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Progress Report on the North Atlantic Humpback Whale Catalog

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Progress Report on the North Atlantic Humpback Whale Catalog

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Abstract

The North Atlantic Humpback Whale Catalog (NAHWC) currently includes photographs and data from 50,000 sightings of 11,690 individual non-calf humpback whales identified by ventral fluke photos. This report highlights the collaborative efforts of over 850 contributors across the North Atlantic Ocean basin, detailing the current methods used for photographic-identification (photo-ID) and cataloging. Notably, advancements in digital photo-ID analysis techniques have enhanced the cataloging process, incorporating automated identification algorithms while maintaining stringent comparison standards. The report discusses recent findings on North Atlantic humpback whale movement patterns, including interregional migrations, preliminary results from stranded humpback whales, and sightings from areas of increasing importance.

Introduction

First published in 1977, the North Atlantic Humpback Whale Catalog (NAHWC), curated by Allied Whale at College of the Atlantic, has been a resource for managing and researching humpback whales for over four decades. More than 850 researchers and citizen scientists have contributed images and data to the NAHWC and have been critical to this work since its inception. Currently, the NAHWC includes over 50,000 photos and sightings of 11,690 individual non-calf humpback whales (as of 20 March 2024), identified only by good quality photos of their ventral fluke pattern.

The NAHWC spans the entire North Atlantic Ocean basin, with the majority of submissions originating from the primary high-latitude feeding grounds, the low-latitude breeding or calving grounds, and mid-Atlantic migratory stop-over areas. The five primary high-latitude foraging grounds in the North Atlantic are the Gulf of Maine; Atlantic Canada, including the Gulf of St. Lawrence, Newfoundland and Labrador; West Greenland; Iceland; and northern Norway. Along the breeding/calving range, the NAHWC includes photos across the West Indies, the Greater and Lesser Antilles, and the Cape Verde Islands. Fluke photos have been submitted across the West Indies range. However, the highest number of sightings originate from the banks off the Dominican Republic (Silver Bank, Navidad Bank, Mouchoir/Pañuelo Bank) and Samana Bay. Identification images from the mid-Atlantic migratory stop-over regions are documented in the NAHWC as well, including Bermuda and the Azores. Furthermore, additional sightings from other regions, such as the United States mid-Atlantic from Florida north to Rhode Island, the British Isles, and the Mediterranean Sea, are gathered to investigate new trends and monitor humpback populations in areas beyond the primary areas of aggregation in the North Atlantic.

Methods

Fluke photos and associated sightings data are submitted to the NAHWC via file transfer or an online public submission platform on the Allied Whale website at <https://www.coa.edu/allied-whale/research/>. At a minimum, one high quality fluke photo per year per area is requested from each contributor, though additional images and data are welcome. Submitted photos are edited per the standards of the catalog and a unique serial number is assigned to every photo.

From 1977 to 2017, trained photographic-identification (photo-ID) technicians employed solely visual comparison methods to detect matches and incorporate new whales into the catalog under the standards in Katona and Whitehead (1981). Since 2017, we have incorporated digital photo-ID analysis techniques into the review process. Initially, fluke photos are compared using automated identification algorithms outlined in Cheeseman *et al.* (2021) against a private reference catalog in the platform Happywhale (HW). Any positive matches identified by the algorithms are then independently confirmed by two trained reviewers to mitigate false positives. In cases where the algorithms fail to find a match in the reference catalog, an experienced photo-ID technician visually compares the fluke photo to the NAHWC a second time to avoid false negatives or overlooked matches. Images that the algorithms struggle with, such as those showing only a portion of the right or left flukes, carcasses, or lower quality photos taken underwater, undergo visual comparison by two reviewers against the catalog. If an individual is not conclusively matched to an existing animal in the catalog despite both automated identification and visual comparison, it is assigned a new NA number and incorporated into the NAHWC. Photos of poor quality, where inadequate focus significantly impedes accurate identification or less than 20% of the right or left fluke is visible, are excluded.

