The Maldives National Red List of Threatened Species
Scope: National
Language: English

Acropora clathrata

Roe, P.

Citation: Roe, P.,2022. *Acropora clathrate*. The Maldives Red List of Threatened Species

Maldives National Red List Assessment: *Acropora clathrata*

A. Background Information

1. Assessment Information

Assessor Name(s)	Philippa Roe
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2. Taxonomic Information

Scientific Name		*Acropora clathrata* (Brook 1981)
Common Name (English)		-
Common Name (Dhivehi)		Generic name: Muraka | ދުރަކަ
Taxonomy	Order	Scleractinia
	Sub-order	Astrocoeniina (Vaughan and Wells 1943)
	Family	Acroporidae
Taxonomic Notes		-

3. Geographic Range

3.1 Summary of Global Distribution

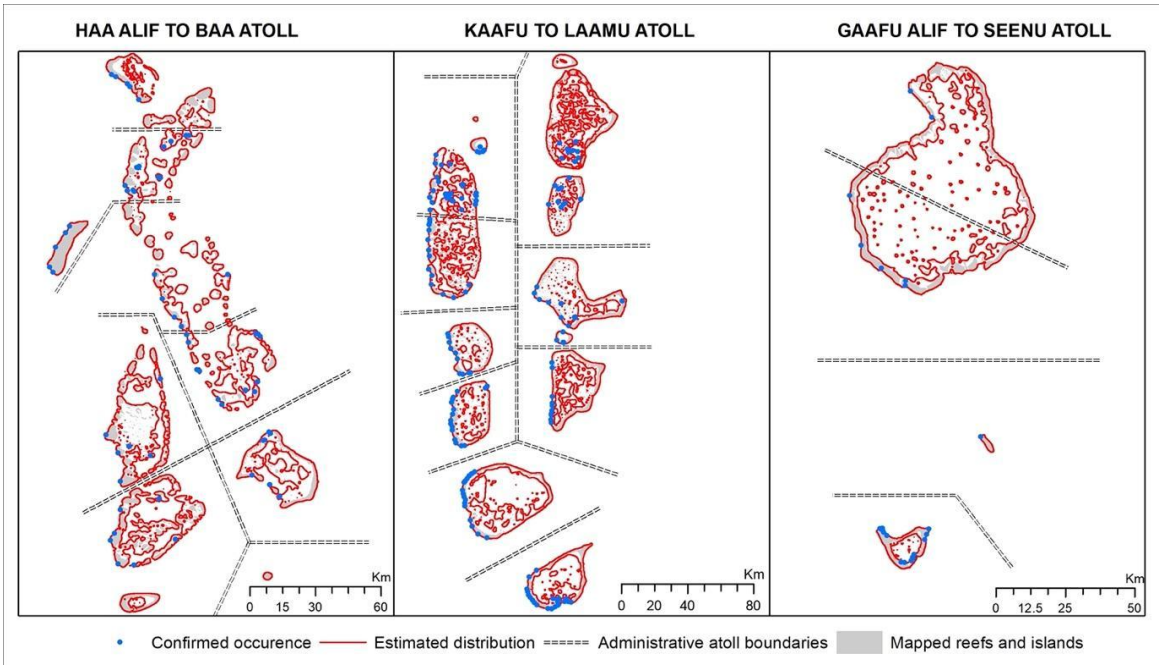
This species is widely distributed including the Red Sea and the Gulf of Aden, the south-west and northern Indian Ocean, the central Indo-Pacific, Australia, Southeast Asia, Japan and the East China Sea, the oceanic west Pacific and the central Pacific.

3.2 Countries of Occurrence

American Samoa, Australia, British Indian Ocean Territory, Cambodia, Comoros, Djibouti, Egypt, Eritrea, Fiji, French Polynesia, Guam, India, Indonesia, Israel, Japan, Jordan, Kenya, Kiribati, Madagascar, Malaysia, Maldives, Mauritius, Mayotte, Micronesia, Mozambique, Myanmar, Nauru, Australia, Niue, Oman, Palau, Papua New Guinea, Philippines, Qatar, Saudi Arabia, Seychelles, Singapore, Solomon Islands, Somalia, South Africa, Sri Lanka, Sudan, Taiwan, China, Tanzania, Thailand, Tonga, Vanuatu, Viet Nam, Yemen.

