Template for Submission of Information, including Traditional Knowledge, to Describe Areas Meeting Scientific Criteria for Ecologically or Biologically Significant Marine Areas

Abstract (*in less than 150 words)*
The Tropic Seamount, located in an Area Beyond National Jurisdiction (ABNJ) in the subtropical North Atlantic, revealed numerous VMEs, including high-density octocoral gardens, *Solenosmilia variabilis* patch reefs, xenophyophores, crinoid fields and deep-sea sponge grounds. A recent study offered the first biological insight to ground-truth the occurrence of potential VMEs on Tropic Seamount, alongside predictive models to increase the spatial coverage beyond ROV and AUV surveys. Predicted habitat for the glass sponge *Poliopogon amadou*, a biogeographically restricted hexactinellid forming extensive near-monospecific grounds, was found to favour the deep seamount flanks within a very narrow oceanographic regime. This first visual and sampling survey on the area by the MarineE-Tech project found deposits of ferromanganese crusts at all depths. Therefore we present a case toward designating the Tropic Seamount as an Ecologically or Biologically Significant marine Area as a contribution to address biodiversity conservation in ABNJs.

Introduction

(To include: feature type(s) presented, geographic description, depth range, oceanography, general information data reported, availability of models)

The Tropic Seamount, located in the northeastern Atlantic (23°55' N, 20°45' W), is a four-armed, star-shaped guyot dated to 91.1 - 0.2 Ma (van den Bogaard, 2013). With a flat-topped summit (slope of 0.5°–4°) sitting at approximately 1,000 m water depth with its base rooted at approximately 4,200 m depth, the seamount presents a truncated cone slightly elongated along a north-south axis, measuring about 42 km in length and 37 km in width (Palomino et al., 2016). The flanks of the seamount are divided by four ridges 10–13 km in length with slopes ranging from 5° to 45°. Radiating from the summit, the flanks also exhibit gullies measuring 3–10 km in length (Palomino et al., 2016). The seamount is thought to have once been an oceanic island that eroded and subsided to its present depth at 1,000 m (Schmincke and Graf, 2000).

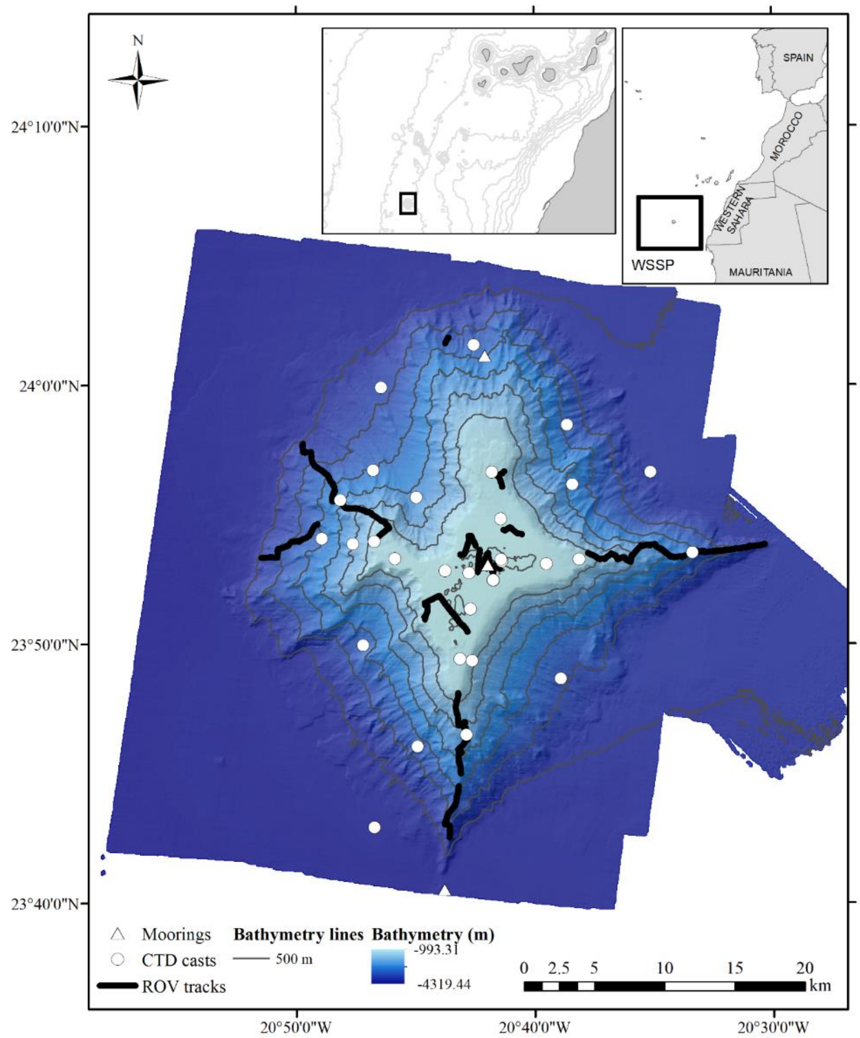
This seamount sits between the seasonally productive waters off the NW African coast and the more oligotrophic waters of the North Atlantic subtropical gyre (Henderiks, 2001). The surface waters are supplied by the Canary Current (CC), which flows south-westward along the African coast, turning west to join the North Equatorial Current at 20°–25° N. Below the seasonal thermocline and waters influenced by coastal upwelling (<100 m), the North Atlantic Central Water (NACW) and South Atlantic Central Water (SACW) lie above ~700 m. The NACW is characterized by a higher level of dissolved oxygen than the SACW. Intermediate depths, 700–1,600 m, are ventilated by the lower salinity Antarctic Intermediate Water (AAIW). Deeper layers from ~1,600 m to the seafloor, are defined by the Upper North Atlantic Deep Water (NADW), which is the shallowest deep water mass influenced by the Mediterranean Water (MW) (Hernández-Guerra et al., 2001; Knoll et al., 2002; Hernández-Guerra et al., 2005; Pastor et al., 2012; Bashmachnikov et al., 2015; Pastor et al., 2015). The influence of the MW decreases southward and seasonally, stretching south in winter (Pastor et al., 2012). Phytoplankton-enriched waters from upwelling events extend offshore to the study area (Hernández-Guerra et al., 2005). Dissolved oxygen levels at the seamount drop to 2.5–3.5 mg ml^{-1} in the core of the oxygen minimum zone in ~750 m and rise to 5 mg ml^{-1} at 3,000 m (Koschinsky et al., 1996).

