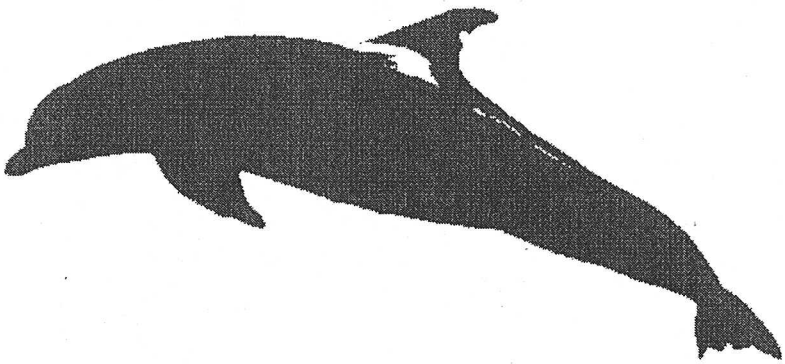
NOAA ADMINISTRATIVE REPORT NMFS-SEFSC-425

STATUS OF THE PHOTO-IDENTIFICATION CATALOG OF COASTAL BOTTLENOSE DOLPHINS OF THE WESTERN NORTH ATLANTIC: REPORT OF A WORKSHOP OF CATALOG CONTRIBUTORS

Kim W. Urian
Aleta A. Hohn
Larry J. Hansen



June 1999

U. S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southeast Fisheries Science Center
NOAA Beaufort Laboratory
101 Pivers Island Road
Beaufort, NC 28516-9722

NOAA ADMINISTRATIVE REPORT NMFS-SEFSC-425

STATUS OF THE PHOTO-IDENTIFICATION CATALOG OF COASTAL BOTTLENOSE DOLPHINS OF THE WESTERN NORTH ATLANTIC: REPORT OF A WORKSHOP OF CATALOG CONTRIBUTORS

Kim W. Urian
Aleta A. Hohn

NMFS/Southeast Fisheries Science Center
NOAA Beaufort Laboratory
101 Pivers Island Road
Beaufort, NC 28516-9722

Larry J. Hansen

NMFS/Southeast Fisheries Science Center
c/o National Ocean Service
219 Fort Johnson Road
Charleston, SC 29412

U. S. DEPARTMENT OF COMMERCE
William M. Daley, Secretary
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
D. James Baker, Administrator
NATIONAL MARINE FISHERIES SERVICE
Penelope D. Dalton, Assistant Administrator for Fisheries

June 1999

NOTICE

The National Marine Fisheries Service (NMFS) does not approve, recommend or endorse any proprietary product or material mentioned in this publication. No reference shall be made to NMFS, or to this publication furnished by NMFS, in any advertising or sales promotion which would indicate or imply that NMFS approves, recommends or endorses any proprietary product or proprietary material herein or which has as its purpose any intent to cause directly or indirectly the advertised product to be used or purchased because of NMFS publication.

Correct citation of this report is:

Urian, K.W., A.A. Hohn, and L J. Hansen. 1999. Status of the Photo-identification Catalog of Coastal Bottlenose Dolphins of the Western North Atlantic: Report of a Workshop of Catalog Contributors. NOAA Administrative Report NMFS-SEFSC-425, 22 p.

Copies of this report can be obtained from:

National Marine Fisheries Service
Beaufort Laboratory
101 Pivers Island Road
Beaufort, NC 28516-9722

or

National Technical Information Service
5258 Port Royal Road
Springfield, VA 22161
(703) 487-4650, Fax (703) 321-8547
Rush orders: (800) 336-4700

ABSTRACT

In 1997 the U.S. National Marine Fisheries Service (NMFS) established the Mid-Atlantic Bottlenose Dolphin Photo-ID Catalog (MABDC). This catalog is part of a NMFS program to define stock structure of coastal bottlenose dolphins of the western North Atlantic; the current stock assessment assumes that coastal bottlenose dolphins from New York to central Florida form a single stock. The MABDC is a cooperative program, comprised of images and data contributed by researchers conducting photo-ID studies along the mid-Atlantic States. The NMFS convened a workshop in Virginia Beach, VA to update the contributors on the status of the MABDC, and to discuss future goals and applications of the Catalog. Selection of images from New Jersey (Cape May), Virginia (Virginia Beach and Wallops Island), North Carolina (Nags Head, Cape Hatteras, Beaufort and Wilmington), South Carolina (Charleston and Hilton Head) and Florida (Jacksonville, FL) was completed in December 1998. Images of 3,843 individual dolphins were evaluated at these sites; 1,933 were selected and digitized in the MABDC with associated field data. Systematic matching efforts by the catalog curator are underway; potential matches will be circulated to contributors for verification. Contributors working independently of the MABDC have made a number of matches, and these researchers have provided their results to the MABDC curator. Workshop participants agreed to the following recommendations: additional sites should be included in the MABDC to complete coverage of the putative range of the coastal migratory stock(s) of bottlenose dolphins; images will be submitted from existing catalogs to update the MABDC through 1997; a hard copy of the MABDC will be published and available in 2000. Contributors agreed to provide sighting histories of matched animals and to collaborate on a synthesis paper to be published in the primary literature that describes matches resulting from the MABDC in the context of stock discrimination.

TABLE OF CONTENTS

INTRODUCTION

The National Marine Fisheries Service, Southeast Fisheries Science Center (SEFSC) has established a central photo-identification catalog of bottlenose dolphins, *Tursiops truncatus*, along the Atlantic coast of the United States. The development of the catalog is part of a SEFSC strategy to use multiple methods (including genetics, stable isotope ratios, morphometrics and telemetry) to elucidate stock structure of mid-Atlantic bottlenose dolphins (Hohn 1997). The catalog is based on methods developed by researchers who have managed photo-ID catalogs for decades, specifically the manatee (Beck and Reid, 1995), right whale (Crone and Kraus, 1990), bottlenose dolphin (Urian and Wells, 1996), and humpback whale catalogs (Mizroch et al. 1990, Friday, et al. 1997).

Stock structure is a critical issue for the assessment of mid-Atlantic bottlenose dolphins. The 1994 Amendments to the Marine Mammal Protection Act (MMPA) required the preparation of stock assessments for all marine mammals in U.S. waters. The current assessment assumes the existence of a single migratory stock of coastal bottlenose dolphins in the western Atlantic that ranges from New York to central Florida (Waring et al. 1999). This assumption is predicated on the unusual mortality event that occurred in 1987-1988, in which dolphins stranded along the entire U.S. east coast in a pattern interpreted as consistent with the existence of a single, migratory stock (Scott et al. 1988) as suggested by aerial survey data from nearly 20 years ago (CETAP, 1982). As a result of the die-off, the coastal migratory stock of bottlenose dolphins was listed as depleted under the MMPA in 1993 (59 CFR 17789).

The assumption of a single stock of bottlenose dolphins from New York to Florida has important implications for the assessment of human activities on these dolphins. If these dolphins constitute a single stock as currently defined, then impacts of mortality must be considered for all portions of its range. However, patterns emerging from photo-ID studies (summarized in Hohn 1997) suggest that more than one stock exists in this region. The stock complex may, in fact, contain both resident and migratory dolphins. The existence of multiple stocks of bottlenose dolphins in the Mid-Atlantic may complicate management and conservation efforts, but it is necessary to focus these efforts on the appropriate biological units.

In March 1996, the SEFSC and Chicago Zoological Society organized a workshop that brought together researchers conducting photo-ID studies along the Mid-Atlantic coast. The primary goal of the workshop was, "To reach a consensus across independent research efforts on the best means to reliably, accurately, and expeditiously identify bottlenose dolphins from one Atlantic coast research site to the next" (Urian and Wells 1996). The workshop participants supported the development of a central photo-ID catalog and database as the most efficient way to achieve this goal.

