Acropora rudis

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Roe, P.

Maldives National Red List Assessment: *Acropora Rudis*

A. Background Information

1. Assessment Information

Assessor Name(s)	Philippa Roe
Date of Assessment	17 February 2022
Contributors	Hana Amir, Simone Montano, 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
Facilitators	James Tallant
Reviewers	Janice Chanson, Maldives Marine Research Institute

2. Taxonomic Information

Scientific Name		*Acropora rudis (*Rehberg 1892)
Common Name (English)		Acropora rudis
Common Name (Dhivehi)		Generic name: Muraka | މުރަކަ
Taxonomy	Order	Scleractinia
	Sub-order	-
	Family	Acroporidae
Taxonomic Notes		-

3. Geographic Range

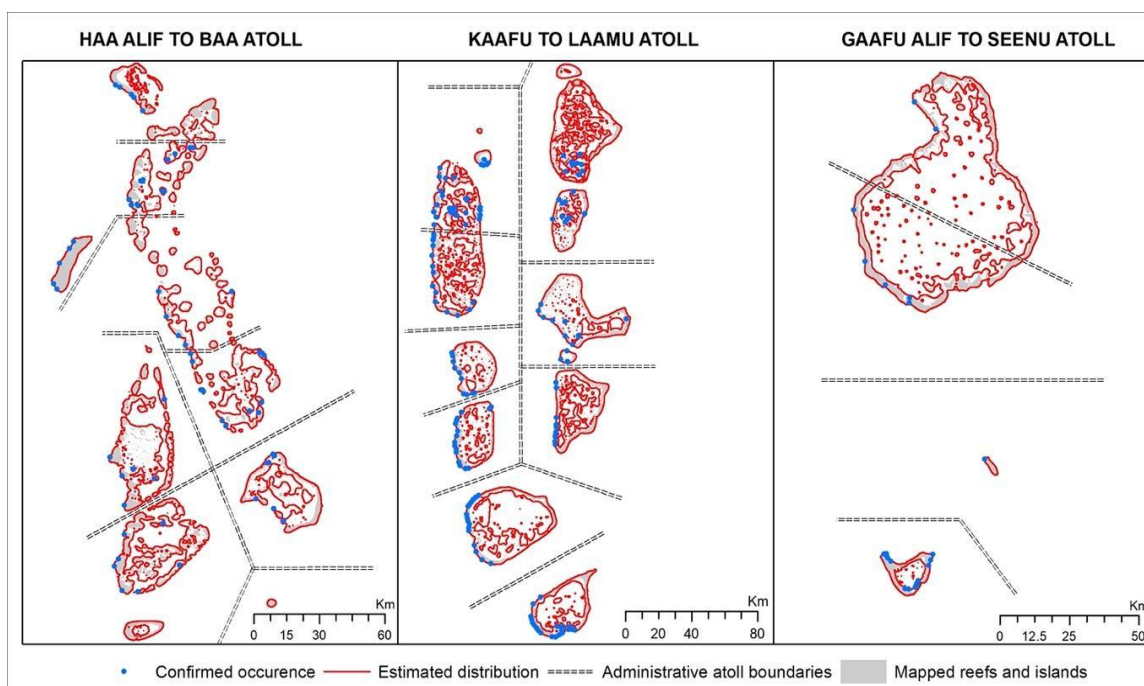#### 3.1 Summary of Global Distribution

Central and Eastern Indian Ocean, Indo-Pacific - uncommon and disjunct distribution and isolated regions.

3.2 Countries of Occurrence

Thailand, Indonesia, Andamans, American Samoa, Sri Lanka, Australia, American Samoa, Bangladesh, British Indian Ocean Territory, India, Malaysia, Maldives, Marutius, Mayamar, Samoa, Seychelles, Thailand

3.3 National Distribution

Although exact species distribution is unknown, its presence has been recorded in single occurrences in studies in Maldives (Bigot & Amir, 2012; Jimenze *et al.* 2021). However, the genus is widely recorded in every Atoll. Based on species characteristics and genus data it is estimated this species may be distributed from North to South of Maldives on mid-to lower mesophotic slopes (Turak & DeVantier, 2019), but is uncommon.

| HAA ALIF TO BAA ATOLL | KAAFU TO LAAMU ATOLL | GAAFU ALIF TO SEENU ATOLL |

• Confirmed occurence ——— Estimated distribution ===== Administrative atoll boundaries ▨ Mapped reefs and islands

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

The species is described as uncommon and are recorded in single occurrences in studying within Maldives (Bigot & Amir, 2012; Jimenze *et al.* 2021). 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, and likely to be lower due to low species records
.

