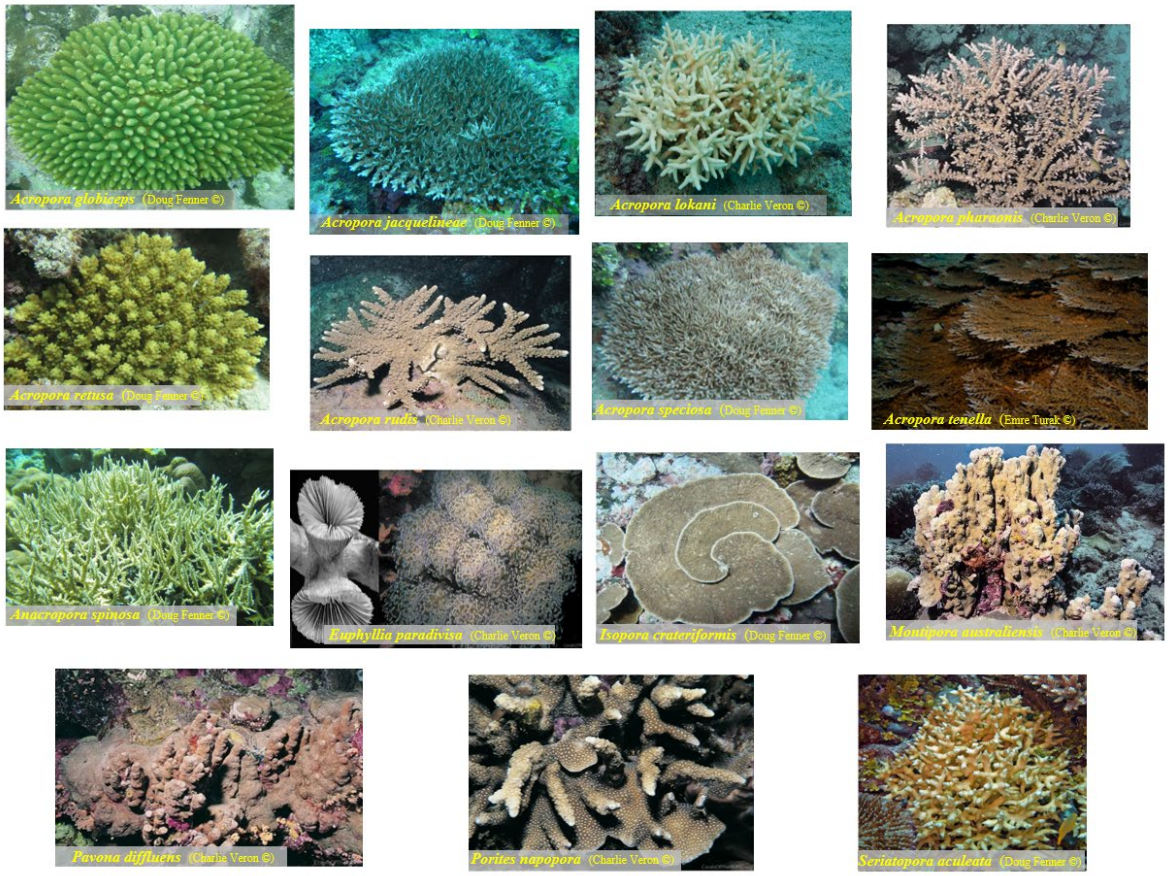
NOAA FISHERIES

5-Year Reviews for 15 Species of Indo-Pacific Corals Listed under the Endangered Species Act



August 2023, Pacific Islands Regional Office

NOAA National Marine Fisheries Service

NATIONAL MARINE FISHERIES SERVICE
5-YEAR REVIEW
15 Indo-Pacific coral species *(Acropora globice*

Current Classification: Threatened

Recommendation resulting from the 5-Year Review

☐ Downlist to Threatened
☐ Uplist to Endangered
☐ Delist
☒ No change is needed

Review Conducted By (Name and Office):

Lance Smith, Pacific Islands Regional Office

REGIONAL OFFICE APPROVAL:

Lead Regional Administrator, NOAA Fisheries

Approve MALLOY.SARAH.JOAN.1262526743 Digitally signed by MALLOY.SARAH.JOAN.1262526743 Date: 2024.02.29 11:14:12 -10'00' Date: 2/29/24

Cooperating Regional Administrator, NOAA Fisheries

☐ Concur ☐ Do Not Concur ☒ N/A

Signature _____ Date: _____

HEADQUARTERS APPROVAL:

Assistant Administrator, NOAA Fisheries

☒ Concur ☐ Do Not Concur

Signature COIT.JANET.LOUISE.1605731623 Digitally signed by COIT.JANET.LOUISE.1605731623 Date: 2024.04.01 16:58:11 -04'00' Date: 4/1/24

Contents

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Tables

5-Year Reviews for 15 Coral Species:
Summary and Evaluation
(Short Template[1])

Common Names: None

Scientific names:
Acropora globiceps
Acropora jacquelineae
Acropora lokani
Acropora pharaonis
Acropora retusa
Acropora rudis
Acropora speciosa
Acropora tenella
Anacropora spinosa
Fimbriaphyllia paradivisa
Isopora crateriformis
Montipora australiensis
Pavona diffluens
Porites napopora
Seriatopora aculeata

Current Classification: All threatened

NOAA Fisheries
Pacific Islands Regional Office
Honolulu, HI

1. General Information

1.1. Reviewer

Lead Regional or Headquarters Office: Pacific Islands Regional Office (PIRO), Protected Resources Division, Lance Smith, lance.smith@noaa.gov, 808-725-5131.

1.2. Methodology Used to Complete the Reviews

A 5-year review is a periodic analysis of a species' status conducted to ensure that the listing classification of a species as threatened or endangered on the List of Endangered and Threatened Wildlife and Plants (List; 50 CFR 17.11–17.12) is accurate. Five-year reviews are required by section 4(c)(2) of the Endangered Species Act of 1973, as amended (ESA). This review was prepared pursuant to the joint National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service's 5-year Review Guidance and Template (USFWS and NMFS 2006). These 5-year reviews

[1] This short template is used for this 5-year review report because this set of 5-year reviews is being done concurrent with the Recovery Status Review for the same 15 coral species, the peer reviewed version of which is an addendum.

summarize information from our 2023 document "Recovery Status Review for 15 Species of Indo-Pacific Reef-building Corals Listed under the Endangered Species Act" (attached, NMFS 2023), and provide recommendations regarding listing classifications for each species. The Recovery Status Review (RSR), which will be part of the 3-part framework for our forthcoming Indo-Pacific Corals Recovery Plan, represents the best scientific and commercial information available on the status and threats for each of the 15 listed corals. The first draft of the RSR was written for our 2021 Recovery Workshop for the 15 listed corals and modeled after the original 2011 Status Review Report (SRR, Brainard et al. 2011), which was completed for the 2014 final listing rule for these 15 species (79 FR 53851). The SRR provided a threats evaluation describing the common global and local threats to all 15 species, as well as species-specific descriptions of the distribution, abundance, and threats for each species.

Since 2021, we updated the RSR with recent coral, coral reef, and species-specific literature. We also updated the RSR with the Intergovernmental Panel on Climate Change's (IPCC) new Sixth Assessment (AR6), mainly from the 2021 Physical Basis component of AR6 (IPCC 2021) but also from the 2022 Impacts, Adaptation, and Vulnerability component of AR6 (IPCC 2022). The RSR was researched and written by PIRO's Dr. Lance Smith, an Indo-Pacific reef-building coral expert. The RSR was peer-reviewed in late 2022 by three Indo-Pacific reef-building coral experts, and the updated draft (NMFS 2023) is an addendum to this 5-year review report.

1.3. FR Notice Citation Announcing Initiation of These Reviews

PIRO announced initiation of 5-year reviews for the 15 listed corals species on January 7th, 2021 (86 FR 1090). We received two public comments, each of which provided numerous relevant literature citations that we incorporated into the RSR.

2. Review Analysis

As explained in the 2014 final listing rule (79 FR 53851), the status of a reef-building coral species (i.e., its vulnerability to extinction) results from the combination of its spatial (i.e., distribution) and demographic (i.e., abundance) characteristics, threat susceptibilities, and consideration of the baseline environment and future projections of threats. Thus, the current status of each of the 15 listed coral species depends on the updated species-specific distribution and abundance information, together with the updated information on the threats to the species, especially those resulting from global climate change (i.e., ocean warming and ocean acidification).

Since the publication of the final listing rule in 2014, extensive new information has become available relevant to the status of each of the 15 listed Indo-Pacific corals, which is described in the RSR. The new information most important to the current statuses of the 15 listed corals is summarized in this section, including: (1) Species-specific spatial and demographic information; and (2) general trends and projections in global climate change threats (i.e., relevant to all 15 species), as summarized below from the RSR (NMFS 2023). In addition, some limited information on the other threats (i.e., disease, fishing, land-based sources of pollution, predation, collection and trade, and inadequacy of existing regulatory mechanisms) has become available since the final rule in 2014. This information is described in detail in the RSR (NMFS 2023) and incorporated in the species summaries in section 3.

2.1. Species-specific Spatial and Demographic Information

The two types of demographic information most important to the determination of the status of the listed corals is their distribution and abundance. Since the publication of the original SRR in 2011 (Brainard et al. 2011) and the final rule in 2014 (79 FR 53851), extensive species-specific distribution and abundance information has become available for the 15 listed corals, as described in the RSR for each species (NMFS 2023) and summarized in Section 3 of this document. Background information for distribution and abundance is provided in Sections 2.1.1 and 2.1.2 below.

2.1.1. Distribution

The geographic distribution of the listed coral species is a key factor in determining their status. The best available information on the distributions of Indo-Pacific reef-building corals has long been provided by Charlie Veron's Corals of the World books (Veron 2000) and website (Veron et al. 2016). Veron divides the coral reefs of the Indo-Pacific into 133 ecoregions, and the SRR (Brainard et al. 2011) and final listing rule (79 FR 53851) both determined the distributions of the listed species in terms of Veron ecoregions. However, this document uses Spalding et al.'s (2007) Marine Ecoregions of the World (MEOWs) to portray the geographic distributions of the 15 listed coral species. The switch from Veron ecoregions to MEOWs was made because mapping data and files are more readily available for the latter, and MEOW provinces are more useful for recovery planning.

The MEOW system divides the world's marine environments into 12 realms, 62 provinces, and 232 ecoregions. The collective ranges of the 15 listed corals occur in a total of 76 MEOWs across 26 provinces, as shown in Figure 1. The geographic distributions of each of the 15 listed corals are provided in Sections 3.1 – 3.15 below in terms of MEOWs.

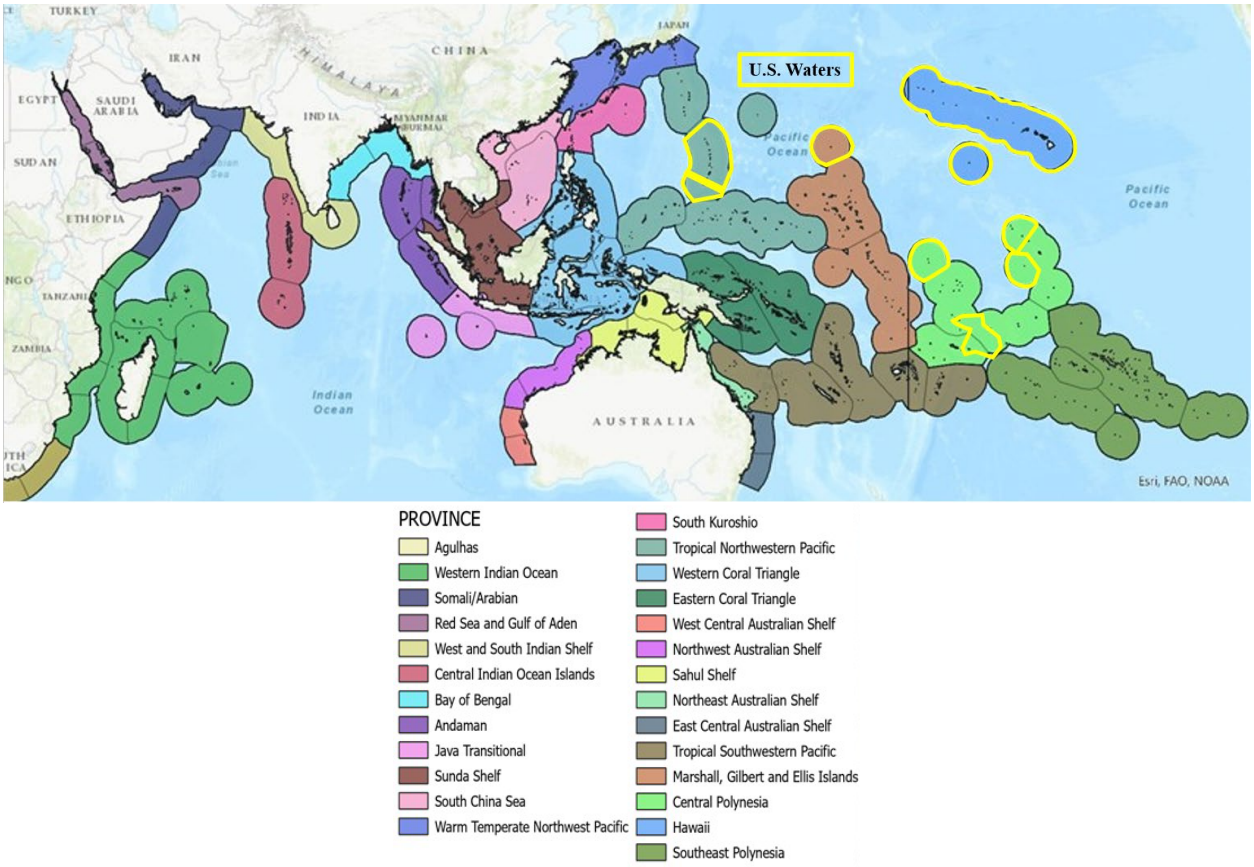

Figure 1. Collective geographic distributions of the 15 listed corals in the Indo-Pacific, based on the species-specific information in Section 3. The 15 species occur in 26 provinces and 76 ecoregions of Spalding et al.'s (2007) Marine Ecoregions of the World, including within U.S. waters as shown in yellow.

In addition to geographic distribution, the depth distribution of a species also influences their status. Unlike the geographic distributions of reef-building coral species provided in the COTW books (Veron 2000) and website (Veron et al. 2016), there is no comprehensive source of information on depth distributions. However, the Coral Traits Database (https://coraltraits.org/) provides depth distributions for many of the world's reef-building coral species.

2.1.2. Abundance

Abundance of the listed coral species is also a key factor in determining their status. Abundance can be represented as relative abundance (i.e., how common a species is compared to others). While there is no comprehensive source for the relative abundances of reef-building coral species, DeVantier and Turak (2017) published a large study on the abundances of over 600 Indo-Pacific reef-building coral species in 31 of Veron 133 Indo-Pacific ecoregions, based on survey data collected from 1994 to 2016. Their results provide ecoregion-scale relative abundance data for all of the listed corals in terms of the following categories: Very Rare, Rare, Uncommon, Common, Very Common; and Near Ubiquitous (DeVantier and Turak 2017).

Abundance can also be represented as absolute abundance (i.e., the total number of colonies of a species that currently exists throughout its range). While there is no comprehensive source for the absolute abundances of reef-building coral species, several studies provide estimates for some species, including Dietzel et al. (2021) and Richards et al. (2008, 2019). Also, the final listing rule used distribution and relative abundance information to develop minimum absolute abundance estimates for each of the listed species (79 FR 53851).

The most informative abundance metric regarding the status of the species is its rangewide abundance trend over time. Such data are extremely difficult to collect and there is no such information for any of the listed species. The final listing rule (79 FR 53851) and RSR (NMFS 2023) assume that based on the continued worsening of the most important threats, it is likely that the listed species are decreasing in overall abundance (i.e., abundance across all the ecoregions that make up a species' range).

2.2. Global Climate Change Threats

Ocean warming and ocean acidification are the two most important threats contributing to the extinction risk of Indo-Pacific reef-building corals (NMFS 2023). Global climate change refers to increased concentrations of greenhouse gases (GHGs) such as carbon dioxide (CO_2) into the atmosphere from anthropogenic emissions, and subsequent warming of the oceans, acidification of the oceans, rising sea levels, and other impacts since the mid-19th century. The release of GHGs from industrial and agricultural activities has increased atmospheric CO_2 concentrations from approximately 280 ppm in 1850 to 420 ppm in 2023, leading to an increase in mean global temperatures (i.e., mean annual temperatures over land and sea) of over 1°C. At the same time, the increasing atmospheric CO_2 concentrations and corresponding increase in CO_2 uptake by the oceans has led to a reduction in global mean surface pH in the oceans of more than 0.1 pH units from approximately 8.2 to <8.1 units since the mid-19th century, otherwise known as ocean acidification. The rates of ocean warming and ocean acidification have both increased in recent years and are projected to increase even more rapidly in the foreseeable future (NMFS 2023), as summarized in Trends and Projections below.

2.2.1. Trends

Trends in ocean warming are shown by global mean surface seawater temperatures (SSTs), which increased by 0.88°C from the mid-19th century to 2011–2018, with 0.60°C of this warming having occurred since 1980. The tropical oceans have been warming faster than other regions since 1950, with the fastest warming in the equatorial Indian Ocean and the Coral Triangle area of the western Pacific Ocean. Since 2018, there has been a continued increase in global mean SSTs as well as those within the Indo-Pacific. This recent increase in ocean warming has led to an increase in anomalous warm seawater events known as "marine heatwaves," which in turn have caused more frequent warming-induced coral bleaching events in the Indo-Pacific and elsewhere since 2014. To make matters worse, these coral bleaching events have been the longest, most widespread, and most damaging on record (NMFS 2023).

Trends in ocean acidification are shown by changes in the aragonite saturation state (Ω_{arg}) of seawater. As ocean pH decreases, Ω_{arg} also decreases. Lower Ω_{arg} reduces calcification and skeletal growth rates of reef-building corals while also increasing erosion of coral reefs. Mean Ω_{arg} of the surface waters of the open ocean across the tropical Indo-Pacific decreased from approximately 4.0-4.5 in the pre-industrial era to 3.5-4.0 in recent decades. Since 2014, the rate of ocean acidification and associated Ω_{arg} declines in the surface waters of the open ocean have accelerated across the Indo-Pacific. Decreases in calcification and skeletal growth rates of reef-building corals, as well as increases in coral reef erosion rates, are widely reported across the Indo-Pacific, especially in recent years (NMFS 2023).

2.2.2. Projections

Current global GHG management policies are projected by UNEP (2022) to result in increased global warming roughly consistent with the Intergovernmental Panel on Climate Change's (IPCC) SSP3-7.0 scenario (IPCC 2021). Under SSP3-7.0, global mean SSTs are projected to increase nearly 3°C above the mid-19th century baseline over the foreseeable future (i.e., from now to 2100), and

SST projections are spatially highly variable within the Indo-Pacific. For example, mean SSTs in most regions are projected to increase 2.75-3.25°C, while some (e.g., Red Sea, Northeastern Africa) are projected to increase by over 3.5°C or even approximately 4.0°C (Persian Gulf) by 2100 (IPCC 2021). Models of the responses of the world's reef-building corals to this level of ocean warming project sharp increases in warming-induced bleaching, the extent of which depend on the models' assumptions regarding the acclimatization and adaptation capacities of corals and other factors. However, even the best-case scenario (i.e., extensive acclimatization and adaptation capacities) project much greater levels of warming-induced coral bleaching in the foreseeable future than currently (NMFS 2023).

