



Contemporary sightings of eastern North Pacific right whales, 2006 to 2023

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ABSTRACT: North Pacific right whales *Eubalaena japonica* once numbered in the 10s of 1000s. Today, the eastern population is one of the most endangered large whale stocks in the world. A lack of dedicated surveys and a population in the 10s of animals have resulted in considerable knowledge gaps. Here, we collate all contemporary sightings of eastern North Pacific right whales (ENPRWs) from 2006 through 2023 to investigate possible migratory routes and elucidate important habitat. Sightings in the northern Bering Sea, Gulf of Alaska, and along the west coast of North America have increased. Of the 99 sightings recorded between 2006 and 2023, 58 occurred during the few dedicated ENPRW surveys with simultaneous aerial and vessel platforms. All animals sighted were non-calves. Opportunistic sightings along the California coast were only reported in spring months (February–May). While this timing would coincide with a northward migration from lower latitudes, poor photo quality prevented matching of these animals, making it difficult to determine migratory patterns. Furthermore, there have been no sightings in Hawai'i or Mexico since 1996, and no sightings in the eastern North Pacific off the continental shelf since the 1970s. To date, only 2 animals have been photographically matched from Alaska to more southerly latitudes, and there have been no photographic matches between the Bering Sea and the Gulf of Alaska. Feeding has been observed throughout their range, suggesting right whales opportunistically feed whenever possible. While their primary migratory destinations remain unknown, these recent sightings provide insight into important ENPRW habitat in Alaska.

KEYWORDS: *Eubalaena japonica* · Right whale · Migration · Feeding · Sighting · Distribution · Alaska

1. INTRODUCTION

Once numbering in the 10s of 1000s, North Pacific right whales *Eubalaena japonica* became the target of intensive commercial whaling in the 1800s, followed by illegal captures in the mid-20th century (Scarff 2001, Ivashchenko & Clapham 2012). The species comprises 2 populations, eastern and western, which are genetically differentiated (Pastene et al. 2022). The western population ranges from the Russian Sea of Okhotsk and Kuril Islands to the waters off Japan and is thought to number in the several 100s of individuals, although current estimates are considered unreliable (Miyashita & Kato 1998, Brownell et al. 2001, Matsuoka et al. 2018). The eastern population of North Pacific right

whales (hereafter ENPRWs) historically ranged from Alaska down to Mexico and Hawai'i (Scarff 1986, Sheldon et al. 2005, Ford et al. 2016). Today, an estimated fewer than 50 individuals remain, making it one of the most critically endangered large whale populations in the world (Wade et al. 2011). Despite the classification of North Pacific right whales as Endangered by the IUCN (Cooke & Clapham 2018), there have been very few dedicated ENPRW surveys, resulting in a lack of knowledge surrounding their migratory routes, calving grounds, life history, and population demography.

In 2006, the US National Marine Fisheries Service (NMFS) designated areas in the southeastern Bering Sea (SEBS) and Gulf of Alaska (GOA) as critical habitat (see Fig. 1) under the Endangered Species Act for

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northern right whales *E. glacialis* (NMFS 2006). This was later changed to North Pacific right whale Critical Habitat (RWCH) in 2008, following the classification of northern right whales into 2 distinct species, North Atlantic right whales *E. glacialis* and North Pacific right whales (NMFS 2008). The habitat boundaries were determined based on the best available data through 2005, largely acquired through dedicated surveys in the Bering Sea and GOA (see Sheldon et al. 2005 for review). Most survey effort since then has been focused on their summer feeding grounds in Alaska. However, the last dedicated ENPRW surveys took place in 2010 in the Bering Sea and in 2015 in the GOA (Clapham et al. 2012, Rone et al. 2015); all sightings since then have occurred during other marine mammal surveys or were opportunistic reports from other sources (e.g. fishermen, recreational boaters, whale watch operators).

Right whales can be individually identified by the pattern of callosities (raised roughened skin patches on their heads), which are unique to each animal (Kraus et al. 1986a, Hamilton & Martin 1999). Photographs of an animal can then be compared with a catalog of known individuals to determine whether the animal is newly documented or is a re-sight from a previous encounter (Kraus et al. 1986a). As with all large whale photo-ID studies, the discovery of matches from different sighting locations and encounters greatly expands our knowledge of migratory patterns, population demographics, and behavior (e.g. Wade et al. 2011, Vernazzani et al. 2014). For example, recent matches between southern right whales *E. australis* seen on breeding and feeding grounds have shed light on migratory patterns of that species in the southwest Atlantic (Savenko & Friedlaender 2022, Kennedy et al. 2024).

ENPRWs are rarely sighted outside of Alaska waters, yet sightings along the west coast of North America have been increasing in recent years. This study reports on all contemporary sightings (i.e. 2006–2023) collected by or reported to NMFS' Alaska Fisheries Science Center's Marine Mammal Laboratory (MML) since the RWCH designation to expand on our current knowledge of ENPRW distribution and elucidate areas that might be important habitat.

2. METHODS

The Cetacean Assessment and Ecology Program at the MML has been cataloging ENPRW images from marine mammal surveys and opportunistic platforms since the 1970s (see Wade et al. 2011 for a description of the ENPRW cataloging methods). Here, we compile all

contemporary right whale sightings in the eastern North Pacific, including those both from dedicated marine mammal surveys and opportunistic reports (e.g. recreational boaters, ecotourism passengers and naturalists, NOAA Platforms of Opportunity Program; Boucher & Boaz 1989). Photographs from sightings were matched to the MML catalog as well as to available photographs of western North Pacific right whale individuals ($n = 14$). Those sightings where feeding was observed or presumed were noted. Feeding was confirmed if the animal was seen skim feeding or if feces or defecation was observed. Feeding was presumed if the animal was seen flushing its baleen (Werth 2001) or had mud on its head or body (Hamilton & Kraus 2019). The whales were also presumed to be feeding when they conducted several short, shallow surfacings followed by a long (5–12 min) deep dive (indicated by visible fluking when diving) with no apparent consistent direction of travel (Baumgartner & Mate 2003, Baumgartner et al. 2017). Any instances where the behavior could not be determined are labeled 'unknown'. The type of platform that reported the sighting was noted as 'RWS' for dedicated ENPRW surveys, 'MMS' for dedicated marine mammal surveys, and 'OPP' for opportunistic reports (e.g. from fishing vessels, citizen scientists).

3. RESULTS

There are currently 68 identified individuals in the ENPRW catalog, yet only 31 are considered reliably unique due to a lack of adequate imagery (e.g. coverage of only one side or poor image composure). Between 2006 and 2023, there were 99 sightings of right whales in the eastern North Pacific; 58 of these sightings occurred during dedicated ENPRW shipboard and aerial surveys (2008–2009), 17 during other marine mammal surveys in Alaska and the North Pacific, and 25 during opportunistic effort (see Figs. 1 & 2, Tables 1–3). All sightings were adults, subadults, or juveniles; no calves have been sighted since 2004.

