



Pavona venosa

Leaf Coral

Montano, S.

Citation: Montano, S., 2022. *Pavona varians*, Leaf Coral. The Maldives Red List of Threatened Species.

Maldives National Red List Assessment: *Pavona venosa*

A. Background Information

1. Assessment Information

Assessor Name	Simone Montano
Date of Assessment	10/02/2022
Contributors	Hana Amir, Phillipa Roe, Ilham Mohamed
Institutional contributors	Ministry of Environment, Climate Change and Technology; Maldives Marine Research Institute; IUCN Project REGENERATE; Maldives Allen Coral Atlas; Noo Raajje; Six Senses Laamu, MarHE center
Facilitators	James Tallant
Reviewers	Janice Chanson, Maldives Marine Research Institute

2. Taxonomic Information

Scientific Name	<i>Pavona venosa</i> (Ehremberg, 1834)	
Common Name (English)	Leaf coral	
Common Name (Dhivehi)	-	
Taxonomy	Order	Scleractinia
	Sub-order	-
	Family	Agariciidae
Taxonomic Notes	It does not appear to be molecularly distinguishable from <i>P. varians</i> (Terraneo 2017)	

3. Geographic Range

3.1 Summary of Global Distribution

Distinct populations can be found in the Indo-Pacific and Red Sea

3.2 Countries of Occurrence

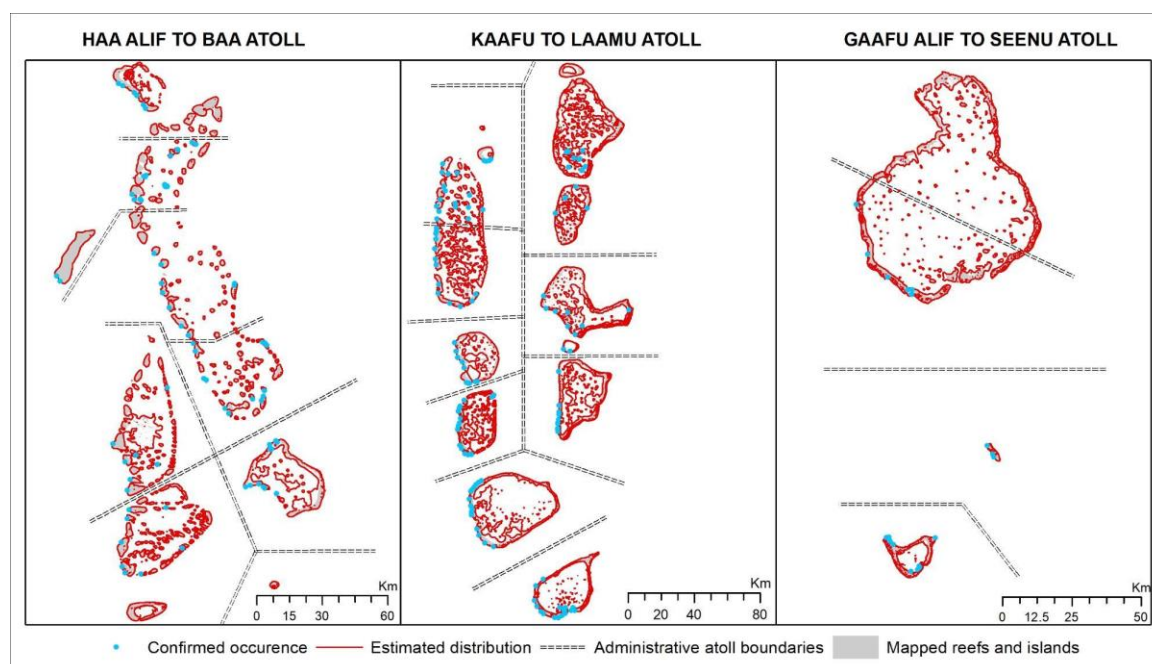
Australia; Bahrain; British Indian Ocean Territory; Cambodia; Christmas Island; Cocos (Keeling) Islands; Comoros; Djibouti; Egypt; Eritrea; Fiji; Guam; India; Indonesia; Iran, Islamic Republic of; Iraq; Israel; Japan; Jordan; Kenya; Kiribati; Kuwait; Madagascar; Malaysia; Maldives; Marshall Islands; Mauritius; Mayotte; Micronesia, Federated States of; Mozambique; Myanmar; Nauru; New Caledonia; Northern Mariana Islands; Oman; Pakistan; Palau; Papua New Guinea; Philippines;

