iAtlantic Ocean basin area and Regions

(updated April 2021)

Ocean basin scale

As discussed during the iAtlantic GA, there was a need to agree on the boundaries of the Atlantic Ocean that should be considered in the iAtlantic project. This is very important for WP5 data compilation task that was already ongoing, but may also be relevant for other WPs. IMAR launched an online questionnaire to help and inform the discussions on this boundary. We got 12 responses from all regions. In general, most responses suggested to be as inclusive as possible and therefore most areas were suggested to be included in the iAtlantic basin-scale work. The main responses and decisions are summarized here:

North boundary: shall we use the North limit of the Atlantic Ocean and change Region 1 boundaries?

- No (include a portion of the Arctic ocean named the Norwegian Sea, Greenland Sea)
- We adjusted the northern limit to boundary of Region #1; i.e. 74°N

Labrador Sea, Davis Strait and Baffin bay?

- Include the Labrador Sea and the Davis Strait

North Sea, Celtic Sea, Bay of Biscay?

- Include the Celtic Sea, Bay of Biscay
- Most of the answers received did not mentioned the need to include the North Sea. Some argued the North Sea is not deep sea or open ocean. However, during the September 2020 SC meeting, strong arguments in favor of including this area were presented. Namely, related to the importance of the North Sea for European economy and policy. This are is now included as a part of the iAtlantic basin scale.

Caribbean Sea, Gulf of Mexico and Gulf of Guinea?

- Include the Caribbean Sea, Gulf of Mexico, Gulf of Guinea

Southern boundaries: Do you agree to exclude the CCAMLR convention area?

- No, use the IHO south limits of the Atlantic Ocean

SE and SW boundaries: do you agree using the IHO SE and SW boundaries?

- Use the IHO SW boundary but expand the SE boundary to 21°E

During the July/August 2020 SC meeting, the relevance of the Mediterranean Sea for the Atlantic marine ecosystem and the iAtlantic work was discussed. Although it was decided to leave the Mediterranean Sea out of the iAtlantic study area, iAtlantic should not keep the Mediterranean out of focus. The importance of the Mediterranean Sea[1] within the Atlantic context has been shown to significantly affect Atlantic

[1] By Covadonga Orejas and Pedro Vélez Belchí

meridional overturning circulation (AMOC), in the long term, since salinity provided by salty Mediterranean Outflow Water (MOW) play an important role in the North Atlantic deep-water formation, and therefore in strengthening and stabilising the AMOC (Rahmstorf 1998; Voelker et al. 2006; Ivanovic et al. 2014).

The MOW is an intermediate water mass, salty, and warm, found between 800 and 1,500 m depth (Daniault et al. 1994), formed when the dense Mediterranean water reaches the Gulf of Cadiz through the Strait of Gibraltar and mixes with the lighter Atlantic water flowing over, forming a less salty water mass (Bozec et al. 2011). After leaving the Gulf of Cadiz, the MOW spreads in two directions: northwards, following the continental slopes of the Iberian Peninsula, and westwards, to the central-North Atlantic (Iorga and Lozier 1999).

From the biological point of view it has been also proved the importance of the MOW influence in the Atlantic biodiversity (e.g. Mosquera-Giménez et al. 2019 and references therein). Indeed, the possible Mediterranean origin for Cold-water corals (CWCs) in the Atlantic has been hypothesized in some studies (De Mol et al. 2005; Henry et al. 2014). Cold-water corals have been described along the path of the MOW in several Atlantic locations (e.g. Gulf of Cadiz: Rueda et al., 2016, the Galicia Bank: Duineveld et al. 2004; Serrano et al. 2017, and Porcupine Seabight: De Mol et al. 2002). More recently, the study by Mosquera-Gimenez et al. (2019) has addressed the ocean circulation and hydrographic conditions over seamounts in the pathway of the MOW, investigating the potential role of this water mass in the occurrence of megabenthic fauna, demonstrating the strong relation between the North Atlantic Central Water (NACW)–MOW interface, associated with the activity of internal waves, and the abundance of benthic suspension feeders.

Bozec, A., Lozier, M. S., Chassignet, E. P., & Halliwell, G. R. (2011). On the variability of the Mediterranean Outflow Water in the North Atlantic from 1948 to 2006. Journal of Geophysical Research: Oceans, 116(C9).

Daniault, N., Mazé, J. P., & Arhan, M. (1994). Circulation and mixing of Mediterranean Water west of the Iberian Peninsula. Deep Sea Research Part I: Oceanographic Research Papers, 41(11-12), 1685-1714.

De Mol, B., Henriet, J. P., & Canals, M. (2005). Development of coral banks in Porcupine Seabight: do they have Mediterranean ancestors?. In Cold-Water Corals and Ecosystems (pp. 515-533). Springer, Berlin, Heidelberg.

De Mol, B., Van Rensbergen, P., Pillen, S., Van Herreweghe, K., Van Rooij, D., McDonnell, A., ... & Henriet, J. P. (2002). Large deep-water coral banks in the Porcupine Basin, southwest of Ireland. Marine Geology, 188(1-2), 193-231.

Henry, L. A., Frank, N., Hebbeln, D., Wienberg, C., Robinson, L., van de Flierdt, T., ... & Rogers, A. D. (2014). Global ocean conveyor lowers extinction risk in the deep sea. Deep Sea Research Part I: Oceanographic Research Papers, 88, 8-16.

Iorga, M. C., & Lozier, M. S. (1999). Signatures of the Mediterranean outflow from a North Atlantic climatology: 1. Salinity and density fields. Journal of Geophysical Research: Oceans, 104(C11), 25985-26009.

