HMCS Yukon: A Case Study in Marine Citizen Science

Abstract

The HMCS Yukon is a 366 ft long former Canadian warship that was sunk in about 100 ft of water off the coast of San Diego, California (32.7800, -117.2853) in 2000 to act as an artificial reef. The first scientific study of the marine life on the Yukon was done in 2005 by the San Diego Oceans Foundation and Dr. Ed Parnell of Scripps Institution of Oceanography. This study documents the current changes in marine biodiversity colonizing the shipwreck since the previous study. High resolution cameras and iNaturalist, a citizen science app maintained by the California Academy of Sciences, were used to inventory the taxonomic diversity of marine life on the HMCS Yukon as of 2020.

Keywords

Artificial reefs, citizen science, biodiversity, iNaturalist, marine ecology

Introduction

In 2000, the HMCS Yukon, a 366 ft long former Canadian warship, was sunk in about 100 ft of water off the coast of San Diego to act as an artificial reef. The first scientific study of marine life associated with the Yukon was conducted in 2004 by the San Diego Oceans Foundation and Dr. Ed Parnell of Scripps Institution of Oceanography. In 2003, the authors, along with other advanced divers, became some of the early Yukon Research Divers.

The scientific utility of artificial reefs has been debated. Parnell's program engaged trained volunteer divers in fish counts along transect lines and photographic quadrates on the hull and deck. For reasons of safety, no data were collected inside the vessel. Data reliability varied with diver training levels.

Parnell (2004) noted, "The volunteer program was successful as a pilot program... However, because the study was voluntary, sampling effort was random." Further, Parnell (2005) highlighted concerns regarding diver accuracy: "...many problems with the fish counts... [were] attributed to insufficient training and variable skill levels." Accuracy in species identification depended upon diver training in species recognition, which often varied.

2015 Ocean Sanctuaries diver survey

Recognizing methodological limitations, Ocean Sanctuaries began using high-definition cameras in 2015, facilitating the photographic documentation of species from 2015 to 2025. Photographs were uploaded to iNaturalist, which uses AI for species identification.

AI revolution

AI in platforms like iNaturalist enables automated species identification from uploaded photographs. The app compares user photographs against a vast species database using neural networks and artificial intelligence. Uploaded

observations which are confirmed by iNaturalist experts and attain Research Grade are uploaded to the **GBIF [Global Biodiversity Information Facility]** database (Boone & Basille, 2019).

Methodology

1. Certified divers independently photographed marine species during normal dives. No particular species were sought out.

2. Photographs of both vertebrates and invertebrates were captured.

3. Images were uploaded to iNaturalist under the Ocean Sanctuaries Yukon Marine Life Survey Project.

4. iNaturalist AI scanned images and suggested identifications.

5. Marine biologists and naturalists vetted for Research Grade classification.

6. All data remain open source for scientific and public use.

7. Due to safety concerns, existing transect lines on the vessel were not reused.

Challenges

The challenges the Yukon divers experienced while collecting data on the Yukon over the 5 year period included extreme depth, around 100 ft., cold temperatures and swift currents and at times, extremely limited visibility—sometimes 5 ft. or less.

Observations

Between 2015 and 2020, 237 observations including 58 species were documented by nine Ocean Sanctuaries divers. Most observed species were sessile or free-swimming fish. Planktonic species were noted but not considered reef inhabitants.

Below are some sample observations:

Fig. 1. Blacksmith Chromis *(Chromis punctipinnis*)

Fig. 2 Giant Sea Star (*Pisaster giganteus*)

