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Interim Report: IWC Research Contract 16,  
Antarctic Humpback Whale Catalogue

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INTERNATIONAL  
WHALING COMMISSION

# Interim Report: IWC Research Contract 16, Antarctic Humpback Whale Catalogue

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## ABSTRACT

College of the Atlantic has maintained a collection of humpback whale (*Megaptera novaeangliae*) identification photographs from the Antarctic since 1987. In 1998 the International Whaling Commission (IWC) approved funding to support the expansion of this catalogue to members of the IWC, with an aim to substantially improve the accessibility and organization of the database. The collection has been internationally collaborative from its beginning, with photographic contributions from 400 researchers and opportunistic sources. During the contract period, the Antarctic Humpback Whale Catalogue (AHWC) catalogued 820 photo-identification images representing 709 individual humpback whales captured in Southern Hemisphere waters. These catalogued images were submitted by 25 individuals and research organizations. Photographic comparison of submitted photographs to the AHWC during the contract period yielded 183 resights of known individuals. These submissions bring the total number of catalogued whales identified by fluke, right dorsal fin/flank and left dorsal fin/flank photographs to 7476, 414 and 408 respectively. This report details these findings, as well as other recent advances in the AHWC.

## INTRODUCTION

The Antarctic Humpback Whale Catalogue (AHWC) is an international collaborative project investigating movement patterns of humpback whales (*Megaptera novaeangliae*) in the Southern Ocean and corresponding lower latitude waters. College of the Atlantic (COA) has maintained a collection of humpback whale identification photographs from the Antarctic since 1987, with initial contributions coming primarily from collaborating scientists and opportunistic sources from South America and the Antarctic Peninsula. In 1998, the International Whaling Commission (IWC) approved funding to support the expansion of this catalogue, with an aim to improving its accessibility and scope.

The collection has grown substantially in size and geographic range. It now contains records of individual whales collected throughout the Southern Ocean Sanctuary, in all of the Antarctic management areas, the feeding grounds in southern Chile and also in most of the known or suspected low-latitude breeding areas, allowing comparisons to be made between all of the major regions used by Southern Hemisphere humpback whales without preconceptions about expected movement patterns. The collection spans more than three decades, continuing to yield important results from early contributions. Early resightings confirmed migration of humpbacks between the Antarctic Peninsula and the western coast of South America (Ecuador and Colombia) (Stone *et al.* 1990, Stevick *et al.* 2004). More recent re-sightings have documented seasonal migration of humpbacks between the eastern coast of South America (Brazil) and Sector II (South Georgia) (Stevick *et al.* 2006), between East Australia and Sector V (Rock *et al.* 2006), between the western coast of Central America (Costa Rica and Panama) and the Antarctic Peninsula (Rasmussen *et al.* 2007, Guzmán *et al.* 2014, Acevedo *et al.* in press), and between American Samoa and the Antarctic Peninsula (Robbins *et al.* 2011). Inter-oceanic and inter-breeding-group movement has also been documented between the eastern coast of South America (Brazil) and Madagascar (Stevick *et al.* 2010) and between western coast of South America (Ecuador) and the eastern coast of South America (Brazil; Stevick *et al.* 2014). The collection is a collaborative venture, with photographic contributions from 400 researchers and opportunistic sources from across the globe. This interim report summarizes progress to date on the work outlined within the contract between COA and the IWC.