With regard to ocean acidification in the Indo-Pacific under SSP3-7.0, the mean surface pH of the open ocean is projected to decrease by 0.20 to 0.30 pH units from current levels between now and 2100 (IPCC 2021). These pH changes are projected to cause Ω_{arg} to decrease to <3.0 across most of the surface waters of the open ocean within the Indo-Pacific by 2100. Models of the responses of the world's reef-building corals to this level of ocean acidification project sharp decreases in coral calcification and skeletal growth, sharp increases in reef erosion and dissolution of reef substrates, and severe impacts to coral reproduction (NMFS 2023).

3. Summaries and Results of the 15 Reviews

Please refer to the RSR (NMFS 2023) for the general Threats Evaluation (RSR Section 3), as well as species reports that describe the biology, distribution, abundance, and threats for each of the 15 species (RSR Section 4). Those two sections of the RSR together provide the complete 5-factor analysis applicable to all 15 species, as summarized in the conclusion of each species report. Summaries of relevant information for each species are provided below. Details for each category of information are provided in the RSR (NMFS 2023). In addition, each species summary also has a Results section that provides the recommended classification and Recovery Priority Number for that species based on the information in the 5-year review.

3.1. *Acropora globiceps*

3.1.1. Distribution

Geographic Distribution. *Acropora globiceps* has a relatively broad distribution, occurring in 39 MEOWs (Fig. 2). The distribution of the species within U.S. waters is summarized below. The current information indicates that *A. globiceps* occurs in four more MEOWs than we were aware of at the time of listing in 2014 (NMFS 2023).

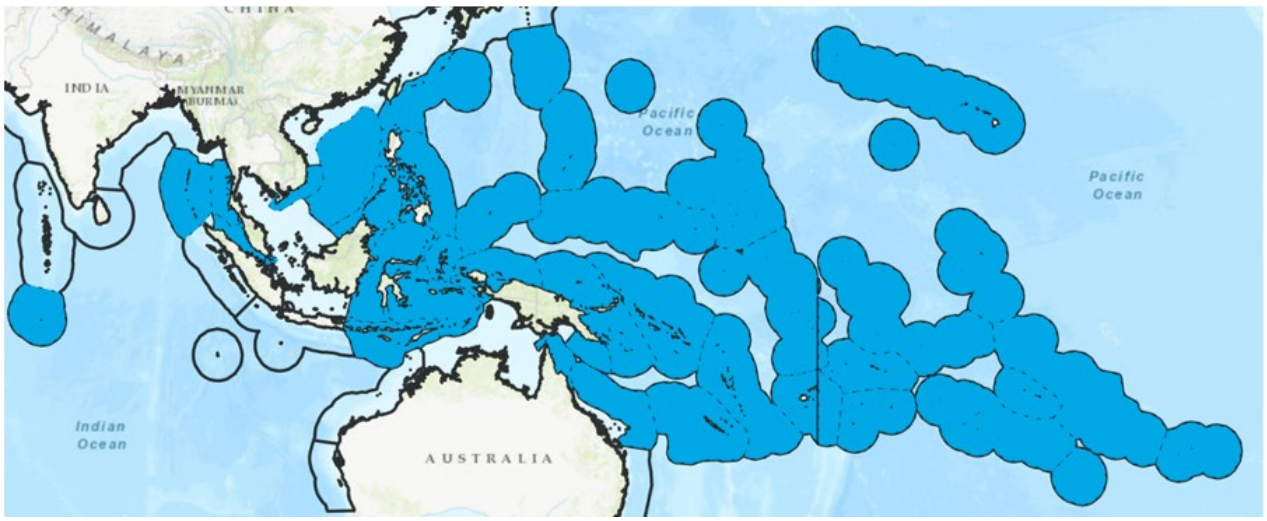

Figure 2. Geographic distribution of *A. globiceps*.

Depth Distribution. *Acropora globiceps* has a depth distribution of 0–20 m, more than twice as large as we were aware of at the time of listing in 2014 (<8 m; NMFS 2023).

U.S. Distribution. *Acropora globiceps* occurs in Guam, the Commonwealth of the Northern Mariana Islands (CNMI), American Samoa, the Pacific Remote Island Area (PRIA), and the Northwestern Hawaiian Islands (NMFS 2023).

3.1.2. Abundance

Relative Abundance. Current information indicates that *A. globiceps* has a rangewide relative abundance of uncommon to common, the same as we were aware of at the time of listing in 2014 (NMFS 2023).

Absolute Abundance. Current information indicates that *A. globiceps* has a higher absolute abundance (at least hundreds of millions of colonies) than we were aware of at the time of listing in 2014 (at least tens of millions; NMFS 2023).

Abundance Trends. Based on the continued worsening in the most important threats, it is likely that *A. globiceps* is decreasing in overall abundance (i.e., abundance across all the ecoregions that make up its range). This is similar to what we were aware of at the time of listing in 2014 (NMFS 2023).

3.1.3. Threats

The threats that contributed to the listing of *A. globiceps* include ocean warming, ocean acidification, disease, fishing, LBSP, predation, and inadequacy of existing regulatory mechanisms (79 FR 53851). In addition, current information indicates that collection and trade is also impacting the status of the species (NMFS 2023). For each threat to *A. globiceps*, the relative importance of the threat to the extinction risk of the species, the observed trend since 2014, and the projected trend in the foreseeable future are provided in Table 1 below.

Ocean warming is the most important threat to the species and has substantially worsened since 2014 (Hughes 2017, Eakin et al. 2019, Skirving et al. 2019). Recent warming-induced bleaching events have resulted in extensive mortality of *A. globiceps* on Guam in the Mariana Islands (Raymundo et al. 2019), Kiritimati (Christmas) Atoll in the Line Islands of Kiribati (Bowden-Kerby et al. 2021), Moorea in French Polynesia (Speare et al. 2022), and likely many other locations throughout its range. In addition, since *A. globiceps* was listed in 2014, many of the other threats to the species have worsened, including at least ocean acidification, disease and predation (Table 1).

All threats except the inadequacy of existing regulatory mechanisms are expected to worsen in the foreseeable future (i.e., between now and 2100; Table 1), as explained in more detail in the RSR (NMFS 2023).

Table 1. Summary of threats evaluation for *A. globiceps*.

Threat (ESA listing factor)	**Importance**	**Observed Trend in Effects Since 2014**	**Projected Trend in Effects to 2100**
Ocean Warming (Factor E)	Very High	Substantially worsened	Greatly worsen
Ocean Acidification (Factor E)	High	Worsened	Greatly worsen
Disease (Factor C)	High	Worsened	Substantially worsen
Fishing (Factor A)	Medium	Continued	Substantially worsen
LBSP (Factors A and E)	Low-Medium	Continued	Substantially worsen
Predation (Factor C)	Low-Medium	Worsened	Substantially worsen
Collection and Trade (Factor B)	Low-Medium	Continued	Substantially worsen
Sea-level Rise (Factor E)	Low	No detectable trends	Worsen
Inadequacy of Existing Regulatory Mechanisms (Factor D)	High	Some improvement but still inadequate	Improvement but likely still inadequate

3.1.4. Conclusion

As explained in the 2014 final listing rule (79 FR 53851), a species' vulnerability to extinction results from the combination of its spatial (i.e., distribution) and demographic (i.e., abundance) characteristics, threat susceptibilities, and consideration of the baseline environment and future projections of threats. *Acropora globiceps* was listed as threatened in 2014 because of its narrow depth distribution, high susceptibility to ocean warming, susceptibilities to ocean acidification, disease, fishing, LBSP, and predation, inadequate regulatory mechanisms, declining baseline conditions, and projected worsening of threats (79 FR 53851).

Since 2014, we have learned that *A. globiceps* has: (1) a broader geographic distribution (39 MEOWs instead of 35), (2) a broader depth distribution (0–20 m instead of 0–8 m) although it is typically more abundant at <8 m depth; and (3) higher absolute abundance (at least hundreds of millions of colonies instead of at least tens of millions of colonies). That is, *A. globiceps* is more broadly distributed and more abundant than we believed in 2014, and thus may have a higher capacity to moderate the effects of the threats (NMFS 2023).

Since 2014, the effects of ocean warming have substantially worsened, and the effects of most other threats have worsened as well. The extensive bleaching and mortality of *A. globiceps* in response to ocean warming events in 2016 and 2019 confirm its high susceptibility to this threat. All threats are projected to substantially worsen under current global GHG regulatory mechanisms, which would result in global warming of 2.6–3.4°C above the pre-industrial baseline by 2100 (see Fig. 4 in Section 3.1 of the RSR). Even if the goal of the Paris Agreement is achieved (i.e., limiting global warming to 1.5°C above pre-industrial by 2100), the threats would become much worse than they are currently (Dixon et al. 2022), likely preventing the recovery of *A. globiceps*. Current regulatory mechanisms are grossly inadequate, especially GHG management (NMFS 2023).

Overall, the information in the RSR (NMFS 2023) shows that *A. globiceps* is more broadly distributed and more abundant than we believed in 2014, but that the threats have worsened and that collection and trade is also an important threat to the species. Especially concerning is that the most important threat to the species, ocean warming, has substantially worsened since the species was listed in 2014. The other important threats to the species, including ocean acidification, disease, fishing, LBSP, predation, and collection and trade have also either worsened or continued since 2014. While there has been some progress with regulatory mechanisms, primarily because of the 2016 Paris Agreement, regulatory mechanisms for both global and local threats are still inadequate. However, the species' distribution is broader and its abundance is greater than we were aware of at the time of listing in 2014, both of which are key factors for moderating threats.

Based on this information, we conclude that *A. globiceps* is still likely to become an endangered species in the foreseeable future due to Factors A, B, C, D, and E, but does not appear to be in danger of extinction currently. Thus, no change in status is recommended at this time.

3.1.5. Results

Recommended Classification:

_____Downlist to Threatened
_____Uplist to Endangered
_____Delist (Indicate reason for delisting per 50 CFR 424.11):
    _____Extinction
    _____Recovery
    _____Original data for classification in error
__X__No change is needed

New Recovery Priority Number: No Change. The current Recovery Priority Number for *A. globiceps* is 3C, based mainly on moderate demographic risk and high understanding of major threats. This 5-year review does not provide any new information that would justify a change in the Recovery Priority Number.

3.2. *Acropora jacquelineae*

3.2.1. Distribution

Geographic Distribution. *Acropora jacquelineae* has a relatively limited geographic distribution, occurring in 15 MEOWs (Fig. 3), none of which are in U.S. waters. The current information indicates that *A. jacquelineae* occurs in two more MEOWs than we were aware of at the time of listing in 2014 (NMFS 2023).

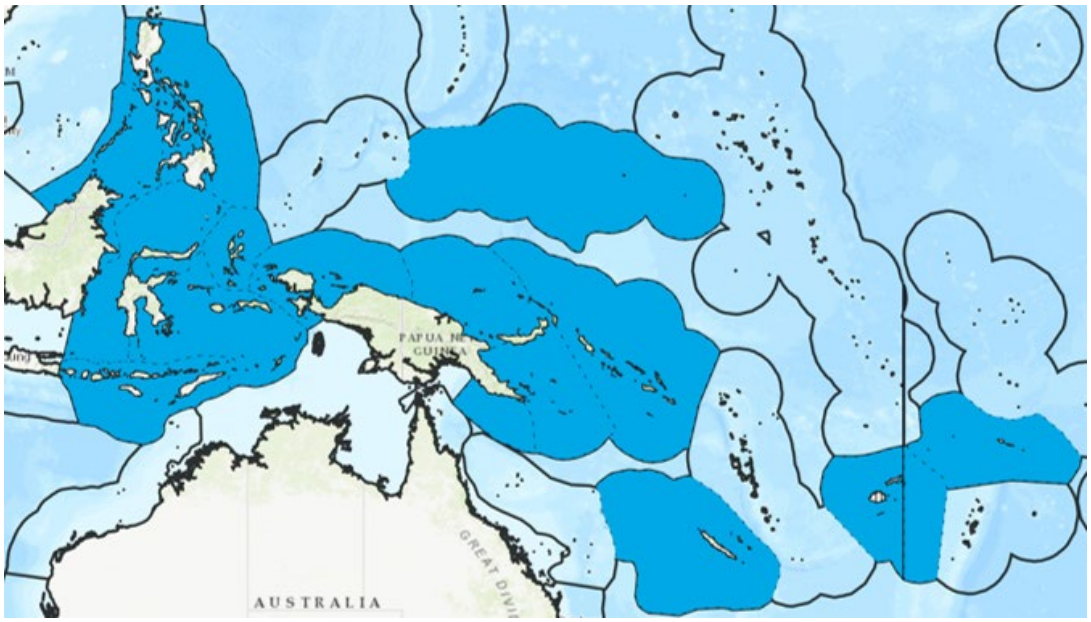

Figure 3. Geographic distribution of *A. jacquelineae*.

Depth Distribution. *Acropora jacquelineae* has a depth distribution of 10–50 m, somewhat larger than we were aware of at the time of listing in 2014 (10–35 m; NMFS 2023).

3.2.2. Abundance

Relative Abundance: Current information indicates that *A. jacquelineae* has a rangewide relative abundance of uncommon, the same as we were aware of at the time of listing in 2014 (NMFS 2023).

Absolute Abundance. Current information indicates that *A. jacquelineae* has an absolute abundance of at least tens of millions of colonies, the same as we were aware of at the time of listing in 2014 (NMFS 2023).

Abundance Trends. Based on the continued worsening of the most important threats, it is likely that *A. jacquelineae* is decreasing in overall abundance (i.e., abundance across all the ecoregions that make up its range). This is similar to what we were aware of at the time of listing in 2014 (NMFS 2023).

3.2.3. Threats

The threats that contributed to the listing of *A. jacquelineae* include ocean warming, ocean acidification, disease, fishing, LBSP, predation, and inadequacy of existing regulatory mechanisms (79 FR 53851). In addition, current information indicates that collection and trade is also impacting the status of the species (NMFS 2023). For each threat to *A. jacquelineae*, the relative importance of the threat to the extinction risk of the species, the observed trend since 2014, and the projected trend in the foreseeable future are provided in Table 2 below.

Ocean warming is the most important threat to the species and has substantially worsened since 2014 (Hughes et al. 2017, Eakin et al. 2019, Skirving et al. 2019). Recent warming-induced bleaching events have resulted in extensive mortality of *Acropora* species within the range of *A. jacquelineae* (e.g., Hughes et al. 2018a,b), likely heavily impacting the species. In addition, since *A. jacquelineae* was listed in 2014, many of the other threats to the species have worsened, including at least ocean acidification, disease and predation (Table 2). All threats except the inadequacy of existing regulatory mechanisms are expected to worsen in the foreseeable future (i.e., between now and 2100; Table 2), as explained in more detail in the RSR (NMFS 2023).

Table 2. Summary of threats evaluation for *A. jacquelineae*.

Threat (ESA listing factor)	Importance	Observed Trend in Effects Since 2014	Projected Trend in Effects to 2100
Ocean Warming (Factor E)	Very High	Substantially worsened	Greatly worsen
Ocean Acidification (Factor E)	High	Worsened	Greatly worsen
Disease (Factor C)	High	Worsened	Substantially worsen
Fishing (Factor A)	Medium	Continued	Substantially worsen
LBSP (Factors A and E)	Low-Medium	Continued	Substantially worsen
Predation (Factor C)	Low-Medium	Worsened	Substantially worsen
Collection and Trade (Factor B)	Low-Medium	Continued	Substantially worsen
Sea-level Rise (Factor E)	Low	No detectable trends	Worsen
Inadequacy of Existing Regulatory Mechanisms (Factor D)	High	Some improvement but still inadequate	Improvement but likely still inadequate

3.2.4. Conclusion

As explained in the 2014 final listing rule (79 FR 53851), a species' vulnerability to extinction results from the combination of its spatial (i.e., distribution) and demographic (i.e., abundance) characteristics, threat susceptibilities, and consideration of the baseline environment and future projections of threats. *Acropora jacquelineae* was listed as threatened in 2014 because of its limited geographic distribution restricted to the Coral Triangle and western Pacific, low abundance, high susceptibility to ocean warming, susceptibilities to ocean acidification, disease, fishing, LBSP, and predation, inadequate regulatory mechanisms, declining baseline conditions, and projected worsening of threats (79 FR 53851).

Since 2014, we have learned that *A. jacquelineae* has: (1) a broader geographic distribution (15 MEOWs instead of 13); and (2) a broader depth distribution (10–50 m instead of 10–35 m). That is, *A. jacquelineae* is more broadly distributed than we believed in 2014, and thus may have a higher capacity to moderate the effects of the threats (NMFS 2023).

Since 2014, the effects of ocean warming have substantially worsened, and the effects of most other threats have worsened as well. All threats are projected to substantially worsen under current global GHG regulatory mechanisms, which would result in global warming of 2.6–3.4°C above the pre-industrial baseline by 2100 (see Fig. 4 in Section 3.1 of the RSR). Even if the goal of the Paris Agreement is achieved (i.e., limiting global warming to 1.5°C above pre-industrial by 2100), the threats would become much worse than they are currently (Dixon et al. 2022), likely preventing the recovery of *A. jacquelineae*. Current regulatory mechanisms are grossly inadequate, especially GHG management (NMFS 2023).

Overall, the information in the RSR (2023) shows that *A. jacquelineae* is more broadly distributed than we believed in 2014, but that the threats have worsened and that collection and trade is also an important threat to the species. Especially concerning is that the most important threat to the species, ocean warming, has substantially worsened since the species was listed in 2014. The other important threats to the species, including ocean acidification, disease, fishing, LBSP, predation, and

collection and trade have also either worsened or continued since 2014. While there has been some progress with regulatory mechanisms, primarily because of the 2016 Paris Agreement, regulatory mechanisms for both global and local threats are still inadequate. However, the species' distribution is broader than we were aware of at the time of listing in 2014, which is a key factor for moderating threats.

Based on this information, we conclude that *A. jacquelineae* is still likely to become an endangered species in the foreseeable future due to Factors A, B, C, D, and E, but does not appear to be in danger of extinction currently. Thus, no change in status is recommended at this time.

3.2.5. Results

Recommended classification:

_____Downlist to Threatened
_____Uplist to Endangered
_____Delist (Indicate reason for delisting per 50 CFR 424.11):
    _____Extinction
    _____Recovery
    _____Original data for classification in error
__X__No change is needed

New Recovery Priority Number: No Change. The current Recovery Priority Number for *A. jacquelineae* is 3C, based mainly on moderate demographic risk and high understanding of major threats. This 5-year review does not provide any new information that would justify a change in the Recovery Priority Number.