Work on the development of the NMFS Mid-Atlantic Bottlenose Dolphin Photo-Identification Catalog (MABDC) began in July 1997. Researchers at field sites from New Jersey to northern Florida were contacted and asked to collaborate with the MABDC. The MABDC will benefit researchers interested in understanding the movement patterns of dolphins in their study area. It will also address the broader questions of stock structure required for effective management and conservation, by linking all components of the NMFS program to identify stocks of bottlenose dolphins along the western North Atlantic coast of the United States. For example, knowledge of the ranging patterns of individual dolphins will facilitate interpretation of genetic analyses of skin samples obtained from biopsies.

As the MABDC has now reached its operational phase, SEFSC organized a workshop in Virginia Beach, VA, in March 1999 to provide an update on the progress of the MABDC and discuss future goals and applications of the MABDC, in the context of the mid-Atlantic bottlenose dolphin stock-identification program. This report summarizes the discussions and recommendations arising from the workshop.

CURRENT STATUS OF THE MID-ATLANTIC BOTTLENOSE DOLPHIN PHOTO-IDENTIFICATION CATALOG

Size and Geographic Extent of the MABDC

Development of the MABDC began in July 1997. As of December 1998, 11 field sites have been included (multiple efforts exist at some sites): New Jersey (Cape May), Virginia (Virginia Beach and Wallops Island), North Carolina (Nags Head, Cape Hatteras, Beaufort and Wilmington), South Carolina (Charleston and Hilton Head) and Florida (Jacksonville) (Figure 1). These field sites are distributed along the entire range of the currently defined coastal migratory stock of bottlenose dolphins. Five of the field sites included in the MABDC are supported in whole or in part by the SEFSC: Virginia Beach, VA, Beaufort, NC (North Carolina Maritime Museum), Wilmington, NC, Charleston, SC, and Jacksonville, FL.

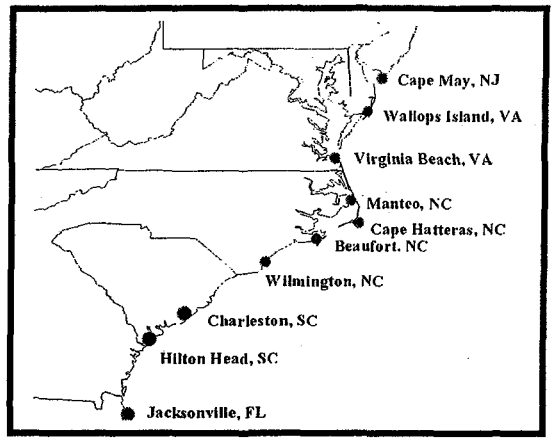


Figure 1. Field sites included in the MABDC to date.

Individual photo-ID catalogs from these sites ranged in size from 112-1,805 individuals. Images of 3,843 dolphins were evaluated from these 11 sites; 2220 images of 1933 individual dolphins were selected, digitized and included in the MABDC (Table 1). Multiple images of some dolphins were included; for example, right and left side images were selected for a number of individuals, and some represent fins that have changed over time. The size of the MABDC has grown from 461 individual dolphins in May 1998 to 1,933 dolphins in May 1999. However, this is likely to be an overestimate of the actual number of individuals because some dolphins may have been included from more than one field site, but have not yet been matched. The size of the MABDC will be refined once systematic matching efforts are complete and all images cross-matched both between and within areas.

Table 1. Current status of the MABDC. The asterisks indicate sites where images were submitted to the MABDC, and thus the catalog was not evaluated by the MABDC curator.

Field Site	Dolphins selected	Catalog size	Period	Contributor	Abbrev.
Cape May, NJ	54	*	1991-96	R. Mallon-Day	NJ-RMD
Wallops Island, VA	21	*	1997-	D. Schofield/W. Ryan	VA-DS
Virginia Beach, VA	256	492	1989-	S. Barco	VA-SB
Manteo, NC	61	94	1997-	R. Mallon-Day	NC-RMD
Cape Hatteras, NC	10	*	1979-80	G. Oliver	NC-GO
Beaufort & Ocracoke, NC	545	1805	1985-	K. Rittmaster	NC-KR
Wilmington &	342	396	1991-	L. Sayigh/G. Rountree	NC-LS
Beaufort, NC			1995-	A. Read	NC-AR
Charleston, SC	93	112	1994-	E. Zolman	SC-EZ
Hilton Head, SC	161	310	1994-98	C. Gubbins	SC-CG
Hilton Head, SC	13	*	1993	T. Murphy	SC-TM
Jacksonville, FL	377	634	1994-97	M. Caldwell	FL-MJC
Total	**1933**	**3843**			

Selection of images for the MABDC

Standard protocols for selection of images and a dorsal fin classification system were developed by the curator (Appendices 3 and 4). To correctly identify an individual dolphin and ensure a high probability of being matched, the quality of the image and distinctiveness of the fin must meet minimum standards. The selection of images was based on measurements of photographic quality and dorsal fin distinctiveness (Appendix 5) using a protocol similar to that developed by researchers working with the North Atlantic Humpback Whale Catalog (Friday et al. 1997).

Measurements of photographic quality and dorsal fin distinctiveness are referred to as Image Quality scores and Overall Distinctiveness scores, respectively. The Image Quality score is based on the quality of the image independent of the distinctiveness of the dorsal fin. For example, an excellent image may show a non-distinctive animal or, conversely, a distinctive dorsal fin may be visible in a poor quality image. The Image Quality score is determined by an evaluation of the following characteristics of the image: clarity, contrast, angle of the fin to the photographer, and visibility of the fin in the frame. The Overall Distinctiveness score is based on the amount of information contained on the fin or body.

We are currently conducting a study to assess the ability of judges to grade image quality and dorsal fin distinctiveness. The experimental design involves a 3x3 analysis, with three judges grading a random selection of 100 catalog images three times to examine both inter- and intra-individual variation among different judges. The results of this study will help us to further refine the scoring system to ensure that it is as objective as possible.

At most field sites, the contributor's entire catalog was evaluated for selection of images for the MABDC. At a few other sites, the contributors submitted images to the MABDC, so that all catalog images were not examined. As noted above, not all images from each contributor's catalog was included in the MABDC. On average, about half of the images from each catalog evaluated were included in the MABDC (Table 2). Images selected for the MABDC are included as the type specimen of each dolphin; the images are scanned and archived digitally, and incorporated into a relational database with associated field data. The digital images of dorsal fins are organized in separate catalogs for each field site.

Table 2. The proportion of individuals selected from photo-ID catalogs that were systematically evaluated by the MABDC curator.

Field Site	Catalog size	No. of Dolphins	Proportion
Virginia Beach, VA	492	256	0.52
Manteo, NC	94	61	0.65
Beaufort, NC	1805	545	0.30
Wilmington & Beaufort, NC	396	342	0.86
Charleston, SC	112	93	0.83
Hilton Head, SC	310	161	0.52
Jacksonville, FL	634	377	0.59
TOTAL	**3843**	**1835**	**0.48**

Methods for Systematic Matching

Systematic matching efforts by the MABDC curator are currently underway. Each dolphin is compared to every other dolphin in all the digital catalogs. The accession number assigned to each individual dolphin is based on a dorsal fin feature code that indicates the location of the most prominent feature of the fin (Appendix 4). The dorsal fin categories are designed to facilitate searching for potential matches within the MABDC, e.g., it would not be necessary to search for a fin categorized as a 'mutilation' in the 'trailing edge' category. However, the current categories are general, and a more specific coding scheme based on the Manatee Individual Photo-Identification System, MIPS (Beck and Reid, 1995) has been developed (Appendix 6). This coding system will be implemented in 1999 to reduce time spent searching for potential matches within the MABDC.