Location

(Indicate the geographic location of the area/feature. This should include a location map.)

The Tropic Seamount is located in the northeastern Atlantic (23°55’ N, 20°45’ W), within the Western Sahara Seamount Province, along the northwestern African continental margin.

Figure 1. Location of the Tropic Seamount in the northeast tropical Atlantic with the different sampling operations: ROV tracks (thick black lines), CTD casts (white circles) and moorings (white triangles). Inset images show the location of the study area in relation to northwest Africa and the Western Sahara Seamount Province (WSSP).



Feature description of the proposed area

(This should include information about the characteristics of the feature to be proposed, e.g. in terms of physical description (water column feature, benthic feature, or both), biological communities, role in ecosystem function, and then refer to the data/information that is available to support the proposal and whether models are available in the absence of data. This needs to be supported where possible with maps, models, reference to analysis, or the level of research in the area)

Remotely operated vehicle images showed high diversity of VME indicator taxa on Tropic Seamount (**Figure 2**). Coral debris was observed in still images mainly on the summit dives but also on some of the ridges to a depth of 1,800 m. Fifteen cold-water coral species were observed, including one scleractinian, twelve octocorals and two black corals (**Table 1**). The main scleractinian coral identified from the images was *Solenosmilia variabilis* (Duncan, 1873), which was normally present on ledges, forming patches at depths from _1,000 to 1,800 m. Octocoral composition varied with depth, with *Acanella arbuscula* (Johnson, 1862), *Metallogorgia melanotrichos* (Wright and Studer, 1889), *Corallium tricolor* (Johnson, 1899), and species from the genus *Chrysogorgia* (Duchassaing and Michelotti, 1864), *Iridogorgia* (Verrill, 1883), and *Thouarella* (Gray, 1870) generally present at depths of _1,010–3,000 m on rocky substrates. The octocorals *Narella bellissima* (Kükenthal, 1915), *Acanthogorgia armata* (Verrill, 1878) and *cf.* Swiftia (Duchassaing and Michelotti, 1864) were commonly observed at depths up to 3,600 m associated to volcanic substrates. Unidentified black coral species belonging to the genus *Parantipathes* (Brooke, 1889) and *Bathypathes* (Brooke, 1889) were also observed. Extensive coral gardens, another type of animal forests (Rossi et al., 2017), dominated by bamboo corals (Familiy Isididae) tentatively assigned based on branching patterns to the genus *Keratoisis* (Wright, 1869) and *Lepidisis* (Verrill, 1883) based on ROV images were recorded at 2,500–3,500 m depth.

Deep-sea squid eggs from an unidentified species were observed laying on bamboo corals on several occasions, indicating a potential spawning and/or nursery ground. Cold-water coral composition for Tropic Seamount is comparable to the reported for the la Concepción Bank and El Hierro ridge (Northern Seamounts group WSSP) and to the Canary Island slopes, with dominance of octocorals (Brito and Ocaña, 2004; Almón et al., 2014; Álvarez et al., 2016). Dense assemblages of bamboo corals of the genus *Keratoisis* have also been reported for Cape Verde seamounts between 1,900 and 3,699 m (Hansteen et al., 2014).

Besides *Poliopogon amadou*, other sponges seen included the hexactinellid *Pheronema carpenteri* (Thomson, 1869), *Stylocordyla pellita* (Topsent, 1904), *Hertwigia falcifera* (Schmidt, 1880), *Aphrocallistes beatrix* (Gray, 1858), and species from the genus *Euplectella* (Owen, 1841); *Hyalonema* (Gray, 1832); *Caulophacus* (Schulze, 1886); *Asconema* (Kent, 1870); and *Phakellia* (Bowerbank, 1862). Demosponges and other undetermined massive and encrusting sponges were also observed.