3.1. By region

Five ENPRW sightings occurred in the northern Bering Sea; 4 of these northern sightings were opportunistic reports (see Figs. 1 & 2, Table 1), although 3 lacked photographs for species confirmation¹. Of

¹These sightings lacking photos were reported by Native Alaskan villagers that are very familiar with whale species identification. As such, they are considered reliable sightings

Table 1. All contemporary (2006–2023) sighting records of eastern North Pacific right whales in the Bering Sea or Aleutian Island chain. No. of ind.: number of animals sighted; (*) at least 1 individual in the encounter is a confirmed re-sight (known animal that has been seen previously). RWCH: right whale critical habitat; SEBS: southeastern Bering Sea; BS: Bering Sea. RWS: dedicated eastern North Pacific right whale survey; MMS: dedicated marine mammal survey; OPP: opportunistic report; (†) no photos obtained for species confirmation. Note: Most sightings during the NOAA Pacific Right Whale Ecology Study (PRIEST) RWSs were re-sights of the same individuals

Date	No. of ind.	Latitude (° N)	Longitude (° W)	Location	Feeding	Platform	Source and notes
8/4/2008	3	57.2810	163.6760	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
8/5/2008	1	57.3150	163.7490	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; aerial
8/5/2008	2*	57.2320	163.7040	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; aerial
8/5/2008	2	57.2460	163.6530	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; aerial
8/5/2008	1	57.3330	163.7640	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; aerial
8/7/2008	1*	57.3330	163.7640	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
8/8/2008	2*	57.2160	163.6470	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
8/8/2008	3*	57.2650	163.6750	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
8/9/2008	1*	57.2770	164.0240	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
8/9/2008	1*	57.3080	163.7660	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
8/11/2008	3*	57.0970	163.5320	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
8/21/2008	2*	57.0340	164.4430	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel and aerial
8/21/2008	1	56.9300	164.4400	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; aerial
8/21/2008	1	57.0000	164.5045	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; aerial
8/22/2008	2*	56.9200	164.3630	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
8/22/2008	1*	56.9380	164.4900	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
8/22/2008	1*	56.8920	164.7790	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
8/23/2008	2*	56.9450	164.6560	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
8/23/2008	1*	56.9390	164.4860	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
8/28/2008	1*	57.2683	163.5167	RWCH SEBS	Yes	RWS	NOAA PRIEST RWS ^a ; aerial
8/28/2008	1*	57.4383	164.6300	RWCH SEBS	Yes	RWS	NOAA PRIEST RWS ^a ; aerial
8/28/2008	2*	57.4383	164.6283	RWCH SEBS	Yes	RWS	NOAA PRIEST RWS ^a ; aerial
9/3/2008	1*	56.8410	164.7150	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
9/4/2008	1*	56.7320	164.4890	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
9/4/2008	1*	56.8440	164.5960	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
9/4/2008	2*	56.7540	164.5870	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
7/24/2009	3*	57.3240	162.8930	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
7/25/2009	5*	57.2160	162.8870	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
7/26/2009	1*	57.1955	161.0832	SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
7/31/2009	2*	57.2320	163.3340	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel and aerial
7/31/2009	1*	57.1542	163.2208	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; aerial
7/31/2009	1*	57.1578	163.3625	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; aerial
8/1/2009	1	57.2358	163.5075	RWCH SEBS	Yes	RWS	NOAA PRIEST RWS ^a ; aerial
8/1/2009	1	57.2708	163.4867	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; aerial
8/1/2009	1*	57.2430	163.2210	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
8/1/2009	7*	57.2790	163.4660	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
8/7/2009	2*	57.3208	163.9025	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; aerial
8/14/2009	1	57.2620	163.6880	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
8/14/2009	1*	57.2823	163.7565	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; aerial
8/14/2009	2*	57.2790	163.7798	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; aerial
8/14/2009	3*	57.2890	163.7800	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel and aerial

Table continued on next page

Table 1 (continued)

Date	No. of ind.	Latitude (° N)	Longitude (° W)	Location	Feeding	Platform	Source and notes
8/15/2009	1*	57.2757	164.0536	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; aerial
8/15/2009	1*	57.1906	164.6343	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; aerial
8/15/2009	1*	57.1467	163.9517	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; aerial
8/15/2009	1*	57.3390	164.2478	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel and aerial
8/22/2009	1*	57.2450	164.2034	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; aerial
8/22/2009	1*	57.1631	163.9158	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; aerial
8/22/2009	2*	57.1379	163.8590	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; aerial
8/22/2009	2*	57.7450	164.9690	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
8/23/2009	1*	57.1432	163.9366	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; aerial
8/23/2009	1*	57.2024	164.0767	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; aerial
8/23/2009	1*	57.2133	164.1169	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
8/23/2009	1*	57.1400	163.8920	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
8/24/2009	1*	57.2844	164.1548	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; aerial
8/24/2009	1*	57.8239	165.1857	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; aerial
8/24/2009	1*	57.3472	164.3295	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; aerial
8/24/2009	1*	57.1620	163.9050	RWCH SEBS	Unknown	RWS	NOAA PRIEST RWS ^a ; vessel
8/25/2009	2*	57.5357	164.7994	RWCH SEBS	Yes	RWS	NOAA PRIEST RWS ^a ; aerial
9/18/2010	1*	57.4500	164.6610	RWCH SEBS	Unknown	OPP	NOAA CHAOZ survey ^b
8/13/2011	4*	57.4070	164.7780	RWCH SEBS	Unknown	OPP	NOAA CHAOZ survey ^b ; 4 sighted but only 2 photographed. Re-sight of animals from 2009 NOAA PRIEST RWS ^a
11/27/2012	1	63.7860	170.5390	St. Lawrence Island, BS	Unknown	OPP†	Native villagers (pers. obs.), reported to G. Sheffield, Univ. Alaska Fairbanks (pers. comm.); no photos
8/6/2017	2*	57.6083	160.7250	SEBS	Presumed	MMS	IWC-POWER 2017 ^c ; re-sights of known animals
8/8/2017	6*	57.6283	160.4917	SEBS	Yes	MMS	IWC-POWER 2017 ^c ; 6 sighted but only 3 photographed; those 3 were re-sights of known animals
8/8/2017	1	57.5517	160.5650	SEBS	Presumed	MMS	IWC-POWER 2017 ^c
8/8/2017	1	57.5983	160.7733	SEBS	Presumed	MMS	IWC-POWER 2017 ^c
8/9/2017	1	57.3633	163.1083	RWCH SEBS	Yes	MMS	IWC-POWER 2017 ^c
9/8/2017	2*	56.5867	165.8483	RWCH SEBS	Unknown	MMS	IWC-POWER 2017 ^c ; re-sights of known animals
9/9/2017	2*	56.8700	165.2767	RWCH SEBS	Unknown	MMS	IWC-POWER 2017 ^c ; one was a re-sight of a known animal
6/26/2018	2	63.7203	171.5027	St. Lawrence Island, BS	Unknown	OPP†	Native villagers (pers. obs.), reported to G. Sheffield, Univ. Alaska Fairbanks (pers. comm.); no photos
7/18/2018	2*	57.0533	162.7967	RWCH SEBS	Yes	MMS	IWC-POWER 2018 ^c ; one was a re-sight of a known animal
7/26/2018	1	63.2467	171.2450	St. Lawrence Island, BS	Presumed	MMS	IWC-POWER 2018 ^c
8/7/2018	1	64.8500	172.9600	Penkigney	Presumed	OPP	Heritage Charter Expeditions (pers. obs.) as described in Filatova et al. (2019); Re-sight of IWC-POWER 2018 ^c ; sighting on 26 July 2018
5/15/2019	1	64.1795	171.0227	St. Lawrence Island, BS	Unknown	OPP†	Native villagers (pers. obs.), reported to G. Sheffield, Univ. Alaska Fairbanks (pers. comm.); no photos
2/5/2022	2	54.6667	164.9500	Unimak Pass, Aleutian Islands	Yes	OPP	J. Trosvig (cod fisherman; pers. comm.); skim-feeding animals

