

Development of a Web-Based Mid-Atlantic Humpback Whale Catalog: 2017 Annual Progress Report

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Cover Photo Credit:

Humpback whale (*Megaptera novaeangliae*) diving with flukes exposed (top) used in photo-identification. Image of a humpback whale lunge feeding nearshore Virginia Beach, VA (bottom).

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Acronyms and Abbreviations

CCS	Center for Coastal Studies
GOMDIS	Gulf of Mexico Dolphin Identification System
GOMHWC	Gulf of Maine Humpback Whale Catalog
MABDC	Mid-Atlantic Bottlenose Dolphin Catalog
MAHWC	Mid-Atlantic Humpback Whale (Photo-ID) Catalog
NAHWC	North Atlantic Humpback Whale Catalog
NARWC	North Atlantic Right Whale Catalog
OBIS-SEAMAP	Ocean Biogeographic Information System-Spatial Ecological Analysis of Megavertebrate Populations
photo-ID	photo-identification
photo-ID app	Photo-Identification Application
PIPIN	Pacific Islands Photo-Identification Network
U.S.	United States
VAQF	Virginia Aquarium & Marine Science Center Foundation, Inc.

1. Introduction and Background

Humpback whales (*Megaptera novaeangliae*) are the most common mysticete in the nearshore waters off the coast of Virginia (Malette et al. 2016). Evidence of seasonal use, foraging, and site fidelity from photo-identification (photo-ID) efforts suggests that the mid-Atlantic provides important seasonal habitat for humpback whales (Swingle et al. 1993, Barco et al. 2002, Malette et al. 2016). Barco et al. (2002) suggested that some individual humpback whales overwinter in the mid-Atlantic, and that this region may serve as a supplemental winter feeding ground.

Over the last two decades, the Virginia Aquarium & Marine Science Center Foundation, Inc. (VAQF) has conducted photo-ID of humpback whales off the coast of Virginia and North Carolina and currently curates the Mid-Atlantic Humpback Whale Photo-ID Catalog (MAHWC), an expanding collection of photographs of 329 unique whales. The objectives of these long-term efforts are to establish baseline data on humpback whale movement patterns, population demographics, site fidelity, and seasonal habitat use in the mid-Atlantic while supporting multi-decadal photo-ID efforts and research in the broader western North Atlantic. These efforts can also serve to support assessment of human impacts (e.g., injuries from entanglement or watercraft), body condition, and behavior (e.g., foraging). Longitudinal mark-recapture data can also serve as a non-invasive mechanism to investigate and detect changes in patterns of humpback whale occurrence, inter-annual variation, and changes in distribution and phenology over time.

Naval Station Norfolk is the world's largest naval station, with a high concentration of military vessel traffic and training exercises occurring in the nearshore and offshore waters of Virginia. The United States (U.S.) Navy (Navy) has expressed an interest in the identity, residency, site fidelity, and habitat use of humpback whales sighted in the mid-Atlantic region through the funding of tagging and biopsy efforts (Aschettino et al. [2016, 2017](#)), and aerial surveys (Malette et al. [2016, 2017](#)). The U.S. Navy provided additional support to VAQF and key collaborators to develop a web-based Mid-Atlantic and Southeast Humpback Whale Photo-ID Catalog (MAHWC).

Survey effort and opportunistic sightings in the mid-Atlantic and southeastern United States have increased substantially in the past few years. To more effectively integrate data from a multitude of sources both current and historic, a streamlined process for data/image submissions, management, and access is necessary. The MAHWC will be an integrative platform that serves this purpose while providing a broad-scale and high-quality scientific product that can inform users of the identity, residency, site fidelity, and habitat use of humpback whales in the waters off the mid-Atlantic and southeastern U.S.

In addition, simplifying and standardizing submissions from the mid-Atlantic to the broader regional and North Atlantic catalogs is essential to efficient exchange of information between regions. This tool will benefit researchers, managers, and educators by supporting informed management and environmental planning.

This project contributes to the overall community effort to help monitor the West Indies Distinct Population Segment and complements existing Navy marine species monitoring efforts ([Mid-Atlantic Humpback Whale Monitoring](#), [Mid-Atlantic Continental Shelf Break Cetacean Study](#), and [Aerial Survey Baseline Monitoring](#)).

