2018 ASPIRE WHITE PAPER SUBMISSION: DEEP SEARCH CONNECTIVITY

Contact Information

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Willing to Attend Workshop?

(Yes/No) Yes

Target Name(s)

Main Feature(s)/Area(s) of Interest:

- The Atlantic Equatorial Belt: Cold seep/chemosynthetic communities at the Barbados accretion prism, the Mid-Atlantic Ridge, and the West African Seeps
- The Coral Circle: Deep-sea coral habitats on the Angolan margin and Orenoque

Geographic Area(s) of Interest within the North Atlantic Ocean (Indicate all that apply)

Northwest
North Central* (Mid-Atlantic Ridge)
Northeast
Southwest* (Barbados accretionary prism, Orenoque)
South Central
Southeast* (West African cold seeps)

Relevant Subject Area(s) (Indicate all that apply)

Biology*
Geology
Chemistry
Physical Oceanography
Marine Archaeology
Other

Description of Topic or Region Recommended for Exploration

Brief Overview of Area or Feature: To investigate the presence of stepping stone and/or preferred pathways explaining the present-day connectivity across the Atlantic, deep-sea coral and cold seep habitats that lie within the Atlantic Equatorial Belt that are potentially influenced by the AMOC current are proposed for targeted characterization. Key deep-sea coral habitats include Orenoque in the Southwest and Regab and Anna Ridge in the Southeast Atlantic off Angola. Cold seep and vent communities at the Barbados accretionary prism, the mid-Atlantic Ridge (MAR; Lucky Strike, Snake Pit, and Logachev), and the Angolan margin (Worm Hole, Lobes, and Regab) are also suggested for exploration, allowing for complete amphi-Atlantic species connectivity assessment for multiple habitat types and species, enhancing regional analyses that are ongoing in the U.S. and Europe.

Brief Summary of Current State of Knowledge:

A high-priority goal of ASPIRE is to, “increase understanding of deep-sea ecosystem connectivity across the Atlantic basin.” To meet this goal, good representation from both sides of the Atlantic is required for

robust connectivity analyses, yet specimens are often available for one side or the other, and to date, most connectivity studies have been regional in scope. Mechanisms of larval dispersal remain poorly characterized across the Atlantic in part due to a lack of information for individual species regarding larval development time and behavior, unknown potential stepping stone habitats across the Atlantic, and the influence of major currents such as the Atlantic Meridional Overturning Circulation (AMOC), the "conveyor belt". Major initiatives in the Eastern Atlantic (ATLAS) and Western Atlantic (DEEP SEARCH) are adding to regional connectivity studies. However, several pivotal locations do not fall within the study areas for these projects. Therefore, we propose key areas for exploration under ASPIRE that would fill sampling and data gaps for trans-Atlantic cold seep and deep-sea coral species, allowing for a robust and comprehensive analysis of connectivity.

Large overlap in the dominant cold seep genera and species, such as *Bathymodiolus* mussels, *Alvinocaris* shrimps, vesicomyid clams, and *Escarpia* tube worms, led to the hypothesis of the existence of recent or contemporary faunal linkages across an "Atlantic Equatorial Belt" connecting fauna originally described from the western Atlantic, Gulf of Mexico, West Florida Escarpment and the Barbados accretionary prism and the West African seeps from the eastern side of the Atlantic basin. Sunken wood, vertebrate carcasses and other organic matter were thought to be stepping stones allowing gene flow and maintaining species commonality from the western and eastern Atlantic, but molecular work has suggested that the Mid-Atlantic Ridge (MAR) may be an important a stepping stone as well. Collections of target amphi-Atlantic species from the Barbados and West African seeps and the MAR would complement those obtained through DEEP SEARCH and previous research efforts.

Many cold-water corals are widely distributed in the Atlantic, with corals occurring in the "coral circle" from Canada to Argentina in the west and from Norway to southern Africa in the east. Reefs are often dominated by a limited set of structure-forming scleractinian species, including *Lophelia pertusa*, *Madrepora oculata*, and less frequently *Solenosmilia variabilis*. Octocorals, such as *Acanella arbuscula*, *Primnoa resedaeformis*, *Paragorgia arborea*, and *Anthomastus* sp., as well as the black corals *Leiopathes* and *Bathypathes* species are present on both sides of the Atlantic and are targets for connectivity studies. Genomic RADseq methodologies are being standardized between partners and offer expanded possibilities to test hypotheses regarding ancient (geological time) versus present (ecological time) larval exchanges to explain present day patterns of connectivity.

Rationale for Future Exploration: Dominant ocean circulation patterns have likely affected distributions of widely distributed deep-sea corals and seep species. However, species-specific patterns of past connectivity, refuge areas and recolonization pathways are still uncertain. Collections from the proposed areas will fill gaps in sampling, allowing for robust connectivity analyses that estimate past and present trans-Atlantic dispersal as inferred from genomic analyses. As threats from global habitat loss, rapid climate change and ocean acidification increase, an improved understanding of extinction risks is imperative for effective predictions and ecosystem-based spatial management plans.

Relevant Partnerships (If Applicable)

The areas proposed for exploration will optimize two major initiatives, including two in the United States (e.g. the BOEM/NOAA/USGS and others, and the NOAA Deep Sea Coral Research and Technology Program Southeastern Initiative), plus the European ATLAS project (Sophie Arnaud-Haond). The cold seep and coral communities proposed for exploration were chosen by members of these campaigns to capitalize on existing transatlantic connectivity research efforts in the western and eastern Atlantic, catalyzing and stimulating interactions and providing crucial samples to be utilized in a comprehensive analysis of both taxonomy and connectivity across the Atlantic Basin.