



## ***Montipora foliosa***

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# Maldives National Red List Assessment: *Montipora foliosa*

## A. Background Information

### 1. Assessment Information:

Assessor Name(s)	Hana Amir
Date of Assessment	4 March 2022
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### 2. Taxonomic Information:

Scientific Name	<i>Montipora foliosa</i> (Pallas, 1766)	
Common Name (English)	-	
Common Name (Dhivehi)	-	
Taxonomy	Order	Scleractinia
	Sub-order	-
	Family	Acroporidae
Taxonomic Notes	Originally described as <i>Madrepora foliosa</i> (Pallas, 1776)	

### 3. Geographic Range:

#### 3.1 Summary of Global Distribution

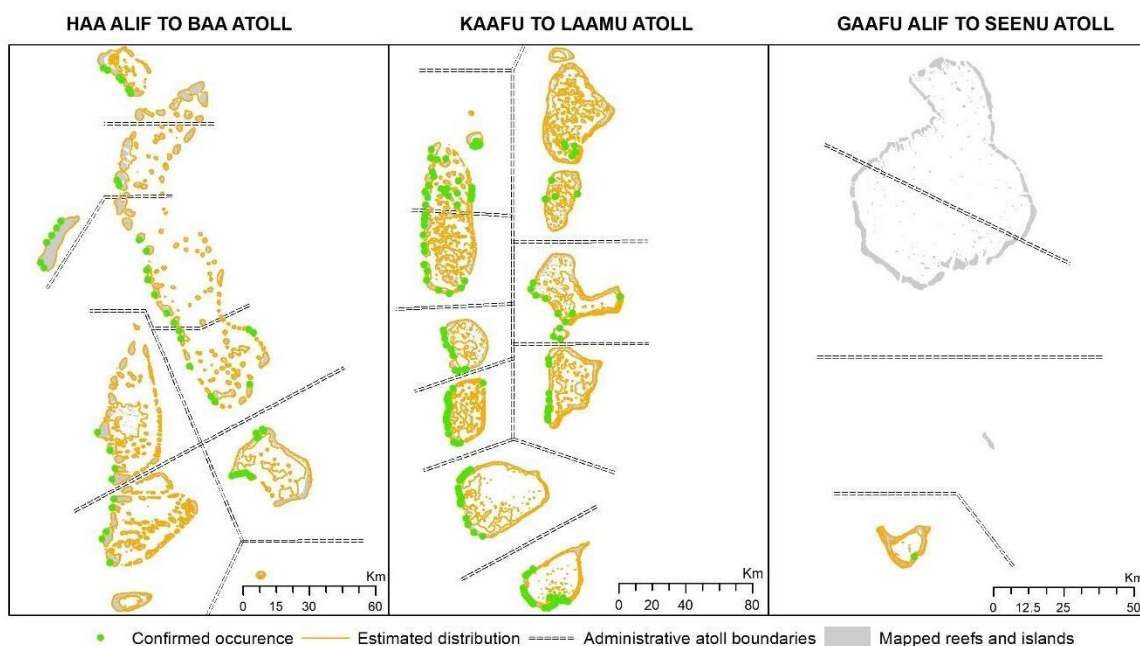
The species extends from the Red Sea, the Gulf of Aden, southwest, northwest, and northern Indian Ocean, the Arabian/Iranian Gulf, the central Indo Pacific, Australia, South-East Asia, Japan, East China Sea and the oceanic West and Central Pacific (DeVantier et al., 2014).

### 3.2 Summary of Global Distribution

American Samoa, Australia, Bahrain British Indian Ocean Territory, Cambodia, Christmas Island, Cocos Islands, Comoros, Cook Islands, Djibouti, Egypt, Eritrea, Fiji, French Polynesia, Guam, India, Indonesia, Iran, Iraq, Israel, Japan, Jordan, Kenya, Kiribati, Kuwait, Madagascar, Malaysia, Marshall Islands, Mauritius, Mayotte, Micronesia, Mozambique, Myanmar, Nauru, New Caledonia, Niue, Norfolk Islands, Northern Mariana Islands, Oman, Pakistan, Palau, Papua New Guinea, Philippines, Qatar, Reunion, Samoa, Saudi Arabia, Seychelles, Singapore, Solomon Islands, Somalia, Sri Lanka, Taiwan, Thailand, Tokelau, Tonga, Tuvalu, United Arab Emirates, Vanuatu, Vietnam, Wallis and Futuna (DeVantier et al., 2014).