3.3. *Acropora lokani*

3.3.1. Distribution

Geographic Distribution. *Acropora lokani* has a relatively limited distribution, occurring in 14 MEOWs (Fig. 4), none of which are in U.S. waters. The current information indicates that *A. lokani* occurs in one more Veron ecoregion (Sunda Shelf between Malaysia and Borneo) than we were aware of 2014 (i.e., 21 Veron ecoregions instead of 20). However, because Veron ecoregions are smaller than MEOWs (see Section 2.1.1), the species still occurs in the same number of MEOWs as we were aware of in 2014 (i.e., 14 MEOWs; NMFS 2023).

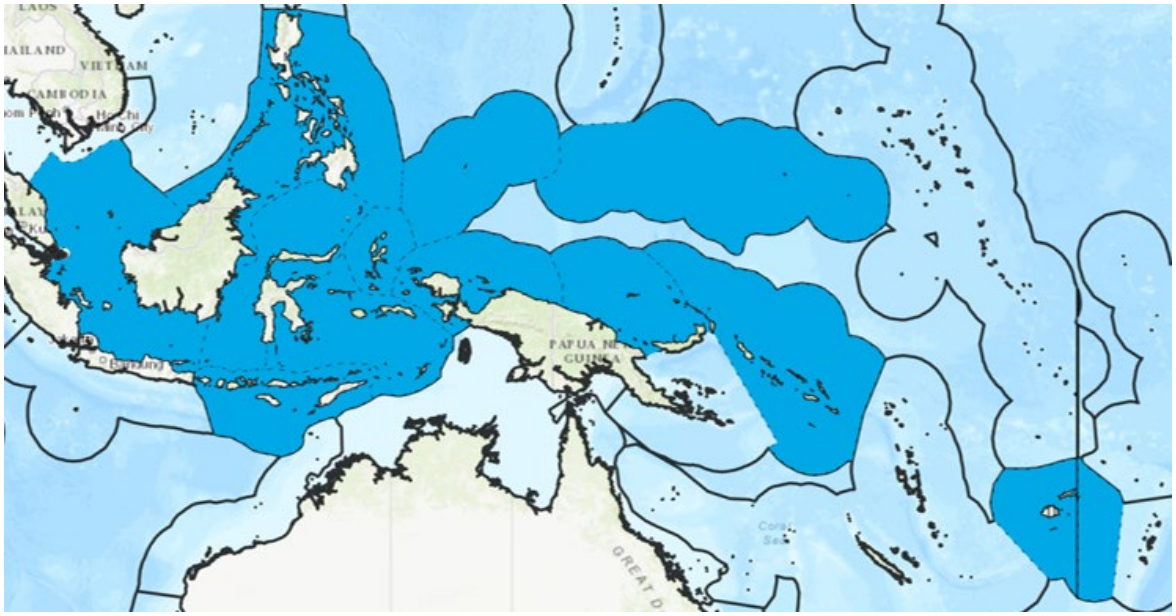

Figure 4. Geographic distribution of *A. lokani*.

Depth Distribution. *Acropora lokani* has a depth distribution of 8–50 m, approximately twice as large as we were aware of at the time of listing in 2014 (8–25 m; NMFS 2023).

3.3.2. Abundance

Relative Abundance: Current information indicates that *A. lokani* has a rangewide relative abundance of uncommon, the same as we were aware of at the time of listing in 2014 (NMFS 2023).

Absolute Abundance. Current information indicates that *A. lokani* has an absolute abundance of at least tens of millions of colonies, the same as we were aware of at the time of listing in 2014 (NMFS 2023).

Abundance Trends. Based on the continued worsening in the most important threats, it is likely that *A. lokani* is decreasing in overall abundance (i.e., abundance across all the ecoregions that make up its range). This is similar to what we were aware of at the time of listing in 2014 (NMFS 2023).

3.3.3. Threats

The threats that contributed to the listing of *A. lokani* include ocean warming, ocean acidification, disease, fishing, LBSP, predation, and inadequacy of existing regulatory mechanisms (79 FR 53851). In addition, current information indicates that collection and trade is also impacting the status of the species (NMFS 2023). For each threat to *A. lokani*, the relative importance of the threat to the extinction risk of the species, the observed trend since 2014, and the projected trend in the foreseeable future are provided in Table 3 below.

Ocean warming is the most important threat to the species and has substantially worsened since 2014 (Hughes et al. 2017, Eakin et al. 2019, Skirving et al. 2019). Recent warming-induced bleaching events have resulted in extensive mortality of *Acropora* species within the range of *A. lokani* (e.g., Hughes et al. 2018a,b), likely heavily impacting the species. In addition, since *A. lokani* was listed in 2014, many of the other threats to the species have worsened, including at least ocean acidification, disease and predation (Table 3). All threats except the inadequacy of existing regulatory mechanisms are expected to worsen in the foreseeable future (i.e., between now and 2100; Table 3), as explained in more detail in the RSR (NMFS 2023).

Table 3. Summary of threats evaluation for *A. lokani*.

Threat (ESA listing factor)	Importance	Observed Trend in Effects Since 2014	Projected Trend in Effects to 2100
Ocean Warming (Factor E)	Very High	Substantially worsened	Greatly worsen
Ocean Acidification (Factor E)	High	Worsened	Greatly worsen
Disease (Factor C)	High	Worsened	Substantially worsen
Fishing (Factor A)	Medium	Continued	Substantially worsen
LBSP (Factors A and E)	Low-Medium	Continued	Substantially worsen
Predation (Factor C)	Low-Medium	Worsened	Substantially worsen
Collection and Trade (Factor B)	Low-Medium	Continued	Substantially worsen
Sea-level Rise (Factor E)	Low	No detectable trends	Worsen
Inadequacy of Existing Regulatory Mechanisms (Factor D)	High	Some improvement but still inadequate	Improvement but likely still inadequate

3.3.4. Conclusion

As explained in the 2014 final listing rule (79 FR 53851), a species' vulnerability to extinction results from the combination of its spatial (i.e., distribution) and demographic (i.e., abundance) characteristics, threat susceptibilities, and consideration of the baseline environment and future projections of threats. *Acropora lokani* was listed as threatened in 2014 because of its limited geographic distribution largely restricted to the Coral Triangle region and parts of the western equatorial Pacific Ocean, low abundance, high susceptibility to ocean warming, susceptibilities to ocean acidification, fishing, LBSP, disease, and predation, inadequate regulatory mechanisms, declining baseline conditions, and projected worsening of threats (79 FR 53851).

Since 2014, we have learned that *A. lokani* has a larger geographic distribution (21 instead of 20 Veron ecoregions) and broader depth distribution (8–50 m instead of 8–25 m) than we believed in 2014. That is, *A. lokani* is more broadly distributed than we believed in 2014, and thus may have a higher capacity to moderate the effects of the threats (NMFS 2023).

Since 2014, the effects of ocean warming have substantially worsened, and the effects of most other threats have worsened as well. All threats are projected to substantially worsen under current global GHG regulatory mechanisms, which would result in global warming of 2.6–3.4°C above the pre-industrial baseline by 2100 (see Fig. 4 in Section 3.1 of the RSR). Even if the goal of the Paris Agreement is achieved (i.e., limiting global warming to 1.5°C above pre-industrial by 2100), the threats would become much worse than they are currently (Dixon et al. 2022), likely preventing the recovery of *A. lokani*. Current regulatory mechanisms are grossly inadequate, especially GHG management (NMFS 2023).

Overall, the information in the RSR (NMFS 2023) shows that *A. lokani* is more broadly distributed than we believed in 2014, but that the threats have worsened and that collection and trade is also an important threat to the species. Especially concerning is that the most important threat to the species, ocean warming, has substantially worsened since the species was listed in 2014. The other important threats to the species, including ocean acidification, disease, fishing, LBSP, predation, and

collection and trade have also either worsened or continued since 2014. While there has been some progress with regulatory mechanisms, primarily because of the 2016 Paris Agreement, regulatory mechanisms for both global and local threats are still inadequate. However, the species' distribution is broader than we were aware of at the time of listing in 2014, which is a key factor for moderating threats.

Based on this information, we conclude that *A. lokani* is still likely to become an endangered species in the foreseeable future due to Factors A, B, C, D, and E, but does not appear to be in danger of extinction currently. Thus, no change in status is recommended at this time.

3.3.5. Results

Recommended classification:

_____Downlist to Threatened
_____Uplist to Endangered
_____Delist (Indicate reason for delisting per 50 CFR 424.11):
    _____Extinction
    _____Recovery
    _____Original data for classification in error
__X__No change is needed

New Recovery Priority Number: No Change. The current Recovery Priority Number for *A. lokani* is 3C, based mainly on moderate demographic risk and high understanding of major threats. This 5-year review does not provide any new information that would justify a change in the Recovery Priority Number.

3.4. *Acropora pharaonis*

3.4.1. Distribution

Geographic Distribution. *Acropora pharaonis* has a relatively limited distribution, occurring in 19 MEOWs (Fig. 5), none of which are in U.S. waters. The current information indicates that *A. pharaonis* occurs in one more Veron ecoregion (Gulf of Oman) than we were aware of 2014 (i.e., 20 Veron ecoregions instead of 19). However, because Veron ecoregions are smaller than MEOWs (see Section 2.1.1), the species still occurs in the same number of MEOWs as we were aware of in 2014 (i.e., 19 MEOWs, NMFS 2023).

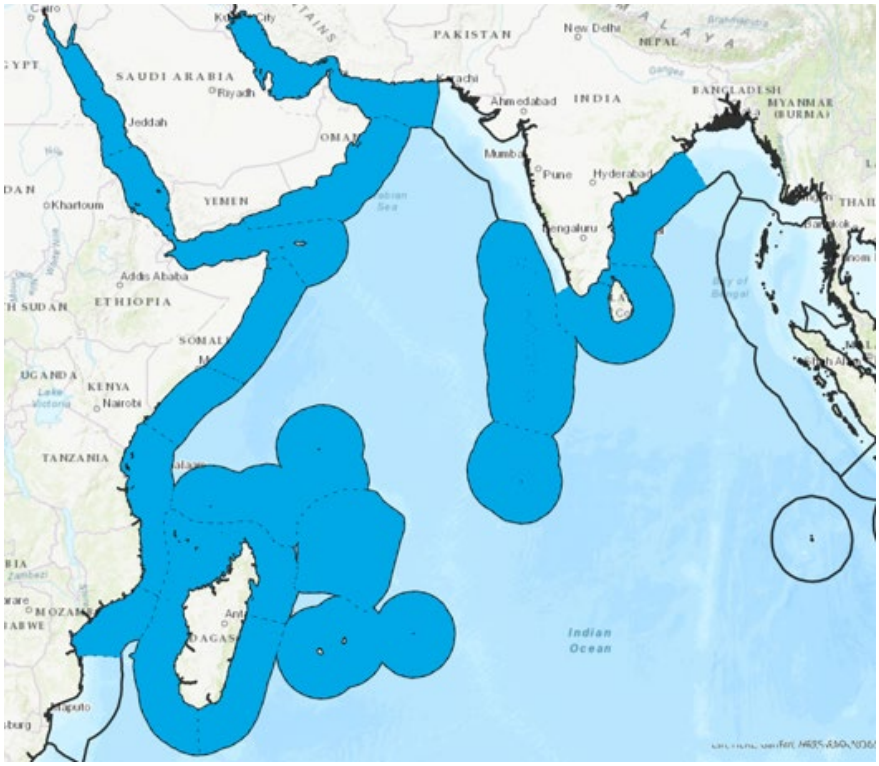

Figure 5. Geographic distribution of *A. pharaonis*.

Depth Distribution. *Acropora pharaonis* has a depth distribution of 2–44 m, approximately twice as large as we were aware of at the time of listing in 2014 (5–25 m; NMFS 2023).

3.4.2. Abundance

Relative Abundance: Current information indicates that *A. pharaonis* has a higher relative abundance (common) than we were aware of at the time of listing in 2014 (uncommon; NMFS 2023).

Absolute Abundance. Current information indicates that *A. pharaonis* has a higher absolute abundance (at least tens of millions of colonies) than we were aware of at the time of listing in 2014 (at least millions; NMFS 2023).

Abundance Trends. Based on the continued worsening in the most important threats, it is likely that *A. pharaonis* is decreasing in overall abundance (i.e., abundance across all the ecoregions that make up its range). This is similar to what we were aware of at the time of listing in 2014 (NMFS 2023).

3.4.3. Threats

The threats that contributed to the listing of *A. pharaonis* include ocean warming, ocean acidification, disease, fishing, LBSP, predation, and inadequacy of existing regulatory mechanisms (79 FR 53851). In addition, current information indicates that collection and trade is also impacting the status of the species (NMFS 2023). For each threat to *A. pharaonis*, the relative importance of the threat to the extinction risk of the species, the observed trend since 2014, and the projected trend in the foreseeable future are provided in Table 4 below.

Ocean warming is the most important threat to the species and has substantially worsened since 2014 (Hughes et al. 2017, Eakin et al. 2019, Skirving et al. 2019). Recent warming-induced bleaching events have resulted in extensive mortality of *Acropora* species within the range of *A. pharaonis* (e.g., Hughes et al. 2018a,b), likely heavily impacting the species. In addition, since *A.*

pharaonis was listed in 2014, many of the other threats to the species have worsened, including at least ocean acidification, disease and predation (Table 4). All threats except the inadequacy of existing regulatory mechanisms are expected to worsen in the foreseeable future (i.e., between now and 2100; Table 4), as explained in more detail in the RSR (NMFS 2023).

Table 4. Summary of threats evaluation for *A. pharaonis*.

Threat (ESA listing factor)	**Importance**	**Observed Trend in Effects Since 2014**	**Projected Trend in Effects to 2100**
Ocean Warming (Factor E)	Very High	Substantially worsened	Greatly worsen
Ocean Acidification (Factor E)	High	Worsened	Greatly worsen
Disease (Factor C)	High	Worsened	Substantially worsen
Fishing (Factor A)	Medium	Continued	Substantially worsen
LBSP (Factors A and E)	Low-Medium	Continued	Substantially worsen
Predation (Factor C)	Low-Medium	Worsened	Substantially worsen
Collection and Trade (Factor B)	Low-Medium	Continued	Substantially worsen
Sea-level Rise (Factor E)	Low	No detectable trends	Worsen
Inadequacy of Existing Regulatory Mechanisms (Factor D)	High	Some improvement but still inadequate	Improvement but likely still inadequate

3.4.4. Conclusion

As explained in the 2014 final listing rule (79 FR 53851), a species' vulnerability to extinction results from the combination of its spatial (i.e., distribution) and demographic (i.e., abundance) characteristics, threat susceptibilities, and consideration of the baseline environment and future projections of threats. *Acropora pharaonis* was listed as threatened in 2014 because of its limited geographic distribution restricted largely to the Red Sea and Arabian Gulf, high susceptibility to ocean warming, susceptibilities to ocean acidification, fishing, LBSP, disease, and predation, inadequate regulatory mechanisms, declining baseline conditions, and projected worsening of threats (79 FR 53851).

Since 2014, we have learned that *A. pharaonis* has: (1) a broader geographic distribution (20 instead of 19 Veron ecoregions); (2) a broader depth distribution (2–44 m instead of 5–25 m); (3) a higher relative abundance (common instead of uncommon); and (4) a higher absolute abundance (at least tens of millions of colonies instead of at least millions of colonies). That is, *A. pharaonis* is more broadly distributed and more abundant than we believed in 2014, and thus may have a higher capacity to moderate the effects of the threats (NMFS 2023).

Since 2014, the effects of ocean warming have substantially worsened, and the effects of most other threats have worsened as well. All threats are projected to substantially worsen under current global GHG regulatory mechanisms, which would result in global warming of 2.6–3.4°C above the pre-industrial baseline by 2100 (see Fig. 4 in Section 3.1 of the RSR). Even if the goal of the Paris Agreement is achieved (i.e., limiting global warming to 1.5°C above pre-industrial by 2100), the threats would become much worse than they are currently (Dixon et al. 2022), likely preventing the

recovery of *A. pharaonis*. Current regulatory mechanisms are grossly inadequate, especially GHG management (NMFS 2023).

Overall, the information in the RSR (NMFS 2023) shows that *A. pharaonis* is more broadly distributed and more abundant than we believed in 2014, but that the threats have worsened and that collection and trade is also an important threat to the species. Especially concerning is that the most important threat to the species, ocean warming, has substantially worsened since the species was listed in 2014. The other important threats to the species, including ocean acidification, disease, fishing, LBSP, predation, and collection and trade have also either worsened or continued since 2014. While there has been some progress with regulatory mechanisms, primarily because of the 2016 Paris Agreement, regulatory mechanisms for both global and local threats are still inadequate. However, the species' distribution is broader and its abundance is greater than we were aware of at the time of listing in 2014, both of which are key factors for moderating threats.

Based on this information, we conclude that *A. pharaonis* is still likely to become an endangered species in the foreseeable future due to Factors A, B, C, D, and E, but does not appear to be in danger of extinction currently. Thus, no change in status is recommended at this time

3.4.5. Results

Recommended classification:

_____Downlist to Threatened
_____Uplist to Endangered
_____Delist (Indicate reason for delisting per 50 CFR 424.11):
    _____Extinction
    _____Recovery
    _____Original data for classification in error
__X__No change is needed

New Recovery Priority Number: No Change. The current Recovery Priority Number for *A. pharaonis* is 3C, based mainly on moderate demographic risk and high understanding of major threats. This 5-year review does not provide any new information that would justify a change in the Recovery Priority Number.

3.5. *Acropora retusa*

3.5.1. Distribution

Geographic Distribution. *Acropora retusa* has a relatively broad geographic distribution, occurring in 35 MEOWs (Fig. 6). The distribution of the species within U.S. waters is summarized below. The current information indicates that *A. retusa* occurs in 35 MEOWs, the same number that we were aware of at the time of listing in 2014, but with two changes: We no longer consider *A. retusa* to occur in the Mariana Islands MEOW because the existing records appear to be of a different or undescribed species, and we now have records of *A. retusa* from the Chagos MEOW (NMFS 2023).

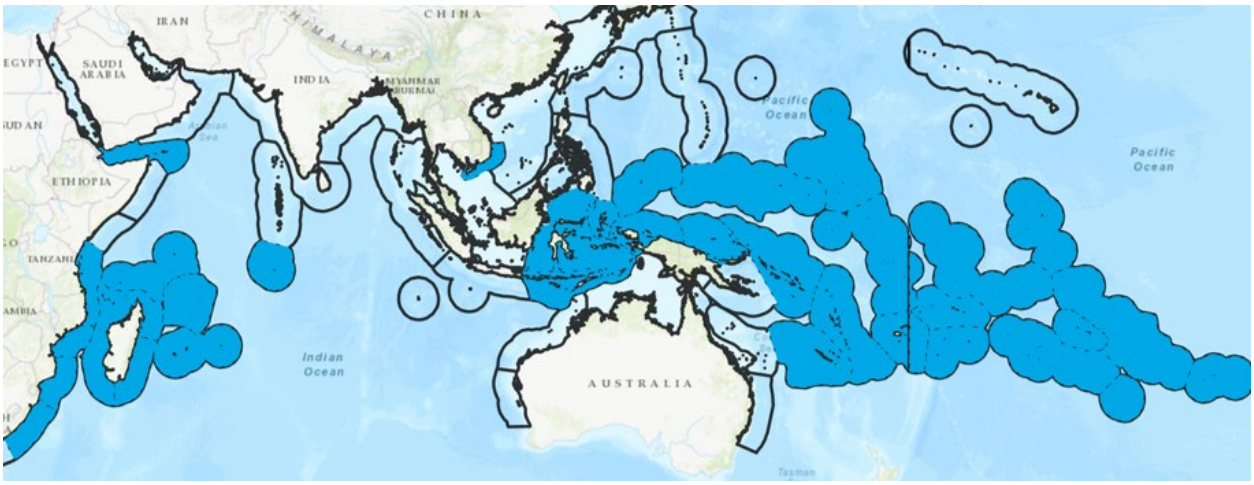

Figure 6. Geographic distribution of *A. retusa*.

