



Pavona maldivensis

Leaf coral

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Maldives National Red List Assessment: *Pavona maldivensis*

A. Background Information

1. Assessment Information:

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Date of Assessment	11/02/2022
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Facilitators	James Tallant
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2. Taxonomic Information:

Scientific Name	<i>Pavona maldivensis</i> (Gardiner, 1905)	
Common Name (English)	Leaf coral	
Common Name (Dhivehi)		
Taxonomy	Order	Scleractinia
	Sub-order	-
	Family	Agariciidae
Taxonomic Notes	-	

3. Geographic Range:

3.1 Summary of Global Distribution

In the Indo-West Pacific, this species is found in the Red Sea and the Gulf of Aden, the southwest and northwest Indian Ocean, the Arabian/Iranian Gulf, the central Indian Ocean, the central Indo-Pacific, tropical Australia, southern Japan and the South China Sea, the oceanic west Pacific, the central Pacific, and the far eastern Pacific.

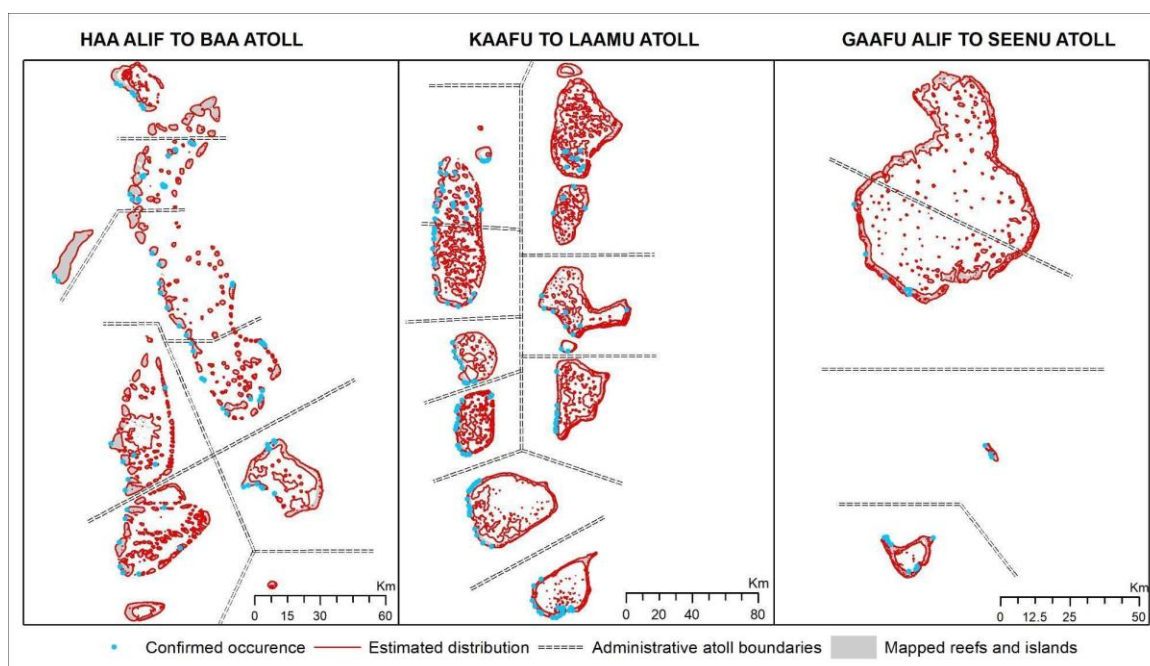
3.2 Countries of Occurrence

American Samoa; Australia; Bahrain; British Indian Ocean Territory; Cambodia; Christmas Island; Cocos (Keeling) Islands; Colombia; Comoros; Cook Islands; Costa Rica; Djibouti; Ecuador; Egypt; El Salvador; Eritrea; Fiji; French Polynesia; Guadeloupe; Guam; Honduras; India; Indonesia; Iran, Islamic Republic of; Iraq; Israel; Japan; Jordan; Kenya; Kiribati; Kuwait; Madagascar; Malaysia; Maldives; Marshall Islands; Mauritius; Mayotte; Mexico; Micronesia, Federated States of ; Mozambique; Myanmar; Nauru; New Caledonia; Nicaragua; Niue; Northern Mariana Islands; Oman; Pakistan; Palau; Panama; Papua New Guinea; Philippines; Qatar; Réunion; Samoa; Saudi Arabia; Seychelles; Singapore; Solomon Islands; Somalia; Sri Lanka; Sudan; Taiwan, Province of China; Tanzania, United Republic of; Thailand; Tokelau; Tonga; Tuvalu; United Arab Emirates; United States Minor Outlying Islands; Vanuatu; Viet Nam; Wallis and Futuna; Yemen

3.3 National Distribution

Although exact species distribution is unknown, presence records for the species are available in literature and the genus has been observed in every atoll.

