Photo-Identification Analyses in the Cape Hatteras Study Area

2024

ANNUAL PROGRESS REPORT

PREPARED BY

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Toothless adult male goose-beaked whale (*Ziphius cavirostris*) surfacing off Cape Hatteras, North Carolina. Photographed by Will Cioffi, Duke University, taken under General Authorization Letter of Confirmation 25471 held by Duke University.

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Table of Contents

Figures

Tables

Acronyms and Abbreviations

BRS	Behavioral Response Study
DUML	Duke University Marine Lab
CMARI	Clearwater Marine Aquarium Research Institute
Gg	*Grampus griseus* (Risso's dolphin)
Gm	*Globicephala macrorhynchus* (short-finned pilot whale)
GOM	Gulf of Mexico
HAT	Cape Hatteras study area
ID	identification/Identifier
JAX	Jacksonville
M	match
NEAQ	New England Aquarium
NOAA	National Oceanic and Atmospheric Administration
NOR	Norfolk Canyon
OSB	Onslow Bay
photo-ID	photo-identification
SBU	Stony Brook University
SP	Sutherland/Patteson
Tt	*Tursiops truncatus* (bottlenose dolphin)
UNCW	University of North Carolina Wilmington
USACE	U.S. Army Corp of Engineers
U.S.	United States
Zc/Zca	*Ziphius cavirostris* (goose-beaked whale)

1. Cape Hatteras Photo-Identification

During 2024 fieldwork supporting the Atlantic Behavioral Response Study (BRS) (Southall et al. 2025) and other related research, the study team collected more than 7,900 digital images within the Cape Hatteras study area. The team used these images to confirm species, identify individual animals, compile sighting histories and conduct follow-up monitoring of satellite-tagged animals. The field team took digital photographs with Canon or Nikon digital single lens reflex cameras equipped with 100- to 400-millimeter zoom lenses in 24-bit color at a resolution of 6016 × 4016 pixels and saved in .jpg format. The team obtained photographs of eight species, but most were from goose-beaked whales (*Ziphius cavirostris*), the focal species of the Atlantic BRS (**Table 1**).

Table 1. Cetacean sightings with the numbers of photo-ID images collected for each species within the Cape Hatteras study area during 2024.

Species	Common Name	Number of Sightings	Number of Photo-ID Images
Balaenoptera physalus	Fin whale	1	146
Delphinus delphis	Common dolphin	2	0
Globicephala macrorhynchus	Short-finned pilot whale	28	2,615
Grampus griseus	Risso's dolphin	1	44
Megaptera novaeangliae	Humpback whale	1	51
Physeter macrocephalus	Sperm whale	2	304
Stenella frontalis	Atlantic spotted dolphin	1	0
Stenella species	Spotted dolphin species	2	0
Tursiops truncatus	Bottlenose dolphin	27	1,332
Unidentified odontocete	Unidentified odontocete	2	0
Unidentified ziphiid[a]	Unidentified ziphiid	2	3
Ziphius cavirostris	Goose-beaked whale	31	3,306
Total	—	**100**	**7,801**

Key: photo-ID = photo-identification;

[a] Unidentified ziphiid may be either *Mesoplodon* sp. or *Ziphius*.

Danielle Waples graded each digital image for photographic quality and animal distinctiveness, then sorted all images of sufficient quality and distinctiveness by individual within a sighting and assigned temporary identifications. Ms. Waples then selected the best image for each individual in that sighting, and cropped and compiled these images into a folder for each sighting for later photo-identification (photo-ID). Sighting data and photo-ID information were stored in an Access database managed by Kim Urian (Duke University Marine Lab [DUML]).

During the 2024 reporting period, the team added images of 69 newly identified animals to photo-ID catalogs of fin whales *(Balaenoptera physalus*), short-finned pilot whales (*Globicephala macrorhynchus*), Risso's dolphins (*Grampus griseus*), humpback whales (*Megaptera novaeangliae*), sperm whales (*Physeter macrocephalus)*, bottlenose dolphins (*Tursiops truncatus*) and goose-beaked whales (*Ziphius cavirostris*) (**Table 2**). Sixteen new photo-ID re-sights were made within the sperm whale, bottlenose dolphin and goose-beaked whale catalogs.

Table 2. Summary of images collected by species during fieldwork within the Cape Hatteras study area during 2024, with numbers of new identifications, photo-ID catalog sizes, numbers of new re-sights, and total re-sights to date.

Species	New Images Collected	New IDs	Catalog Size	New Re-sights	Re-sights To Date
Balaenoptera physalus	146	1	2	0	0
Delphinus delphis	0	0	46	0	1
Globicephala macrorhynchus	2,615	2	1,390	0	480
Grampus griseus	44	7	54	0	6
Kogia species	0	0	1	0	0
Megaptera novaeangliae	51	2	4	0	0
Mesoplodon species	0	0	10	0	2
Physeter macrocephalus	304	2	32	2	3
Stenella clymene	0	0	3	0	0
Stenella frontalis	0	0	42	0	0
Tursiops truncatus	1,332	7	376	1	20
Ziphius cavirostris	3,306	48	359	13	148
Total	**7,923**	**69**	**2,319**	**16**	**660**

A bottlenose dolphin, Ttr_2-016, first sighted in June 2022 was re-sighted in July 2024, two years after its initial sighting (**Figure 1**). Prior to this field season, the study team had only one sperm whale re-sight, a sperm whale seen two days after its initial sighting in 2013. During 2024, the field team had re-sights of two additional sperm whales. Pma_022 was first seen off Cape Hatteras in August 2020 and it was re-sighted off Raleigh Bay in August 2024 (**Figure 2**). Ms. Waples compared the DUML sperm whale catalog to images collected by Dr. Doug Nowacek and colleagues during an acoustic survey for sperm whales made from the Research Vessel *Song of the Whale* and made a third photo-ID match. Dr. Nowacek first saw Pma_032 in May 2019, and it was biopsied and equipped with a Digital Acoustic Recording Tag. The field team re-sighted the sperm whale in August 2024, five years after its initial sighting (**Figure 3**). The team shared its images of this sperm whale with Jessica Aschettino at HDR, who also photographed this whale during HDR's 2020 field season within the Norfolk Canyon area.

In addition to the existing 12 photo-ID catalogs previously created for cetacean species within the Cape Hatteras area, the team created a new catalog during 2024. On 14 July 2024, the field team encountered and photographed what appears to have been a Bryde's whale (*Balaenoptera brydei*). It was identified as being a member of the Bryde's whale complex based on the three parallel ridges extending from the blowhole to the rostrum (**Figure 4** and **Figure 5**). Images were sent to Dr. Keith Mullins at the NOAA Southeast Fisheries Science Center, where they were compared to a catalog of Rice's whales (*Balaenoptera ricei*) from the Gulf of Mexico, but no photographic matches were made. Bryde's whales are extremely rare in the western North Atlantic, and the phylogeographic relationship between these whales and the closely related Rice's whale is unclear.

To date, therefore, the team has created photo-ID catalogs for 13 taxa within the Cape Hatteras study area, across multiple United States Navy Atlantic Fleet Training and Testing (AFTT) monitoring projects. These catalogs include more than 2,300 distinct individuals, with 660 individuals re-sighted across all species (**Table 2**).

Danielle Waples also compared the DUML photo-ID catalogs to images of stranded cetaceans along the North Carolina coast. During 2024 she searched for potential matches of a sperm whale and a humpback whale, which stranded along the North Carolina coast and were submitted by Marina Doshkov, the Marine Mammal Stranding Coordinator at Jennette's Pier Aquarium, Nags Head, North Carolina. She also compared images of five sperm whales that stranded in southwestern Florida that were submitted by Emily Cramer, a Marine Mammal Research Biologist at the Florida Fish and Wildlife Conservation Commission. No matches were made to either of the catalogs, but Ms. Waples will continue to compare stranded cetacean images to the catalogs when they are submitted.

Figure 1. Photographs of Ttr_2-016, initially sighted in June 2022 (top) and re-sighted in July 2024 (bottom).

Figure 2. Photographs of Pma_022, initially sighted in August 2020 (top) and re-sighted in August 2024 (bottom).

Figure 3. Photographs of Pma_032, initially sighted in May 2019 (top) and re-sighted in August 2024 (bottom).

Figure 4. Photograph of Bbr_001 taken in July 24; note the presence of three rostral ridges.

Figure 5. Photograph of Bbr_001, submitted to Dr. Keith Mullin for comparison to the catalog of Rice's whales.

1.1 Goose-Beaked Whales

The study team added 47 new identifications to DUML's goose-beaked whale photo-ID catalog during 2024. Another 13 whales were re-sighted for the first time. The current re-sighting rate for goose-beaked whales within the Cape Hatteras area is 41 percent. To date, 101 of the 148 (68 percent) re-sighted goose-beaked whales have been documented in multiple years, and 57 have been re-sighted more than three years after their initial sighting (**Table 3**; tables and figures are provided at the end of this subsection). Four goose-beaked whales were satellite tagged during 2024; none of these tagged whales had prior photo-ID histories.

The goose-beaked whale sighted most frequently is Zca_049, which has been photographed on 13 occasions from 2018 to 2023 and satellite-tagged in 2021 (ZcTag114; **Table 4**). Two goose-beaked whales share the longest interval between re-sightings of eight to nine years (**Table 5**). Zca_016 was first photographed by the University of North Carolina Wilmington (UNCW) aerial survey team in August 2014. It was re-sighted by the team in 2015, 2019, 2020, 2022 and notably in July 2023, when it was accompanied by a calf. Over a nearly nine-year period, this female acquired few if any scars (**Figure 6**). Zca_024 was satellite-tagged in May 2016 (ZcTag046); at that time, it already had erupted teeth. It was seen again in 2017 and in 2020 when it was equipped with a second satellite tag (ZcTag103) and was photographed again in July 2024. It appears that both adult males and females exhibit site fidelity to the Cape Hatteras area.