### 3.3 National Distribution

The exact species distribution is not known though it has been reported in literature (Pichon and Benzoni 2007). There are confirmed occurrences for the genus in nearly every atoll in the Maldives and therefore, it is possible that the species can be found throughout the Maldives. It is also likely that the species is also found in Huvadhu atoll though it is not included in the distribution due to lack of a confirmed source.



## 4. Population:

### 4.1 Summary

Species specific population information is not available. Population estimates are derived based on best available generic information.

### 4.2 Population Size

The global population size is generalized as “common” (Devantier, Turak and Szava-Kovats 2020). National population size is unknown.

A ten-year generic mean, the mean percent cover of the genus over a ten year period of time, was calculated for each genus. This was used as a proxy for the potential species population size.

The ten-year generic percent cover mean derived from available data is  $1.31 \pm 0.16\%$  ( $\pm$  S.E). Recent estimates indicate genus cover is 3.00 – 8.00% across most atolls (Noo Raajje 2021). Therefore, based on generic estimates

the species population may vary between ~1.00 to ~8% cover assuming differing levels of dominance in a community.

#### 4.3 Population Trend

The global population is decreasing. National past population trends are unknown. The national future population trend is likely to be decreasing.

#### 4.4 Generation Length

Estimates for coral generation lengths are based on Carpenter *et al.* 2008, as follows. The coral colony is considered to be the mature individual, as it typically lives, is injured, or dies as a unit. The average age of natural survival of a coral colony was defined as the average age of a mature individual, or one generation length. Based on available knowledge of coral species' biology and life history, this was determined to be 10 years. Therefore, population reductions are estimated over 30 years, representing three generation lengths.

#### 4.5 Continuing Decline in Number of Mature Individual?

Unknown.

#### 4.6 Extreme fluctuations

No

#### 4.7 Severely Fragmented

This species is not considered severely fragmented. Degree of fragmentation is unknown. However, it is assumed to be minimal or limited based on observations indicating there could be connectivity between islands and atolls.

### 5. Habitat and Ecology:

#### 5.1 Summary

The species is found in shallow reef environments between 2-20 m in protected reef environments (Veron *et al.*, 2022)

#### 5.2 Systems (terrestrial / freshwater / marine)

Marine

#### 5.3 Continuing Decline in Area, Extent, and/or Quality of Habitat?

Shallow habitats decline in area, extent, and quality due to coastal developments. Deeper habitats may remain intact and act as a refuge for the species.

No.

### 6. Use and Trade

#### 6.1 Is the species used or traded?

Unknown

#### 6.2 Summary

Unknown

## 7. Threats:

### 7.1 Summary

The understanding of threats to this species are predominantly based on genus-level threats. The species is known to be highly susceptible to coral bleaching with low resilience (Carroll, Harrison and Adjeroud, 2016), vulnerable to sedimentation (Erfteimeijer et al., 2007) although it recovers quickly from bleaching. It is affected by overall declines in ecosystem and habitat quality found in shallow reef habitats (<30 m), it is expected that the species is particularly vulnerable to the impacts of coastal development projects and of climate change. Moreover, the habitat of the species is located close to human habitation, resorts, and therefore they can be subject to stressors in the form of untreated sewage (where infrastructure is lacking) and domestic waste.

The projected date of onset of Annual Severe Bleaching (ASB) is the date after which the capacity of coral reefs to recover from repeated bleaching events is expected to significantly reduce - resulting in fundamental, permanent population changes (UNEP 2017). The calculation of ASB by UNEP (2020) is restricted to a 30 m depth, due to the dataset used for the spatial analysis.

We calculated the mean year of ASB onset, assuming 0° coral adaptation (UNEP 2020) to climate change, for areas occupied by the genus. A 0° adaptation (i.e. no adaptation) to climate change was applied as a precautionary approach:

- as the capacity of coral to adapt to climate change is not yet well understood
- as there are other climate change impacts that may compound population decline and affect population refuges, and
- to account for impacts from coastal development that could potentially exacerbate the effect of bleaching prompted by climate change.

