



---

# Humpback Whale (*Megaptera novaeangliae*) Intra/Inter-Seasonal Exchanges Between Puerto Rico and the Southeastern Caribbean

Mithriel M. MacKay<sup>1\*</sup>, Cathy E. Bacon<sup>1</sup>, Laurent Bouveret<sup>2</sup>, Sabrina Fossette<sup>3</sup>,  
and Peter T. Stevick<sup>4</sup>

<sup>1</sup>Marine and Coastal Ecology Research Center, USA

<sup>2</sup>Observatoire des Mammifères Marins de l'Archipel Guadeloupéen, Guadeloupe, FWI

<sup>3</sup>Association Megaptera, Paris, France

<sup>4</sup>College of the Atlantic, USA

\*Corresponding author (Email: [Mithriel@Marine-Eco.org](mailto:Mithriel@Marine-Eco.org))

**Citation** – MacKay, M. M., Bacon, C. E., Bouveret, L., Fossette, S., & Stevick, P. T. (2019). Humpback whale (*Megaptera novaeangliae*) intra/inter-seasonal exchanges between Puerto Rico and the southeastern Caribbean. *Animal Behavior and Cognition*, 6(2), 98–104. <https://doi.org/10.26451/abc.06.02.02.2019>

**Abstract** – A study of humpback whales (*Megaptera novaeangliae*, Borowski, 1781) was conducted off Puerto Rico, from 2012 through 2016, in an attempt to understand the spatial and temporal connection among current low density areas throughout the southeastern Caribbean. Six hundred and sixteen animals were sighted, of which 87 (14%) were individually identified. Seventeen individuals (20%) were re-sighted in one or more of the North Atlantic Caribbean breeding areas. Two newly reported inter-seasonal re-sightings (between Puerto Rico and Guadeloupe), and one intra-seasonal exchange (including the only reported match between Puerto Rico and Anguilla) between Puerto Rico and the southeastern Caribbean are reported here. A paucity of data failed to confirm that humpback whales are repopulating their full extent of the historical range, including Puerto Rico; however, these observations may provide a glimpse of the future importance of the southeastern Caribbean. It is especially important to understand the occupancy, movements, and habitat use throughout the entire winter range as sources of anthropogenic impacts (including vessel traffic from the growing cruise ship industry) increase throughout the Caribbean.

**Keywords** – Humpback whale, *Megaptera novaeangliae*, Caribbean, Puerto Rico, Photo-identification, Migratory movements

---

A majority of research on the North Atlantic humpback whale (*Megaptera novaeangliae* [Borowski, 1781]) breeding grounds has been conducted in the highest density area off the Dominican Republic (Mattila, Clapham, Katona, & Stone, 1989; Mattila, Clapham, Vásquez, & Bowman, 1994; Robbins et al., 2001; Whitehead & Moore, 1982). In contrast, fewer studies have been conducted in other areas of the Caribbean (Clapham et al., 2005; Fossette, Vely, Maslac, & Souan, 2014; Kennedy & Clapham, 2017; Levenson & Leaply, 1978; Mattila & Clapham, 1989; Rinaldi, Rinaldi, & Sahagian, 2006; Rinaldi, Sears, Stevick, & Carlson, 2009; Stevick et al., 2018; Swartz, Martinez, Stamates, Burks, & Mignucci-Giannoni, 2002; Swartz et al., 2003; Winn, Edel, & Taruski, 1975), limiting our understanding of the connection between low-density wintering areas and the larger aggregation. Occurrence of individuals throughout their historical range, including the southeastern Caribbean, in greater numbers is a reasonable consequence of their successful recovery. As this population increases,

marine managers will benefit from a clear understanding of where to anticipate overlap with human activity.

