MAPPING AND ASSESSING THE STATE OF ECOSYSTEMS & THEIR SERVICES IN THE OUTERMOST REGIONS

MARINE HABITATS OF MACARONESIA

TITLE/HABITAT NAME/EUNIS CODE

A5.51 Characterization of rhodolith beds in Macaronesia (EUNIS v2012)

Summary (Description, pressures & threats, conservation & management)

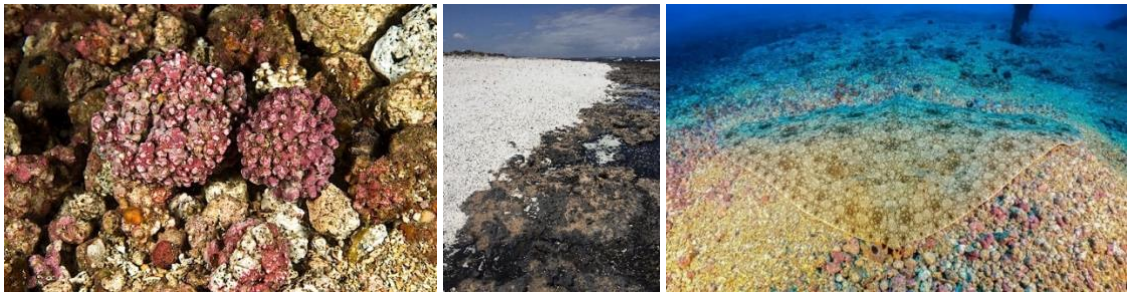
Beds of rhodoliths are composed of free-living, calcareous red algae that form nodules of rugged appearance and diverse morphology. The rhodolith beds in Macaronesia are composed by several species of red calcareous algae, mainly of the genera *Lithothamnion* and *Phymatolithon.* They are locally distributed as a mosaic of neighbouring habitat patches typically between depths of 15-50m in coarse clean sediments of gravels and clean sands. This habitat occurs on the open coast or in tide-swept channels of marine inlets and is present in all the Macaronesian island groups. Associated species include molluscs, crustaceans, echinoderms, sponges, worms, fishes and other invertebrates as well as algae.

The main pressures and threats to this habitat are associated with pollution, coastal development, introduction of exotic species and harvesting of marine resources. There is also a growing realisation that these habitats may be especially vulnerable to ocean acidification. There is there is very limited information on trends in either quantity of quality of this habitat type.

Conservation status: DATA DEFICIENT

There is very limited information on trends in either quantity of quality of this habitat type because of the absence of time series studies. Some regression of this habitat type has been reported in Gran Canaria but further data are required to make an assessment of trends.

Images



Photos: (from left to right) Rhodolith habitat in Gando Bay (Gran Canaria - Canary Islands); Accumulation of dead rhodoliths on the shore in the north of Fuerteventura (Canary Islands)); Butterfly ray (*Gymnura altívela*) resting over rhodolith seabed in Gando bay. (© Photo credits: Fernando Espino, François Simard, Juanjo García Cuervo)

This project has received funding from the European Union represented by European Commission Directorate General Environment under grant agreement N° 07.027735/2019/SI2.808239/SUB/ENV.D2. This document only reflects the views of its authors. The Commission is not responsible for any use that may be made of the information it contains.

HABITAT TYPE

EUNIS Code (Level 4, v2022)
MB 322 Maerl beds on Atlantic infralittoral coarse sediment
MB 421 Maerl beds on Atlantic infralittoral mixed sediment

MAES;
Marine – Marine inlets and transitional waters
Marine - Coastal

Annex 1 (Habitats Directive):
1110 Sandbanks which are slightly covered by seawater all the time
1160 Large shallow inlets and bays

MSFD
Shallow coarse or mixed sediments

Habitat Description

The rhodolith beds in Macaronesia are composed by several species of red calcareous algae, mainly of the genera *Lithothamnion* and *Phymatolithon. Neogoniolithon brassica-florida* is present in sparse aggregations, but may constitute the dominant maerl species in current-swept coarse sands and fine gravels in the Azores, while *Lithophyllum crouaniorum* can be found on shallow infralittoral sands between 2 m and 5 m depth. Beds of *Lithothamnion cf. corallioides* are present in the Canary Islands and Madeira from 20m down to 100 m and 50 m respectively, with the Madeira beds also characterized by the presence of *Spongites fruticulosa*[1,2]. Azores also showed some sites where rhodoliths distributed between 2 and 4m (e.g. Vila Franca do Campo)[2].