Based on this analysis, *M. foliosa* is expected to undergo ASB starting in 2040.

### 7.2 Major Threats to the Species (using IUCN Threat Classification Scheme)

#### 1. Residential & commercial development:

##### 1.1. Housing & urban areas

Timing: Ongoing

Stresses:

1. Ecosystem/Community stresses
  - 1.1. Ecosystem conversion
  - 1.2. Ecosystem degradation
  - 1.3. Indirect ecosystem effects
2. Species stresses
  - 2.2. Species disturbance
  - 2.3. Indirect species effects
    - 2.3.7. Reduced reproductive success

##### 1.2. Commercial & industrial areas

Timing: Ongoing

Stresses:

1. Ecosystem/Community stresses
  - 1.1. Ecosystem conversion
  - 1.2. Ecosystem degradation
  - 1.3. Indirect ecosystem effects
2. Species stresses
  - 2.2. Species disturbance
  - 2.3. Indirect species effects
    - 2.3.7. Reduced reproductive success

##### 1.3. Tourism & recreational areas

Timing: Ongoing

Stresses:

- 1. Ecosystem/Community stresses
  - 1.1. Ecosystem conversion
  - 1.2. Ecosystem degradation
  - 1.3. Indirect ecosystem effects
- 2. Species stresses
  - 2.2. Species disturbance
  - 2.3. Indirect species effects
    - 2.3.7. Reduced reproductive success
- 7. Natural system modifications:
  - 7.3. Other ecosystem modifications
    - Timing: Ongoing
    - Stresses:
      - 1. Ecosystem/Community stresses
        - 1.1. Ecosystem conversion
        - 1.2. Ecosystem degradation
        - 1.3. Indirect ecosystem effects
      - 2. Species stresses
        - 2.2. Species disturbance
        - 2.3. Indirect species effects
          - 2.3.7. Reduced reproductive success
- 8. Invasive & other problematic species, genes & disease:
  - 8.2. Problematic native species/diseases
    - 8.2.1. Unspecified species/disease
      - 2. Species stresses
        - 2.1. Species mortality
        - 2.2. Species disturbance
        - 2.3. Indirect species effects
          - 2.3.2. Competition
          - 2.3.7. Reduced reproductive success
- 9. Pollution:
  - 9.1. Domestic & urban wastewater
    - 9.1.1. Sewage
      - Timing: Ongoing
      - Stresses:
        - 1. Ecosystem/Community stresses
          - 1.2. Ecosystem degradation
    - 9.1.2. Run-off
      - Timing: Ongoing
      - Stresses:
        - 1. Ecosystem/Community stresses
          - 1.2. Ecosystem degradation
  - 9.4. Garbage and solid waste
    - Timing: Ongoing
    - Stresses:
      - 1. Ecosystem/Community stresses
        - 1.2. Ecosystem degradation
- 11. Climate change & severe weather:
  - 11.1. Habitat shifting & alteration
    - Timing: Ongoing
    - Stresses:
      - 1. Ecosystem/Community stresses

- 1.2. Ecosystem degradation
- 2. Species stresses
  - 2.1. Species mortality
  - 2.2. Species disturbance
  - 2.3. Indirect species effects
    - 2.3.2. Competition
    - 2.3.7. Reduced reproductive success
- 11.2. Temperature extremes
  - Timing: Ongoing
  - Stresses:
    - 1. Ecosystem/Community stresses
      - 1.2. Ecosystem degradation
    - 2. Species stresses
      - 2.1. Species mortality
      - 2.2. Species disturbance
      - 2.3. Indirect species effects
        - 2.3.2. Competition
        - 2.3.7. Reduced reproductive success
- 11.4. Storms & flooding
  - Timing: Ongoing
  - Stresses:
    - 1. Ecosystem/Community stresses
      - 1.2. Ecosystem degradation

### 7.3 Species vulnerability modifiers

Coral abundance and distribution data is only available at the genus level. Species characteristics were used to evaluate how susceptible each species is to treats. This data was gathered from the IUCN SSC Coral Working Group's Global Traits Database, and available literature. Each species was assigned a vulnerability score for each trait (3 = high vulnerability; 2 = medium vulnerability; 1 = low vulnerability). This species was scored as follows.