Over the course of this project, the team has observed individual goose-beaked whales associating in the same groups over days to weeks, but observations of long-term social associations continue to be rare. Previously, only four instances of a long-term association had been documented: two adult male pairs and two adult male and adult female pairs. The study team found an additional long-term association this year. The team observed Zca_049, an adult male, with Zca_080r in May 2018 and June 2023. In 2023, Zca_080r was accompanied by a calf, confirming she is an adult female. This is the third long-term association the study team has observed between an adult male and an adult female.

Danielle Waples is continuing to compare images of goose-beaked whales off Cape Hatteras to five other catalogs created from images contributed by: (1) UNCW aerial survey team; (2) pelagic seabird trips conducted by Kate Sutherland and Brian Patteson aboard the *Stormy Petrel* off Cape Hatteras; (3) HDR researchers near Norfolk Canyon; (4) aerial surveys by the New England Aquarium at the Northeast Canyons and Seamounts Marine National Monument in 2017 and 2023; and (5) Lesley Thorne and Joshua Meza-Fidalgo at Stony Brook University in 2019 during boat-based surveys along the shelf break off New York (**Table 6**). Ms. Waples continues to maintain these goose-beaked whale catalogs for the Northwest Atlantic.

The researchers had previously made nine photo-ID matches between four of the catalogs; the three longest-term re-sightings of goose-beaked whales are derived from these inter-catalog comparisons. These include: a match between the Cape Hatteras and UNCW catalogs of an adult female with eight years between re-sightings; a match between the Cape Hatteras and *Stormy Petrel* catalogs of an adult male, first photographed by Kate Sutherland in 2010 and satellite-tagged by Duke researchers 10 years later in August 2020; and an adult male photographed by Kate Sutherland in May 2004 and satellite-tagged by the Duke team in July

2019, 15 years after its first sighting. The researchers made an additional inter-catalog match during this reporting period. Kate Sutherland photographed Zca_029 off Oregon Inlet in July 2003. The field team satellite-tagged this adult male 14 years later in May 2017, and it was re-sighted again in August 2021 with two healed scars in the dorsal fin (**Figure 7**). This is currently the longest photo-ID match of a goose-beaked whale in the Northwest Atlantic.

Ms. Waples is planning to develop a sixth external goose-beaked whale catalog from aerial images collected by research staff at the Clearwater Marine Aquarium Research Institute (CMARI). The North Carolina aerial survey team flies from the Virginia-North Carolina border to the North Carolina-South Carolina border, up to 40 miles offshore, from mid-November to mid-April supporting the U.S. Army Corp of Engineers (USACE). These would be valuable images as the CMARI team works during winter months when the DUML team has little or no offshore effort, and the CMARI surveys cover an extensive geographic area. The team has received permission from the USACE for access to these images and is coordinating with Melanie White at CMARI as to how best share images and data.

During summer 2024, Maya Reilly, an undergraduate student at Duke University, examined the stability of goose-beaked whale social associations over time. She analyzed all re-sightings of individual goose-beaked whales, using the social analysis program SOCPROG, developed by Hal Whitehead (Dalhousie University, Halifax, Nova Scotia, Canada). SOCPROG produces a matrix of association indices for each pair of whales that ranges from 0.0 (animals never photographed together) to 1.0 (animals always photographed together). Ms. Reilly used SOCPROG to create a social network, using only whales with four or more re-sightings and an association index greater than 0.5 (**Figure 8**). No defined grouping was identified within the social network, unlike species with strong social bonds, such as killer whales (*Orcinus orca;* Weiss et al. 2020).

Kira Lichtenfeld, another undergraduate student at Duke University, investigated the rate of wound healing in goose-beaked whales off Cape Hatteras. Ms. Lichtenfeld examined photographs of individuals with new wounds, caused by conspecifics, and followed the process of wound healing. She characterized new wounds as being open with broken skin, appearing textured, often pink or orange and sometimes containing pus (**Figure 9**). She calculated the number of days between the sighting of a new wound and subsequent re-sightings, and scored whether the wound had healed, characterized by a flat white scar (**Figure 10**). She found that the shortest healing time of a wound was 35 days. This information is useful in defining scar acquisition rate over time.

Ms. Lichtenfeld also used her analysis to determine if there is seasonality to the acquisition of new wounds and calculated the rate of wound acquisition for each month (**Figure 11**). The results were not statistically significant but suggested a trend of increased wound acquisition rate during August. More data are needed, but Ms. Lichtenfeld's results suggest that there may be some seasonality to reproduction, because new wounds on adult males likely reflect agonistic social interactions during competition for mates (MacLeod 1998). More data are needed from winter months when little field effort occurs.

Danielle Waples presented a poster, co-authored by Will Cioffi, Zach Swaim, and Andy Read, at the 25th Biennial Conference on the Biology of Marine Mammals held in Perth, Western Australia from 11 to 15 November 2024. The title of the poster was "Goose-beaked whales (*Ziphius cavirostris*) off Cape Hatteras, North Carolina, USA live in a fission-fusion society." The aim of the poster was to provide insights into the social structure of goose-beaked whales off Cape Hatteras. The authors calculated catalog size and photo-ID re-sight rates, both within and between years, and the range of group sizes. The authors calculated fission-fusion events (joins and exits into or out of a group) by comparing the identities of individuals in sequential sightings of groups. The authors focused on groups re-sighted the day after their initial sighting and found an average of 4.3 joins/exits per day (±3.5). This rate is much lower than published rates from other odontocetes that exhibit fission-fusion societies, such as Indo-Pacific bottlenose dolphins (*Tursiops aduncus*), for which joins/exits have been calculated as 5.3 (±0.21) per hour (Galezo et al. 2018). The authors concluded that goose-beaked whales off Cape Hatteras live in a fission-fusion society, in which long-term associations are rare, but short-term associations of days to weeks are common. The author's findings provide important new information on the social structure of this goose-beaked whale population that can be used to evaluate their social responses to mid-frequency sonar.

Table 3. Sighting histories of goose-beaked whales re-sighted over multiple years within the Cape Hatteras study area, 2003–2024.

ID[a]	Year[b]															
	2003	2004	2010	2011	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Zca_001r	—	—	—	—	X	—	X	—	—	—	—	—	—	—	—	—
Zca_002 (ZcTag074)	—	—	—	—	X	—	—	—	—	X^m	X^m	—	—	—	—	—
Zc_003 (ZcTag124)	—	—	—	—	—	X	—	—	—	X	—	—	X^y	—	—	—
Zca_003r (ZcTag029)	—	—	—	—	—	X^m	—	—	—	X	—	—	—	—	—	—
Zca_005	—	—	—	—	—	X	X	—	X	—	—	—	—	—	—	—
Zca_006 (ZcTag040)	—	—	—	—	—	X	X	—	X	X	—	X	—	—	—	—
Zca_008r (ZcTag047)	—	—	—	—	—	X^y	—	X^m	X^y	X^y	—	—	—	—	—	—
Zca_011r (ZcTag070)	—	—	—	X	—	—	—	—	—	X^m	—	—	—	—	—	—
Zca_015 (ZcTag039, ZcTag077)	—	—	—	—	—	—	X	—	—	X	—	—	—	—	—	—
Zca_016 (UNCW M-003)	—	—	—	—	—	X	X	—	—	—	X	X	—	X	X	—
Zca_017	—	—	—	—	—	—	X	—	—	—	—	—	—	X		—
Zca_019 (ZcTag043)	—	—	—	—	—	X	X	—	—	—	—	—	—	—	—	—
Zca_020	—	—	—	—	—	—	X	—	—	—	X	—	X	—	—	—
Zca_022	—	—	—	—	—	—	X	—	—	—	—	X	—	—	—	—
Zca_023r	—	—	—	—	—	—	X	—	—	—	X^y	—	—	—	—	—
Zca_024 (ZcTag046, ZcTag103)	—	—	—	—	—	—	—	X	X	—	—	X^m	—	—	—	X
Zca_026	—	—	—	—	—	—	—	X	—	—	—	—	X^y	—	—	—
Zca_027r (ZcTag129)	—	—	—	—	—	—	X	—	—	X	—	X	X	X	—	—
Zca_028 (ZcTag051)	—	—	—	—	—	—	—	X	—	—	—	—	X^m	—	—	—
Zca_029 (ZcTag054)	—	—	—	—	—	—	—	—	X^y	—	—	—	X^y	—	X^m	—
Zca_030 (ZcTag055)	—	—	—	—	—	—	—	—	X^y	—	X^m	X	—	—	—	—
Zca_031 (ZcTag056)	—	—	—	—	—	—	—	—	X	—	X	X^y	X^y	—	X^m	—
Zca_032	—	—	—	—	—	—	—	—	X	X^m	—	—	—	—	—	—