Two research groups are developing computer-automated matching systems for bottlenose dolphins: Texas A&M University and the University of Texas Medical Branch (Galveston and College Station, TX) and Eckerd College (St. Petersburg, FL). These systems hold great promise to minimize time spent searching for matches by identifying a set of potential matches. Both systems are in the developmental stages, but the digital images of MABDC may provide an opportunity to test the effectiveness of each system for future use.

Comparisons Made to Date

As recommended by collaborators in the Bottlenose Dolphin Stock Identification Program (Hohn 1997), catalogs from field sites located at the presumed northern (Cape May, NJ) and southern (Jacksonville, FL) limits of the range of the coastal migratory stock were compared first, with subsequent comparisons progressing toward sites in closer proximity (Table 3; Figures 2 and 3). Once all catalogs have been compared, 1,536,459 comparisons will have been made to identify potential matches (Table 4).

Table 3. This matrix is organized by sites from north to south, with the state abbreviation and contributors' initials (see Table 1), and shows the catalogs that have been systematically compared to date.

	NJ-RMD	VA-DS	VA-SB	NC-RMD	NC-GO	NC-KR	NC-LS	SC-EZ	SC-TM	SC-CG	FL-MJC
NJ-RMD		✓	✓	✓	✓	✓					✓
VA-DS			✓	✓	✓	✓	✓		✓		
VA-SB											
NC-RMD									✓		✓
NC-GO									✓		✓
NC-KR											
NC-LS											✓
SC-EZ									✓	✓	✓
SC-TM										✓	✓
SC-CG											✓
FL-MJC											

Table 4. Matrix of catalog comparisons. Fifty-five comparisons of different catalogs ranging in size from 10-545 individual dolphins will be required based on catalog sizes in the MABDC to date. For example, to systematically compare the two largest catalogs, NC-KR with FL-MJC, 205,465 comparisons will be required.

	NJ-RMD *54*	VA-DS *21*	VA-SB *256*	NC-RMD *61*	NC-GO *10*	NC-KR *545*	NC-LS *342*	SC-EZ *93*	SC-TM *13*	SC-CG *161*	FL-MJC *377*	*TOTAL 1933*
NJ-RMD *54*		1,134	13,824	3,294	540	29,430	18,468	5,022	702	8,694	20,358	101,466
VA-DS *21*			5,376	1,281	210	11,445	7,182	1,953	273	3,381	7,917	39,018
VA-SB *256*				15,616	2,560	139,520	87,552	23,808	3,328	41,216	96,512	410,112
NC-RMD *61*					610	33,245	20,862	5,673	793	9,821	22,997	94,001
NC-GO *10*						5,450	3,420	930	130	1,610	3,770	15,310
NC-KR *545*							186,390	50,685	7,085	87,745	205,465	537,370
NC-LS *342*								31,806	4,446	55,062	128,934	220,248
SC-EZ *93*									1,209	14,973	35,061	51,243
SC-TM *13*										2,093	4,901	6,994
SC-CG *161*											60,697	60,697
FL-MJC *377*												**1,536,459**

Table 5. The number of matches made between field sites to date. 'TBD' indicates those matches that need 'to be determined'; these are cases where systematic comparisons have been made and potential matches identified that will be circulated to the contributors for verification. The 0's represent complete comparisons between catalogs where there were no matches found. The italicized numbers indicate matches made by contributors and provided to the MABDC; the pluses indicate additional matches made by the curator during the image selection process, that need to be verified by the contributors.

	Cape May	Wallops Is.	Va. Beach	Manteo	Hatteras	Beaufort	Wilmington	Charleston	Hilton Head	Jacksonville
Cape May		0	*4* / TBD	0	0	0				0
Wallops Is.			TBD	0	0	TBD	0			
Va. Beach				*2+*		*36+*				
Manteo						*24+*				0
Hatteras										0
Beaufort							*44+*			
Wilmington										0
Charleston									0	0
Hilton Head										2
Jacksonville										

Potential matches made by the curator are circulated to the contributors for verification (Appendix 8). When a potential match is verified, a match number is assigned to the individual dolphin in the database and the match number becomes the dolphin's new accession number in the MABDC.

Contributors have also made matches between their field sites. The matching efforts of the Virginia Marine Science Museum, the North Carolina Maritime Museum, and the Nags Head Dolphin Watch have been very active, and they continue to compare their catalogs independently, and provide their results to the MABDC. Although these comparisons are not conducted systematically, this information has already provided considerable insight into the movements of some bottlenose dolphins in the western North Atlantic. Matches made by contributors and provided to the MABDC are identified in the database as 'contributor matches' (Table 5).

Temporal, in addition to spatial matches, can also be identified; temporal matches are those made between catalogs from the same area from different time periods. For example, Tom Murphy (South Carolina Department of Natural Resources) contributed images from Hilton Head taken in 1993, and nearly all of these individuals were matched to dolphins that Cara Gubbins (Hilton Head Dolphin Study) identified in Hilton Head during her study that began in 1994.

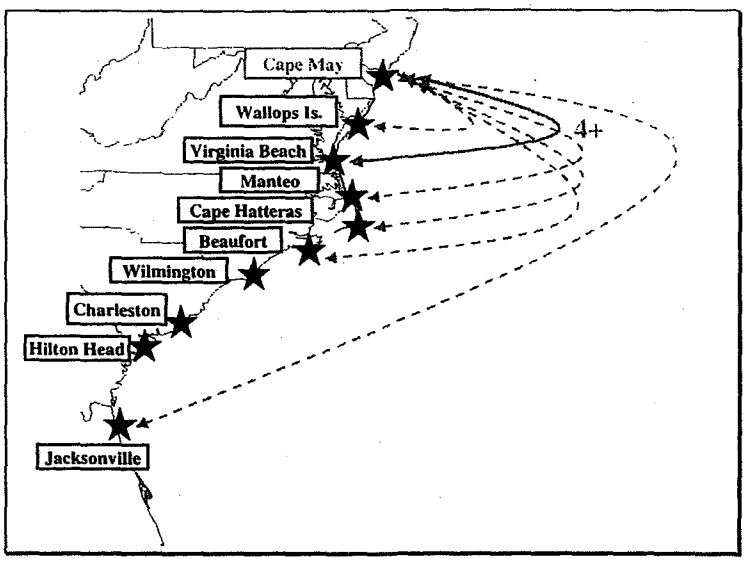


Figure 2. Comparisons made between Cape May, NJ, and Wallops Island and Virginia Beach, VA, Cape Hatteras, Manteo, and Beaufort, NC, and Jacksonville, FL. The dashed lines indicate comparisons for which there were no matches found; the solid line indicates contributor matches. The plus indicates that additional potential matches have been identified by the curator which need to be verified by the contributors. The images from Cape May have not yet been compared to Wilmington, NC, and Charleston and Hilton Head, SC. There are at least 4 matches between Cape May and Virginia Beach, but no matches between Cape May and these other sites.