Humpback whales use discrete seasonal habitats reflecting different resource needs for reproduction and foraging (Clapham, 2000). High-latitude productive areas, where there is abundant prey, define summer habitats, while breeding and calving occur in low latitudes in winter. The largest and best-known breeding and calving area in the North Atlantic is located in the waters north of the Dominican Republic (Balcomb & Nichols, 1982; Mattila et al., 1989, 1994; Whitehead & Moore, 1982). Occurrence of humpback whales near Puerto Rico, the Virgin Islands, the Turks and Caicos, and throughout the southeastern Caribbean have been observed with less frequency and in lower numbers (Balcomb & Nichols, 1982; Kennedy & Clapham, 2017; Levenson & Leaply, 1978; MacKay, Würsig, Bacon, & Selwyn, 2016; MacKay, Daigneault, Bacon, Sesani, & Stadler, 2017; Mattila, 1984; Mattila & Clapham, 1989; Mattila et al., 1989; Rinaldi et al., 2009; Stevick et al., 2018; Swartz et al., 2002; 2003; Whitehead & Moore, 1982; Winn et al., 1975). Additionally, the eastern North Atlantic has a known wintering aggregation off Africa's northwestern coast, among the Cape Verde Islands (Bettridge et al., 2015; Hazevoet, Gravanita, & Wenzel, 2011; Wenzel et al., 2009). Although there is little evidence of mixing of North Atlantic humpback whales between these two primary winter breeding areas, the recent discovery of movement by four individuals between the Cape Verde Islands and the southeastern Caribbean complicates this interpretation (Stevick et al., 2016).

Seasonal occurrence of humpback whales in Mona Passage, between the eastern Dominican Republic and western Puerto Rico, was confirmed several decades ago (Mattila, 1984; Mattila & Clapham, 1989; Smith et al., 1999). Since then, this has been the subject of occasional study until 2012 when dedicated effort began in Mona Passage (MacKay, 2015; MacKay et al. 2016). These data provided a limited understanding of the temporal and spatial exchange with other low-latitude areas (Katona & Beard, 1990; Mattila & Clapham, 1989). There is a paucity of reported data available to facilitate an understanding of humpback whale movement between Puerto Rico and the southeastern Caribbean. Sparse data have been collected east of the Virgin Islands. Humpback whales have been reported east of the Anegada Passage and as far south as Venezuela, where the number of individuals sighted and recorded was low (Heenehan & Stanistreet, 2017; Kennedy & Clapham, 2017; Mattila & Clapham, 1989; Rinaldi et al., 2009; Stevick, Carlson, & Balcomb, 1999; Swartz et al. 2002; 2003; Winn et al., 1975; Winn & Winn, 1978). Although, there are 262 individual humpback whales identified by natural markings from the southeastern Caribbean (from Antigua in the north to Trinidad and Tobago in the south) in the North Atlantic Humpback Whale Catalogue (NAHWC, Stevick et al., 2018), there are only two previously reported exchanges from Puerto Rico to this region (Dominica, Stevick et al., 1999; Guadeloupe, NAHWC, unpublished data). It is not clear if this is due to the relatively few individuals occurring in this area or a result of survey effort.

We conducted a study in Mona Passage, off western Puerto Rico, during multiple winter seasons to investigate the connection between Puerto Rico and areas in the southeastern Caribbean. Here, we report our findings, including the only known re-sighting of an individual humpback whale between Puerto Rico and Anguilla, and two re-sightings between Puerto Rico and Guadeloupe. The data add to knowledge of humpback whale movements on the breeding grounds, and highlight unanswered questions on this topic within the species' Caribbean range.

## Methods

Digital fluke identification photographs were obtained from land- and vessel-based platforms during dedicated surveys in Mona Passage off western Puerto Rico (18°11'48.11"N, 67° 3'34.11"W, Figure 1) in winters (January-April) 2012 – 2016. Effort was not consistent across all years and varied in terms of length of field season and by the number of platforms utilized (Table 1).

The Puerto Rico Humpback Whale Catalog (PRHWC) contains identification photographs obtained during surveys in Mona Passage from 2012 to 2016. The PRHWC includes fluke identification photograph(s), images of dorsal fins, scars, and other distinctive natural markings. The NAHWC is an

ocean-wide collaborative project compiling fluke identification photographs and data from contributors throughout the North Atlantic (Katona & Beard, 1990). All individual humpback whales with ventral fluke images from the PRHWC were submitted to the NAHWC for comparison using standard procedures (Katona & Beard, 1990).