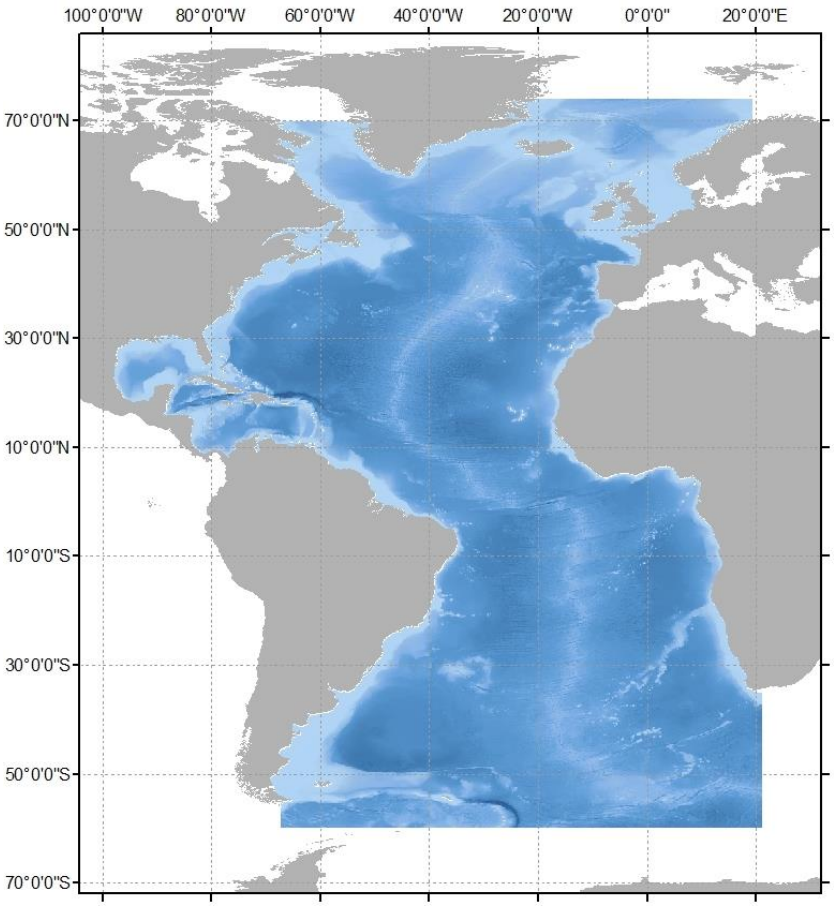
Ivanovic, R. F., Valdes, P. J., Gregoire, L., Flecker, R., & Gutjahr, M. (2014). Sensitivity of modern climate to the presence, strength and salinity of Mediterranean-Atlantic exchange in a global general circulation model. Climate dynamics, 42(3-4), 859-877.

Mosquera Giménez, Á., Vélez-Belchí, P., Rivera, J., Piñeiro, S., Fajar, N., Caínzos, V., ... & Carreiro-Silva, M. (2019). Ocean Circulation over North Atlantic underwater features in the path of the Mediterranean Outflow Water: the Ormonde and Formigas seamounts, and the Gazul mud volcano. Frontiers in Marine Science, 6, 702.

Rahmstorf, S. (1997). Risk of sea-change in the Atlantic. Nature, 388(6645), 825-826.

Rueda, J. L., González-García, E., Krutzky, C., López-Rodriguez, F. J., Bruque, G., López-González, N., ... & Díaz-del-Río, V. (2016). From chemosynthesis-based communities to cold-water corals: vulnerable deep-sea habitats of the Gulf of Cádiz. Marine Biodiversity, 46(2), 473-482.

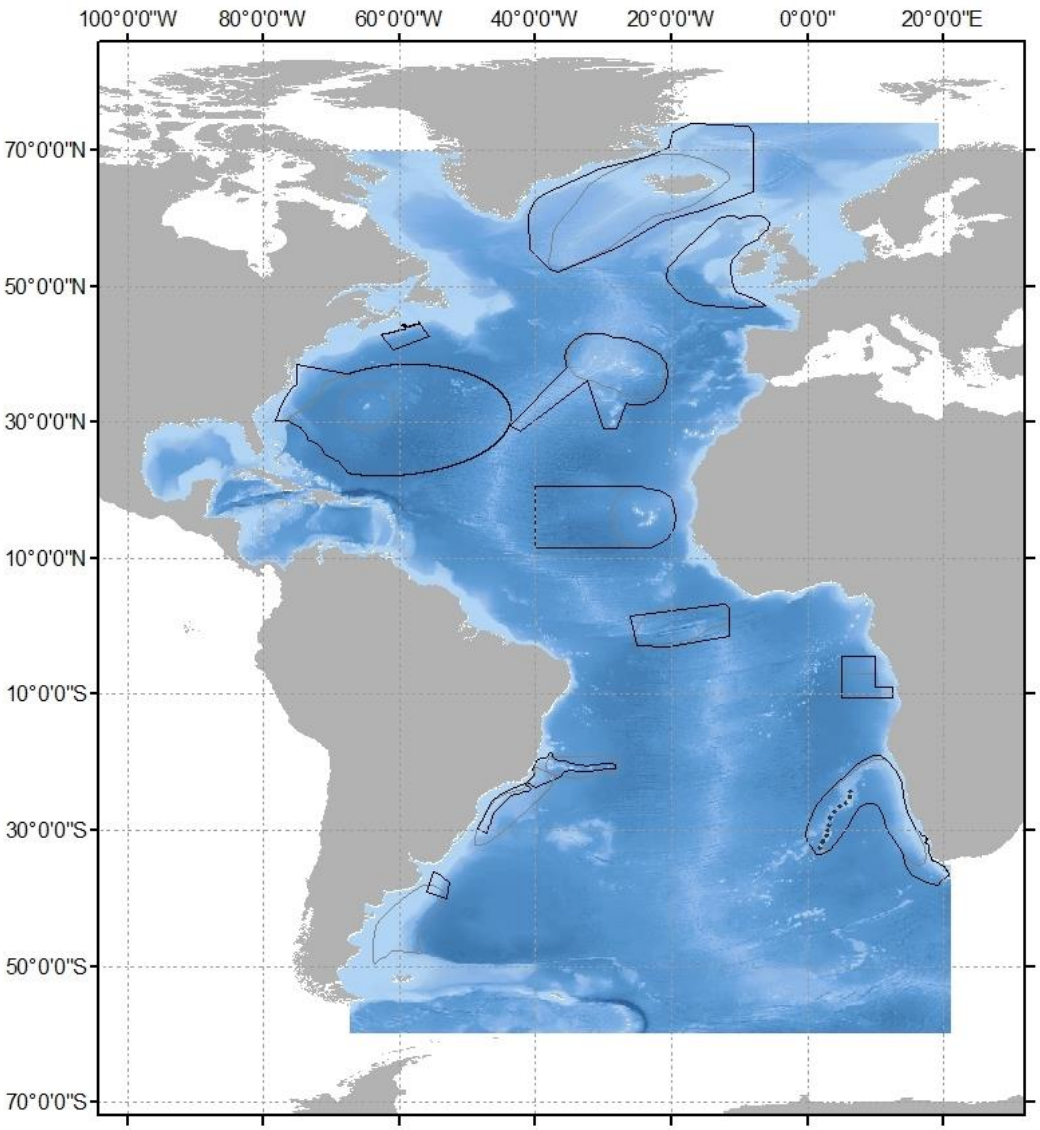
Voelker, A. H., Lebreiro, S. M., Schönfeld, J., Cacho, I., Erlenkeuser, H., & Abrantes, F. (2006). Mediterranean outflow strengthening during northern hemisphere coolings: a salt source for the glacial Atlantic?. Earth and Planetary Science Letters, 245(1-2), 39-55.



iAtlantic Ocean basin scale maps after the discussions.

iAtlantic Regions

IMAR lead the discussion to clarify the boundaries of the individual iAtlantic Regions. Here we present a summary of the discussions taken for each individual region.