Xenophyophore and crinoid fields were also observed (**Table 1**). Among crinoids, the most common species were fields of stalked *Endoxocrinus (Diplocrinus) wyvillethomsoni* (Thomson, 1872) (Isselicrinidae), and two thalassometrid feather stars: *Koehlermetra porrecta* (Carpenter, 1888), an orange species with 20 or more arms, and a yellow species, perhaps *Thalassometra lusitanica* (Carpenter, 1884). The stalked species, *E. wyvillethomsoni*, is the only member of order Isocrinida found in the NE Atlantic occurring along the eastern Atlantic margin from west of Ile d'Ouessant, France (49° N) to south of the Canary Islands off the coast of Morocco (25° N) at depths from 1,246 to 2,070 m (Roux, 1985). *Koehlermetra porrecta* occurs in the eastern Atlantic from George Bligh Bank (NE end of the Rockall Plateau) to Ascension Island, over a depth range of at least 768–1,448 m (possibly 755–1,769 m) (Carpenter, 1888; Bullimore et al., 2013; Narayanaswamy et al., 2013). Stevenson et al. (2017) reported large populations of *K. porrecta* in 778–941 m in the Bay of Biscay. Records of *Thalassometra lusitanica* range from the Canary Islands and Morocco to off Cape Carvoeiro, Portugal, at depths of 1,229–1,716 m (possibly 914–1,912 m), with one record in 2,165 m (Clark, 1950, 1980).

For the depths where *P. amadou* was recorded (1,960 – 3,660 m), the CTD casts registered temperatures ranging from 2.5° to 4° C, salinity values between 34.91 and 35.05 psu, and oxygen levels between 6.5 and 6.9 mg/ml^{-1}. The casts showed an inflection point in these parameters at ~2,500 m, where oxygen reached values of 6.8 mg/ml^{-1}, the temperature was ~3.25° C and salinity 34.99 psu. Hydrodynamic modeling revealed a strong influence of tides on surface and bottom currents, with a NE-SW current rotating anticlockwise over the diurnal tidal cycle. The elongated ridges extending outward from the star-shaped seamount cause high current variability. The eastern and western flanks dissipate higher energy, whereas the northern and southern spurs dissipate less energy. The distribution of sediment-covered and sediment-poor areas coincided with this energy distribution, which is observable on the ROV videos and the backscatter intensity. The summit had a variable layer of biogenic silty fine sand forming ripples aligned with the (varying) peak current velocity. Numerical modeling indicates the presence of a weak Taylor Cap on the summit of the seamount (Cooper and Spearman, 2017).

Feature condition and future outlook of the proposed area

(Description of the current condition of the area – is this static, declining, improving, what are the particular vulnerabilities? Any planned research/programmes/investigations?)

The sponge grounds of *P. amadou* were one of the most frequent and extensive VMEs observed on the Tropic Seamount, with different body sizes (from approximately 5 cm up to 55 cm) indicating a stable population with on-going recruitment. The depths of most VME indicator taxa on Tropic Seamount make these seamount habitats de facto refuges from bottom fisheries impacts, as supported by a lack of evidence for any contact with bottom-fishing gear from the ROV images and from fishing records across the wider CECAF area (FAO Fiaf/R1184, 2016).

Tropic Seamount could in future become vulnerable to other types of deep-water exploitation. The latest survey on the area by the MarineE-Tech project found deposits of ferromanganese crusts at all depths. In particular, the thickest crusts (<20 cm) are located at the greatest depths of the seamount

(3,000 – 4,000 m) on the eastern and western ridges, while the summit generally hosts the thinnest crusts (Murton et al., 2017). These crusts hold significant resources of tellurium and cobalt, making this underwater feature of interest to future deep-sea mining. Specimens of *P. amadou* were found only on hard substrates corresponding to rocks, of which the majority had a ferromanganese crust. Deep-sea mining will very likely cause some extent of biodiversity loss (Van Dover et al., 2017), and much recent research has addressed this conflict between industry and conservation (e.g., Shirayama et al., 2017; Dunn et al., 2018; Van Dover et al., 2018).
The International Seabed Authority, together with new legally binding policy instruments for ABNJs (Long and Chaves, 2015), can help address these threats and sustainably manage VMEs on Tropic Seamount if a robust evidence base on VME occurrence can be constructed based on ground-truthed and predictive models. The present study offers the first biological study to ground-truth the occurrence of potential VMEs on Tropic Seamount, alongside predictive models to increase the spatial coverage beyond ROV and AUV surveys. Predicted habitat for *P. amadou* was found to be favorable on the deep flanks of the seamount within a very narrow oceanographic regime. Thus, any deep-sea mining operation on these flanks should consider sediment deposition throughout the water column and potential for sediment plumes to spread from adjacent non-flank areas including those on the shallower summit. Other VME taxa observed on Tropic Seamount, such as coral gardens and patches of *S. variabilis* are also likely to provide important ecosystem functions on the seamount, indeed one type of coral garden hosted a nursery ground for deep-sea squid: here too, predictive species and habitat models could greatly aid in building the evidence base for VME occurrences.

