SC/68C/PH/03Rev01

Sub-committees/working group name: PH

Happywhale – Status of Data Collections with emphasis on Photo Identification of Humpback Whales (Megaptera novaeangliae)

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Happywhale – Status of Data Collections with emphasis on Photo Identification of Humpback Whales (*Megaptera novaeangliae*)

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In 2016 (SC/66b/SH/06), 2017 (SC/67A/PH/02) and 2018 (SC/67B/PH/05) we described development and status of Happywhale (www.happywhale.com), a web-based marine mammal photo ID crowd-sourcing platform online since August 2015. Since that time and especially with implementation of fast and accurate automated image recognition of humpback whale fluke photo-ID (Cheeseman, et al., in press, and submitted as 'for info' paper to IWC 2021), this web platform has seen wide adoption as a research collaboration platform for humpback whale fluke photo-ID, with greatest extent in the North Pacific Ocean. Here we present a brief statement of the status of data collections accessible via Happywhale.com.

Region	Ocean Basin	n =	Approximate capture probability
Entire basin	North Pacific Ocean	26,925 individuals in 109,925 ID'd encounters	> 60%*
East Australia	South Pacific Ocean	3750 individuals in 5199 ID'd encounters	> 25%**
Oceania	South Pacific Ocean	2267 individuals in 2841 ID'd encounters	(insufficient data to estimate)
Central and South American west coasts	South Pacific Ocean	3237 individuals in 4210 ID'd encounters	~ 30%**
West Antarctic Peninsula	South Pacific Ocean	4303 individuals in 6361 ID'd encounters	~ 30%**
Brazil	South Atlantic Ocean	442 individuals in 481 ID'd encounters	(insufficient data to estimate)
Scotia Sea	South Atlantic Ocean	306 individuals in 320 ID'd encounters	(insufficient data to estimate)
Southwest Africa	South Atlantic Ocean	296 individuals in 386 ID'd encounters	(insufficient data to estimate)
Entire basin	North Atlantic Ocean	5880 individuals in 9156 ID'd encounters	(no estimate made) ***
Southeast Africa	Indian Ocean	137 individuals in 145 ID'd encounters	(insufficient data to estimate)
Global		47,122 individuals in 142,654 ID'd encounters	(no estimate made)

Table 1. Global status of collections of photo-identified humpback whales. Collections are negligible for regions unrepresented in the table. Approximate capture probability conservatively estimates the likelihood of any adult captured within the region to be found within the known set of individuals within the full dataset. *In the North Pacific, this is the approximate minimum capture probability for any samples in the entire ocean basin photographed from 2000 to the present. **In the South Pacific, capture probabilities vary, with possible effort bias such as, for example, while a humpback whale sampled in coastal waters on the West Antarctic Peninsula has a consistent 30% chance of being known, for lack of data we cannot estimate the capture probability of humpback whales feeding in the Bellingshausen Sea. ***Due to an abundance of research groups in the North Atlantic with photo-ID catalogs in various states of mutual collaboration, we have not actively pursued a research agenda in the region and remain a resource for adoption and use as benefits any and all research efforts.

The immediate result of building a globally integrated humpback whale photo-ID dataset has been a number of unexpected long-range matches. Examples: West Antarctic Peninsula (WAP) to Nicaragua, the farthest northerly migration of any Antarctic mammal (De Weerdt et al., 2020), Ecuadorian to Brazilian breeding grounds (Felix et al., 2020), Straits of Magellan to WAP feeding areas (Acevedo et al., 2021), Brazil to WAP (Sousa-Lima et al., IWC 2021) and several others, manuscripts in preparation.

In the North Pacific, this rich, ocean-basin-wide high capture probability dataset creates a shift from data scarcity to data abundance for a wide-ranging migratory species. For example, as of March 2021, we have found 276 breeding ground interchanges between Hawaii and Mexico, about 3% of each area's population, where prior to this collaboration only about 20 such interchanges had been found, about 0.25% of previously compared datasets. The long-term nature of this dataset has opened new views of change in breeding ground-feeding ground associations over the lifetime of individuals, and may reveal the impact of in- and out-migration between population segments. In high sample-effort sub-regions such as Southeast Alaska, capture probabilities above 90% are enabling studies dependent upon a high recapture rate, such as body condition assessment between breeding and feeding grounds. This dataset is contributing to ongoing abundance and survival estimation by population and sub-populations.