Beds of rhodoliths are composed of free-living, calcareous red algae that form nodules of rugged appearance and diverse morphology. These rhodolith beds appears locally distributed as a mosaic of neighbouring habitat patches in depths of between 15-50m, in coarse clean sediments of gravels and clean sands, which occur either on the open coast or in tide-swept channels of marine inlets (the latter often stony).

An individual rhodolith may be composed of one or several coralline species and may also include other encrusting organisms such as bryozoans, foraminifers and gastropods. The most abundant associated species reported from this habitat in the Canaries are typically molluscs and crustaceans (particularly amphipods) but the habitat also supports echinoderms, sponges, worms, fishes and other vertebrates. Along with coralline algae, typical flora are other red algae, and brown algae other than fucoids and kelp. Green algae are the most abundant associated algae on the shallower beds (0-10m) in the Azores and the Canaries.[2]

[1] European Red List of Habitats https://forum.eionet.europa.eu/european-red-list-habitats/library/marine-habitats/north-east-atlantic/a5.51-atlantic-maerl-beds/download/en/1/A5.51%20Atlantic%20maerl%20beds.pdf; Afonso-Carrillo et al., 1985.
[2] Riera et al., 2012; Otero-Ferrer et al., 2020 ; Rosas- Alquicira et al., 2009

This project has received funding from the European Union represented by European Commission Directorate General Environment under grant agreement N° 07.027735/2019/SI2.808239/SUB/ENV.D2. This document only reflects the views of its authors. The Commission is not responsible for any use that may be made of the information it contains.

ECOSYSTEM SERVICES

- Regulation & maintenance

Rhodoliths are formed by coralline algae with relatively slow growth rates. They can accumulate in large beds with a three-dimensional matrix that provides a wide range of ecological niches. They have considerable ecological significance due to the high diversity of associated organisms.

Recent studies have started to examine the role of maerl in carbon capture and storage[3]. The calcium carbonate skeleton of maerl, including of rhodoliths, persists after the death of the living algal tissue and accumulates to form long-lasting deposits. These deposits act as a long-term store for inorganic carbon and lock up associated calcifying biota in their matrix like structure.

- Provisioning

The complex structure of rhodolith beds provides a habitat for many species of both epifauna and infauna as well as mobile species.

- Cultural

Some areas of rhodolith beds are popular SCUBA diving sites and therefore have a leisure value.

GEOGRAPHIC OCCURRENCE

Presence in Macaronesian archipelagos

REGION	*Present*	*Absent*	*Unknown*
Azores	YES		
Canary Islands	YES		
Madeira	YES		

Distribution and extent across Macaronesian region
(using Red List criteria, thresholds and categories)

The extent of mapped habitat in GRAFCAN is just over 118 km^2.

Azores
As far as it is known, rhodolith concentrations in the Azores occur only in two protected bays, Ilhéu de Vila Franca on São Miguel Island and Lajes do Pico on Pico Island[4]. The species present forming rhodoliths are *Neogoniolithon brassica-florida, Lithophyllum crouanii* and *Phymatolithon calcareum* (the first two in Ilhéu de Vila Franca, São Miguel Island, and the third at Lajes do Pico, Pico Island). Rhodoliths covered a small area of bays' seabed, 6.56% (525 m^2) at Ilhéu de Vila Franca and 6.12% (306 m^2) in Lajes do Pico. Beds have been located in Sao Miguel, Pico and Graciosa Islands in both shallow (2-5m) and deep (7-10m) waters. [4]. Transport by storms appears to be an important factor in the formation of some deep-water rhodoliths such as those sampled between 64-73m depth off the south coast of Pico[5]

[3] E.g. Hendriks et al., 2020. https://www.eea.europa.eu/publications/carbon-stocks-and-sequestration-rates/carbon-stocks-and-sequestration-in/carbon-stocks/view
[4] Rosas-Alquicira et al., 2009
[5] Rebelo et al., 2018

This project has received funding from the European Union represented by European Commission Directorate General Environment under grant agreement N° 07.027735/2019/SI2.808239/SUB/ENV.D2. This document only reflects the views of its authors. The Commission is not responsible for any use that may be made of the information it contains.

Canary Islands

Rhodolith beds occur in the shallow subtidal in the Canary Islands (15-40m) [6]. This includes near Gando Bay on the east coast of Gran Canaria where the rhodolith bed occurs as a mosaic of neighbouring habitat patches between 15-50m.