ID[a]	Year[b]															
	2003	2004	2010	2011	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Zca_033	—	—	—	—	—	—	—	—	X	—	—	X	—	—	X	—
Zca_034 (ZcTag126)	—	—	—	—	—	—	—	—	X	—	—	—	X[m]	—	—	—
Zca_035 (ZcTag076)	—	—	—	—	—	—	—	—	X	X[y]	—	X	X	—	—	—
Zca_035r (ZcTag048)	—	—	—	—	—	—	—	X		X	—	—	—	—	—	—
Zca_036	—	—	—	—	—	—	—	—	X	—	—	—	X[y]	—	—	—
Zca_037 (ZcTag068)	—	—	—	—	—	—	—	—	X[y]	—	—	X	—	—	—	—
Zca_038	—	—	—	—	—	—	—	—	X	X	—	—	X	—	—	—
Zca_039	—	—	—	—	—	—	—	—	X	X	—	—	—	—	—	—
Zca_040	—	—	—	—	—	—	—	—	X[y]	—	X	—	—	—	—	—
Zca_043	—	—	—	—	—	—	—	—	X	—	—	X	—	—	—	—
Zca_044r	—	—	—	—	—	—	—	X	—	X[m]	—	X	—	—	—	—
Zca_046r	—	—	—	—	—	—	—	X	—	—	—	X	—	—	—	—
Zca_048	—	—	—	—	—	—	—	—	X	—	X[m]	—	—	—	—	—
Zca_049 (ZcTag114)	—	—	—	—	—	—	—	—	—	X	—	—	X[y]	X	X[y]	—
Zca_050 (ZcTag078)	—	—	—	—	—	—	—	—	—	X[y]	—	—	X	—	—	—
Zca_050r (ZcTag057)	—	—	—	—	—	—	—	—	X	X	—	—	—	—	—	—
Zca_051r (ZcTag058)	—	—	—	—	—	—	—	—	X[y]	X[m]	—	—	—	—	—	—
Zca_052 (ZcTag084)	—	—	—	—	—	—	—	—	—	X	X[m]	X[m]	—	—	X	X
Zca_054 (ZcTag080)	—	—	—	—	—	—	—	—	—	X[m]	—	—	X	—	—	—
Zca_054r (ZcTag049, ZcTag099)	—	—	—	—	—	—	—	X	X[y]	—	X	X[y]	—	—	—	—
Zca_055 (ZcTag071)	—	—	—	—	—	—	—	—	—	X	—	X[m]	—	—	—	—
Zca_056 (ZcTag072)	—	—	—	—	—	—	—	—	—	X	—	X[m]	X	—	X	X
Zca_057 (ZcTag079)	—	—	—	—	—	—	—	—	—	X	—	—	—	X	—	—
Zca_058	—	—	—	—	—	—	—	—	—	X	X	—	—	—	—	—
Zca_059	—	—	—	—	—	—	—	—	—	X[y]	—	—	X	—	X	—
Zca_059r	—	—	—	—	—	—	—	—	X	X[y]	—	—	—	—	—	—

ID[a]	Year[b]															
	2003	2004	2010	2011	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Zca_061	—	—	—	—	—	—	—	—	—	X	X	—	—	—	—	—
Zca_063 (ZcTag098)	—	—	—	—	—	—	—	—	—	X[m]	—	X[y]	—	—	—	—
Zca_065	—	—	—	—	—	—	—	—	—	X	X	—	X	X	—	—
Zca_066	—	—	—	—	—	—	—	—	—	X[m]	—	—	X[m]	—	—	—
Zca_067	—	—	—	—	—	—	—	—	—	X	—	—	—	X	—	—
Zca_067r (ZcTag060)	—	—	—	—	—	—	—	—	X	—	—	X	X	—	—	—
Zca_068r	—	—	—	—	—	—	—	—	X	—	—	—	X[m]	—	—	—
Zca_071r (ZcTag081)	—	—	—	—	—	—	—	—	X	X[m]	—	—	—	—	X	—
Zca_072	—	—	—	—	—	—	—	—	—	—	X	—	X	—	X	—
Zca_074	—	—	—	—	—	—	—	—	—	—	X	—	X	—	—	—
Zca_074r	—	—	—	—	—	—	—	—	X	X	—	—	X[y]	—	X	—
Zca_075	—	—	—	—	—	—	—	—	—	—	X	X[m]	—	—	—	—
Zca_076	—	—	—	—	—	—	—	—	—	—	X[y]	X[y]	—	—	—	—
Zca_077r (ZcTag085)	—	—	—	—	—	—	—	—	—	X	C	—	—	—	—	—
Zca_078 (ZcTag089, ZcTag109)	—	—	—	—	—	—	—	—	—	—	X	X	—	—	—	—
Zca_079	—	—	—	—	—	—	—	—	—	—	X	—	—	—	X	—
Zca_080	—	—	—	—	—	—	—	—	—	—	X	—	X	—	—	—
Zca_080r	—	—	—	—	—	—	—	—	—	X	—	—	—	—	X[y]	—
Zca_082r	—	—	—	—	—	—	—	—	—	X[y]	X	—	X	—	—	—
Zca_083	—	—	—	—	—	—	—	—	—	—	X	X	—	X	—	—
Zca_085 (ZcTag090)	—	—	—	—	—	—	—	—	—	—	X[m]	—	—	—	—	X
Zca_086 (ZcTag091)	—	—	—	—	—	—	—	—	—	—	X[m]	—	X[y]	—	—	
Zca_091 (ZcTag095)	—	—	—	—	—	—	—	—	—	—	X[m]	X	—	—	—	—
Zca_092 (ZcTag096, ZcTag112)	—	—	—	—	—	—	—	—	—	—	X[m]	—	X	—	X	—
Zca_096r	—	—	—	—	—	—	—	—	—	X[m]	—	—	X	—	—	—

ID[a]	Year[b]															
	2003	2004	2010	2011	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Zca_097r	—	—	—	—	—	—	—	—	X	X[m]	—	X[y]	—	—	—	—
Zca_098 (ZcTag102, ZcTag 143, SP M-001)	—	—	—	—	—	—	—	—	—	X	—	X[m]	X[m]	—	X	—
Zca_099	—	—	—	—	—	—	—	—	—	—	—	X	X[m]	—	—	—
Zca_099r (ZcTag083)	—	—	—	—	—	—	—	—	—	X[m]	X	—	—	—	—	—
Zca_104 (ZcTag108)	—	—	—	—	—	—	—	—	—	—	—	X[m]	—	X	X	—
Zca_106	—	—	—	—	—	—	—	—	—	—	—	X	—	—	X	—
Zca_106r (ZcTag111)	—	—	—	—	—	—	—	—	—	X	—	X[m]	X	—	—	—
Zca_108r (ZcTag106)	—	—	—	—	—	—	—	—	—	X	—	X[y]	X	X	—	—
Zca_112r	—	—	—	—	—	—	—	—	—	X	—	X[y]	X	X	—	—
Zca_117r	—	—	—	—	—	—	—	—	—	X[y]	—	—	X	—	—	—
Zca_128 (ZcTag122)	—	—	—	—	—	—	—	—	—	—	—	—	X[y]	X	—	—
Zca_136	—	—	—	—	—	—	—	—	—	—	—	—	X	—	X	—
Zca_139	—	—	—	—	—	—	—	—	—	—	—	—	X	—	X	—
Zca_140r	—	—	—	—	—	—	—	—	—	—	X	—	X	—	—	—
Zca_142r	—	—	—	—	—	—	—	—	—	—	X	—	X	—	—	—
Zca_144	—	—	—	—	—	—	—	—	—	X	—	—	X	—	—	—
Zca_145	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—	—
Zca_145r	—	—	—	—	—	—	—	—	—	—	X	—	X	—	—	—
Zca_146r (ZcTag101)	—	—	—	—	—	—	—	—	—	—	X	X[m]	X	—	—	—
Zca_157r	—	—	—	—	—	—	—	—	—	—	X	X	X[y]	—	—	—
Zca_162r (ZcTag104)	—	—	—	—	—	—	—	—	—	—	—	X[m]	X	—	—	—
Zca_166r (ZcTag110)	—	—	—	—	—	—	—	—	—	—	—	X[m]	X	—	—	—
Zca_167r	—	—	—	—	—	—	—	—	—	—	—	X	X[m]	—	—	—
Zca_173r	—	—	—	—	—	—	—	—	—	—	—	X	X	—	—	—
Zca_182r	—	—	—	—	—	—	—	—	—	—	—	X[y]	X	—	—	—

ID[a]	Year[b]															
	2003	**2004**	**2010**	**2011**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
Zca_185r (ZcTag116)	—	—	—	—	—	—	—	—	—	—	—	X	X^y	—	—	—
Zca_198r	—	—	—	—	—	—	—	—	—	—	—	—	X^y	X	—	X
UNCW M-004	—	—	—	—	X	—	—	—	X	—	—	—	—	—	—	—
SP M-002 (ZcTag127)	—	—	—	—	—	—	—	—	—	X	—	—	X	—	—	—
SP M-003 (ZcTag090)	—	X	—	—	—	—	—	—	—	—	X	—	—	—	—	—
SP M-004 (ZcTag108)	—	—	X	—	—	—	—	—	—	—	—	X^m	—	—	—	—
SP M-005	—	—	—	—	—	—	—	—	—	—	X	—	—	—	X	—
SP M-006 (ZcTag054)	X	—	—	—	—	—	—	—	X	—	—	—	X	—	—	—
HDR M-001	—	—	—	—	—	—	—	—	—	—	—	X	—	X	—	—

[a] ID = Identification; Zca = *Ziphius cavirostris*; UNCW M = aerial-vessel matches to University of North Carolina Wilmington catalog; SP M = matches made to the Sutherland/Patteson catalog from seabirding trips south of Cape Point; HDR M = matches made to the HDR catalog from vessel research trips offshore Norfolk, Virginia; r = goose-beaked whales that are identified by scarring patterns (rake marks).

[b] X = sighted; X^m = re-sighted within same month; X^y = re-sighted within same year

Table 4. Frequency distribution of the number of sightings of photo-identified goose-beaked whales within the Cape Hatteras study area.

Number of Sightings	Number of Individuals
1	211
2	56
3	34
4	19
5	12
6	13
7	6
8	2
9	2
10	2
11	1
12	0
13	1
Total	**359**

Table 5. Frequency distribution of the number of years between first and last sightings of re-sighted goose-beaked whales within the Cape Hatteras study area.

