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

Goniopora stokesi

Anemone coral

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Maldives National Red List Assessment: *Goniopora stokesi*

A. Background Information

1. Assessment Information

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2. Taxonomic Information:

Scientific Name		*Goniopora stokesi* (Milne Edwards & Haime, 1851)
Common Name (English)		Anemone coral
Common Name (Dhivehi)		Genus name: Maaga’ndu hiri | މާގަނޑު ހިރި
Taxonomy	Order	Scleractinia
	Sub-order	-
	Family	Poritidae
Taxonomic Notes		-

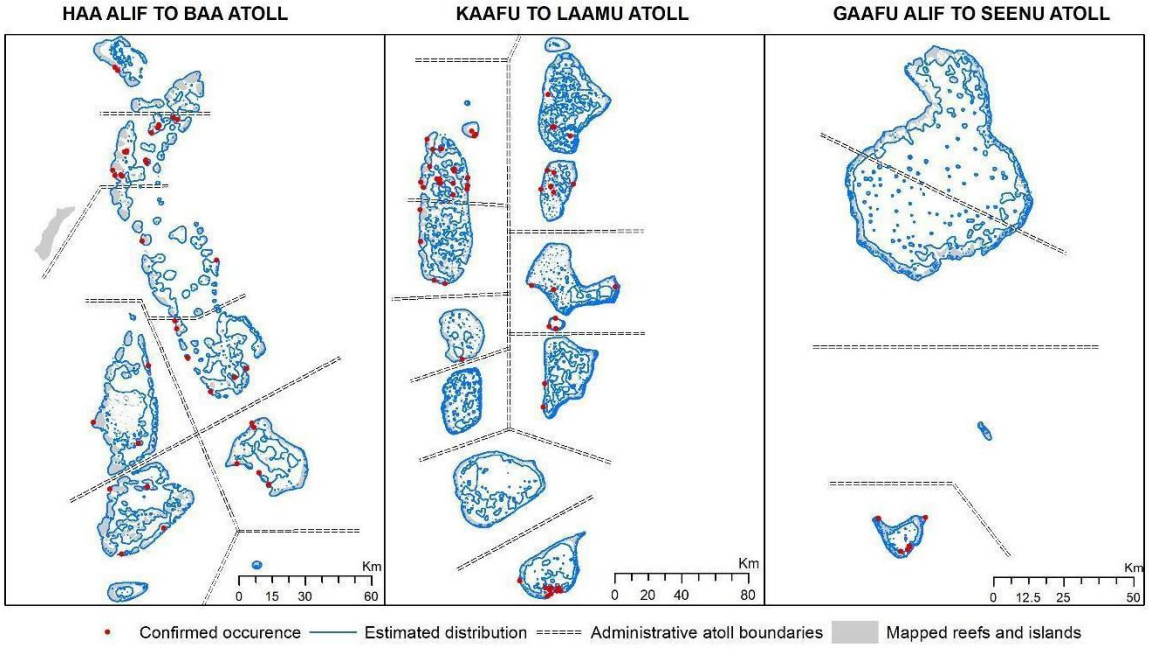
3. Geographic Range:

Summary of Global Distribution	The species is found along the Red Sea, the Gulf of Aden, Southwest, Northwest and North Indian Ocean, throughout the central Indo-pacific, Australia, Southeast Asia, Japan, South China Sea, and the oceanic west pacific (Sheppard et al., 2008).
Countries of Occurrence	Australia, British Indian Ocean Territory, Cambodia, Comoros, Djibouti, Egypt, Eritrea, Fiji, India, Indonesia, Israel, Japan, Jordan, Kenya, Kiribati, Madagascar, Malaysia, Marshall Islands, Mauritius, Mayotte, Micronesia, Mozambique, Myanmar, Nauru, New Caledonia, Pakistan, Palau, Papua New Guinea,

Philippines, Reunion, Saudi Arabia, Seychelles, Singapore, Solomon Islands, Somalia, Sri Lanka, Sudan, Taiwan, Tanzania, Thailand (Sheppard et al., 2008)

National distribution

Presence records for the species are available in literature (Pichon and Benzoni 2007) though the exact national distribution is unknown. The genus has been either recorded or observed in nearly 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 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

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 mean derived from available data is 1.85 ± 0.39% (± S.E). Therefore, based on generic estimates the species population may vary between 1.85 ± 0.39% cover assuming differing levels of dominance in a community

4.3 Population Trend

Global and national past population trends are currently unknown. Future population trends are 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 and mode of reproduction, although degree of connectivity (genetic or otherwise) within and between atolls is unknown

5. Habitat and Ecology:

5.1 Summary

The species can be found between 2-30 m. Unlike others of this genera, the species can be found on soft substrates and often free-living (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?

Potentially.

6.2 Summary

The genus is collected for aquaria so there is a possibility the species is collected by chance. This harvesting is unlikely to represent a threat to the species.

7. Threats:

7.1 Summary

Species specific threats are not known. The genus is well known to be resilient to bleaching (Baird et al., 2009; Ng et al., 2020) and sedimentation (Junjie et al., 2014). However, as the species is found in shallow reef habitats (<30 m), it is expected that the species is 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, *G. stokesi* 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

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
2.3. Indirect species effects
2.3.2. Competition
2.3.7. Reduced reproductive success

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	1

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

8. Conservation and Research:

8.1 Summary

The species is 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, as a coral the species is included within CITES Appendix II. It is 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
3.4. *Ex situ* conservation
3.4.1. Captive breeding/artificial propagation
3.4.2. Genome resource bank
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

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 (%)		30-40%
Meets Criteria Thresholds?	A1	-
	A2	-
	A3	Projected 30-40% reduction over the next three generations (VU 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 VU A3ce

Reasoning:

Our assessment of future population reduction is based on the projected date of onset of ASB. *G. stokesi* is expected to undergo ASB starting in 2041.

The species ranges between 2-30 m and 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.

However, the species is considered to be relatively resilient to bleaching, with low susceptibility and high resistance, based on literature review and scientific expertise. In addition, the species has the capability to be free-living and can often be found on soft sediments suggesting populations of the species could be found off coral reefs. This can allow the species to exist in habitats where other hard corals are absent which can reduce competition for the same resources. Therefore, the population reduction is likely to not be as severe as that of other coral species.

This species is projected to undergo population reduction of 30-40% 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 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 VU A3c

Regional	Up-list, Down-list, or No Change?	No change

Adjustment	Justification for Regional Adjustment	No likely interaction with individuals outside the region

Final Assessment VU A3c

Narrative Justification for Assessment:

Goniopora stokesi is likely distributed throughout all the atolls of the Maldives, with a depth range of 2-30 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.

Although the current population size and past rate of decline are not known, it is anticipated that the species will undergo a reduction 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), it is estimated that ASB will commence in the year 2041 over this species' distribution, affecting 100% of its depth range.

However, the species has been identified as being relatively resilient to bleaching (with low susceptibility and high resistance), robust to predation, and only moderately vulnerable to loss of quality and quantity of suitable habitat. In addition, the species has been noted to have the capacity to be free-living on soft sediments, indicating that they may have off-reef populations.

Given its traits for resilience and capacity to thrive in soft sediments, it is anticipated that ASB will constitute only a 30-40% reduction in population size for this species.

Based on the best available data, we project a 30-40% reduction in population size within the next three generations (2022-52), prompted by degradation in habitat quality associated with the impacts of climate change. This meets the threshold for Vulnerable under Criterion A3c.

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