The MAHWC will be hosted on the Ocean Biogeographic Information System-Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP; Halpin et al. 2009) a web-based biogeographic database of occurrence and multi-platform survey data for marine megafauna. It provides tools for mapping and visualizing species sighting data on a global scale. Currently, OBIS-SEAMAP hosts multiple other photo-ID catalogs (e.g., Mid-Atlantic Bottlenose Dolphin Catalog [MABDC], Pacific Islands Photo ID Network [PIPIN]) and provides a user-friendly interface that provides efficient tools for comparison of collections.

The development of the MAHWC is currently in year two of the anticipated three-year project. Year one focused on engaging key stakeholders involved in humpback whale research, management, and outreach, as well as potential contributors to the MAHWC. This was achieved through the MAHWC Stakeholder Workshop, during which data-access protocols were developed; standardized protocols for data/image submission and quality assurance for the MAHWC were established; and the workflow for submission of images/sighting data between the MAHWC, larger regional catalogs, and contributors was agreed upon. Additionally, a draft web interface/database design modeled after that of the MABDC was developed for stakeholders to review and offer their feedback. A Stakeholder Workshop Report ([Mallette et al. 2017b](#)) summarizing the outcomes was developed (see **Figure 1** of Stakeholder Workshop participants during a meeting).

This report describes the progress on MAHWC project development in 2017.

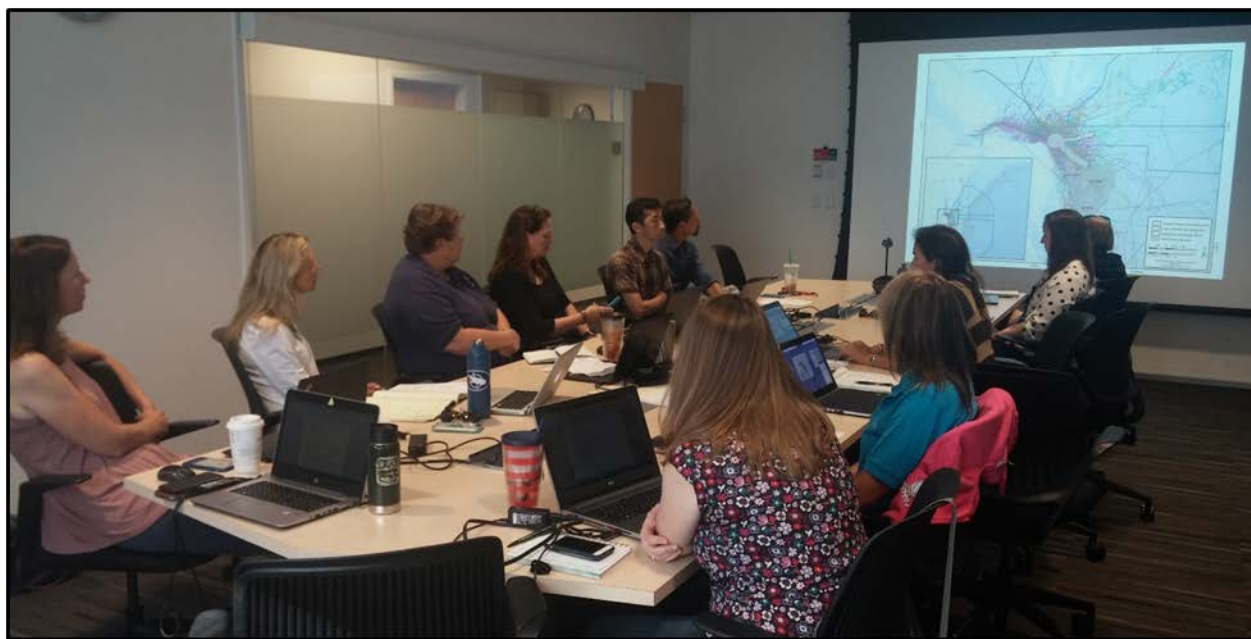


Figure 1. Stakeholder Workshop participants at the HDR office in Virginia Beach, Virginia.

2. Methods

Existing examples of web-based photo-ID catalogs (e.g., MABDC; Gulf of Mexico Dolphin Identification System [GOMDIS], [PIPIN] Catalog for Spinner Dolphins; the North Atlantic Right Whale Catalog [NARWC], and Antarctic Humpback Whale Catalogue) have served as models for identifying the key components needed to develop an online catalog accessible by multiple researchers and tailored specifically to collaborative humpback whale photo-ID efforts. Consultations with the core stakeholder group provided invaluable guidance through the development of the data-sharing agreement and data/image submission, quality assurance, and matching protocols. The draft photo-ID application (web interface/database) of the MAHWC was developed by Duke University Programmer Ei Fujioka and in consultation with Kim Urian, curator of the MABDC. Refinements to the photo-ID app are being made in year two based upon feedback from the Stakeholder Workshop and discussions among Duke, Urian, and VAQF.