Number of Years Between First and Last Sighting	Number of Individuals
Less than 1	47
1 to 2	26
2 to 3	18
3 to 4	21
4 to 5	11
5 to 6	10
6 to 7	10
7 to 8	3
8 to 9	2
Total	**148**

Table 6. Location and contributor of goose-beaked whale catalogs created; includes number of individuals in each catalog and years when the images were collected.

Catalog Descriptor[a]	Research Location	Contributor(s)	Years Images Collected	Number of Individuals
SP catalog	South of Cape Point, North Carolina	Kate Sutherland/ Brian Patteson	2003–2023	21
DUML catalog	Cape Hatteras, North Carolina	Andy Read	2007–2024	359
UNCW catalog	Cape Hatteras, North Carolina Aerial Surveys	Bill McLellan	2012–2017	51
NEAQ catalog	Northeast Canyons and Seamounts Marine National Monument Aerial Surveys	Orla O'Brien	2017–2023	7
HDR catalog	Norfolk, Virginia	Jessica Aschettino	2019–2022	3
SBU catalog	New York Shelf Break, New York	Lesley Thorne/ Josh Meza-Fidalgo	2019	4

[a] SP catalog = Sutherland/Patteson catalog from seabird trips south of Cape Point; DUML catalog = Duke University Marine Lab catalog from research trips off Cape Hatteras; UNCW catalog = University of North Carolina Wilmington catalog made from aerial surveys; NEAQ catalog = New England Aquarium Northeast Canyons and Seamounts Marine National Monument catalog from aerial surveys; HDR catalog = HDR catalog from research trips offshore Norfolk, Virginia; SBU catalog = Stony Brook University catalog from research trips off the New York shelf break

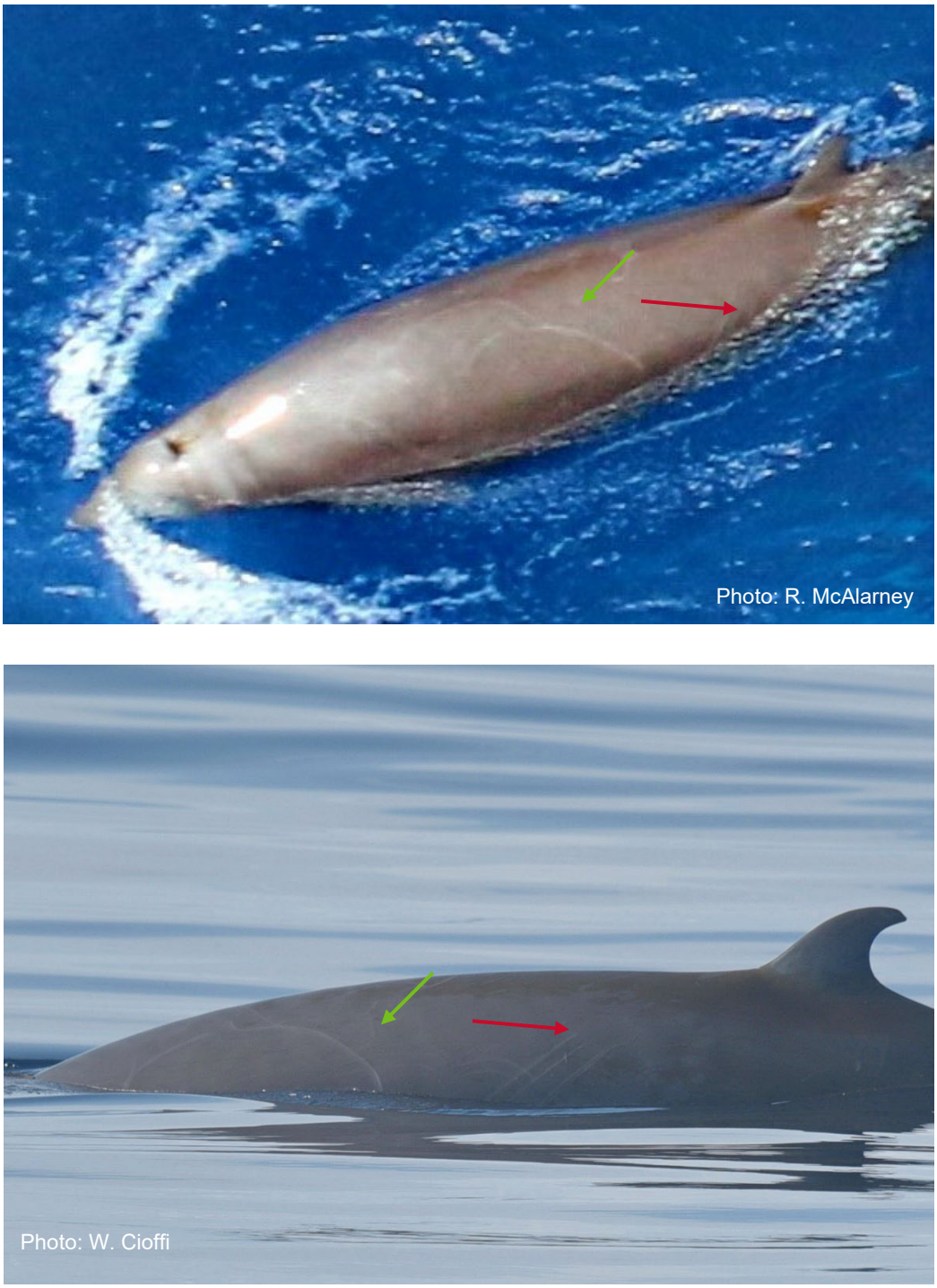

Figure 6. **Photographs of Zca_016 first seen by the UNCW aerial survey team in August 2014 (top) and most recent re-sight by Duke researchers in July 2023 (bottom). Note that few, if any, scars were acquired during that time.**

Figure 7. Photographs of Zca_029, initially seen in July 2003 (top), satellite-tagged in May 2017 (ZcTag054; middle) and re-sighted in August 2021 (bottom).

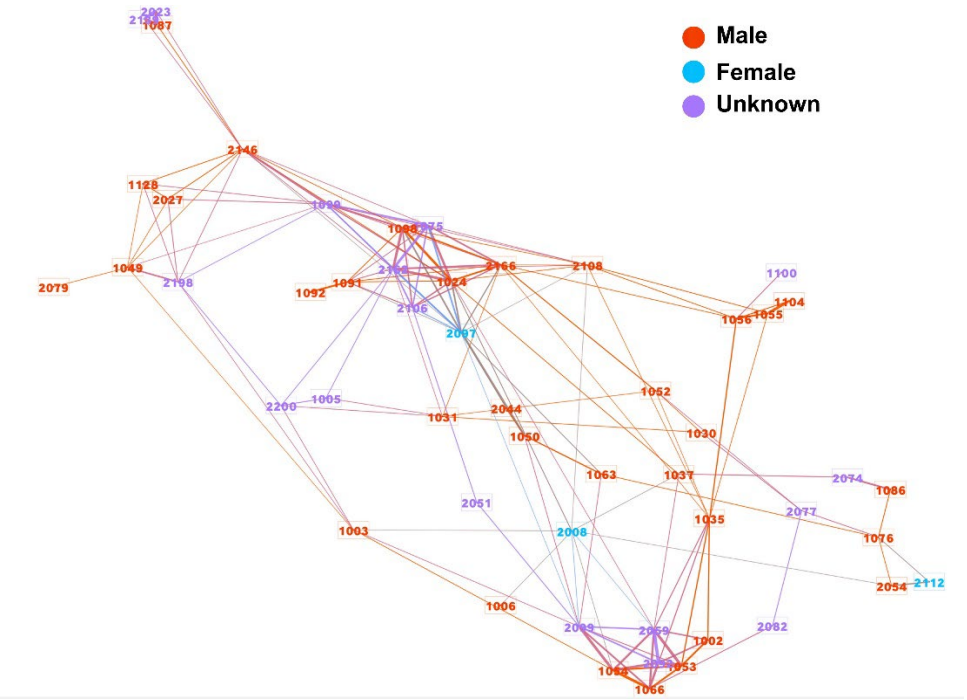

Figure 8. Social network of goose-beaked whales off Cape Hatteras, created by Maya Reilly (Duke University) using SOCPROG.

Figure 9. New wound on Zca_031 photographed on 18 August 2020; the wound is characterized by textured broken pink skin.

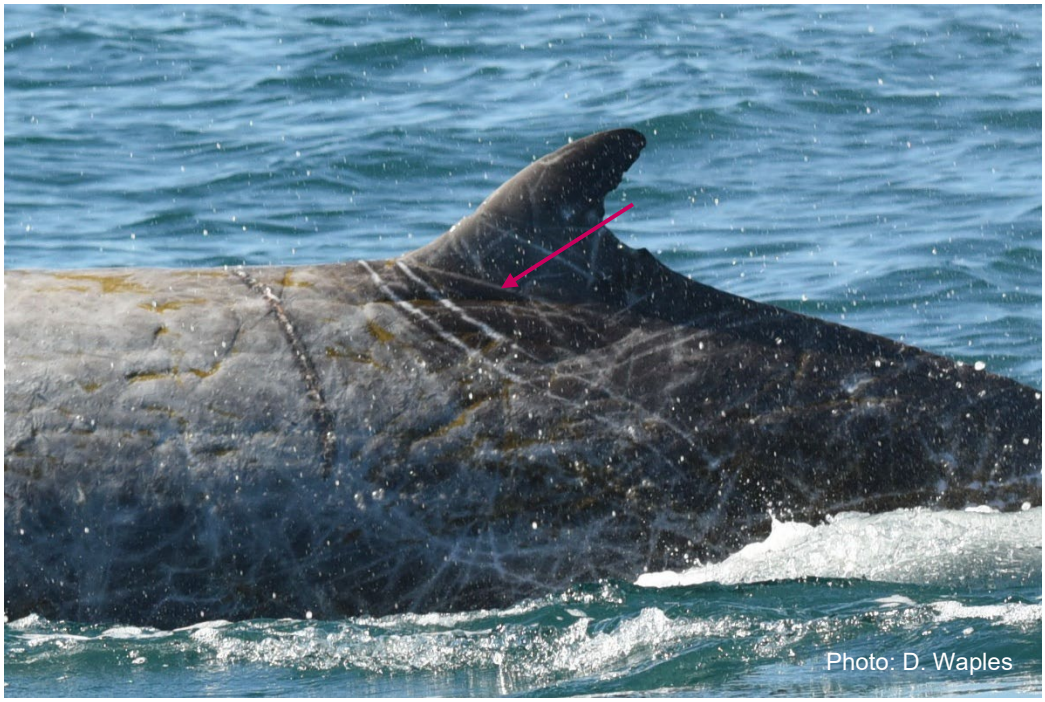

Figure 10. Healed scar on Zca_031 photographed on 01 October 2020; the scar is closed, flat and white in appearance. Note that an additional new wound is anterior to the healed scar.