The preliminary (grey) and new (black) boundaries of the 12 iAtlantic regions

1. Subpolar Mid-Atlantic Ridge (MAR) open ocean ecosystem off Iceland

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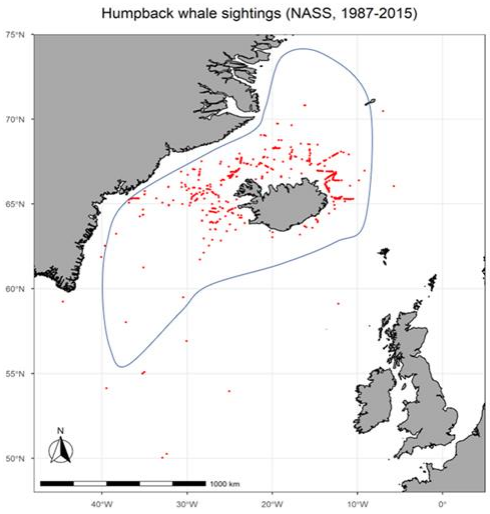
Discussions:

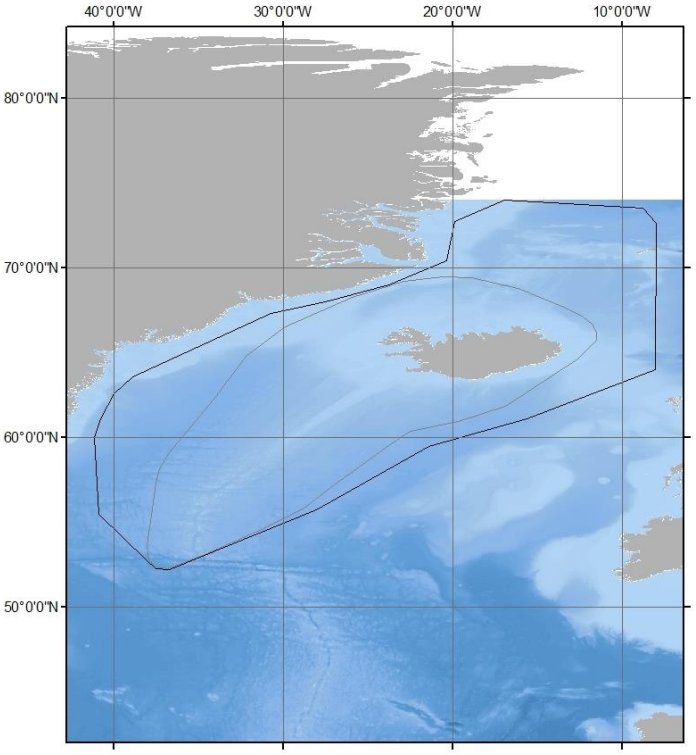
Region #1 preliminary boundaries were adequate for most species of interest, because it encompassed the distribution of most VME indicator species and the groundfish species. However, MFRI suggested to expand Region #1 to better encompass the distribution humpback whales and capelin.

- The new area encompasses better the T-NASS humpback whale (*Megaptera novaeangliae*) distributions, i.e. North of Iceland and closer to Greenland;



- The new area encompasses better the distribution of the capelin (*Mallotus villosus*), according to local experts working on this region. The boundaries were enlarged to **74°N** to cover the imporatnt feeding grounds around Scoresbysund; to **8°W** (east and south east of iceland) to include known spawning migrations; and to **40°W** to include potential nursery areas close to Greenland. It was noticed that the capelin distribution does extends further north.
- The extension to 74°N further north may also be useful for addressing climate change research questions, since the spatial distribution of many species has been extending further north concomitant with ocean warming

New boundary



2. Abyssal plain and deep-sea coral banks from the Rockall Trough to the Porcupine Abyssal Plain

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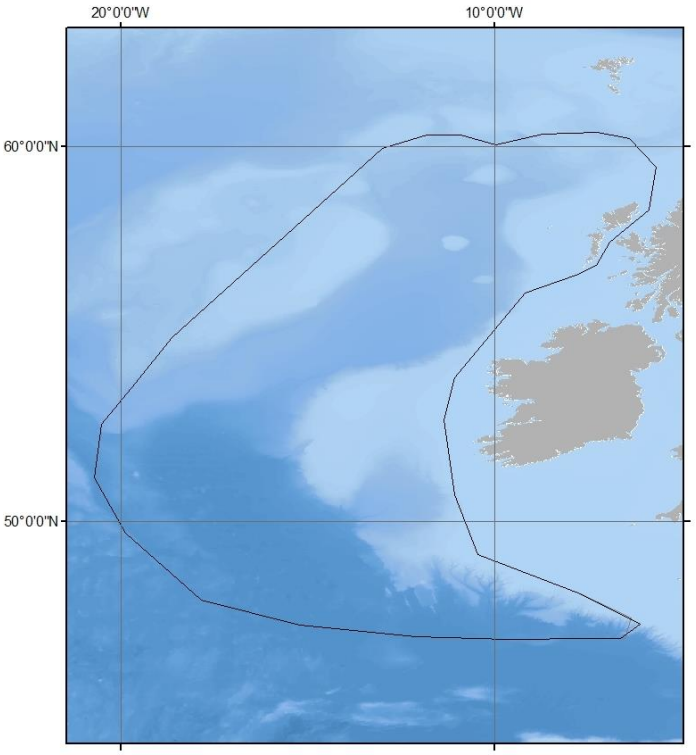
Discussions:

Region #2 preliminary boundaries were mostly adequate, but adjusted to encompass the Bourcart spur.

- It was noticed that the existing boundary it's fine for the area around Mingulay and Darwin Mounds, but there were some discussions on the need to expand the boundary slightly in other those areas
- IFREMER suggested a slight modification of the southern boundary of the Region, to match with the Bourcart spur that would allow to give a physiographic boundary to the region.

