



Physogyra lichtensteini

Pear bubble coral

Basheer, A.

Citation: Basheer, A., 2022. *Physogyra lichtensteini*, Pear bubble coral. The Maldives Red List of Threatened Species.

Maldives National Red List Assessment: *Physogyra lichtensteini*

A. Background Information

1. Assessment Information

Assessor Name(s)	Ahmed Basheer
Date of Assessment	18 February 2022
Contributors	Hana Amir, Phillipa Roe, Ilham Mohamed, Simone Montana
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, ZSL, EDGE of Existence Programme, Zoological Society of London, UK.
Facilitators	James Tallant
Reviewers	Janice Chanson, Maldives Marine Research Institute

2. Taxonomic Information

Scientific Name	<i>Physogyra lichtensteini</i> (Milne Edwards & Haime, 1851)	
Common Name (English)	Pear bubble coral	
Common Name (Dhivehi)	No species name Vai boki gaa	
Taxonomy	Order	Scleractinia
	Sub-order	-
	Family	Euphyllidae
Taxonomic Notes	-	

3. Geographic Range

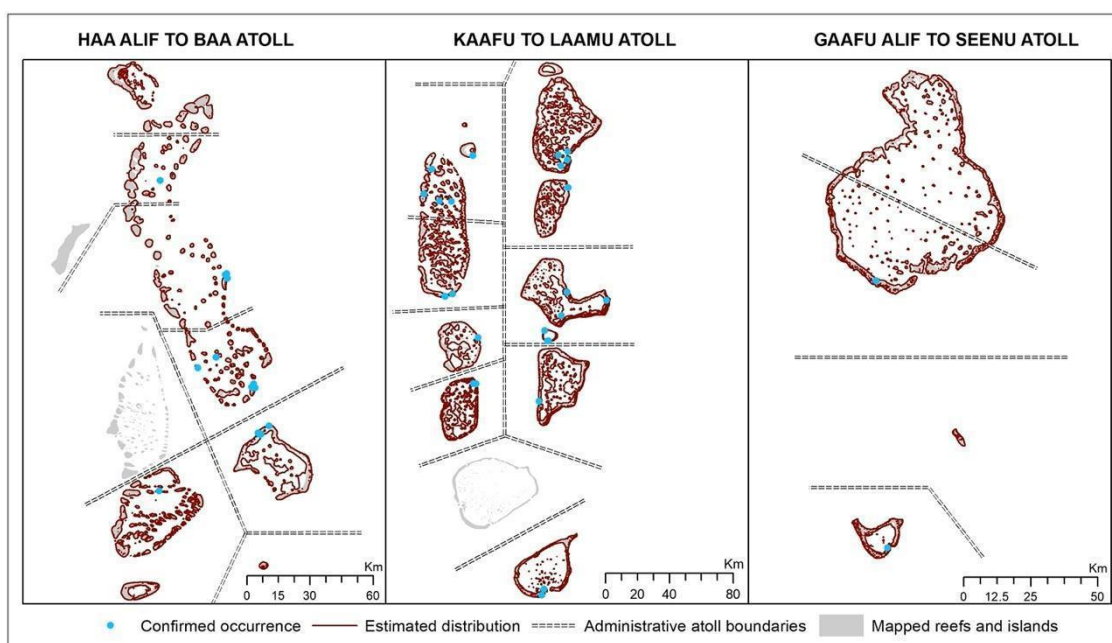
3.1 Summary of Global Distribution

This species is widespread and uncommon throughout its range. It can be found in the south-west and northern Indian Ocean, the central Indo-Pacific, Australia, Japan and the East China Sea, and the oceanic west Pacific. It is found in Southeast Asia, the central Pacific (Richards pers. comm.) and Palau (Randall 1995).

3.2 Countries of Occurrence

Australia; British Indian Ocean Territory; Comoros; Fiji; India; Indonesia; Japan; Kiribati; Madagascar; Malaysia; Maldives; Marshall Islands; Mauritius; Mayotte; Micronesia, Federated States of; Mozambique; Myanmar; Nauru; New Caledonia; Palau; Papua New Guinea; Philippines; Réunion; Seychelles; Singapore; Solomon Islands; Sri Lanka; Taiwan, Province of China; Thailand; Tuvalu; Vanuatu
National distribution

Although exact species distribution is unknown, presence records for the species are available in some literature. It is the only species in this genus. Data confirms that the species is recorded in 7 atolls, and it is estimated that this species is likely to be distributed throughout the country.



4. Population

4.1 Summary

Species-specific population information, including exact population size, is not available. Population estimates and distribution are derived based on best available generic information.

4.2 Population Size

The global population size is generalized as “common” (Devantier, Turak and Szava-Kovats 2020). National population size is unknown.

A ten-year generic means, the mean percentage 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 percent cover mean derived from available data is $0.47 \pm 0.19\%$ (\pm S.E).

4.3 Population Trend

Global and national past population trends are unknown. 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?

No. Population assumed to be cohesive based on generic distribution although degree of connectivity between atolls is unknown.

5. Habitat and Ecology

5.1 Summary

These species are commonly found in protected habitats such as crevices and overhangs, especially in turbid water with tidal currents (Veron and Pichon 1980); (Veron et al, 2000).