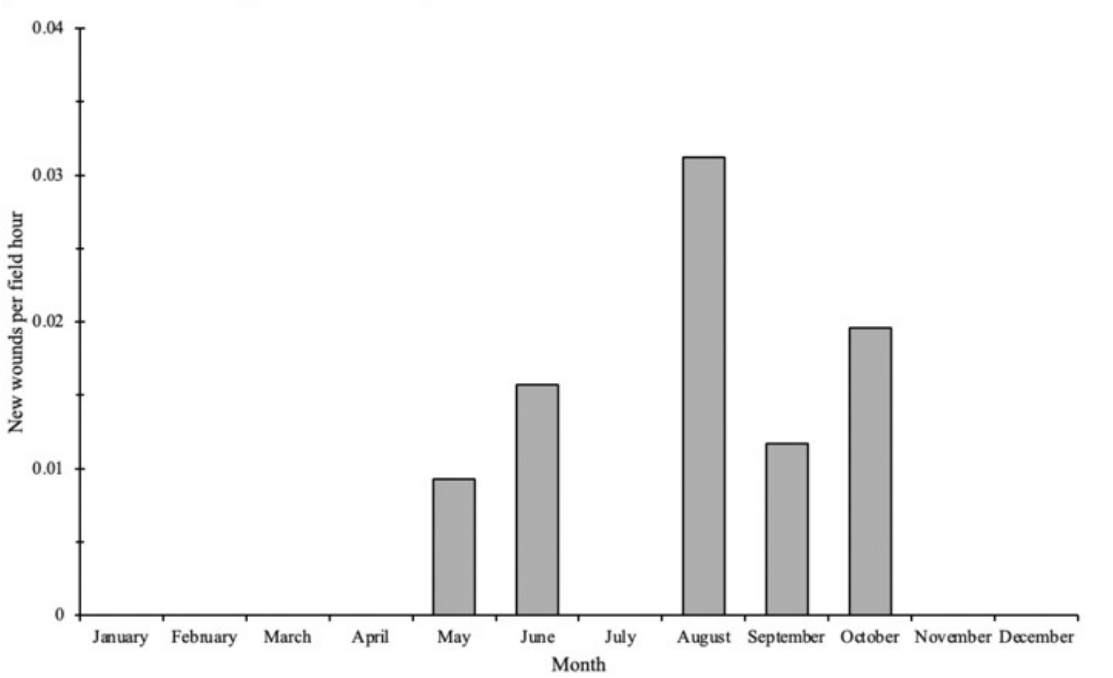

Figure 11. New wounds acquired by goose-beaked whales per field effort by month; figure created by Kira Lichtenfeld (Duke University).

1.2 Short-Finned Pilot Whales

The team added two new identifications to the short-finned pilot whale catalog during 2024; the team did not re-sight any new individuals but did photograph animals in 2024 that had been previously re-sighted. The current re-sighting rate of this species is 34 percent, unchanged from 2023. More than 200 short-finned pilot whales have been photographed on three or more occasions, and 24 animals have been re-sighted more than six times (**Table 7**; tables and figures are provided at the end of this subsection). The short-finned pilot whale most frequently re-sighted is Gma_6-078, an animal that has been photographed on 12 occasions over a 17-year period. It was first seen May 2007 and re-sighted multiple times in 2008 and 2015; it was re-sighted again in 2018, when it was equipped with a satellite tag (GmTag218) and finally seen again in May 2024 (**Figure 12**).

Short-finned pilot whales return to or are resident within the Cape Hatteras study area over extended periods. More than 120 pilot whales have spans of at least five years between their first and last sightings, and 26 pilot whales have records that span a decade or more (**Table 8**). In addition to the 17-year re-sight mentioned above, another 17-year re-sight was made during this reporting period. Gma_6-097 was first seen in August 2007. It was re-sighted several times in 2010, again in 2015 and finally in May 2024 (**Figure 13**). These two 17-year re-sights are the longest found within the Cape Hatteras short-finned pilot whale catalog. These long-term photo-ID records demonstrate that short-finned pilot whales exhibit strong, but intermittent, site fidelity to the Cape Hatteras area.

The study team has documented many associations of short-finned pilot whales over long periods. For example, Gma_8-075 and Gma_9-094 were first photographed in the same group in May 2007 and were later seen together in December 2015. Four pilot whales (Gma_1-023, Gma_1-030, Gma_7-016, and Gma_7-112) were observed together in May 2008 and May 2015. Another two pilot whales (Gma_9-010 and Gma_9-118) were photographed in the same group four times between 2007 and 2014. During 2024 the team found two pilot whales that had been seen in the same group over a 16-year period. Gma_6-078 (mentioned above) and Gma_7-174 were seen together several times in 2008 and 2018 and were also seen together in 2024. This 16-year association is the longest that the team has documented in short-finned pilot whales off Cape Hatteras. These long-term associations confirm lasting social bonds in this strongly matrifocal species.

Danielle Waples completed a systematic comparison of the 13 newly identified short-finned pilot whales added to the Cape Hatteras photo-ID catalog in 2023, and the two whales from 2024, to catalogs for this species from Onslow Bay, North Carolina, and Jacksonville, Florida. No new matches were made between any of these catalogs. Ms. Waples has previously matched four pilot whales between the Cape Hatteras and Onslow Bay study areas. These four photo-ID matches are the only short-finned pilot whale matches documented between the Cape Hatteras and Onslow Bay catalogs. To date, no matches have been made between the Cape Hatteras and Jacksonville catalogs.

Jessica Aschettino provided images of short-finned pilot whales collected by HDR researchers during their 2024 field work within the Norfolk Canyon area. Approximately 900 images were graded for photographic quality and animal distinctiveness, and all images of sufficient quality and distinctiveness were then sorted by individual within each sighting. The best image for each individual was then compared to the existing Norfolk photo-ID catalog. A total of 4 new individuals were added to the Norfolk short-finned pilot whale catalog; this catalog currently contains 324 individuals (**Table 9**). No new re-sightings of a pilot whale within the Norfolk catalog occurred.

Ms. Waples compared the 4 new individuals in the Norfolk short-finned pilot whale catalog to the Cape Hatteras short-finned pilot whale catalog, which contains 1,390 individuals. No new matches were made between the catalogs; currently 47 matches exist between the Norfolk and Cape Hatteras catalogs. Ms. Waples also compared the new Norfolk pilot whale IDs to the short-finned pilot whale catalogs from Onslow Bay, North Carolina; Jacksonville, Florida; and Stony Brook University, New York, but did not make any matches.

Currently Ms. Waples has created short-finned pilot whale catalogs for six research locations (**Table 10**). She will continue to maintain and update these catalogs, as images are provided, and make inter-catalog comparisons for short-finned pilot whales. To date, 57 photo-ID matches have been made between these inter-catalog comparisons. DUML researchers look forward to receiving additional photographs from the contributors to increase understanding of the movements of short-finned pilot whales along the U.S. East Coast, Gulf of Mexico, and the Caribbean.

Table 7. Frequency distribution of the number of sightings of photo-identified short-finned pilot whales within the Cape Hatteras study area.

Number of Sightings	Number of Individuals
1	913
2	271
3	99
4	56
5	27
6	10
7	8
8	4
9	0
10	1
11	0
12	1
Total	**1,390**

Table 8. Frequency distribution of the number of years between first and last sightings of re-sighted short-finned pilot whales within the Cape Hatteras study area.

Number of Years Between First and Last Sighting	Number of Individuals
Less than 1	141
1 to 2	43
2 to 3	44
3 to 4	64
4 to 5	65
5 to 6	17
6 to 7	20
7 to 8	45
8 to 9	14
9 to 10	1
10 to 11	12
11 to 12	9
More than 12	5
Total	**480**

Table 9. Number of new identifications, re-sights within the Norfolk Canyon catalog, and matches to the Cape Hatteras catalog of short-finned pilot whales made during each field season by HDR researchers.

Field Season	New IDs	Catalog Size	Resights within NOR Catalog	Matches between NOR and HAT Catalogs
2015	84	84	0	11
2016	47	131	3	13
2017	48	179	3	13
2018	19	198	0	0
2019	32	230	1	3
2020	26	256	2	2
2021	26	282	1	1
2022	13	295	0	1
2023	25	320	1	3
2024	4	324	0	0
Total	**324**	**—**	**11**	**47**

Key: HAT = Cape Hatteras study area; ID = Identifications; NOR = Norfolk Canyon study area

Table 10. Location and contributor of short-finned pilot whale catalogs created for other research groups; includes number of individuals in each catalog and years when the images were collected.