New boundary



3. Deep-sea coral and hydrothermal vent ecosystems, central Mid-Atlantic Ridge

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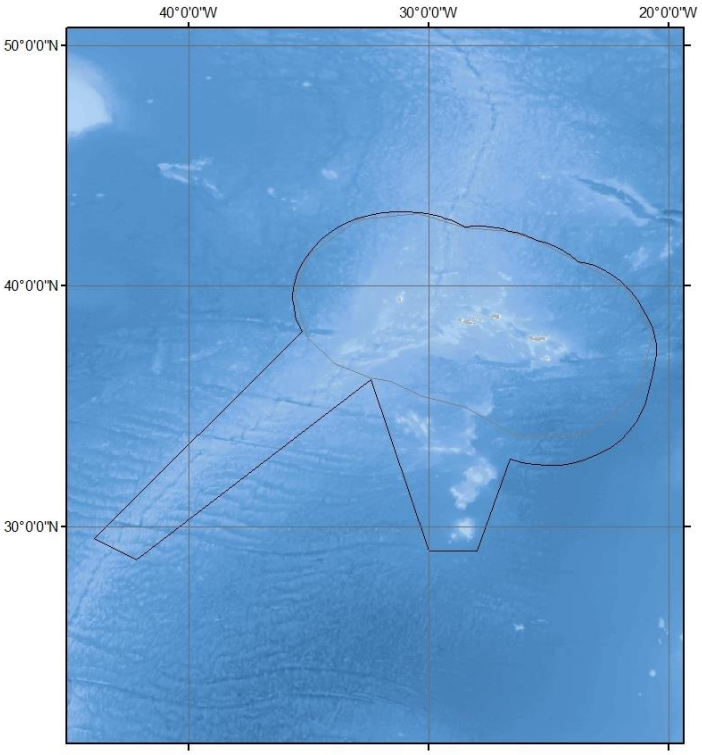
Discussions

The original boundary of Region #3 was limited to Azores EEZ. However, GEOMAR noted possible mapping opportunities in Region#3 but outside the areas of national jurisdiction. Therefore, the area was expanded to capture these opportunities, namely to encompass the Greater Meteor Seamount complex (proposed as a new EBSA) and portions of the MAR south of the Azores EEZ. The new weird shape was not a problem to the group.

After the ***September 2020 SC*** meeting, the area #3 was expanded further south to include the Broken Spur Hydrothermal Vent (Latitude: 29.1700; Longitude: -43.1717).

New boundary



4. Deep-sea canyons and open-ocean ecosystems, NW Atlantic

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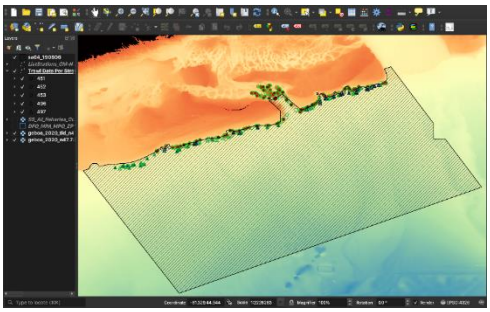
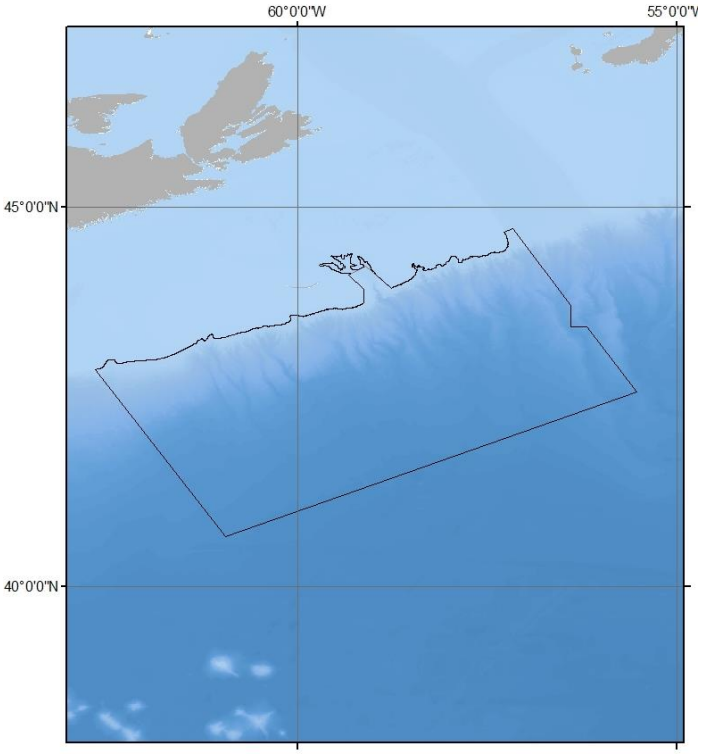
Discussions

- DFO noticed that boundary of Region#4 did not encompass all trawl data from stratum 452. Therefore, the boundary was expanded further inshore to encompass all available data.



New boundary



5. Subtropical open-ocean ecosystems of the Sargasso Sea

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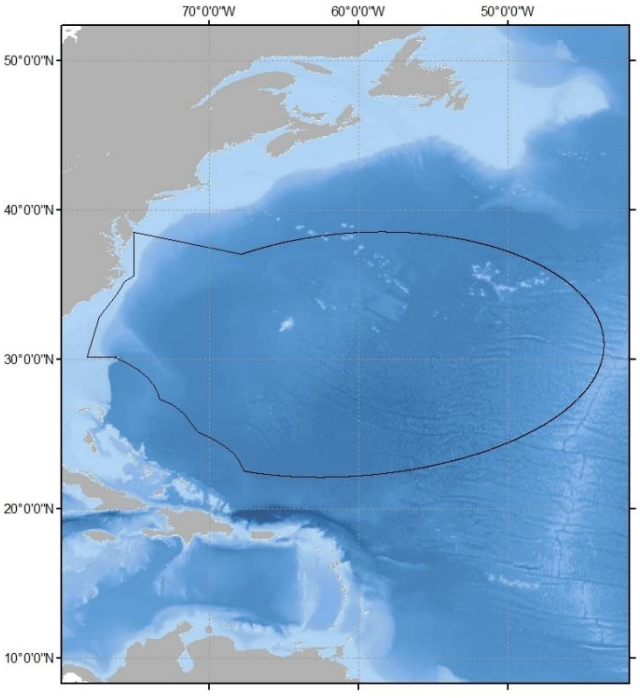
Discussions

The area was expanded to the West to encompass the cruises planned in the US continental shelf.