## PROCESSING AND ANALYSIS OF PHOTOGRAPHS

A total of 820 photographs of 709 individual humpback whales was catalogued during this contract period (Table 1), including the following:

College of the Atlantic: 50 individuals, Antarctic Peninsula  
Happywhale: 77 individuals, Antarctic Peninsula; 3 individuals, Chile; 5 individuals, Galapagos  
HIHWNMS: 11 individuals, American Samoa  
Museo de Ballenas, Salinas: 286, Ecuador; 3 individuals, Antarctic Peninsula

Opportunistic: 76 individuals, Antarctic Peninsula; 1 individual, Chile; 1 individual, Scotian Sea; 1 individual, Costa Rica  
 Pacific Whale Foundation: 105 individuals, Ecuador  
 Panacetacea: 105 individuals, Panama

	No. of photographs	No. of whales	No. of re-sightings	No. of new whales
Sector II, east of 45W	1	1	0	1
Antarctic Peninsula	251	215	50	165
Chile	4	4	3	1
Breeding stock E	14	11	1	10
Breeding stock G	550	487	137	350
Total	820	709	183	526

Table 1. Photographs catalogued during the contract period.

The fluke photographic collection has continued to increase rapidly in size, and now consists of 11339 photographs of 7476 individual whales. The right dorsal fin/flank collection consists of 522 photographs of 414 individuals. The left dorsal fin/flank collection consists of 505 photographs of 408 individuals. Distribution of the photographs by area is shown below in Table 2.

Region	Fluke		R. dorsal		L. dorsal	
	Photos	# whales	Photos	# whales	Photos	# whales
Antarctic Peninsula	3066	1815	50	34	42	34
Antarctic II-VI total	630	410	145	110	169	127
Sector II (E of 45W)	75	63	-	-	-	-
Sector III	196	117	16	13	26	15
Sector IV	169	109	82	59	72	63
Sector V	174	111	30	26	53	37
Sector VI	11	7	17	12	18	12
Chile	97	84	-	-	-	-
Breeding stock A	2067	1331	2	2	5	5
Breeding stock B	3	2	-	-	-	-
Breeding stock B1	95	79	-	-	-	-
Breeding stock B2	11	7	-	-	-	-
Breeding stock C1	259	252	-	-	-	-
Breeding stock C2	171	139	-	-	-	-
Breeding stock C3	961	777	-	-	-	-
Breeding Stock D	362	284	251	236	221	213
Breeding stock E/F	526	321	-	-	2	2
Breeding stock E1	95	77	1	1	2	2
Breeding stock E3	295	230	-	-	-	-
Breeding stock F	4	3	-	-	-	-
Breeding stock F2	2	2	-	-	-	-
Breeding stock G	2688	1893	73	31	64	26
TOTALS	11339	7476	522	414	404	408

Table 2. Fluke and dorsal photographic collections, by region. Individual whales that have been identified in multiple regions are listed in each region, so the total number of individuals listed may not be the same as the column totals. American Samoa falls at the boundary between breeding stock E3 and breeding stock F, and stock identity is not clear. As such, they are included as E/F in this table. The region designated as the Antarctic Peninsula includes individuals identified along the coast

of the peninsula and South Shetland Islands as far to the east as the South Orkney Islands (45°W). Area II includes individuals identified east of the South Orkneys to 0° (see Dalla Rosa *et al.* 2012; SC/60/SH42).

During this contract period, substantial additions were made from some of the areas with the longest history and most extensive coverage in the database. A major increase was made to the collection from whales identified within Breeding Stock G: off Ecuador (382 individuals), Panama (105 individuals) and Costa Rica (1 individual). This sample also included the first whales to date for the Galapagos Archipelago (5 individuals). Other substantial additions came from the Antarctic Peninsula (215 individuals).

Analysis during this contract period yielded 183 resights to previously sighted individuals, more than a quarter of the individuals entered. This represents the largest number of resightings in a single year to date and a 41% increase from the previous year. This reflects the substantial effort in collections from the Antarctic Peninsula and breeding stock G, where there is a longstanding history of photographic effort. All long-distance seasonal migrations identified were between breeding stock G and the Antarctic Peninsula (38). Within-region re-sightings were identified in breeding stock G (111) and the Antarctic Peninsula (33) and Chilean (3) feeding areas.

