

Research activities at HIHWNMS during the 2018-19 whale season

Prepared by Marc Lammers

Assessing recent trends in Hawaii's humpback whale population

Background: In late 2015 ocean users and scientists in Hawai'i began reporting reduced numbers of whale sightings and these observations continued into 2018. This trend raised concerns about the status of the Hawai'i distinct population segment (DPS), which is now considered "recovered" and was removed from the U.S. endangered species list in 2016. To assess the significance of these trends and to meet the requirements of a Post-delisting Monitoring Plan developed to ensure the DPS remains healthy and doesn't "backslide", HIHWNMS and NOAA's Pacific Islands Regional Office collaborated to organize a workshop of whale experts to discuss the topic.



Accomplishments: A two-day workshop was held in Honolulu on 27-28 November 2018 that convened key researchers and managers involved in studies examining recent trends in humpback whale abundance, distribution, and health in both Hawai'i and Alaska. The objectives of the meeting were to present data that address reported changes in humpback whale sighting rates in Hawai'i and Alaska over the past 3-4 years, evaluate the validity and significance of these reports, consider potential explanations for the observed trends, identify knowledge gaps, establish research priorities for filling those gaps, evaluate strategies, and establish a consensus on an action plan. The workshop included presentations on the latest data from various research groups and discussion/brainstorming sessions to address the stated objectives. There was broad consensus among participants that whale presence has been lower both in Hawai'i and Alaska over the past 3-4 years and that changes in prey abundance/distribution in Alaska are likely influencing the trend. The group identified numerous knowledge gaps and discussed the types of research efforts that would be needed to address these gaps. There was agreement that the group should continue to engage via periodic updates from field efforts and by the formation of working groups to address specific priority issues. A report on the workshop has been drafted and is in the review process.

Unde of humpback whale song



Background: Male humpback whales produce a complex song during the breeding season that is thought to play an important role in mediating reproductive behavior. The exact function of song remains a matter of debate, but is generally believed to be a display of fitness, with behavioral evidence suggesting that it is a male-male display. To investigate the hypothesis that song conveys information about male fitness, the variability of song produced by individual whales is being examined in a collaborative study with the University of Hawai'i (UH) at Hilo and the University of Alaska Fairbanks. As part of this effort, singing whales off Maui are located and then recorded by divers using a calibrated recorder/video camera system along with a handheld dive sonar to establish distance to the animal. Underwater videogrammetry is used to establish the size of each singer and biopsy samples are obtained to examine steroid hormone levels in order to establish the relationship between song characteristics, singer size and testosterone levels.

Accomplishments: Nine days of fieldwork were conducted between February and March, resulting in 13 singers being recorded and 6 biopsies collected. A crew from PBS came to film the effort and the research was highlighted in an episode of the documentary series "Changing Seas", which aired on June 26, 2019 and is now available online. The data obtained from this year's effort will be added to the 22 singers that were recorded using the same methods during previous years. Processing of this year's data is underway. A publication detailing the results of this work is planned after this year's data have been analyzed.

Acoustic monitoring of humpback whale chorusing

Background: Between December and April, male humpback whale song becomes the dominant source of underwater ambient noise in many parts of Hawai'i, creating a chorus of whale singing. Because whale song can transmit over several miles, the acoustic energy produced by singing whales can be used to track the relative presence of whales in an area, revealing the timing of their arrival, their peak abundance and their departure. The abundance of song can also be used to compare the relative occurrence of whales across locations and between years, providing a useful metric for studying geographic variability and annual trends in whale presence. Metrics of whale song abundance are obtained through bottom-moored acoustic recorders that measure the soundscape of an area, which includes whale chorusing, over the course of the breeding season. Automated algorithms are then used to quantify the amount of whale song present in recordings. This effort is led by HIHWNMS in partnership with Oceanwide Science Institute and with partial funding support from the U.S. Navy via the SanctSound Project, an Office of National Marine Sanctuaries endeavor to characterize the soundscapes in seven national marine sanctuaries and one marine national monument.



Accomplishments: Beginning in October of 2018, seven Ecological Acoustic Recorders (EARs) were deployed in waters around Maui Nui (Maui, Molokai, Lanai and Kahoolawe) at locations ranging in depth between 15 m and 200 m. Several of these sites have been acoustically monitored since 2014, providing a five-year time series of acoustic recordings that can be used to track inter-annual variability in whale chorusing levels. In addition to the EARs, five SoundTrap recorders were deployed in Sanctuary waters off Maui (Olowalu), Molokai (Penguin Bank), Oahu (Makapuu Point) and Kauai (north shore) as part of the SanctSound Project. Two SoundTrap recorders were also deployed at Maro Reef and at Lisianski Island in the Papahānaumokuākea Marine National Monument (PMNM) as part of the SanctSound Project. The EARs and SoundTraps in HIHWNMS were recovered in May/June. The two PMNM SoundTraps will be recovered during a chartered research cruise in July 2019. Appendix A Figure 1 shows preliminary results from a shallow-water EAR deployed off Olowalu.