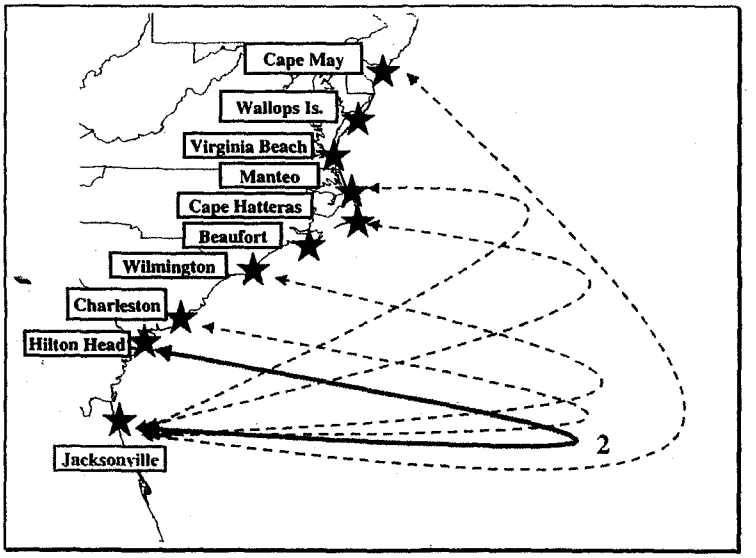


Figure 3. Comparisons made between Jacksonville, FL, and Hilton Head and Charleston, SC, Wilmington, Cape Hatteras and Manteo, NC, and Cape May, NJ. Images from Jacksonville, FL have not yet been compared to Beaufort, NC, and Virginia Beach and Wallops Island, VA. Two matches have been verified between Jacksonville, FL, and Hilton Head, SC, by the contributors and the curator, but no other matches were found between Jacksonville, FL, and the other sites compared to date.

The MABDC curator identified two matches between Jacksonville, FL and Hilton Head, SC, which have been verified by the contributors. Similarly, matches made by some contributors and preliminary matching efforts by the curator have already identified two dolphins at 4 different field sites: MABDC #026 and #033 were sighted in Virginia Beach, VA, Manteo, NC, Neuse River, NC, and Beaufort, NC. To date, 138 individual dolphins have been identified at more than one site.

The MABDC allows for a systematic comparison among sites, not just those for which matches are likely to be made, but also those where no matches are found. Although matches between sites are most striking, a lack of matches is just as important; comparisons between sites need to account for catalog size and survey effort, which will be done when matching and verifications are complete. A lack of matches between sites indicates no known movement between these areas, which will allow definition of appropriate stock boundaries. This underscores the need for a cooperative system and systematic comparisons between sites, because it will be imperative to identify individuals at multiple sites. The patterns emerging however, suggest a complex stock structure that will require innovative approaches to management and conservation.

FUTURE PRIORITIES FOR THE MABDC

Contributors to the MABDC met in Virginia Beach, VA in March 1999 to discuss the status of the catalog and identify priorities for future work with the MABDC. This section of the report summarizes these discussions and the prioritized recommendations for continued development and implementation of the MABDC. Details of these recommendations are listed in order of priority in Appendix 7.

1. Update MABDC through 1997 for existing sites

Some contributor catalogs have been evaluated through 1997 (NC-LS, NC-KR FL-MJC) while others need to be updated. Workshop participants **agreed** that all sites be updated through 1997. This will require further evaluation of the following catalogs: VA-DS, VA-SB, NC-RMD, SC-EZ, and SC-CG. In particular, workshop participants suggested that efforts be directed first to sites where biopsy sampling has been conducted, such as Charleston, SC, Jacksonville, FL, and Virginia Beach, VA. It is particularly important to obtain images of individuals from which biopsy samples are available. For example, more than 100 biopsy samples have been obtained from Charleston, SC, but images of these dolphins have not yet been submitted to the MABDC. Analysis of multiple samples from individual animals is a high priority for the Bottlenose Dolphin Stock Identification Program (Hohn 1997).

2. Add additional sites to the MABDC

Workshop participants **recommended** that additional sites be included in the MABDC. These additional sites should be located in areas where there are gaps in the geographical distribution of photo-identification effort (Figure 4). Several additional sites were identified, although these may change as systematic matching attempts are completed. These include existing catalogs, such as Coastal Carolina University (Conway, SC), Florida Institute of Technology (Melbourne, FL), University of Central Florida (Indian River Lagoon), the Dolphin Project (Savannah, GA), and the Cape May Dolphin Survey (Cape May, NJ). It was agreed that the MABDC should include images from as far south as the Indian River, FL, as this is the southern boundary of the coastal migratory stock as it is currently defined.

Workshop participants also **recommended** that additional photo-identification survey effort be directed to areas where no effort currently exists. It is particularly important to obtain images of dolphins in the northern portion of their summer range and northern limit of their winter range. Such areas include: the coasts of New Jersey, New York, and Delaware in summer and the Outer Banks of North Carolina in winter, since dolphins are known to be migratory in these areas. Effort should also be directed in coastal waters at sites where previous work has been focused in estuaries.

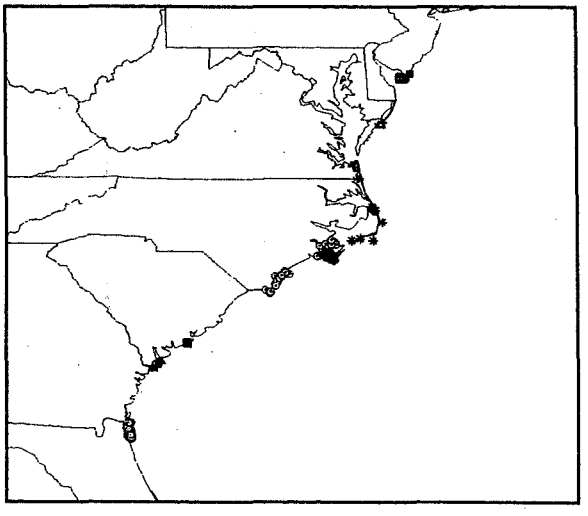


Figure 4. Sighting locations of dolphins included in the MABDC. Each symbol represents a different contributor.

3. Verification of matches between field sites

There was considerable discussion on procedures for verifying potential matches. The workshop participants agreed on a standard form that would be circulated to the contributors for their verification of potential matches (Appendix 8). The form will include the MABDC image from each site, the MABDC accession number for each fin, the contributor's ID Code, and the date each image was taken. A series of options will be presented for the contributor to select upon evaluation of the potential match: Agree/Disagree/Needs to be Verified with Original Image/CBD. 'CBD' indicates that after review of all available images, the potential match 'Cannot Be Determined'. The form will also include a section for the contributors to note whether multiple images of the dolphin are available in their archives, and a section for any relevant comments. The curator will send two copies of the form to each contributor; the contributor will evaluate the potential match, complete the form, return one copy to the curator, and retain the second copy for their files.

It was **recommended** that the desired turn-around time be two weeks for the contributors to evaluate potential matches and return the form to the curator, recognizing that this may not always be possible (Figure 5). As catalog comparisons between sites are completed, the curator will circulate potential matches incrementally to the contributors. To confirm a match between two sites, there must be consensus between the contributors from each site and the curator. Proxy can be used if a contributor is no longer active. Verification of potential (problematic) matches could be conducted at the annual Atlantic Coastal Dolphin Conference.