Descriptor[a]	Research Location	Contributor(s)	Years Images Collected	Number of Individuals
GOM catalog	Gulf of Mexico	Keith Mullin	2003–2007	180
HAT catalog	Cape Hatteras, North Carolina	Andy Read	2006–2024	1,390
OSB catalog	Onslow Bay, North Carolina	Andy Read	2007–2013	24
JAX catalog	Jacksonville, Florida	Andy Read	2009–2018	52
HDR catalog	Norfolk Canyon, Virginia	Jessica Aschettino	2015–2024	324
SBU catalog	New York Shelf Break, New York	Lesley Thorne/ Josh Meza-Fidalgo	2018–2019	14

[a] GOM catalog = Catalog from NOAA research cruises in the Gulf of Mexico; HAT catalog = Duke University Marine Lab catalog from research trips off Cape Hatteras; OSB catalog = Duke University Marine Lab catalog from research trips off Onslow Bay; JAX catalog = Duke University Marine Lab catalog from research trips off Jacksonville; HDR catalog= HDR catalog from research trips offshore Norfolk; SBU catalog= Stony Brook University catalog from research trips off the New York shelf break

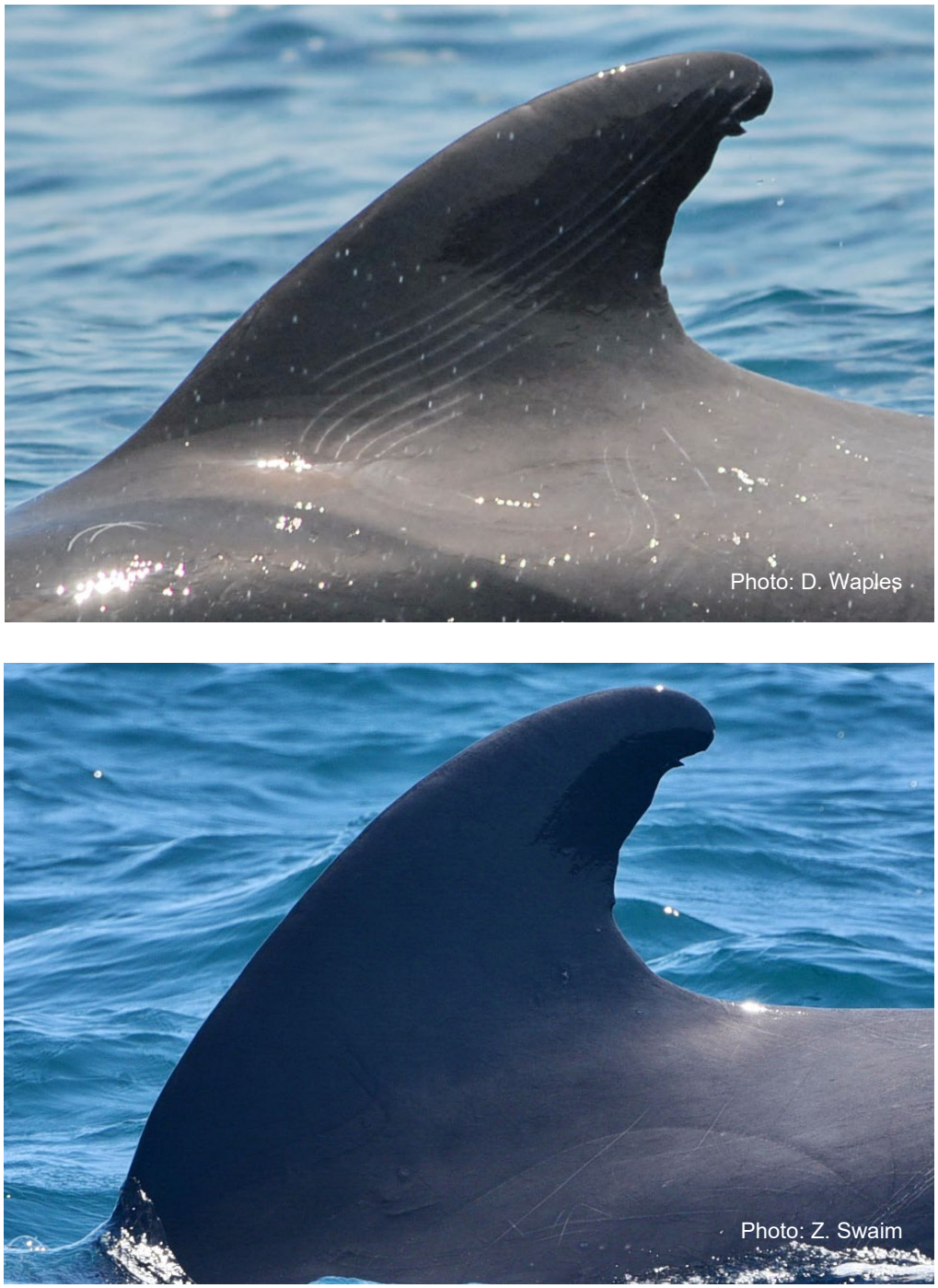

Figure 12. Photographs of Gma_6-078 in May 2007 (top) and May 2024 (bottom).

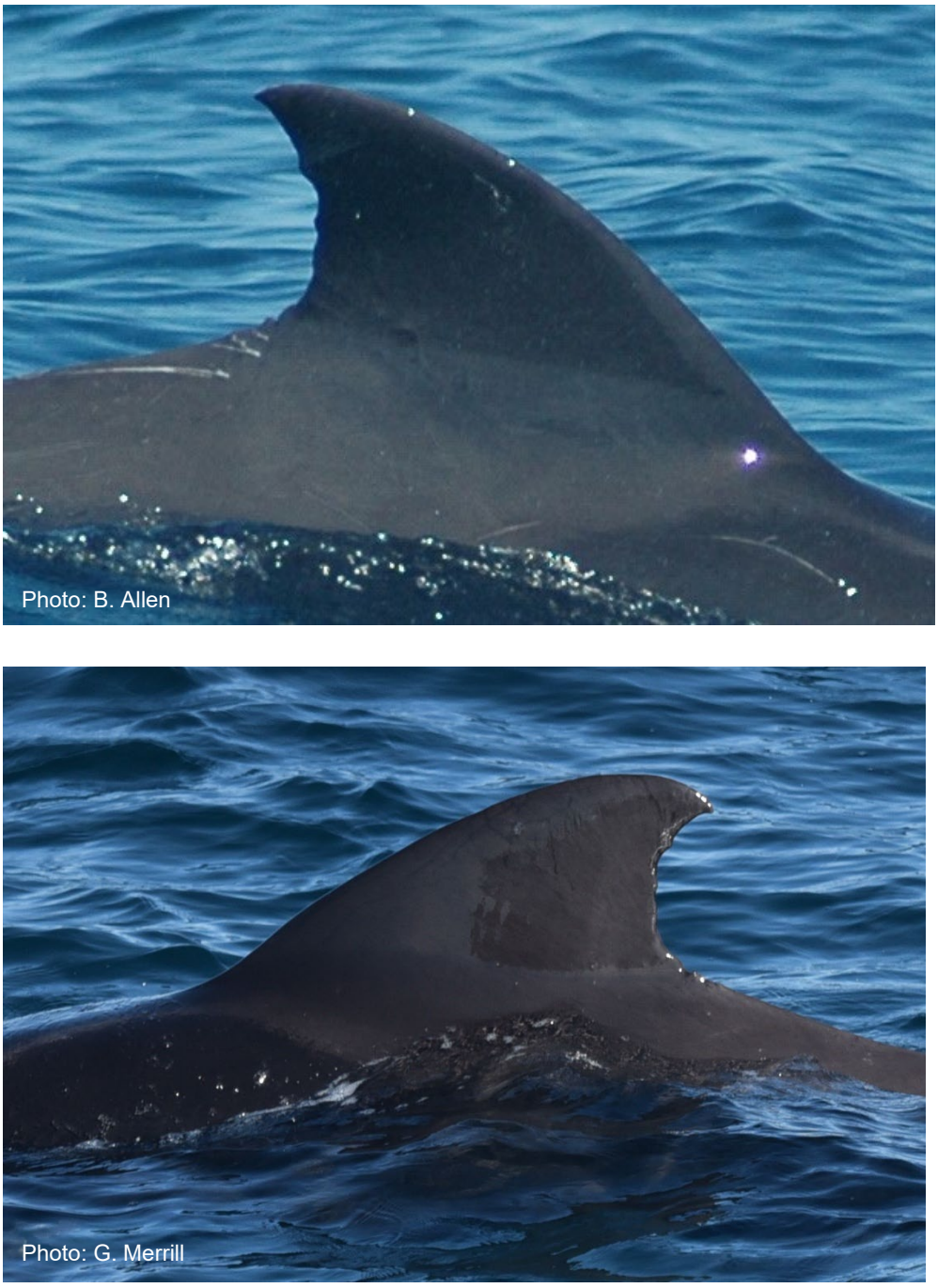

Figure 13. Photographs of Gma_6-097 in August 2007 (top) and May 2024 (bottom).

1.3 Satellite Tag Post-Deployment Monitoring

Follow-up monitoring of the health of satellite-tagged animals continues to be an important focus for the study team's photo-ID efforts. The field team has deployed 109 satellite tags on 103 individual goose-beaked whales between 2014 and 2024 and has re-sighted 70 of these animals (64 percent). Many re-sightings occurred within the same field season, but 41 whales (58 percent) were photographed at least one year after tagging (**Table 11**).