Unique variations in the ventral fluke pattern; fluke trailing edge shape; shape, size, and scarring of the dorsal fin; and other scars, marks, and features are used to catalog individual humpback whales (Katona and Whitehead 1981). In order to maintain as much consistency as possible, one of the primary roles of the MAHWC curator will be to assign feature codes to images that are included in the catalog. These unique codes will permit more efficient filtering through the catalog.

While the MAHWC photo-ID app is being updated, fluke and dorsal fin images of individual humpback whales submitted by Virginia contributors are being systematically compared to identify resights, and to assign new individuals to the catalog when no match is made to the existing collection.

For the online web catalog, contributors will provide sighting data via standard templates and will follow image- and data-accession protocols agreed to at the Stakeholder Workshop, which will allow efficient processing/management and quality control of the database. Data and images from Virginia contributed to date have been integrated into a geospatial database and each image has been scored for quality to reduce the potential for false negatives when matching. Each image was also coded based upon the standard identifiable features established for the North Atlantic Humpback Whale Catalog (NAHWC) and the Gulf of Maine Humpback Whale Catalog (GOMHWC). To ensure quality data, each sighting location was checked to ensure there was a corresponding image of sufficient quality to identify the individual whale. If no image existed, that data point was deleted. See Stakeholder Workshop Report for protocols for scoring photo quality and coding dorsal fin and fluke image features ([Malette et al. 2017b](#)).

The MAHWC database workflow was modeled after that of the MABDC. The web-based interface will permit searches by study site and/or coded features of identifying characteristics. It will provide mapping features and enable a matching workflow between contributors. When images are marked as a match, the image contributors will be automatically prompted by email to review the potential match. Each contributor of the proposed match will either provide consent or reject the match. If both parties agree, and the curator verifies the match, it will be

placed into a 'Verified' state. At the time of consent or rejection, the database will be updated with a unique match identifier for the two matched IDs. An email prompt will then be sent to the matching team and the contributors. The curator will oversee this process. More detail can be found in the Stakeholder Workshop Report ([Mallette et al. 2017b](#)).

To facilitate the exchange of information between contributors, data-access protocols were developed by the stakeholders with the goal of sharing data agreed upon by the stakeholders and with the approval of the respective contributors.

3. Progress

Local contributor images and sighting data collected between the 2013 and 2017 seasons submitted by VAQF, HDR, Inc., Rudee Flipper Whale Watch have been standardized in the contributor template and images scored based on feature codes and image quality for integration into MAHWC. All whales submitted during this time period have been compared and new whales integrated into the catalog. As of December 2017, the catalog included 329 unique whales. Humpback whales in the MAHWC documented from 1989 through 2016 have been compared to the NAHWC. Virginia images from 2017 are at various stages of comparison with both the NAHWC and GOMHWC. Whales with MAHWC ID's are being compared to contributions from other contributors based in New York, New Jersey, Virginia, North Carolina, Georgia, and Florida. At the end of each season, the best images of all new whales are added to the MAHWC and are sent in batch to the Center for Coastal Studies, Provincetown, Massachusetts (CCS) and Allied Whale, Bar Harbor, Maine to be added to and compared with the GOMHWC and NAHWC.

Fluke code categories have been modified from those developed by the NAHWC. Consistent with how Allied Whale scores flukes, these are initially classified by the grading of fully white (Type 1) to fully black (Type 5) coloring on the ventral surface of the flukes. Common patterns in the amount of light/dark pigmentation on the ventral flukes allow categorization of similar flukes into "Types" for direct comparison to a smaller number of possible matches. Within each Type, subcategories were also assigned (e.g., "typical, wide black trailing edge, white on trailing edge, white eyes"). Dorsal fin, peduncle knuckles, and body scarring categories are also useful features to code, especially in the mid-Atlantic and southeastern regions where whales may not fluke as often as farther north, and, therefore, are being used for categorizing and filtering non-fluke images for identification (see [Mallette et al. 2017b](#) for MAHWC feature codes). A protocol for systematically scoring humpback whale images (based on NAHWC methods) has been drafted and is being tested. The final methods will be integrated into the curator package that will be completed in year three of the project. A collection of reference images for each category of fluke and dorsal fin has been compiled to be validated by CCS and Allied Whale curators. This includes "Type" feature codes with text descriptions and will also include an example image for contributors for reference when selecting a category to search for matching.