GRAFCAN shows an extensive area of "horizonte de *Lithothamnium*" along the north east coast of Lanzarote, as well as patches off Caleta de Famara (NE coast) as well as an area of this habitat in the channel between Lanzarote and Fuerteventura.

Madeira archipelago

A habitat mapping study[7] has identified 46 rhodolith beds at eleven different locations spread across three islands (Madeira, Desertas and Porto Santo) covering areas ranging from 776 to 101,081 m^2 and at depths between 12 and 35 m. the authors observations and results suggest more rhodolith beds are likely to exist in the archipelago particularly at greater depths and unexplored locations.

Extent of Occurrence (EOO)	Area of Occupancy (AOO)	Most recent estimated total area	Comment
The area of sea bounded by the Macaronesian islands exceeds 50,000km^2 therefore no habitats present on any of the island groups would qualify as having a restricted geographical distribution. Restricted distribution may apply if considered at the level of island groups for habitats that are present only in Madeira or the Azores but that is not the case for this habitat type[8].	Present in >50 locations therefore Least Concern under this criterion	118km^2	

[6] Otero-Ferrer et al., 2020

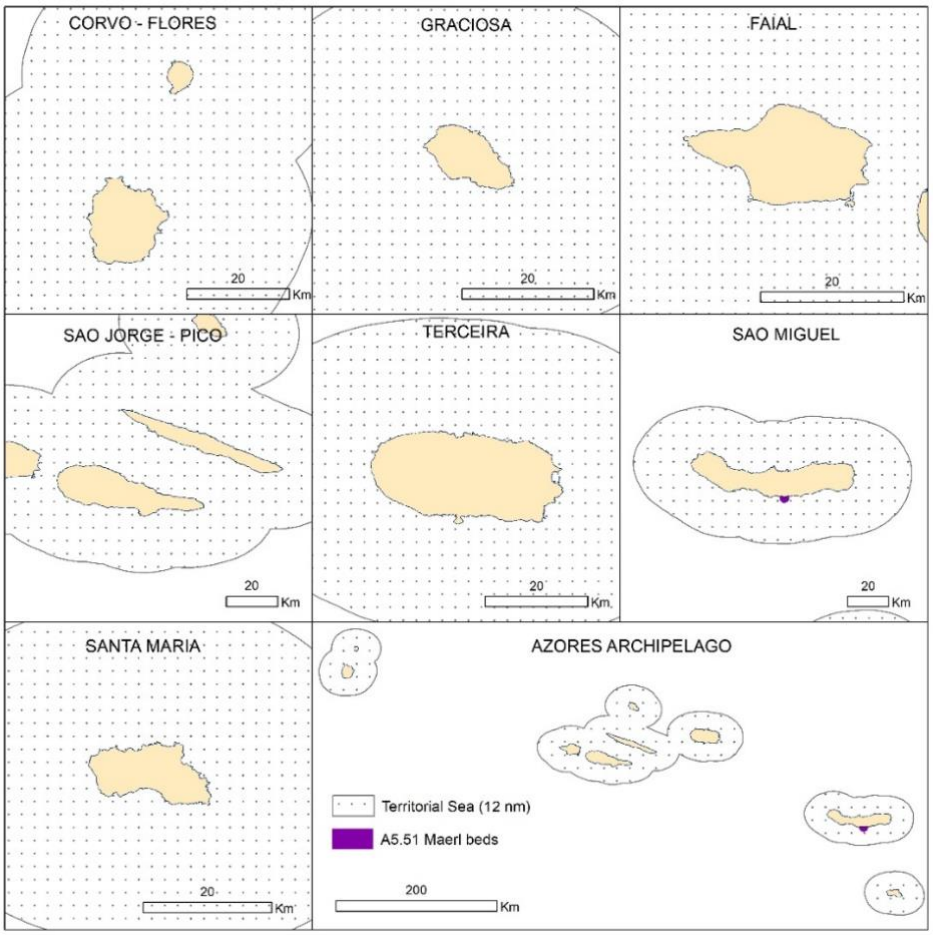
[7] Neves, et al., 2021; Rosas-Alquicira et al., 2009. https://www.researchgate.net/publication/235407837_New_additions_to_the_Azorean_algal_flora_with_ecological_observations_on_rhodolith_formations [accessed May 20 2022].

[8] Estimated sea area enclosed by Madeira (3,935.64km^2), Azores (48,217.39km^2) and the Canarias (63,566.25km^2) and all the Macaronesian islands (688,986km^2).

