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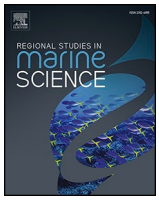

Largest discovered population of the endangered Scleractinian coral *Dendrophyllia ramea* off the Canary Islands (Spain)

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ABSTRACT

The mesophotic coral *Dendrophyllia ramea* is a Vulnerable Marine Ecosystem indicator species occurring in the NE Atlantic and in the Mediterranean, yet protection is unevenly articulated across regions. While studies on its occurrence, biology, and ecology have been published on Mediterranean populations, quantitative information for Atlantic ones is lacking. During the DEEP CANARIES expedition, aimed at partially addressing this gap regarding the Atlantic, an outstanding population of *Dendrophyllia ramea* was discovered off the southeastern coast of Tenerife (Canary Islands). Here, we document the density and colony-size structure of this exceptional population and discuss the relevance of this finding for the region and the need to protect it.

Video sampling was conducted with a remotely operated vehicle, and *Dendrophyllia ramea* density, occupancy, and colony size were measured. Video records unveiled a dense population, with a maximum density of 9.3 colonies $\cdot$ m^{-2} and an occupancy of 37.26% in the area with the highest colony concentration. Large colonies represented the highest proportion of the population, reaching a maximum size of 68.5 cm. Densities and dimensions reported here are consistent with the maximum values recorded for Mediterranean populations, being the densest one documented for the Atlantic heretofore.

Considering the potential implementation of an offshore wind farm in the area, the data presented here highlight the urgent need to protect this unique population, expanding the scope of existing regulatory frameworks, and extending the species' inclusion within the *Spanish List of Wildlife Species under Special Protection Regime and Catalogue of Threatened Species* to Atlantic populations.

The mesophotic ahermatypic Scleractinian coral *Dendrophyllia ramea* (Linnaeus, 1758) is an indicator species of Vulnerable Marine Ecosystems (VMEs) (FAO, 2009). Therefore, locations harbouring communities dominated by *D. ramea* may qualify to be declared as areas closed to fisheries (EU, 2016/2336, 2016), specifically to bottom-contacting fishing gears (EU, 2022/1614, 2022). *Dendrophyllia ramea* occurs in the North East Atlantic, from sub-polar to tropical latitudes, and across the Mediterranean (e.g., Angiolillo et al., 2022; Bracchi et al., 2025; Orejas et al., 2019; Salvati et al., 2021; Zibrowius, 1980). *Dendrophyllia ramea* from the Mediterranean is included in the *Mediterranean Red List*

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of the *International Union for Conservation of Nature* (IUCN) and catalogued as "*vulnerable*" (Otero et al., 2017). This species is protected in Mediterranean waters as well, under the *Barcelona Convention* agreement (listed in the Annex II of the *Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean*; UNEP/MAP-SPA/RAC, 2018), and at Spanish national level, it has been recently included in the *Spanish List of Wildlife Species under Special Protection Regime and Catalogue of Threatened Species* (BOE-A-2025–9192, 2025; TED/452/2025). Whereas quantitative studies on occurrence and distribution patterns of *D. ramea* (e.g., Angiolillo et al., 2022; Bracchi et al., 2025; Orejas et al., 2019; Salvati et al., 2021), and studies on its biology and ecology (e.g., Orejas et al., 2023; Reynaud et al., 2021) have been conducted in the Mediterranean, from the Levantine- to the Alboran Sea, no quantitative information for Atlantic populations is available.

The research expedition DEEP CANARIES (February 20th – March 3rd, 2025; Orejas et al., 2025), on board the Research Vessel (RV) Ángeles Alvariño, and part of the tasks of the Project "BIODIV Activity 5.1" (Spanish Ministry of Ecological Transition and Demographic Challenge), contributed to partially cover this knowledge gap regarding Atlantic *D. ramea* populations. During the survey, an exceptionally dense population of *D. ramea,* with remarkably large colonies, was discovered off the south-eastern coast of Tenerife (Canary Islands). Here, we document the occurrence and density of this exceptional population as well as its colony-size structure. The relevance of this finding for the region is discussed, along with the urgent need of protection of this population, considering the forthcoming anthropogenic activities, specifically the potential implementation of an offshore wind farm in the area.