Assessment of the area against CBD EBSA Criteria
(Discuss the area in relation to each of the CBD criteria and relate the best available information. Note that a proposed area for EBSA description may qualify on the basis of one or more of the criteria, and that the polygons of the EBSA need not be defined with exact precision. And modeling may be used to estimate the presence of EBSA attributes. Please note where there are significant information gaps)

CBD EBSA Criteria (Annex I to decision IX/20)	**Description** (Annex I to decision IX/20)	**Ranking of criterion relevance** (please mark one column with an X)			
		No information	**Low**	**Medium**	**High**
Uniqueness or rarity	Area contains either (i) unique ("the only one of its kind"), rare (occurs only in few locations) or endemic species, populations or communities, and/or (ii) unique, rare or distinct, habitats or ecosystems; and/or (iii) unique or unusual geomorphological or oceanographic features.				X
Explanation for ranking (must be accompanied by relevant sources of scientific articles, reports or documents) The Tropic Seamount harbors diverse and near pristine benthic communities that include several VMEs such as reef-building coral species Solenosmilia variabilis, several species of octocorals and black corals, and, in the case of *P. amadou*, biogeographically unique VMEs, that formed diverse animal forests, crinoid fields, and sponge grounds. This diversity is most likely related to the specific oceanographic characteristics and hydrography of the Tropic Seamount.					
Special importance for life-history stages of species	Areas that are required for a population to survive and thrive.			X	
Explanation for ranking (must be accompanied by relevant sources of scientific articles, reports or documents) Deep-sea squid eggs from an unidentified species were observed laying on bamboo corals on several occasions, indicating a potential spawning and/or nursery ground.					

<table>
<tr><td>Importance for threatened, endangered or declining species and/or habitats</td><td>Area containing habitat for the survival and recovery of endangered, threatened, declining species or area with significant assemblages of such species.</td><td></td><td></td><td></td><td>X</td></tr>
<tr><td colspan="6">Explanation for ranking (must be accompanied by relevant sources of scientific articles, reports or documents)
The Tropic Seamount hosts numerous VME indicator taxa that have international conservation and management significance through this designation, and therefore the Seamount is a significant area for the survival of these protected species. These underwater mountains provide hard substrata for VME indicator taxa such as corals, sponges and other species -like the ones found on Tropic-to settle and grow (Rogers et al., 2007; Samadi et al., 2007; Clark et al., 2012). Seamounts are often characterized by particular hydrography, enhancing the flow of currents and ultimately, the availability of food to suspension feeders (Watling and Auster, 2017). High densities of corals and sponges can be found on those features (Genin et al., 1986; Rogers et al., 2007; Roberts et al., 2009; Henry et al., 2013; Victorero et al., 2018), although benthic assemblages and biomass may vary among seamounts in less productive regions, where substratum is not suitable, or where seamounts are not adjacent to continental slopes (Rowden et al., 2010).</td></tr>
<tr><td>Vulnerability, fragility, sensitivity, or slow recovery</td><td>Areas that contain a relatively high proportion of sensitive habitats, biotopes or species that are functionally fragile (highly susceptible to degradation or depletion by human activity or by natural events) or with slow recovery.</td><td></td><td></td><td></td><td>X</td></tr>
<tr><td colspan="6">Explanation for ranking (must be accompanied by relevant sources of scientific articles, reports or documents)

The Tropic Seamount hosts numerous VME indicator taxa including reef-building coral species such as Solenosmilia variabilis; several species of octocorals, black corals and sponges; extensive grounds of the glass sponge P. amadou; crinoids and xenophyophores. These taxa are characterized for being slow-growing, long-lived and late-maturing species, traits that limit their potential for resilience and recovery from human disturbances such as bottom-contact fishing and, in the future, deep-sea mining (Ramirez-Llodra et al., 2011).</td></tr>
<tr><td>Biological productivity</td><td>Area containing species, populations or communities with comparatively higher natural biological productivity.</td><td></td><td></td><td>?</td><td></td></tr>
<tr><td colspan="6">Explanation for ranking (must be accompanied by relevant sources of scientific articles, reports or documents)
The Tropic Seamount hosts a vast amount of VME species including extensive and dense monospecific sponge grounds of Poliopogon amadou of different body sizes (from approximately 5 cm up to 55 cm), large octocoral gardens and reef-building corals. The biomass this seamount supports is probably explained by the phytoplankton-enriched waters from the Sahara upwelling events that can extend offshore reaching the Tropic Seamount (Hernández-Guerra et al., 2005). These waters are fed by the iron-rich dust coming from the Sahara desert making the NW waters off Morocco a very productive oceanographic area (Henderiks, 2001). The existence of a weak Taylor Cap on the seamount summit (Cooper and Spearman, 2017) may be affecting the distribution of particulate organic carbon keeping organic matter suspended and circulated within certain depth ranges (Clark et al., 2010) supporting the extraordinary secondary production.</td></tr>
<tr><td>Biological diversity</td><td>Area contains comparatively higher diversity of ecosystems, habitats, communities, or species, or has higher genetic diversity.</td><td></td><td></td><td></td><td>X</td></tr>
<tr><td colspan="6">Explanation for ranking (must be accompanied by relevant sources of scientific articles, reports or documents)
Video analysis revealed the existence of a diverse set of VME indicator taxa, throughout the different depth levels of the seamount. Coral debris was observed in still images mainly on the summit dives but also on some of the ridges to a depth of 1,800 m. Fifteen cold-water coral species were observed, including one scleractinian, twelve octocorals and two black corals (Table 1). Glass, massive and encrusting sponges, and</td></tr>
</table>

xenophyophores and crinoid fields were also observed. One of the most distinctive observation was the occurrence of dense aggregations of the hexactinellid sponge *Poliopogon amadou* Thomson (1877), which formed extensive areas of sponge grounds in the deeper flanks of the seamount. Ensemble modelling suggested high probability of presence across the entire seamount at a marked bathymetric bel between 2,000-3,500 m water depth, but with particular higher probability of occurrence in the eastern and western spurs of the seamount (**Figure 3**).