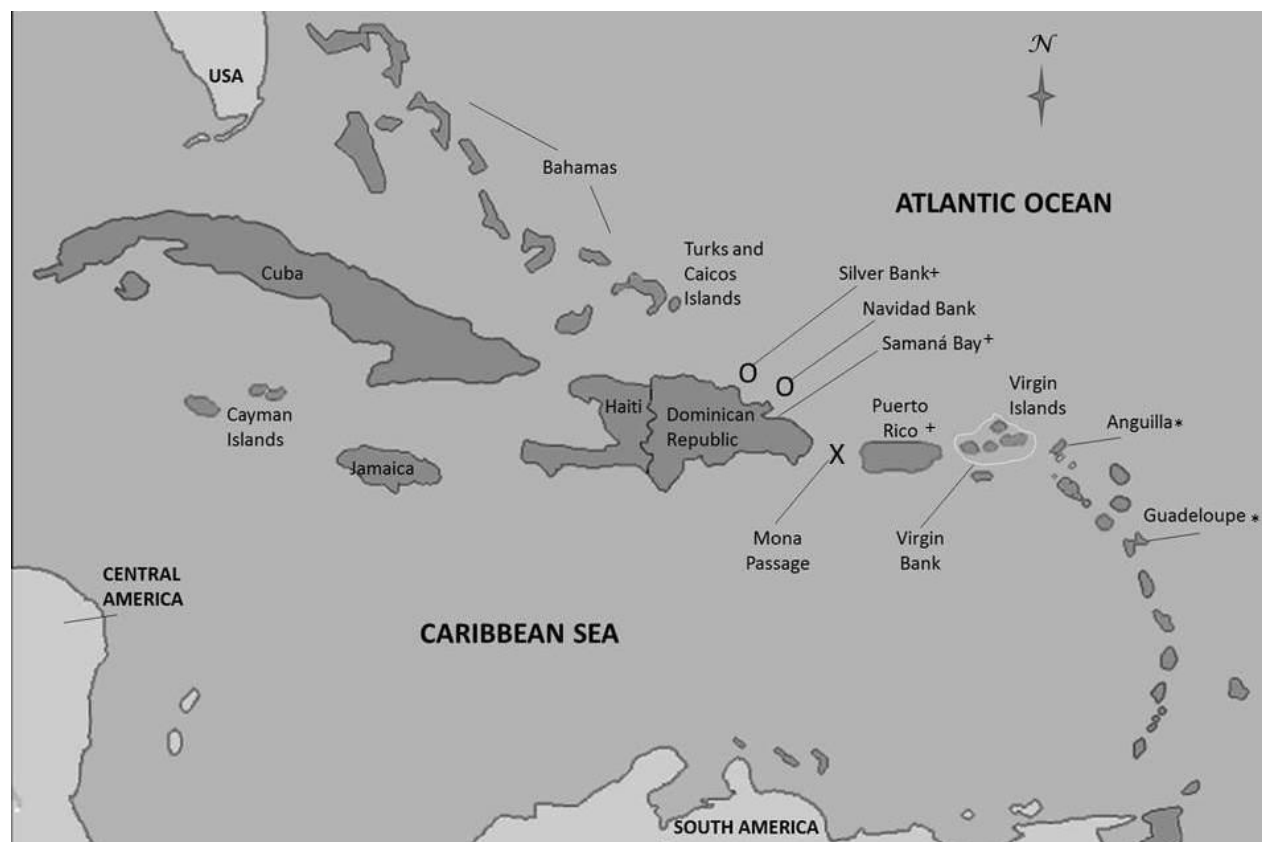


Figure 1. Breeding grounds for North Atlantic humpback whales (*Megaptera novaeangliae*) off the Dominican Republic (Silver Bank, Navidad Bank, and Samaná Bay) and the West Indies chain.