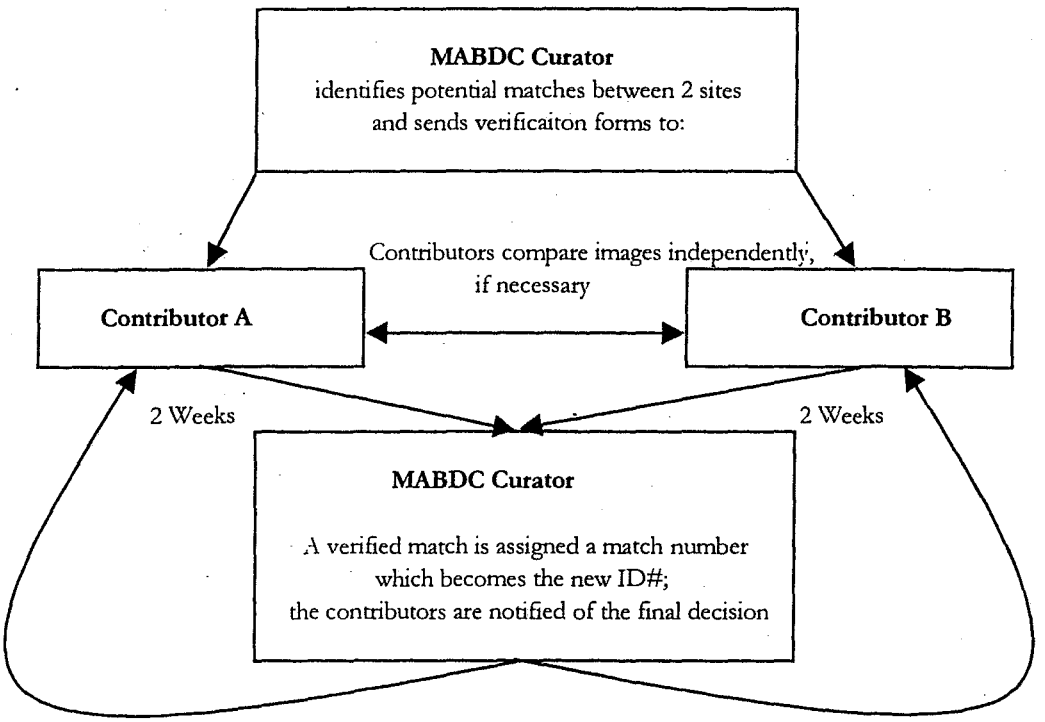


Figure 5. Schematic of procedures for verification of matches for the MABDC.

4. Contribution of sighting histories for matched dolphins

The workshop participants **agreed** to contribute sighting histories of dolphins matched between different sites. The contributors will provide the sighting dates (month/day/year) and sighting locations (latitude and longitude) immediately following notification of a confirmed match by the MABDC curator. This information is critical to understand the spatial and temporal movements of individual dolphins. The MABDC curator will verify sighting histories of individuals from each catalog, as is logistically feasible. Consensus between the MABDC curator and the contributor for each image for a sighting record will be required; if the contributor and the curator do not agree, then the sighting on that date is not included in the MABDC. It was agreed that final resolution of potential matches should be completed by spring 2000.

5. Abstract submission to the Conference on the Biology of Marine Mammals, Maui, HI, November 1999

Workshop participants **agreed** that a multi-authored abstract will be submitted for presentation at the Biennial Conference on the Biology of Marine Mammals in Hawaii. The abstract will include: the number of sites included in the MABDC, time frame of each study, the number of images evaluated and selected from each site, comparisons made between sites to date, the number of matches and lack of matches between sites, and applications of the MABDC to examine stock structure for coastal bottlenose dolphins along the Mid-Atlantic States.

6. Publication of MABDC matches

Workshop participants **agreed** to publish a synthesis of the results of the MABDC efforts. A workshop will be convened early in 2000 to discuss the matches made between sites in the context of the Stock Identification Program. At that time contributors to the MABDC will agree on the structure and general conclusions of this paper. It was emphasized that contributors should be active participants in the development of this paper.

7. Access to the MABDC

All contributors to the MABDC sign a consent form that ensures that any information submitted to the MABDC cannot be used without their approval (Appendix 9); data will not be used for any purpose without the explicit agreement of the contributor. The match database (including sighting histories) will not be available except for the synthesis paper. The option of 'blanket' authorization for the MABDC to use data and images for certain uses was discussed, and workshop participants **agreed** that contributors could waive the need for their consent if they choose.

8. Production of a hard copy of the MABDC as a NOAA Technical Memorandum

There was consensus among the workshop participants that production of a hard copy of the MABDC would be a useful tool for the contributors, stranding networks, and researchers initiating new photo-identification studies along the Mid-Atlantic coast. It was **agreed** that a version of the MABDC should be published as a NOAA Technical Memorandum that will include: the best quality image for each individual dolphin, photo credit, the MABDC accession number, the state in which it was photographed, and a list of the MABDC contributors. A separate list of the verified matches will be provided to the MABDC contributors.

ACKNOWLEDGMENTS

We would like to thank Susan Barco, Mark Swingle and the Virginia Marine Science Museum for hosting the meeting and making the arrangements in Virginia Beach. Jeanie Fulford and Susan Griffin from the NMFS-Beaufort Lab were responsible for the travel and logistic arrangements for the workshop participants. Many thanks to Gail Cannon for serving as rapporteur for the meeting, and to Andy Read for editorial assistance. We are particularly grateful to the contributors for their support of the MABDC and for their suggestions, insights, and enthusiasm during the workshop and throughout the development of the MABDC. We would also like to acknowledge the efforts of all those that work with the contributors on these photo-ID projects. The NMFS-SEFSC sponsored this meeting.

LITERATURE CITED

Beck, C.A. and Reid, J.R. 1995. An automated photo-identification catalog for studies of the life history of the Florida manatee. Pages 120-134 *in* T.J. O'Shea, B.B. Ackerman, and H.F. Percival, (eds.). Population biology of the Florida manatee. U.S. Department of the Interior, National Biological Service, Information and Technology Report 1. 289pp.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and North Atlantic areas of the U.S. outer continental shelf. Final report of the Cetacean and Turtle Assessment Program. U.S. Dep. Inter., Washington, D.C. Bur. Land Management Contr. AA 551-CT8-48, 450pp.

Crone, M.J. and S.D. Kraus, (eds.). 1990. Right whales (*Eubalaena glacialis*), in the western North Atlantic: a catalog of identified individuals. Published for the North Atlantic Right Whale Consortium. 223pp.

Friday, N., T. Smith, P. Stevick, and J. Allen. 1997. Measurement of photographic quality and whale distinctiveness for the photographic identification of humpback whales. Presented at the International Whaling Committee Scientific Committee Meeting, Bournemouth, England, September, 1997. 23pp.

Hohn, A.A. 1997. Design for a multiple-method approach to determine stock structure of bottlenose dolphins in the mid-Atlantic. NOAA Tech. Mem. NMFS-SEFSC-401. 22pp.

Mizroch, S.A., J.A. Beard, and M. Lynde. 1990. Computer-assisted photo-identification of humpback whales. Report of the International Whaling Commission, Special Issue 12:63-70.

Scott, G.P., D.M. Burn, and L.J. Hansen. 1988. The dolphin die-off: long-term effects and recovery of the population. Proceedings of the Oceans '88 Conference: 819-823.

Urian, K.W. and R. S. Wells. 1996. Bottlenose dolphin photo-identification workshop. NOAA Tech. Mem. NMFS-SEFSC-393. 92pp.

Waring, G.T., D.L. Palka, P.J. Clapham, S. Swartz, M.C. Rossman, T.V.N. Cole, K.D. Bisack, and L.J. Hansen. 1999. U.S. Atlantic Marine Mammal Stock Assessments-1998. NOAA Tech. Mem. NMFS-NE-116. 182pp.