Over the last few years, the NAHWC has contributed to the development and advancement of the automated identification algorithms used by HW. The algorithms have significantly improved matching efficiency; however, errors are still discovered and incorporated to improve effectiveness and reliability. At this time, sightings submitted to HW are not automatically contributed to the NAHWC, though the open data could be integrated into the NAHWC for a unified ocean-basin-wide collection of fluke photos and further formal collaborations are in discussion. A subset of public sightings from the NAHWC, such as those from the Years of the North Atlantic project (Smith *et al.* 1999), are available on HW, and location information is available on OBIS-SEAMAP [<https://seamap.env.duke.edu/>].

Results

Since our last report to the Photo-ID working group of the IWC SC presented on 5 May 2021, a total of 7,899 photos of 3,497 individuals, including 1,269 new individuals, have been added to the NAHWC. Additional resightings were found between all areas where many previous studies have documented movement, as well as several resightings between areas not previously described. Over the last couple of years, the NAHWC has focused matching efforts on previously under-represented areas such as the Lesser Antilles, US mid-Atlantic, Ireland and the UK, and the migratory stop-over area of the Azores. Additionally, the flukes of whales documented deceased during the ongoing Unusual Mortality Event for humpbacks along the US

Atlantic Coast are an ongoing priority (NOAA 2024); our staff have compared and cataloged 177 dead whales to date. Preliminary results of photo-ID analyses of whales who died during the UME indicate that these whales are from both the Gulf of Maine and Atlantic Canada feeding grounds. Table 1 presents the number of individual humpback whales identified by fluke photo incorporated into the NAHWC, subsetted by region.

Table 1. Number of individual humpback whales (N) per region incorporated in the NAHWC as of 20 March 2024. The type of area is included in column one, with the West Indies breeding stock further subsetted into the Greater and Lesser Antilles. The Mid-Atlantic includes the migratory stop-over areas of Bermuda and the Azores, as well as areas where humpback sightings have increased in recent years: the US mid-Atlantic states and Ireland, including the UK.

	Area	N
Breeding/calving ground	Greater Antilles	3,857
	Lesser Antilles	492
	Cape Verde Islands	282
Mid-Atlantic area	US mid-Atlantic	404
	Bermuda	347
	Azores	119
	Ireland, UK (and mainland Europe)	132
Feeding ground	Gulf of Maine (including the Scotian Shelf)	2,475
	Atlantic Canada	3,618
	West Greenland	576
	Iceland	1,269
	Northern Norway	712
	TOTAL	11,690

Discussion

Humpback whales in the North Atlantic Ocean return to their maternal feeding grounds; however, data from the NAHWC and prior publications indicate a small level of movement between adjacent feeding grounds. On the southern breeding/calving grounds in the West Indies, whales from different feeding areas mix unevenly and arrive at varying times. From the Cape Verde Islands, which house an endangered distinct population segment, whales had been resighted only in the eastern North Atlantic feeding grounds of Iceland and northern Norway (Wenzel *et al.* 2020). This trend is significant, considering the larger sample sizes from western feeding grounds such as the Gulf of Maine and Atlantic Canada. Notably, we recently found the first resighting between the Cape Verde Islands and any western North Atlantic feeding ground, that of West Greenland, documented over a span of 22 years, available in Chosson *et al.* (2024).

Humpback whales from the Lesser Antilles, specifically from the Anegada Passage to the coast of Venezuela, have been identified on all five feeding grounds. However, they are more

commonly sighted on the eastern feeding grounds. Conversely, humpbacks documented off the Greater Antilles, primarily around the banks off the Dominican Republic, have been seen on all five feeding grounds but tend to have a higher likelihood of migrating to the western North Atlantic feeding grounds of the Gulf of Maine, Atlantic Canada, and West Greenland.