A standard template for image and sighting data submissions was developed and recently modified to accommodate supplemental data agreed upon by contributors—including tagging, biopsy, and survey effort data. A draft reference document guiding contributors through completing the template has been drafted and is being reviewed. This template and the reference document describing the fields in the template will be provided to a subgroup of

contributors in years two and three for initial testing and to ensure protocols are streamlined. Other contributors will be invited to join once a subset of submissions has been tested.

One of the primary goals of the Stakeholder Workshop was to finalize the data-access and data-sharing protocols. Draft data-sharing agreements from the key photo-ID catalogs (MABDC, PIPIN, GOMDIS, NARWC) and Terms of Reference from OBIS-SEAMAP were presented at the workshop. VAQF is working with the core collaborators to develop a draft MAHWC data-sharing agreement. After the Stakeholder Workshop, specific considerations presented at the workshop were integrated into the data-access protocols and then circulated among the core group. These edits were integrated into the data-access protocols (See Appendix A).

In order to populate the online catalog, the curator at VAQF will request submissions from potential contributors. The curator will perform a complete quality-control review of submissions from contributors offline and then submit images and data in batches to the programmer for upload to the photo-ID app. Matching among contributors will occur on the OBIS-SEAMAP platform and queries will be run by the contributors, who will be able to export their data for offline storage and analyses. VAQF is working with the programmer to streamline the photo-ID app and make it as user friendly as possible, given that humpback whale photo-ID is more complicated than some other species because more than one body area is used for ID. When technical modifications are complete, testing and de-bugging of the database by the core group will occur, and VAQF will launch the MAHWC web-based catalog for beta testing with Virginia images. In the meantime, the template will be sent out to a subset of contributors. The contributors will test the submission process for efficiency, to troubleshoot any problems, and to evaluate instructions that need more clarity before posting the final submission package.

4. Future Work

Year 2: February 2018–July 2018

- Continue to systematically assign image quality and feature codes to remaining images from Virginia sightings (VAQF, HDR, whale watch) – VAQF (Malette)
- Integrate test images and data from Virginia sightings (VAQF, HDR, whale watch) into the photo-ID app – VAQF & Duke
- Make modifications to the catalog and workflow – VAQF & Urian
- Implement changes to the photo-ID app and workflow – VAQF, Duke, Urian
- Identify bugs through testing OBIS-based catalog - VAQF
- Get feedback from stakeholders on user interface of the photo-ID app – VAQF (Malette)
- Solicit contributions from other mid-Atlantic and southeastern groups and integrate images and data into catalog – VAQF & Whale & Dolphin Conservation (WDC)
- Validate fluke scoring codes for the OBIS-based catalog and submission of mid-Atlantic images to the NAHWC – VAQF & AW
- Validate dorsal fin scoring codes for the OBIS-based catalog and submission of mid-Atlantic images to the GOMHWC – VAQF & CCS

- Develop and test final workflow to submit annual sighting data/images from the OBIS-based catalog to the NAHWC and GOMHWC –VAQF, Duke, AW, CCS
- Conduct systematic matching among all mid-Atlantic and southeastern images and collate data agreed to in data sharing agreement – VAQF (Malette)
- Launch the beta version of the OBIS-based MAHWC for use by collaborators – VAQF, Urian, Duke
- Prepare and submit monthly and annual reports – VAQF (Malette)
- Outline manuscript and seek input/approval from co-authors – VAQF & collaborators

Year 3: August 2018 –July 2019

- Conduct a final bug fixing for the OBIS-based catalog.
- Develop website content for MAHWC as a central location for communication among contributors, including sharing information on the workshop, curating pertinent publications, providing relevant links to other websites such as the Navy Marine Species Monitoring website, highlighting current photo-ID techniques, and providing guides to exemplar images.
- Develop a training guide for coding images based on cross-training with AW and CCS for the curator training.
- Finalize curator protocols and plan curator training for future sustainability of the catalog.
- Prepare and submit manuscript(s) from the project.
- Work with northeastern and southeastern stranding networks to collate and integrate photo-id stranding data into the OBIS-based catalog.