^aClapham et al. (2012); ^bBerchok et al. (2015); ^cMatsuoka et al. (2022)

note, one of the northerly whales, first sighted during the 2018 International Whaling Commission's Pacific Ocean Whale and Ecosystem Research (IWC-POWER) survey (<https://iwc.int/power>), was resighted 3 wk later approximately 185 km north in Penkigney Bay, Russia (Filatova et al. 2019, Matsuoka et al. 2022).

The total number of right whale sightings reported from the GOA has more than doubled in recent years; there were only 8 sightings documented prior to 2006, whereas 14 sightings have been reported from 2006 to 2023 (Fig. 1, Table 2). All but one contemporary sighting occurred outside the GOA RWCH. Sightings outside of Alaska have also increased. There have been 5 recent sightings off British Columbia; one right whale sighting off Haida Gwaii in May 2013 marked the first right whale documented in the area since the

1960s (Ford et al. 2016) (Table 3). The total number of sightings off California has increased considerably; 7 sightings were documented from 1970 to 2005, and 6 have been reported since 2015 (Table 3). There have been no sightings in Mexico or Hawai'i since 1996 (Fig. 1). There has never been a sighting reported off the coast of Oregon. Finally, there have been no sightings of right whales off the continental shelf of the eastern North Pacific since the Japanese sighting surveys of the 1970s (Fig. 1; see also Sheldon et al. 2005).

There has only been one contemporary ENPRW long-distance match. An animal first sighted by the Department of Fisheries and Oceans Canada off Haida Gwaii in June 2021 was resighted 2 mo later in August off Kodiak Island in the GOA (Fig. 1, orange circles) (Crance et al. 2022). While resights of individuals within the Be-

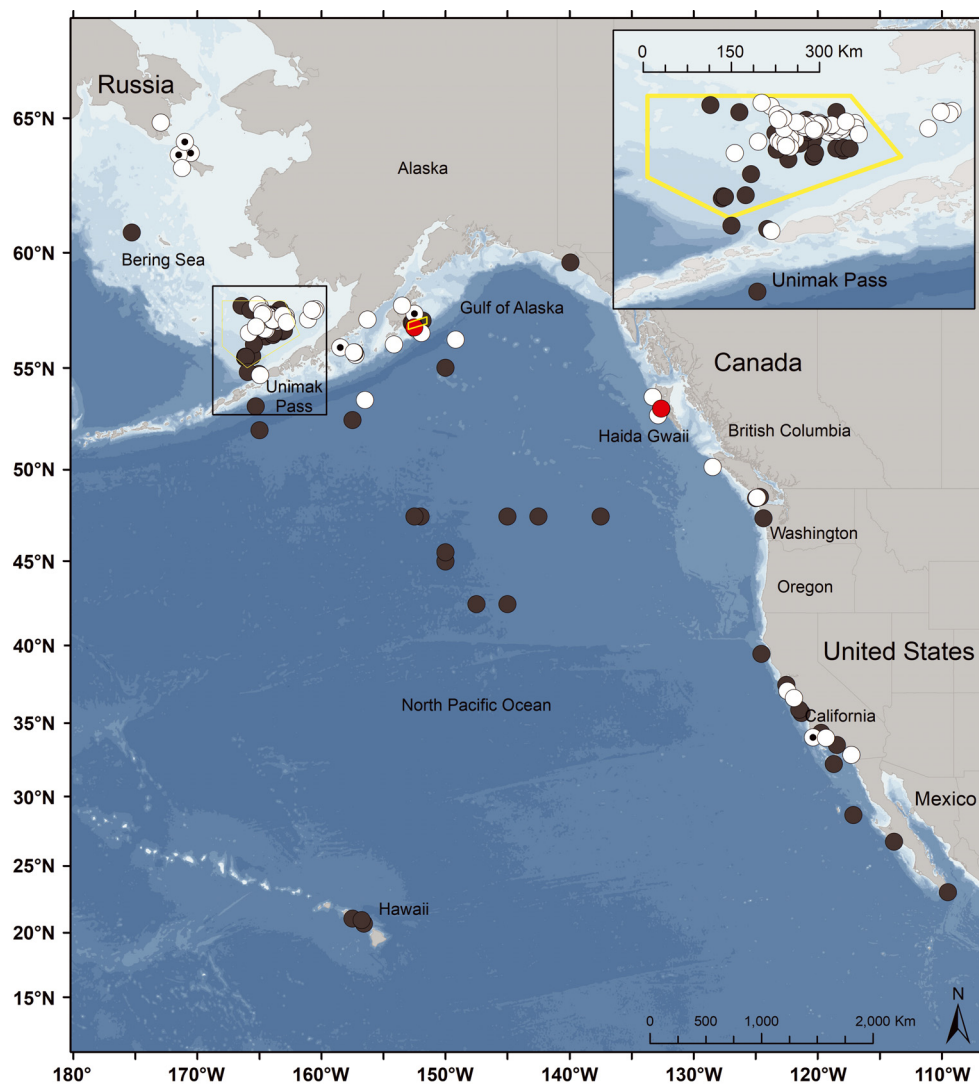


Fig. 1. All eastern North Pacific right whale sightings from 2006 to 2023 (white circles) and 1970 through 2005 (dark gray circles). Red circle: a long-distance match from 2021. White circles with black dots: sighting reports that do not have photos for species confirmation. Critical habitat demarcated by yellow line. Inset area demarcated by black square

Table 2. All contemporary (2006–2023) sighting records of eastern North Pacific right whales in the Gulf of Alaska (GOA); (*) indicates that at least one individual in the encounter is a confirmed re-sight. RWCH: right whale critical habitat. MMS: dedicated marine mammal survey; OPP: opportunistic report; †) no photos obtained for species confirmation