Other cetacean data collections

98% of the Happywhale data collection consists of humpback whale encounters, the other 2%, 7133 of 149,797 global cetacean encounters, includes encounters of 62 species and ecotypes (Table 2). The data included here originates primarily from opportunistic citizen science contributions but also includes efforts from research collaborators. Collections of most species are trivial in number but in some cases, such as some beaked whale species and ecotype D killer whales, represent a substantial proportion of observations of the respective species. Unlike with humpback whales, Happywhale does not currently have automated photoidentification implemented for any of these species. Individual identification has been applied either (1) opportunistically, where contributors have notified Happywhale data managers of unique individuals, (2) from research collaborators with specific projects (Bryde's, Fin and Sei whales), or (3) through manual matching efforts by data managers. In particular, we would like to acknowledge and thank Emma Luck for volunteer efforts with all ecotypes of killer whales. Most encounters are supported by photo-documentation, with varying portions of these of sufficient quality for individual photo-ID. Examples of research use of opportunistic photo-ID data use include over a dozen individuals added to the Antarctic Blue Whale catalog (Olson *pers comm*) and is the finding of a southern right whale (*Eubalaena australis*) encountered both along the Antarctic Peninsula and off the island of South Georgia, the first recorded migratory connectivity for this area for the species (https://happywhale.com/individual/45049). This match was found by Amy Kennedy of the South Georgia Right Whale Project (Jackson et al., IWC 2021).

Species: Common name	Species: Latin name	Encounters	Individuals	Region (in general order of volume of collection)
Arnoux's Beaked Whale	*Berardius arnuxii*	6		Antarctic Peninsula and South Georgia
Atlantic Spotted Dolphin	*Stenella frontalis*	11		Atlantic, north and south
Atlantic White-sided Dolphin	*Lagenorhynchus acutus*	20		Atlantic, north
Baird's Beaked Whale	*Berardius bairdii*	3		Pacific, north
Beluga	*Delphinapterus leucas*	21		Arctic, North Pacific, North Atlantic
Blainville's Beaked Whale	*Mesoplodon densirostris*	4		Atlantic, north and south and Pacific, south
Blue Whale	*Balaenoptera musculus*	1008	54	Pacific, north and south, Atlantic, north and south, and Antarctic and Indian
Boto	*Inia geoffrensis*	1		Amazon
Bottlenose Dolphin	*Tursiops truncatus*	175	7	Global
Bowhead Whale	*Balaena mysticetus*	44	2	Arctic, North Pacific
Bryde's Whale	*Balaenoptera brydei*	86	53	Atlantic, south and Pacific, north
Chilean Dolphin	*Cephalorhynchus eutropia*	4		Chile, coastal
Clymene dolphin	*Stenella clymene*	2		Atlantic, south
Commerson's Dolphin	*Cephalorhynchus commersonii*	12		Atlantic, south
Common Dolphin	*Delphinus delphis*	57	3	Pacific, north and south, Atlantic, north, Black Sea
Cuvier's Beaked Whale	*Ziphius cavirostris*	4		Pacific, north and south, Atlantic, north
Dall's Porpoise	*Phocoenoides dalli*	26		Pacific, north
Deraniyagala's Beaked Whale	*Mesoplodon hotaula*	1		Indian Ocean
Dusky Dolphin	*Lagenorhynchus obscurus*	8		Argentina and Chile, coastal
False Killer Whale	*Pseudorca crassidens*	11		Pacific, north, Atlantic, north and south, and Indian
Fin Whale	*Balaenoptera physalus*	995	143	Pacific, north and south, Atlantic, north and south, and Mediterranean
Gray Whale	*Eschrichtius robustus*	1306	79	Pacific, north
Guiana Dolphin	*Sotalia guianensis*	2		Brazil