5. Acknowledgements

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A

Final Data-Access Protocols



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The Mid-Atlantic and Southeast Humpback Whale Photo-identification Catalog

This protocol for data requests to the MAHWC is based on the Protocol for Data Access for the Mid-Atlantic Bottlenose Dolphin Catalog, 2009 and North Atlantic Right Whale Consortium Data, 2002.

Protocol for Data Access

Categories of data access

There are three categories of data access: the first is a request for data for research that will lead to a publication or presentation (“Data for Publication”). The second type is a request for data that will be used solely for management purposes (“Data for Management”), and the third category is for data requests specifically for education and outreach purposes (“Data for Education”); the second and third request types would not result in publication of data or analysis of data acquired from the MAHWC. Each type of request has a separate access protocol. Proposals for all three types of data access should be submitted to the MAHWC curator (Sarah Mallette; MAHWCdata@gmail.com), to circulate to the relevant contributors.

I. Data for Publication

Protocol for data access

To ensure that research being planned or currently conducted by contributors is not compromised or unnecessarily duplicated, and that proper authorship or acknowledgment of all data contributors occurs, any request for data must be submitted to the MAHWC in the form of a brief proposal (e-mail is preferred). The proposal need not be lengthy, but it should at a minimum contain the following:

- Name of the requesting institution(s) and of the Principal Investigator;
- Outline of the proposed work, including questions being addressed or hypotheses tested;
- Anticipated data requirements;
- Anticipated products of the work (e.g. scientific paper, student thesis, EA/EIS);
- Estimated time frame to completion of the study, not to exceed 2 years. A report summarizing the work will be due 6 months following the project end date. It is understood that peer-reviewed and thesis publications may require a longer time frame and so a progress report indicating the outcome of the study may be filed while awaiting publication).

Proposals for scientific analyses, publication and presentation will be reviewed by the individual contributors of the respective data and the curator within three weeks of submission. Their review will: ensure that duplication of effort is minimized; propose appropriate analyses; and identify potential co-authors. Recommendations for authorship will be sent to the applicant; in some cases, the reviewers may suggest that, instead of authorship, acknowledgement of the MAHWC and/or certain institutions/persons be included in any published document. Once authorship has been agreed upon by the applicant, contributors and

curator, the data will be released. The applicant will then be provided with the requested data, with the method (e-mail, CD, FTP, USB drive) determined by the size of the requested information file.

The curator and the reviewers will treat proposals as confidential and ideas or hypotheses that they may contain will not be shared with third parties. The only exception to this confidentiality may occur if the reviewers wish to obtain confidential peer review of the proposed work in order to judge its feasibility or merit; this would only be done with prior approval of the applicant.

The MAHWC encourages multi-investigator proposals where interests of several investigators may overlap. Conflicts over the use of the data will be mediated by MAHWC contributors and curator in as timely a fashion as possible.

Grounds for rejection of a proposal will include: a lack of qualification; lack of necessary resources; an assessment that the scope of the project is unreasonably large or not feasible within the proposed time frame; unwillingness of the applicant(s) to acknowledge or offer authorship to major data contributors; proposed methods that do not adequately address a meaningful question or hypothesis, or a determination that the proposed work is already underway by the original contributors or by someone else.

I. Data for Publication

a) Conditions for data access

Provision of any data will be subject to the conditions given below, to which the applicant must agree within his/her proposal. These conditions are designed to eliminate misunderstanding and to protect the applicant, the data contributors and their organizations, and the curator.

- For a reasonable period of time (generally that of the estimated time frame of the applicant's proposed study), the MAHWC will not provide similar data to others for the same or similar scientific purposes described in the applicant's proposal, without first obtaining the applicant's written permission.
- The applicant will use the requested materials only for those purposes set forth in his/her proposal. Requests for significant departures from the scope of the proposal must be submitted in writing to the curator who will disseminate the request to the relevant contributors for approval.
- The applicant will not share the requested materials with any third party without first obtaining written permission from the MAHWC contributors and curator.
- The applicant agrees to complete the work in the time frame given, although requests for reasonable extensions of this time frame will be considered.
- The applicant agrees to publish the results in a refereed journal or conference presentation in a timely manner. A draft of the manuscript must be submitted to the MAHWC contributors and curator prior to submission to the journal. It is encouraged to submit the manuscript to contributors earlier in manuscript development to ensure contributor data is interpreted accurately. Failure to supply a draft will preclude further data access.
- The applicant must cite the MAHWC, OBIS-SEAMAP and the relevant contributor(s) when presenting any data provided by the MAHWC.
 - The appropriate citations will be provided to you with the requested data.

