



## ***Acropora muricata***

**Mohamed, I.**

**Citation:** Mohamed, I., 2022. *Acropora muricata*. The Maldives Red List of Threatened Species.

# Maldives National Red List Assessment: *Acropora muricata*

## A. Background Information

### 1. Assessment Information

Assessor Name(s)	Ilham Mohamed
Date of Assessment	29 February 2022
Contributors	Hana Amir, Phillipa Roe, Simone Montano
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	<i>Acropora muricata</i> [Dana, 1846]	
Common Name (English)	-	
Common Name (Dhivehi)	Generic name: Muraka   ދުލުމަލު	
Taxonomy	Order	Scleractinia
	Sub-order	-
	Family	Acroporidae
Taxonomic Notes	-	

### 3. Geographic Range

#### 3.1 Summary of Global Distribution

Found in the Western Pacific Ocean and Indian Ocean

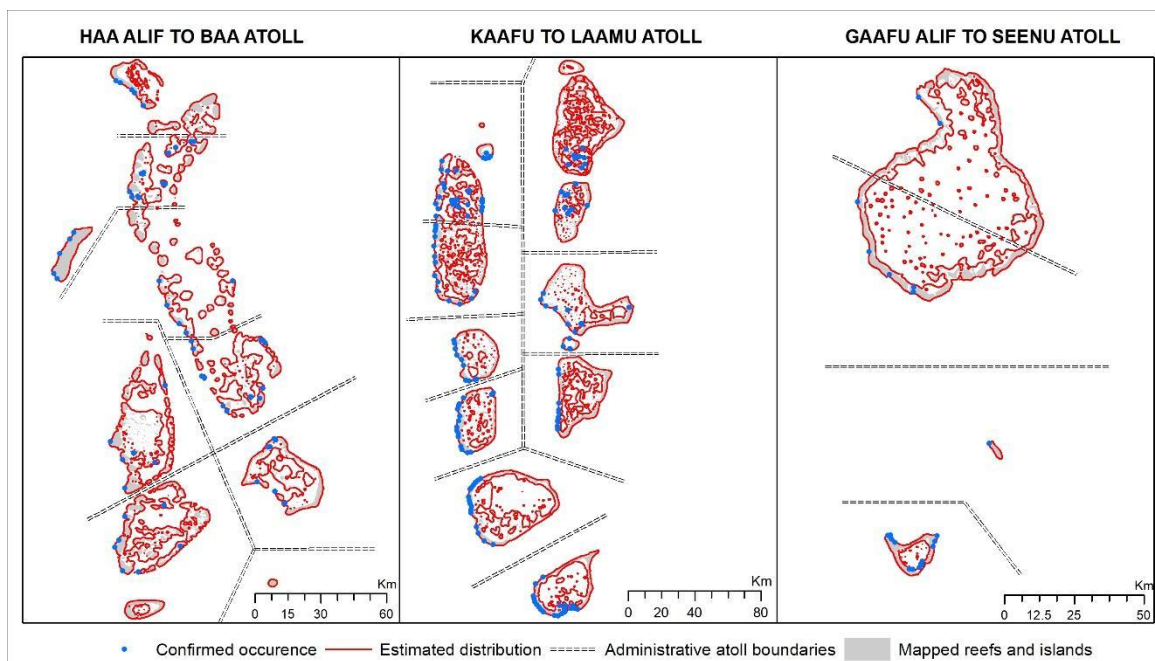
### 3.2 Countries of Occurrence

American Samoa; Australia; Bahrain; British Indian Ocean Territory; Cambodia; Christmas Island; Cocos (Keeling) Islands; Comoros; Cook Islands; Djibouti; Egypt; Eritrea; Fiji; French Polynesia; Guam; India; Indonesia; Iran, Islamic Republic of; Israel; Japan; Jordan; Kenya; Kiribati; Madagascar; Malaysia; Maldives; Marshall Islands; Mauritius; Mayotte; Micronesia, Federated States of; Mozambique; Myanmar; Nauru; New Caledonia; Niue; Northern Mariana Islands; Oman; Pakistan; Palau; Papua New Guinea; Philippines; Qatar; Réunion; Samoa; Saudi Arabia; Seychelles; Singapore; Solomon Islands; Somalia; South Africa; Sri Lanka; Sudan; Taiwan, Province of China; Tanzania, United Republic of; Thailand; Tokelau; Tonga; Tuvalu; United Arab Emirates; United States Minor Outlying Islands; Vanuatu; Viet Nam; Wallis and Futuna; Yemen

### 3.3 National Distribution

Although exact 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 (e.g., Ciara and Passeri 1993).