During DEEP CANARIES, video sampling was carried out using the remotely operated vehicle (ROV) *Liropus 2000*, equipped with a full HD color camera and two laser pointers, spaced 10 cm apart, used for measuring. A total of 13 ROV dives were conducted (details on performed dives can be found in Orejas et al., 2025). Here, we describe the exceptional population of *D. ramea* found off the SE coast of Tenerife (ROV dive 12: 1791.5 m transect length, dive start 28°5'8.3''N, 16°27'59.3''W; dive end 28°5'18.6''N, 16°27'51.2''W, depth range 92–108 m, see Fig. 1, Table 1). *Dendrophyllia ramea* density (colonies per area) was calculated in sampling units (SU) of 3 m^2. The SU area was chosen taking into account the average width of the transect (2.5 m) and in order to quantify the distribution of *D. ramea* along the transects. This selected SU has been previously used, being considered a suitable area for the quantitative study of this species (e.g., Angiolillo et al., 2022). Occupancy was computed as the percentage of SUs with *D. ramea* presence. Colony sizes were measured using the ROV lasers as scale and following the methodology applied by Orejas et al., (2019), classifying colonies into four size-classes according to their width: small colonies (< 10 cm), medium-sized colonies (10–20 cm), large colonies (20–40 cm), and very large colonies (> 40 cm).

The video record collected during ROV dive 12 (Fig. 1, Table 1) revealed a dense and well-developed population of *D. ramea*, displaying, as it is typical for many benthic organisms, a patchy distribution. Colonies were attached to rocky substrates with scattered thin sediment layers. A total of 190 colonies have been recorded (Table 1). The mean density value for the area with the highest colony concentration reached up to 1.06 ± 0.26 (mean ± SE) colonies · m^{-2}, yielding an occupancy of 37.26% in that area, extending from 91 to 98 m depth. The highest density recorded was 9.3 colonies · m^{-2} (Table 1), at a depth of 93 m. A