Depth Distribution. *Acropora retusa* has a depth distribution of 0–29 m, much greater than we were aware of at the time of listing in 2014 (0-5 m; NMFS 2023).

U.S. Distribution. *Acropora retusa* occurs on Tutuila, Ofu, Olosega, and Rose Atoll in American Samoa, and on Wake Atoll in PRIA (NMFS 2023).

3.5.2. Abundance

Relative Abundance: Current information indicates that *A. retusa* has a rangewide relative abundance of rare to uncommon, the same as we were aware of at the time of listing in 2014 (NMFS 2023).

Absolute Abundance. Current information indicates that *A. retusa* has a higher absolute abundance (at least hundreds of millions of colonies) than we were aware of at the time of listing in 2014 (at least millions; NMFS 2023).

Abundance Trends. Based on the continued worsening in the most important threats, it is likely that *A. retusa* is decreasing in overall abundance (i.e., abundance across all the ecoregions that make up its range). This is similar to what we were aware of at the time of listing in 2014 (NMFS 2023).

3.5.3. Threats

The threats that contributed to the listing of *A. retusa* include ocean warming, ocean acidification, disease, fishing, LBSP, predation, and inadequacy of existing regulatory mechanisms (79 FR 53851). In addition, current information indicates that collection and trade is also impacting the status of the species (NMFS 2023). For each threat to *A. retusa*, the relative importance of the threat to the extinction risk of the species, the observed trend since 2014, and the projected trend in the foreseeable future are provided in Table 5 below.

Ocean warming is the most important threat to the species and has substantially worsened since 2014 (Hughes et al. 2017, Dietzel et al. 2020, Gilmour et al. 2022). Recent warming-induced bleaching events have resulted in extensive mortality of *A. retusa* on Kiritimati (Christmas) Atoll in the Line Islands of Kiribati (Bowden-Kerby et al. 2021) and Moorea in French Polynesia (Speare et al. 2022), and likely many other locations throughout its range. In addition, since *A. retusa* was listed in 2014, many of the other threats to the species have worsened, including at least ocean acidification, disease and predation (Table 5). All threats except the inadequacy of existing regulatory mechanisms are expected to worsen in the foreseeable future (i.e., between now and 2100; Table 5), as explained in more detail in the RSR (NMFS 2023).

Table 5. Summary of threats evaluation for *A. retusa*.

Threat (ESA listing factor)	Importance	Observed Trend in Effects Since 2014	Projected Trend in Effects to 2100
Ocean Warming (Factor E)	Very High	Substantially worsened	Greatly worsen
Ocean Acidification (Factor E)	High	Worsened	Greatly worsen
Disease (Factor C)	High	Worsened	Substantially worsen
Fishing (Factor A)	Medium	Continued	Substantially worsen
LBSP (Factors A and E)	Low-Medium	Continued	Substantially worsen
Predation (Factor C)	Low-Medium	Worsened	Substantially worsen
Collection and Trade (Factor B)	Low-Medium	Continued	Substantially worsen
Sea-level Rise (Factor E)	Low	No detectable trends	Worsen
Inadequacy of Existing Regulatory Mechanisms (Factor D)	High	Some improvement but still inadequate	Improvement but likely still inadequate

3.5.4. Conclusion

As explained in the 2014 final listing rule (79 FR 53851), a species' vulnerability to extinction results from the combination of its spatial (i.e., distribution) and demographic (i.e., abundance) characteristics, threat susceptibilities, and consideration of the baseline environment and future projections of threats. *Acropora retusa* was listed as threatened in 2014 because of its limited depth distribution, low abundance, high susceptibility to ocean warming, susceptibilities to ocean acidification, fishing, LBSP, disease, and predation, inadequate regulatory mechanisms, declining baseline conditions, and projected worsening of threats (79 FR 53851).

Since 2014, we have learned that *A. retusa* has: (1) a much broader depth distribution (0–29 m instead of 0–5 m); and (2) higher absolute abundance (at least hundreds of millions of colonies instead of at least millions of colonies) than we believed in 2014. That is, *A. retusa* is more broadly distributed and more abundant than we believed in 2014, and thus may have a higher capacity to moderate the effects of the threats (NMFS 2023).

Since 2014, the effects of ocean warming have substantially worsened, and the effects of most other threats have worsened as well. All threats are projected to substantially worsen under current global GHG regulatory mechanisms, which would result in global warming of 2.6–3.4°C above the pre-industrial baseline by 2100 (see Fig. 4 in Section 3.1 of the RSR). Even if the goal of the Paris Agreement is achieved (i.e., limiting global warming to 1.5°C above pre-industrial by 2100), the threats would become much worse than they are currently (Dixon et al. 2022), likely preventing the recovery of *A. retusa*. Current regulatory mechanisms are grossly inadequate, especially GHG management (NMFS 2023).

Overall, the information in the RSR (NMFS 2023) shows that *A. retusa* is more broadly distributed and more abundant than we believed in 2014, but that the threats have worsened and that collection and trade is also an important threat to the species. Especially concerning is that the most important threat to the species, ocean warming, has substantially worsened since the species was listed in 2014. The other important threats to the species, including ocean acidification, disease,

fishing, LBSP, predation, and collection and trade have also either worsened or continued since 2014. While there has been some progress with regulatory mechanisms, primarily because of the 2016 Paris Agreement, regulatory mechanisms for both global and local threats are still inadequate. However, the species' depth distribution is broader and its abundance is greater than we were aware of at the time of listing in 2014, both of which are key factors for moderating threats.

Based on this information, we conclude that *A. retusa* is still likely to become an endangered species in the foreseeable future due to Factors A, B, C, D, and E, but does not appear to be in danger of extinction currently. Thus, no change in status is recommended at this time.

3.5.5. Results

Recommended classification:

_____Downlist to Threatened
_____Uplist to Endangered
_____Delist (Indicate reason for delisting per 50 CFR 424.11):
    _____Extinction
    _____Recovery
    _____Original data for classification in error
__X__No change is needed

New Recovery Priority Number: No Change. The current Recovery Priority Number for *A. retusa* is 3C, based mainly on moderate demographic risk and high understanding of major threats. This 5-year review does not provide any new information that would justify a change in the Recovery Priority Number.

3.6. *Acropora rudis*

3.6.1. Distribution

Geographic Distribution. *Acropora rudis* has a relatively restricted geographic distribution, occurring only in nine MEOWs (Fig. 7), none of which are in U.S. waters. The current information indicates that *A. rudis* occurs in nine MEOWs, the same number that we were aware of at the time of listing in 2014 (NMFS 2023).

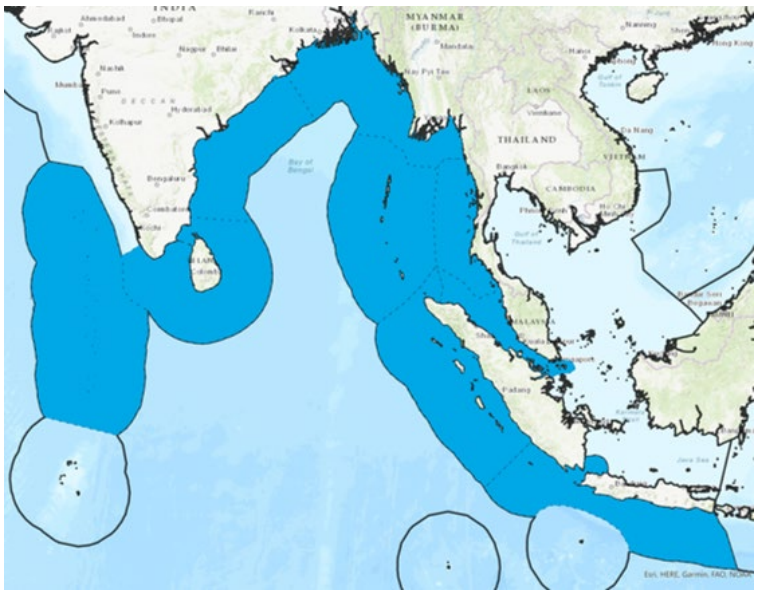

Figure 7. Geographic distribution of *A. rudis*.

Depth Distribution**.** *Acropora rudis* has a depth distribution of 3–30 m, approximately twice as large as we were aware of at the time of listing in 2014 (3–15 m; NMFS 2023).

3.6.2. Abundance

Relative Abundance: Current information indicates that *A. rudis* has a higher rangewide relative abundance (uncommon) than we were aware of at the time of listing in 2014 (rare; NMFS 2023).

Absolute Abundance. Current information indicates that *A. rudis* has an absolute abundance of at least millions of colonies, the same as we were aware of at the time of listing in 2014 (NMFS 2023).

Abundance Trends. Based on the continued worsening in the most important threats, it is likely that *A. rudis* is decreasing in overall abundance (i.e., abundance across all the ecoregions that make up its range). This is similar to what we were aware of at the time of listing in 2014 (NMFS 2023).

3.6.3. Threats

The threats that contributed to the listing of *A. rudis* include ocean warming, ocean acidification, disease, fishing, LBSP, predation, and inadequacy of existing regulatory mechanisms (79 FR 53851). In addition, current information indicates that collection and trade is also impacting the status of the species (NMFS 2023). For each threat to *A. rudis*, the relative importance of the threat to the extinction risk of the species, the observed trend since 2014, and the projected trend in the foreseeable future are provided in Table 6 below.

Ocean warming is the most important threat to the species and has substantially worsened since 2014 (Hughes et al. 2017, Eakin et al. 2019, Skirving et al. 2019). Recent warming-induced bleaching events have resulted in extensive mortality of *Acropora* species within the range of *A. rudis* (e.g., Hughes et al. 2018a,b), likely heavily impacting the species. In addition, since *A. rudis* was listed in 2014, many of the other threats to the species have worsened, including at least ocean acidification, disease and predation (Table 6). All threats except the inadequacy of existing regulatory mechanisms are expected to worsen in the foreseeable future (i.e., between now and 2100; Table 6), as explained in more detail in the RSR (NMFS 2023).

Table 6. Summary of threats evaluation for *A. rudis*.

Threat (ESA listing factor)	**Importance**	**Observed Trend in Effects Since 2014**	**Projected Trend in Effects to 2100**
Ocean Warming (Factor E)	Very High	Substantially worsened	Greatly worsen
Ocean Acidification (Factor E)	High	Worsened	Greatly worsen
Disease (Factor C)	High	Worsened	Substantially worsen
Fishing (Factor A)	Medium	Continued	Substantially worsen
LBSP (Factors A and E)	Low-Medium	Continued	Substantially worsen
Predation (Factor C)	Low-Medium	Worsened	Substantially worsen
Collection and Trade (Factor B)	Low-Medium	Continued	Substantially worsen
Sea-level Rise (Factor E)	Low	No detectable trends	Worsen
Inadequacy of Existing Regulatory Mechanisms (Factor D)	High	Some improvement but still inadequate	Improvement but likely still inadequate

3.6.4. Conclusion

As explained in the 2014 final listing rule (79 FR 53851), a species' vulnerability to extinction results from the combination of its spatial (i.e., distribution) and demographic (i.e., abundance) characteristics, threat susceptibilities, and consideration of the baseline environment and future projections of threats. *Acropora rudis* was listed as threatened in 2014 because of its limited geographic distribution, low abundance, high susceptibility to ocean warming, susceptibilities to ocean acidification, fishing, LBSP, disease, and predation, inadequate regulatory mechanisms, declining baseline conditions, and projected worsening of threats (79 FR 53851).

Since 2014, we have learned that *A. rudis* has: (1) a broader depth distribution (3–30 m instead of 3–15 m); and (2) a higher relative abundance (uncommon instead of rare) than we believed in 2014. That is, *A. rudis* is more broadly distributed and more abundant than we believed in 2014, and thus may have a higher capacity to moderate the effects of the threats (NMFS 2023).

Since 2014, the effects of ocean warming have substantially worsened, and the effects of most other threats have worsened as well. All threats are projected to substantially worsen under current global GHG regulatory mechanisms, which would result in global warming of 2.6–3.4°C above the pre-industrial baseline by 2100 (see Fig. 4 in Section 3.1 of the RSR). Even if the goal of the Paris Agreement is achieved (i.e., limiting global warming to 1.5°C above pre-industrial by 2100), the threats would become much worse than they are currently (Dixon et al. 2022), likely preventing the recovery of *A. rudis*. Current regulatory mechanisms are grossly inadequate, especially GHG management (NMFS 2023).

Overall, the information in the RSR (NMFS 2023) shows that *A. rudis* is more broadly distributed and more abundant than we believed in 2014, but that the threats have worsened and that collection and trade is also an important threat to the species. Especially concerning is that the most important threat to the species, ocean warming, has substantially worsened since the species was listed in 2014. The other important threats to the species, including ocean acidification, disease, fishing, LBSP, predation, and collection and trade have also either worsened or continued since 2014. While there has been some progress with regulatory mechanisms, primarily because of the 2016 Paris Agreement, regulatory mechanisms for both global and local threats are still inadequate. However, the species' distribution is broader and its abundance is greater than we were aware of at the time of listing in 2014, both of which are key factors for moderating threats.

Based on this information, we conclude that *A. rudis* is still likely to become an endangered species in the foreseeable future due to Factors A, B, C, D, and E, but does not appear to be in danger of extinction currently. Thus, no change in status is recommended at this time.

3.6.5. Results

Recommended classification:

_____Downlist to Threatened
_____Uplist to Endangered
_____Delist (Indicate reason for delisting per 50 CFR 424.11):
    _____Extinction
    _____Recovery
    _____Original data for classification in error
__X__No change is needed

New Recovery Priority Number: No Change. The current Recovery Priority Number for *A. rudis* is 3C, based mainly on moderate demographic risk and high understanding of major threats. This 5-

year review does not provide any new information that would justify a change in the Recovery Priority Number.

3.7. *Acropora speciosa*

3.7.1. Distribution

Geographic Distribution. *Acropora speciosa* has a relatively broad distribution, occurring in 33 MEOWs (Fig. 8). The distribution of the species within U.S. waters is summarized below. The current information indicates that *A. speciosa* occurs in three more MEOWs than we were aware of at the time of listing in 2014 (NMFS 2023).

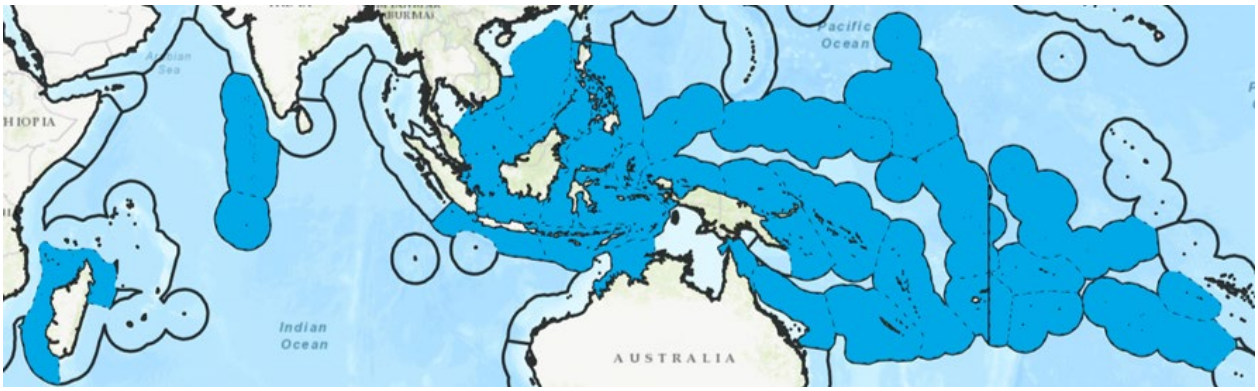

Figure 8. Geographic distribution of *A. speciosa*.

Depth Distribution. *Acropora speciosa* has a depth distribution of 12–65 m, considerably larger than we were aware of at the time of listing in 2014 (12-40 m). In addition, the species occurs on a variety of hard substrates not just walls and steeps slopes with certain characteristics (NMFS 2023).

U.S. Distribution. *Acropora speciosa* occurs on Tutuila in American Samoa but has not been recorded elsewhere within U.S. waters (NMFS 2023).

3.7.2. Abundance

Relative Abundance: Current information indicates that *A. speciosa* has a higher rangewide relative abundance (common) than we were aware of at the time of listing in 2014 (rare to uncommon; NMFS 2023).

Absolute Abundance. Current information indicates that *A. speciosa* has an absolute abundance of at least tens of millions of colonies, the same as we were aware of at the time of listing in 2014 (NMFS 2023).

Abundance Trends. Based on the continued worsening in the most important threats, it is likely that *A. speciosa* is decreasing in overall abundance (i.e., abundance across all the ecoregions that make up its range). This is similar to what we were aware of at the time of listing in 2014 (NMFS 2023).

3.7.3. Threats

The threats that contributed to the listing of *A. speciosa* include ocean warming, ocean acidification, disease, fishing, LBSP, predation, and inadequacy of existing regulatory mechanisms(79 FR 53851). In addition, current information indicates that collection and trade is also impacting the status of the species (NMFS 2023). For each threat to *A. speciosa*, the relative importance of the threat to the extinction risk of the species, the observed trend since 2014, and the projected trend in the foreseeable future are provided in Table 7 below.

Ocean warming is the most important threat to the species and has substantially worsened since 2014 (Hughes et al. 2017, Eakin et al. 2019, Skirving et al. 2019). Recent warming-induced bleaching events have resulted in extensive mortality of *Acropora* species within the range of *A. speciosa* (e.g., Hughes et al. 2018a,b), likely heavily impacting the species. In addition, since *A. speciosa* was listed in 2014, many of the other threats to the species have worsened, including at least ocean acidification, disease and predation (Table 7). All threats except the inadequacy of existing regulatory mechanisms are expected to worsen in the foreseeable future (i.e., between now and 2100; Table 7), as explained in more detail in the RSR (NMFS 2023).

Table 7. Summary of threats evaluation for *A. speciosa*.