Species: Common name	Species: Latin name	Encounters	Individuals	Region (in general order of volume of collection)
Harbor Porpoise	*Phocoena phocoena*	73		Pacific, north, Atlantic, north
Hector's Dolphin	*Cephalorhynchus hectori*	2		New Zealand
Hourglass Dolphin	*Lagenorhynchus cruciger*	3		Atlantic, south
Indian Ocean Humpback Dolphin	*Sousa plumbea*	17	12	South Africa, Indian Ocean
Indo-Pacific Bottlenose Dolphin	*Tursiops aduncus*	1		Indian Ocean
Killer Whale - Antarctic Type A	*Orcinus orca*	61	10	Antarctic Peninsula, Atlantic, south, and Pacific, south
Killer Whale - Antarctic Type B1	*Orcinus orca*	55	4	Antarctic Peninsula and South Georgia
Killer Whale - Antarctic Type B2	*Orcinus orca*	243	12	Antarctic Peninsula and South Georgia
Killer Whale - Antarctic Type C	*Orcinus orca*	10	2	Ross Sea
Killer Whale - Antarctic Type D	*Orcinus orca*	16		Drake Passage/Scotia Sea, and off New Zealand
Killer Whale - Eastern Tropical Pacific	*Orcinus orca*	41	14	Pacific, north
Killer Whale - Northern Hemisphere Bigg's (transient)	*Orcinus orca*	470	108	Pacific, north
Killer Whale - Northern Hemisphere Offshore	*Orcinus orca*	7	1	Pacific, north (California)
Killer Whale - Northern Hemisphere Resident	*Orcinus orca*	367	150	Pacific, north
Killer Whale - type unknown	*Orcinus orca*	497	6	Pacific, north and south, Atlantic, north and south, and Indian
Long-finned Pilot Whale	*Globicephala melas*	44	13	Atlantic, north and south and Pacific, south
Melon-headed Whale	*Peponocephala electra*	2		Atlantic, south and Pacific, south
Minke Whale	*Balaenoptera acutorostrata*	354	2	Pacific, north and south, Atlantic, north and south
North Atlantic Right Whale	*Eubalaena glacialis*	1		Atlantic, north
North Pacific Right Whale	*Eubalaena japonica*	2		Pacific, north
Northern Bottlenose Whale	*Hyperoodon ampullatus*	16		Atlantic, north
Northern Right Whale Dolphin	*Lissodelphis borealis*	7		Pacific, north

Species: Common name	Species: Latin name	Encounters	Individuals	Region (in general order of volume of collection)
Pacific White-sided Dolphin	*Lagenorhynchus obliquidens*	29		Pacific, north
Pantropical Spotted Dolphin	*Stenella attenuata*	14		Atlantic, south and Pacific, north
Peale's Dolphin	*Lagenorhynchus australis*	17		coastal South America and Falklands (Malvinas)
Pygmy Blue Whale	*Balaenoptera musculus brevicauda*	1		west Australia
Risso’s Dolphin	*Grampus griseus*	186	4	Pacific, north and south, Atlantic, north and south
Rough-toothed dolphin	*Steno bredanensis*	2		Brazil
Sei Whale	*Balaenoptera borealis*	144	65	Atlantic, south (especially, Falkland Islands) and north, and Pacific, north and south
Short-finned Pilot Whale	*Globicephala macrorhynchus*	34		Atlantic, north and south and Pacific, north and south
Southern Bottlenose Whale	*Hyperoodon planifrons*	8		Atlantic, south and Antarctic Peninsula
Southern Right Whale	*Eubalaena australis*	114	1	Atlantic, south, Antarctic Peninsula and Pacific, south
Southern Right Whale Dolphin	*Lissodelphis peronii*	4		Pacific, south and Atlantic, south
Sowerby's beaked whale	*Mesoplodon bidens*	2		Atlantic, north
Sperm Whale	Physeter macrocephalus	436	103	Atlantic, north and south and Pacific, north and south, Indian
Spinner Dolphin	Stenella longirostris	14		Atlantic, north and south and Pacific, north and south, Indian
Strap-toothed Whale	Mesoplodon layardii	2		Atlantic, south and Antarctic Peninsula
Striped Dolphin	Stenella coeruleoalba	4		Atlantic, north
White-beaked Dolphin	Lagenorhynchus albirostris	26		Atlantic, north

Table 2. Global status of non-humpback whale collections of cetacean encounters in the Happywhale database. “Individuals”, where present, are cases where photo-ID supported encounter records have been manually identified to individual. Individual identification has been applied either (1) opportunistically, where contributors have notified Happywhale data managers of unique individuals, (2) from research collaborators with specific projects (Bryde’s, Fin and Sei whales), or (3) through manual matching efforts by data managers.

