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

Stylophora subseriata

Birdsnest coral, brush finger coral

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Citation: Amir, H., 2022. *Stylophora subseriata*. Birdsnest coral, brush finger coral. The Maldives Red List of Threatened Species.

Maldives National Red List Assessment: *Stylophora subseriata*

A. Background Information

1. Assessment Information

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2. Taxonomic Information

Scientific Name		*Stylophora subseriata* (Ehrenberg, 1834)
Common Name (English)		Birdsnest coral, Brush finger coral
Common Name (Dhivehi)		-
Taxonomy	Order	Scleractinia
	Sub-order	-
	Family	Pocilloporidae
Taxonomic Notes		Originally Porites subseriata (Ehrenberg 1834)

3. Geographic Range

3.1 Summary of Global Distribution

The species' range stretches along the southwest Indian Ocean, the Gulf of Aden, the Red Sea through the Arabian Gulf to the northwest Indian Ocean (Hoeksema et al., 2008).

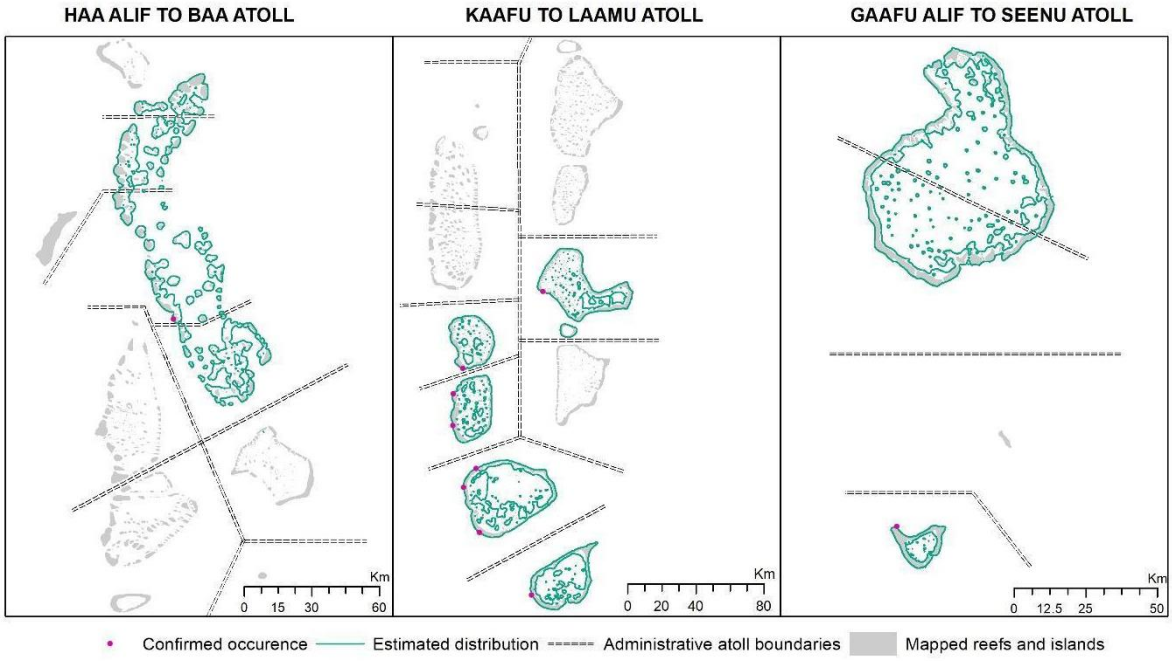
3.2 Countries of Occurrence

Australia, Bahrain, British Indian Ocean Territory, Comoros, Djibouti, Egypt, Eritrea, Fiji, Indonesia, Islamic Republic of Iran, Israel, Jordan, Kenya, Kiribati, Kuwait, Madagascar, Malaysia, Marshall Islands, Mauritius, Mayotte, Federated States of Micronesia, Mozambique, Nauru, New Caledonia, Oman, Pakistan, Palau, Papua New Guinea, Philippines, Qatar, Reunion, Saudi Arabia, Seychelles, Singapore, Solomon Islands, Somalia, South Africa, Sudan, Tanzania, United Republic of Thailand, Tuvalu, United Arab Emirates, United States Minor Outlying Islands, Vanuatu, Yemen (Hoeksema et al., 2008).

3.3 National distribution

The species distribution is unknown. Most historical records have the genus restricted to the central-southern and southern atolls. The genus has recently been recorded in Shaviyani, Vaavu, Faafu, Dhaalu, Meemu, Laamu, Huvadhoo and Addu atoll.

Based on observations, data records and species characteristics, it is estimated that this species is likely to be found throughout these atolls. As Shaviyani atoll is part of a bigger geographic atoll ("Bodu Thiladhumathi"), the distribution from the Shaviyani record has been extrapolated for the entire structure. The species is restricted to shallow reef systems and may not be found in the deep atoll lagoons. However, its distribution is estimated wider than that of *S. pistillata* as this species has a wider depth range.



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 "Common". National 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 less than 0.23 ± 0.08% (± S.E). However, this is derived from less than 15 data records.

4.3 Population Trend

Global and local past population trends are not yet known. However, populations have been noted to have been more abundant prior to the 1998 bleaching event with recent sightings considered "rare". The species has been recorded in

the early pioneering expeditions of the Maldives (Pichon and Benzoni 2007) but without population information required to assess a trend. Future population trend is 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?

Unknown. Potentially fragmented. However, populations appear to be restricted to a limited number of atolls within the Maldives.

5. Habitat and Ecology

5.1 Summary

The species is found on various reef habitats. However, its preferred habitat is recorded as mid to slow sloped environments within various types of reefs. The species can be found between 2 m and 30 m depths (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

This species is targeted and harvested for the aquarium trade. This harvesting may represent a threat to the species.

7. Threats

7.1 Summary

Specific species threats are not known. The species is likely vulnerable to sedimentation (Ammar et al., 2011), bleaching (Bhagooli and Hidaka 2004; Fitt et al., 2009; Yakovleva and Hidaka 2004), predation, and coral disease (Aeby et al. 2021). Additionally, the species is slow to recover from bleaching and disease once affected.

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, *S. subseriata* is expected to undergo ASB starting in 2040.

Though not formally recorded within the Maldives, the species is one that is targeted and harvested for the aquarium trade globally.

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

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

7.2 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 "Least Concern" on the IUCN Red List of Threatened species and is listed on 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 and support the development and implementation of necessary legislatures. Targeted studies are required to understand whether and to what degree the species is locally exploited for the aquarium trade or propagations projects.

8.2 Conservation Actions/Research in Place

Globally, as a coral the species is listed 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 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

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 the 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. *S. subseriata* is expected to experience ASB starting in 2040.

The species has a depth range 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.

The species range is also limited with records from only a few atolls.

The species is likely to be relatively vulnerable to bleaching (Bhagooli and Hidaka 2004; Fitt et al., 2009; Yakovleva and Hidaka 2004), sedimentation (Ammar et al., 2011) and coral disease (Aeby et al., 2021) with high susceptibility and low resilience 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 in population size 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**

10. 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:

Stylophora subseriata appears to be distributed in only a few 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.

This species is likely to be relatively vulnerable to bleaching, sedimentation, and coral disease (with high susceptibility and low resistance).

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 2040 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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