Date	No. of ind.	Latitude (° N)	Longitude (° W)	Location	Feeding	Platform	Source and notes
9/1/2006	1	56.7792	152.4268	Barnabas Trough	Unknown	OPP	K. Hough (pers. comm.) on NOAA ship 'Miller Freeman'
9/24/2006	1	56.5817	151.9417	Barnabas Trough	Unknown	OPP	FV 'Trailblazer' (pers. comm.), reported to POP ^a
5/1/2010	1	57.4300	152.5000	Pasagshak Bay	Unknown	OPP†	W. Wilhelm (pers. obs.) ^b . Location is approximate
12/15/2011	1	57.7870	153.5070	Uganik Bay	Unknown	OPP	B. and A. Pingree (pers. obs.), reported to K. Wynne (pers. comm.)
7/23/2011	1	53.4833	156.4997 water depth	4600 m	Unknown	OPP	M. Wood, M. Cummings, K. Davis (on a GOA seismic survey, R/V 'Marcus G. Langseth) (pers. comm.)
7/24/2012	1	56.2917	149.1783 water depth	4500 m	Presumed	MMS	IWC-POWER 2012 ^c
7/7/2017	1	57.1750	156.3000	Kilokak Rocks	Unknown	OPP	Expedition Sail ^d (pers. obs.)
8/8/2018	1	55.9313	158.4886	SW of Chignik	Unknown	OPP†	K. Garcia on FV 'Aquila' (pers. comm.); no photos
8/21/2021	2*	56.8371	152.5153	RWCH	Yes	MMS	NOAA PacMAPPS survey ^e . One animal matched to Department of Fisheries and Oceans Canada sighting on 12 June 2021 (Table 3)
8/24/2021	2*	56.0758	154.1503	Trinity Islands	Yes	MMS	NOAA PacMAPPS survey ^e . One animal matched to Barnabas Trough sighting on 1 September 2006
9/19/2023	1	55.6033	157.2617	SW of Sutwik Island	Unknown	MMS	IWC-POWER 2023 ^f
9/20/2023	1	55.7083	157.3317	SW of Sutwik Island	Unknown	MMS	IWC-POWER 2023 ^f
9/20/2023	1	55.7183	157.3600	SW of Sutwik Island	Unknown	MMS	IWC-POWER 2023 ^f
9/20/2023	2	55.7217	157.4017	SW of Sutwik Island	Unknown	MMS	IWC-POWER 2023 ^f)

^aNOAA Platforms of Opportunity Program, <https://www.fisheries.noaa.gov/inport/item/17407>; ^brecord of sighting at <https://www.sfcelticmusic.com/js/RTWHALES/nprightw.htm>; ^cMatsuoka et al. (2022); ^d<https://expeditionssail.com/>; ^eCrance et al. (2022); ^fMurase et al. (2023)

ring Sea are relatively common (8 animals have been resighted at least once since 2006), only one animal has been resighted within the GOA (Table 2). Furthermore, there has never been a photographic match between an individual in the GOA and the Bering Sea. Finally, none of the sightings were matched to animals in the western North Pacific right whale catalog.

3.2. By platform

Of the 99 total contemporary sightings, 58 occurred during the NOAA Pacific Right Whale Ecology Study (PRIEST) dedicated ENPRW research surveys (Clapham et al. 2012) (Fig. 2). All but one of these sightings occurred inside the RWCH, where the majority

of effort was concentrated. Of note, during the last dedicated ENPRW survey in the GOA (in 2015), ENPRWs were detected acoustically but there were no visual sightings (Fig. 2; Rone et al. 2015). A total of 17 sightings of ENPRWs were reported during other non-ENPRW marine mammal surveys (Fig. 2). Of these, 9 were in the Bering Sea, 7 in the GOA, and one off British Columbia. Finally, 24 sightings were from opportunistic sources, the majority of which occurred outside Alaska (Fig. 2).

3.3. By month

The majority of sightings in Alaskan waters occurred during the summer and fall (July through

Table 3. All contemporary (2006–2023) sighting records of eastern North Pacific right whales outside of Alaska. BC: British Columbia; CA: California. MMS: dedicated marine mammal survey; OPP: opportunistic report; (†) no photos obtained for species confirmation

Date	No. of ind.	Latitude (° N)	Longitude (° W)	Location	Feeding	Platform	Source and notes
6/9/2013	1	53.6250	133.2867	Haida Gwaii, BC	Yes	OPP	Ford et al. (2016)
10/25/2013	1	48.5173	124.8717	Vancouver Island, BC	Unknown	OPP	Ford et al. (2016)
2/14/2015	1	34.0376	120.3724	San Miguel Island, CA	Unknown	OPP†	R. L. DeLong (pers. comm.); no photos
4/15/2017	1	32.8518	117.2725	La Jolla, CA	Unknown	OPP	C. Houser (pilot, pers. comm.), sighted by a passenger
5/5/2017	1	34.0113	119.3312	Channel Islands, CA	Unknown	OPP	S. Johnson (on board 'Zoarces'; pers. comm.)
6/4/2018	1	53.0517	132.5967	Haida Gwaii, BC	Unknown	OPP	Canadian Coast Guard (pers. comm.)
5/26/2020	1	50.1333	128.4500	Vancouver Island, BC	Unknown	OPP	R. Goings (on container ship; pers. comm.)
6/12/2021	1	53.0638	132.6235	Haida Gwaii, BC	Yes	MMS	J. Pilkington and J. Towers, Department of Fisheries and Oceans Canada (pers. comm.) (see also 21 Aug 2021; Table 2)
7/27/2021	2	52.7436	132.8647	Haida Gwaii, BC	Unknown	OPP	J. Molineaux on the 'Marcus Langseth' during a seismic survey (pers. comm.)
4/19/2022	1	37.1035	122.4334	Año Nuevo, CA	Yes	OPP	J. Gross (pers. comm.); skim-feeding animal
3/5/2023	1	36.6467	121.9067	Point Pinos, CA	Unknown	OPP	Monterey Bay whale watch (pers. comm.). Animal covered in barnacles

November; Fig. 3), which corresponds with peak recreational boating and marine mammal survey season. No sightings in Alaska have been reported in March or April, and only one in December, though this may be due to limited effort, shorter day length, and poorer conditions in winter. However, there was one winter sighting of 2 right whales in February just northeast of Unimak Pass in the Aleutian Islands chain. All sightings along the west coast of the USA occurred in spring, from February through May, while those along the coast of British Columbia, Canada, were in May–July or October (Fig. 3). There have been no contemporary sightings of ENPRWs reported in January.

3.4. Group size

All sightings of 3 or more animals occurred in the SEBS. Mean (\pm SD) group size for Bering Sea sightings was 1.6 ± 1.1 individuals (range: 1–7) (Table 1, Fig. 4). Only 2 sightings had a group size of 6 or 7 animals, and both were in the SEBS (one in the RWCH,

one just east of the RWCH; Table 1, Fig. 4). In the GOA, 3 of the 14 sightings were of 2 individuals; the remaining 11 sightings were of single animals (mean group size: 1.2 ± 0.4 ; Table 2, Fig. 4). However, 3 of the sightings in 2023 occurred in very close proximity to one another; these animals may have been grouped prior to the initial sighting. For sightings outside of Alaskan waters ($n = 12$), all but one sighting consisted of a single animal (mean group size: 1.1 ± 0.3), and all sightings of single animals were south of 50° N (Table 3, Fig. 4).