Jones *et al.* (in review) provides an update on the ocean-basin-wide movement patterns of North Atlantic humpback whales, analyzing sightings data from the NAHWC between 1980 and 2015 from the five feeding grounds and the breeding regions of the Cape Verde Islands and the West Indies, further dividing the West Indies into the Greater and Lesser Antilles to investigate the differences in movement patterns of whales from those two regions. Additional research is required, integrating data from photo-identification analyses, genetics, satellite tagging, and acoustic analyses to delve into the distinctions among humpback whales inhabiting the Lesser Antilles compared to those in the Greater Antilles.

With increasing sightings from mid-Atlantic regions and areas outside the species' normal range, such as the Mediterranean, it remains vital to assess these individuals to determine their stock identities and other important life history information. To date, the NAHWC has cataloged seven humpbacks from the Mediterranean (Frantzis *et al.* 2004; Genov *et al.* 2009; Ruíz *et al.* 2018); of particular significance is the first information on the breeding ground identity of one whale documented in the Mediterranean, previously seen on Silver Bank off the Dominican Republic, which offers crucial insights into the stock identity of humpbacks visiting the Mediterranean (Violi *et al.* 2021). Another interesting resighting discovered recently was the first documented case of a humpback known to move out of the Mediterranean - from the Ligurian Sea in the Northern part of Pelagos Sanctuary to the Algarve Coast, Portugal (na12778) over 54 days, 11 April 2023 to 4 June 2023 (Menkab 2023).

More information from photo-ID is now available on the increasing presence of humpbacks along the coast of Ireland (Berrow *et al.* 2021; Blázquez *et al.* 2023). Similarly, humpback sightings from the mid-Atlantic states of the US have increased over the past decade, and their population identity, site fidelity, and demographic characteristics were assessed in Brown *et al.* (2022) for 101 individual humpbacks documented in the New York Bight region from 2012 to 2018. Photo-ID results indicated that the individuals sighted in the New York Bight region were primarily confirmed or suspected juveniles that originated from the Gulf of Maine or Atlantic Canada feeding grounds, and a level of annual return to the region was found (mean 31.3%; Brown *et al.* 2022). Humpback mortalities in the waters off the mid-Atlantic US states have been increasing and further investigation into the live sightings in these urban areas is important for conservation of the species.

In the absence of a comprehensive global or ocean-wide stranding and reporting system for humpback whale mortalities, the North Atlantic Humpback Whale Catalog (NAHWC) serves as a valuable resource for identifying and documenting deceased humpback whales, contingent upon the availability of a ventral fluke photograph. To date, a total of 177 deceased humpbacks have been cataloged. One recent notable finding was a live stranded humpback on Sable Island, Canada, which subsequently died, identified as an individual first documented on the Silver Bank breeding ground in the early 1980s by the ORES and during the YoNAH survey in 1993 (CBC 2023; Smith *et al.* 1999). Going forward, it is recommended that high-quality photo-ID

images be collected from all future humpback strandings or mortalities when possible and compared to formal catalogs to enhance understanding of stock identities and migration patterns. Our goal in 2024 is to compare and catalog all existing fluke photos from whales that stranded during the ongoing Atlantic US coast Unusual Mortality Event to provide management with more information on their stock identity and life histories.

The North Atlantic Humpback Whale Catalog (NAHWC) has been a cornerstone resource for over four decades in monitoring and researching humpback whales, with a long-term database including more than 50,000 photos of 11,690 individual humpbacks, thanks to contributions from over 850 collaborators from across the ocean basin. Recent methodological advancements have incorporated digital photo-ID analysis techniques, enhancing the review process with automated identification algorithms and maintaining rigorous visual comparison standards. Continual efforts focus on improving matching efficiency while ensuring accuracy and reliability. Additionally, ongoing contributions to the catalog facilitate a deeper understanding of humpback whale movement patterns and stock identities, with recent findings shedding light on interregional migrations and the significance of migratory habitats. Moreover, the NAHWC's role extends to documenting deceased humpback whales, offering valuable insights into mortalities and emphasizing the importance of continued data collection and analysis for conservation and management purposes.

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Recent Publications

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