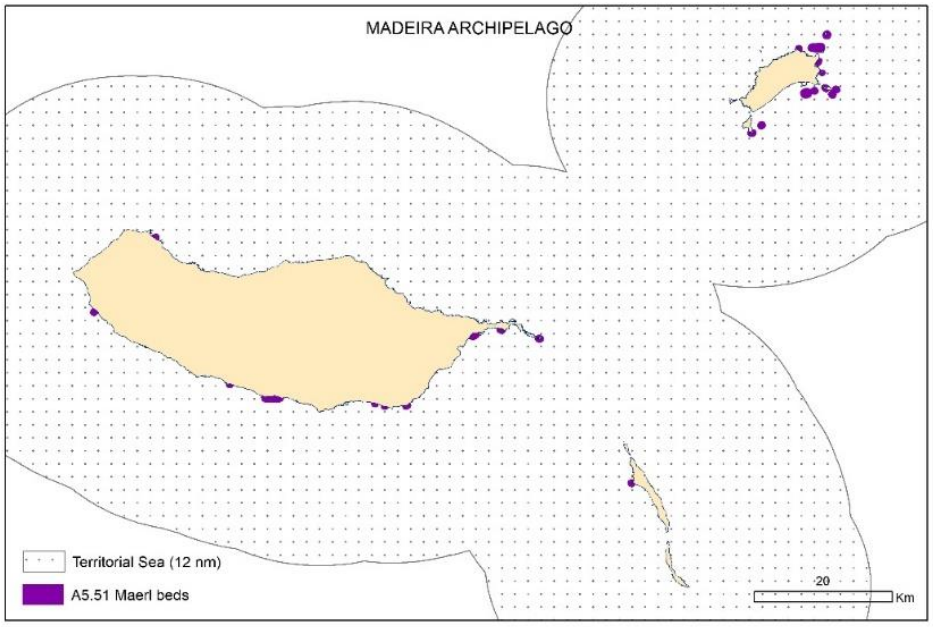
This project has received funding from the European Union represented by European Commission Directorate General Environment under grant agreement N° 07.027735/2019/SI2.808239/SUB/ENV.D2. This document only reflects the views of its authors. The Commission is not responsible for any use that may be made of the information it contains.

