Substrate Analysis of Seamounts in the Hawaiian Emperor Seamount Chain

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Background

- The Hawaiian Emperor Seamount Chain (HESC) is a largely understudied area of the deep sea.
- Seamounts are the result of underwater volcanic eruptions, and their ecosystems are homes to incredibly diverse communities of marine organisms (e.g. Morgan et al. 2015).
- Studies suggest that bottom relief that allows for stability and less risk of burial is a key factor in the distribution of some species of corals (Parrish et al. 2007).
- This ongoing study aims to analyze substrate characteristics of the seamounts Pioneer Bank, East Northampton, Yuryaku, and Kammu to test if seamounts inside the Papahānaumokuākea Marine National Sanctuary (PMNS) have more habitable substrate for corals than seamounts outside of the protected area.
- Understanding the substrate characteristics of seamounts allows us to better protect the native deep-sea lifeforms from disruptive practices such as bottom contact fishing (Baco et al. 2020).

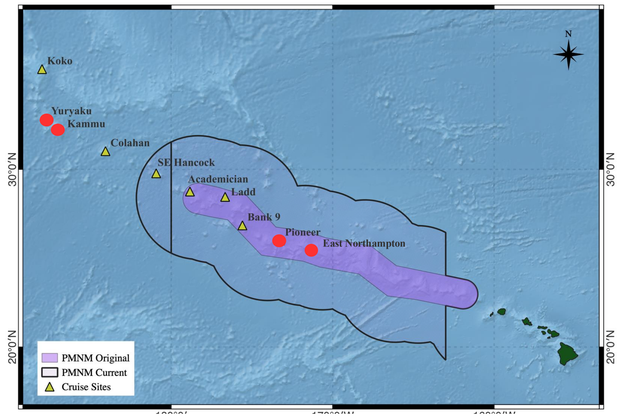


Fig 1. Map of the PMNS before 2016 (purple) and after 2016 (outlined) and the four seamounts studied (red)

Methods

- In 2016 and 2017, the submersible Pisces IV took video transects of several seamounts in the HESC at 500-600 meters.
- The footage was then converted into images at ten second intervals and annotated using a label tree and the software BIIGLE (Bio-Imaging Indexing and Graphic Labelling Environment).
- The label tree included substrate composition categories of: dead coral, dead sponge, live coral, live sponge, grey sand, white sand, live reef, manganese/basalt, coral rubble, dead intact reef, and carbonate and the substrate size categories of: biology, sand, pebble, coral rubble, intact reef, cobble, boulder, outcrop, and hardpan.
- The area of the annotated image was recorded, and 15 randomly selected points were generated on each image and then annotated for substrate composition and size.
- The annotations for each transect were then grouped by seamount and the percentages of each composition and size were averaged and compared in Excel.

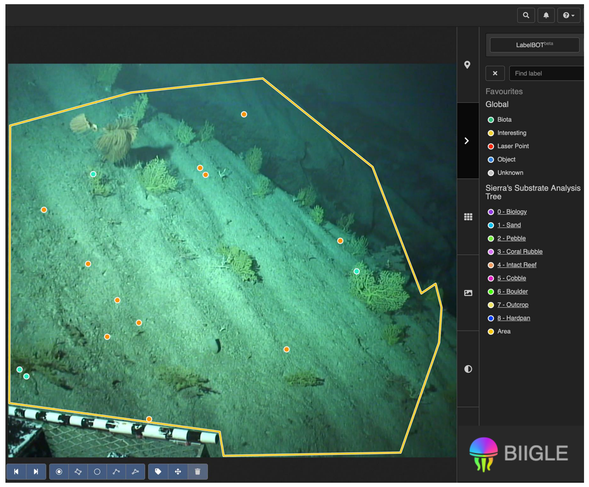
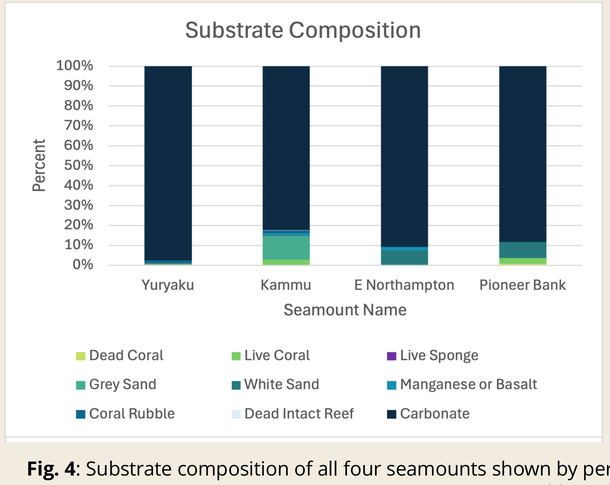


Fig. 2: Example of the BIIGLE software interface and labels used for annotation. Image from the seamount Pioneer Bank.