3.5. Feeding

In total, 7 sightings had documented feeding activity within the Bering Sea and GOA RWCH (Fig. 5). An additional 8 sightings documented feeding or presumed feeding outside RWCH, but within their Alaska feeding grounds. Finally, there were 3 sightings with documented feeding outside their Alaska feeding grounds; 2 off British Columbia and one off the coast of central California (Fig. 5).

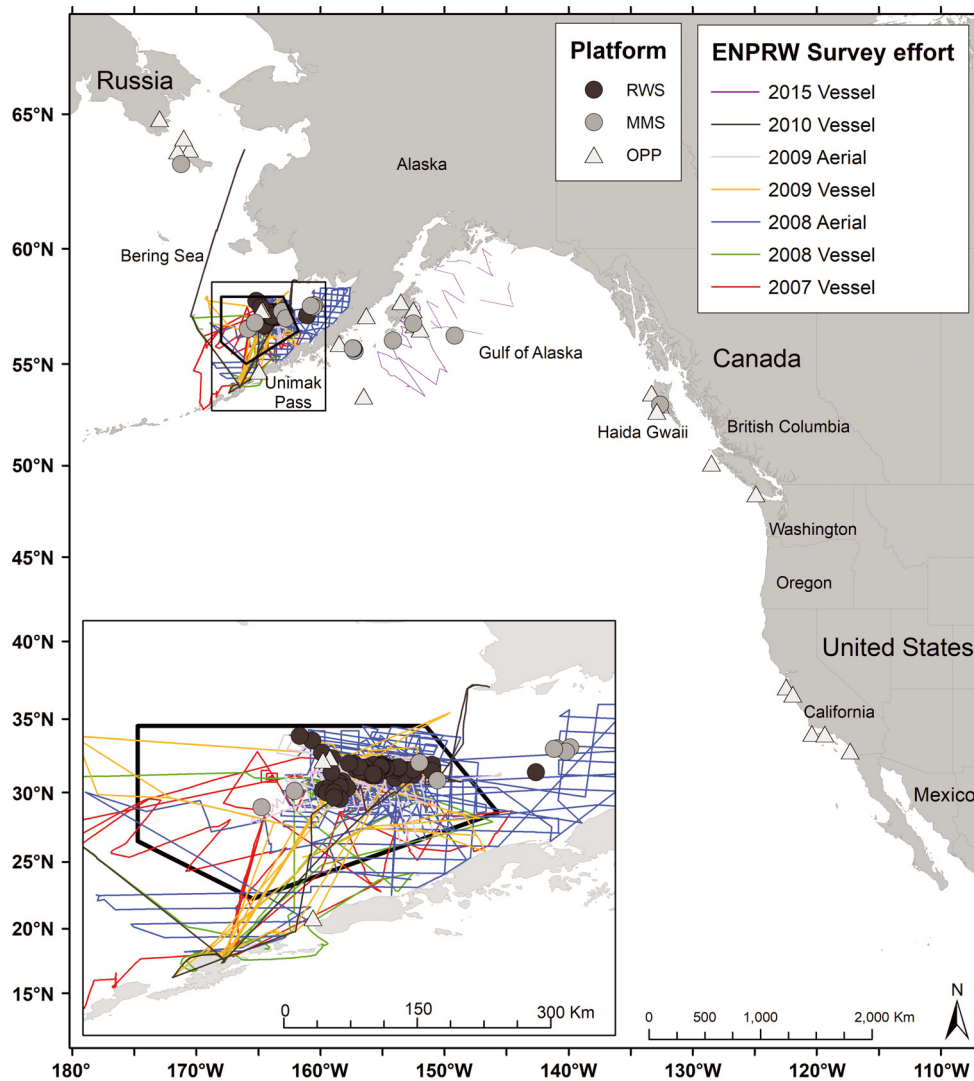


Fig. 2. All contemporary (2006–2023) eastern North Pacific right whale (ENPRW) sightings by platform. RWS: dedicated ENPRW survey; MMS: other marine mammal survey; OPP: opportunistic sighting report. Survey effort for dedicated ENPRW surveys (colored lines) presented by year and platform. Note: this does not include other non-ENPRW marine mammal survey effort. Critical habitat demarcated by thick black polygon. Inset area demarcated by black square

4. DISCUSSION

From 1970 through 2005, 74 sightings of ENPRW were reported; a total of 99 sightings were reported from 2006 to 2023, bringing the total number of sightings to 173. It remains unknown whether this increase in sightings reflects an increase in population size, an increase in public awareness, or whether it can be attributed to the increase in dedicated marine mammal survey effort. Indeed, 58 of the 100 contemporary sightings occurred during the PRIEST dedicated ENPRW surveys in the SEBS (Clapham et al. 2012) (Fig. 2). The PRIEST surveys combined concurrent

aerial (2008–2009) and shipboard (2007–2010) surveys in the SEBS during summer months (July–September). Data collection during these multi-disciplinary surveys included photo-ID photographs, biopsy sampling, satellite telemetry deployment, passive acoustics, prey sampling, and oceanographic data (Clapham et al. 2012, Baumgartner et al. 2013, Zerbini et al. 2015). The results from the PRIEST study highlight the importance of dedicated right whale surveys to assess the status of this Critically Endangered population (Cooke & Clapham 2018). However, because these surveys incorporated aerial, vessel, and acoustic platforms, multiple sightings of the same animal(s) oc-