APPENDICES

Meeting of the Contributors to the Mid-Atlantic Bottlenose Dolphin Photo-identification Catalog

Friday, 19 March, 1999

10:00-12:00 Welcome and introductions (Aleta Hohn, Larry Hansen)

Goals and objectives of this meeting (Aleta Hohn, Larry Hansen)
1. Objectives
2. Desired products of the meeting

Background of the NMFS Bottlenose Dolphin Stock Identification Program and the MABDC
1. Stock Identification Program (Aleta Hohn)
2. Genesis of the MABDC, (Charleston Workshop, 1996) (Kim Urian)

Status of the MABDC (Kim Urian)
1. Sites included to date
2. Measurement of photographic quality and fin distinctiveness
3. Summary of the Catalog
4. Methods for systematic matching
5. Implementation of coding scheme to facilitate matching

Future goals of the MABDC (Aleta Hohn, Kim Urian)
1. Identify additional sites to be included in the MABDC
2. Update sites already included in the catalog to have the Catalog current through 1997
3. Production of a hard copy of the MABDC as a NOAA Tech. Memo

12:00-13:00 Lunch

13:00-15:00 Future goals of the MABDC – continued
4. Procedures for verification of matches between field sites (Kim Urian)
5. Verified matches in the context of the Bottlenose Dolphin Stock Identification Program (Aleta Hohn, Kim Urian)
6. Access to the MABDC (Kim Urian)

15:00-15:15 Coffee break

15:15-17:00 Future goals of the MABDC – continued
7. Abstract submission to the Meeting of the Society for Marine Mammalogy in Hawaii, November 1999
8. Publications

Discussion: comments, suggestions, future plans

17:00 Adjourn

Appendix 2. MEETING PARTICIPANTS

Name	Address	E-mail Address
Susan Baker	Chesapeake Bay Dolphin Project 11601 Bootljack Ct. North Potomac, MD 20878 301-435-0649 (O) 301-251-6680 (H)	sxb@cu.nih.gov
Sue Barco	Virginia Marine Science Museum 717 General Booth Blvd. Virginia Beach, VA 23451 757-437-6159 (O) 757-422-1471 (H)	ocrab@erols.com
Nan Bowles	North Carolina Maritime Museum 315 Front Street Beaufort, NC 28516-2125 252-504-2452 (O)	
Gail Cannon	Duke University Marine Lab 135 Duke Marine Lab Road Beaufort, NC 28516 252-504-7605 (O)	gcannon@duke.edu
Cara Gubbins	Hilton Head Dolphin Study 2015 Dockside Drive Valrico, FL 33594 813-643-2411	caragubbins@hotmail.com
Larry Hansen	NMFS-SEFSC c/o NOAA/NOS 219 Fort Johnson Rd Charleston, SC 29412 803-762-8541	Larry.Hansen@noaa.gov
Aleta Hohn	NMFS-SEFSC Beaufort Lab 101 Pivers Island Road Beaufort, NC 28516 252-728-8797	Aleta.Hohn@noaa.gov
Guen Jones	Biological Sciences UNCW 601 S. College Road Wilmington, NC 28403-3297 910-962-3473	jonesg@uncwil.edu
Tina Khidadad	Florida Institute of Technology Department of Biological Sciences 150 W. University Blvd Melbourne, FL 32901	cmkhodadad@aol.com

Appendix 2. MEETING PARTICIPANTS

Name	Address	E-mail Address
Rich Mallon-Day	Nags Head Dolpin Watch 40 Orchard Lane Berwyn, PA 19312 610-695-9309	r.mallon1@genie.com http://dolphin-watch.com
Kristen Mazzarella	Nags Head Dolphin Watch P.O. Box 8 Manteo, NC 27954 252-449-4085	ktmazz@juno.com
Andy Read	Duke University Marine Lab 135 Duke Marine Lab Road Beaufort, NC 28516 252-504-7590 (O)	aread@duke.edu
Keith Rittmaster	North Carolina Maritime Museum 315 Front Street Beaufort, NC 28516-2125 252-504-2452; 728-7317	kritt@coastalnet.com
George Rountree	The Dolphin Project Christoper Newport University Biology Department 50 Shoe Lane Newport News, VA 23606 757-595-4447	groundtr@drake.cnu.edu
Wendy Ryan	Marine Science Consortium Department of Biology Kutztown University Kutztown, PA 19530 610-683-4310	ryan@kutztown.edu
David Schofield	National Aquarium in Baltimore Pier 3 501 East Pratt Street Baltimore, MD 21202-3194 410-576-1098	dschofield@aqua.org
Mark Swingle	Virginia Marine Science Museum 717 General Booth Blvd. Virginia Beach, VA 23451 757-437-6022 (O)	mswingle@city.virginia-beach.va.us
Julie Tapia	Florida Institute of Technology Department of Biological Sciences 150 W. University Melbourne, FL 32901 407-674-8197	jtapia@fit.edu

Appendix 2. MEETING PARTICIPANTS

Name	Address	E-mail Address
Vicky Thayer	NMFS-SEFSC Beaufort Lab 101 Pivers Island Road Beaufort, NC 28516 252-728-8601	Vicky.Thayer@noaa.gov
Kim Urian	c/o NMFS-SEFSC Beaufort Lab 101 Pivers Island Road Beaufort, NC 28516 252-504-7014 (H)	kurian@aol.com
Rob Young	Coastal Carolina University P.O. Box 261954 Conway, SC 29528 843-349-2277	ryoung@coastal.edu
Eric Zolman	NOAA/NOS/CCEHBR 219 Ft. Johnson Road P.O. Box 12607 Charleston, SC 29412 843-762-8624	Eric.Zolman@noaa.gov

Protocol for the NMFS Mid-Atlantic Bottlenose Dolphin Photo-Identification Catalog (MABDC)

Protocol for selecting images to be included in the MABDC:

1. To systematically select the "type specimen" image of a dolphin to be included in the MABDC, each research group should provide a list of all the individual dolphins in their catalog.

   This list will be used to ensure that all dolphins have been evaluated for inclusion in the catalog.

2. The best quality right and left side images will be selected for the MABDC.
   Images (slides, negatives, video, based on the medium used by each group) will be scanned on-site into the image database. Only high quality images will be included; some images lose resolution when digitized, and thus will not be useful for the digital image catalog, but may be useful in another format, i.e., slide dupe, print, photo-CD.

3. Information associated with the image, including the contributor's identification number/code, the sighting date and number, roll/frame, location (latitude and longitude), age and sex class (if known) will be entered in the database.

4. An accession number will be assigned to each dolphin, based on the dorsal fin feature code.

5. These steps will be repeated for each dolphin on the contributor's list.

6. For animals that have subtle features and/or have only been photographed once, a consensus decision will be made to determine whether it should be included in the MABDC. The MABDC curator will score each image for image quality and dolphin distinctiveness.

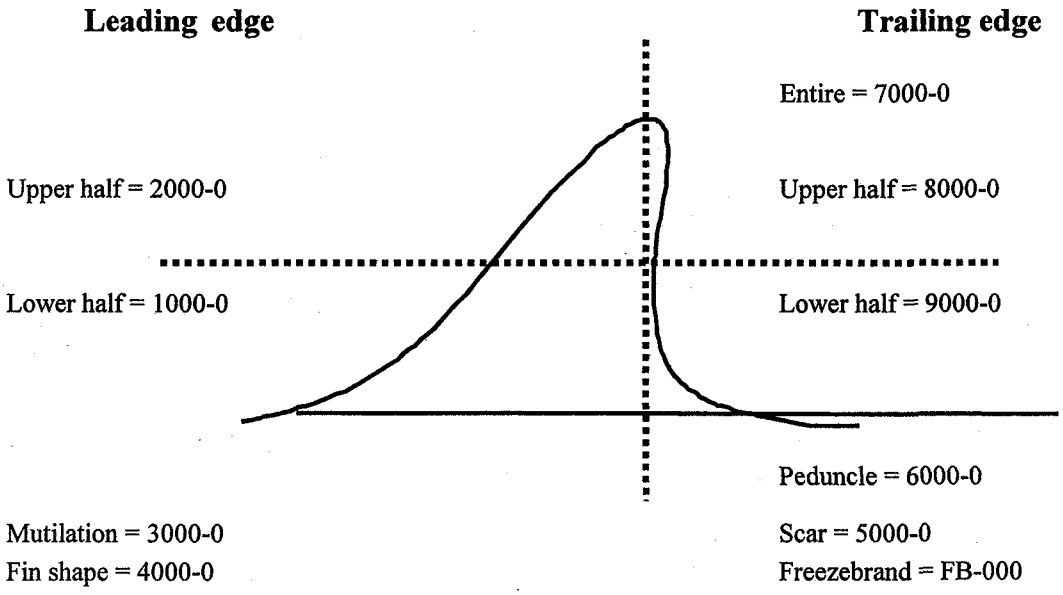
7. The feature codes used to categorize each dorsal fin are based on the location of the most distinctive or prominent feature, and are hierarchical (i.e., leading edge takes precedence over trailing edge, mutilation over trailing edge, etc., refer to MABDC key):