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 harvested for use in coral nurseries and illegally harvested for aquarium trade. This harvesting may represent a threat to the species.

7. Threats

7.1 Summary

This species is known to be vulnerable to bleaching and diseases. The species is also affected by overall declines in ecosystem and habitat quality. Therefore, as the species is found in shallow reef habitats (<20 m), it is expected that the species is particularly 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, *P. lichtensteini* 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*

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*

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

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	3
Susceptibility to predation	2
Recovery from sedimentation	1
Resistance to sedimentation	1
Susceptibility to sedimentation	1
Average	2

8. Conservation and Research

8.1 Summary

The species is globally 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

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 and 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

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 (%)	80-90%
Meets Criteria Thresholds?	A1
	A2
	A3 Projected reduction in population size of 80-90% 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 **CR A3ce** Criterion A

Reasoning Our assessment of future population reduction is based on the projected date of onset of ASB. *Physogyra Lichtensteini* is expected to experience ASB starting in 2041.

The species ranges between 5 m and 20 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, total population decline is anticipated over 100% of the species' depth range. In addition, this species is considered to have low resistance to bleaching, with high susceptibility to the same threat based on literature review and scientific expertise. Similarly, it is susceptible to diseases and predation.

Therefore, this species is projected to undergo a population 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	-

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:

Although uncommon, *Physogyra lichtensteini* is known from shallow reef systems throughout the Maldives, with a depth range of 5-20 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 known to be impacted by threats including bleaching and disease.

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), it is estimated that Annual Severe Bleaching (ASB) is likely to commence in 2041 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.

C. References

Basheer, A. R., Pisapia, K., Najeeb, C., Rilwan, A., Naeem, Y., Fisam, A., ... & Fisam, A. Pearl Bubble coral, *Physogyra lichtensteini*.

Carpenter, K.E., Abrar, M., Aeby, G., Aronson, R.B., Banks, S., Bruckner, A., Chiriboga, A., Cortés, J., Delbeek, J.C., DeVantier, L., Edgar, G.J., Edwards, A.J., Fenner, D., Guzmán, H.M., Hoeksema, B.W., Hodgson, G., Johan, O., Licuanan, W.Y., Livingstone, S.R., Lovell, E.R., Moore, J.A., Obura, D.O., Ochavillo, D., Polidoro, B.A., Preech, W.F., Quibilan, M.C., Reboton, C., Richards, Z.T., Rogers, A.D., Sanciangco, J., Sheppard, A., Sheppard, C., Smith, J., Stuart, S., Turak, E., Veron, J.E.N., Wallace, C., Weil, E. and Wood, E. 2008. One-Third of Reef-Building Corals Face Elevated Extinction Risk from Climate Change and Local Impacts. *Science*. 25 July 2008: 560-563. DOI: 10.1126/science.1159196. Supporting online material: www.sciencemag.org/cgi/content/full.1159196.

DeVantier, L., & Turak, E. (2017). Species richness and relative abundance of reef-building corals in the Indo-West Pacific. *Diversity*, 9(3), 25.

DeVantier, L., Turak, E., & Szava-Kovats, R. (2020). Species Richness and Abundance of Reef-Building Corals in the Indo-West Pacific: The Local–Regional Relation Revisited. *Frontiers in Marine Science*, 7, 487.

McClanahan, T. R., Ateweberhan, M., Graham, N. A. J., Wilson, S. K., Sebastián, C. R., Guillaume, M. M., & Bruggemann, J. H. (2007). Western Indian Ocean coral communities: bleaching responses and susceptibility to extinction. *Marine Ecology Progress Series*, 337, 1-13.

Milne Edwards H, Haime J. (1851). Monographie des polypiers fossiles des terrains palaeozoïques, précédée d'un tableau général de la classification des polypes. *Muséum National d'Histoire Naturelle, Paris, Archives*. 5: 1–502, 20 pls.

IUCN. 2014. The IUCN Red List of Threatened Species. Version 2014.1. Available at: www.iucnredlist.org. (Accessed: 12 June 2014).

Rasheed, S., Warder, S. C., Plancherel, Y., & Piggott, M. D. (2021). An Improved Gridded Bathymetric Data Set and Tidal Model for the Maldives Archipelago. *Earth and Space Science*. <https://doi.org/10.1029/2020EA001207>

UNEP 2017. Coral Bleaching Futures - Downscaled projections of bleaching conditions for the world's coral reefs, implications of climate policy and management responses. United Nations Environment Programme, Nairobi, Kenya

UNEP 2020. Projections of future coral bleaching conditions using IPCC CMIP6 models: climate policy implications, management applications, and Regional Seas summaries. United Nations Environment Programme, Nairobi, Kenya

Veron, J.E.N. and Pichon, M. (1980). Scleractinia of eastern Australia. Part III. Families Agariciidae, Siderastreidae, Fungiidae, Oculinidae, Merulinidae, Mussidae, Pectiniidae, Caryophylliidae, Dendrophylliidae. (Townsville, Australia: Australian Institute of Marine Science), 4:1-422.

Veron, J.E.N. (2000a). Corals of the World. Townsville: Australian Institute of Marine Science.
Volumes 1-3. 1410pp.