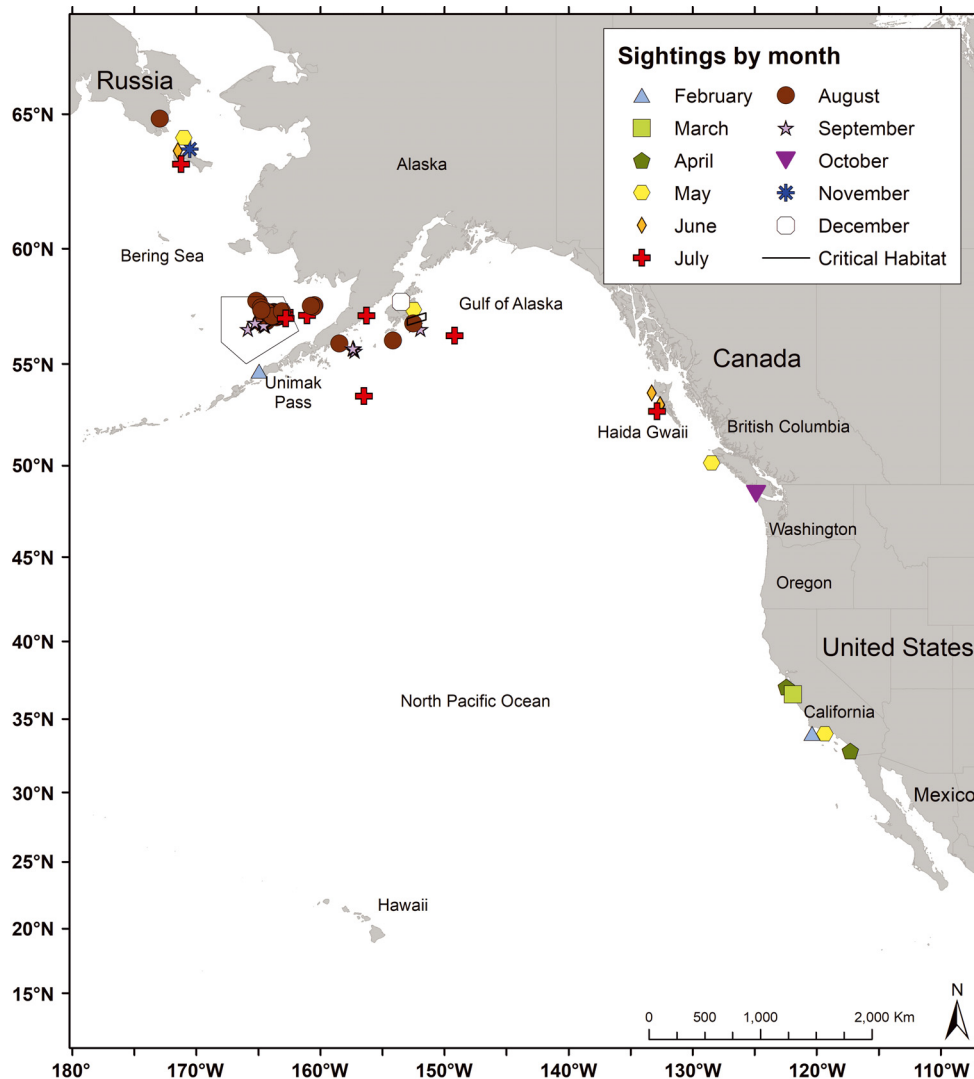


Fig. 3. All contemporary (2006–2023) sightings of eastern North Pacific right whales color-coded by month. There have been no contemporary sightings in January. Critical habitat demarcated by thin black line

curred. In all, the 58 sightings recorded during PRIEST were of only 12 unique ENPRWs, all of which were adults. While the last dedicated ENPRW survey was in 2015, there have been several marine mammal surveys since then in both the Bering Sea and the GOA that have reported ENPRW sightings. For instance, the IWC-POWER surveys have photographed 20 different ENPRWs since the surveys began in 2010, several of which had been sighted previously (Matsuoka et al. 2022, Murase et al. 2023). Additional comprehensive line-transect or other mark–recapture based survey effort may help determine whether these sightings reflect an increase in ENPRW numbers.

Recent sightings of right whales north of St. Lawrence Island (Fig. 1) correlate with the increased acoustic detections presented in Wright et al. (2019).

While the acoustic detections in Wright et al. (2019) may represent an anomalous year, all but one of these northern Bering Sea sightings occurred in years with warmer-than-average sea temperatures (Stabeno & Bell 2019). This supports Wright et al.'s (2023) and Zerbini et al.'s (2015) findings that ENPRWs will move farther north and/or be more widely distributed to follow their zooplanktonic prey in years with warmer water temperatures. Townsend (1935) and Omura et al. (1969) show a number of right whale catches in the northern Bering Sea during the years of commercial whaling, although these northernmost takes may have been misidentifications of bowhead whales *Balaena mysticetus* (Scarff 1986, Smith et al. 2012). Because of the inconsistencies and possible misidentifications in the old whaling logbooks, it is unknown to what extent

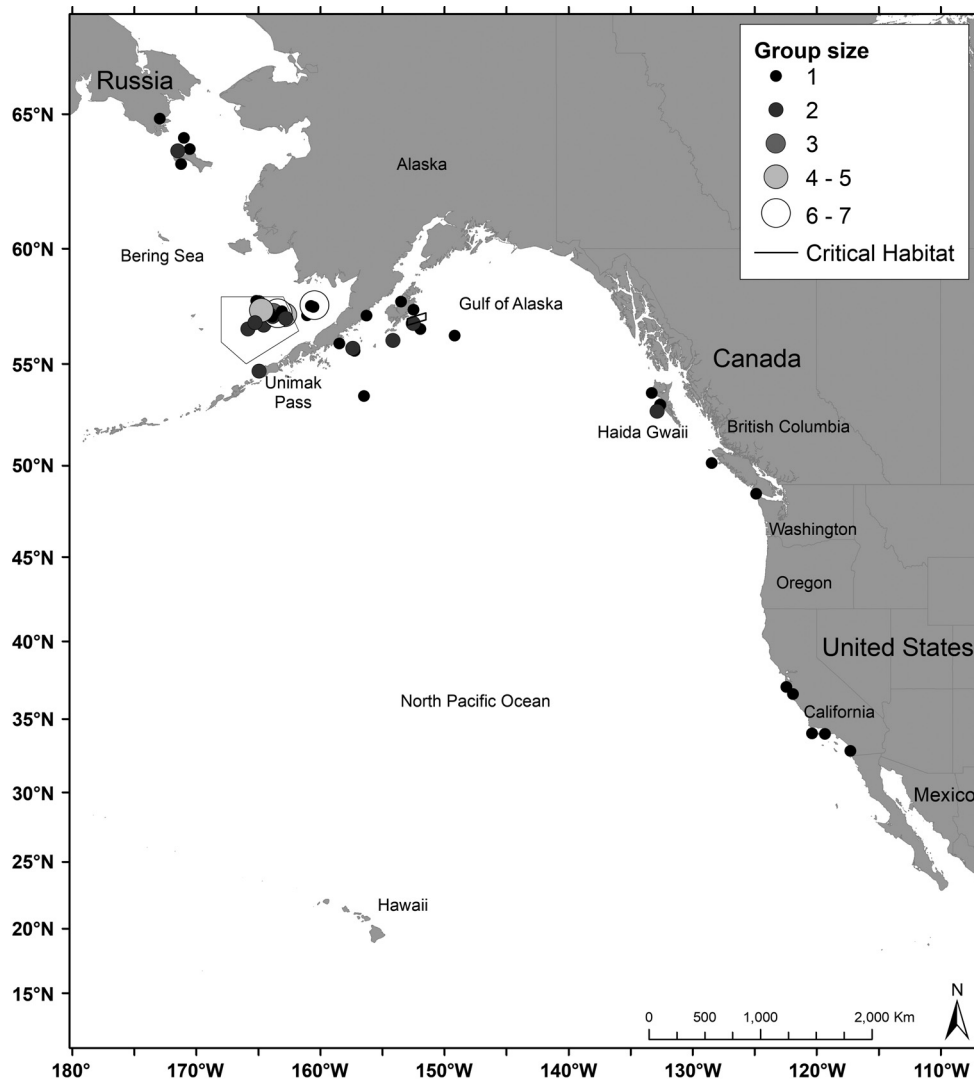


Fig. 4. All contemporary (i.e. 2006–2023) sightings of eastern North Pacific right whales by group size. Critical habitat demarcated by thin black line

right whales used to inhabit the northern Bering Sea and whether this represents a reoccupation of their range prior to their near extirpation or whether these recent sightings reflect a distribution shift as a result of changing oceanographic conditions.