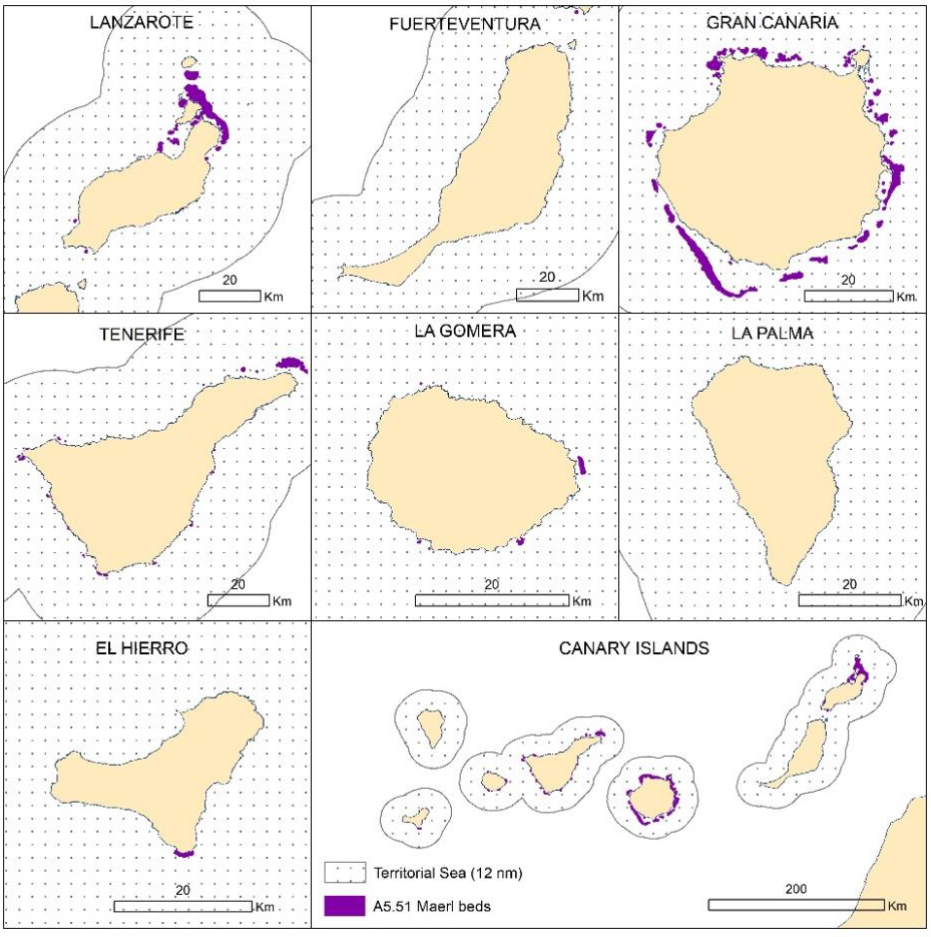
Distribution maps

This habitat is present around all the Macaronesian island groups. The distribution maps presented here have been derived from experts and literature collected through the SeaSketch survey.



This project has received funding from the European Union represented by European Commission Directorate General Environment under grant agreement N° 07.027735/2019/SI2.808239/SUB/ENV.D2. This document only reflects the views of its authors. The Commission is not responsible for any use that may be made of the information it contains.





PRESSURES AND THREATS

This project has received funding from the European Union represented by European Commission Directorate General Environment under grant agreement N° 07.027735/2019/SI2.808239/SUB/ENV.D2. This document only reflects the views of its authors. The Commission is not responsible for any use that may be made of the information it contains.

Pressures and threats currently reported for this habitat are associated with pollution, coastal development, introduction of exotic species and harvesting of marine resources. Large fishing pressure on inshore resources, including illegal fishing, is a current and likely future pressure on this habitat type as is climate change.

Due to the very slow rate of growth, maerl, including rhodolith forming species, are considered to be a non-renewable resource. There is also a growing realisation that these habitats may be especially vulnerable to ocean acidification since the high Mg-calcite skeletons of coralline algae dissolve easily as CO_2 levels rise[9]. Many of studies confirm the negative effect of ocean acidification, rise of temperature and burial on the physiology of rhodolith-forming species, suggesting that a combination of physical stressors can affect coralline species and the flora and fauna assemblages associated with them.[10]

Pressure indicators[11]	Current pressures	Likely future pressures
Habitat conversion and degradation		
- Urban coastal development	x	
- Physical disturbance (trawling, dredging, trampling etc.)		
Climate change		
- Global warming and sea level rise	x	x
Pollution and nutrient enrichment		
- Poorly managed waste/dredge disposal	X	
- Sewage discharge	X	
- Acute pollution incidents		
- Thermal stress	X	X
- Eutrophication	x	x
Over-exploitation		
- Harvesting of marine resources	x	x
Introduction of invasive alien species		
- Introduction of exotic species	x	

TRENDS

Trends in quantity and quality (recent / historic)

There is there is very limited information on trends in either quantity of quality of this habitat type because of the absence of time series studies. Habitat regression of this habitat type has however been reported from the eastern part of Gran Canaria island (*pers. comm.*).

CONSERVATION AND MANAGEMENT

No specific conservation policy or instrument that may affect this habitat has been recorded for the Canary Islands or the Azores although this habitat is present within some Marine Protected Areas.

ASSESSMENT OF CONSERVATION STATUS WITHIN THE EU

[9] E.g. Nelson 2009, Büdenbender et al. 2011, Díaz-Pulido et al. 2012, Noisette et al. 2013
[10] Hernandez-Kantun et al., 2017
[11] Pressure indicators for marine inlets, transitional waters, coastal ecosystems, shelf and ocean waters. From Teller et al., 2018. Mapping and Assessment of Ecosystems and their Services: An analytical framework for ecosystem condition. Publications office of the European Union, Luxembourg.

This project has received funding from the European Union represented by European Commission Directorate General Environment under grant agreement N° 07.027735/2019/SI2.808239/SUB/ENV.D2. This document only reflects the views of its authors. The Commission is not responsible for any use that may be made of the information it contains.

Atlantic maerl beds have been assessed as **Vulnerabl**e in the EU according to the European Red List of Habitats (published 2016)

ASSESSMENT OF CONSERVATION STATUS WITHIN MACARONESIA

Criterion A – Reduction in quantity There is there is very limited information on trends in the quantity of this habitat type although some declines have been observed in recent years. This habitat has therefore been assessed as DATA DEFICIENT under criterion A.

Criterion B – Restricted geographical distribution. This habitat exceeds minimum EOO and AOO thresholds therefore has been assessed as LEAST CONCERN under criterion B.

Criterion C – Reduction in quality There is a lack of information on trends in quality of this habitat type. It has therefore been assessed as DATA DEFICIENT under criterion C.