Table 1

*Effort and Sighting Summary of North Atlantic Humpback Whales (Megaptera novaeangliae) Photographed off Western Puerto Rico*

Year	Number of Animals	Number of Groups	Number of Individuals Photographed	Total Number of Individuals Matched to Another Breeding Area	Total Number of Days of Land Effort	Total Number of Days of Vessel Effort
2012	19	12	3	1	19	16
2013	145	78	34	2	21	22
2014	104	71	20	8	15	33
2015	148	97	20	5	9	19
2016	200	142	10	0	6	18
Total	616	400	87	16	70	108

## Results

Vessel- and land-based surveys were conducted over 178 days in the winter months from January 2012 to April 2016 in Mona Passage, using ad lib data collection, targeting locations known to be occupied by humpback whales in winter. Four hundred groups of 616 animals were observed in the study area during the 5-year period. Ventral fluke identification photographs were available for 87 (14%) of the 616 animals sighted and 17 of those individuals (20%) were also sighted in one or more of the Caribbean breeding areas (Table 1). Re-sightings were made to Guadeloupe, Anguilla and Puerto Rico, as well as to two areas of the Dominican Republic, Samaná Bay and Silver Bank (Figure 1). Three (17.6%) of the 17 matches occurred in the southeastern Caribbean: one in Anguilla and two in Guadeloupe (Table 2). One match occurred within the breeding season when an individual was photographed in Mona Passage in February 2014 and then 34 days later in March off Anguilla (French West Indies, Lesser Antilles, Table 2).

Table 2

*New Intra- and Inter-seasonal Re-sightings of Wintering North Atlantic Humpback Whales in the Southeast Caribbean*

PRHWC-ID	NAHWC-ID	Puerto Rico	
		Sighting Date	Re-Sighting Date and Location
MCERC#78	na9488	2014 February 12	2013 March 29 Désirade, Guadeloupe, French West Indies
MCERC#87 <sup>+</sup>	na6757	2014 February 19	2014 March 25 Anguilla, French West Indies
MCERC#101	na6910	2015 February 19	2017 February 21 Pointe des Châteaux, Guadeloupe, French West Indies

<sup>+</sup>Intra-seasonal re-sightings

## Discussion

North Atlantic humpback whales continue to recover since cessation of whaling in 1955. However, it is unclear how distribution and movement of individuals throughout the Caribbean will change as the population increases. Smith and Reeves (2003) presented a review of whaling logs that is arguably the best representation of occurrence patterns of humpback whales in the southeastern Caribbean in the 19<sup>th</sup> century. Movement patterns throughout this area of the winter grounds are not part of the historical record because those data were based on killed animals prior to the inception of a centralized catalog. Thus, re-sightings of individual humpback whales in areas where whales were previously hunted in the southeastern Caribbean provide insights into movement patterns throughout their entire historical breeding range.

Previously reported instances of exchange between breeding habitats in the Caribbean include Puerto Rico and Dominica (Stevick et al., 1999), Puerto Rico and the Dominican Republic: Silver Bank, Samaná Bay, or Navidad Bank (Mattila et al., 1989), the Dominican Republic and Virgin Bank (Mattila & Clapham, 1989; Mattila et al., 1989), and Puerto Rico and Virgin Bank (Mattila & Clapham, 1989). The in-season breeding ground exchange reported here between Puerto Rico and Anguilla and the matches between Puerto Rico and Guadeloupe suggests that North Atlantic humpback whales may move more than expected throughout the Caribbean during the a single breeding season (Kennedy et al., 2013; Mattila & Clapham, 1989; Stevick et al., 1999). Observed in-season movement (has also been observed in the southwest Indian Ocean (Cerchio et al., 2016; Dulau et al., 2017; Fossette, Heide-Jørgensen, et al., 2014) and Hawaii (Cartwright & Sullivan, 1999; Mate, Gisiner, & Mobley, 1998; Pack et al., 2017). The recent discovery of movement by four individuals between the Cape Verde Islands and the southeastern Caribbean (Stevick et al., 2016) may be an indication of broader spatial movements of North Atlantic humpback whales.