Data from our prior work in breeding stock G, the Antarctic Peninsula and off Chile has contributed to a recently accepted paper on migratory connectivity in these waters (Acevedo *et al.*, in press). It was also used for a presentation at the workshop presented at the Sociedade Latino-Americana de Especialistas em Mamíferos Aquáticos (Society of Latin American Specialists in Marine Mammals; SOLAMAC) meeting held in Valparaiso, Chile in 2016. This presentation highlighted plans for preparation of a more robust abundance estimate for breeding stock G, a project in which the AHWC will collaborate.

The database now contains records of 514 individuals identified in more than one year. Twenty-three individuals have been identified over a span of 20 years, the longest span being 36 years (AHWC#0015, seen in the Antarctic Peninsula in 1981, 1993 and 2016). There were 274 individuals identified in more than one region.

During this contract period, photographs from eco-tourism once again made a substantial contribution to the database. Opportunistic data represent a significant portion of the AHWC. For the period 1981 through 2017, 1,721 individuals have been identified from ecotourism and other opportunistic sources. In the Antarctic Peninsula region, 70% of the catalogued individuals have been contributed by opportunistic sources, primarily from ecotourism. Last year, the citizen-science based online site Happywhale (<https://happywhale.com>) established a partnership with the AHWC, agreeing to contribute all Southern hemisphere photos received (Cheeseman *et al.* 2016). In this second year we received photos of 224 whales, and were able to catalog 85 individuals, 22 of which were resighted to other years or areas.

The availability of these data from opportunistic sources has broadened our understanding of the exchange between areas and in some cases provided information that was previously not available. A photograph collected from a whale watch vessel contributed to the first re-sighting between breeding group A and breeding group C (Stevick *et al.* 2010). The submission of photos from cruise ships has contributed to publications documenting movement between South Georgia and Brazil (Stevick *et al.* 2006), and between the Antarctic Peninsula and Costa Rica (Rasmussen *et al.* 2007) and Panama (Guzmán *et al.* 2014). More recently it has contributed to a fuller understanding of migratory connectivity between Central and South America and the Antarctic Peninsula (Acevedo *et al.*, in press). Data from a cruise ship expedition guide were also instrumental in documenting the movement of an individual between the Peninsula and South Orkney, helping to define the limits of that feeding aggregation (Dalla Rosa *et al.* 2012). Progress continues in efforts to stimulate submission of such opportunistic data from eco-tourism expeditions in the Southern Ocean and from research organizations and expeditions working throughout this region and the Southern Hemisphere. The AHWC provides a unique clearinghouse for these opportunistic data, facilitating public education and participation, and providing a valuable source of data to researchers for scientific analysis.

Opportunistic identification records from the AHWC and vessel track data from IAATO are being analyzed by a Master's student at COA to examine distribution and movement around the Antarctic Peninsula. A total of 1125 opportunistic sightings has been analyzed. These were collected over 30 years by a total of 192 contributors. A heat map [Figure 1] from preliminary analysis shows several areas of high use as represented by high concentrations of sightings. Progressive movement through the season [Figure 2] is also demonstrated with the fewest sightings in November and December near the South Shetland Islands and highest numbers of sightings in January and February concentrated in the Gerlache Strait and adjacent areas. Sightings from March to April decrease and are located near Anvers Island.