Qatar; Réunion; Saudi Arabia; Seychelles; Singapore; Solomon Islands; Somalia; Sri Lanka; Sudan; Taiwan, Province of China; Tanzania, United Republic of; Thailand; Tuvalu; United Arab Emirates; Vanuatu; Viet Nam; 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 “uncommon”. 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

Global and national past population trends are unknown. 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 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 1 m and 20 m depths. The species occurs in a very wide range of marine environments, especially shallow reef slopes, but it may be common in some lagoons and sheltered upper reef slopes

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

-

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 (BBD, WS, UWS). Therefore, as the species is found 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. venosa* 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 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	1
Resistance to bleaching	1
Recovery from bleaching or disease	2
Resistance to disease	3
Susceptibility to predation	3
Recovery from sedimentation	3
Resistance to sedimentation	1
Susceptibility to sedimentation	3
<i>Average</i>	2

8. Conservation and Research

8.1 Summary

The species is listed as “Vulnerable” 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 Vulnerable within the IUCN Red List of Threatened Species.

8.3 Conservation Actions Needed

Recommended measures for conserving this species should include research in taxonomy, population, abundance and trends, ecology and habitat status, threats and resilience to threats. Disease, pathogen and parasite characterization should be a priority.

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% decline over the 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**

Our assessment of future population reduction is based on the projected date of onset of ASB. *P. venosa* is expected to experience ASB starting in 2041.

The species ranges between 1 m and 40 m although it is most commonly found at 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.

Therefore, total population decline is anticipated over nearly 100% of the species' depth range.

However, this species is relatively resistant to bleaching, with low susceptibility based on literature review and scientific expertise, but susceptible to diseases and predation.

Therefore, this species is projected to undergo a 80-90% population reduction 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	-
	(i) EOO	-

Extreme 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	
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)	-

14. Preliminary and Final Assessment

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:

Pavona venosa is likely distributed throughout all the atolls of the Maldives, with a depth range of 1-20 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.

C. References

Carpenter, K.E., Abrar, M., Aeby, G., Aronson, R.B., Banks, S., Bruckner, A., Chiriboga, A., Cortés, J., Delbeek, J.C., DeVantier, L., Edgar, G.J., Edwards, A.J., Fenner, D., Guzmán, H.M., Hoeksema, B.W., Hodgson, G., Johan, O., Licuanan, W.Y., Livingstone, S.R., Lovell, E.R., Moore, J.A., Obura, D.O., Ochavillo, D., Polidoro, B.A., Precht, W.F., Quibilan, M.C., Reboton, C., Richards, Z.T., Rogers, A.D., Sanciangco, J., Sheppard, A., Sheppard, C., Smith, J., Stuart, S., Turak, E., Veron, J.E.N., Wallace, C., Weil, E. and Wood, E. 2008. One-Third of Reef-Building Corals Face Elevated Extinction Risk from Climate Change and Local Impacts. *Science*. 25 July 2008: 560-563. DOI: 10.1126/science.1159196. Supporting online material: www.sciencemag.org/cgi/content/full.1159196.

Montano, S., Seveso, D., Maggioni, D., Galli, P., Corsarini, S., & Saliu, F. (2020). Spatial variability of phthalates contamination in the reef-building corals *Porites lutea*, *Pocillopora verrucosa* and *Pavona varians*. *Marine Pollution Bulletin*, 155, 111117.

Montano, S., Strona, G., Seveso, D., Maggioni, D., & Galli, P. (2015). Widespread occurrence of coral diseases in the central Maldives. *Marine and Freshwater Research*, 67(8), 1253-1262.

Pisapia, C., Burn, D., & Pratchett, M. S. (2019). Changes in the population and community structure of corals during recent disturbances (February 2016-October 2017) on Maldivian coral reefs. *Scientific reports*, 9(1), 1-12.

Rodriguez, L., García, J. J., Tuya, F., & Martínez, B. (2020). Environmental factors driving the distribution of the tropical coral *Pavona varians*: Predictions under a climate change scenario. *Marine Ecology*, 41(3), 1-12.

Terraneo, T. I., Arrigoni, R., Benzoni, F., Tietbohl, M. D., & Berumen, M. L. (2017). Exploring the genetic diversity of shallow-water Agariciidae (Cnidaria: Anthozoa) from the Saudi Arabian Red Sea. *Marine Biodiversity*, 47(4), 1065-1078.

UNEP 2017. Coral Bleaching Futures - Downscaled projections of bleaching conditions for the world's coral reefs, implications of climate policy and management responses. United Nations Environment Programme, Nairobi, Kenya.

UNEP 2020. Projections of future coral bleaching conditions using IPCC CMIP6 models: climate policy implications, management applications, and Regional Seas summaries. United Nations Environment Programme, Nairobi, Kenya.