Data confirmed occurrences of the genus are available from every atoll. Based on known observations, available data, species characteristics it is estimated that there is possibility for the genus and the species to occur on shallow reef systems in the North, Central and South of the Maldives. Depending on depth, the species may not be found.



4. Population:

4.1 Summary

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

4.2 Population Size

Global population is generalized as “common”. National species 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 $1.42 \pm 0.20\%$ (\pm S.E). Recent estimates

indicate genus cover is between 0.3 – 5.00% across most atolls.

4.3 Population Trend

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 Individuals?

Unknown

4.6 Extreme Fluctuations?

No

4.7 Severely Fragmented?

No. Population assumed to be cohesive based on generic distribution although degree of connectivity between atolls is unknown.

5. Habitat and Ecology:

5.1 Summary

Frequently found between 5 m and 20 m depths. The species occurs in a very wide range of marine environments, including inner shallow reefs (lagoon-facing sides of the atoll rim) especially those exposed to strong wave action. In addition, it can be found on vertical reef slopes and deeper reefs.

5.2 Systems (terrestrial / freshwater / marine)

Marine

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

Yes. There is continuous loss of area, extent and habitat quality stemming from coastal development projects and increase in frequency and magnitude of climate change impacts including extreme temperature fluctuations.

5.4 A Migratory Species?

The species is not migratory

6. Use and Trade:

6.1 Is the species used or traded?

No

6.2 Summary

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7. Threats:

7.1 Summary

The understanding of threats to this species are predominantly based on genus-level threats. The genus is known to be vulnerable to sedimentation, bleaching, predation by corallivores (e.g., COTS) and disease (WS). The species is affected by overall declines in ecosystem and habitat quality. Therefore, as the species is found mainly in shallow reef habitats (<15 m), it is expected that the species is particularly vulnerable to the impacts of coastal development projects and of climate change.

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, *P. maldivensis* is expected to undergo ASB starting in 2041.

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

Residential & commercial development:

- 1.1. Housing & urban areas
- 1.2. Commercial & industrial areas
- 1.3. Tourism & recreational areas

Natural system modifications:

- 7.3. Other ecosystem modifications

Invasive & other problematic species, genes & disease:

- 8.2. Problematic native species/diseases

Climate change & severe weather:

- 11.1. Habitat shifting & alteration
- 11.2. Temperature extremes
- 11.4. Storms & flooding

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 threats. 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	2
Resistance to disease	3

Susceptibility to predation	3
Recovery from sedimentation	2
Resistance to sedimentation	2
Susceptibility to sedimentation	2
<i>Average</i>	3

8. Conservation and Research:

8.1 Summary

The species is listed as “last concern” 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 and further species-specific research for threats would support development and implementation of necessary legislation.

8.2 Conservation Actions/Research in Place

Globally, the species is listed within CITES Appendix II and listed as Last Concern within the IUCN Red List of Threatened Species.

8.3 Conservation Actions Needed

Recommended measures for conserving this species include research in abundance and trends, ecology and habitat status, threats and resilience to threats. Establishment and management of new protected areas; expansion of protected areas; recovery management; and disease, pathogen and parasite management are strongly suggested. Restoration action may include artificial asexual and sexual propagation. These strategies will become important for conserving coral biodiversity.

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

4. Education & awareness

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

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% reduction over next three 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. *P. maldivensis* is expected to experience ASB starting in 2041.

The species ranges between 5 m and 20 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.

Therefore, total population decline is anticipated over 100% of the species' depth range. In addition, this species is considered to have low resistance to bleaching, with high susceptibility to the same threat based on literature review and scientific expertise. Similarly, it is susceptible to diseases and predation.

Therefore, this species is projected to undergo a population reduction of 80-90% over the next three generations (2022-2052).

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	(i) EOO	-

Fluctuations?	(ii) AOO	-
	(iii) Locations / Subpopulations	-
	(iv)Mature Individuals	-

Assessment Under Criterion B DD

11. 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

12. CRITERION D

Criterion D

No. Mature Individuals		Unknown
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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

13. 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

14. Preliminary and Final Assessment

Preliminary Assessment CR A3ce

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

Final Assessment **CR A3ce**

Narrative Justification for Assessment:

Pavona maldivensis is likely distributed throughout all the atolls of the Maldives, with a depth range of 5-20 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.

This species has been identified as being susceptible to bleaching, to predation, and diseases. A key threat is extensive reduction in coral reef habitat, due to a combination of processes.

Although its population size is not known, we anticipate that this species will undergo a severe 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), Annual Severe Bleaching (ASB) is likely to commence in 2041 over this species' distribution, affecting 100% of its depth range. ASB reduces corals' ability to recover from repeated bleaching events, resulting in fundamental, permanent population changes (UNEP 2017). ASB is expected to constitute at least a 80-90% reduction in population size.

Therefore, we project a 80-90% population reduction over the next three generations (2022-2052), resulting from degradation in habitat quality associated with the impacts of climate change. This meets the threshold for CR A3c.

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