ZcTag090 was satellite-tagged in July 2019 and re-sighted once during that field season. It was not sighted again until July 2024 (**Figure 14**). Both the tag and hardware had been shed with only two small scars remaining. ZcTag121 was tagged in July 2021; it was re-sighted in June 2022 and still had the satellite tag and associated hardware, although the tag was no longer transmitting. It was photographed again in August 2024, and the tag and hardware had been shed, leaving two scars on the dorsal fin (**Figure 15**). It was accompanied by a small calf, confirming that this whale is an adult female.

During 2024, two goose-beaked whales were re-sighted for the first time since they were satellite-tagged (**Table 11**). ZcTag083 was tagged in May 2019 and not sighted again until it was photographed in July 2024 (**Figure 16**) The tag and hardware had been shed with two scars remining. Finally, ZcTag141, an adult male, was satellite-tagged in July 2023 and was photographed in August 2024. The tag and hardware had been shed and there was a new healed notch on the trailing edge of the dorsal fin. (**Figure 17**).

To date, the field team has deployed 80 satellite tags on 79 short-finned pilot whales off Cape Hatteras and resighted 31 of these animals (39 percent). Most of these re-sightings occurred within the same field season, but 12 (39 percent) occurred across multiple years (**Table 11**). One satellite-tagged short-finned pilot whale was re-sighted during this reporting period. GmTag218 had been photographed in 2007, 2008 and 2015; it was satellite-tagged in August 2018. It was photographed again in May 2024 (**Figure 18**). The tag and hardware had been shed and only a very small scar remained.

The DUML research team is continuing to work on their manuscript of the effects of satellite tags on goose-beaked whales and short-finned pilot whales, with Dr. Andrew Read as the lead author. The team is planning to submit this manuscript during 2025.

Table 11. Photo-ID sighting histories of cetaceans satellite-tagged and re-sighted within the Cape Hatteras study area.

ID[a]	Year[b]											
	2006–2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
GgTag017	—	—	—	X[m]	—	—	—	—	—	—	—	—
GmTag087	—	X[y]	—	—	—	—	—	—	—	—	—	—
GmTag089	—	X	X	—	—	—	—	—	—	—	—	—
GmTag091	X	X	X	—	—	—	—	—	—	—	—	—
GmTag096	X[y]	X	—	—	X	X[y]	—	—	—	—	—	—
GmTag097	X[y]	X	X	—	—	—	—	—	—	—	—	—
GmTag122	X		X[m]	—	—	—	—	—	—	—	—	—
GmTag127	—	—	X[m]	—	—	—	—	—	—	—	—	—
GmTag134	—	—	X	—	—	X	—	—	—	X	—	—
GmTag135	—	—	X[y]	—	—	X	X	—	—	X	—	—
GmTag136	X	—	X[y]	—	—	X[m]	—	—	—	—	—	—
GmTag140	—	—	X	—	X	—	—	—	—	—	—	—
GmTag157	—	—	—	X	X	—	—	—	—	—	—	—
GmTag172	—	—	—	—	X[m]	—	—	—	—	—	—	—
GmTag175	X	—	—	—	X[m]	—	—	—	—	—	—	—
GmTag176	X	—	—	—	X	—	—	X	—	—	—	—
GmTag179	—	—	—	—	X	X	—	—	—	—	—	—
GmTag182	—	—	—	—	X[m]	—	—	—	—	—	—	—
GmTag197	X	X	X	—	X	X[y]	—	—	—	—	—	—
GmTag198 (GmTag227)	X	—	—	—	—	X[y]	X[y]	—	—	—	—	—
GmTag199	—	—	—	—	—	X[m]	—	—	—	—	—	—
GmTag201	—	—	—	—	—	X[y]	—	—	—	X	—	—
GmTag203	—	—	—	—	—	X[y]	—	—	—	—	—	—
GmTag204	—	—	X[y]	—	—	X[y]	—	—	—	—	—	—
GmTag205	—	—	—	—	—	X[y]	—	—	—	—	—	—
GmTag206	—	—	—	—	—	X[y]	—	—	—	—	—	—
GmTag207	X[y]	—	X	—	—	X[m]	—	—	—	—	—	—
GmTag208	—	—	—	—	—	X[m]	—	—	—	—	—	—
GmTag216	—	—	—	—	—	X[m]	—	—	—	—	—	—
GmTag218	X[y]	—	X[m]	—	—	X[m]	—	—	—	—	—	X
GmTag223	X[y]	—	—	X	—	—	X[m]	—	—	—	—	—
GmTag226	—	—	—	—	—	—	X[y]	—	—	—	—	—
TtTag015	—	X[m]	—	—	—	—	—	—	—	—	—	—
ZcTag029	—	X[m]	—	—	—	X	—	—	—	—	—	—
ZcTag039 (ZcTag077)	—	—	X	—	—	X	—	—	—	—	—	—

ID[a]	Year[b]											
	2006–2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
ZcTag040	—	X	X	—	X	X	—	X	—	—	—	—
ZcTag046 (ZcTag103)	—	—	—	X	X	—	—	X[m]	—	—	—	X
ZcTag047	—	X[y]	—	X[y]	X[y]	X[y]	—	—	—	—	—	—
ZcTag048	—	—	—	X	—	X	—	—	—	—	—	—
ZcTag049 (ZcTag099)	—	—	—	X	X[y]	—	X	X[y]	—	—	—	—
ZcTag051	—	—	—	X	—	—	—	—	X[m]	—	—	—
ZcTag054	—	—	—	—	X[y]	—	—	—	X[y]	—	X[m]	—
ZcTag055	—	—	—	—	X[y]	—	X[m]	X	—	—	—	—
ZcTag056	—	—	—	—	X	—	X	X[y]	X[y]	—	X[m]	
ZcTag057	—	—	—	—	X	X	—	—	—	—	—	—
ZcTag058	—	—	—	—	X[y]	X[m]	—	—	—	—	—	—
ZcTag060	—	—	—	—	X	—	—	X	X	—	—	—
ZcTag062	—	—	—	—	X[m]	—	—	—	—	—	—	—
ZcTag069	—	—	—	—	—	X[y]	—	—	—	—	—	—
ZcTag071	—	—	—	—	—	X	—	X[m]	—	—	—	—
ZcTag072	—	—	—	—	—	X	—	X[m]	X	—	X	X
ZcTag073	—	—	—	—	—	X[y]	—	—	—	—	—	—
ZcTag074	X	—	—	—	—	X[m]	X[m]	—	—	—	—	—
ZcTag075	—	—	—	—	—	X[m]	—	—	—	—	—	—
ZcTag076	—	—	—	—	X	X[m]	—	X	X	—	—	—
ZcTag078	—	—	—	—	—	X[m]	—	—	X	—	—	—
ZcTag079	—	—	—	—	—	X	—	—	—	X	—	—
ZcTag080	—	—	—	—	—	X[m]	—	—	—	—	—	—
ZcTag081	—	—	—	—	X	X[m]	—	—	—	—	X	—
ZcTag082	—	—	—	—	—	—	X[y]	—	—	—	—	—
ZcTag083	—	—	—	—	—	X[y]	X	—	—	—	—	X
ZcTag084	—	—	—	—	—	X	X[m]	X[m]	—	—	X	X
ZcTag085	—	—	—	—	—	X	X[y]	—	—	—	—	—
ZcTag086	—	—	—	—	—	—	X[y]	X[y]	—	—	—	—
ZcTag088	—	—	—	—	—	—	X[m]	—	—	—	—	—
ZcTag089 (ZcTag109)	—	—	—	—	—	—	X	X	—	—	—	—
ZcTag090	—	—	—	—	—	—	X[y]	—	—	—	—	X
ZcTag091	—	—	—	—	—	—	X[m]	—	X	—	—	—
ZcTag092	—	—	—	—	—	—	X[y]	—	—	—	—	—
ZcTag093	—	—	—	—	—	—	X[y]	—	—	—	—	—
ZcTag095	—	—	—	—	—	—	X[m]	X	—	—	—	—

ID[a]	Year[b]											
	2006–2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
ZcTag096 (ZcTag112)	—	—	—	—	—	—	X[m]	—	X[y]	—	X	—
ZcTag097	—	—	—	—	—	—	X[m]	—	—	—	—	—
ZcTag098	—	—	—	—	—	X[m]	—	X[y]	—	—	—	—
ZcTag101	—	—	—	—	—	—	X	X[m]	X	—	—	—
ZcTag102 (ZcTag143)	—	—	—	—	—	—	—	X[m]	X[y]	—	X	—
ZcTag104	—	—	—	—	—	—	—	X[m]	X	—	—	—
ZcTag105	—	—	—	—	—	—	—	X[m]	—	—	—	—
ZcTag106	—	—	—	—	—	X	—	X[y]	X	X	—	—
ZcTag107	—	—	—	—	—	—	—	X[y]	—	—	—	—
ZcTag108	—	—	—	—	—	—	—	X[m]	—	X	X	—
ZcTag110	—	—	—	—	—	—	—	X[m]	X	—	—	—
ZcTag111	—	—	—	—	—	X	—	X[m]	X	—	—	—
ZcTag114	—	—	—	—	—	X	—	—	X[y]	X	X	—
ZcTag115	—	—	—	—	—	—	—	—	X[y]	—	—	—
ZcTag116	—	—	—	—	—	—	—	—	X[y]	—	—	—
ZcTag117	—	—	—	—	—	—	—	—	X[y]	—	—	—
ZcTag120	—	—	—	—	—	—	—	—	X[y]	—	—	—
ZcTag121	—	—	—	—	—	—	—	—	X[y]	X	—	—
ZcTag122	—	—	—	—	—	—	—	—	X[y]	X	—	—
ZcTag123	—	—	—	—	—	—	—	—	X[y]	—	—	—
ZcTag124	—	X	—	—	—	X	—	—	X[y]	—	—	—
ZcTag125	—	—	—	—	—	—	—	—	X[m]	—	—	—
ZcTag126	—	—	—	—	X	—	—	—	X[m]	—	—	—
ZcTag129	—	—	X	—	—	X	—	X	—	X[y]	—	—
ZcTag130	—	—	—	—	—	X	X	—	X	X[y]	—	—
ZcTag131	—	—	—	—	—	—	—	—	—	X[m]	—	—
ZcTag132	—	—	—	—	—	—	—	—	—	X	X	—
ZcTag135	—	—	—	—	—	—	—	—	—	X[m]	—	—
ZcTag136	—	—	—	—	—	—	—	—	—	—	X[m]	—
ZcTag137	—	—	—	—	—	—	—	—	—	—	X[y]	—
ZcTag141	—	—	—	—	—	—	—	—	—	—	X	X
ZcTag144	—	—	—	—	—	—	—	—	—	—	X[m]	—