Naturalness	Area with a comparatively higher degree of naturalness as a result of the lack of or low level of human-induced disturbance or degradation.				X
Explanation for ranking (must be accompanied by relevant sources of scientific articles, reports or documents) The depths of most VME indicator taxa on Tropic Seamount make these seamount habitats de facto refuges from bottom fisheries impacts, as supported by a lack of evidence for any contact with bottom-fishing gear from the ROV images and from fishing records across the wider CECAF area (FAO Fiaf/R1184, 2016).					

Sharing experiences and information applying other criteria (Optional)

Other Criteria	**Description**	**Ranking of criterion relevance** (please mark one column with an X)			
		Don't Know	**Low**	**Medium**	**High**
Add relevant criteria					
Explanation for ranking (must be accompanied by relevant sources of scientific articles, reports or documents)					

References

(e.g. relevant documents and publications, including URL where available; relevant data sets, including where these are located; information pertaining to other relevant material, models, etc.)

Almón, B., Arcos, J. M., Martín, V., Pantoja, J., Consuegra, E., Martín Sosa, P., et al. (2014). Banco de la Concepción. Áreas de estudio del proyecto LIFE+ INDEMARES. Available at: www.indemares.es

Álvarez, H., Perry, A. L., Blanco, J., and Aguilar, R. (2016). "Expedición 2014 'Atlantic Seamounts'. El Hierro y montañas submarinas". Available at: https://eu.oceana.org/sites/default/files/oceana_el_hierro_y_montanas_submarinas_expedicion_2014.pdf

Bashmachnikov, I., Nascimento, Â., Neves, F., Menezes, T., and Koldunov, N. V (2015). Distribution of intermediate water masses in the subtropical northeast Atlantic. *Ocean Sci* 11, 803–827. doi:10.5194/os-11-803-2015.

Brito, A., and Ocaña, O. (2004). *Corales de las Islas Canarias*. Francisco Lemus Editor. La Laguna. Available at: https://www.casadellibro.com/libro-corales-de-las-islas-canarias/9788487931673/1011260.

Bullimore, R. D., Foster, N. L., and Howell, K. L. (2013). Coral-characterized benthic assemblages of the deep Northeast Atlantic: defining "Coral Gardens" to support future habitat mapping efforts. *ICES J. Mar. Sci.* 70, 511–522. doi:10.1093/icesjms/fss195.

Clark, A. H. (1950). A Monograph of the Existing Crinoids. 1(4c). 1–383, 32 plates. Available at: https://repository.si.edu/handle/10088/21346

Clark, A. M. (1980). Crinoidea collected by the Meteor and Discovery in the NE Atlantic. Available at: http://biostor.org/reference/110

Clark, M. R., Rowden, A. A., Schlacher, T., Williams, A., Consalvey, M., Stocks, K. I., et al. (2010). The Ecology of Seamounts: Structure, Function, and Human Impacts. *Ann. Rev. Mar. Sci.* 2, 253–278. doi:10.1146/annurev-marine-120308-081109.

Clark, M. R., Schlacher, T. A., Rowden, A. A., Stocks, K. I., and Consalvey, M. (2012). Science Priorities for Seamounts: Research Links to Conservation and Management. *PLoS One* 7, e29232. doi:10.1371/journal.pone.0029232.

Cooper, A. J., and Spearman, J. (2017). Validation of a TELEMAC - 3D model of a seamount. in *Proceedings of the TELEMAC-MASCARET user Conference, 17-20* 854 *October 2017* (Graz University of Technology, Austria, 29-34). Available at: https://henry.baw.de/bitstream/handle/20.500.11970/104505/03_Cooper_2017.pdf?sequence=1&isAllowed=y.

Dunn, D. C., Van Dover, C. L., Etter, R. J., Smith, C. R., Levin, L. A., Morato, T., et al. (2018). A strategy for the conservation of biodiversity on mid-ocean ridges from deep-sea mining. *Sci. Adv.* 4, eaar4313. doi:10.1126/sciadv.aar4313.

FAO FIAF/R1184 (2016). FAO / CECAF Technical Workshop on Deep-Sea Fisheries and Vulnerable Marine Ecosystems in the Eastern Central Atlantic.

Genin, A., Dayton, P. K., Lonsdale, P. F., and Spiess, F. N. (1986). Corals on seamount peaks provide evidence of current acceleration over deep-sea topography. *Nature* 322, 59–61. doi:10.1038/322059a0.