Threat (ESA listing factor)	**Importance**	**Observed Trend in Effects Since 2014**	**Projected Trend in Effects to 2100**
Ocean Warming (Factor E)	Very High	Substantially worsened	Greatly worsen
Ocean Acidification (Factor E)	High	Worsened	Greatly worsen
Disease (Factor C)	High	Worsened	Substantially worsen
Fishing (Factor A)	Medium	Continued	Substantially worsen
LBSP (Factors A and E)	Low-Medium	Continued	Substantially worsen
Predation (Factor C)	Low-Medium	Worsened	Substantially worsen
Collection and Trade (Factor B)	Low-Medium	Continued	Substantially worsen
Sea-level Rise (Factor E)	Low	No detectable trends	Worsen
Inadequacy of Existing Regulatory Mechanisms (Factor D)	High	Some improvement but still inadequate	Improvement but likely still inadequate

3.7.4. Conclusion

As explained in the 2014 final listing rule (79 FR 53851), a species' vulnerability to extinction results from the combination of its spatial (i.e., distribution) and demographic (i.e., abundance) characteristics, threat susceptibilities, and consideration of the baseline environment and future projections of threats. *Acropora speciosa* was listed as threatened in 2014 because of its specialized habitat, low abundance, high susceptibility to ocean warming, susceptibilities to ocean acidification, fishing, LBSP, disease, and predation, inadequate regulatory mechanisms, declining baseline conditions, and projected worsening of threats (79 FR 53851).

Since 2014, we have learned that *A. speciosa* has: (1) less specialized habitat (occurs on a variety of hard substrates not just walls and steeps slopes with certain characteristics); (2) a broader depth distribution (12–65 m instead of 12–40 m); and (3) a higher relative abundance (common instead of rare to uncommon) than we believed in 2014. That is, *A. speciosa* has less specialized habitat and is more broadly distributed and more abundant than we believed in 2014, and thus may have a higher capacity to moderate the effects of the threats (NMFS 2023).

Since 2014, the effects of ocean warming have substantially worsened, and the effects most other threats have worsened as well. All threats are projected to substantially worsen under current global GHG regulatory mechanisms, which would result in global warming of 2.6–3.4°C above the pre-industrial baseline by 2100 (see Fig. 4 in Section 3.1 of the RSR). Even if the goal of the Paris

Agreement is achieved (i.e., limiting global warming to 1.5°C above pre-industrial by 2100), the threats would become much worse than they are currently (Dixon et al. 2022), likely preventing the recovery of *A. speciosa*. Current regulatory mechanisms are grossly inadequate, especially GHG management (NMFS 2023).

Overall, the information in the RSR (NMFS 2023) shows that *A. speciosa* is more broadly distributed and more abundant than we believed in 2014, but that the threats have worsened and that collection and trade is also an important threat to the species. Especially concerning is that the most important threat to the species, ocean warming, has substantially worsened since the species was listed in 2014. The other important threats to the species, including ocean acidification, disease, fishing, LBSP, predation, and collection and trade have also either worsened or continued since 2014. While there has been some progress with regulatory mechanisms, primarily because of the 2016 Paris Agreement, regulatory mechanisms for both global and local threats are still inadequate. However, the species' distribution is broader and its abundance is greater than we were aware of at the time of listing in 2014, both of which are key factors for moderating threats.

Based on this information, we conclude that *A. speciosa* is still likely to become an endangered species in the foreseeable future due to Factors A, B, C, D, and E, but does not appear to be in danger of extinction currently. Thus, no change in status is recommended at this time.

3.7.5. Results

Recommended classification:

_____Downlist to Threatened
_____Uplist to Endangered
_____Delist (Indicate reason for delisting per 50 CFR 424.11):
    _____Extinction
    _____Recovery
    _____Original data for classification in error
__X__No change is needed

New Recovery Priority Number: No Change. The current Recovery Priority Number for *A. speciosa* is 3C, based mainly on moderate demographic risk and high understanding of major threats. This 5-year review does not provide any new information that would justify a change in the Recovery Priority Number.

3.8. *Acropora tenella*

3.8.1. Distribution

Geographic Distribution. *Acropora tenella* has a relatively limited geographic distribution, occurring in 23 MEOWs (Fig. 9), none of which are in U.S. waters. The current information indicates that *A. tenella* occurs in five more MEOWs than we were aware of at the time of listing in 2014 (NMFS 2023).

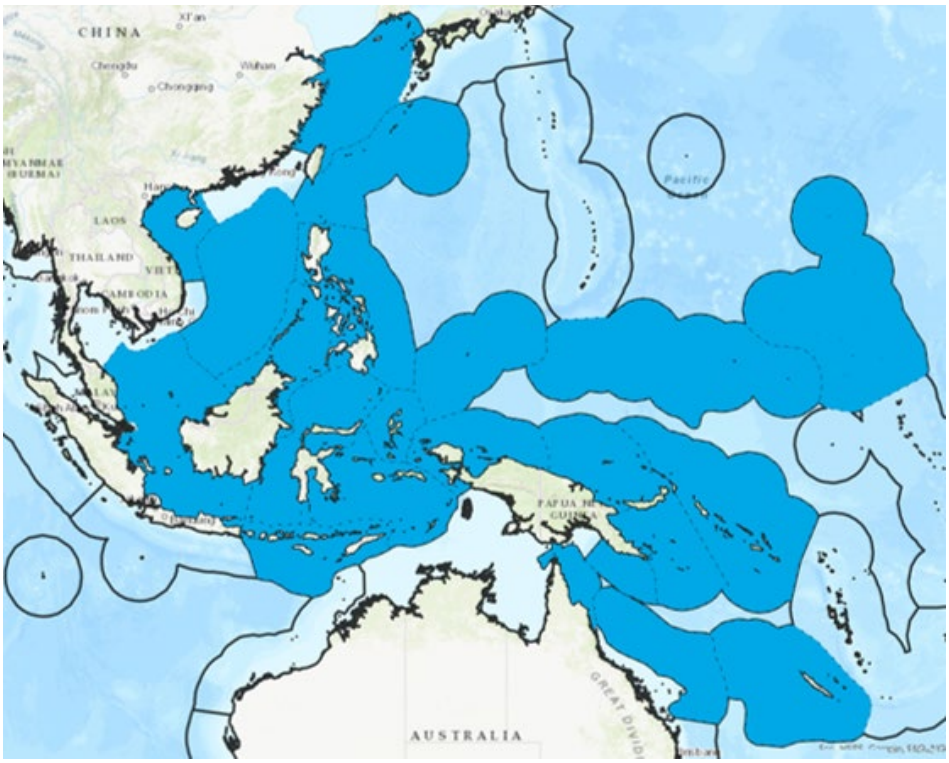

Figure 9. Geographic distribution of *A. tenella*.

Depth Distribution. *Acropora tenella* has a depth distribution of 6–110 m, much greater than we were aware of at the time of listing in 2014 (40–70 m; NMFS 2023).

3.8.2. Abundance

Relative Abundance: Current information indicates that *A. tenella* has a higher relative abundance (uncommon to common) than we were aware of at the time of listing in 2014 (rare; NMFS 2023).

Absolute Abundance. Current information indicates that *A. tenella* has a higher absolute abundance (at least tens of millions of colonies) than we were aware of at the time of listing in 2014 (approximately 5.2 million colonies; NMFS 2023).

Abundance Trends. Based on the continued worsening in the most important threats, it is likely that *A. tenella* is decreasing in overall abundance (i.e., abundance across all the ecoregions that make up its range). This is similar to what we were aware of at the time of listing in 2014 (NMFS 2023).

3.8.3. Threats

The threats that contributed to the listing of *A. tenella* include ocean warming, ocean acidification, disease, fishing, LBSP, predation, and inadequacy of existing regulatory mechanisms (79 FR 53851). In addition, current information indicates that collection and trade is also impacting the status of the species (NMFS 2023). For each threat to *A. tenella*, the relative importance of the threat to the extinction risk of the species, the observed trend since 2014, and the projected trend in the foreseeable future are provided in Table 8 below.

Ocean warming is the most important threat to the species and has substantially worsened since 2014 (Hughes et al. 2017, Eakin et al. 2019, Skirving et al. 2019). Recent warming-induced bleaching events have resulted in extensive mortality of *Acropora* species within the range of *A. tenella* (e.g., Hughes et al. 2018a,b), likely heavily impacting the species. In addition, since *A. tenella* was listed in 2014, many of the other threats to the species have worsened, including at least ocean

acidification, disease and predation (Table 8). All threats except the inadequacy of existing regulatory mechanisms are expected to worsen in the foreseeable future (i.e., between now and 2100; Table 8), as explained in more detail in the RSR (NMFS 2023).

Table 8. Summary of threats evaluation for *A. tenella*.

Threat (ESA listing factor)	Importance	Observed Trend in Effects Since 2014	Projected Trend in Effects to 2100
Ocean Warming (Factor E)	Very High	Substantially worsened	Greatly worsen
Ocean Acidification (Factor E)	High	Worsened	Greatly worsen
Disease (Factor C)	High	Worsened	Substantially worsen
Fishing (Factor A)	Medium	Continued	Substantially worsen
LBSP (Factors A and E)	Low-Medium	Continued	Substantially worsen
Predation (Factor C)	Low-Medium	Worsened	Substantially worsen
Collection and Trade (Factor B)	Low-Medium	Continued	Substantially worsen
Sea-level Rise (Factor E)	Low	No detectable trends	Worsen
Inadequacy of Existing Regulatory Mechanisms (Factor D)	High	Some improvement but still inadequate	Improvement but likely still inadequate

3.8.4. Conclusion

As explained in the 2014 final listing rule (79 FR 53851), a species' vulnerability to extinction results from the combination of its spatial (i.e., distribution) and demographic (i.e., abundance) characteristics, threat susceptibilities, and consideration of the baseline environment and future projections of threats. *Acropora tenella* was listed as threatened in 2014 because of its limited geographic distribution, low abundance, high susceptibility to ocean warming, susceptibilities to ocean acidification, fishing, LBSP, disease, and predation, inadequate regulatory mechanisms, declining baseline conditions, and projected worsening of threats (79 FR 53851).

Since 2014, we have learned that *A. tenella* has: (1) a broader geographic distribution (23 MEOWs instead of 18); (2) a much broader depth range (6–110 m instead of 40–70 m); (3) higher relative abundance (uncommon to common instead of rare); and (4) higher absolute abundance (at least tens of millions of colonies instead of approximately 5.2 million colonies) than we believed in 2014. That is, *A. tenella* is more broadly distributed and more abundant than we believed in 2014, and thus may have a higher capacity to moderate the effects of the threats (NMFS 2023).

Since 2014, the effects of ocean warming have substantially worsened, and the effects of most other threats have worsened as well. All threats are projected to substantially worsen under current global GHG regulatory mechanisms, which would result in global warming of 2.6–3.4°C above the pre-industrial baseline by 2100 (see Fig. 4 in Section 3.1 of the RSR). Even if the goal of the Paris Agreement is achieved (i.e., limiting global warming to 1.5°C above pre-industrial by 2100), the threats would become much worse than they are currently (Dixon et al. 2022), likely preventing the recovery of *A. tenella*. Current regulatory mechanisms are grossly inadequate, especially GHG management (NMFS 2023).

Overall, the information in the RSR (NMFS 2023) shows that *A. tenella* is more broadly distributed and more abundant than we believed in 2014, but that the threats have worsened and that collection and trade is also an important threat to the species. Especially concerning is that the most important threat to the species, ocean warming, has substantially worsened since the species was listed in 2014. The other important threats to the species, including ocean acidification, disease, fishing, LBSP, predation, and collection and trade have also either worsened or continued since 2014. While there has been some progress with regulatory mechanisms, primarily because of the 2016 Paris Agreement, regulatory mechanisms for both global and local threats are still inadequate. However, the species' distribution is broader and its abundance is greater than we were aware of at the time of listing in 2014, both of which are key factors for moderating threats.

Based on this information, we conclude that *A. tenella* is still likely to become an endangered species in the foreseeable future due to Factors A, B, C, D, and E, but does not appear to be in danger of extinction currently. Thus, no change in status is recommended at this time.

3.8.5. Results

Recommended classification:

_____Downlist to Threatened
_____Uplist to Endangered
_____Delist (Indicate reason for delisting per 50 CFR 424.11):
    _____Extinction
    _____Recovery
    _____Original data for classification in error
__X__No change is needed

New Recovery Priority Number: No Change. The current Recovery Priority Number for *A. tenella* is 3C, based mainly on moderate demographic risk and high understanding of major threats. This 5-year review does not provide any new information that would justify a change in the Recovery Priority Number.

3.9. *Anacropora spinosa*

3.9.1. Distribution

Geographic Distribution. *Anacropora spinosa* has a relatively limited distribution, occurring in 17 MEOWs (Fig. 10), none of which are in U.S. waters. The current information indicates that *A. spinosa* occurs in one more MEOW than we were aware of at the time of listing in 2014 (NMFS 2023).

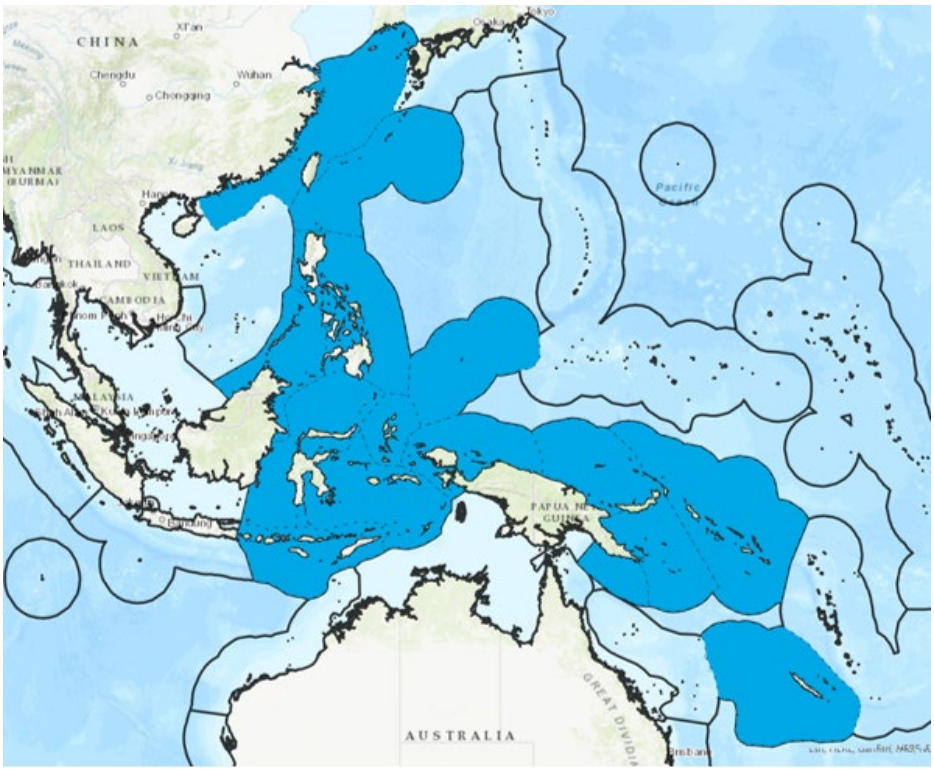

Figure 10. Geographic distribution of *A. spinosa*.

Depth Distribution. *Acropora spinosa* has a depth distribution of 5-15 m, the same as we were aware of at the time of listing in 2014 (NMFS 2023).

3.9.2. Abundance

Relative Abundance: Current information indicates that *A. spinosa* has a rangewide relative abundance of uncommon, the same as we were aware of at the time of listing in 2014 (NMFS 2023).

Absolute Abundance. Current information indicates that *A. spinosa* has a higher absolute abundance (at least millions of colonies), the same as we were aware of at the time of listing in 2014 (NMFS 2023).

Abundance Trends. Based on the continued worsening of the most important threats, it is likely that *A. spinosa* is decreasing in overall abundance (i.e., abundance across all the ecoregions that make up its range). This is similar to what we were aware of at the time of listing in 2014 (NMFS 2023).

3.9.3. Threats

The threats that contributed to the listing of *A. spinosa* include ocean warming, ocean acidification, disease, fishing, LBSP, predation, and inadequacy of existing regulatory mechanisms (79 FR 53851). In addition, current information indicates that collection and trade is also impacting the status of the species (NMFS 2023). For each threat to *A. spinosa*, the relative importance of the threat to the extinction risk of the species, the observed trend since 2014, and the projected trend in the foreseeable future are provided in Table 9 below.

Ocean warming is the most important threat to the species and has substantially worsened since 2014 (Hughes 2017, Eakin et al. 2019, Skirving et al. 2019). In response to warming events in 2016 and 2020, *Anacropora* corals were among the most susceptible to bleaching of all corals (Muir et al. 2017, Nolan et al. 2021), likely heavily impacting *A. spinosa*. In addition, since *A. spinosa* was listed

in 2014, many of the other threats to the species have worsened, including at least ocean acidification, disease and predation (Table 9). All threats except the inadequacy of existing regulatory mechanisms are expected to worsen in the foreseeable future (i.e., between now and 2100; Table 9), as explained in more detail in the RSR (NMFS 2023).

Table 9. Summary of threats evaluation for *A. spinosa*.

Threat (ESA listing factor)	**Importance**	**Observed Trend in Effects Since 2014**	**Projected Trend in Effects to 2100**
Ocean Warming (Factor E)	Very High	Substantially worsened	Greatly worsen
Ocean Acidification (Factor E)	High	Worsened	Greatly worsen
Disease (Factor C)	High	Worsened	Substantially worsen
Fishing (Factor A)	Medium	Continued	Substantially worsen
LBSP (Factors A and E)	Low-Medium	Continued	Substantially worsen
Predation (Factor C)	Low-Medium	Worsened	Substantially worsen
Collection and Trade (Factor B)	Low-Medium	Continued	Substantially worsen
Sea-level Rise (Factor E)	Low	No detectable trends	Worsen
Inadequacy of Existing Regulatory Mechanisms (Factor D)	High	Some improvement but still inadequate	Improvement but likely still inadequate

3.9.4. Conclusion

As explained in the 2014 final listing rule (79 FR 53851), a species' vulnerability to extinction results from the combination of its spatial (i.e., distribution) and demographic (i.e., abundance) characteristics, threat susceptibilities, and consideration of the baseline environment and future projections of threats. *Anacropora spinosa* was listed as threatened in 2014 because of its limited geographic distribution largely restricted to the Coral Triangle region, susceptibilities to ocean warming, ocean acidification, fishing, LBSP, disease, and predation, inadequate regulatory mechanisms, declining baseline conditions, and projected worsening of threats (79 FR 53851).

Since 2014, we have learned that *A. spinosa* has a broader geographic distribution (17 MEOWs instead of 16) than reported in the 2014 final listing rule. While its geographic distribution is only one MEOW greater, the addition of that MEOW (New Caledonia) means that its geographic distribution extends much farther to the southeast and includes over 100 more islands and extensive coral reefs than previously believed. That is, *A. spinosa* is more broadly distributed than we believed in 2014, and thus may have a higher capacity to moderate the effects of the threats (NMFS 2023).

Since 2014, the effects of ocean warming have substantially worsened, and the effects of most other threats have worsened as well. All threats are projected to substantially worsen under current global GHG regulatory mechanisms, which would result in global warming of 2.6–3.4°C above the pre-industrial baseline by 2100 (see Fig. 4 in Section 3.1 of the RSR). Even if the goal of the Paris Agreement is achieved (i.e., limiting global warming to 1.5°C above pre-industrial by 2100), the threats would become much worse than they are currently (Dixon et al. 2022), likely preventing the

recovery of *A. spinosa*. Current regulatory mechanisms are grossly inadequate, especially GHG management (NMFS 2023).

