



Acropora hyacinthus

Brush Coral

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
Maldives National Red List Assessment: *Acropora hyacinthus*

A. Background Information

1. Assessment Information

Assessor Name(s)	Ilham Mohamed
Date of Assessment	28 February 2022
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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
Facilitators	James Tallant
Reviewers	Janice Chanson, Maldives Marine Research Institute

2. Taxonomic Information

Scientific Name	<i>Acropora hyacinthus</i> [Dana, 1846]	
Common Name (English)	Brush Coral	
Common Name (Dhivehi)	Generic name: Muraka 	
Taxonomy	Order	Scleractinia
	Sub-order	-
	Family	Acroporidae
Taxonomic Notes	-	

3. Geographic Range

3.1 Summary of Global Distribution

Widely distributed in the Western Pacific and the Indian Ocean.

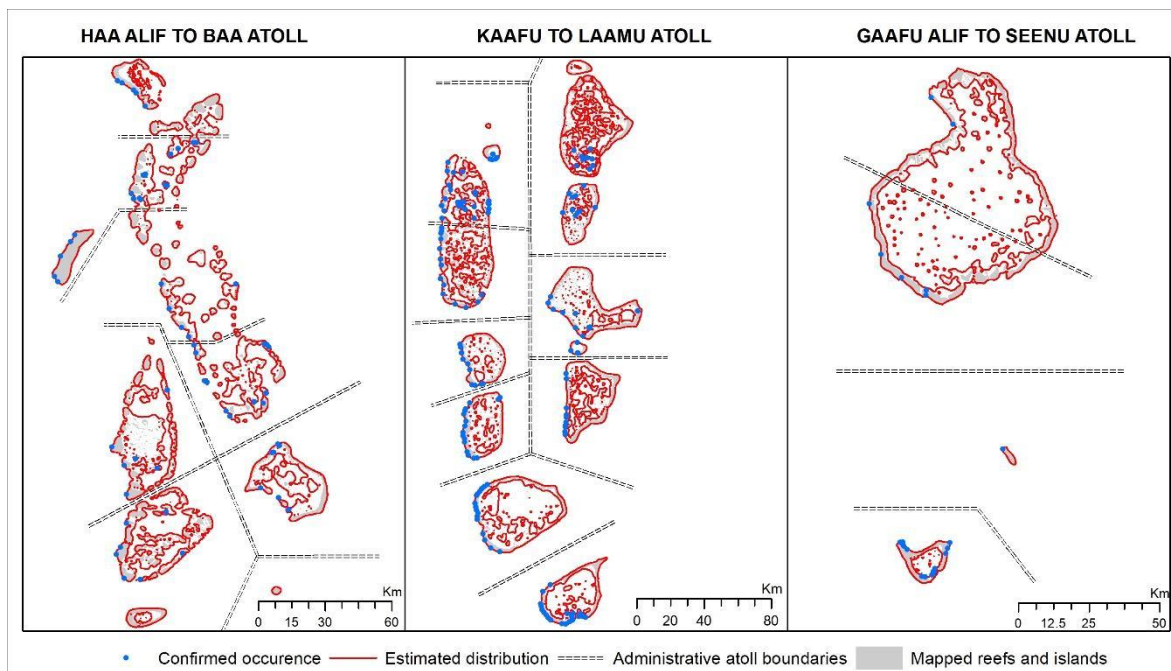
3.2 Countries of Occurrence

American Samoa; Australia; British Indian Ocean Territory; Cambodia; Chile; Christmas Island; Cocos (Keeling) Islands; Comoros; Cook Islands; Djibouti; Egypt; Eritrea; Fiji; French Polynesia; India; Indonesia; Japan; Kenya; Kiribati; Madagascar; Malaysia; Maldives; Marshall Islands; Mauritius; Mayotte; Micronesia, Federated States of ; Mozambique; Myanmar; Nauru; New Caledonia; Niue; Pakistan; Palau; Papua New Guinea; Philippines; Pitcairn; Réunion; Samoa; Saudi Arabia; Seychelles; Singapore; Solomon Islands; Somalia; South Africa; Sri Lanka; Sudan; Taiwan, Province of China; Tanzania, United Republic of; Thailand; Tokelau; Tonga; Tuvalu; 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 (Pichon and Benzoni 2007; Bigot and Amir 2012; Jimenez et al. 2012) and the genus has been widely observed nationwide (e.g., Ciara and Passeri 1993).

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



4. Population

4.1 Summary

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

Global species population is generalized as “Common” (Devantier, Turak and Szava-Kovats 2020). 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 species. This was used as a proxy for the potential species population size.

The ten-year generic percent cover mean derived from available data is $3.00 \pm 0.27\%$ (\pm S.E). Recent estimates indicate genus cover is between 3.00 – 5.00% across most atolls apart from Ari atoll where cover peaks between

~5.00 to ~10.00% (Noo Raajje 2021). Therefore, based on generic estimates the species population may vary between ~0.1 to ~10% cover assuming differing levels of dominance in a community

4.3 Population Trend

The global population of the species is decreasing.

The genus is known to fluctuate with bleaching events with population minimums recorded following these events, followed by a recovery. It is likely that similar patterns are observed for the species. However, not all morphologies of the genus are being observed to return suggesting not all species within the genus are recovering equally after each major decline after a bleaching event. Moreover, community compositions of reefs are shifting with the genus becoming less dominant suggesting a decline in overall population.

Hence, similar to global populations it is possible that national populations of this species may also be declining but insufficient information is available to accurately determine a percentage reduction over the past three generations.

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 in the shallow areas of the reef between 5 m and 20 m depths, the species occurs in upper reef slopes and outer reef flats (Veron et al., 2022).

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?

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 genus is known to be vulnerable to sedimentation (e.g. Humanes et al. 2017), bleaching (e.g., Sakai, Singh, and Iguchi 2019), predation by corallivores (e.g., COTS) and disease (e.g., Aeby et al. 2011). Though its growth rate is rapid compared to other genera, overall populations of acropora have been recorded to be slow to recover. Being located close to human habitation, either island communities or resorts, they are subject to stressors in the form of untreated sewage (where infrastructure is lacking), agricultural runoff and domestic waste. As the species is affected by overall declines in ecosystem and habitat quality. Therefore, as the species is found in shallow reef habitats (<20 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, *A. hyacinthus* is expected to undergo ASB starting in 2041.

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	3

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 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, the species is listed within CITES Appendix II and listed as Near Threatened on 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
- 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

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. *A. hyacinthus* is expected to undergo ASB starting in 2041 (less than three generations from the present). The species ranges between 5-20 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 relatively vulnerable to bleaching, with high susceptibility and low resistance based on literature review and scientific expertise. Therefore, total population decline is anticipated over 100% of the species' depth range.

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

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)	-

Assessment Under Criterion E DD

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 interactions with individuals outside the region

Final Assessment ~~CR A3ce~~ CR A3ce

Narrative Justification for Assessment:

Acropora hyacinthus is known from shallow reef systems throughout 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.

Acropora species are known to be impacted by threats including sedimentation, bleaching, predation by corallivores, and disease. *A. hyacinthus* has been identified as being vulnerable to bleaching, with high susceptibility and low resistance, vulnerable to predation, and vulnerable to loss of quality and quantity of suitable habitat.

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 (2022-52), resulting from degradation in habitat quality associated with the impacts of climate change. This meets the threshold for CR A3c.

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