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

MARINE HABITATS OF MACARONESIA

TITLE/HABITAT NAME/EUNIS CODE

A3.24 Faunal communities on moderate energy infralittoral rock (EUNIS v2012)

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

Anthropologically disrupted infralittoral habitat (locally known as "blanquizales" in the Canary Islands) characterized by a high density of the long-spined sea urchin *Diadema africanum* on a barren rocky seabed. Recorded from intertidal areas to depths of up to 80 m. Algae cover is cleared by sea urchins grazing, being replaced in some areas by sponges, calcareous red algae, barnacles, crustaceans, polychaetes and stony corals.

Overexploitation of coastal fisheries and subsequent reduction in urchin predators has led to colonization and fast growth of populations of *D.africanum*. Their intense grazing activity has resulted in shift from large areas of rocky reefs covered by complex erect macroalgae beds to overgrazed substrates ('urchin barrens') dominated by encrusting algae and some sessile invertebrates.

Conservation status: LEAST CONCERN

This habitat has been increasing in extent across many of the Macaronesian islands since the 1990's due to increases in the population of the sea urchin *D.antillarum*.

Images

Photos: (From left to right) Sea-urchin barren grounds in Gran Canaria (Canary Islands) (© Photo credit: Fernando Espino)

HABITAT TYPE

EUNIS Code (Level 3, v2022)

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MB 12 Atlantic infralittoral rock

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

Annex 1 (Habitats Directive):
1170 Reefs

MSFD
Infralittoral rock & biogenic reef

Habitat Description

Anthropologically disrupted infralittoral habitat (locally known as "blanquizales" in the Canary islands) characterized by a high density of the long-spined sea urchin *Diadema africanum*[1] on a barren rocky seabed. Found in the intertidal zone down to depths of up to 80 m. There is no erect macroalgal cover due to overgrazing by the sea urchins. This is replaced in some areas by other organisms such as sponges (*Batzella inops*), calcareous red algae, balanids (*Megabalanus tintinnabulum and Balanus trigonus*), crustaceans, polychaetes (*Spirobranchus triqueter*), and stony corals (*Polycyathus muellerae*). The black sea urchin *Arbacia lixula* may also be present in this habitat which is typically moderately exposed to tide/wave action. Algae that are present tend to be mostly coralline with some green algae and fucoids.

The diversity of coastal fish in this habitat is inversely proportional to the density of *Diadema* urchins, with areas supporting a higher density of urchins having a lower the richness of fish species. This is because browsing by high densities of sea urchins, reduces or removes the tussock carpet, on which herbivorous fish species feed. In turn, the disappearance of herbivores results in an absence of large, high- value carnivorous fish species. On the other hand, the mature "blanquizales" have a greater abundance of certain fast-growing fish such as the fulas (white and black), due to lack of predators.

ECOSYSTEM SERVICES

- Regulation & maintenance

Macroalgae are a major energy source and the main biological engineers on rocky reefs of the Macaronesian archipelagos. Expansion of this habitat is therefore having a negative effect on primary productivity by removing algae. Loss of macroalgae beds due to intensive urchin grazing leads to lower species diversity as well as a reduced habitat suitable for fish feeding and reproduction.

- Provisioning

[1] As referenced in the updated biological guide Marine Biodiversity of Canary Islands. Previously referred to as *Diadema antillarum* in some literature.

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Expansion of this habitat is having a negative effect by removing algae that provide food and shelter for associated invertebrates and fishes. Primary production can decrease to almost zero[2]. There is a also loss of biodiversity as well as impacts on reproduction and breeding of invertebrates and fish.

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)

Azores
Urchin barrens are present but are restricted in extent in the Azores[3] as the dominant sea urchin species (*A. lixula*, *P. lividus*, and *S. granularis*) appear have a remarkably lower voracity than *D. africanum* [4]. *D.africanum* has been recorded in the Azores (in 2007 at Santa Maria Island) but is currently rare[5].

Canary Islands
The most abundant sea-urchin species in coastal rocky habitats of the Canary Islands are: *P. lividus, A. lixula, S. granularis* and *D. africanum*, however the barrens generated by *D.africanum* are widespread throughout the archipelago[6]. A 2010 report[7] estimated that blanquizales cover around 24% of subtidal habitat (to 50m depth) of the Canary Islands extending over an estimated 479.2km^2. The most extensive coverage was in Fuerteventura (33.6%) followed by Tenerife (28%). Very high densities of *D.africanum*, upto 10/m^2, have been recorded in Tenerife and the lowest densities around El Hierro.

Madeira archipelago
The population of *D.africanum* has been increasing around Madeira since the early 1990s and the subsequent high density has led to the reduction of canopy-forming algae, transforming areas supporting macroalgal communities to patchy coverage of turf[8]. Population densities of 8–17/m^2 have been recorded, and a maximum record of 68/m^2 on the southern coast of Madeira[9]. The increase in sea urchins has been linked to high recreational fishing pressure leading to a reduction in the number of their predators[10].

