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

Galaxea astreata

Octopus coral

Amir, H.

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Maldives National Red List Assessment: *Galaxea astreata*

A. Background Information

1. Assessment Information:

Assessor Name(s)	Hana Amir
Date of Assessment	3 March 20222
Contributors	Phillipa Roe, 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		*Galaxea astreata* (Lamarck, 1816)
Common Name (English)		Octopus coral
Common Name (Dhivehi)		Generic name: Ufuli gaa | ދުއްލިގަ
Taxonomy	Order	Scleractinia
	Sub-order	-
	Family	Euphylliidae
Taxonomic Notes		Originally *Caryophillia astreata* (Lamark, 1816)

3. Geographic Range:

3.1 Summary of Global Distribution

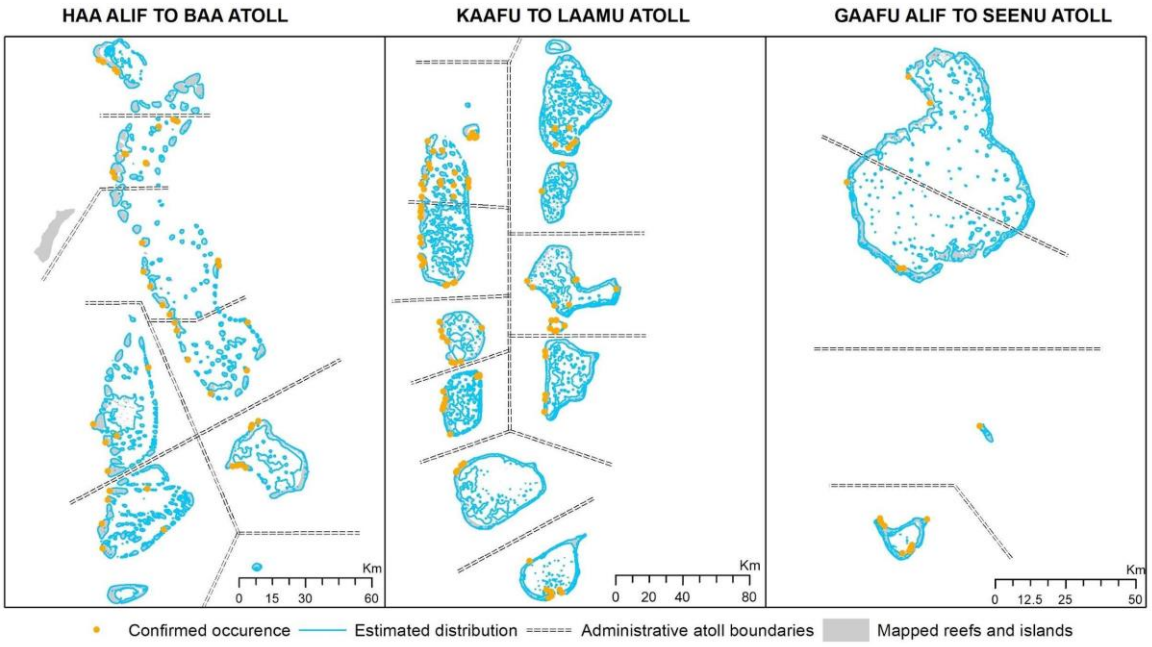
The species is found from the Red Sea, the Gulf of Aden, through southwestern and central Indian Ocean, central Indo-Pacific, Australia, Japan, South China Sea and the oceanic west pacific (Hoeksema et al., 2008).

3.2 Countries of Occurrence

American Samoa, Australia, British Indian Ocean Territory, Cambodia, China, 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, Samoa, Saudi Arabia, Seychelles, Singapore, Solomon Islands, Somalia, Sri Lanka, Sudan, Taiwan, Tanzania, Thailand, Tokelau, Tonga, Tuvalu, Vanuatu, Vietnam, Wallis and Futuna, Yemen (Hoeksema et al., 2008).

3.3 National Distribution

Exact species distribution is unknown. There are confirmed records of the species (Pichon and Benzoni 2007) and the genus has been recorded from most atolls within the Maldives. Based on observations, confirmed genus data, available data, and species characteristics, it is estimated that the genus is widely distributed from the North to the South of the Maldives. Hence, depending on the depth and habitat, it is possible that species is also widely distributed across all the atolls.



4. Population:

4.1 Summary

There is no species-specific population information available. Therefore, population size, trends and distribution are estimated from generic information.

4.2 Population Size

Global 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 genus. This was used as a proxy for the potential species population size.

The ten-year generic mean derived from available data is 0.54 ± 0.70% (± SE). Recent estimates indicate cover is between >0.00 and ~5.00% (Noo Raajje 2021). Therefore, based on generic estimates the species population may vary between ~>0.0 to ~5% cover assuming differing levels of dominance in a

community.

4.3 Population Trend

Global and national past population trends are not known. However, although the species is thought to be relatively resistant to bleaching, local records indicate that the species is highly impacted by thermal stress anomalies and is vulnerable to bleaching. Future population trends are therefore 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 on mid to low slopes on reef habitats between depths of 1m and 30m. It is generally found in locations that are protected from exposure and wave action (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?

Yes

6.2 Summary

The species is collected for aquarium use. This harvesting may represent a threat to the species.

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 with low recovery (Junjie et al., 2014) and vulnerable to coral disease (Ammar et al., 2011). While recovery from bleaching has been noted to be variable within this genus (Li et al., 2012), it is highly susceptible to bleaching (McClanahan and Muthiga 2014; Ibrahim et al., 2017; Obura 2001). As the species is found in shallow habitats (<30 m), it is expected that it is vulnerable to both coastal development and climate change impacts. Moreover, 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.

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. astreata* is expected to undergo ASB starting in 2041.

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

1. <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

5. Biological resource use:

5.4. Fishing & harvesting aquatic resource

5.4.3. Unintentional effects: subsistence/small scale

Timing: Ongoing

Stresses:

1. Ecosystem/Community stresses

1.2. Ecosystem degradation

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

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
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
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	2
Susceptibility to predation	2
Recovery from sedimentation	2
Resistance to sedimentation	2
Susceptibility to sedimentation	2
Average	*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 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 "Vulnerable" 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. 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
3.3. Trade 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. *G. astreata* is expected to experience ASB starting in 2041.

The species ranges between 1-30 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.

This genus was noted to be one that bleached intensely in the Maldives in 2016 and the species has been noted as susceptible to bleaching events, suggesting that it is highly vulnerable to thermal stress (McClanahan and Muthiga 2014; Ibrahim et al., 2017; Obura 2001). A decline of the population is expected over 100% of its depth range.

Therefore, this species is projected to undergo a reduction of 80-90% 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	**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:

Galaxea astreata is likely distributed throughout all of the atolls of the Maldives, with a depth range of 1-30 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.

The genus has suffered in the most recent bleaching event in the Maldives and is known to be highly susceptible to bleaching with low resilience. In addition, it is vulnerable to disease and sedimentation,

Although the current population size and past rate of decline are not known, it is anticipated that the population will undergo a significant 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), it is estimated that Annual Severe Bleaching (ASB) will commence in the year 2041 over this species' distribution, affecting 100% of its depth range. ASB is expected to constitute a 90-100% reduction in population size.

Therefore, based on the best available data, we project a 80-90% decline 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 CR A3c.

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