Tagging humpback whales to understand their behavior



communication, movements and activity levels.

Background: Although humpback whales have been studied in Hawai'i for decades, much of their behavior remains a mystery. For example, not much is known about what whales do at night and whether their activities differ from those observed during the day. Very little is also still known about how whales respond to acoustic disturbances, such as vessel traffic and other sources of human-generated noise. HIHWNMS is part of a long-term collaborative partnership with researchers at the Hawaii Institute of Marine Biology and UH-Hilo to examine these and other open questions about whale behavior through the use of sensor tags placed on whales using suction cups. These tags measure sound, dive behavior and the whale's three-dimensional movements using tri-axial accelerometers and magnetometers. The data generated provide unique insights into what whales do when they slip under the surface and out of our view, allowing us to examine questions about their

Accomplishments: The U.S. Government shutdown resulted in the cancellation of four tagging days in January, but six field days were conducted in February and March. These resulted in four tag deployments on whales that lasted in duration between 20 minutes and 12 hours. These included tags that were placed on a whale in a dyad (~4 hours), a female in a competitive pod (~7.5 hours) and two secondary escorts in competitive pods (~20 min and ~12 hours). Unfortunately, the tag on the longest deployment malfunctioned and stopped recording data shortly after being placed on the whale. These data complement a 37-hour tag deployment on a singer previously obtained on March 2018, which is currently being analyzed and the results prepared for publication. A Nancy Foster scholar will spend approximately 6 weeks at HIHWNMS this fall to assist with the analysis of the data from these tag deployments.

Vessel and shore-based surveys to quantify whale abundance

Background: Trends in the abundance occurring in the Maui Nui region are not well Acoustic monitoring efforts are providing an whale presence based on the singing activity it is not clear how well this captures the population overall, including non-singing ma and calves. To more accurately mea abundance in Maui Nui and to relate whale recorded levels of song chorusing (see above based and vessel-based surveys are c partnership with UH-Manoa. Shore-based sur UH graduate student employ a surveyor's



geospatially “fix” the position of whales from an observation station off Olowalu during 30-minute scans of the area. In addition, vessel surveys led by HIHWNMS using the R/V Koholā record whale sightings along a systematic transect line that overlaps the area monitored from the shore station and also several bottom-moored acoustic recorders. These data streams are then combined to create time series of whale abundance off west Maui within and between seasons.

Accomplishments: Weekly shore-station counts of whales began on January 8, 2019 and ended on April 24, 2019, resulting in a total of 17 survey days. The U.S. Government shutdown resulted in the cancellation of three scheduled vessel survey days in January. However, a total of eight vessel surveys were conducted between December 21, 2018 and April 24, 2019. These data are being analyzed by a UH PhD student as part of her dissertation research and will be used to relate whale song chorusing levels measured in decibels to metrics of whale density measured visually. Preliminary results from this analysis are shown in Appendix A Figure 2.

Investigating the connectivity between HIHWNMS and PMNM



Background: The Hawaiian archipelago is the primary breeding habitat for the north Pacific humpback whale population. Within the archipelago, approximately one third of the whales' preferred habitat (shallow water less than 600 feet deep) is found in the main Hawaiian Islands (MHI) and two thirds occurs in the Northwestern Hawaiian Islands (NWHI). Acoustic recordings and visual sighting confirm that humpback whales use the NWHI, but it is not known in what abundance and whether these whales also visit the MHI or are part of a different breeding population. Both HIHWNMS and the Papahānaumokuākea Marine National Monument (PMNM) have prioritized better understanding the connectivity between whale habitats across the archipelago.

Accomplishments: In early April 2019 HIHWNMS Vessel Operations Coordinator Lt. Sara Thompson and Research Coordinator Dr. Marc Lammers participated in a Pacific Islands Fisheries Science Center cruise to PMNM aboard the NOAA ship Oscar Elton Sette. The objective of the cruise was to explore the islands and banks of the northwestern Hawaiian Islands for the presence of humpback whales. Lt. Thompson and Dr. Lammers were part of the observer team and also participated in photo ID and biopsy sampling. The cruise entered PMNM via Middle Bank and spent time at Nihoa, Mokumanamana, French Frigate Shoals and St. Rogatien Bank. Humpback whales were encountered at all locations visited. In total, approximately 180 whales were sighted, including 13 calves, of which 47 were photo identified via fluke ID and 10 were biopsy-sampled. The data will be used to examine connectivity between these whales and whales from the main Hawaiian islands and other parts of the north Pacific using photo ID matching and genetic analysis.