Overall, the information in the RSR (NMFS 2023) shows that *A. spinosa* is more broadly distributed than we believed in 2014, but that the threats have worsened and that collection and trade is also an important threat to the species. Especially concerning is that the most important threat to the species, ocean warming, has substantially worsened since the species was listed in 2014. The other important threats to the species, including ocean acidification, disease, fishing, LBSP, predation, and collection and trade have also either worsened or continued since 2014. While there has been some progress with regulatory mechanisms, primarily because of the 2016 Paris Agreement, regulatory mechanisms for both global and local threats are still inadequate. However, the species' distribution is broader than we were aware of at the time of listing in 2014, which is a key factor for moderating threats.

Based on this information, we conclude that *A. spinosa* is still likely to become an endangered species in the foreseeable future due to Factors A, B, C, D, and E, but does not appear to be in danger of extinction currently. Thus, no change in status is recommended at this time.

3.9.5. Results

Recommended classification:

_____Downlist to Threatened
_____Uplist to Endangered
_____Delist (Indicate reason for delisting per 50 CFR 424.11):
    _____Extinction
    _____Recovery
    _____Original data for classification in error
__X__No change is needed

New Recovery Priority Number: No Change. The current Recovery Priority Number for *A. spinosa* is 3C, based mainly on moderate demographic risk and high understanding of major threats. This 5-year review does not provide any new information that would justify a change in the Recovery Priority Number.

3.10. *Fimbriaphyllia paradivisa*

This species was listed as *Euphyllia paradivisa* in 2014 (79 FR 53851). Since then, Luzon et al. (2017) elevated *Fimbriaphyllia* from a subgenus to replace the *Euphyllia* genus, based on genetics results, thus changing *Euphyllia paradivisa* to *Fimbriaphyllia paradivisa*, which is accepted by WoRMS (Hoeksma and Cairns 2021).

3.10.1. Distribution

Geographic Distribution. *Fimbriaphyllia paradivisa* occurs in 24 MEOWs (Fig. 11). The distribution of the species within U.S. waters is summarized below. The current information indicates that *F. paradivisa* occurs in nine more MEOWs than we were aware of at the time of listing in 2014 (NMFS 2023).

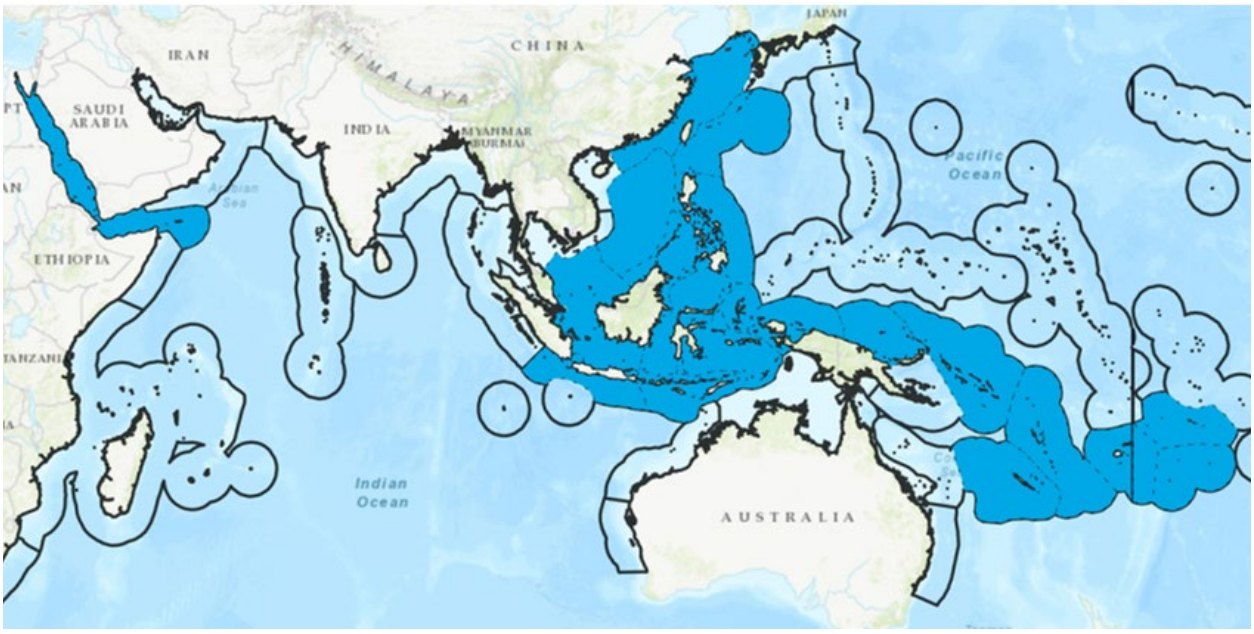

Figure 11. Geographic distribution of *F. paradivisa*.

Depth Distribution. *Fimbriaphyllia paradivisa* has a depth distribution of 5–75 m, much greater than we were aware of at the time of listing in 2014 (5–20 m; NMFS 2023).

U.S. Distribution. *Fimbriaphyllia paradivisa* occurs on Tutuila in American Samoa but has not been recorded elsewhere within U.S. waters (NMFS 2023).

3.10.2. Abundance

Relative Abundance: Current information indicates that *F. paradivisa* has a higher relative abundance (uncommon) than we were aware of at the time of listing in 2014 (rare; NMFS 2023).

Absolute Abundance. Current information indicates that *F. paradivisa* has a higher absolute abundance (at least hundreds of millions of colonies) than we were aware of at the time of listing in 2014 (at least tens of millions; NMFS 2023).

Abundance Trends. Based on the continued worsening of the most important threats, it is likely that *F. paradivisa* is decreasing in overall abundance (i.e., abundance across all the ecoregions that make up its range). This is similar to what we were aware of at the time of listing in 2014 (NMFS 2023).

3.10.3. Threats

The threats that contributed to the listing of *F. paradivisa* include ocean warming, ocean acidification, disease, fishing, LBSP, predation, collection and trade, and inadequacy of existing regulatory mechanisms (79 FR 53851). For each threat to *F. paradivisa*, the relative importance of the threat to the extinction risk of the species, the observed trend since 2014, and the projected trend in the foreseeable future are provided in Table 10 below.

Ocean warming is the most important threat to the species and has substantially worsened since 2014 (Hughes 2017, Eakin et al. 2019, Skirving et al. 2019). *Fimbriaphyllia* corals have been heavily bleached by past warming events (79 FR 53851), and Pratchett et al. (2020) found that *F. glabrescens* had moderate bleaching susceptibility to elevated seawater temperature. In addition, since *F. paradivisa* was listed in 2014, many of the other threats to the species have worsened, including at least ocean acidification, disease and predation (Table 10). However, recent information indicates that *F. paradivisa* may have lower susceptibilities to ocean warming (Eyal et

al. 2016) and LBSP (Fujii et al. 2020, Sinniger and Harii 2018) than we were aware of at the time of listing in 2014. In any case, all threats except the inadequacy of existing regulatory mechanisms are expected to worsen in the foreseeable future (i.e., between now and 2100; Table 10), as explained in more detail in the RSR (NMFS 2023).

Table 10. Summary of threats evaluation for *F. paradivisa*.

Threat (ESA listing factor)	**Importance**	**Observed Trend in Effects Since 2014**	**Projected Trend in Effects to 2100**
Ocean Warming (Factor E)	Very High	Substantially worsened	Greatly worsen
Ocean Acidification (Factor E)	High	Worsened	Greatly worsen
Disease (Factor C)	High	Worsened	Substantially worsen
Fishing (Factor A)	Medium	Continued	Substantially worsen
LBSP (Factors A and E)	Low	Continued	Substantially worsen
Predation (Factor C)	Low-Medium	Worsened	Substantially worsen
Collection and Trade (Factor B)	Low-Medium	Continued	Substantially worsen
Sea-level Rise (Factor E)	Low	No detectable trends	Worsen
Inadequacy of Existing Regulatory Mechanisms (Factor D)	High	Some improvement but still inadequate	Improvement but likely still inadequate

3.10.4. Conclusion

As explained in the 2014 final listing rule (79 FR 53851), a species' vulnerability to extinction results from the combination of its spatial (i.e., distribution) and demographic (i.e., abundance) characteristics, threat susceptibilities, and consideration of the baseline environment and future projections of threats. *Fimbriaphyllia paradivisa* was listed as threatened in 2014 (as *Euphyllia paradivisa*) because of its limited geographic distribution largely restricted to the Coral Triangle, low abundance, susceptibilities to ocean warming, ocean acidification, fishing, LBSP, disease, predation, and collection and trade, inadequate regulatory mechanisms, declining baseline conditions, and projected worsening of threats (79 FR 53851).

Since 2014, we have learned that *F. paradivisa* has: (1) a much broader geographic distribution (24 MEOWs instead of 15); (2) a much broader depth range (5–75 m instead of 5–20 m); (3) higher overall relative abundance (uncommon instead of rare); and (4) higher absolute abundance (at least hundreds of millions of colonies instead of at least tens of millions) than we believed in 2014. That is, *F. paradivisa* is more broadly distributed and more abundant than we believed in 2014, and thus may have a higher capacity to moderate the effects of the threats (NMFS 2023).

Since 2014, the effects of most threats have worsened. All threats are projected to substantially worsen under current global GHG regulatory mechanisms, which would result in global warming of 2.6–3.4°C above the pre-industrial baseline by 2100 (see Fig. 4 in Section 3.1 of the RSR). Even if the goal of the Paris Agreement is achieved (i.e., limiting global warming to 1.5°C above pre-industrial by 2100), the threats would become much worse than they are currently (Dixon et al. 2022), potentially preventing the recovery of *F. paradivisa*. Current regulatory mechanisms are grossly inadequate, especially GHG management (NMFS 2023).

Overall, the information in the RSR (NMFS 2023) shows that *F. paradivisa* is much more broadly distributed and more abundant than we believed in 2014, but that the threats have worsened. Especially concerning is that the most important threat to the species, ocean warming, has substantially worsened since the species was listed in 2014. The other important threats to the species, including ocean acidification, disease, fishing, predation, and collection and trade have also either worsened or continued since 2014. While there has been some progress with regulatory mechanisms, primarily because of the 2016 Paris Agreement, regulatory mechanisms for both global and local threats are still inadequate. However, the species' distribution is much broader and its abundance is greater than we were aware of at the time of listing in 2014, both of which are key factors for moderating threats.

Based on this information, we conclude that *F. paradivisa* is still likely to become an endangered species in the foreseeable future due to Factors A, B, C, D, and E, but does not appear to be in danger of extinction currently. Thus, no change in status is recommended at this time.

3.10.5. Results

Recommended classification:

_____Downlist to Threatened
_____Uplist to Endangered
_____Delist (Indicate reason for delisting per 50 CFR 424.11):
    _____Extinction
    _____Recovery
    _____Original data for classification in error
__X__No change is needed

New Recovery Priority Number: No Change. The current Recovery Priority Number for *F. paradivisa* is 3C, based mainly on moderate demographic risk and high understanding of major threats. This 5-year review does not provide any new information that would justify a change in the Recovery Priority Number.

3.11. *Isopora crateriformis*

3.11.1. Distribution

Geographic Distribution. *Isopora crateriformis* has a relatively limited geographic distribution, occurring in 27 MEOWs (Fig. 12). The distribution of the species within U.S. waters is summarized below. The current information indicates that *I. crateriformis* occurs in one more MEOW than we were aware of at the time of listing in 2014 (NMFS 2023).

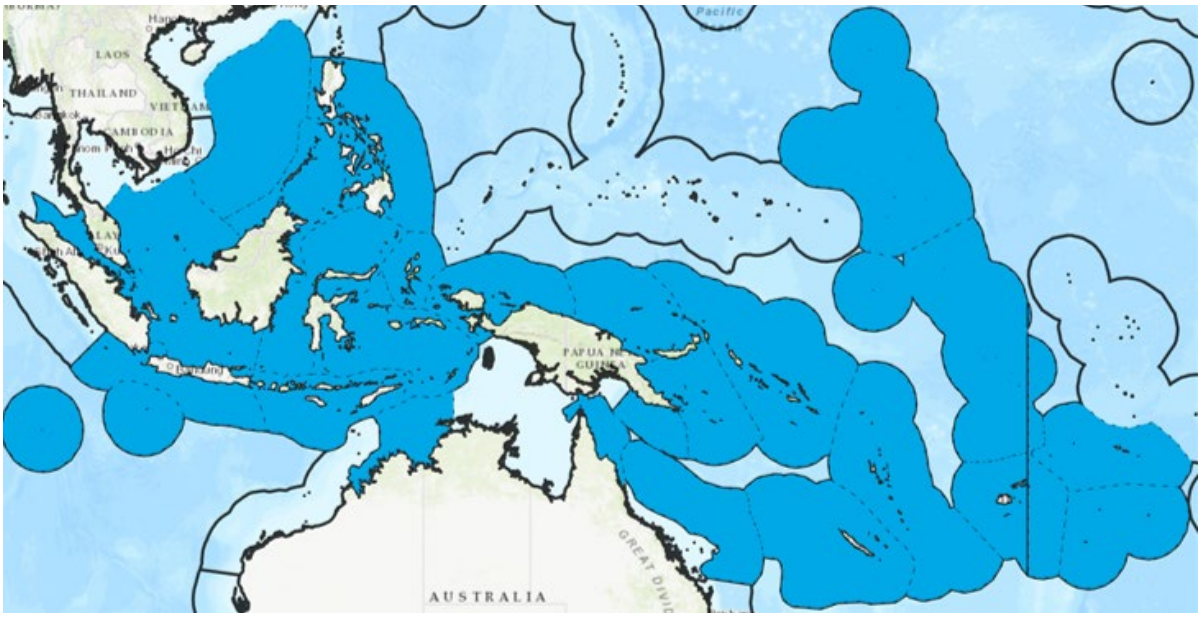

Figure 12. Geographic distribution of *I. crateriformis*.

Depth Distribution. *Isopora crateriformis* has a depth distribution of 0–25 m, approximately twice as large as we were aware of at the time of listing in 2014 (0–12 m; NMFS 2023).

U.S. Distribution. *Isopora crateriformis* occurs on Tutuila, Ofu, Olosega and Ta'u in American Samoa (NMFS 2023).

3.11.2. Abundance

Relative Abundance: Current information indicates that *I. crateriformis* has a higher relative abundance (uncommon to common) than we were aware of at the time of listing in 2014 (rare; NMFS 2023).

Absolute Abundance. Current information indicates that *I. crateriformis* has a higher absolute abundance (at least tens of millions of colonies) than we were aware of at the time of listing in 2014 (at least millions; NMFS 2023).

Abundance Trends. Based on the continued worsening of the most important threats, it is likely that *I. crateriformis* is decreasing in overall abundance (i.e., abundance across all the ecoregions that make up its range). This is similar to what we were aware of at the time of listing in 2014 (NMFS 2023).

3.11.3. Threats

The threats that contributed to the listing of *I. crateriformis* include ocean warming, ocean acidification, disease, fishing, LBSP, predation, and inadequacy of existing regulatory mechanisms (79 FR 53851). In addition, current information indicates that collection and trade is also impacting the status of the species (NMFS 2023). For each threat to *I. crateriformis*, the relative importance of the threat to the extinction risk of the species, the observed trend since 2014, and the projected trend in the foreseeable future are provided in Table 11 below.

Ocean warming is the most important threat to the species and has substantially worsened since 2014 (Hughes 2017, Eakin et al. 2019, Skirving et al. 2019). In response to the 2014–2017 series of warming-induced bleaching events, *Isopora* corals were generally among the most impacted coral taxa in different locations around the Indo-Pacific (e.g., Frade et al 2018, Hughes et al 2018a,

Gilmour et al. 2022). In a study of the changes in the GBR's coral communities, which is within *I. crateriformis*'s range, between 1995/96 and 2016/17, Dietzel et al. (2020) found that *Isopora* species declined by 38.5% on the reef crest and 52.5% on the reef slope (6–7 m depth). In addition, since *I. crateriformis* was listed in 2014, many of the other threats to the species have worsened, including at least ocean acidification, disease and predation (Table 11). All threats except the inadequacy of existing regulatory mechanisms are expected to worsen in the foreseeable future (i.e., between now and 2100; Table 11), as explained in more detail in the RSR (NMFS 2023).

Table 11. Summary of threats evaluation for *I. crateriformis*.

Threat (ESA listing factor)	**Importance**	**Observed Trend in Effects Since 2014**	**Projected Trend in Effects to 2100**
Ocean Warming (Factor E)	Very High	Substantially worsened	Greatly worsen
Ocean Acidification (Factor E)	High	Worsened	Greatly worsen
Disease (Factor C)	High	Worsened	Substantially worsen
Fishing (Factor A)	Medium	Continued	Substantially worsen
LBSP (Factors A and E)	Low-Medium	Continued	Substantially worsen
Predation (Factor C)	Low-Medium	Worsened	Substantially worsen
Collection and Trade (Factor B)	Low-Medium	Continued	Substantially worsen
Sea-level Rise (Factor E)	Low	No detectable trends	Worsen
Inadequacy of Existing Regulatory Mechanisms (Factor D)	High	Some improvement but still inadequate	Improvement but likely still inadequate

3.11.4. Conclusion

As explained in the 2014 final listing rule (79 FR 53851), a species' vulnerability to extinction results from the combination of its spatial (i.e., distribution) and demographic (i.e., abundance) characteristics, threat susceptibilities, and consideration of the baseline environment and future projections of threats. *Isopora crateriformis* was listed as threatened in 2014 because of its limited geographic distribution largely restricted to the Coral Triangle and western equatorial Pacific, low abundance, high susceptibility to ocean warming, susceptibilities to ocean acidification, fishing, LBSP, disease, and predation, inadequate regulatory mechanisms, declining baseline conditions, and projected worsening of threats (79 FR 53851).

Since 2014, we have learned that *I. crateriformis* has: (1) a broader geographic distribution (27 MEOWs instead of 26); (2) a broader depth range (0–25 m instead of 0–12 m); (3) higher relative abundance (uncommon to common instead of rare); and (4) higher absolute abundance (at least tens of millions of colonies instead of at least millions of colonies). That is, *I. crateriformis* is more broadly distributed and more abundant than we believed in 2014, and thus may have a higher capacity to moderate the effects of the threats (NMFS 2023).

Since 2014, the effects of ocean warming have substantially worsened, and the effects of most other threats have worsened as well. All threats are projected to substantially worsen under current global GHG regulatory mechanisms, which would result in global warming of 2.6–3.4°C above the pre-industrial baseline by 2100 (see Fig. 4 in Section 3.1 in the RSR). Even if the goal of the Paris

Agreement is achieved (i.e., limiting global warming to 1.5°C above pre-industrial by 2100), the threats would become much worse than they are currently (Dixon et al. 2022), likely preventing the recovery of *I. crateriformis*. Current regulatory mechanisms are grossly inadequate, especially GHG management (NMFS 2023).