- TU noted that the Deep Search program is focused on the area between about 30N and 37N on the continental shelf of the US. A few of their cruises have been listed as part of the iAtlantic field work, but do not fall within the preliminary boundary.
- UCL noted that their paleo work have some cores on the continental shelf (Gulf of Maine and also of New Jersey - Hudson Canyon) and also continental slope cores off Cape Hatteras. However, since this is quite a broad area the region boundary was note modified.
- After the ***September 2020*** SC meeting UEDIN noted the northern boundary could be extended very slightly to bring Norfolk & Baltimore canyons (38.5°N) into scope. It turns out both UEDIN through the cold seep megafauna work and Didier at the Sorbonne have activities on-going there. The boundary would need to extend to.
- UEDIN noted (April 2021) that iAtlantic is working with datasets from the Bermudan EEZ including the BATS time series and the citizen science data from Whales Bermuda. It was an oversight to exclude the EEZ from the regional working areas so the boundary was rectified.

New boundary



6. Eastern Tropical North Atlantic, Cabo Verde

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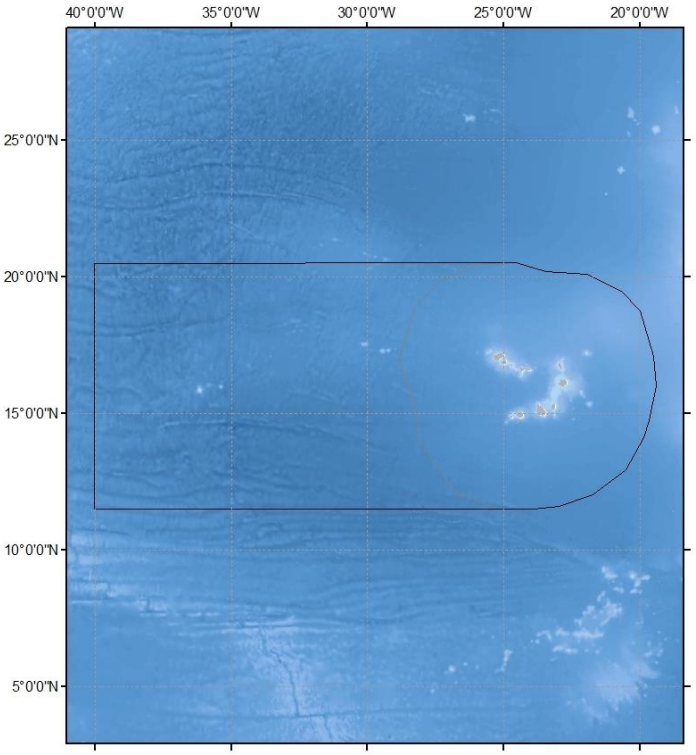
Discussions

The boundary if Region #6 was expanded to the West and the name was adjusted to capture the offical name of the country Cabo Verde

- HWU noted the region boundary should be expanded further west to the eastern flank of the Mid-Atlantic-Ridge to about 35-40° West would be good.
- IEO agreed with the suggestion since it migth be possible to work in that area during the iMirabilis cruise
- GEOMAR noted the name of the region should be changed to “Eastern tropical North Atlantic, Cabo Verde” and updated in the Website

New boundary



7. Equatorial Atlantic, Romanche Fracture Zone

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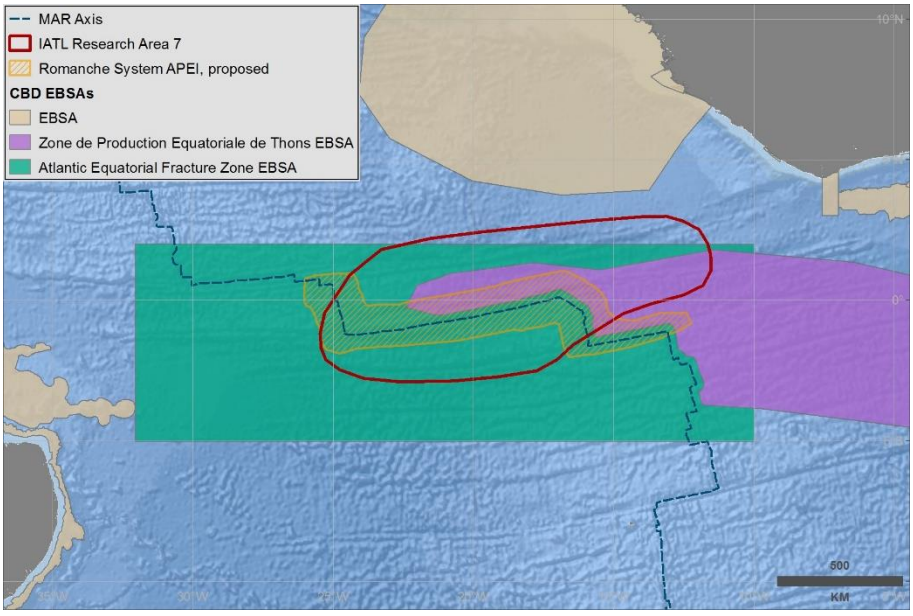
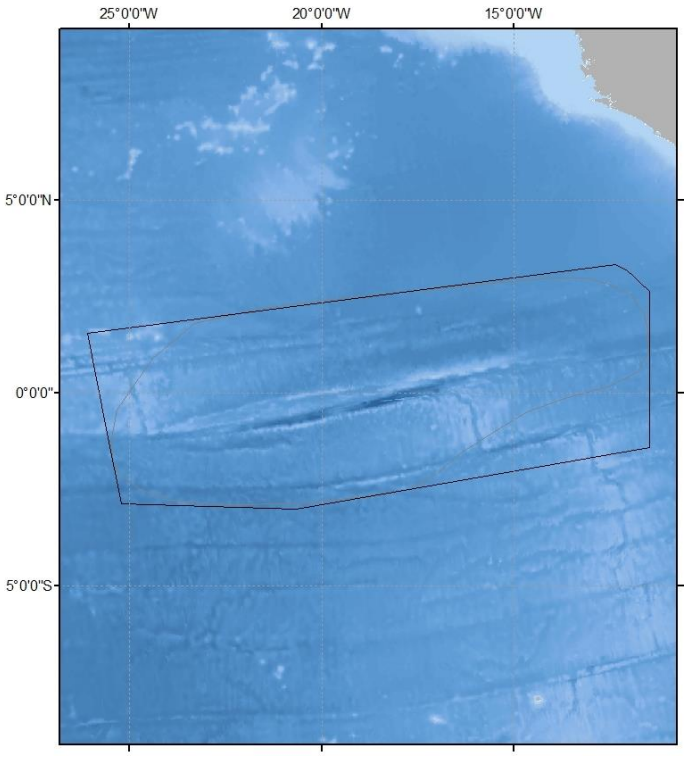
Discussions

Following some suggestion the Region #7 boundary was slightly enlarged in the NW and SE corners to better encompass the proposed APEI.

