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

Porites cylindrica

Hump coral

Amir, H.

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Maldives National Red List Assessment: *Porites cylindrica*

A. Background Information

1. Assessment Information

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2. Taxonomic Information

Scientific Name		*Porites cylindrica* (Dana, 1846)
Common Name (English)		Hump coral
Common Name (Dhivehi)		No species name Generic name: Hiri | ހިރި
Taxonomy	Order	Scleractinia
	Sub-order	-
	Family	Poritidae
Taxonomic Notes		Porites andrewsi (Vaughan, 1918) is now accepted as Porites cylindrica.

3. Geographic Range

3.1 Summary of Global Distribution

The species is found in the western Indian Ocean, northern Indian Ocean, the central Indo-Pacific region, through to Australia, Japan, South China Sea, and the west Pacific (Sheppard et al., 2014).

3.2 Countries of Occurrence

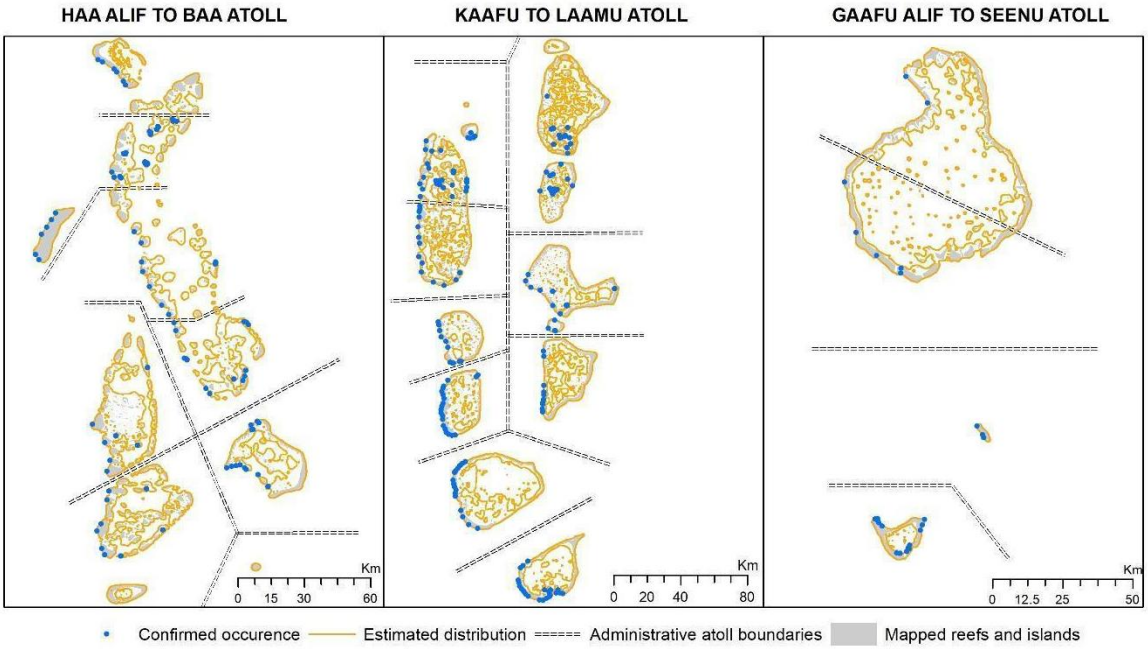
American Samoa, Australia, British Indian Ocean Territory, Cambodia, China, Christmas Island, Cocos Islands, Comoros, Fiji, Guam, India, Indonesia, Japan, Kenya, Kiribati, Madagascar, Malaysia, Maldives, Marshall Islands, Mauritius, Mayotte,

Federated States of Micronesia, Mozambique, Myanmar, Nauru, New Caledonia, Northern Mariana Islands, Palau, Papua New Guinea, Philippines, Reunion, Samoa, Seychelles, Singapore, Solomon Islands, Somalia, Sri Lanka, Taiwan, United Republic of Tanzania, Thailand, Tokelau, Tonga, Tuvalu, Vanuatu, Vietnam, Wallis and Futuna (Sheppard et al., 2014).