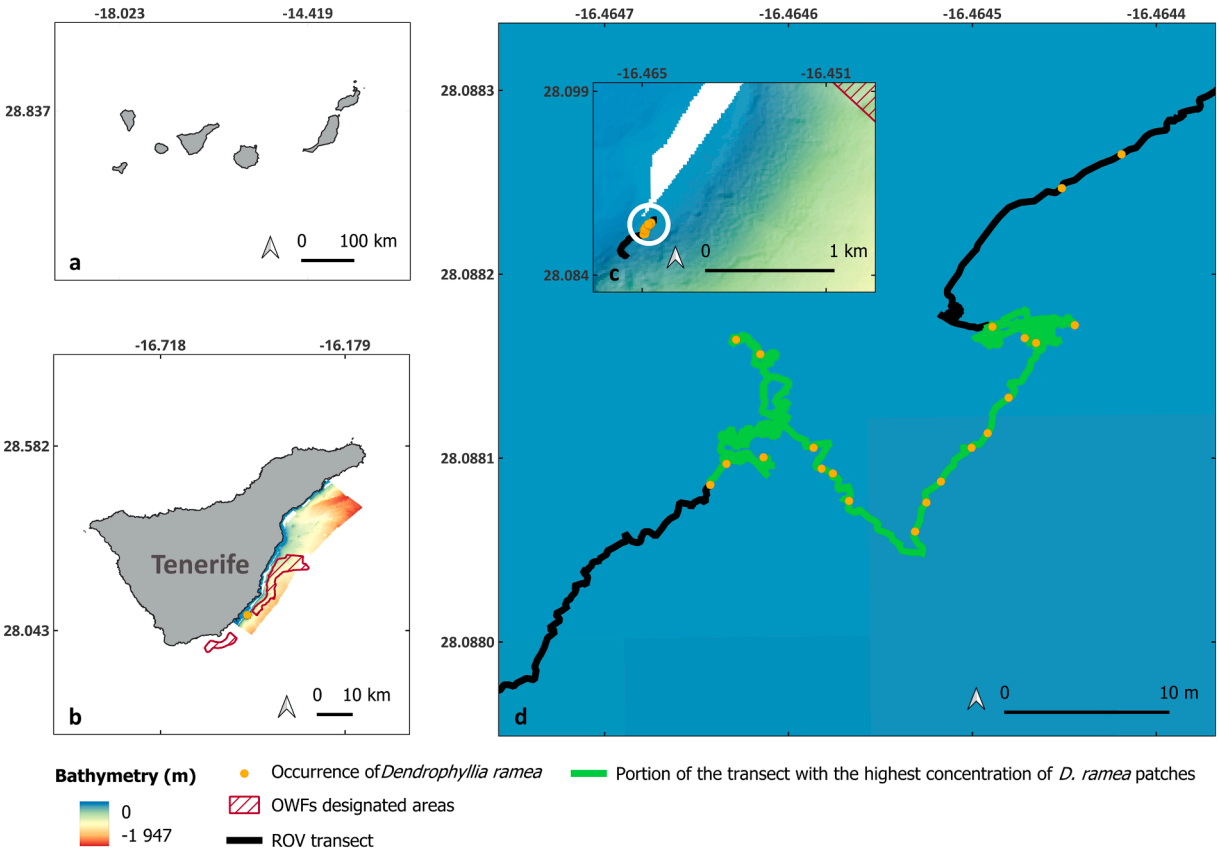

Fig. 1. Map of the studied area, showing (a) the Canary Islands Archipelago, (b) the location where the described population of *Dendrophyllia ramea* occurs (represented by an orange dot), off the SE coast of Tenerife Island, including also the areas designated for the construction of offshore wind farms (OWFs) (represented by red, hatched polygons), (c) detail of the ROV transect, encircling the area of the transect showed in panel (d) (white circle), and (d) the portion of the transect where the highest concentration of *D. ramea* patches was found.

Table 1
Comparative table of the available information on *Dendrophyllia ramea* densities, occupancy, and dimensions from video records. Transect depth range and length, and sampling unit (SU) used are provided. Depth range, total number of *D. ramea* colonies recorded per transect, maximum density and occupancy of colonies, maximum size and dominant size class, and the proportion of large (> 20 cm wide) colonies are indicated when available. Ocean/Sea, locality and country, and sampling date (year) of each reported population, and the reference of the corresponding study are also provided. Only studies reporting at least 15 *D. ramea* colonies per transect are included.

O/S	Locality (country)	Date	Transect depth range (m)	Transect length (m)	SU (m^2)	Colonies depth range (m)	Colonies number (n°)	Maximum density $(col.m^{-2})$	Occupancy (%)	Maximum size (cm)	Dominant size class (cm)	Proportion of large colonies (%)	Study
ATL	SE Tenerife (Spain)	2025	91–160	1791.5	3	92–108	190	9.3	5.73	68.5	20–40	58	This study
MED	Off Protaras (Cyprus)	2015	100–223	122	1.5	125–155	236	6.7	9.10	~50.0	10–20	< 20	Orejas et al., (2019)
			142–143	1061.4	1.5		224	4.0	10.60	~50.0	< 10	< 20	
	SE Vulcano (Italy)	2017	20–169	1232	657[1]	66–99	29	–	–	71.1	Medium-large[2]	51[3]	Salvati et al., (2021)
			20–114	1290	387[1]	73–85	16	–	–				
	Off Avola (Italy)	2021	72–79	468	3	70–80	78	8.0	24.40	79.9	< 10	~20	Angiolillo et al., (2022)
			70–72	188	3		93		38.90		< 10	< 10	
	Off Marzamemi (Italy)	2022	70–76	50	–	74–76	30	–	–	> 50[4]	< 10	20	Bracchi et al., (2025)
			69–71	115	–	69–71	23	–	–		< 10	30	

Abbreviations: O/S, Ocean/Sea; ATL, Atlantic; MED, Mediterranean.
[1] The SUs provided by Salvati et al., (2021) refer to the whole transect area.
[2] Colony size in Salvati et al., (2021) are provided as qualitative classes, integrating branching, height, and width (classes: single – one polyp; small – colonies with a two-dimensional growth axis and no more than five polyps; and medium and large-sized – colonies with > 5 polyps and a variable branching orientation).
[3] The proportion of large colonies provided for Salvati et al., (2021) is based on the previously indicated integrated classes.
[4] The maximum size provided by Bracchi et al., (2025) is 'over 50 cm'.