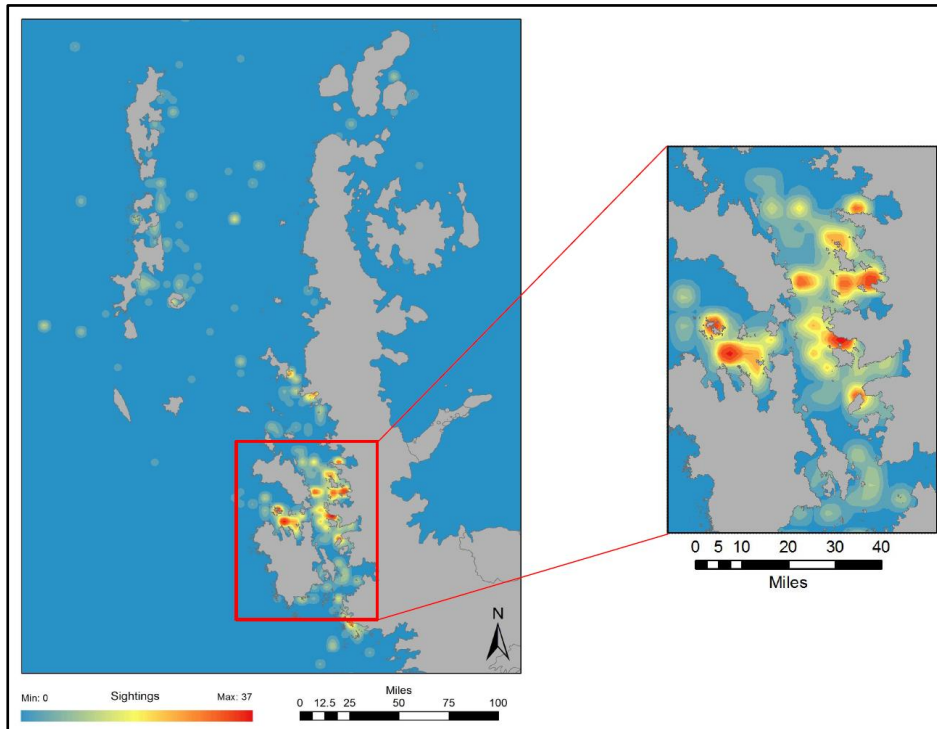


Figure 1. Heat map showing opportunistic sightings from 1986 to 2016 along the Antarctic Peninsula. The inset map shows the distinct hot spots in Dallmann Bay, Wilhelmina Bay and the Gerlache Strait.