Fig. 3: Pisces IV Submersible

Results



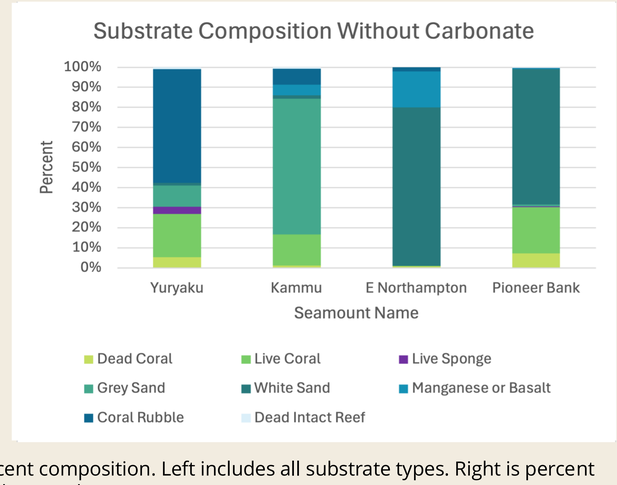
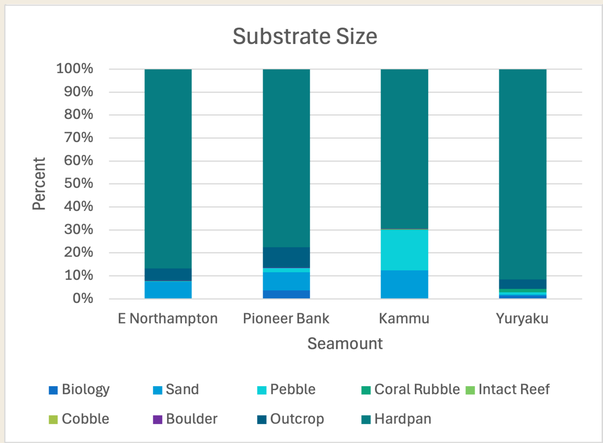


Fig. 4: Substrate composition of all four seamounts shown by percent composition. Left includes all substrate types. Right is percent composition without carbonate.



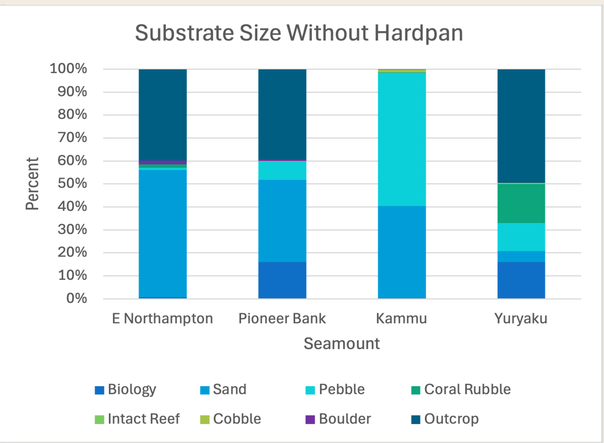


Fig. 5: Substrate size of all four seamounts shown by percent size. Left includes all size types. Right is percent size without hardpan.

Conclusions

- Across all four seamounts, the dominant substrate composition (>80%) was carbonate and the dominant substrate size was hardpan (>70%).
- Kammu, East Northampton, and Pioneer Bank all had much more sand than Yuryaku with over 40% of each of their non-hardpan substrate sizes being sand.
- Yuryaku had the most coral rubble out of the four seamounts making up over 50% of its non-carbonate substrate composition.
- Overall, there was no evidence supporting the hypothesis that seamounts within the PMNS have more habitable substrate than seamounts outside of the national monument.
- These findings can suggest, however, that the recovery of deep-sea habitats is a prolonged process and that damaging the seafloor can have lasting consequences and should be regarded with more concern.

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References