[a] ID = identification; Gg = *Grampus griseus* (Risso's dolphin); Gm= *Globicephala macrorhynchus* (short-finned pilot whale); Tt = *Tursiops truncatus* (bottlenose dolphin); Zc = *Ziphius cavirostris* (goose-beaked whale)

[b] A red "X" denotes the year when satellite tagging occurred for that individual

X = sighted; X[m] = re-sighted within same month; X[y] = re-sighted within same year

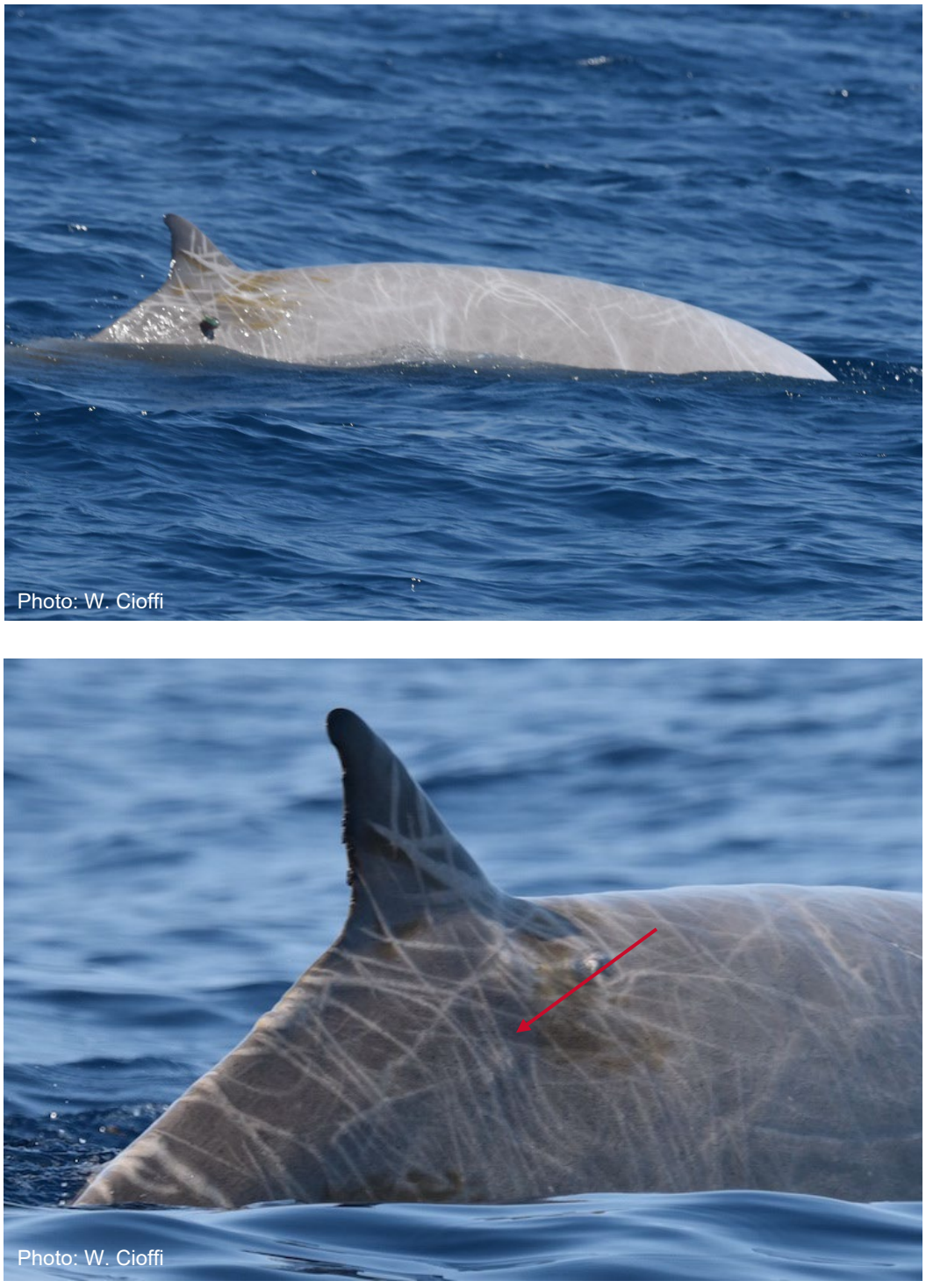

Figure 14. Photographs of ZcTag090 during satellite-tagging in July 2019 (top) and re-sight in July 2024 (bottom).

Figure 15. Photographs of ZcTag121 during satellite-tagging in July 2021 (top) and at re-sight in August 2024; note the healed scars on the dorsal fin (middle) and the young calf accompanying her (bottom).

Figure 16. Photographs of ZcTag083 during satellite-tagging in May 2019 (top) and re-sight in July 2024 (bottom).

Figure 17. Photographs of ZcTag141 during satellite-tagging in July 2023 (top) and re-sight in August 2024 (bottom).

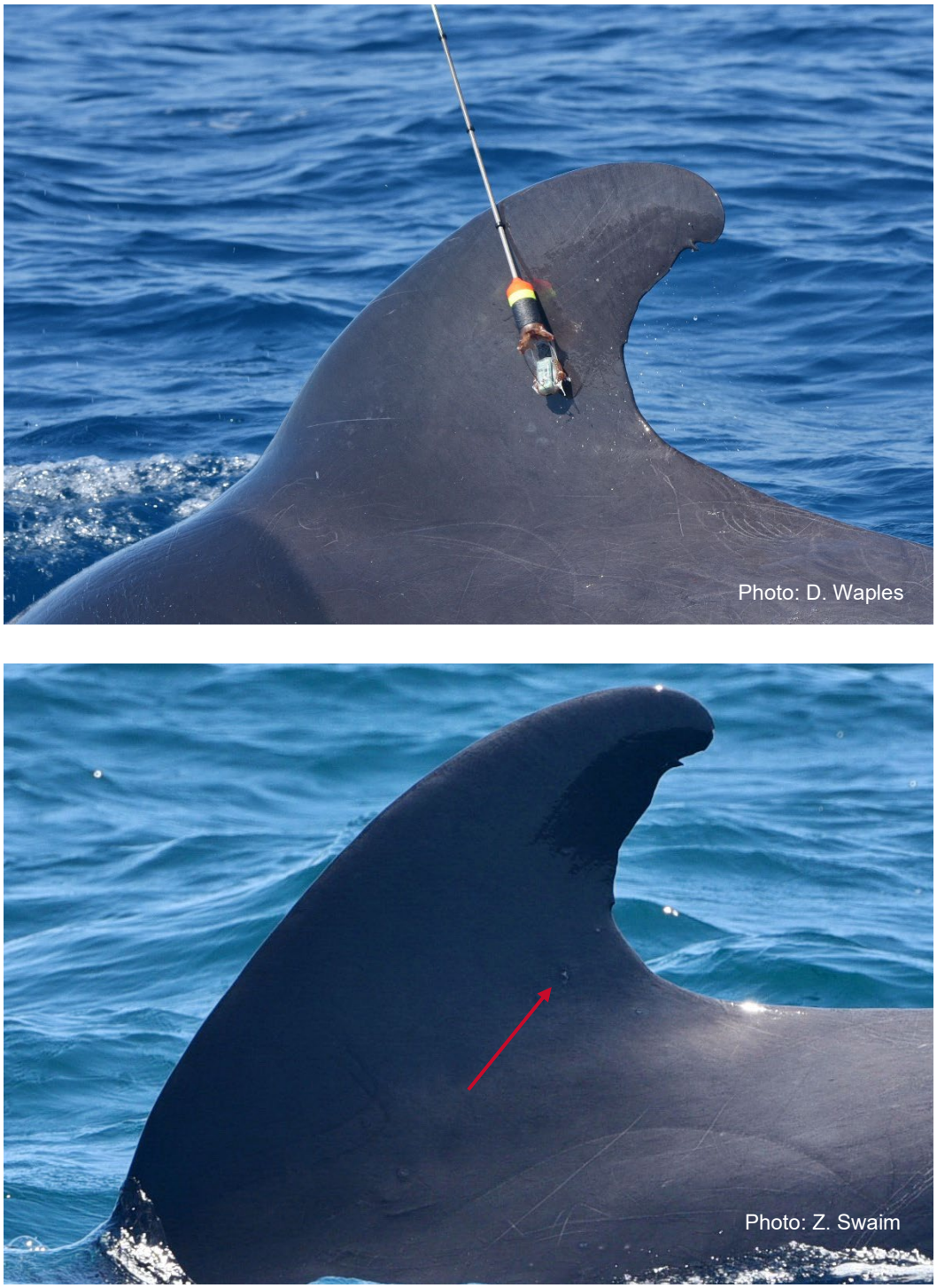

Figure 18. Photographs of GmTag218 during satellite-tagging in August 2018 (top) and re-sight in May 2024 (bottom); note the very small, healed scars at the base of the dorsal fin.

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