Trait	Vulnerability score
Susceptibility to bleaching	3
Resistance to bleaching	3
Recovery from bleaching or disease	1
Resistance to disease	3
Susceptibility to predation	3
Recovery from sedimentation	2
Resistance to sedimentation	2
Susceptibility to sedimentation	3
<i>Average</i>	3

## 8. Conservation and Research:

### 8.1 Summary

The species is globally listed as “Near Threatened” on the IUCN Red List of Threatened Species and is included within CITES Appendix II. Collection, killing and export of live and dead scleractinian corals is illegal under Maldivian fisheries law. Distribution of the species falls under multiple national MPAs though not all the MPAs are properly managed. Species distribution and population information would be required to better manage and protect the species especially as it is a popular target for propagation products and for aquaria. Further species-specific research for threats would support development and implementation of necessary legislation.

### 8.2 Conservation Actions/Research in Place

Globally, as a coral the species is included within CITES Appendix II. It is listed as “Near Threatened” within the IUCN Red List of Threatened Species.

Nationally, collection, killing, and export of both live and dead scleractinian corals (under phylum Cnidaria) are illegal in the Maldives under the Maldives Fisheries Law 2020/R-75. The distribution of the genus, and likely the species, overlaps multiple MPAs including Baa atoll biosphere reserve SAMPA.

### 8.3 Conservation Actions Needed

Despite laws and regulations protecting coral species within the country, implementation of such laws and regulations are a challenge. There is a need to create infrastructure and capacity that would enable relevant laws and regulations to be enforced whilst educating the general public that they exist. Educational and training needs extend to more educational opportunities in the marine field as well as skill training opportunities that can support research, further education, institutional development, awareness and communication efforts. Moreover, with the spatial distribution of maldivian reefs and the corals that are found within them, there is an urgent need to foster intra-governmental as well as inter-agency and inter-organizational cooperation and partnerships to mediate limitations related to capacity and resources. Areas of high abundance of specific species along with areas of high coral cover and resilience need to be identified and managed if not fully protected to ensure sustainable use and longevity. Management includes mitigating impacts from coastal development and resolving conflict of multi-use resources. Further, with increasing interest in restoration of reefs, there is a need to properly manage species harvest for projects to ensure that wild stocks are not decimated and species are able to recover.

#### 1. Land/water protection

- 1.1. Site/area protection
- 1.2. Resource & habitat protection

#### 2. Land/water management

- 2.1. Site/area management
- 2.3. Habitat & natural process restoration

#### 3. Species management

- 3.1. Species management
  - 3.1.1. Harvest management
- 3.2. Species recovery
- 3.4. *Ex situ* conservation
  - 3.4.1. Captive breeding/artificial propagation
  - 3.4.2. Genome resource bank

#### 4. Education & awareness

- 4.1. Formal education
- 4.2. Training
- 4.3. Awareness & communications

#### 5. Law & policy

- 5.3. Private sector standards & codes
- 5.4. Compliance & enforcement



5.4.1. Scale unspecified

7. External capacity building

- 7.1. Institutional & civil society development
- 7.2. Alliance & partnership development
- 7.3. Conservation finance

8.4 Research Needed

1. Research

- 1.2. Population size, distribution and past trends
- 1.3. Life history and ecology
- 1.5. Threats
- 1.6. Conservation actions

3. Monitoring

- 3.1. Population trends
- 3.4. Habitat trends

## B. Assessment

### 9. CRITERION A

#### Criterion A

Generation Length 10 years

3 Generations 30 years

Reduction in population size? Yes

Start Date of Reduction 2022

End Date of Reduction 2052

Rate of Reduction (%) 80-90%

Meets Criteria Thresholds?