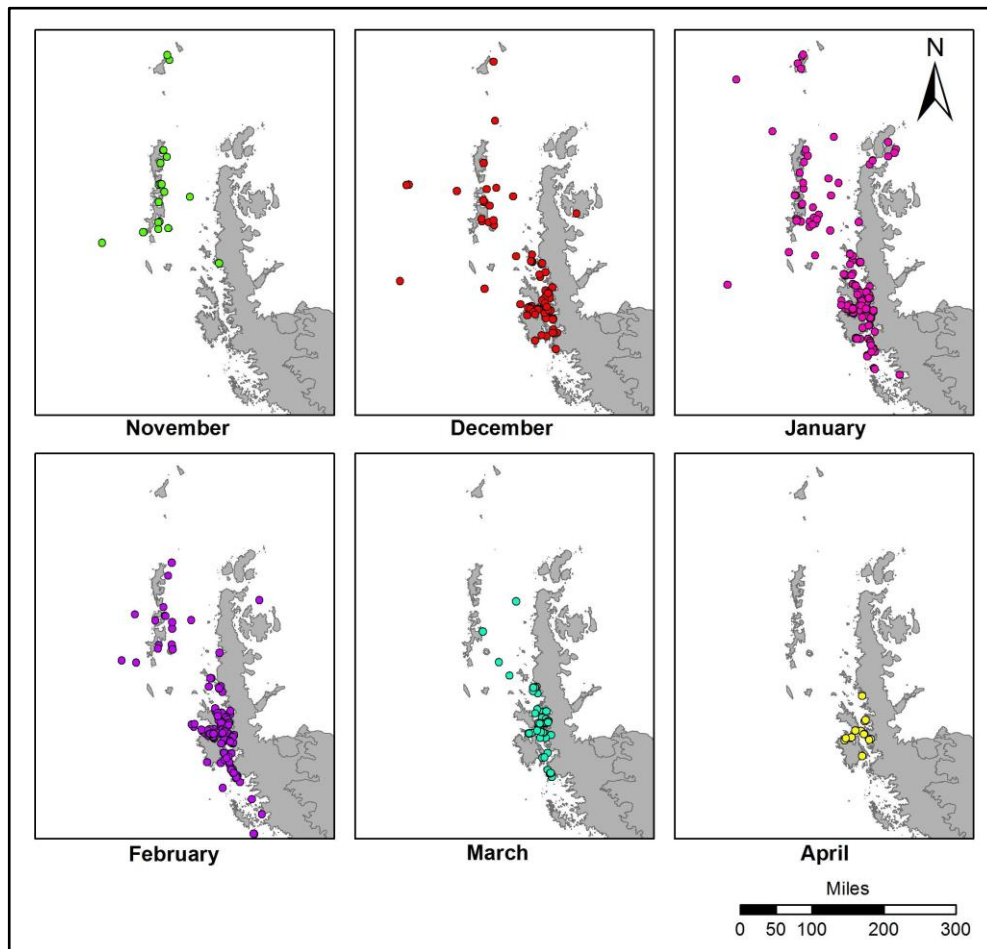


Figure 2. Opportunistic sightings by month (November to April) along the Antarctic Peninsula.

## MANAGEMENT OF PHOTOGRAPHS AND DATA

Photographs of an individual are compared to the catalogue twice before being considered new to the catalogue. Analysis of photographs uses the image management software iMatch©. The best images of each individual are stored in the iMatch© database, and assigned categories including pigment configuration, with categories representing both the proportion of light and dark pigment and also the pattern of that pigment, geographic area, injuries and scar type. This allows the user to conduct detailed and directed searches, substantially increasing the efficiency of analysis. Comparison using iMatch© has reduced the time required for image analysis by as much as 75%. Detailed pattern and mark information along with other relevant data can be stored in the database as well, making it a very effective tool for catalogue management. During this project year we continued the use of cloud storage products (Dropbox and Google Drive) to track processing progress and to share photographs to match on screen. This has helped us make significant progress in comparing accumulated photographs and refining the data management process with image management software.

Data are stored in a relational database. Digital images and data are backed up daily and kept in a separate location. Data are reported to contributors in a standard format.

The AHWC is available on-line at <http://www.flickr.com/ahwc>. Only those photographs which we have received permission to publish electronically are included in the online collection. The site is searchable by pigmentation pattern, geographic area, or catalogue number. No additional data are available on-line, and the images displayed are low resolution. In accordance with IWC policy, access to images collected on the IWC-funded research cruises is available to everyone. In addition, all photographs taken by COA researchers and all opportunistic photos have been included in the online database as public access. Terms of use, which include not publishing or reproducing information without written consent, are posted on the site.

As the collection grows in size, we continue to consider tools that increase efficiency. In this contract year, we began investigating the utility of automated image recognition system in collaboration with Happywhale. We have worked previously with developers of automated systems that used a variety of approaches, but none proved to be practical or effective. Preliminary testing of the Happywhale algorithm is encouraging. Photographs require no pre-processing, allowing even quite large collections to be imported relatively quickly. Once the catalogue is set up, it is fast and easy to use. Initial testing of a small set of photos of known whales against a large catalogue, both with a wide range of quality in photographs, shows a high success rate for high quality photographs (81% were correctly identified) but substantially lower success rate as photo quality degrades (75% of low quality photos were not identified). Further testing and development are ongoing to determine the efficacy of this system to complement our photo comparison work. An effective system would not only prove beneficial to the AHWC, but to photo-identification projects worldwide.

## ACKNOWLEDGEMENT

We wish to acknowledge the enormous contribution our late friend, colleague and co-author Carole Carlson (1947-2017) made to the study of individually identified whales and to our collective understanding of humpback whales and their lives. We are especially indebted to her for her unflagging support of the AHWC since its inception. Carole was a tireless proponent for whales, sustainable whale watching, and whale research and conservation. She will be sorely missed.

