Analyzing Trends in the Hawaiian Humpback Whale Population Using Citizen Science

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INTRODUCTION AND BACKGROUND

Every year in January, February, and March, the Hawaiian Islands Humpback Whale National Marine Sanctuary (HIHWNMS) conducts a Sanctuary Ocean Count during the peak season of humpback whale activity on O'ahu, Hawai'i Island, and Kaua'i. The Sanctuary Ocean Count program began in 1996 and has since grown to include more than 70 sites across these three islands, with over 2,000 local and tourist volunteers participating every year. Originally established as an education and outreach effort, the Sanctuary Ocean Count hopes to increase scientific knowledge of humpback whale biology and ecology by monitoring their migration and breeding patterns (Hawaiian Islands Humpback Whale National Marine Sanctuary, 2023).

RESEARCH QUESTIONS

Using data obtained from the Sanctuary Ocean Count, my focus question for this study was: What are the trends in the Hawaiian humpback whale population across O'ahu, Hawai'i Island, and Kaua'i from 2002 to 2023?

My sub-question included the following:

1. Are there significant differences in the number of humpback whale sightings among different sampling locations and years?

METHODOLOGIES

The Sanctuary Ocean Counts were typically held on the last Saturday of January, February, and March. Volunteers were asked to count how many adult whales and calves were seen from 8am to 12::15pm, in fifteen-minute increments. The 30 site locations that were surveyed at least 80% of the time were included in this analysis.

To account for variability in site usage, whale sightings were standardized by observation effort and reported as sighting rate. The number of adult whale sightings seen in a day were summed up and divided by the number of 15-minute observation periods that occurred in that day at that site location. This number was then rounded up to the nearest whole number and summed by year to calculate total sighting rates each year.

Kruskal-Wallis tests were conducted to determine if there were significant differences in the number of whale sightings by site ID and year.

RESULTS

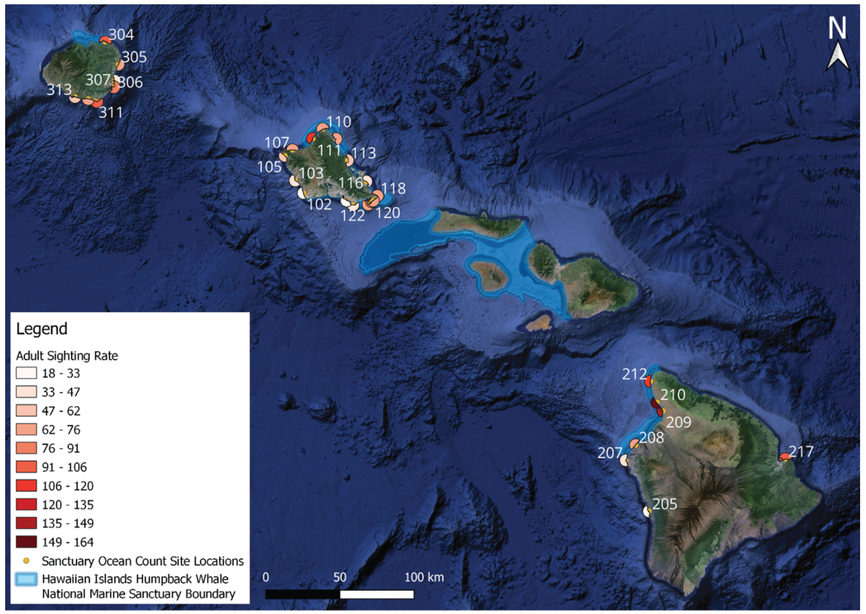


Figure above: Total adult sighting rates across all site locations; Figure below: Adult sighting rates from 2002-2023