These data provide new information on movements to the southeastern Caribbean in the context of North Atlantic humpback whale breeding population structure. The multiple re-sightings between Puerto Rico and the southeastern Caribbean, including movement within a season, indicate that

movement away from the high-density breeding group off the Dominican Republic can occur. It is possible that this could be uncommon behavior, that these whales are routinely using different locations within their winter range or that they are expanding into habitat of historical importance as the population increases. Thus, this study may provide a glimpse into the repopulation of the historical range of humpback whales. Further research is needed to understand occupancy, movements, and habitat use, throughout the entire winter range, which is especially important as sources of anthropogenic impact, including vessel traffic from the growing cruise ship industry, increase throughout the Caribbean (MacKay et al., 2017).

### Acknowledgments

We are grateful for the generosity of contributors to the North Atlantic Humpback Whale Catalogue for the permission to include their efforts in this study: Association Megaptera, MEGARA, and Observatoire des Mammifères Marins de l'Archipel Guadeloupéen or Marine Mammal Guadeloupean Archipelago Observatory. Appreciation is extended to the staff at College of the Atlantic Allied Whale Project for matching assistance. The authors thank the research assistants for their dedication to creating and maintaining the Puerto Rico Humpback Whale Catalog. We thank Captain Michael Lopez for his mariner skill, experience, and local knowledge supporting data collection. Research was conducted under permits from the National Marine Fisheries Service and Puerto Rico Department of Natural and Environmental Resources. We extend a special thanks to Jooke Robbins, Phillip Clapham, and Bernd Würsig for their patience and guidance from the inception of this project.

### References

- Balcomb, K. C., & Nichols, G. (1982). Humpback whale censuses in the West Indies. *Reports of the International Whaling Commission*, 32, 401–406.
- Bettridge, S., Baker, C. S., Barlow, J., Clapham, P. J., Ford, M., Gouveia, D.,...Wade, P. R. (2015). *Status review of the humpback whale (Megaptera novaeangliae) under the endangered species act*. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-540.
- Cartwright, R., & Sullivan, M. (2009). Behavioral ontogeny in humpback whale (*Megaptera novaeangliae*) calves during their residence in Hawaiian waters. *Marine Mammal Science*, 25, 659–680.
- Cerchio, S., Trudelle, L., Zerbini, A. N., Charrassin, J. B., Geyer, Y., Mayer, F. X.,...Rosenbaum, H. C. (2016). Satellite telemetry of humpback whales off Madagascar reveals insights on breeding behavior and long-range movements within the southwest Indian Ocean. *Marine Ecology Progress Series*, 562, 193–209.
- Clapham, P. J. (2000). The humpback whale seasonal feeding and breeding in a baleen whale. In: J. Mann, R. C. Connor, P. L. Tyack, & H. Whitehead (Eds.), *Cetacean societies: Field studies of dolphins and whales* (pp. 173–198). Chicago: University of Chicago Press.
- Clapham, P. J., Barco, S., Jann, G., Martinez, A., Mattila, D., Nelson, M.,...Wenzel, F. (2005). *Update on a new assessment of North Atlantic humpback whales*. Paper SC/57/AWMP9 submitted to the Scientific Committee of the International Whaling Commission, June 2005.
- Dulau, V., Pinet, P., Geyer, Y., Fayon, J., Mongin, P., Cottarel, G.,...Cerchio, S. (2017). Continuous movement behavior of humpback whales during the breeding season in the southwest Indian Ocean: On the road again! *Movement Ecology*, 5, 1–17.
- Fossette, S., Heide-Jørgensen, M. P., Jensen, M. V., Kiszka, J., Bérubé, M., Bertrand, N., & Vély, M. (2014). Humpback whale (*Megaptera novaeangliae*) post breeding dispersal and southward migration in the western Indian Ocean. *Journal of Experimental Marine Biology and Ecology*, 450, 6–14.
- Fossette, S., Vely, M., Maslach, N., & Souan, H. (2014). *Mission deployment de balises satellites sans les aires de reproduction baleines a bosse (Megaptera novaeangliae) du nord des petites Antilles*. Rapport interne, Reserve Naturelle de Saint Martin.
- Hazevoet, C. J., Gravanita, B., & Wenzel, F. W. (2011). Seasonality of humpback whale *Megaptera novaeangliae* (Borowski, 1781) records in Cape Verde seas: Evidence for the occurrence of stocks from both hemispheres. *Zoologia Caboverdiana*, 2, 25–29.