- UNIVALI noted that an EBSA has been proposed for this area and that the ISA meeting in Evora described this region as an APEI. Two features make this region ecologically important; the benthic features (Romanche Fracture Zone system & abyssal North - South connections) and the pelagic feature (equatorial upwelling). The preliminary boundary for Region #7 was capturing both features but portion of the fracture zone system may have been left out. Expanding this boundary seems a good compromise with the pelagic feature, e.g. including yellowfin tuna catch area and spawning grounds (addressed in WP3).



New boundary



8. Continental slope, margin and cold seep ecosystems – Angola to the Congo Lobe

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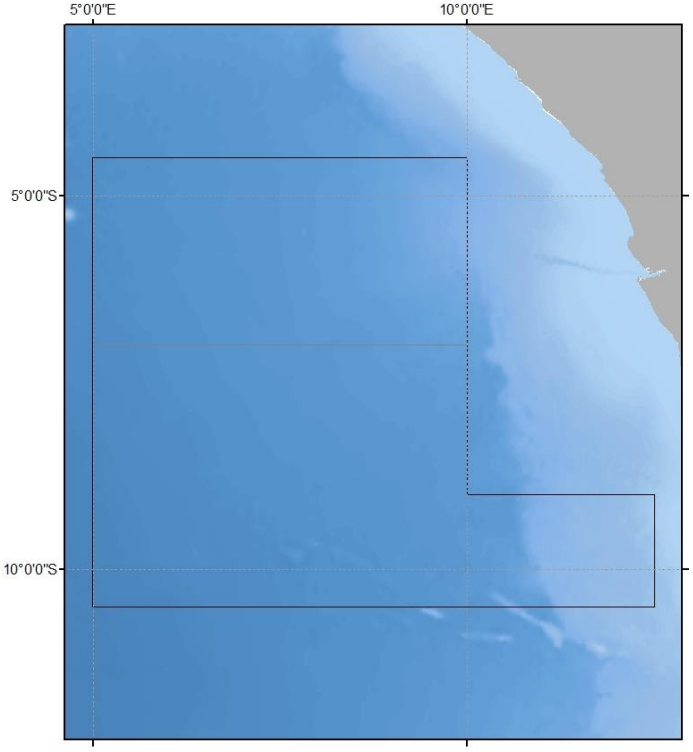
Discussion

The boundary of Region #8 was adjusted to better capture the work being carried out off Angola.

- UNIHB noted that the main working area off Angola is between 9°30' and 10°S and between 12°40' and 12°50' E.
- IFREMER noted they have some data on bathymetry and occurrence of pockmarks and cold seep fauna (although not very active) in the Gabon EEZ, Guiness site, at -1°34'S - 8°32'E, between 600-800m depth. However, no changes were made to encompass this area.

New boundary



9. Abyssal plains and deep-sea ridge ecosystems of the Benguela Current from the Walvis Ridge to South Africa

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The southern and inshore boundaries of Region #9 was adjusted to better capture the Ecoregion and bathy regions along the South African coast. The boundary was further expanded to in the north to 19S and in the south to 33.5S to better capture existing topographic features/

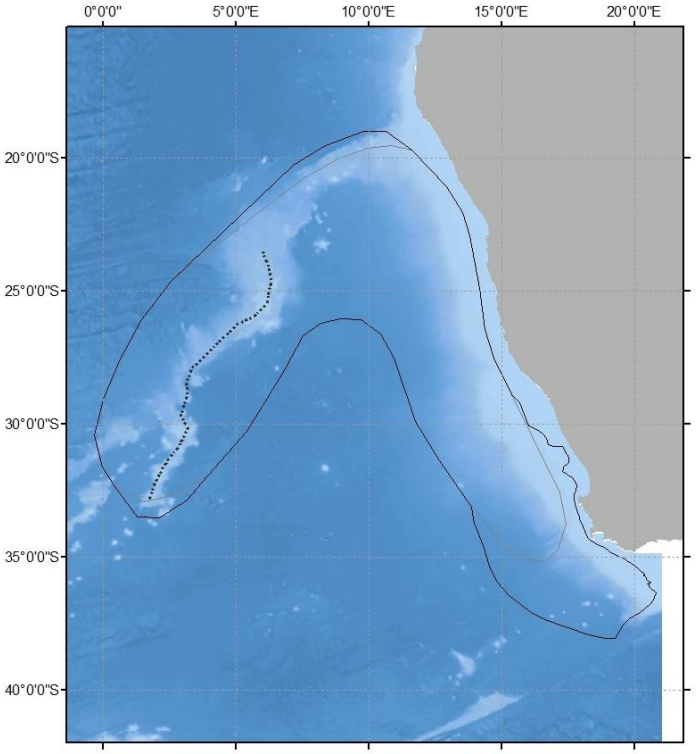
- NMU Noted the southern boundary should aligned with the Southeast Atlantic ecoregion boundary and that it might be useful to use one of the inshore boundaries (e.g., between midshelf, outer shelf, shelf edge or shelf break)
- UWC and the South African Environmental Observation Network proposed to extend the Region#9 southern boundary to align with the current (2018) National Biodiversity Assessment ecosystems delineation. This would mean extending Region#9 to align with the 2 Southeast Atlantic and 2 Southern Benguela Bathyregions. Extending the region to match these recently data-driven, expert informed ecosystems would have greatest meaning for uptake of the broad research to be done in this region.
- AU noted the updated delineation of the Region #9 well represents the model areas and includes all relevant underwater features.
- IEO and NOC considered that from the iMirabilis point of view the new boundary is appropriated.
- UEDI noted the existing boundary was clipping out some of the prominent topography towards the end of the Walvis Ridge. A small adjustment could be made to include this.