Hansteen, T., Kwasnitschka, T., and Klügel, A. (2014). *Cape Verde Seamounts - Cruise No. M80/3 - December 29, 2009 - February 1, 2010 - Dakar (Senegal) - Las Palmas de Gran Canaria (Spain).* Bremen: DFG-Senatskommission für Ozeanographie. doi:10.2312/cr_m80_3.

Henderiks, J. (2001). Coccolith studies in the Canary Basin: Glacial-Interglacial paleoceanography of the Eastern Boundary Current System. Available at: http://www.academia.edu/28505222/Coccolith_studies_in_the_Canary_Basin.

Henry, L. A., Moreno Navas, J., and Roberts, J. M. (2013). Multi-scale interactions between local hydrography, seabed topography, and community assembly on cold-water coral reefs. *Biogeosciences* 10, 2737–2746. doi:10.5194/bg-10-2737-2013.

Hernández-Guerra, A., López-Laatzen, F., Machín, F., De Armas, D., and Pelegrí, J. L. (2001). Water masses, circulation and transport in the eastern boundary current of the North Atlantic subtropical gyre. *Sci. Mar.* 65, 177–186. Available at: http://digital.csic.es/bitstream/10261/5330/1/gyre.pdf.

Hernández-Guerra, A., Fraile-Nuez, E., López-Laatzen, F., Martínez, A., Parrilla, G., and Vélez-Belchí, P. (2005). Canary Current and North Equatorial Current from an inverse box model. *J. Geophys. Res. Ocean.* 110, 1–16. doi:10.1029/2005JC003032.

Knoll, M., Hernández-Guerra, A., Lenz, B., López Laatzen, F., Machín, F., Müller, T. ., et al. (2002). The Eastern Boundary Current system between the Canary Islands and the African Coast. *Deep Sea Res. Part II Top. Stud. Oceanogr.* 49, 3427–3440. doi:10.1016/S0967-0645(02)00105-4.

Koschinsky, a., Halbach, P., Hein, J. R., and Mangini, a. (1996). Ferromanganese crusts as indicators for paleoceanographic events in the NE Atlantic. *Geol. Rundschau* 85, 567–576. doi:10.1007/BF02369011.

Long, R., and Chaves, M. R. (2015). Anatomy of a new international instrument for marine biodiversity beyond national jurisdiction. *Environ. Liabil.* 6, 213–229. Available at: www.lawtext.com.

Narayanaswamy, B. E., Hughes, D. J., Howell, K. L., Davies, J., and Jacobs, C. (2013). First observations of megafaunal communities inhabiting George Bligh Bank, Northeast Atlantic. *Deep Sea Res. Part II Top. Stud. Oceanogr.* 92, 79–86. doi:10.1016/J.DSR2.2013.03.004

Murton, B. J., Lusty, P., Yeo, I. A., and Howarth, S. (2017). Detailed description of FeMn crusts at Tropic Seamount. in *American Geophysical Union, Fall Meeting 2017, abstract #OS34A-05*.

Palomino, D., Vázquez, J.-T., Somoza, L., León, R., López-González, N., Medialdea, T., et al. (2016). Geomorphological features in the southern Canary Island Volcanic Province: The importance of volcanic processes and massive slope instabilities associated with seamounts. *Geomorphology* 255, 125–139. doi:10.1016/J.GEOMORPH.2015.12.016.

Pastor, M., Peña-Izquierdo, J., Pelegrí, J., and Marrero-Díaz, Á. (2012). Meridional changes in water mass distributions off NW Africa during November 2007/2008. *Ciencias Mar.* 38, 223–244. Available at: http://www.cienciasmarinas.com.mx/index.php/cmarinas/article/view/1831/1667.

Pastor, M., Vélez-Belchí, P., and Hernández-Guerra, A. (2015). Water Masses in the Canary Current Large Marine Ecosystem. *IOC Tech. Ser.* 115, 733–79. Available at: http://hdl.handle.net/1834/9178.

Ramirez-Llodra, E., Tyler, P. A., Baker, M. C., Bergstad, O. A., Clark, M. R., Escobar, E., et al. (2011). Man and the Last Great Wilderness: Human Impact on the Deep Sea. *PLoS One* 6, e22588. doi:10.1371/journal.pone.0022588.

Roberts, J. M., Wheeler, A. J., Freiwald, A., and Cairns, S. D. (2009). *Cold-water Corals: The Biology and Geology of Deep-Sea Coral Habitats*. Cambridge University Press. Available at: www.cambridge.org.

Rogers, A. D., Baco, A., Griffiths, H., Hart, T., and Hall-Spencer, J. M. (2007). Corals on Seamounts. *Seamounts Ecol. Fish. Conserv.*, 141–169. doi:10.1002/9780470691953.ch8.

Rowden, A. A., Schlacher, T. A., Williams, A., Clark, M. R., Stewart, R., Althaus, F., et al. (2010). A test of the seamount oasis hypothesis: seamounts support higher epibenthic megafaunal biomass than adjacent slopes. *Mar. Ecol.* 31, 95–106. doi:10.1111/j.1439-0485.2010.00369.x.

Samadi, S., Schlacher, T., and de Forges, B. R. (2007). “Seamount Benthos,” in *Seamounts: Ecology, Fisheries & Conservation* (Oxford, UK: Blackwell Publishing Ltd), 117–140. doi:10.1002/9780470691953.ch7.