- Heenehan, H. L., & Stanistreet, J. E. (2017). Caribbean humpback acoustic monitoring programme: 2016-2017 report. Retrieved from [https://www.nefsc.noaa.gov/press\\_release/pr2018/features/champ/champ-2016-2017-report.pdf](https://www.nefsc.noaa.gov/press_release/pr2018/features/champ/champ-2016-2017-report.pdf)
- Katona, S. K., & Beard, J. A. (1990). Population size, migrations, and feeding aggregations of the humpback whale (*Megaptera novaeangliae*) in the western North Atlantic Ocean. *Reports of the International Whaling Commission, Special Issue, 12*, 295–306.
- Kennedy A. S., & Clapham, P. J. (2017). From whaling to tagging: The evolution of North Atlantic humpback whale research in the West Indies. *Marine Fisheries Review* 79, 23–37.
- Kennedy, A. S., Zerbini, A. N., Vásquez, O. V., Gandilhon, N., Clapham, P. J., & Adam, O. (2013). Local and migratory movements of humpback whales (*Megaptera novaeangliae*) satellite-tracked in the North Atlantic Ocean. *Canadian Journal of Zoology*, 92, 8–17.
- Levenson, C., & Leapley, W. T. (1978). Distribution of humpback whales (*Megaptera novaeangliae*) in the Caribbean by a rapid acoustic method. *Journal of the Fisheries Board of Canada*, 35, 1150–1152.
- MacKay, M. M. (2015). *Occurrence patterns and social behaviors of humpback whales (Megaptera novaeangliae) wintering off Puerto Rico, USA* (unpublished doctoral dissertation). Texas A&M University Galveston, Galveston, TX.
- MacKay, M. M., Daigneault, N. D., Bacon, C. E., Sesani, V., & Stadler, L. R. (2017). *Behaviors and movement patterns of humpback whales (Megaptera novaeangliae), a summary of the whale watching industry, and sea turtle surveys from Salt Cay, Turks and Caicos Islands, British West Indies, 30 December 2016 – 1 April 2017 - Final Report*. Prepared by the Marine and Coastal Ecology Research Center, Spring Hill, Florida, USA. Submitted to the Ministry of Environment and District Administration, Department of Environmental and Coastal Resources, Lower Bight Road, Providenciales, Turks and Caicos Islands Government, British West Indies.
- MacKay, M. M., Würsig, B., Bacon, C. E., & Selwyn, J. D. (2016). Humpback whale (*Megaptera novaeangliae*) hotspots defined by bathymetric features off western Puerto Rico. *Canadian Journal of Zoology*, 94, 517–527.
- Mate, B. R., Gisiner, R., & Mobley, J. (1998). Local and migratory movements of Hawaiian humpback whales tracked by satellite telemetry. *Canadian Journal of Zoology*, 76, 863–868.
- Mattila, D. K. (1984). *Humpback whales in the Mona Passage, Puerto Rico: A summary*. Provincetown, MA: Center for Coastal Studies.
- Mattila, D. K., & Clapham, P. J. (1989). Humpback whales (*Megaptera novaeangliae*) and other cetaceans on Virgin Bank and in the northern Leeward Islands, 1985 and 1986. *Canadian Journal of Zoology*, 67, 2201–2211.
- Mattila, D. K., Clapham, P. J., Katona, S. K., & Stone, G. S. (1989). Population composition of humpback whales (*Megaptera novaeangliae*) on Silver Bank 1984. *Canadian Journal of Zoology*, 67, 281–285.
- Mattila, D. K., Clapham, P. J., Vásquez, O., & Bowman, R. S. (1994). Occurrence, population composition, and habitat use of humpback whales in Samana Bay, Dominican Republic. *Canadian Journal of Zoology*, 72, 1898–1907.
- North Atlantic Humpback Whale Catalogue. (2018). North Atlantic Humpback Whale Catalogue. Guadeloupe, Unpublished raw data.
- Pack, A. A., Herman, L. M., Craig, A. S., Spitz, S. S., Waterman, J. O., Herman, E. Y. K....Lowe, C. (2017). Habitat preferences by individual humpback whale mothers in the Hawaiian breeding grounds vary with the age and size of their calves. *Animal Behaviour*, 133, 131–144.
- Rinaldi, C., Rinaldi, R., & Sahagian, P. (2006). *Report of surveys conducted on small cetaceans off Guadeloupe 1998–2005*. Paper SC/58/SM17 submitted to the Scientific Committee of the International Whaling Commission, June 2006.
- Rinaldi, C., Sears, R., Stevick, P. T., & Carlson, C. (2009). *First re-sighting of a humpback whale between the French Lesser Antilles and the North Atlantic feeding grounds off Canada*. Paper SC/61/O13 submitted to the Scientific Committee of the International Whaling Commission, June 2009.
- Robbins, J., Bérubé, M., Clapham, P., Palsbøll, P., Stevick, P., & Mattila, D. (2001). *Group composition and social dynamics of North Atlantic humpback whales (Megaptera novaeangliae) on their West Indies breeding grounds*. Paper SC/53/NAH4 submitted to the Scientific Committee of the International Whaling Commission, June 2001.
- Smith, T. D., Allen, J., Clapham, P. J., Hammond, P. S., Katona, S., Larson, F....Øien, N. (1999). An ocean-basin-wide mark-recapture study of the North Atlantic humpback whale (*Megaptera novaeangliae*). *Marine Mammal Science*, 15, 1–32.