During the **September 2020 SC meeting** we were asked to verify what EBSAs are covered by the current version of the boundary

- Benguela Upwelling System EBSA is partially included. The inshore areas as the northern tip are not inside the Region 09;
- Walvis Ridge EBSA is partially included but the westernmost portion of the EBSA is outside Region 09;
- Orange Shelf Edge (Namibia/South Africa) EBSA is fully included;
- Childs Bank (South Africa) EBSA is fully included

- Cape Canyon and Surrounds (South Africa) EBSA is fully included with the exception of the very coastal areas;
- Namib Flyway (Namibia)he offshore portion of the Namib Flyway (Namibia) EBSA is included;
- Browns Bank (South Africa) EBSA is mostly included;
- Subtropical Convergence Zone EBSAS is mostly outside the Region 09.

New boundary



10. Deep-sea continental slope, banks and cold seep ecosystems off Brazil

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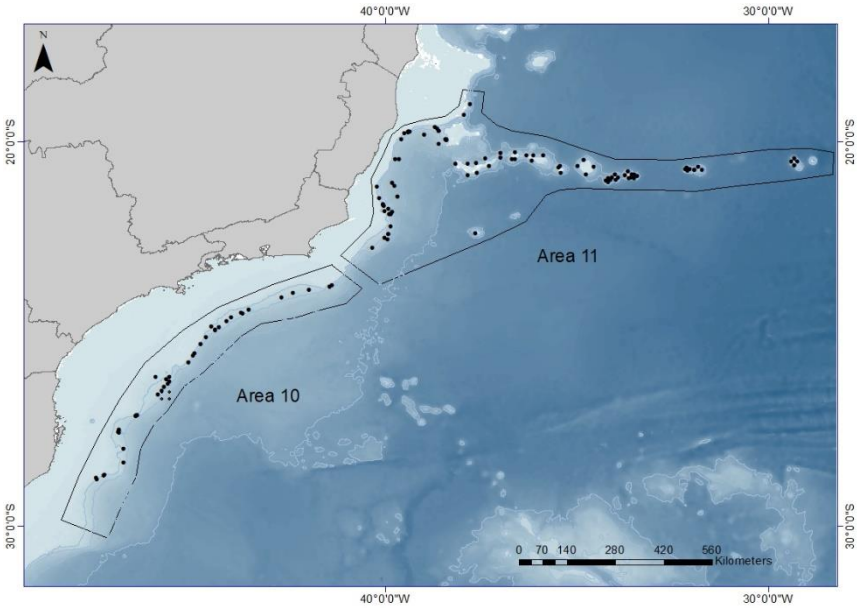
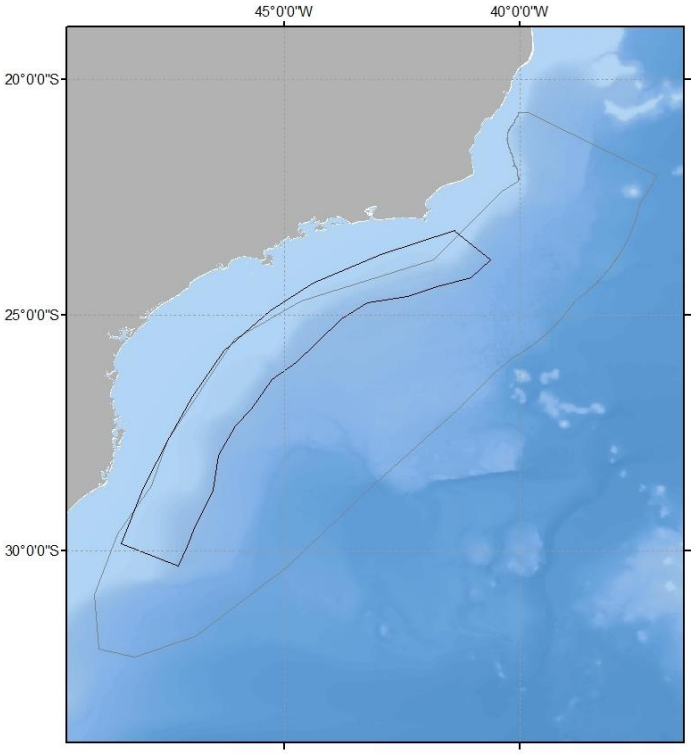
Discussions

The boundary of Region #10 was slightly adjusted to better capture existing data

- UNIVALI have analysed available data available for Region #10 and suggested slight modifications of the original polygons.



New boundary



During the ***September 2020*** SC meeting it was suggested to evaluate the need for keeping region #10 and #11 separated or if they could be combined. It was noted that Region #10 refers to the slope of the continental margin, while Region #11 refers to a chain of seamounts. Since they are distinct geomorphological features with their own biophysical processes, they should be kept separated. It was also noted that the original polygons differentiated the two features better. However, to increase the chances for cruise opportunities in Brazil, Region #11 was extended.