   FB-000 = Freezebrand
   1000-0 = Leading edge, lower half
   2000-0 = Leading edge, upper half
   3000-0 = Mutilation (missing tips, slices, etc.)
   4000-0 = Fin shape (bends, unique shapes)
   5000-0 = Scars (permanent scars: white, pink, lobomycosis)
   6000-0 = Peduncle scars, notches
   7000-0 = Equally prominent features in trailing upper and lower halves
   8000-0 = Trailing edge, upper half
   9000-0 = Trailing edge, lower half

A clean calf is identified by the number code of its mother and the last digit indicates the serial position of the calf in its mother's offspring history (e.g., 1000-1 is the first known calf of presumed female, 1000-0.)

8. The contributor will sign a consent form for inclusion of images in the MABDC; a list of the images selected will be provided to the contributor.

NMFS Mid-Atlantic Bottlenose Dolphin Photo-ID Catalog (MABDC)
Dorsal Fin Categories



The categories are based on the location of the most prominent feature on the dorsal fin. Location is determined by examining the fin, beginning at the anterior insertion of the dorsal fin and following along the fin contour to the posterior insertion of the fin, and using the following key:

		MABDC Category
1. a) Dolphin has a freezebrand on dorsal fin and/or body	**Freezebrand**	**[FB-000]**
2. a) The most prominent feature is located on the dorsal fin.....3		
b) The most prominent feature is located on the peduncle	**Peduncle**	**[6000-0]**
3. a) Dorsal fin is intact, with "typical" shape.....4		
b) Dorsal fin is not intact or does not have "typical" shape:..... ...A		
A. Fin has notch, nick or slice on lower half of leading edge	**Lead, lower half**	**[1000-0]**
B. Fin has notch, nick or slice on upper half of leading edge	**Lead, upper half**	**[2000-0]**
C. Fin is cut off, top or tip of fin is missing	**Mutilation**	**[3000-0]**
D. Fin has unique shape or is canted/bent/curled	**Left/Right Bend**	**[4000-0]**
4. a) Dorsal fin has scarring, pigmentation pattern, healed wound	**Scarring**	**[5000-0]**
b) Dorsal fin does not have scarring.....5		
5. a) Fin has most prominent feature on trailing edge:.....A		
A. equally distinctive features in upper & lower half of fin	**Entire**	**[7000-0]**
B. distinctive features in upper half of fin	**Upper half**	**[8000-0]**
C. distinctive features in lower half of fin	**Lower half**	**[9000-0]**

Measurement of Photographic Quality and Dolphin Distinctiveness for the NMFS Mid-Atlantic Bottlenose Dolphin Photo-ID Catalog Images

I. OVERALL PHOTOGRAPHIC QUALITY

Overall Photographic Quality is based on the quality of the photograph **independent** of the distinctiveness of the fin.

The Overall Photographic Quality score is based on an evaluation of the following characteristics:

- **Clarity**
  Crispness or sharpness of the image. Lack of clarity may be caused by poor focus, excessive enlargement, poor developing or motion blur.

  Based on 1-5 scale: 1 = the clearest image, 5 = the least clear.

- **Contrast**
  Range of tones in the image. Images may display too much contrast or too little. Photographs with too much contrast lose detail as small features wash out to white. Images with too little contrast lose the fin into the background and features lack definition.

  Based on 1-5 scale: 3 = ideal contrast, 1 = excessive contrast, 5 = minimal contrast.

- **Angle**
  Angle of the fin to the camera.

  Based on a 1-5 scale: 1 = a photograph nearly perpendicular to the fin, 5 = the most oblique angles.

- **Partial**
  A fin is given a partial rating if so little of the fin is visible that the likelihood of re-identifying the animal is compromised on that basis alone. Fins obscured by waves, *Xenobalanus*, or other dolphins, would be evaluated using this rating.

To score Overall Photographic Quality, of all the photographs examined, is this photograph in the:

1 – Top third
2 – Middle third
3 – Bottom third

II. OVERALL DISTINCTIVENESS

Overall Distinctiveness is based on the amount of information contained on the fin; information content is drawn from leading and trailing edge features, and pattern, marks, and scars.

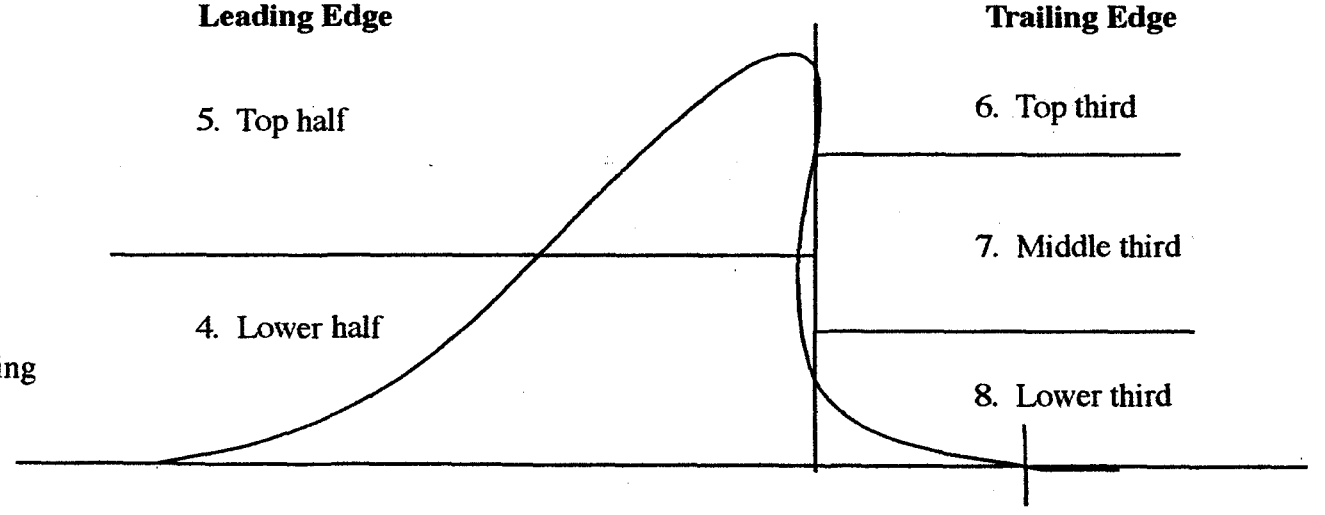
1 - Very distinctive; features evident even in distant or poor quality photograph
2 - Average amount of information content
3 - Not distinctive; very little information content in pattern, markings or leading and trailing edge features
Unknown – Distinctiveness cannot be assessed because:

a) 50% or less of the fin is visible or so much is obscured by waves, *Xenobalanus*, etc., that the fin cannot be evaluated.
b) photographic quality (clarity, contrast, and angle) is so poor that it substantially obscures the information content of the fin.