Criterion E – Risk of collapse. There has been no quantitative analysis estimating the probability of collapse of this habitat therefore it is assessed as DATA DEFICIENT under criterion E.

Overall Category & Criteria

DATA DEFICIENT

Confidence in assessment

Low: Whilst there are data on the current distribution of this habitat type there is a lack of information on trends in quantity and quality.

Assessors/Contributors

Francisco Otero Ferrer, Ricardo Haroun Tabraue, Fernando Tuya Cortés, Marta Quintana Ponce, Claudia Lopes, Alejandro García Mendoza, Susan Gubbay

Date of Assessment

November 2022

References

Afonso-Carrillo, J. *et al.,* 1985. Some aspects of the application of scanning electron microscopy to the study of Corallinaceae algae (Rhodophyta). *Huh. Biol. Mar.* 25: 427-433.

Rosas-Alquicira, E.F., *et al.,* 2009.New additions to the Azoreal algal flora, with ecological observations on rhodolith formations. Cahiers de Biologie Marine 50(2):143-151.

Büdenbender J, Riebesell U, Form A. 2011. Calcification of the Arctic coralline red algae *Lithothamnion glaciale* in response to elevated CO2. Mar Ecol Prog Ser 441:79–87. https://doi.org/10.3354/meps09405

This project has received funding from the European Union represented by European Commission Directorate General Environment under grant agreement N° 07.027735/2019/SI2.808239/SUB/ENV.D2. This document only reflects the views of its authors. The Commission is not responsible for any use that may be made of the information it contains.

Díaz-Pulido, G. *et al.* 2012 Interactions between ocean acidification and warming on the mortality and dissolution of coralline algae. Journal of Phycology 48: 32-39.

Hendriks, K. *et al.,* 2020. Carbon stocks and sequestration in terrestrial and marine ecosystems: a lever for nature restoratin? A quick scan for terrestrial and marine EUNIS habitat types. Wageningen Environmental Research, Internal Report. 66pp.

Hernandez-Kantun, J.J. *et al.* 2017. North Atlantic Rhodolith Beds. In: Riosmena-Rodríguez, R., Nelson, W., Aguirre, J. (eds) Rhodolith/Maërl Beds: A Global Perspective. Coastal Research Library, vol 15. Springer, Cham. https://doi.org/10.1007/978-3-319-29315-8_10

Nelson, W.A. 2009. Calcified macroalgae—critical to coastal ecosystems and vulnerable to change: a review. Mar Freshw Res 60:787. https://doi.org/10.1071/MF08335

Neves, P. *et al.,* 2021 "Pink round stones" – rhodolith beds: an overlooked habitat in Madeira Archipelago. *Biodivers Conserv* **30**, 3359–3383 (2021). https://doi.org/10.1007/s10531-021-02251-2

Noisette, F., *et al.,* 2013. Effects of elevated CO_2 on the metabolism of a temperate rhodolith *Lithothamnion corallioides* grown under different temperatures. J Phycol 49:746–757. https://doi.org/10.1111/jpy.12085

Otero-Ferrer, F. *et al.,* 2020. Effect of depth and seasonality on the functioning of rhodolith seabeds. Est.Coastal.Shelf Sci 235. 106579. http://fernandotuya.org/wp-content/uploads/2010/10/Rodoliths_depth_ECSS2020.pdf

Rebelo, A.C,. *et al.,* 2018. Modern rhodoliths from the insular shelf of Pico in the Azores (Northeast Atlantic Ocean). Est. & Shelf Sci.210:7–17

Rebelo A.C. *et al.* 2022. Rhodolith beds and their onshore transport in Fuerteventura Island (Canary Archipelago, Spain). Front. Mar. Sci. 9:917883. doi: 10.3389/fmars.2022.917883

Riera, R., *et al.,* 2012. Macrofaunal communities of threatened subtidal maërl seabeds on Tenerife (Canary Islands, north-east Atlantic Ocean) in summer. Acta Oceanol Sin 31:98–105. https://doi.org/10.1007/s13131-012-0181-4

Teller *et al.,* 2018 . Mapping and Assessment of Ecosystems and their Services: An analytical framework for ecosystem condition. Publications office of the European Union, Luxembourg.

This project has received funding from the European Union represented by European Commission Directorate General Environment under grant agreement N° 07.027735/2019/SI2.808239/SUB/ENV.D2. This document only reflects the views of its authors. The Commission is not responsible for any use that may be made of the information it contains.