total of 147 colonies have been measured, exhibiting a tree-like morphotype (Fig. 2). Different colony sizes have been documented, with large colonies (> 20 cm width, pooling large- and very large-sized ones) representing the highest proportion of the population (58%), followed by medium-sized (31%) and small (11%) colonies. Colony size (width) reached up to 68.5 cm (Table 1), with a mean value of 24.09 ± 1.10 cm. Both, density and colony dimensions reported here, are consistent with the maximum values recorded in other populations found in the Mediterranean (Table 1). To the best of our knowledge, no studies have been published on the occurrence, distribution, and population structure of *D. ramea* for Atlantic waters, with Brito and Ocaña (2004) pointing to the existence of large banks of *D. ramea* in the Canary Islands, but with no data provision. Considering the over 250 video surveys conducted during the last decade off the Canaries (Oliva et al., unpublished data), this is the densest population documented in the Archipelago to date. The lack of documentation on comparably dense *D. ramea* populations in Atlantic waters stresses the relevance of this particularly well-preserved population reported here off the SE coast of Tenerife. This is the densest population described so far for the Atlantic, and comparable to the described and quantified Mediterranean populations (Table 1). The reasons underlying these high densities of large colonies are beyond the scope of this short communication and are the subject of a more extensive study currently underway (Oliva et al., unpublished data). However, they are likely the result of the confluence of a particularly favourable habitat and local hydrodynamic conditions (e.g., Orejas et al., 2019).

The zonation established under the *Spanish Marine Spatial Management Plans* (BOE-A-2023–5704, 2023), for the implementation of offshore wind farms (OWFs) includes areas close (< 2 km) to the *D. ramea* population here described (Fig. 1). While OWFs may negatively impact benthic sessile fauna in many ways, including habitat loss, promotion of sedimentation, water turbidity and pollution, or substrate alteration, among others (e.g., Watson et al., 2025), they may also exert indirect impacts in close by areas due to the displacement of human activities prohibited within OWF exclusion zones. This includes fishing activity, thereby likely intensifying cumulative human pressures in surrounding areas, what may hinder the achievement of Good Environmental Status (GES) as mandated by the Marine Strategy Framework Directive, (2008); Lloret et al., (2022)). Indeed, in the area where this exceptional population of *D. ramea* has been discovered, remains of fishing gears were documented during the DEEP CANARIES expedition (Fig. 2). Lost fishing gears could cause ghost fishing (e.g., Seixas et al., 2024), damaging the colonies. These fishing remains denote that this population is already potentially subjected to fishing-related pressure. In conclusion, considering the potential implementation of an offshore wind farm in the area, the data presented here evidence the urgent need to protect this unique population. These findings also support expanding the scope of existing regulatory frameworks (EU, 2016/2336, 2016; EU, 2022/1614, 2022), and extending the species' inclusion (at present, only applying to Mediterranean waters) within the *Spanish List of Wildlife Species under Special Protection Regime and Catalogue of Threatened Species* (BOE-A-2025–9192, 2025; TED/452/2025) to Spanish Atlantic waters.

CRediT authorship contribution statement

Silvia Oliva: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Pablo Martín-Sosa:** Writing – review & editing, Supervision, Project administration, Investigation, Conceptualization. **Beatriz Vinha:** Writing – review & editing, Methodology, Investigation, Conceptualization. **Ohiana Revuelta:** Writing – review & editing, Methodology, Investigation, Conceptualization. **Raúl Jiménez Romero:** Writing – review & editing, Investigation, Data curation. **Ángela Mosquera-Giménez:** Writing – review & editing, Investigation. **María Montseny:** Writing – review & editing, Investigation. **Gerardo Bruque:** Writing – review & editing,