3.3 National distribution

Although species distribution is unknown, presence records for the species are available in literature (Pichon and Benzoni 2007; Bigot and Amir 2012; Jimenez et al. 2012) and the genus has been widely observed nationwide throughout the years (e.g., Ciara and Passeri 1993).

Data confirmed occurrences of the genus are available from 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 shallow reef systems in the North, Central and South of the Maldives.



4. Population:

4.1 Summary

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

4.2 Population Size

The global population is generalized as being “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 3.00 ± 0.27% (± S.E). Recent estimates indicate genus cover is between 10.00 – 15.00% and is the most dominant genus (Noo Raajje 2021). Therefore, based on generic estimates the species population may vary between ~0.1 to ~10% cover assuming differing levels of dominance in a community

4.3 Population Trend

Both 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 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 does not appear to have a particular habitat preference on the reef. The species is commonly found at shallow depths between 1 and 20 m (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 shallow 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?

Unknown

6.2 Summary

Unknown

7. Threats:

7.1 Summary

The understanding of threats to this species are predominantly based on genus-level threats. The species is known to be relatively resilient to bleaching and to recover quickly from bleaching (Fitt et al., 2009; Nordemar, Nystrom and Dizon 2003). However, it can be relatively vulnerable to disease and sedimentation (Gowan, Tootell and Carpenter 2014; Kavousi et al, 2013). Therefore, while the species is likely to face the impacts of coastal development and climate change due to its shallow depth range (<20 m), it also has a higher chance of recovering from and surviving the impacts. Being located close to human habitation, either island communities or resorts, they can be 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, P. cylindrica is expected to undergo ASB starting in 2041.

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

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

11.4. 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	1
Resistance to bleaching	1
Recovery from bleaching or disease	1
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 “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 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

   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 (%)		50-60%
Meets Criteria Thresholds?	A1	-
	A2	-
	A3	Projected reduction of 50-60% over the next three generations (EN A3)
	A4	-
Reduction Based on Which Sub-criteria?	a	-
	b	-
	c	Decline in habitat quality associated with impacts of climate change (onset of annual severe bleaching).
	d	-
	e	Mortality due to repeated bleaching
Assessment Under Criterion A		**EN A3c**
Reasoning:		Our assessment of future population reduction is based on the projected date of onset of ASB. P. cylindrica is expected to undergo ASB starting in 2041.

The species has a depth range of 1-20 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.

Although some studies indicate that the species may not acclimatize to repeated bleaching (Visram and Douglas 2007), other studies indicate that it can tolerate increased temperatures even when this is compounded by other stressors (Nordemear, Nystrom and Dizon 2003; Harii et al 2014). The species also utilizes mechanisms to counteract stressors that allow it to survive better than other species in similar conditions and circumstances (Zhang et al. 2021).

As such, the species is considered to be relatively resilient to climate change, with low susceptibility and high resistance based on literature review and scientific expertise. Therefore, although population decline is anticipated over 100% of the species' depth range, it is not expected to experience as severe a population decline as other coral species.

This species is projected to undergo a reduction of 50-60% 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	**EN 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	**EN A3ce**

Narrative Justification for Assessment:

Porites cylindrica is likely distributed throughout the Maldives, with a depth range of 1-20 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.

However, the species has been identified as being relatively resilient to bleaching, with low susceptibility and high resilience. Whilst it is vulnerable to loss of quality and quantity of suitable habitat, the species has mechanisms that allow it to survive better than other species in similar conditions and circumstances.

Although the population size and past rate of decline are not known, it is anticipated that the population will undergo a 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), ASB is likely to commence in 2041 over this species' distribution, affecting 100% of its depth range. However, due to this species' relative resilience to bleaching, ASB is expected to result in a population reduction of only 50-60%.

Therefore, we project a 50-60% population reduction over the next three generations (2022-52), resulting from degradation in habitat quality associated with the impacts of climate change. This meets the threshold for EN A3c.

C. References

Biggot, L., & Amir, H. (2012). *Scleractinia corals of Baa Atoll (Maldives): First checklist and overview of stony corals community structure*.

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., Precht, 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.