I. Data for Management

a) Protocol for data access

The MAHWC recognizes that access to current data will allow managers to improve management decisions regarding humpback whales in the western North Atlantic. Requests for data that will be used solely for management decisions should be submitted to the curator who will then circulate it to the appropriate contributor(s). The requests should include:

- Name of the requesting institution(s) and of the Principal Investigator;
- Anticipated management application (e.g. Stock Assessment Update);
- Anticipated data requirements;
- Anticipated products of the work;
- Estimated time frame for completion

If no conflicts are evident, the applicant will be provided with the requested data, with the method (email, CD, FTP, USB drive) determined by the size of the requested information file.

Conditions for data access

- Applicants may use the data for other management related analyses on the condition that they inform the curator of additional projects. This process allows the MAHWC to establish links between the applicant and other managers and/or scientists interested in similar analyses. Also, by tracking the manner in which the data are used, the MAHWC can further illustrate the benefits of data sharing. Although persons other than the initial applicant may perform the additional analyses, it remains the responsibility of the initial applicant to inform the MAHWC of the additional work.
- If the analyses conducted for management needs result in publishable information, the applicant is required to submit an additional request for publication. If another individual has already applied for data to publish a similar analysis, the MAHWC will encourage a dialog among the parties, but publication rights will go to the applicant who first applied for data under the publication request process.
- Use of this data outside of public comments requires permission from original data contributors.
- It is understood that raw data will not be displayed in publicly available management reports.
- A report summarizing the work will be due 6 months following the project end date.
- The applicant must cite the MAHWC, OBIS-SEAMAP and the relevant contributor(s) when presenting any data provided by the MAHWC.
 - The appropriate citations will be provided to you with the requested data.

I. Data for Education

a) Protocol for data access

Many contributions to the MAHWC are from individuals and organizations involved in

education and outreach programs. Access to information included in the MAHWC will allow educators to update the public and students on the biology and management decisions regarding humpback whales of the western North Atlantic. These data would be used to enhance the education and experience of students and teachers, and the general public but will not be used for commercial gain. Requests for data that will be used solely for education and outreach purposes should be submitted to the curator who will then pass it to the appropriate contributor(s). The requests should include:

- Name of the requesting institution(s) and of the Principal Investigator;
- Anticipated education or outreach program (e.g. public presentations, displays);
- Anticipated data requirements;
- Anticipated products of the work;
- Estimated time frame for completion, when appropriate

If no conflicts are evident, the applicant will be provided with the requested data, with the method (email, CD, FTP, USB drive) determined by the size of the requested information file.

Conditions for data access

- Applicants may use the data for other education programs on the condition that they inform the curator of additional projects. As stated above, by tracking the manner in which the data are used, the MAHWC can further illustrate the benefits of data sharing.
- If any analyses conducted for education or outreach purposes result in publishable information, the applicant is required to submit an additional request for publication. If another individual has already applied for data to publish a similar analysis, the MAHWC will encourage a dialog among the parties, but publication rights will go to the applicant who first applied for data under the publication request process.
- A report summarizing the work will be due 6 months following the project end date, when applicable, or annually for ongoing education projects.
- Potential use of MAHWC data on any social media outlet must be clearly defined and outlined in the proposal. Any use of these data not outlined in the proposal will preclude access to any future data. If contributors and curator agree and access is granted each social media post containing MAHWC data or images must include explicit information on the proper reporting channels for sightings (e.g. to the MAHWC, NAHWC and GOM catalog curators).

The Mid-Atlantic and Southeast Humpback Whale Photo-identification Catalog

This protocol for data requests to the MAHWC is based on the Protocol for Data Access for the Mid-Atlantic Bottlenose Dolphin Catalog, 2009 and North Atlantic Right Whale Consortium Data, 2002.

If you have any questions, please contact the curator at MAHWCdata@gmail.com. Proposals will be distributed to the appropriate contributor(s) and the curator of the data for review, as applicable.

All proposals must include the following agreement:

Protocol for Data Access

Agreement:

I have read and understand all of the conditions for data access and use listed in the "Mid-Atlantic and Southeast Humpback Whale Catalog Conditions for Data Access" and agree to be bound by them.

Printed Name: _____

Organization: _____

Signed Name: _____

Date: _____

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