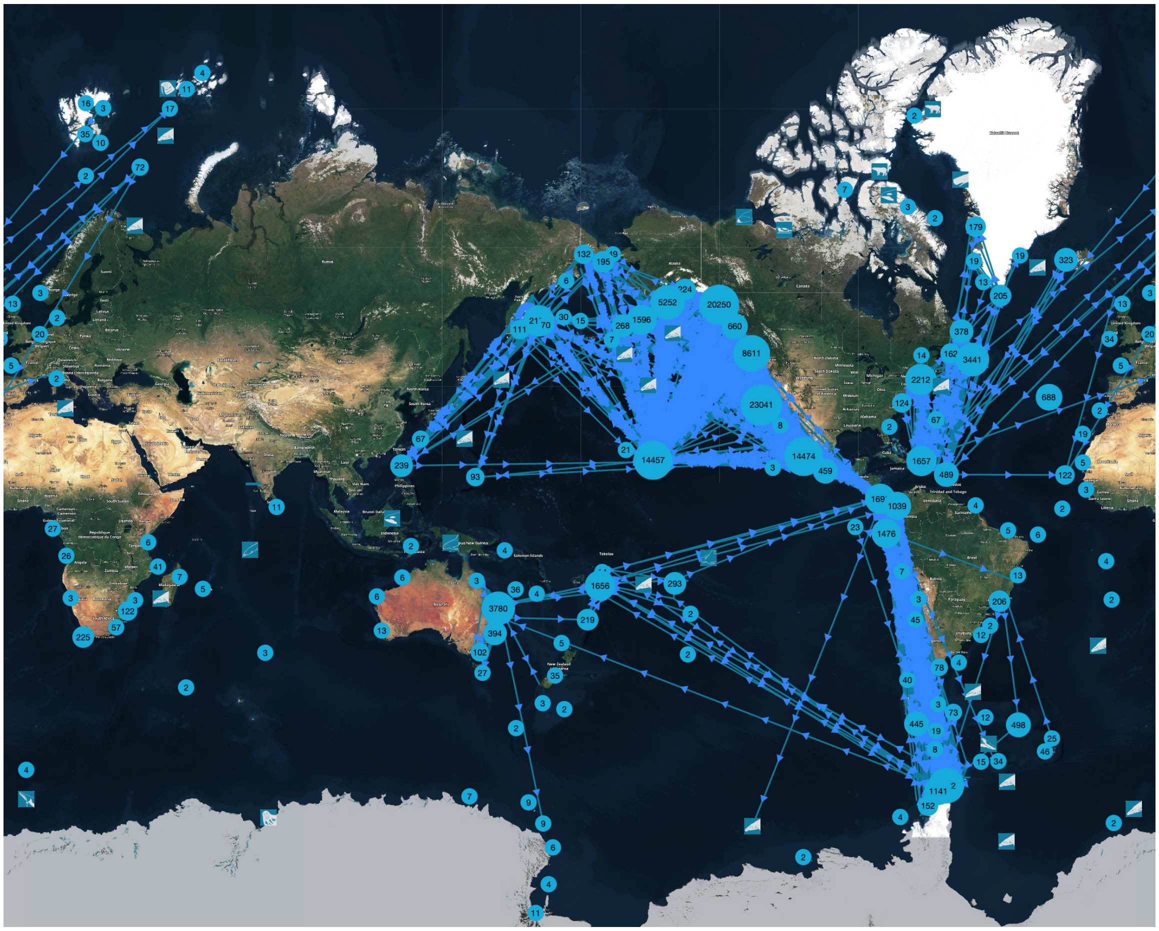

Figure 1. Global map of marine mammal encounter data in the Happywhale database. Numbers represent a count of identified encounters irrespective of the number of individuals shown. Arrows show chronology of migratory connections, and do not necessarily represent actual migratory path followed.

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