It is difficult to quantify how much the increase in sightings reported in the GOA is due to an increase in survey effort, vessel traffic, and/or an increase in awareness of ENPRWs as a result of the MML's outreach in recent years. Since 2006, 6 marine mammal surveys have been conducted in the GOA (Rone et al. 2010, 2014, 2015, Matsuoka et al. 2013, 2019, Crance et al. 2022), yet ENPRWs were only sighted on the IWC-POWER survey in 2012 and the NOAA Pac-MAPPS survey in 2021. Five of the surveys used passive acoustic monitoring (PAM) to complement visual

effort; in 3 of these surveys, right whale vocalizations were detected but the whales were not sighted (Rone et al. 2014, 2015, Matsuoka et al. 2019). In 2023, 4 unique ENPRWs were sighted opportunistically in the GOA at the end of the IWC-POWER survey, which occurred in the central North Pacific (Murase et al. 2023). While 7 of the GOA sightings were from non-ENPRW marine mammal surveys (2 IWC-POWER surveys [Matsuoka et al. 2022], 1 NOAA survey [Crance et al. 2022]; Table 2), the other 7 sightings in the GOA were opportunistic reports from seismic surveys, fishing vessels, and members of the general public (Fig. 2). This may suggest an increase in public awareness regarding species identification.

There has never been a photographic match between an individual in the GOA and the Bering Sea,

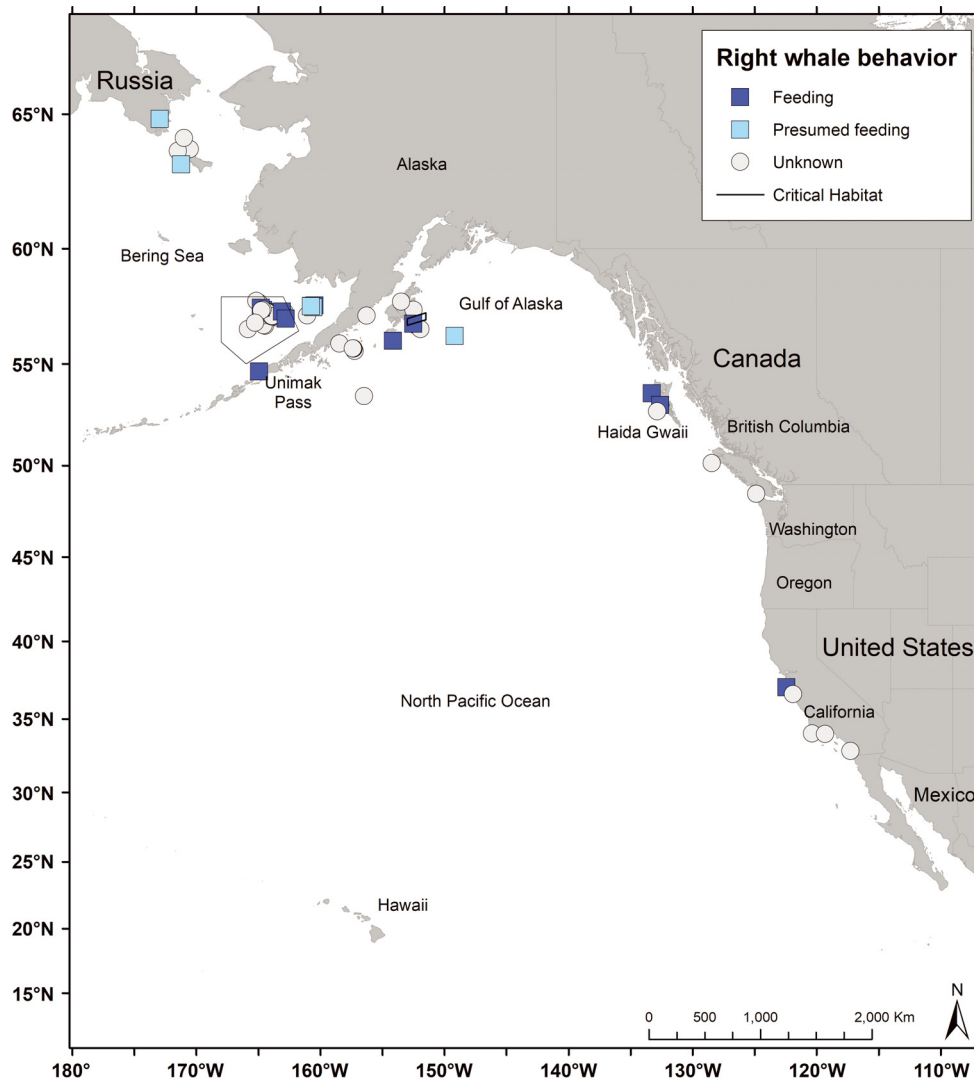


Fig. 5. All contemporary (2006–2023) sightings of eastern North Pacific right whales where feeding was confirmed (dark blue square), presumed (light blue square), or unknown (light gray circle). Critical habitat demarcated by thin black line

despite the recent increase in right whale photographs from both areas. Additionally, 11 right whales have been resighted multiple times in the Bering Sea, but there has only been 1 re-sight of an animal within the GOA and 1 from the GOA to British Columbia. It is possible that ENPRWs may comprise 2 separate subgroups or that individuals show strong site fidelity within the GOA and Bering Sea basins. While the possibility of 2 separate subgroups has important conservation and management implications, it remains hypothetical at this point, and further research is needed to describe the population dynamics of each region.

No animals from the contemporary sightings were photographically matched to the catalog of western North Pacific right whale individuals used for this

study. However, there are very few cataloged individuals in the western population ($n = 14$); thus, confirming which population individual right whales belong to remains difficult. Although all biopsy samples collected from animals in the sightings in this study were from the eastern population, given the overall lack of comprehensive photo-ID and/or biopsy coverage, these results do not preclude the possibility of overlap between the 2 populations.

All sightings outside of Alaska were along the west coast of the USA and Canada (Table 3, Fig. 1). Additionally, all sightings off the coast of California were in spring, and sightings off the coast of British Columbia were in May–July or October (Fig. 3). This suggests a possible migratory route along the west coast, similar to their Atlantic congeners' east coast

movement (Kraus et al. 1986b). Unfortunately, none of the individuals photographed off California have ever been rematched; the only contemporary long-distance match was between a whale sighted off the coast of British Columbia and in the GOA (Fig. 1). It is important to note, however, that most catalog images of whales prior to 2000 or contemporary opportunistic sightings are low resolution and/or poor quality, making positive identification difficult. Of note, all but one contemporary sighting along the west coast were opportunistic reports (Fig. 2), despite numerous marine mammal surveys off the coast of California (e.g. Campbell et al. 2015). While most of these surveys were in summer or fall, and thus did not overlap seasonally with previous right whale presence in that area, the lack of sightings in an area of considerable survey effort is noteworthy.