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?

Yes

4.6 Extreme Fluctuations?

No

4.7 Severely Fragmented?

No. Although described as "fragmented and disjunct populations" or "isolated" (Wallace & Richards, 2001), this is unlikely to constitute severe fragmentation.

5. Habitat and Ecology

5.1 Summary

Occurs in the mesophotic zone within coral reef systems typically below 10 m depth on lower reef slopes, with water clarity less than 20 m visibility (Tarak & DeVentier, 2019). In Maldives it has also been observed at deeper than 30 m (pers. Obvs).

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 via dredging and land reclamation. Additional declines in shallow reef ecosystems due to temperature induced bleaching events may also impact the deeper reef slope, however the full extent of this is unknown. This species is found in deeper habitats with less direct impacts of destruction, can cope with lower light levels, however, general reef ecosystem breakdown will highly impact this genus and species.

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 preferences.

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, however, this species is tolerant to lower light conditions and this growth form has been found capable of shedding sediment when on downward slopes (which is this species habitat preference- Tarak & DeVantier 2019; Jones, Fisher & Bessell-Browne, 2019).

Another threat of temperature rise and risk of bleaching. This species is found to be highly susceptible to coral bleaching and slower to recruit than other growth forms of its genus (Burt, Bartholomew & Usseglio, 2008; Pratchett *et al.*, 2013; Bianchi *et al.*, 2006). Despite this, the genera exhibits declines in proportion of colonies affected by successive bleaching events (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. rudis* is expected to undergo ASB starting in 2041.

Other threats include further ecosystem breakdown, induced by fishing pressure and breakdown of the shallow reef-impacts unknown.

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

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
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	1
Resistance to bleaching	3
Recovery from bleaching or disease	3
Resistance to disease	2
Susceptibility to predation	1

Recovery from sedimentation	2
Resistance to sedimentation	1
Susceptibility to sedimentation	1
Average	2

8. Conservation and Research:

8.1 Summary
This species is listed as 'Endangered' on the IUCN Red List of Threatened species and is included in CITES Appendix II. 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 would be needed to better manage and protect this species, including understanding distribution and impact of shallow-reef threats to the deeper reef slope.

8.2 Conservation Actions/Research in Place
Globally, as a coral the species is included within CITES Appendix II. It is listed as "Endangered" 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. 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
    3.1.1. Harvest management

    3.2. Species recovery
4. <u>Education & awareness</u>
    4.1. Formal education
    4.2. Training
    4.3. Awareness & communications
5. <u>Law & policy</u>
    5.3. Private sector standards & codes
    5.4. Compliance & enforcement
      5.4.1. Scale unspecified
7. <u>External capacity building</u>
    7.1. Institutional & civil society development
    7.2. Alliance & partnership development
    7.3. Conservation finance

8.4 Research Needed

1. <u>Research</u>
 1.2. Population size, distribution and past trends
 1.3. Life history and ecology
 1.5. Threats
 1.6. Conservation actions
3. <u>Monitoring</u>
    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 (%)			60-70%
Meets Criteria Thresholds?	A1		-
	A2		-
	A3		Projected 60-70% decline over the next 3 generations (EN 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. rudis* is expected to undergo ASB starting in 2041 (less than three generations from the present). However, the species has

a depth range of 10 - >30 m. Only part of its depth range is 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, a portion of this species' distribution is less likely to experience ASB within the next three generations.

This species is considered to be moderately vulnerable to bleaching, with high susceptibility and low resistance based on literature review and scientific expertise.

Therefore, although this species is projected to undergo ASB within the next three generations, as a portion of the species' range is deeper than 30 m (and therefore less impacted by bleaching), we project a population reduction of ≥60% between 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		-
	(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)	-

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 rudis is known from shallow reef systems throughout the Maldives, with a depth range of 10 m to greater than 30 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 rudis* has been identified as being moderately vulnerable to bleaching, vulnerable to predation, and vulnerable to loss of quality and extent of suitable habitat.

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. ASB reduces corals' ability to recover from repeated bleaching events, resulting in fundamental, permanent population changes (UNEP 2017).

However, as this species has a depth range of 10 m to greater than 30 m, a portion of this range (deeper than 30 m) is relatively well protected from temperature fluctuations, and therefore less likely to experience ASB within the next three generations.

Therefore, we project a 60-70% 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 EN A3c.

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