3.3 National Distribution

The exact distribution of this species is poorly known, although it has been recorded numerous times throughout the Maldives (Bigot & Amir, 2012; Jimenze et al. 2021; Pichon & Benzoni, 2007, Ciarapica & Passeri, 1993). At the genus level, there are confirmed occurrences from every atoll. Based on known observations, available data and species characteristics, it is estimated that it is distributed from north to south in the Maldives on outer reef and reef edge.



4. Population

4.1 Summary

Species specific population information, including exact population size and trends, is not available. Population estimates and distribution are derived based upon best available genus information and species characteristics and requirements.

4.2 Population Size

Species described as abundant and recorded in multiple occurrences in Maldives (Bigot & Amir, 2012; Jimenze et al. 2021; Pichon & Benzoni, 2007, Ciarapica & Passeri, 1993). 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 ± 0.27% (± 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 in the genera. 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?

This is not considered to be severely fragmented. It is described as widely distributed and found in multiple occurrences. Presumed well connected and cohesive based upon genus distribution although connectivity within and between atolls is unknown.

5. Habitat and Ecology

5.1 Summary

Occurs mostly in coral reef habitats in waters 8 m to 18 m depth and on outside reef or reef edge (Riegl et al., 1995).

5.2 Systems (terrestrial / freshwater / marine)

Marine.

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

Yes. There is a continuous decline in habitat with disturbance of shallow reefs via dredging and land reclamation. Additional declines in shallow reef ecosystems due to temperature induced bleaching events, in addition to further deterioration from structure breakdown and storms.

5.4 A Migratory Species?

No

6. Use and Trade

6.1 Is the species used or traded?

Unknown

6.2 Summary

Unlikely, due to deeper habitat preference.

7. Threats:

7.1 Summary

Species specific threats are unknown, and estimates are made based upon generic threats in addition to species characteristics and traits. Ecosystem threats include sedimentation and lowering light levels from dredging and land reclamation. This species is considered to be less susceptible to sedimentation due to being found on the reef edge or outside, as reclamation projects tend to take place within the lagoon or inside protected areas facing the inside of the Atoll. This form of threat is distributed throughout this genus's distribution.

Another threat is temperature rise and risk of bleaching. This genus is known to be highly susceptible to coral bleaching, although the proportion of colonies affected by successive bleaching events appears to decline (Pratchett et al., 2013).

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. clathrata is expected to undergo ASB starting in 2041.

Other threats include further ecosystem breakdown, induced by fishing pressure and breakdown of the shallow reef. In shallow reefs, reef breakdown causes further damage with storms damaging surviving corals with rubble.

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

<u>Residential & commercial development:</u>

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

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
2. Species stresses
2.2. Species disturbance

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	1
Susceptibility to predation	1
Recovery from sedimentation	3
Resistance to sedimentation	1
Susceptibility to sedimentation	1
Average	*2*

8. Conservation and Research:

8.1 Summary

This species is listed as 'Least Concern' on the IUCN RedList of Threatened species. Collection, killing and export of live and dead Scleractinia corals is illegal under Maldivian fisheries law. Distribution of the species falls under multiple national MPAs though these do not have effective management.

Species specific surveys are needed to better manage and protect this species, including understanding its distribution and the connectivity between shallow-reef threats, such as sedimentation by dredging, impacting outer reefs.

8.2 Conservation Actions/Research in Place

Globally, as a coral the species is included within CITES Appendix II. It is listed as "Least Concern" within the IUCN Red List of Threatened Species.

Nationally, collection, killing, and export of both live and dead Scleractinia corals (under phylum Cnidaria) are illegal in the Maldives under the Maldives Fisheries Law 2020/R-75. Marine protected areas are established throughout Maldives; however, they do not have effective management plans or procedures, therefore conservation of the species and genera cannot be assumed.

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
3.2. 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
1.1. Taxonomy
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 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**

Reasoning:

Our assessment of future population reduction is based on the projected date of onset of ASB. A. clathrata is expected to undergo ASB starting in 2041. The species has a depth range of 8-18 m, and therefore is fully 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 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 undergo reduction of 80-90% over the next three generations (2022 and 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 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 interaction with individuals outside the region

Final Assessment **CR A3ce**

Narrative Justification for Assessment:

Acropora clathrata is known from shallow reef systems throughout the Maldives, with a depth range of 8-18 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. Acropora clathrata has been identified as being vulnerable to bleaching (with high susceptibility and low resistance), vulnerable to predation, and vulnerable to loss of quality and extent 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 (2022-2052), resulting from degradation in habitat quality associated with the impacts of climate change. This meets the threshold for CR A3c.

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