Overall, the information in the RSR (NMFS 2023) shows that *I. crateriformis* is more broadly distributed and more abundant than we believed in 2014, but that the threats have worsened and that collection and trade is also an important threat to the species. Especially concerning is that the most important threat to the species, ocean warming, has substantially worsened since the species was listed in 2014. The other important threats to the species, including ocean acidification, disease, fishing, LBSP, predation, and collection and trade have also either worsened or continued since 2014. While there has been some progress with regulatory mechanisms, primarily because of the 2016 Paris Agreement, regulatory mechanisms for both global and local threats are still inadequate. However, the species' distribution is broader and its abundance is greater than we were aware of at the time of listing in 2014, both of which are key factors for moderating threats.

Based on this information, we conclude that *I. crateriformis* is still likely to become an endangered species in the foreseeable future due to Factors A, B, C, D, and E, but does not appear to be in danger of extinction currently. Thus, no change in status is recommended at this time.

3.11.5. Results

Recommended classification:

_____Downlist to Threatened
_____Uplist to Endangered
_____Delist (Indicate reason for delisting per 50 CFR 424.11):
    _____Extinction
    _____Recovery
    _____Original data for classification in error
__X__No change is needed

New Recovery Priority Number: No Change. The current Recovery Priority Number for *I. crateriformis* is 3C, based mainly on moderate demographic risk and high understanding of major threats. This 5-year review does not provide any new information that would justify a change in the Recovery Priority Number.

3.12. *Montipora australiensis*

3.12.1. Distribution

Geographic Distribution. *Montipora australiensis* has a relatively broad distribution, occurring in 36 MEOWs (Fig. 13), none of which are in U.S. waters. This is the same as what we were aware of at the time of listing in 2014 (NMFS 2023).

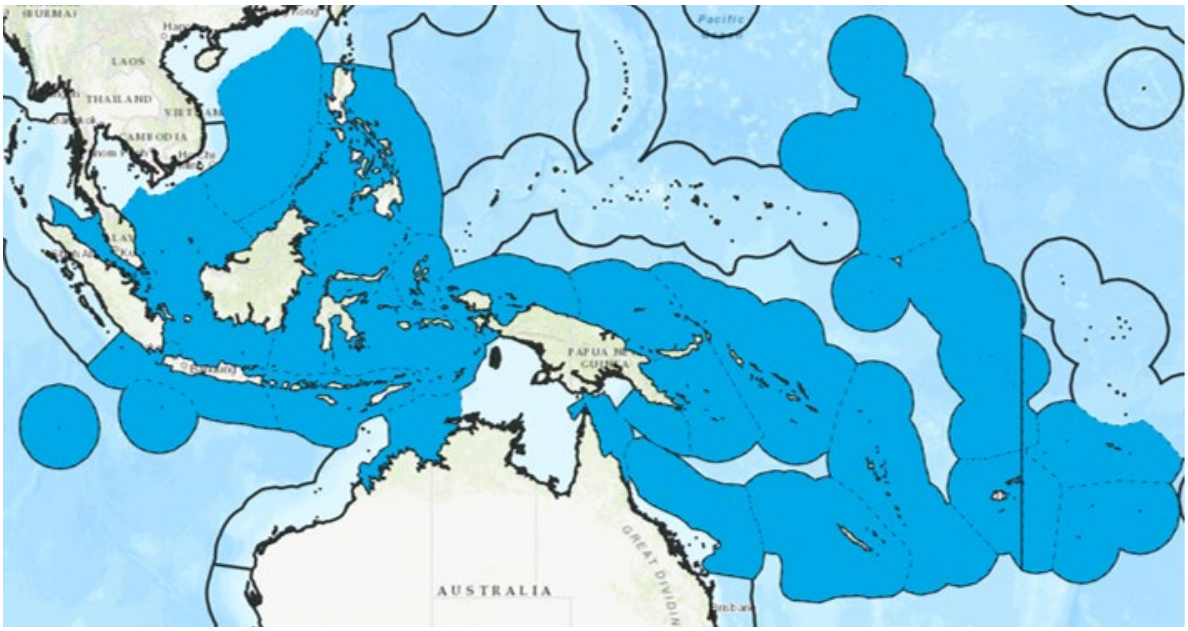

Figure 13. Geographic distribution of *M. australiensis*.

Depth Distribution. *Montipora australiensis* has a depth distribution of 2–30 m, the same as we were aware of at the time of listing in 2014 (NMFS 2023).

3.12.2. Abundance

Relative Abundance: Current information indicates that *M. australiensis* has a higher relative abundance (rare to uncommon) than we were aware of at the time of listing in 2014 (rare; NMFS 2023).

Absolute Abundance. Current information indicates that *M. australiensis* has a higher absolute abundance (at least tens of millions of colonies) than we were aware of at the time of listing in 2014 (at least millions; NMFS 2023).

Abundance Trends. Based on the continued worsening of the most important threats, it is likely that *M. australiensis* is decreasing in overall abundance (i.e., abundance across all the ecoregions that make up its range). This is similar to what we were aware of at the time of listing in 2014 (NMFS 2023).

3.12.3. Threats

The threats that contributed to the listing of *M. australiensis* include ocean warming, ocean acidification, disease, fishing, LBSP, predation, and inadequacy of existing regulatory mechanisms (79 FR 53851). In addition, current information indicates that collection and trade is also impacting the status of the species (NMFS 2023). For each threat to *M. australiensis*, the relative importance of the threat to the extinction risk of the species, the observed trend since 2014, and the projected trend in the foreseeable future are provided in Table 12 below.

Ocean warming is the most important threat to the species and has substantially worsened since 2014 (Hughes 2017, Eakin et al. 2019, Skirving et al. 2019). In response to the 2014–2017 series of warming-induced bleaching events, *Montipora* corals were generally among the most impacted coral taxa in different locations around the Indo-Pacific (e.g., Frade et al 2018, Fox et al. 2019, McClanahan et al. 2020, Gilmour et al. 2022). In a study of the changes in the GBR's coral communities, which is within *M. australiensis*'s range, between 1995/96 and 2016/17, Dietzel et al.

(2020) found that *Montipora* species declined by 72.1% on the reef crest and 35.3% on the reef slope (6–7 m depth). In addition, since *M. australiensis* was listed in 2014, many of the other threats to the species have worsened, including at least ocean acidification, disease and predation (Table 12). All threats except the inadequacy of existing regulatory mechanisms are expected to worsen in the foreseeable future (i.e., between now and 2100; Table 12), as explained in more detail in the RSR (NMFS 2023).

Table 12. Summary of threats evaluation for *M. australiensis*.

Threat (ESA listing factor)	Importance	Observed Trend in Effects Since 2014	Projected Trend in Effects to 2100
Ocean Warming (Factor E)	Very High	Substantially worsened	Greatly worsen
Ocean Acidification (Factor E)	High	Worsened	Greatly worsen
Disease (Factor C)	High	Worsened	Substantially worsen
Fishing (Factor A)	Medium	Continued	Substantially worsen
LBSP (Factors A and E)	Low-Medium	Continued	Substantially worsen
Predation (Factor C)	Low-Medium	Worsened	Substantially worsen
Collection and Trade (Factor B)	Low-Medium	Continued	Substantially worsen
Sea-level Rise (Factor E)	Low	No detectable trends	Worsen
Inadequacy of Existing Regulatory Mechanisms (Factor D)	High	Some improvement but still inadequate	Improvement but likely still inadequate

3.12.4. Conclusion

As explained in the 2014 final listing rule (79 FR 53851), a species' vulnerability to extinction results from the combination of its spatial (i.e., distribution) and demographic (i.e., abundance) characteristics, threat susceptibilities, and consideration of the baseline environment and future projections of threats. *Montipora australiensis* was listed as threatened in 2014 because of its geographic distribution restricted to parts of the Coral Triangle and western Indian Ocean, low abundance, high susceptibility to ocean warming, susceptibilities to ocean acidification, fishing, LBSP, disease, and predation, inadequate regulatory mechanisms, declining baseline conditions, and projected worsening of threats (79 FR 53851).

Since 2014, we have learned that *M. australiensis* has: (1) higher relative abundance (rare to uncommon instead of rare); and (2) higher absolute abundance (at least tens of millions of colonies instead of at least millions of colonies). That is, *M. australiensis* is more abundant than we believed in 2014, and thus may have a higher capacity to moderate the effects of the threats (NMFS 2023).

Since 2014, the effects of ocean warming have substantially worsened, and the effects of most other threats have worsened as well. All threats are projected to substantially worsen under current global GHG regulatory mechanisms, which would result in global warming of 2.6–3.4°C above the pre-industrial baseline by 2100 (see Fig. 4 in Section 3.1 in the RSR). Even if the goal of the Paris Agreement is achieved (i.e., limiting global warming to 1.5°C above pre-industrial by 2100), the threats would become much worse than they are currently (Dixon et al. 2022), likely preventing the

recovery of *M. australiensis*. Current regulatory mechanisms are grossly inadequate, especially GHG management (NMFS 2023).

Overall, the information in the RSR (NMFS 2023) shows that *M. australiensis* is more abundant than we believed in 2014, but that the threats have worsened and that collection and trade is also an important threat to the species. Especially concerning is that the most important threat to the species, ocean warming, has substantially worsened since the species was listed in 2014. The other important threats to the species, including ocean acidification, disease, fishing, LBSP, predation, and collection and trade have also either worsened or continued since 2014. While there has been some progress with regulatory mechanisms, primarily because of the 2016 Paris Agreement, regulatory mechanisms for both global and local threats are still inadequate. However, the species' abundance is higher than we were aware of at the time of listing in 2014, which is a key factor for moderating threats.

Based on this information, we conclude that *M. australiensis* is still likely to become an endangered species in the foreseeable future due to Factors A, B, C, D, and E, but does not appear to be in danger of extinction currently. Thus, no change in status is recommended at this time.

3.12.5. Results

Recommended classification:

_____Downlist to Threatened
_____Uplist to Endangered
_____Delist (Indicate reason for delisting per 50 CFR 424.11):
    _____Extinction
    _____Recovery
    _____Original data for classification in error
__X__No change is needed

New Recovery Priority Number: No Change. The current Recovery Priority Number for *M. australiensis* is 3C, based mainly on moderate demographic risk and high understanding of major threats. This 5-year review does not provide any new information that would justify a change in the Recovery Priority Number.

3.13. *Pavona diffluens*

3.13.1. Distribution

Geographic Distribution. *Pavona diffluens* has a limited geographic distribution, occurring in only nine MEOWs (Fig. 14), none of which are in U.S. waters. The current information indicates that *P. diffluens* occurs in one more MEOW than we were aware of at the time of listing in 2014 (NMFS 2023).

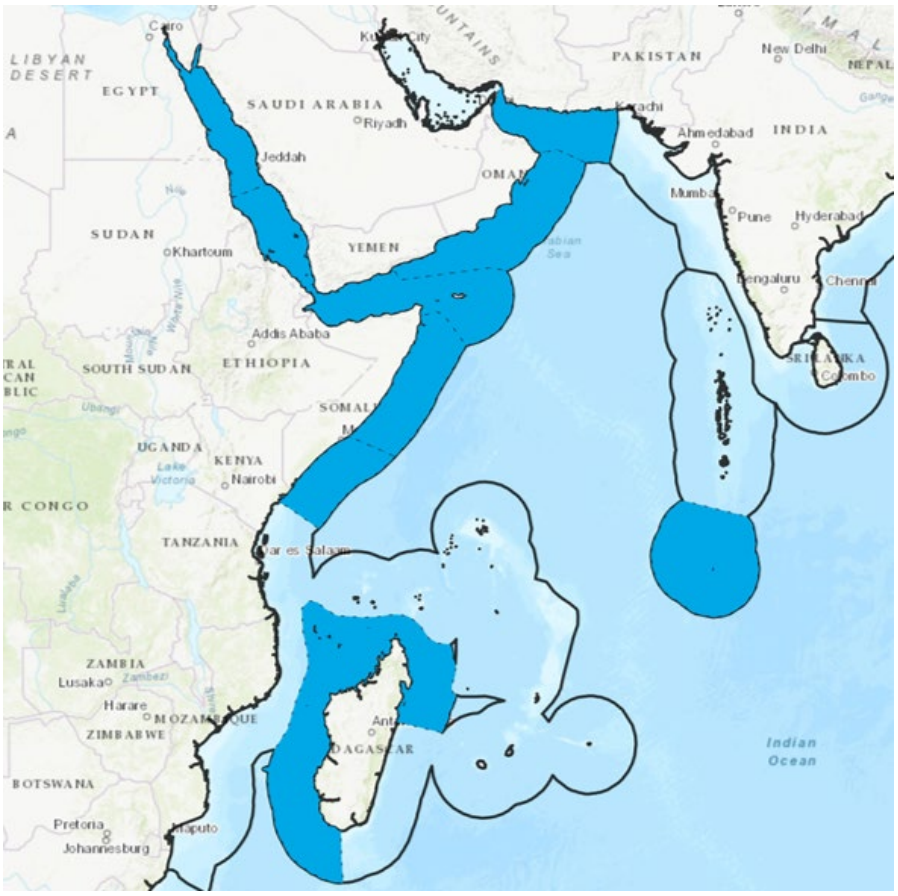

Figure 14. Geographic distribution of *P. diffluens*.

Depth Distribution. *Pavona diffluens* has a depth distribution of 5–20 m, the same as we were aware of at the time of listing in 2014 (NMFS 2023).

3.13.2. Abundance

Relative Abundance: Current information indicates that *P. diffluens* has a rangewide relative abundance of uncommon to common, the same as we were aware of at the time of listing in 2014 (NMFS 2023).

Absolute Abundance. Current information indicates that *P. diffluens* has an absolute abundance of at least millions of colonies, the same as we were aware of at the time of listing in 2014 (NMFS 2023).

Abundance Trends. Based on the continued worsening of the most important threats, it is likely that *P. diffluens* is decreasing in overall abundance (i.e., abundance across all the ecoregions that make up its range). This is similar to what we were aware of at the time of listing in 2014 (NMFS 2023).

3.13.3. Threats

The threats that contributed to the listing of *P. diffluens* include ocean warming, ocean acidification, disease, fishing, LBSP, predation, and inadequacy of existing regulatory mechanisms (79 FR 53851). For each threat to *P. diffluens*, the relative importance of the threat to the extinction risk of the species, the observed trend since 2014, and the projected trend in the foreseeable future are provided in Table 13 below.

Ocean warming is the most important threat to the species and has substantially worsened since 2014 (Hughes 2017, Eakin et al. 2019, Skirving et al. 2019). In response to the 2014–2017 series of

warming-induced bleaching events, *Pavona* corals were among the most impacted coral taxa in some locations (e.g., Vo et al. 2020) but the least impacted in others (McClanahan et al. 2020). However, the current information indicates that *P. diffluens* continues to be susceptible to ocean warming, that this threat has substantially worsened since listing in 2014, and that it will greatly worsen in the foreseeable future. In addition, since *P. diffluens* was listed in 2014, many of the other threats to the species have worsened, including at least ocean acidification, disease and predation (Table 13). All threats except the inadequacy of existing regulatory mechanisms are expected to worsen in the foreseeable future (i.e., between now and 2100; Table 13), as explained in more detail in the RSR (NMFS 2023).

Table 13. Summary of threats evaluation for *P. diffluens*.

Threat (ESA listing factor)	**Importance**	**Observed Trend in Effects Since 2014**	**Projected Trend in Effects to 2100**
Ocean Warming (Factor E)	Very High	Substantially worsened	Greatly worsen
Ocean Acidification (Factor E)	High	Worsened	Greatly worsen
Disease (Factor C)	High	Worsened	Substantially worsen
Fishing (Factor A)	Medium	Continued	Substantially worsen
LBSP (Factors A and E)	Low-Medium	Continued	Substantially worsen
Predation (Factor C)	Low-Medium	Worsened	Substantially worsen
Collection and Trade (Factor B)	Low	Continued	Substantially worsen
Sea-level Rise (Factor E)	Low	No detectable trends	Worsen
Inadequacy of Existing Regulatory Mechanisms (Factor D)	High	Some improvement but still inadequate	Improvement but likely still inadequate

3.13.4. Conclusion

As explained in the 2014 final listing rule (79 FR 53851), a species' vulnerability to extinction results from the combination of its spatial (i.e., distribution) and demographic (i.e., abundance) characteristics, threat susceptibilities, and consideration of the baseline environment and future projections of threats. *Pavona diffluens* was listed as threatened in 2014 because of its restricted geographic distribution, low abundance, susceptibilities to ocean warming, ocean acidification, fishing, LBSP, disease, and predation, inadequate regulatory mechanisms, declining baseline conditions, and projected worsening of threats (79 FR 53851).

Since 2014, we have learned that *P. diffluens* has a broader geographic distribution (nine MEOWs instead of eight) than indicated in the final listing rule (79 FR 53851). While its geographic distribution is only one MEOW greater, the addition of that MEOW (Chagos Islands) means that its geographic distribution is not limited to east Africa and the Red Sea but rather extends into the central Indian Ocean. That is, *P. diffluens* is more broadly distributed than we believed in 2014, and thus may have a higher capacity to moderate the effects of the threats (NMFS 2023).

Since 2014, the effects of ocean warming have substantially worsened, and the effects of most other threats have worsened as well. All threats are projected to substantially worsen under current global GHG regulatory mechanisms, which would result in global warming of 2.6–3.4°C above the

pre-industrial baseline by 2100 (see Fig. 4 in Section 3.1 of the RSR). Even if the goal of the Paris Agreement is achieved (i.e., limiting global warming to 1.5°C above pre-industrial by 2100), the threats would become much worse than they are currently (Dixon et al. 2022), likely preventing the recovery of *P. diffluens*. Current regulatory mechanisms are grossly inadequate, especially GHG management (NMFS 2023).

Overall, the information in the RSR (NMFS 2023) shows that *P. diffluens* is more broadly distributed than we believed in 2014, but that the threats have worsened. Especially concerning is that the most important threat to the species, ocean warming, has substantially worsened since the species was listed in 2014. The other important threats to the species, including ocean acidification, disease, fishing, LBSP, and predation have also either worsened or continued since 2014. While there has been some progress with regulatory mechanisms, primarily because of the 2016 Paris Agreement, regulatory mechanisms for both global and local threats are still inadequate. However, the species' distribution is broader than we were aware of at the time of listing in 2014, which is a key factor for moderating threats.

Based on this information, we conclude that *P. diffluens* is still likely to become an endangered species in the foreseeable future due to Factors A, C, D, and E, but does not appear to be in danger of extinction currently. Thus, no change in status is recommended at this time.

3.13.5. Results

Recommended classification:

_____Downlist to Threatened
_____Uplist to Endangered
_____Delist (Indicate reason for delisting per 50 CFR 424.11):
    _____Extinction
    _____Recovery
    _____Original data for classification in error
__X__No change is needed

New Recovery Priority Number: No Change. The current Recovery Priority Number for *P. diffluens* is 3C, based mainly on moderate demographic risk and high understanding of major threats. This 5-year review does not provide any new information that would justify a change in the Recovery Priority Number.

