



Heterocyathus aequicostatus

Striped bum coral

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Maldives National Red List Assessment: *Heterocyathus aequicostatus*

A. Background Information

1. Assessment Information:

Assessor Name(s)	Hana Amir
Date of Assessment	10 February 2022
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2. Taxonomic Information:

Scientific Name	<i>Heterocyathus aequicostatus</i> (Milne Edwards & Haime, 1848)	
Common Name (English)	Striped bum coral	
Common Name (Dhivehi)	None	
Taxonomy	Order	Scleractinia
	Sub-order	-
	Family	Caryophylliidae
Taxonomic Notes	-	

3. Geographic Range:

3.1 Summary of Global Distribution

The species is found in the northern Indian Ocean, the central Indo-Pacific, Australia, and the oceanic west Pacific (Hoeksema et al., 2008).

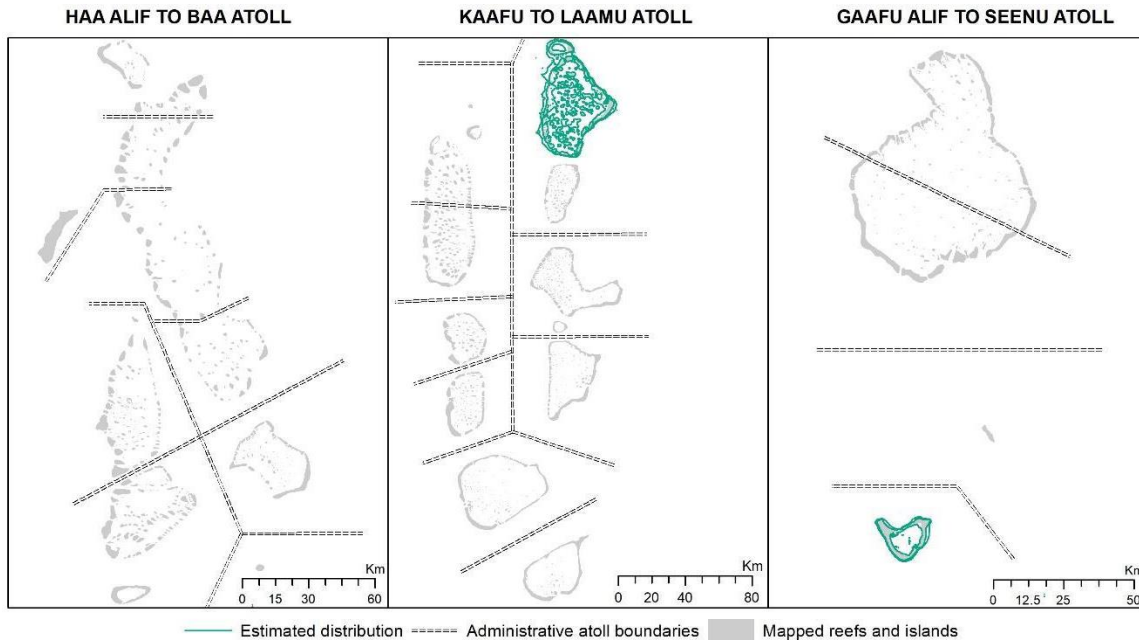
3.2 Countries of Occurrence

Australia, Cambodia, Fiji, Indonesia, Malaysia, Maldives, Marshall Islands, Micronesia, Nauru, New Caledonia, Palau, Papua New Guinea, Philippines, Singapore, Solomon Islands, Thailand, Tuvalu, Vanuatu, Wallis and Futuna (Hoeksema et al., 2008)

3.3 National Distribution

The species has been recorded in both North Male' and Addu atoll. Given its depth range it's possible that species could be found throughout the atoll where depth is greater than 15 m and suitable substrate is available.

As the species is found at depths that are frequently not surveyed or are beyond the legal dive limit, it is possible that species could be distributed throughout all the atolls of the Maldives. However, without confirmed observations or data, these regions are not included in the distribution.



4. Population:

4.1 Summary

Very little is known about the species population and its trends both locally and globally. The species has been recorded as present from locations within the Maldives, but no exact population information is known.

4.2 Population Size

Both global and national population sizes are unknown. The species has been recorded from two atolls, but no population data is available.

4.3 Population Trend

Global and national past population trends are 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?

Unknown

5. Habitat and Ecology:

5.1 Summary

The species is free-living single polyp coral which prefers soft substrates with horizontal or gentle slopes. They are found associated with *Heterospammia* spp and *Cycloseris* spp. They are generally found between 15 m and 40 m depths though they have been occasionally recorded at 100m (Fisk 1983).

5.2 Systems (terrestrial / freshwater / marine)

Marine

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

Exact declines in area, extent and/or quality of habitat are unknown. However, it is expected to be in decline or headed to decline due to the expansive dredging operations within the country.

5.4 A Migratory Species?

No

6. Use and Trade

6.1 Is the species used or traded?

Unknown

6.2 Summary

-

7. Threats:

7.1 Summary

Species specific threats are not known. However, the species is vulnerable to climate change impacts such as coral bleaching (Hoeksema and Matthews 2015). Recent records of the species have been from EIA and dredge sediment reporting that have included the species within their sediment grabs (e.g., Jameel 2022). It is possible that unknown populations have been affected by dredgers collecting material for reclamation and other coastal projects.

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, *H. aequicostatus* is expected to undergo ASB starting in 2038.

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

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	2
Resistance to bleaching	2
Recovery from bleaching or disease	2
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 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. A considerable amount of research is necessary to understand species taxonomy, abundance, population trends and distribution within the Maldives.

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 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 A1 Thresholds?	-
	A2 -
	A3 Projected population reduction of 30-40% over the next three generations (VU A3)
	A4 -
Reduction Based on Which Sub-criteria?	a -
	b -
	c Decline in habitat quality associated with 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. *H. aequicostatus* is expected to undergo ASB starting in 2038. The species ranges between 15-40 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.

While the species has previously been thought to be relatively resilient to bleaching in the shallows, it has recently been reported to have partially bleached during a thermal stress event (Hoeksema and Matthews 2015), suggesting it may be vulnerable to events that increase in frequency and magnitude. Therefore, its previously reported resilience to bleaching may not be a reliable trait and may wither with increasing frequency and magnitude of thermal stress events.

The species also prefers sandy/silty substrate bottoms and has the capacity to survive off-reef and at deeper depths. While this can offer a refugia for bleaching events at depths <30m, the habitat and depth are frequently used to collect reclamation material through dredging within the country. Therefore, it is possible that portions of the population that could replenish the population after a bleaching event are being removed, making population recovery questionable.

Hence, while 60% of its depth range is expected to undergo ASB, it is likely that the resulting population reduction will be much less severe than it would otherwise.

As such, this species is projected to undergo a reduction in population size 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 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 VU A3ce

Narrative Justification for Assessment:

While *Heterocyathus aequicostatus* is known from only a few atolls in the Maldives, it may actually be much more widely distributed, especially off reefs on sandy/silt bottoms. The species has a depth range of 15-40 m. This means that a portion of its distribution (depths less than 30 m) is vulnerable to extreme and fluctuating 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 population 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 Annual Severe Bleaching (ASB) will commence in the year 2041 over this species' distribution, affecting 60% of its depth range.

The species was previously thought to be relatively resilient to bleaching (with low susceptibility and high resilience), however recent reports suggest that this may either not be the case for all individuals, or not be the case with increased magnitude and frequency of thermal stress events.

The fact that this species has some resilience to bleaching, and is found off-reef and at deeper depths, means that ASB is expected to only result in a 30-40% reduction in population size.

Therefore, 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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