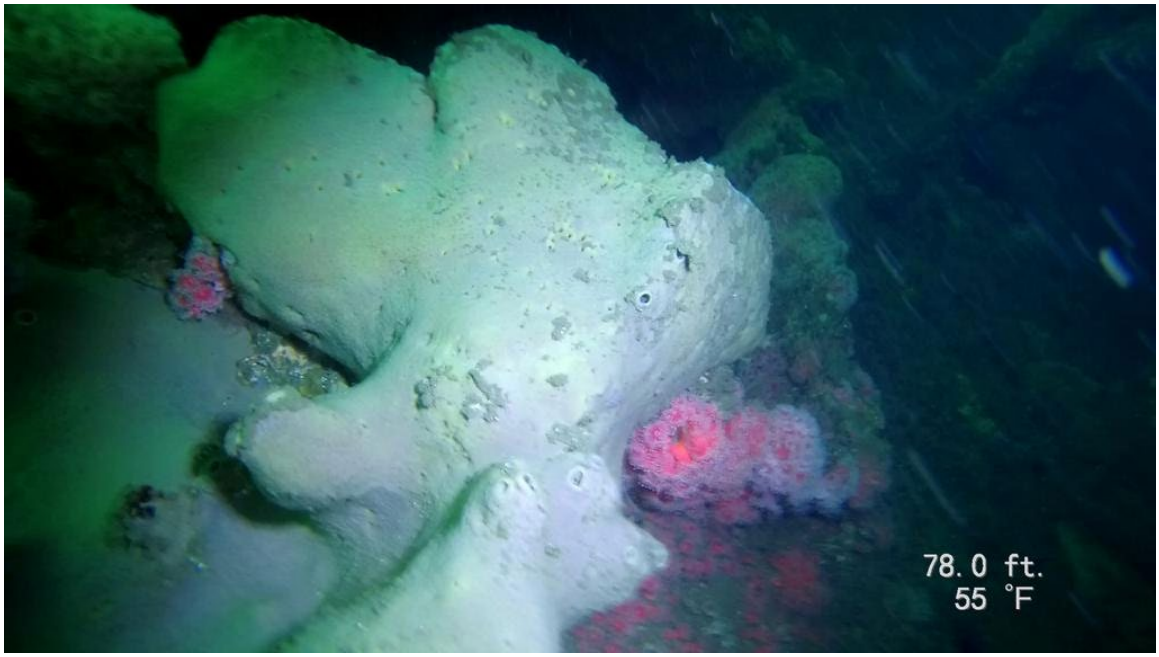

Fig. 3 Giant Moon Sponge (*Spheciospongia confoederata)*

Fig. 4: Hilton's Aelid (*Phidiana hilton*)

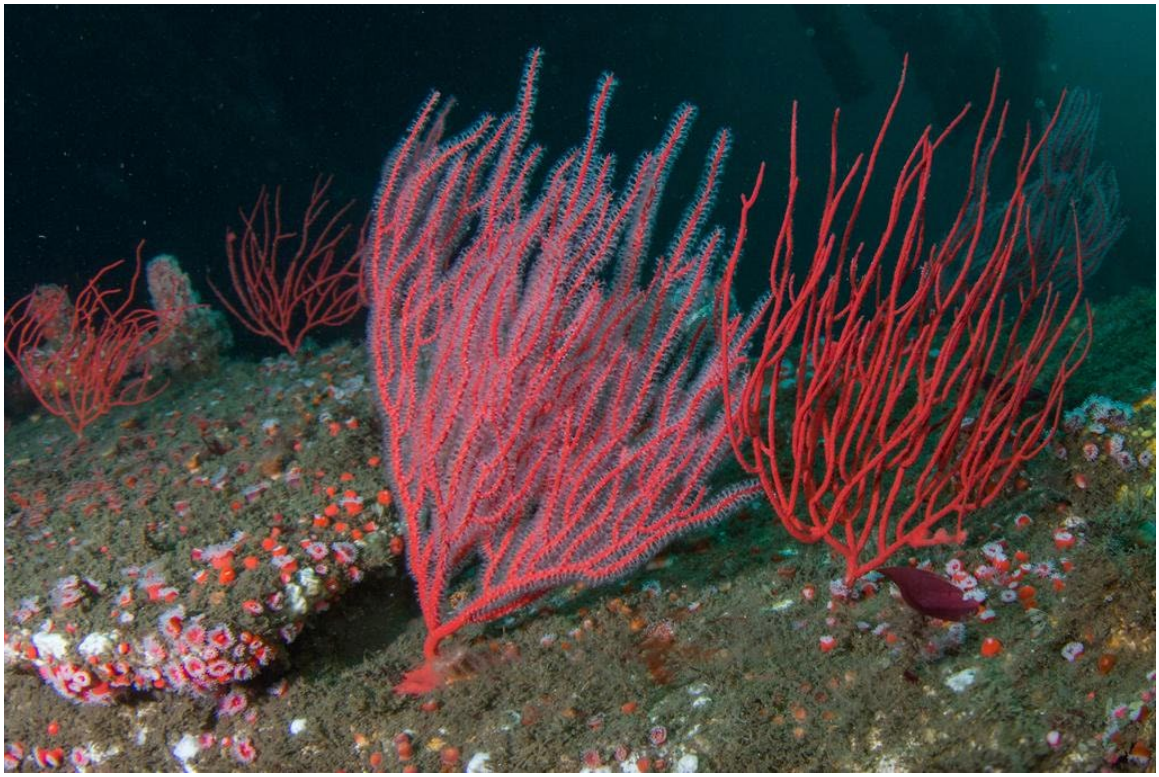

Fig. 5: Red Gorgonian *(Leptogorgia chilensis*)

Fig. 6: Strawberry Anemone (*Corynactis californica*)

Discussion

The data collected from the HMCS Yukon and archived via the iNaturalist and GBIF database not only support ongoing marine biodiversity monitoring, but also contribute valuable insights into several broader questions in marine ecology.