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APPENDIX A – Preliminary Results

NOTE: The figures below are preliminary and unpublished. Please do not publish or post on social media. Contact Dr. Marc Lammers (marc.lammers@noaa.gov) before disseminating further.

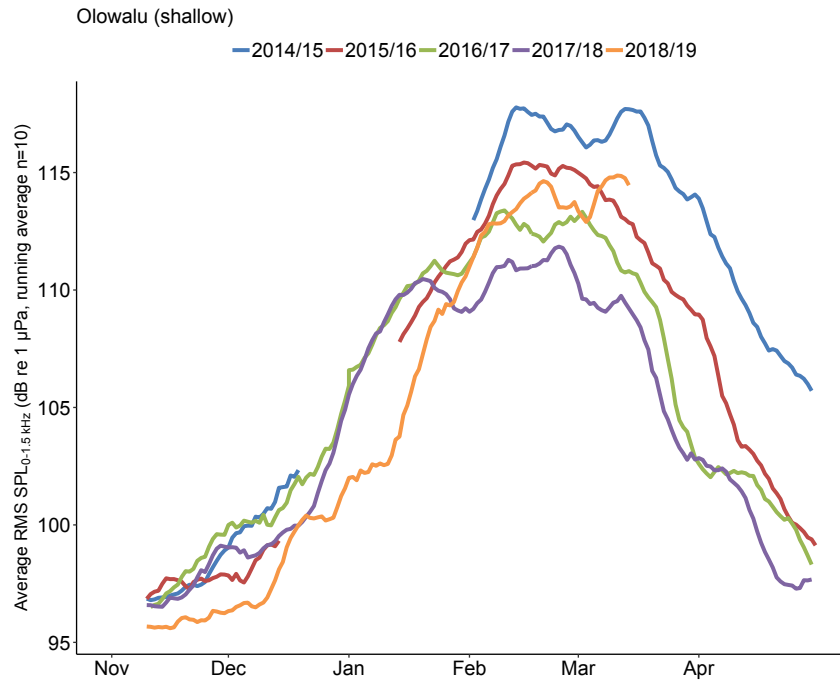


Figure 1 – Humpback whale chorusing levels in decibels measured by a shallow EAR deployed off Olowalu over the past five years. Data gaps represent periods when the EAR did not record.

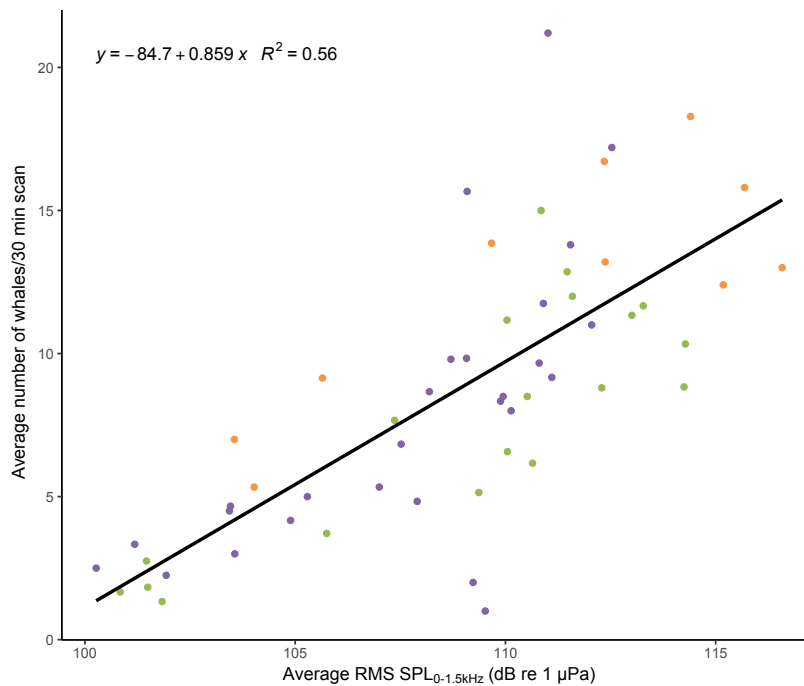


Figure 2 – Linear regression of whale abundance measured from the shore station (y-axis) vs. chorusing levels measured at the Olowalu shallow EAR (x-axis).