## Recent publications/documents arising from the AHWC

(\* indicates that opportunistically collected data were included in the analysis):

- \*Acevedo, J., A. Aguayo-Lobo, J. Allen, N. Botero-Acosta, J. Capella, C. Castro, L. Dalla Rosa, J. Denking, F. Félix, L. Flórez-González, F. Garita, H. M. Guzmán, B. Haase, G. Kaufman, M. Llano, C. Olavarría, A. S. Pacheco, J. Plana, K. Rasmussen, M. Scheidat, E. R. Secchi, S. Silva and P. T. Stevick. in press. Migratory preferences of humpback whales between feeding and breeding grounds in the eastern South Pacific. *Mar. Mamm. Sci.*
- \*Constantine, R., D. Steel, J. Allen, M. Anderson, O. Andrews, C.S. Baker, P. Baverstock, P. Beeman, D. Burns, J-B Charrassin, S. Childerhouse, M.C. Double, P. Ensor, T. Franklin, W. Franklin, N. Gales, C. Garrigue, E. Gates, N. Gibbs, P. Harrison, N. Hauser, A. Hutsel, C. Jenner, M. Jenner, G. Kaufman, A. Macie, D.K. Mattila, C. Olavarría, A. Oosterman, D. Paton, M. Poole, J. Robbins, N. Schmitt, P. Stevick, A. Tagarino, K. Thompson and J. Ward. 2014. Remote humpback whale feeding ground confirmed: implications for population recovery. *Mar. Biol.* 161: 1087-93.
- \*Guzman, H.M., R. Condit, B. Pérez-Ortega, J.J. Capella and P.T. Stevick. 2014. Population size and migratory connectivity of humpback whales wintering in Las Perlas Archipelago, Panama. *Mar. Mamm. Sci.* Doi 10.1111/mms.12136.

Stevick, P.T., J.M. Allen, M.H. Engel, F. Félix, B. Haas and M.C. Neves. 2013. Inter-oceanic movement of an adult female humpback whale between Pacific and Atlantic breeding grounds off South America. *J. Cetacean Res. Manage.* 13: 159-62.

\*Dalla Rosa, L., F. Félix, P. T. Stevick, E. R. Secchi, J. M. Allen, K. Chater, A. R. Martin and M. Basso. 2012. Feeding grounds of the eastern South Pacific humpback whale population include the South Orkney Islands. *Polar Res.* 31:17331-24.

\*Allen, J., C. Carlson and P. Stevick. 2011. A description and summary of the Antarctic Humpback Whale Catalogue. *J. Cetacean Res. Manage. (Special Issue)* 3, 95-9.

\*Robbins, J., L. Dalla Rosa, J.M. Allen, D.K. Matilla, E.R. Secchi, A.S. Friedlaender, P.T. Stevick, D.P. Nowacek and D. Steel. 2011. Return movement of a humpback whale between the Antarctic Peninsula and American Samoa: a seasonal migration record. *Endang. Species Res.* 13: 117-21.

\*Stevick, P.T., M.C. Neves, F. Johansen, M.H. Engel, J. Allen, M.C. Marcondes and C. Carlson. 2010. A quarter of a world away: female humpback whale moves 10,000 km between breeding areas. *Biol. Lett.* 7: 299-302. Doi:10.1098/rsbl.2010.07.0717.

### **Recent SC Documents**

\*Stevick, P.T., C.A Carlson, L. Crowe, T. Fernald and J.M. Allen. 2016. Interim Report: IWC Research Contract 16, Antarctic Humpback Whale Catalogue. Document SC/66b/SH/24.

\*Stevick, P.T., T. Fernald, C.A Carlson and J.M. Allen. 2015. Interim Report: IWC Research Contract 16, Antarctic Humpback Whale Catalogue. Document SC/66a/SH/14.

\*Stevick, P.T., J.M. Allen, C. A. Carlson and T. Fernald. 2014. Interim Report: IWC Research Contract 16, Antarctic Humpback Whale Catalogue. Document SC/65b/SH03.