This study supports growing evidence that artificial reefs can enhance local biodiversity, particularly in regions where natural habitats have been degraded or are absent. The consistent presence of both sessile invertebrates and free-swimming fishes over a five-year period suggests that the Yukon is not merely

aggregating existing species, but actively supporting a functioning ecological community. This distinction is critical for understanding the ecological value of artificial reefs and their role in marine habitat restoration and fishery enhancement.

By revisiting a previously studied site and extending observations over a multi-year timescale, our work contributes to understanding long-term community succession on submerged structures. The presence of increasingly complex species assemblages over time implies that artificial substrates like the Yukon undergo predictable patterns of ecological succession, similar to natural reefs. These patterns are shaped by physical structure, material composition, and external influences such as diver presence, light availability, and oceanographic conditions.

The Yukon also serves as a unique reference point for establishing biodiversity baselines. While our study did not sample natural reefs concurrently, the open-source format and consistent imaging protocol allow future comparisons with nearby natural or disturbed habitats. In this context, the Yukon may function as a sentinel site for tracking ecological responses to regional stressors like ocean warming, pollution, or invasive species.

Our findings also highlight the potential of citizen science and AI-assisted tools to produce scientifically valuable, reproducible biodiversity datasets. The use of

iNaturalist not only democratized data collection but also enabled the creation of a curated and verifiable dataset available to researchers globally.

Taken together, the HMCS Yukon Marine Life Survey Project demonstrates how artificial reefs, coupled with citizen science, can inform broader ecological theories while offering practical benefits for conservation monitoring, habitat management, and public engagement.

Conclusion

This paper compares the Parnell Study (2005) and Ocean Sanctuaries (2015) methodologies and provides an updated species inventory for 2015–2020. It highlights how technological advances in photography and AI have empowered citizen science and improved data reliability in challenging underwater environments.

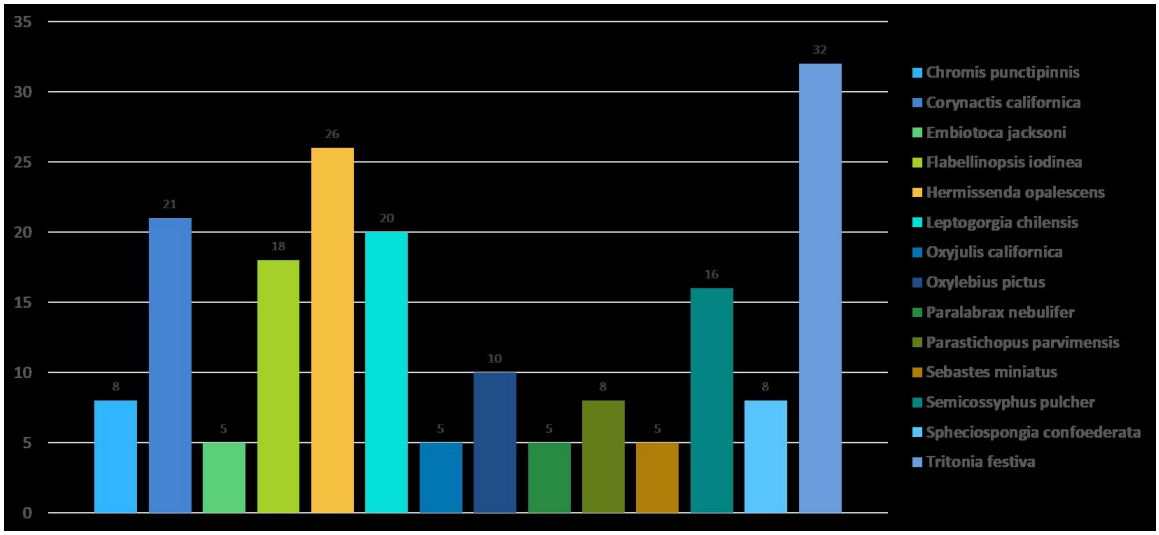

Table 1: Species Abundance Chart–Research Grade Only

Data availability statement

Survey data are available at: https://www.inaturalist.org/projects/yukon-marine-life-survey

Taxonomic checklist: https://www.inaturalist.org/lists/589807-Yukon-Marine-Life-Surveys-Check-List?rank=species&view=taxonomic

Ethics and consent statement

No human or animal subjects were involved in this study.

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No specific funding was received.

Competing interests

The authors declare no competing interests.

Authors' contributions statement

The authors jointly designed the study, performed data collection, and drafted the manuscript.

Notes

None

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