[2] Casañas et al., 1998.
[3] Tittley & Neto, 2000; Bernál-Ibañez et al., 2021
[4] Bulleri et al., 1999; Alves et al., 2001
[5] Minderlein & Wirtz, 2014
[6] Brito, 2004; Tuya et al 2004; Bernál-Ibañez et al., 2021
[7] Monterroso et al., 2010.
[8] Abreu et al., 1995; Friedlander et al., 2017; Bernál-Ibañez et al., 2021
[9] Alves et al., 2001
[10] Alves et al., 2001

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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[11].	Present in >50 locations		

Distribution maps

This habitat type is present in each of the Macaronesian island groups. Distribution obtained from experts and literature collected through SeaSketch survey.

[11] 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).

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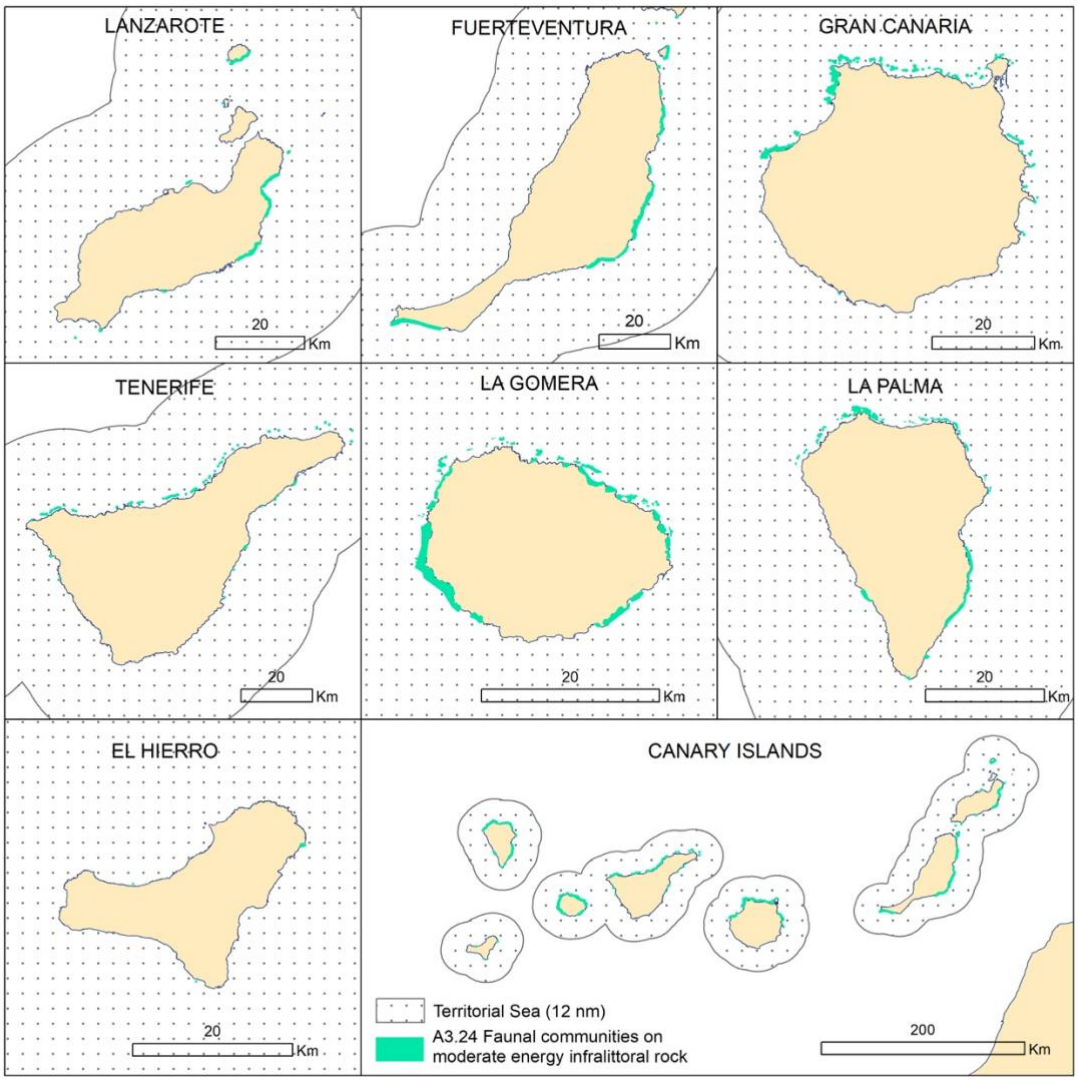

D. africanum is less adapted to cope with intense water movement and therefore increase with depth in areas exposed to wave action. In the Canary Islands, for example the greatest urchin densities and hence this habitat, are concentrated in 15-20m depth zone on wave exposed shores, whereas along sheltered coasts they can be found in the first few meters[12].