\*Allen, J.M., C. A. Carlson, T. Fernald and P.T. Stevick. 2013. Interim Report: IWC Research Contract 16, Antarctic Humpback Whale Catalogue. Document SC/65a/SH15.

\*Allen, J.M., C. A. Carlson, T. Fernald and P.T. Stevick. 2012. Interim Report: IWC Research Contract 16, Antarctic Humpback Whale Catalogue. Document SC/64/SH1.

\*Castro, C., A. Aguayo-Lobo, J. Allen, L. Dalla Rosa, P. Forestell, G. Kaufman, M. Scheidat, D. Secchi, J. Acevedo and C. Marcos. 2012. Humpback whale identification off Ecuador and their migratory connections to Antarctica (Area I and II). Document SC/64/SH23.

Castro, C., J. Acevedo, A. Aguayo-Lobo, J. Allen, J. Capella, L. Dalla Rosa, L. Florez-González, G. Kaufman, P. Forestell, M. Scheidat, E.R. Secchi, P. Stevick and M. C. de O. Santos. Long-term resightings of humpback whales off Ecuador. Document SC/64/SH24

\*Allen, J.M., C. A. Carlson, J. Viechnicki and P.T. Stevick. 2011. Interim Report: IWC Research Contract 16, Antarctic Humpback Whale Catalogue. Document SC/63/SH5.

\*Constantine, R., J. Allen, P. Meeman, D. Burns, J. Charrassin, S. Childerhouse, M. Double, P. Ensor, T. Franklin, W. Franklin, N. Gales, C. Garrigue, E. Gates, N. Gibbs, A. Hutsel, C. Jenner, M. Jenner, G. Kaufman, A. Macie, D. Mattila, A. Oosterman, D. Paton, J. Robbins, N. Schmitt, P. Stevick, A. Tagarino and K. Thompson. 2011. Comprehensive photo-identification matching of Antarctic Area V humpback whales. SC/63/SH16.

Kaufman, G., D. Coughran, J. Allen, D. Burns, C. Burton, C. Castro, S. Childerhouse, R. Constantine, T. Franklin, W. Franklin, P. Forestell, R. Gales, C. Garrigue, N. Gibbs, C. Jenner, D. Paton, M. Noad, J. Robbins, E. Slooten, F. Smith and P. Stevick. 2011. Photographic evidence of interchange between East Australia (BS E-1) and West Australia (BS D) humpback whale breeding populations. SC/63/SH11.

Stevick, P.T., J. Allen, M. Engel, F. Felix, B. Haase and M. Neves. 2011. First record of inter-oceanic movement of a humpback whale between Atlantic and Pacific breeding grounds off South America. SC/63/SH4.

\*Stevick, P.T., M.C. Neves, F. Johansen, M.H. Engels, J. Allen, M. Marcondes and C. Carlson. 2010. Movement of a humpback whale between breeding stocks A and C3 and a new distance record. Document SC/62/SH27.

### **Literature Cited**

Acevedo, J., A. Aguayo-Lobo, J. Allen, N. Botero-Acosta, J. Capella, C. Castro, L. Dalla Rosa, J. Denking, F. Félix, L. Flórez-González, F. Garita, H. M. Guzmán, B. Haase, G. Kaufman, M. Llano, C. Olavarría, A. S. Pacheco, J. Plana, K. Rasmussen, M. Scheidat, E. R. Secchi, S. Silva and P. T. Stevick. in press. Migratory