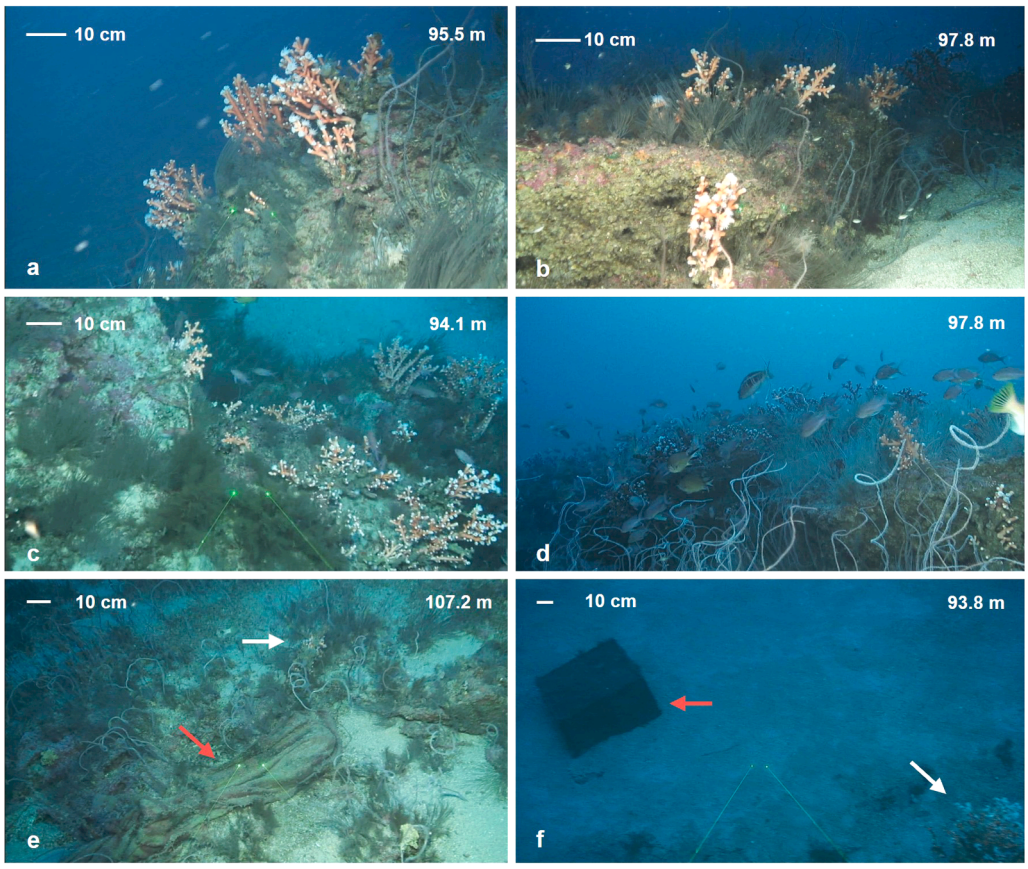

Fig. 2. Video frames from the video records acquired during DEEP CANARIES. Panels (a, b, c, d) display large colonies of *Dendrophyllia ramea* off the SE coast of Tenerife Island, with panel (d) showing a large school of fish associated to the coral habitat. Panels (e) and (f) exhibit fishing gear remains (denoted by red arrows) in the area where the dense *D. ramea* population has been documented (close colonies indicated by white arrows), specifically representing a discarded fishing net and a deep-water mooring in panels (e) and (f), respectively. Green dots are the laser pointers of the ROV (10 cm apart) used as scale. Depth of each location is indicated in the upper right corner of the images. Image credit: BIODIV A5.1 – DEEP CANARIES.

Investigation. **Marcos González-Porto:** Writing – review & editing, Investigation. **Laura Martín-García:** Writing – review & editing, Investigation. **Luís Miguel Fernández-Salas:** Writing – review & editing, Investigation. **Sebastián Jiménez-Navarro:** Writing – review & editing, Investigation. **Covadonga Orejas:** Writing – review & editing, Supervision, Project administration, Investigation, Funding acquisition, Conceptualization.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work presented in this paper.

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Data availability

The data supporting the findings of this study are not publicly available due to ongoing, related research by the authors; but, interested researchers can request access from the corresponding author.

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