- Smith, T. D., & Reeves, R. R. (2003). Estimating American 19th century catches of humpback whales in the West Indies and Cape Verde Islands. *Caribbean Journal of Science*, 39, 286–297.
- Stevick, P. T., Berrow, S. D., Bérubé, M., Bouveret, L., Broms, F., Jann, B.,...Wenzel, F. (2016). There and back again: Multiple and return exchange of humpback whales between breeding habitats separated by an ocean basin. *Journal of the Marine Biological Association of the United Kingdom*, 96, 885–890.
- Stevick, P. T., Bouveret, L., Gandilhon, N., Rinaldi, C. Rinadli, R., Broms, F.,...Wenzel, F. (2018). Migratory destinations and timing of humpback whales in the southeastern Caribbean differ from those off the Dominican Republic. *Journal of Cetacean Research and Management*, 18, 127–133.
- Stevick, P. T., Carlson, C. A., & Balcomb, K. C. (1999). A note on the migratory destinations of humpback whales from the eastern Caribbean. *Journal of Cetacean Research and Management*, 1, 251–254.
- Swartz, S. L., Cole, T., McDonald, M. A., Hildebrand, J. A., Oleson, E. M., Martinez, A.,...Jones, M. L. (2003). Acoustic and visual survey of humpback whale (*Megaptera novaeangliae*) distribution in the eastern and southeastern Caribbean Sea. *Caribbean Journal Science*, 39, 195–208.
- Swartz, S. L., Martinez, A., Stamates, J., Burks, C., & Mignucci-Giannoni, A. A. (2002). *Acoustic and visual survey of cetaceans in the waters of Puerto Rico and the Virgin Islands: February-March 2001*. NOAA Technical Memorandum NMFS-SEFSC- 463.
- Wenzel, F. W., Allen, J., Berrow, S., Hazevoet, C. J., Jann, B., Seton, R. E.,...Whooley, P. (2009). Current knowledge on the distribution and relative abundance of humpback whales (*Megaptera novaeangliae*) off the Cape Verde Islands, eastern North Atlantic. *Aquatic Mammals*, 35, 502–510.
- Whitehead, H., & Moore, M. J. (1982). Distribution and movements of West Indian humpback whales in winter. *Canadian Journal of Zoology*, 60, 2203–2211.
- Winn, H. E., Edel, R. K., & Taruski, A. G. (1975). Population estimate of the humpback whale (*Megaptera novaeangliae*) in the West Indies by visual and acoustic techniques. *Journal of the Fisheries Board of Canada*, 32, 499–506.
- Winn, H., & Winn, L. K. (1978). The song of the humpback whale (*Megaptera novaeangliae*) in the West Indies. *Marine Biology*, 47, 97–114.