11. Vitória-Trindade Seamount Chain off Brazil

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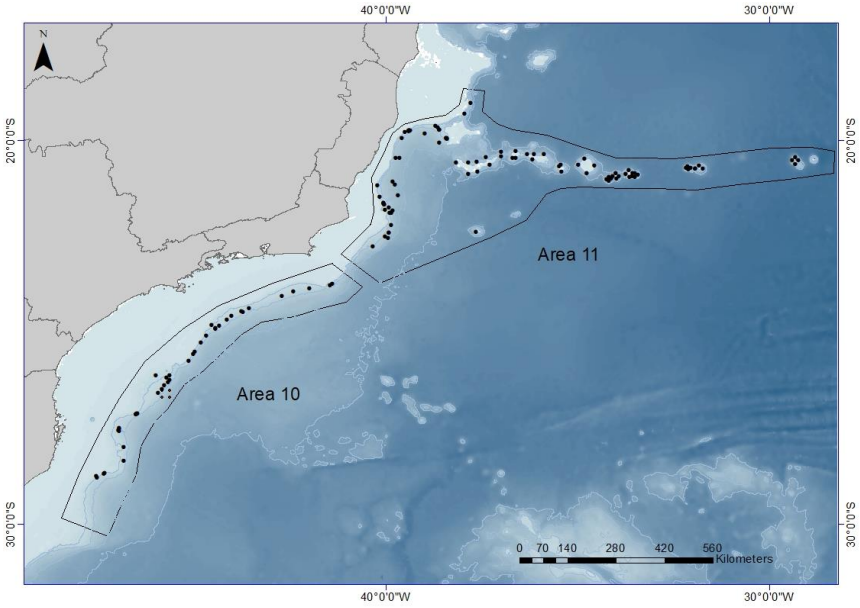
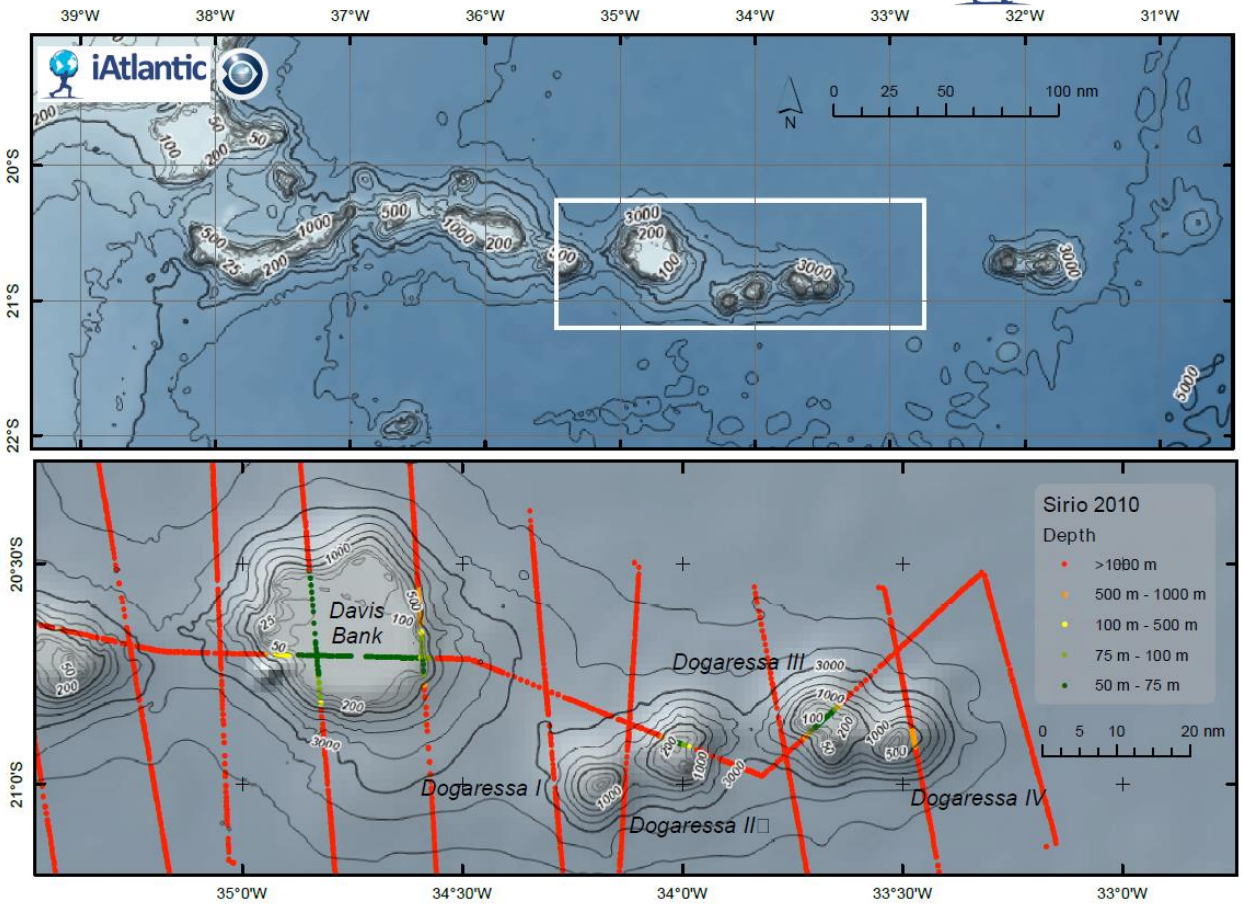
The boundary of Region #11 was slightly adjusted to better capture existing data

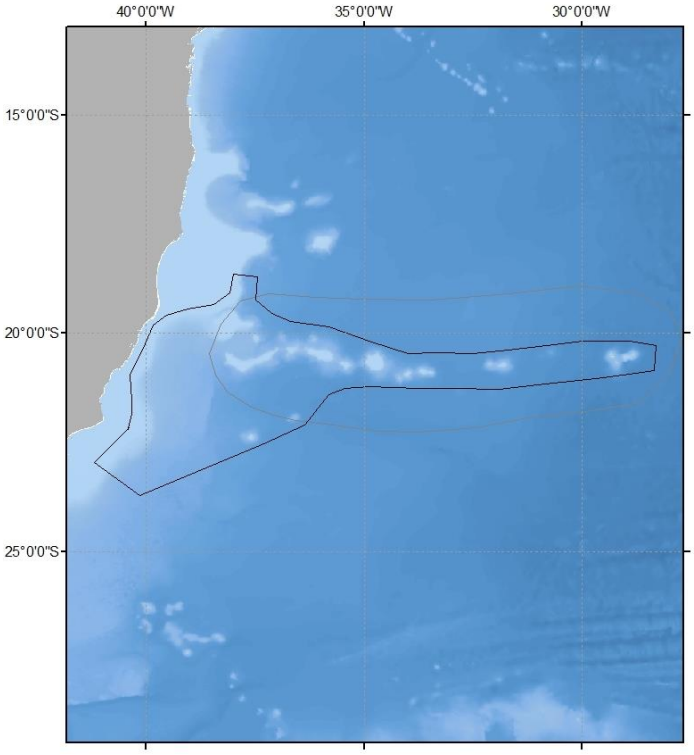
- UNIVALI have analyzed available data available for Region #10 and suggested slight modifications of the original polygons.



IEO noted the target study area for iCorsage cruise is delimited by a white square in the figure attached.


39°W
38°W
37°W
36°W
35°W
34°W
33°W
32°W
31°W
20°S
21°S
22°S
iAtlantic
0 25 50 100 nm
N
20°30'S
21°0'S
Davis Bank
Dogaressa I
Dogaressa II
Dogaressa III
Dogaressa IV
Sirio 2010
Depth
>1000 m
500 m - 1000 m
100 m - 500 m
75 m - 100 m
50 m - 75 m
0 5 10 20 nm
35°0'W
34°30'W
34°0'W
33°30'W
33°0'W

New boundary



12. Deep-sea coral banks in the Malvinas Upwelling Current off Argentina

Key partners
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Discussions

The boundary of Region #12 was adjusted to a much smaller area from about 39S to the northern edge of the Argentinian EEZ at around 37S.

- UNIHB and SHN noted the area of interest stretches slightly north of the preliminary boundary: 36N, 55W, 53W, 39S
- SHN noted the bathymetric information available on the Argentine margin is unfortunately still patchy, especially in its southern sector. For this reason, they recommend considering a smaller area, which might include the continental slope and part of the continental shelf north of 39-40°S.

New boundary