PRESSURES AND THREATS

The main pressure and threats linked to this habitat are harvesting of marine resources and increasing sea water temperatures.

Overexploitation of sea urchin predators[13] has been directly linked to large densities of *D. africanum*, which causes the direct elimination of erect algal beds and results in the prevalence of rocky unvegetated bottoms in the rocky subtidal[14]. The disappearance of these algal beds

[12] Hernandez et al., 2008a
[13] Fish species that prey on sea urchins include *Balistes capriscus, Canthidermis sufflamen* and *Bodianus scrofa*
[14] Eg. Tuya et al., 2004

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limits benthic primary production, as well as the amount of food and shelter these algal habitats provide for associated invertebrates and fishes. It has been postulated that in the future, sea urchin grazing action and uncontrolled fishing will leave a barren seabed.[15]

A positive relationship between the increases in densities of *D. africanum* and the recent increase in sea water temperature has been detected based on a historical compilation of sea water surface temperature data from 1948 to the present and a continuous collection of data on settlement, recruitment and densities from 2001 to 2008[16]. The study concluded that the increase in sea water temperature, coupled with the prevalence of ''urchin barren grounds'', enhanced the survivorship of *D. africanum* recruits. This work predicts an increase in the densities of this sea urchin as well as the extension of ''urchin barren grounds'' under the predicted scenario of raising temperatures.

Marine pollution (underwater outfalls, uncontrolled discharges, etc.) can also be an issue as this can have a direct effect on ecosystems, causing their simplification, a process that favours species with a great capacity for adaptation, such as the *Diadema* sea urchin[17].

Pressure indicators[18]	Current pressures	Likely future pressures
Habitat conversion and degradation		
- Urban coastal development	x	x
- Physical disturbance (SCUBA diving, trampling etc.)	x	x
Climate change		
- Global warming and sea level rise	x	x
Pollution and nutrient enrichment		
- Poorly managed waste/dredge disposal	x	x
- Sewage discharge	x	x
- Eutrophication	x	x
- Marine litter	x	x
Over-exploitation		
- Harvesting of marine resources	x	

TRENDS

Trends in quantity and quality (recent / historic)

This habitat is extensive and common throughout the Macaronesian archipelagos particularly around the Canary Islands and Madeira where there has been a significant increase in extent over recent decades. In some parts of the Canary Islands, for example the habitat has been reported as covering about 75% of the littoral rocky seabed [19]

[15] Hernandez et al., 2010
[16] HernÆndez et al. 2010.
[17] Monterroso et al., 2010.
[18] 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.
[19] Barquín et al. 2004

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There have also been mass mortality events affecting the dominant sea urchin but the impact on the habitat has been short term. In 2009, for example, a mass mortality event of *D.africanum* caused by disease, affected populations from Madeira to the Canary islands. The impacts were seen extending across more than 400km and although there was limited pre-morality data it has been estimated that this resulted in a 65% overall reduction in urchin abundance[20]. Another mass mortality event occurred in 2018 when such data were available and where the population of *D.africanum* around Madeira was estimated to have reduced by up to 90%. This was followed by a rapid recovery with the sea urchin populations reaching 60% of pre-mortality levels within 6 months[21].

CONSERVATION AND MANAGEMENT

There are no specific conservation and management measures for this habitat at the present time.

Creating marine reserves where fishing is totally or partially prohibited could help the recovery of algal beds and hence the structure of the food webs that have been disrupted by intensive urchin grazing but it is a slow process. Around Tenerife there are 17 zones where populations of control of *Diadema* has been proposed and/or is underway.

ASSESSMENT OF CONSERVATION STATUS WITHIN THE EU

Encrusting algal communities on exposed Atlantic infralittoral rock have been assessed as **LEAST CONCERN** 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 evidence that this habitat has been increasing in extent. It is therefore assessed as LEAST CONCERN under criterion A.

Criterion B – Restricted geographical distribution. This habitat is present in the Azores, Canary Islands and Madeira, it exceeds the minimum EOO and AOO thresholds and is therefore assessed as LEAST CONCERN under criterion B.

Criterion C/D – Reduction in quality. This habitat supports a low diversity of species. Expert opinion is that it is likely to be of LEAST CONCERN under criterion C/D.

Criterion E – Risk of collapse. There have been mass mortalities of sea urchins which are keystone species in this habitat but also rapid recoveries and expansion of this habitat around the Macaronesian archipelagos. There has been no quantitative analysis estimating the probability of collapse but as it is expanding this habitat is assessed as LEAST CONCERN under criterion E.

Overall Category & Criteria

LEAST CONCERN

[20] Clemente et al., 2014; Hernandez et al., 2013.
[21] Gizzi et al., 2020

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Confidence in assessment

High: There is a large body of information on the extent of this habitat type across the Macaronesian islands as well as data showing trends since the 1990s.

Assessors/Contributors

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

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updated biological guide Marine Biodiversity of Canary Islands

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