Ciarapica, G., & Passeri, L. (1993). An Overview of the Maldivian Coral Reefs in Felidu and North Male' Atoll. Erlagen, 28(33–66), 9–17.

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.

Fitt, W. K., Gates, R. D., Hoegh-Guldberg, O., Bythell, J. C., Jatkar, A., Grottoli, A. G., ... & Lesser, M. P. (2009). Response of two species of Indo-Pacific corals, Porites cylindrica and Stylophora pistillata, to short-term thermal stress: the host does matter in determining the tolerance of corals to bleaching. *Journal of experimental marine biology and ecology*, *373*(2).

Gowan, J. C., Tootell, J. S., & Carpenter, R. C. (2014). The effects of water flow and sedimentation on interactions between massive Porites and algal turf. Coral Reefs, 33(3), 651-663.

Harii, S., Hongo, C., Ishihara, M., Ide, Y., & Kayanne, H. (2014). Impacts of multiple disturbances on coral communities at Ishigaki Island, Okinawa, Japan, during a 15-year survey. *Marine Ecology Progress Series*, *509*, 171-180.

Hoeksema, B. W.; Cairns, S. (2022). World List of Scleractinia. Porites cylindrica Dana, 1846. Accessed through: World Register of Marine Species at: https://www.marinespecies.org/aphia.php?p=taxdetails&id=207229 on 2022-02-05

Kavousi, Javid, Parviz Tavakoli-Kolour, Abbas Barkhordari, and Arezoo Bahrami. "Mass mortality of Porites corals on northern Persian Gulf reefs due to sediment-microbial interactions." (2013).

Jimenez, H., Bigot, L., Bourmaud, C., Chabanet, P., Gravier-Bonnet, N., Hamel, M. A., Payri, C., Mattio, L., Menou, J. L., Naeem, S., Rilwan, Y., Sattar, S., Scott, L., Shiham, A., Vigliola, L., & Andréfouët, S. (2012). Multi-taxa coral reef community structure in relation to habitats in the Baa Atoll Man and Biosphere UNESCO Reserve (Maldives), and implications for its conservation. *Journal of Sea Research*, *72*, 77–86. https://doi.org/10.1016/j.seares.2012.04.011

NooRaajje (2021). Maldives Coral Reef Assessment. *Waitt Institute*. 73 pp.

Nordemar, I., Nyström, M., & Dizon, R. (2003). Effects of elevated seawater temperature and nitrate enrichment on the branching coral Porites cylindrica in the absence of particulate food. Marine Biology, 142(4), 669-677.

Pichon, M., & Benzoni, F. (2007). Taxonomic re-appraisal of zooxanthellate Scleractinian Corals in the Maldive Archipelago. Zootaxa, 33(1441), 21–33. https://doi.org/10.11646/zootaxa.1441.1.2

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 Spance Science. https://doi.org/10.1029/2020EA001207

Riegl, B. and Piller, W.E. 2003. Possible refugia for reefs in times of environmental stress. International Journal of Earth Sciences 92(4):520-531.

Sheppard, A., Fenner, D., Edwards, A., Abrar, M. & Ochavillo, D. 2014. *Porites cylindrica*. *The IUCN Red List of Threatened Species* 2014: e.T133496A54274373. https://dx.doi.org/10.2305/IUCN.UK.2014-1.RLTS.T133496A54274373.en. Accessed on 04 March 2022.

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., Stafford-Smith M.G., Turak E. and DeVantier L.M. (2022). Corals of the World. Accessed 9 February 2022, Version 0.01 (Beta). http://coralsoftheworld.org/v0.01(Beta). (To go to the current version access: http://coralsoftheworld.org)

Visram, S., & Douglas, A. E. (2007). Resilience and acclimation to bleaching stressors in the scleractinian coral Porites cylindrica. *Journal of Experimental Marine Biology and Ecology*, *349*(1), 35-44.

Zhang, Y., Huang, J., Li, X., Song, C., Xia, J., Ren, Y., ... & Li, X. (2021). Improper Diving Behavior Affects Physiological Responses of Acropora hyacinthus and Porites cylindrica. *Frontiers in Marine Science*.