Schmincke, H.-U., and Graf, G. (2000). DECOS / OMEX II, Cruise No. 43, 25 November 1998 - 14 January 1999. Hamburg: Leitstelle METEOR, Institut für Meereskunde der Universität Hamburg doi:10.2312/cr_m43

Stevenson, A., Gahn, F. J., Baumiller, T. K., and Sevastopulo, G. D. (2017). Predation on feather stars by regular echinoids as evidenced by laboratory and field observations and its paleobiological implications. *Paleobiology* 43, 274–285. doi:10.1017/pab.2016.39.

Shirayama, Y., Itoh, H., and Fukushima, T. (2017). “Recent Developments in Environmental Impact Assessment with Regard to Mining of Deep-Sea Mineral Resources,” in *Deep-Sea Mining* (Cham: Springer International Publishing), 445–463. doi:10.1007/978-3-319-52557-0_15.

van den Bogaard, P. (2013). The origin of the Canary Island Seamount Province - New ages of old seamounts. *Sci. Rep.* 3, 2107. doi:10.1038/srep02107.

Van Dover, C. L., Ardron, J. A., Escobar, E., Gianni, M., Gjerde, K. M., Jaeckel, A., et al. (2017). Biodiversity loss from deep-sea mining. *Nat. Geosci.* 10, 464–465. doi:10.1038/ngeo2983.

Van Dover, C. L., Arnaud-Haond, S., Gianni, M., Helmreich, S., Huber, J. A., Jaeckel, A. L., et al. (2018). Scientific rationale and international obligations for protection of active hydrothermal vent ecosystems from deep-sea mining. *Mar. Policy* 90, 20–28. doi:10.1016/J.MARPOL.2018.01.020.

Victorero, L., Robert, K., Robinson, L. F., Taylor, M. L., and Huvenne, V. A. I. (2018). Species replacement dominates megabenthos beta diversity in a remote seamount setting. *Sci. Rep.* 8, 4152. doi:10.1038/s41598-018-22296-8.

Watling, L., and Auster, P. J. (2017). Seamounts on the High Seas Should Be Managed as Vulnerable Marine Ecosystems. *Front. Mar. Sci.* 4. doi:10.3389/fmars.2017.00014.

Maps and Figures

Figure 2. Seabed photographs showing some of the VME indicator taxa observed on the Tropic Seamount. A. Specimens of *Poliopogon amadou*. B. Sponge ground of *Poliopogon amadou*. C. Coral garden on a ledge with diverse octocorals and patches of *Solenosmilia variabilis*. D. Octocoral garden and coral rubble. E. Antipatharian species, *Metallogorgia melanotrichos* and *Chrysogorgia* sp. F. Unidentified black coral. G. A crinoid field of possibly *Thalassometra lusitanica*. H. Field of xenophyophores. I. ROV *Isis* sampling ferromanganese crust.

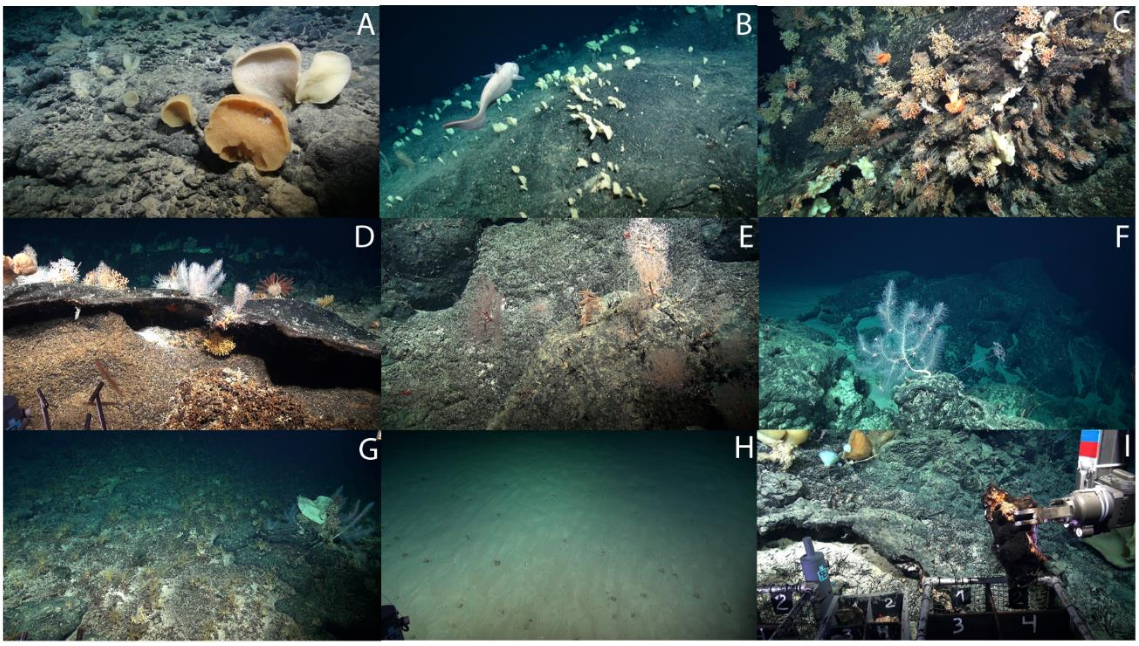


Figure 3. Prediction of *Poliopogon amadou* presence for the ensemble distribution model (A) and (B) uncertainty (CV) for the ensemble distribution model.