In the last 50 yr, there has only been one migratory match, in which an animal seen in Hawai'i in 1996 was resighted in the Bering Sea only 3 mo later (Kennedy et al. 2012). This 1996 sighting was the last sighting of ENPRWs in Hawaiian waters, despite numerous whale watch operators and research effort occurring around the main Hawaiian Islands. Similarly, there are no contemporary sightings off Mexico. While marine mammal tourism off Baja Mexico may be limited, the large number of whale watch operators and surveys in Hawaiian waters suggests that either ENPRWs rarely travel to Hawai'i or they use areas not frequented by researchers or local whale watch operators. Right whale sightings in southerly latitudes are also uncommon for the western population, despite historically being relatively common in winter and spring in the coastal waters around Japan (Omura 1986). However, there have been several contemporary reports of winter sightings (January–March) off the coast of Japan south of 42° N (e.g. Matsuoka et al. 2021, Katsumata et al. 2022, D. Yasutaka Imai pers. comm.), including cow–calf pairs, lending support to the hypothesis that at least some North Pacific right whales migrate south.

Historically, right whales were distributed throughout the entire temperate and sub-tropical eastern North Pacific (Shelden et al. 2005), and there were sightings of ENPRWs from Japanese surveys in the 1970s in the deep basin of the eastern North Pacific (summarized in Scarff 1986 and Shelden et al. 2005) (Fig. 1). Similarly, contemporary surveys of the northwest Pacific Basin showed right whale presence in deeper waters north of 42° N with a general northward migration throughout the summer (Matsuoka et al. 2018). Several marine mammal surveys have occurred as far as 300 nautical miles offshore of the US

west coast (e.g. Moore & Barlow 2013). However, there have been no contemporary sightings of right whales off the continental shelf. Furthermore, while the IWC-POWER cruises have surveyed several areas of the central and eastern North Pacific, there were no documented sightings of right whales outside of Alaska waters. However, PAM was only incorporated into the POWER surveys beginning in 2017. It is well known that the inclusion of passive acoustics increases the number of sightings of right whales (Rone et al. 2012, Crance et al. 2017, Matsuoka et al. 2022) and should be included in future surveys in the central and eastern North Pacific to help maximize the likelihood of right whale detection.

All sightings with a group size more than 2 individuals ($n = 9$) were in the Bering Sea, with the 2 largest group sizes in and just east of the RWCH (Fig. 4). Despite group sizes ranging up to 7 individuals, there was only one instance of very brief surface-active group behavior (Matsuoka et al. 2022), suggesting that most larger aggregations were likely a result of dense prey aggregations as opposed to mating behavior (Stafford et al. 2010, Baumgartner et al. 2013). All sightings along the US west coast were of a maximum of 2 individuals, while all sightings south of 50° N (along a potential migratory route) were of single adult animals. In the North Atlantic, historically, right whales observed in the mid-Atlantic migratory routes were predominantly reproductive females, calves, and juveniles (Kraus et al. 1986b, Winn et al. 1986). Unfortunately, no genetic samples and very few photographs have been collected from ENPRWs south of 50° N, so the demographics of the animals seen off the US west coast are unknown. Most sightings with confirmed or presumed feeding ($n = 20$) were on ENPRW Alaskan feeding grounds ($n = 17$); 9 in total were outside their RWCHs in both the Bering Sea and GOA (Fig. 5). Those sightings with documented feeding in the northern Bering Sea also occurred during a known warm period after a record low sea ice extent in the Bering Sea (in 2018; Stabeno & Bell 2019). These northern sightings correlate well with results from Wright et al. (2023), who hypothesized that ENPRWs move farther north in the Bering Sea to feed during warmer years. There were 3 sightings outside of Alaska where feeding was observed or presumed (Fig. 5). This suggests that ENPRWs opportunistically feed while along migratory routes, as has been documented in other large whale species (e.g. Carroll et al. 1987, Stamation et al. 2007). However, the documented feeding off Unimak Pass in February suggests that some right whales remain in the Bering Sea during some or all of the winter.

Like their Atlantic congeners, ENPRWs face several threats from anthropogenic activities, including vessel strikes and entanglement in commercial fishing gear. There is considerable overlap between the range of ENPRWs and these threats. Alaska has one of the largest fishing industries in the country by volume, and entanglement has already been identified as a threat to bowhead whales in the Bering Sea (Citta et al. 2014, George et al. 2019). Furthermore, right whales have been documented in the heavily trafficked Unimak Pass, which is a main corridor of the Great Circle Route for commercial shipping between North America and Asia (Wright et al. 2018). However, the rarity of sightings and remote locations of these animals greatly reduce the probability that entanglements or vessel strikes will be observed or reported. Therefore, quantifying the direct impacts of these threats on this population will continue to be difficult. Additional research is clearly needed to clarify current threats and inform possible management strategies for this critically endangered population.

While the sightings data presented here provide new insights into important habitat for ENPRWs, there are caveats to note. First, these data represent only those sightings in US and Canadian waters. While sightings of ENPRWs are compared to photographs of animals from the western population when possible, it is conceivable that there is movement and spatial overlap between the 2 populations that is not reflected in this study. It is also important to note, as stated previously, that the majority of dedicated effort has occurred in Alaska, and as such these data may reflect that bias. Increased research effort, both in and outside of Alaska, is essential for furthering our understanding of this small but resilient population. Indeed, the opportunistic sightings reported here may be indicative of a changing habitat-use pattern and should be the target of future research projects in the North Pacific.

5. CONCLUSIONS

Knowledge of migration routes, breeding grounds, important habitat, and population demographics (e.g. age, sex, reproductive status of animals in the population) are essential for effective management and conservation efforts. While most of these remain unknown for ENPRWs, the increase in sightings in recent years both within and outside their known feeding grounds has helped fill in some of those knowledge gaps. Sightings of ENPRWs are increasing within Alaska waters, yet it is difficult to conclude whether

this is due to an increase in survey effort, an increase in public awareness, or whether it truly reflects a growing and/or expanding population. Acoustic detections and sightings reported from St. Lawrence Island northward suggest that the northern Bering Sea may gain importance as a feeding habitat as temperatures continue to rise. While the increased sightings along the west coast hint at possible migratory routes or wintering grounds, insufficient data exist to understand how these southerly animals fit into the overall ENPRW population demographics. Historically, ENPRWs have had a greater pelagic distribution (Scarff 1986, Shelden et al. 2005) than is represented by the current sightings data. Regardless of the underlying causes of the increased sightings, the documented presence of ENPRWs throughout the Bering Sea and GOA should be included in future reviews of the RWCH boundaries. Dedicated photo-ID, biopsy, satellite tagging, and acoustic surveys throughout the Bering Sea and GOA are essential to determine the full extent of ENPRW distribution and describe the spatial and temporal habitat-use demographics of this Critically Endangered population.

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