A1	-
A2	-
A3	Projected 80-90% decline over the next 3 generations (CR A3)
A4	-

Reduction Based on Which Sub-criteria?

a	-
b	-
c	Decline in habitat quality associated with impacts of climate change
d	-
e	Mortality due to repeated bleaching

**Assessment Under Criterion A** CR A3ce

## Reasoning

Our assessment of future population reduction is based on the projected date of onset of ASB. *M. foliosa* is expected to undergo ASB starting in 2040 (less than three generations from the present). The species ranges between 2-20 m and is entirely restricted to depths shallower than 30 m.

Depth and depth range is considered in our assessment, as populations at depths shallower than 30 m are expected to experience greater temperature fluctuations and extreme temperatures (Riegl and Piller 2003), and therefore decline more quickly.

The species is highly vulnerable to bleaching, with high susceptibility and low resistance based on literature review and scientific expertise. However, the species has been noted to have the capacity to recover from bleaching events. Therefore, although total population decline is anticipated over 100% of the species' depth range, it may not be as severe as anticipated.

Therefore, this species is projected to experience a reduction of 80-90% between 2022 and 2052 (three generations in the future).

## 10. CRITERION B

### Criterion B

AOO		-
EOO		-
Meets Criteria Thresholds?	B1	-
	B2	-
Severely Fragmented?		-
No. Locations		-
Threat used to calculate locations		-
Continuing Decline?	(i) EOO	-
	(ii) AOO	-
	(iii) Habitat	-
	(iv) Locations / Subpopulations	--

	(v) Mature Individuals	-
Extreme Fluctuations?	(i) EOO	-
	(ii) AOO	-
	(iii) Locations / Subpopulations	-
	(iv) Mature Individuals	-

**Assessment Under Criterion B DD**

## 10. CRITERION C

### Criterion C

No. Mature Individuals		Unknown
Continuing Decline in Population Size?		-
Is Rate of Decline Known?		-
Generation Length		-
C1	Meets Thresholds for Rate of Decline?	-
	Rate of Decline (%)	-
	Time Period of Decline	-
C2	(a) (i) No. Mature Individuals in Each Subpopulation	-
	(a) (ii) % Mature Individuals in one Sub-population	-
	(b) Extreme Fluctuations in No. Mature Individuals?	-

**Assessment Under Criterion C DD**

## 10. CRITERION D

### Criterion D

No. Mature Individuals	Unknown
Meets Criteria Thresholds?	-
VUD2 AOO	-
No. Locations	-
Plausible Future Threat That Would Quickly Drive Taxon to CR or EX	-
Plausible Future Threat That Would Quickly Drive Taxon to VU or EN	-

**Assessment Under Criterion D DD**

## 10. CRITERION E

### Criterion E

Has a Quantitative Analysis Been Conducted?	No
Type of Quantitative Analysis	-
Generation Length	-
Probability of Extinction within 100 Years	-
Probability of Extinction within 20 Years / 5 Generations (whichever is longer)	-
Probability of Extinction within 10 Years / 3 Generations (whichever is longer)	-

**Assessment Under Criterion E DD**

**Preliminary Assessment** CR A3ce

Regional Adjustment	Up-list, Down-list, or No Change?	No change
	Justification for Regional Adjustment	No likely interaction with individuals outside the region

**Final Assessment** CR A3ce

**Narrative Justification for Assessment:**

*Montipora foliosa* is distributed throughout almost all the atolls of the Maldives, with a depth range of 2-20 m. Coral species found at depths of less than 30 m are more exposed to extreme and fluctuating water temperatures associated with the impacts of climate change, which can lead to population reductions.

The species is known to be highly vulnerable to bleaching with low resilience, and high susceptibility, though it has been seen to recover following bleaching events. In addition, it is known to be vulnerable to coral disease and the impacts of sedimentation.

While the current population size and past rate of decline are not known, it is anticipated that the population will undergo a significant decline in the future based on the impacts of climate change on its local range. Based on published climate model-based bleaching assessments published by UNEP (2017, 2020), it is estimated that Annual Severe Bleaching (ASB) will commence in the year 2041 over this species' distribution, affecting 100% of its depth range and despite its capacity to recover from thermal stress events will face a population reduction of 80-90%.

Therefore, based on the best available data, we project a 80-90% decline in population size within the next three generations (2022-52), prompted by degradation in habitat quality associated with the impacts of climate change. This meets the threshold for CR A3c.

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