3.14. *Porites napopora*

3.14.1. Distribution

Geographic Distribution. *Porites napopora* has a relatively limited geographic distribution, occurring in 19 MEOWs (Fig. 15), none of which are in U.S. waters. This is the same as we were aware of at the time of listing in 2014 (NMFS 2023).

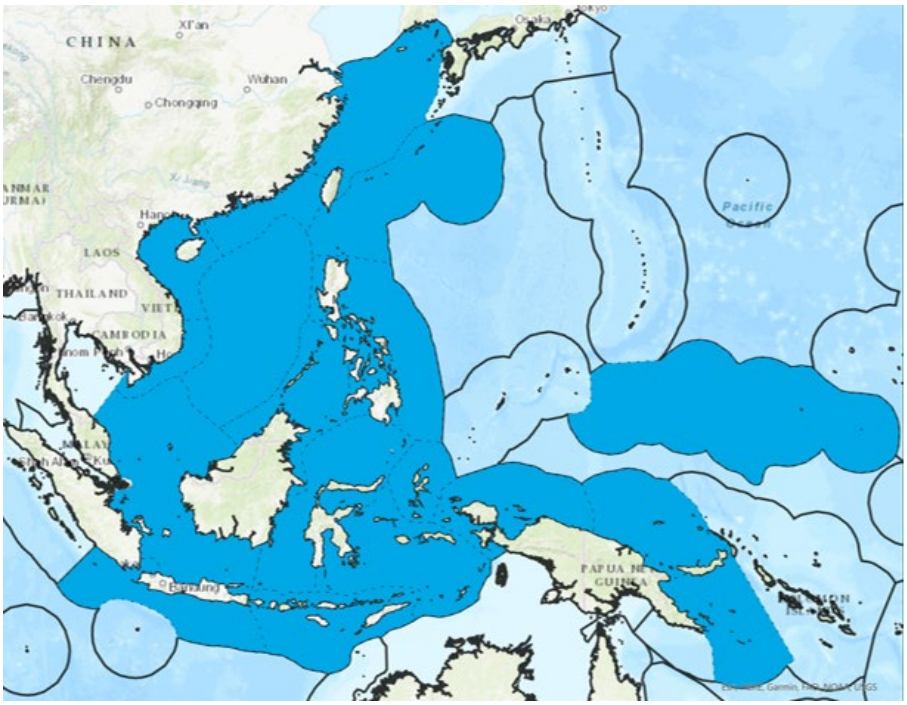

Figure 15. Geographic distribution of *P. napopora*.

Depth Distribution. *Porites napopora* has a depth distribution of 3–17 m, slightly greater than we were aware of at the time of listing in 2014 (3–15 m).

3.14.2. Abundance

Relative Abundance. Current information indicates that *P. napopora* has a higher rangewide relative abundance (uncommon to common) than we were aware of at the time of listing in 2014 (rare to uncommon; NMFS 2023).

Absolute Abundance. Current information indicates that *P. napopora* has an absolute abundance of at least millions of colonies, the same as we were aware of at the time of listing in 2014 (NMFS 2023).

Abundance Trends. Based on the continued worsening of the most important threats, it is likely that *P. napopora* is decreasing in overall abundance (i.e., abundance across all the ecoregions that make up its range). This is similar to what we were aware of at the time of listing in 2014 (NMFS 2023).

3.14.3. Threats

The threats that contributed to the listing of *P. napopora* include ocean warming, disease, fishing, LBSP, and inadequacy of existing regulatory mechanisms (79 FR 53851). For each threat to *P. napopora*, the relative importance of the threat to the extinction risk of the species, the observed trend since 2014, and the projected trend in the foreseeable future are provided in Table 14 below.

Ocean warming is the most important threat to the species and has substantially worsened since 2014 (Hughes 2017, Eakin et al. 2019, Skirving et al. 2019). In response to the 2014–2017 series of warming-induced bleaching events, *Porites* corals were among the most impacted coral taxa in some locations around the Indo-Pacific (e.g., Fox et al. 2019, Vargas-Angel et al. 2019, Vo et al. 2020), especially branching *Porites* species (McClanahan et al. 2020, Gilmour et al. 2022). In addition, since *P. napopora* was listed in 2014, many of the other threats to the species have worsened, including at least ocean acidification, disease and predation (Table 14). All threats except

the inadequacy of existing regulatory mechanisms are expected to worsen in the foreseeable future (i.e., between now and 2100; Table 14), as explained in more detail in the RSR (NMFS 2023).

Table 14. Summary of threats evaluation for *P. napopora*.

Threat (ESA listing factor)	Importance	Observed Trend in Effects Since 2014	Projected Trend in Effects to 2100
Ocean Warming (Factor E)	Very High	Substantially worsened	Greatly worsen
Ocean Acidification (Factor E)	High	Worsened	Greatly worsen
Disease (Factor C)	High	Worsened	Substantially worsen
Fishing (Factor A)	Medium	Continued	Substantially worsen
LBSP (Factors A and E)	Low-Medium	Continued	Substantially worsen
Predation (Factor C)	Low-Medium	Worsened	Substantially worsen
Collection and Trade (Factor B)	Low	Continued	Substantially worsen
Sea-level Rise (Factor E)	Low	No detectable trends	Worsen
Inadequacy of Existing Regulatory Mechanisms (Factor D)	High	Some improvement but still inadequate	Improvement but likely still inadequate

3.14.4. Conclusion

As explained in the 2014 final listing rule (79 FR 53851), a species' vulnerability to extinction results from the combination of its spatial (i.e., distribution) and demographic (i.e., abundance) characteristics, threat susceptibilities, and consideration of the baseline environment and future projections of threats. *Porites napopora* was listed as threatened in 2014 because of its limited geographic distribution restricted largely to parts of the Coral Triangle and the western equatorial Pacific Ocean, susceptibilities to ocean warming, disease, fishing, and LBSP, inadequate regulatory mechanisms, declining baseline conditions, and projected worsening of threats (79 FR 53851).

Since 2014, we have learned that *P. napopora* has: (1) a broader depth distribution (3–17 m instead of 3–15 m); and (2) higher relative abundance (uncommon to common instead of rare to uncommon). That is, *P. napopora* is more broadly distributed and more abundant than we believed in 2014, and thus may have a higher capacity to moderate the effects of the threats (NMFS 2023).

Since 2014, the effects of ocean warming have substantially worsened, and the effects of most other threats have worsened as well. In addition, we have learned that *P. napopora* is also susceptible to ocean acidification and predation. All threats are projected to substantially worsen under current global GHG regulatory mechanisms, which would result in global warming of 2.6–3.4°C above the pre-industrial baseline by 2100 (see Fig. 4 in Section 3.1 in the RSR). Even if the goal of the Paris Agreement is achieved (i.e., limiting global warming to 1.5°C above pre-industrial by 2100), the threats would become much worse than they are currently (Dixon et al. 2022), likely preventing the recovery of *P. napopora*. Current regulatory mechanisms are grossly inadequate, especially GHG management (NMFS 2023).

Overall, the information in the RSR (NMFS 2023) shows that *P. napopora* is more broadly distributed and more abundant than we believed in 2014, but that the threats have worsened and

that ocean acidification and predation are also an important threat to the species. Especially concerning is that the most important threat to the species, ocean warming, has substantially worsened since the species was listed in 2014. The other important threats to the species, including ocean acidification, disease, fishing, LBSP, and predation have also either worsened or continued since 2014. While there has been some progress with regulatory mechanisms, primarily because of the 2016 Paris Agreement, regulatory mechanisms for both global and local threats are still inadequate. However, the species' distribution is broader and its abundance is greater than we were aware of at the time of listing in 2014, both of which are key factors for moderating threats.

Based on this information, we conclude that *P. napopora* is still likely to become an endangered species in the foreseeable future due to Factors A, C, D, and E, but does not appear to be in danger of extinction currently. Thus, no change in status is recommended at this time.

3.14.5. Results

Recommended classification:

_____Downlist to Threatened
_____Uplist to Endangered
_____Delist (Indicate reason for delisting per 50 CFR 424.11):
    _____Extinction
    _____Recovery
    _____Original data for classification in error
__X__No change is needed

New Recovery Priority Number: No Change. The current Recovery Priority Number for *P. napopora* is 3C, based mainly on moderate demographic risk and high understanding of major threats. This 5-year review does not provide any new information that would justify a change in the Recovery Priority Number.

3.15. *Seriatopora aculeata*

3.15.1. Distribution

Geographic Distribution. *Seriatopora aculeata* has a relatively limited geographic distribution, occurring in 26 MEOWs (Fig. 16). Its distribution in U.S. waters or lack thereof is described below under "U.S. Distribution." The current information indicates that *S. aculeata* occurs in four more MEOWs than we were aware of at the time of listing in 2014 (NMFS 2023).

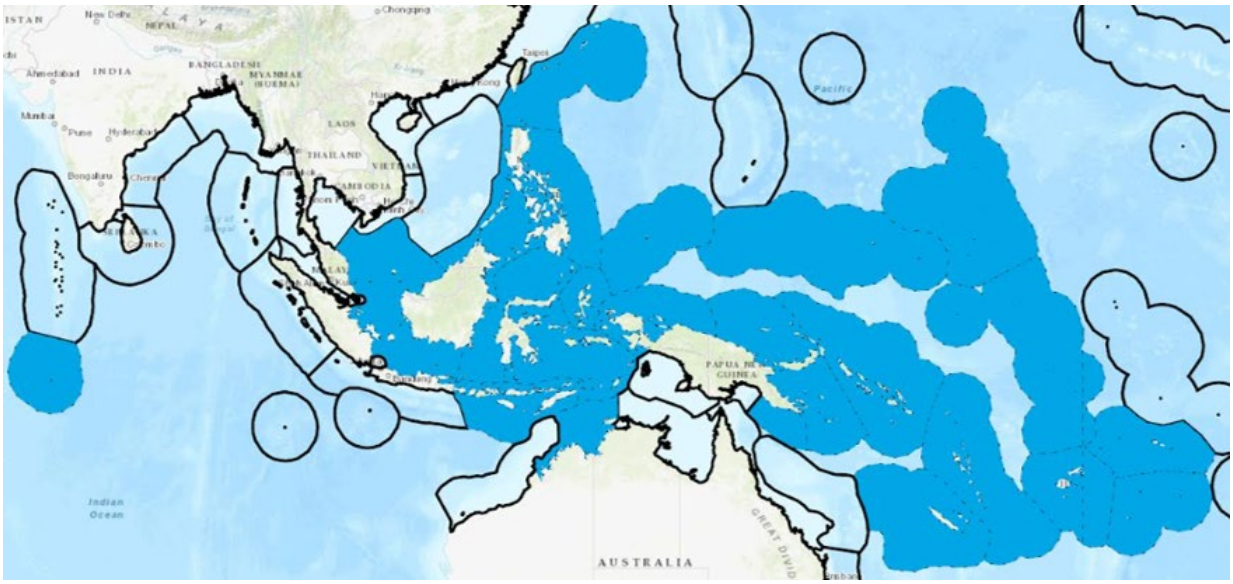

Figure 16. Geographic distribution of *S. aculeata*.

Depth Distribution. *Seriatopora aculeata* has a depth distribution of 3–40 m, the same as we were aware at the time of listing in 2014 (NMFS 2023).

U.S. Distribution. *Seriatopora aculeata* was been recorded in the Mariana Islands MEOW a handful of times between 1980 and 2010. However, despite a large number of expert surveys since then, it has not been recorded. Thus, the existing records do not support a conclusion that the Mariana Islands MEOW is within the current geographic distribution of the species (NMFS 2023).

3.15.2. Abundance

Relative Abundance. Current information indicates that *S. aculeata* has a higher rangewide relative abundance (common) than we were aware of at the time of listing in 2014 (uncommon; NMFS 2023).

Absolute Abundance. Current information indicates that *S. aculeata* has a higher absolute abundance (at least tens of millions of colonies) than we were aware of at the time of listing in 2014 (at least millions; NMFS 2023).

Abundance Trends. Based on the continued worsening of the most important threats, it is likely that *S. aculeata* is decreasing in overall abundance (i.e., abundance across all the ecoregions that make up its range). This is similar to what we were aware of at the time of listing in 2014 (NMFS 2023).

3.15.3. Threats

The threats that contributed to the listing of *S. aculeata* include ocean warming, ocean acidification, disease, fishing, LBSP, collection and trade, and inadequacy of existing regulatory mechanisms (79 FR 53851). In addition, current information indicates that predation is also impacting the status of the species (NMFS 2023). For each threat to *S. aculeata*, the relative importance of the threat to the extinction risk of the species, the observed trend since 2014, and the projected trend in the foreseeable future are provided in Table 15 below.

Ocean warming is the most important threat to the species and has substantially worsened since 2014 (Hughes 2017, Eakin et al. 2019, Skirving et al. 2019). In response to the 2014–2017 series of warming-induced bleaching events, *Seriatopora* corals were among the most impacted coral taxa in different locations around the Indo-Pacific (e.g., Dalton et al. 2020, Frade et al 2018, Hughes et al.

2018a, Quimpo et al. 2020). In addition, since *S. aculeata* was listed in 2014, many of the other threats to the species have worsened, including at least ocean acidification, disease and predation (Table 15). All threats except the inadequacy of existing regulatory mechanisms are expected to worsen in the foreseeable future (i.e., between now and 2100; Table 15), as explained in more detail in the RSR (NMFS 2023).

Table 15. Summary of threats evaluation for *S. aculeata*.

Threat (ESA listing factor)	Importance	Observed Trend in Effects Since 2014	Projected Trend in Effects to 2100
Ocean Warming (Factor E)	Very High	Substantially worsened	Greatly worsen
Ocean Acidification (Factor E)	High	Worsened	Greatly worsen
Disease (Factor C)	High	Worsened	Substantially worsen
Fishing (Factor A)	Medium	Continued	Substantially worsen
LBSP (Factors A and E)	Low-Medium	Continued	Substantially worsen
Predation (Factor C)	Low-Medium	Worsened	Substantially worsen
Collection and Trade (Factor B)	Low-Medium	Continued	Substantially worsen
Sea-level Rise (Factor E)	Low	No detectable trends	Worsen
Inadequacy of Existing Regulatory Mechanisms (Factor D)	High	Some improvement but still inadequate	Improvement but likely still inadequate

3.15.4. Conclusion

As explained in the 2014 final listing rule (79 FR 53851), a species' vulnerability to extinction results from the combination of its spatial (i.e., distribution) and demographic (i.e., abundance) characteristics, threat susceptibilities, and consideration of the baseline environment and future projections of threats. *Seriatopora aculeata* was listed as threatened in 2014 because of its limited geographic distribution largely restricted to parts of Coral Triangle region and western equatorial Pacific Ocean, high susceptibility to ocean warming, susceptibilities to ocean acidification, fishing, LBSP, disease, and collection and trade, inadequate regulatory mechanisms, declining baseline conditions, and projected worsening of threats (79 FR 53851).

Since 2014, we have learned that *S. aculeata* has a: (1) broader geographic distribution (26 MEOWs instead of 22); (2) higher relative abundance (common instead of uncommon); and (3) higher absolute abundance (at least tens of millions of colonies instead of at least millions of colonies) than we believed in 2014. That is, *S. aculeata* is more broadly distributed and more abundant than we believed in 2014, and thus may have a higher capacity to moderate the effects of the threats (NMFS 2023).

Since 2014, the effects of ocean warming have substantially worsened, and the effects of most other threats have worsened as well. All threats are projected to substantially worsen under current global GHG regulatory mechanisms, which would result in global warming of 2.6–3.4°C above the pre-industrial baseline by 2100 (see Fig. 4 in Section 3.1 in the RSR). Even if the goal of the Paris Agreement is achieved (i.e., limiting global warming to 1.5°C above pre-industrial by 2100), the

threats would become much worse than they are currently (Dixon et al. 2022), likely preventing the recovery of *S. aculeata*. Current regulatory mechanisms are grossly inadequate, especially GHG management (NMFS 2023).

Overall, the information in the RSR (NMFS 2023) shows that *S. aculeata* is more broadly distributed and more abundant than we believed in 2014, but that the threats have worsened and that predation is also an important threat to the species. Especially concerning is that the most important threat to the species, ocean warming, has substantially worsened since the species was listed in 2014. The other important threats to the species, including ocean acidification, disease, fishing, LBSP, predation, and collection and trade have also either worsened or continued since 2014. While there has been some progress with regulatory mechanisms, primarily because of the 2016 Paris Agreement, regulatory mechanisms for both global and local threats are still inadequate. However, the species' distribution is broader and its abundance is greater than we were aware of at the time of listing in 2014, both of which are key factors for moderating threats.

Based on this information, we conclude that *S. aculeata* is still likely to become an endangered species in the foreseeable future due to Factors A, B, C, D, and E, but does not appear to be in danger of extinction currently. Thus, no change in status is recommended at this time.

3.15.5. Results

Recommended classification:

_____Downlist to Threatened
_____Uplist to Endangered
_____Delist (Indicate reason for delisting per 50 CFR 424.11):
    _____Extinction
    _____Recovery
    _____Original data for classification in error
__X__No change is needed

New Recovery Priority Number: No Change. The current Recovery Priority Number for *S. aculeata* is 3C, based mainly on moderate demographic risk and high understanding of major threats. This 5-year review does not provide any new information that would justify a change in the Recovery Priority Number.

4. Recommendations for Future Actions

Based on this set of 5-year reviews, two types of actions are recommended. First, actions are needed to gather the information and data required to more accurately determine the statuses of the 15 listed species for future reviews. Second and more importantly, actions are urgently needed to reduce the threats to the listed species, especially ocean warming, as indicated by the ongoing declines of these 15 species as well as other Indo-Pacific reef-building corals and the coral reef ecosystems upon which they depend.

Species-specific information on life history and taxonomy, as well as data on distribution and abundance, are needed for all 15 species to improve our determinations of their statuses under the ESA. As noted in the RSR (NMFS 2023), for most of the 15 species, information on life history is mostly or entirely limited to what is known of the genus. In addition, the taxonomy of many Indo-Pacific reef-building coral genera is changing as traditionally-accepted species with large ranges are being recognized as groups of species with smaller ranges, based on genetic and morphological analyses. This is especially true of Indo-Pacific *Acropora* (Bonito et al. 2021, Ramirez-Cortilla et al. 2022), which includes 8 of the 15 listed species. Whether the taxonomy changes or not, more information is needed on the distributions and abundances of the listed species, especially on their

overall abundance trends, in order to determine whether changes in the statuses of any of the 15 threatened species are warranted (e.g., uplisting from threatened to endangered, or delisting).

This set of 5-year reviews clearly shows that the threats to the 15 listed coral species, as well as other Indo-Pacific reef-building corals and the coral reef ecosystems upon which they depend, are worsening at a rapid pace. This is especially true of the most important threat, ocean warming, resulting from the constantly increasing levels of anthropogenic GHGs in the atmosphere. Thus, the forthcoming draft Recovery Plan for the 15 listed corals should identify and prioritize actions that reduce emissions of and limit atmospheric concentrations of GHGs across the globe, among other actions and activities to address this threat. Without these efforts, even successful implementation of all other recovery actions and activities (e.g., reduction of localized threats, coral restoration and interventions, etc.) cannot lead to recovery of the 15 listed corals.

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