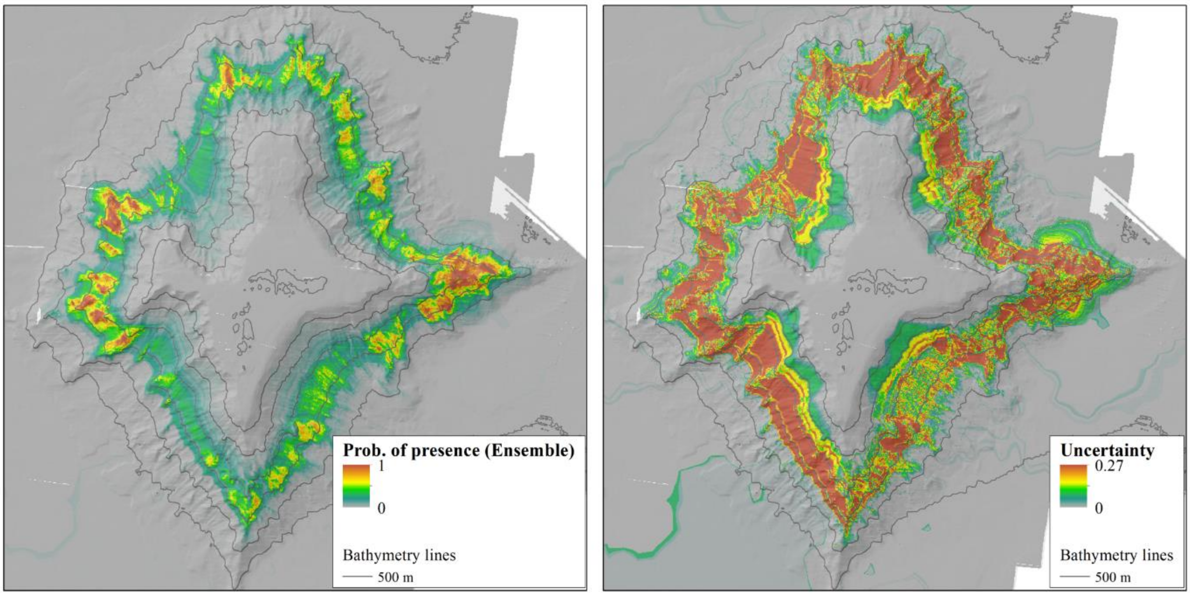


Table 1. VME indicator taxa observed on the images analysed from the Tropic Seamount.

Types of VME indicators	Observations
Cold water coral reefs	
Solenosmilia variabilis Duncan, 1873	Patchily present in ledges, but no large reefs.
Coral gardens	
Acanella arbuscula (Johnson, 1862) *Acanella* sp. *Narella bellissima* (Kükenthal, 1915) *Narella* sp. *Thouarella* sp. *Corallium tricolor* (Johnson, 1899) *Corallium* sp. cf. *Swiftia sp.* *Acanthogorgia armata* Verrill, 1878 *Chrysogorgia* sp. *Metallogorgia melanotrichos* (Wright & Studer, 1889) *Iridogorgia* sp.	Coral gardens of various types included different identified and unidentified octocoral species. A coral garden of the Family Isididae hosted deep-sea squid eggs indicating a potential spawning ground.
Black corals	
Parantipathes sp. *Bathypathes* sp. *Leiopathes* sp. cf. *Sticopathes* sp.	Other unidentified antipatharian species were also observed.
Sponges	
Poliopogon amadou Thomson, 1877 *Pheronema carpenteri* (Thomson, 1869) *Stylocordyla pellita* (Topsent, 1904**)** *Hertwigia falcifera* Schmidt, 1880 *Euplectella* sp. *Aphrocallistes beatrix* Gray, 1858 *Hyalonema* sp. *Caulophacus* sp. *Asconema* sp. *Phakellia* sp.	Sponges recorded during the dives were mainly hexactinellids, but also demosponges (*Phakellia* sp.), and other undetermined and encrusting sponges.
Crinoid fields	
Endoxocrinus (Diplocrinus) wyvillethomsoni (Thomson, 1872)	In addition to the two species contributing to crinoid fields, the thalassometrid Thalassometra lusitanica (Carpenter, 1884) was also seen in numbers in some areas. Other species included a small 5-armed stalked

Koehlermetra porrecta (Carpenter, 1888)	crinoid, either Gephyrocrinus grimaldii Koehler & Bather, 1902 (Hyocrinidae), or Porphyrocrinus sp. (Phrynocrinidae), and possibly Zenometra columnaris (Carpenter, 1881) (Zenometridae) (only the second record of this species from the NE Atlantic).
Other VME indicators	
Xenophyophore beds Brisingids	

Rights and permissions

(Indicate if there are any known issues with giving permission to share or publish these data and what any conditions of publication might be; provide contact details for a contact person for this issue)

???