The definitions of these measurements are based on: Friday et al. 1997. Measurement of photographic quality and whale distinctiveness for the photographic identification of humpback whales. Presented at the International Whaling Committee Scientific Committee Meeting, Bournemouth, England, September, 1997.

MABDC Trial Coding System for Fin Features

Date:



Accession code:	Contributor ID	1	2	3	4	5	6	7	8	9	10

1. Update the MABDC through 1997 for existing sites

2. Add dorsal fin images from additional sites:
   - 2.1 Submission of images from existing photo-ID catalogs:
     - 2.1.1 Cape May Dolphin Survey, Cape May, NJ (prior to 1996)
     - 2.1.2 Coastal Carolina University, Conway, SC
     - 2.1.3 Dolphin Project, Savannah, GA
     - 2.1.4 Florida Institute of Technology, Melbourne, FL
     - 2.1.5 University of Central Florida, Indian River Lagoon, FL
   - 2.2 Focus new photo-identification effort in gaps between existing field sites:
     - 2.2.1 NY/NJ/DE -in summer
     - 2.2.2 Outer Banks of NC-in winter
     - 2.2.3 Ocean sites where existing effort has focused in the estuaries

3. Procedures for verifying matches:
   - 3.1 Hard copies (2) of potential matches will be sent to contributors for verification (Appendix 8); the contributor will retain one and the second will be returned to the curator with the contributors' decision
   - 3.2 The desired turn-around time for verification is 2 weeks, recognizing that this may not always be possible (Appendix 9)
   - 3.3 To confirm a match, consensus is required among the two contributors and the curator
   - 3.4 Proxy can be used if the contributor is no longer active
   - 3.5 Verification of potential (problematic) matches may be conducted at the Atlantic Coastal Dolphin Conference in 2000.

4. Contribution of sighting histories of matched dolphins to the MABDC
   - 4.1 Contributors will provide sighting histories of matched dolphins including: sighting date (month/day/year), latitude and longitude
   - 4.2 The curator and contributor will verify sighting histories of individuals from each catalog as is logistically feasible

5. Abstract submission to the Conference on the Biology of Marine Mammals, Maui, HI, November 1999
   - 5.1 An abstract will be submitted that includes:
     - Number of sites (and time frame of each study)
     - Number of fin images evaluated/selected
     - Comparisons to date
     - Number of matches and lack of matches between sites
     - Applications of the MABDC

6. Publication of MABDC Results
   - 6.1 A workshop will be convened in early 2000 to discuss the matches made between sites in the context of the Stock Identification Program, at which time a consensus will be formed regarding the structure and general conclusions of the synthetic paper
   - 6.2 The paper will be published in the primary literature

7. Access to the MABDC
   - 7.1 Data and images will not be used for any purpose without the explicit agreement of the contributor (Appendix 10)
   - 7.2 The match database (including sighting histories) will not be available except for the synthetic paper

8. Production of a hard copy of the MABDC as a NOAA Tech. Memo. in early 2000
   - 8.1 Include: the best image for each dolphin, photo credit, MABDC accession number, state, and a list of the contributors by state
   - 8.2 Only contributors will be provided a list of the matches made to their sites

Verification of MABDC Potential Match

MABDC Match # _____

MABDC#	Contributor ID#	Sighting Date
SC-CG 3149-0	SC-CG 310	26-Jul-96
FL-MJC 3122-0	FL-MJC 565	4-Feb-97

Please check one of these three choices based on these images:

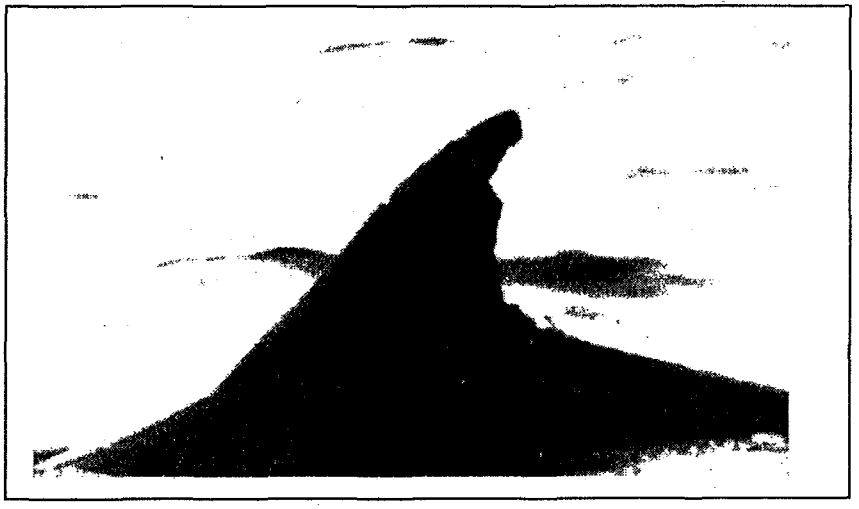
Agree: ☐ Disagree: ☐ Needs to be verified with original image: ☐

Multiple images available for verification, if necessary: Yes ☐ No ☐

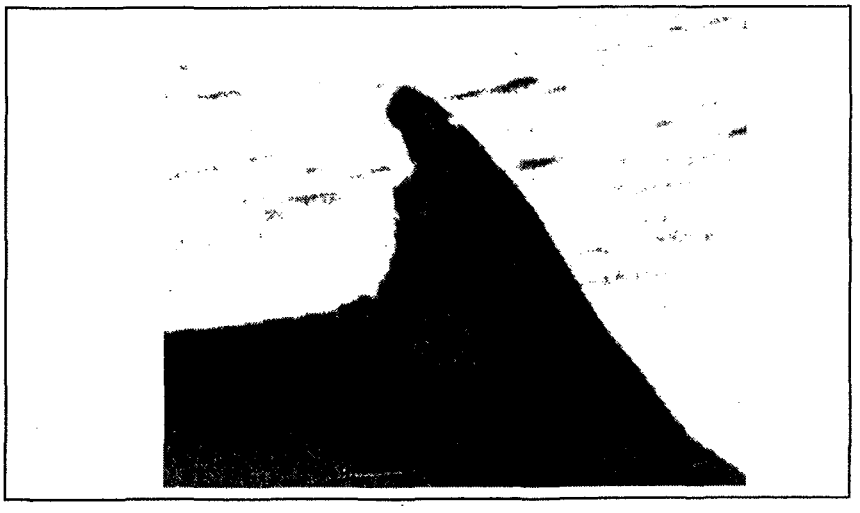
Cannot be determined (after evaluation of all available images): ☐

Comments? _____

SC-CG 3149-0



FL-MJC 3122-0



Consent form for inclusion of images of bottlenose dolphins in the NMFS Mid-Atlantic Bottlenose Dolphin Photo-ID Catalog (MABDC)

CONTRIBUTOR:

Name: _____

Affiliation: _____

Address: _____

Archive location: _____

E-mail address: _____ Phone: _____

Date of submission: _____

Number of images: _____ Number of individual dolphins: _____

Date/Year Contributor catalog evaluated through: _____

Contributor comments:

_____

_____

_____

A list of images selected for the MABDC is attached.

Agreement for collaborative use of image: These images may not be used for purposes other than initial fin matching without the written consent of the contributor- the contributing organization maintains ownership of the image and accompanying data.

_____ _____

Signature of contributor Date