Data on confirmed occurrences of the genus are available from every atoll. Based on known observations, available data and species characteristics, it is estimated that the genus and species may occur on shallow reef systems in the North, Central and South of the Maldives. Depending on depth, the species may not be found within the atoll lagoons or off the edge of atoll reefs.



## 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

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

The ten-year generic percent cover mean derived from available data is  $3.00 \pm 0.27\%$  ( $\pm$  S.E). Recent estimates indicate genus cover is between 3.00 – 5.00% across most atolls apart from Ari atoll where cover peaks between ~5.00 to ~10.00% (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

Increasing

#### 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?

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

Frequently found in shallow waters and on reefs between 5 m and 30 m depths, the species can be found in reef slopes and lagoons (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 harvested for use in coral nurseries and illegally harvested for curio trade. 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 (e.g., Humanes et al. 2017), bleaching (e.g., Sakai, Singh, and Iguchi 2019), predation by corallivores (e.g., COTS) and disease (e.g., Aeby et al. 2011). Though its growth rate is rapid compared to other genera, populations of acropora have been recorded to be slow to recover. Being located close to human habitation, in island communities and resorts, they are subject to stressors in the form of untreated sewage (where infrastructure is lacking), agricultural runoff and domestic waste. The species is found between 5 to 30 m depth and is expected that the species is moderately vulnerable to the impacts of coastal development projects and highly vulnerable to climate change impacts.

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, *A. muricata* 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

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	3
Recovery from sedimentation	2
Resistance to sedimentation	2
Susceptibility to sedimentation	2
<i>Average</i>	3

## 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. 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 South Ari Marine Protected Area.

## 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

### 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% decline over the next 3 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 decline considers population reduction based on the year of onset of ASB. *A. muricata* is expected to undergo ASB starting in 2041 (less than three generations from the present). The species ranges between 5-30 m and is fully restricted to depths shallower than 30 m.

Depth and depth range is considered in our assessment, as populations of species at depths shallower than 30 m are expected to decline faster

as they are more vulnerable due to frequent exposure both to temperature fluctuations and extreme temperatures (Riegl and Piller 2003).

Therefore, total population decline is anticipated over 100% of the species' depth range. Additionally, the species is relatively vulnerable to bleaching, with high susceptibility and low resistance based on literature and scientific expertise.

Therefore, this species is inferred to experience a projected national level decline of 80-90% by the year 2052, or three generations in the future.

## 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 Up-list, Down-list, or No Change? No change

Adjustment

Justification for Regional Adjustment No likely interaction with individuals outside the region

**Final Assessment CRA3ce  
CR A3ce**

**Narrative Justification for Assessment:**

*Acropora muricata* is known from shallow reef systems throughout the Maldives, with a depth range of 5-30 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.

*Acropora* species are known to be impacted by threats including sedimentation, bleaching, predation by corallivores, and disease. *A. muricata* has been identified as being vulnerable to bleaching, with high susceptibility and low resistance, vulnerable to predation, and vulnerable to loss of quality and quantity of suitable habitat.

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 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 (2022-52), resulting from degradation in habitat quality associated with the impacts of climate change. This meets the threshold for CR A3c.

## REFERENCES

- Aeby, G.S., Bourne, D.G., Wilson, B. and Work, T.M., 2011. Coral diversity and the severity of disease outbreaks: A cross-regional comparison of Acropora White Syndrome in a species-rich region (American Samoa) with a species-poor region (Northwestern Hawaiian Islands). *Journal of Marine Biology*, 2011.
- 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](http://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.
- Humanes, A., Ricardo, G. F., Willis, B. L., Fabricius, K. E., & Negri, A. P. (2017). Cumulative effects of suspended sediments, organic nutrients and temperature stress on early life history stages of the coral *Acropora tenuis*. *Scientific Reports*, 7(1), 1-11
- 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.
- Pichon, M., & Benzoni, F. (2007). Taxonomic re-appraisal of zooxanthellate Scleractinian Corals in the Maldivian Archipelago. *Zootaxa*, 33(1441), 21–33. <https://doi.org/10.11646/zootaxa.1441.1.2>
- 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.
- Sakai, K., Singh, T., & Iguchi, A. (2019). Bleaching and post-bleaching mortality of Acropora corals on a heat-susceptible reef in 2016. *PeerJ*, 7, e8138.
- 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\(Beta\)](http://coralsoftheworld.org/v0.01(Beta)). (To go to the current version access: <http://coralsoftheworld.org>)