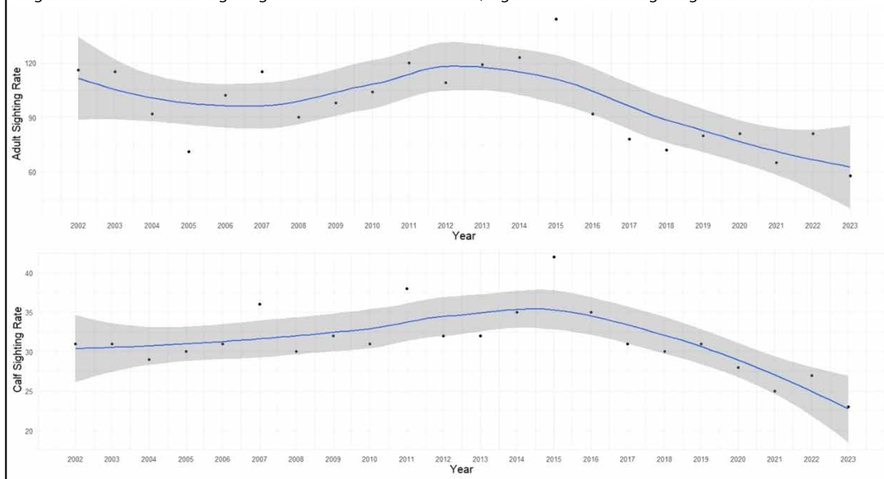
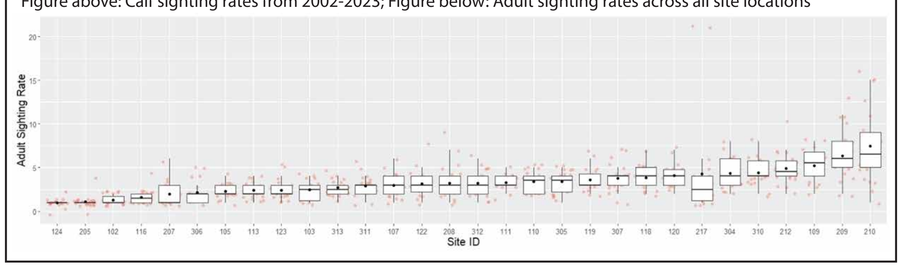


Figure above: Calf sighting rates from 2002-2023; Figure below: Adult sighting rates across all site locations



RESULTS CONTINUED

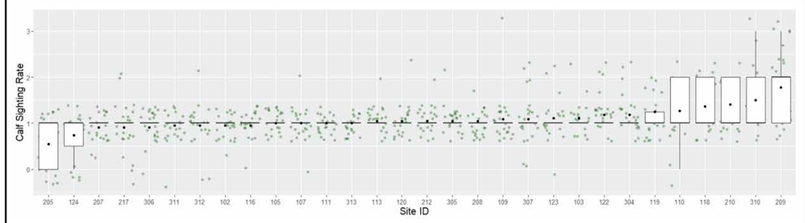
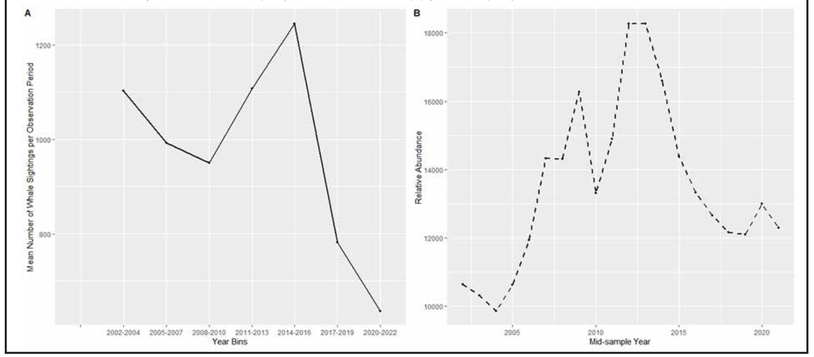


Figure above: Adult sighting rates across all site locations; Figugre below: A comparison of data collected from the Sanctuary Ocean Count project (A) to the Happywhale project (B) (Cheeseman et al., 2024)



DISCUSSION

The results from the Kruskal-Wallis tests reveal a statistically significant difference in adult and calf sighting rate when compared among site locations, as well as individual years. We see a rise in whale sightings across O'ahu, Hawai'i Island, and Kaua'i from 2008 to 2015, where the population hit its peak, followed by a decrease in the subsequent years. The Sanctuary Ocean Count findings are generally consistent with data collected through more traditional research methods, such as photo-identification techniques. Future research should include a more sophisticated modeling approach to examine variations between months, as well as factor environmental data into analysis. Despite concerns regarding data quality and observer bias, results suggest that citizen science data can provide valuable insights into humpback whale distribution, abundance, and habitat use.

REFERENCES

Cheeseman, T., Barlow, J., Acebes, J. M., Audley, K., Bejder, L., Birdsall, C. et al. (2024). Bellwethers of change: population modelling of North Pacific humpback whales from 2002 through 2021 reveals shift from recovery to climate response. Royal Society Open Science, 11(2). https://doi.org/10.1098/rsos.231462

Hawaiian Islands Humpback Whale National Marine Sanctuary (2023). Sanctuary ocean count site leader project guide. https://oceancount.org/wp-content/uploads/2023/01/-Ocean-Count-Site-Leader-Project-Guide_2023.pdf