- preferences of humpback whales between feeding and breeding grounds in the eastern South Pacific. *Mar. Mamm. Sci.*
- Constantine, R., D. Steel, J. Allen, M. Anderson, O. Andrews, C.S. Baker, P. Baverstock, P. Beeman, D. Burns, J-B Charrassin, S. Childerhouse, M.C. Double, P. Ensor, T. Franklin, W. Franklin, N. Gales, C. Garrigue, E. Gates, N. Gibbs, P. Harrison, N. Hauser, A. Hutsel, C. Jenner, M. Jenner, G. Kaufman, A. Macie, D.K. Mattila, C. Olavarría, A. Oosterman, D. Paton, M. Poole, J. Robbins, N. Schmitt, P. Stevick, A. Tagarino, K. Thompson and J. Ward. 2014. Remote humpback whale feeding ground confirmed: implications for population recovery. *Mar. Biol.* 161: 1087-93.
- Cheeseman, T. and K. Southerland. 2016. Happywhale.com: A Web-based Citizen Science Marine Mammal Photo Identification Platform. Document SC/66b/SH.
- Dalla Rosa, L., F. Félix, P. T. Stevick, E. R. Secchi, J. M. Allen, K. Chater, A. R. Martin and M. Basso. 2012. Feeding grounds of the eastern South Pacific humpback whale population include the South Orkney Islands. *Polar Res.* 31:17331-24.
- Guzman, H.M., R. Condit, B. Pérez-Ortega, J.J. Capella and P.T. Stevick. 2014. Population size and migratory connectivity of humpback whales wintering in Las Perlas Archipelago, Panama. *Mar. Mamm. Sci.* Doi: 10.1111/mms.12136.
- Rasmussen K., D.M. Palacios, J. Calambokidis, M.T. Saborío, L. Dalla Rosa, E.R. Secchi, G.H. Steiger, J.M. Allen and G.S. Stone. 2007. Southern Hemisphere humpback whales wintering off Central America: insights from water temperature into the longest mammalian migration. *Biol. Lett.* 3: 302-305. doi:10.1098/rsbl.2007.0067
- Robbins, J., L. Dalla Rosa, J.M. Allen, D.K. Matilla, E.R. Secchi, A.S. Friedlaender, P.T. Stevick, D.P. Nowacek and D. Steel. 2011. Return movement of a humpback whale between the Antarctic Peninsula and American Samoa: a seasonal migration record. *Endang. Species Res.* 13: 117-121.
- Rock, J., L.A. Pastene, G.D. Kaufman, P. Forestell, K. Matsuoka and J. Allen. 2006. A note on East Australia Group V Stock humpback whale movement between feeding and breeding areas based on photo-identification. *J. Cetacean Res. Manage.* 8:301–305.
- Stevick, P.T., A. Aguayo, J. Allen, I.C. Avila, J. Capella, C. Castro, K. Chater, L. Dalla Rosa, M.H. Engel, F. Félix, L. Flórez-González, A. Freitas, B. Haase, M. Llano, L. Lodi, E. Munoz, C. Olavarría, E. Secchi, M.Scheidat and S. Siciliano. 2004. Migrations of individually identified humpback whales between the Antarctic Peninsula and South America. *J. Cetacean Res. Manage.* 6:109-113.
- Stevick, P.T., J.M. Allen, M.H. Engel, F. Félix, B. Haas and M.C. Neves. 2014. Inter-oceanic movement of an adult female humpback whale between Pacific and Atlantic breeding grounds off South America. *J. Cetacean Res. Manage.* 13: 159-62.
- Stevick, P.T., M.C. Neves, F. Johansen, M.H. Engel, J. Allen, M.C. Marcondes and C. Carlson. 2010. A quarter of a world away: female humpback whale moves 10,000 km between breeding areas. *Biol. Lett.* 7: 299-302. Doi:10.1098/rsbl.2010.07.0717.
- Stevick P.T., L. Pacheco de Godoy, M. McOsker, M.H. Engel and J. Allen. 2006. A note on the movement of a humpback whale from Abrolhos Bank, Brazil to South Georgia. *J. Cetacean Res. Manage.* 8:297-300.
- Stone, G.S., L. Florez-Gonzalez and S. Katona. 1990. Whale migration record. *Nature, Lond* 346:705