Biologically Important Areas II for cetaceans within U.S. and adjacent waters – West Coast Region

Supplementary File A: Detailed methods and data processing

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This document provides details on BIA delineation methods applied to all BIA regions in this assessment and data processing methods common among all West Coast BIAs (general methods summarized in the corresponding manuscript). BIA-specific methods are described in the respective BIA's section in the manuscript, Supplementary File B (full BIA descriptions), and on the BIA website.

S1. Overall BIA Methods Summary Provided by NMFS (Harrison et al., 2023)

BIAs for all seven regions around the U.S. were delineated, scored, and labeled using the methodology described in the Introductory chapter included in this special edition, Harrison et al. (2023). Additionally, Harrison et al. (2023) highlights the changes in BIA II since Vans Parijs et al. (2015), describes the intended use of the BIAs, and specifically addresses common mischaracterizations of the BIA I products to try to reduce inappropriate use of BIAs in the future. Fundamentally, BIAs are compilations of the best available science and have no inherent or direct regulatory power. We provide a brief overview of the methods outlined in Harrison et al. (2023) below.

The BIA II effort applied principles of expert elicitation in a more structured manner to identify, delineate, and score BIAs to ensure that information that was not incorporated during BIA I (e.g., Indigenous knowledge, local knowledge, or community science) was included. Expert elicitation is a formal, structured process for obtaining experts' opinions and knowledge to help inform decision-making, particularly in an information-limited situation. The BIA II expert elicitation process included wide-ranging information solicitation; extensive communication of purpose, intention, and protocols; clear documentation of methods; and extensive consistency review. Additional details on expert elicitation are included in Harrison et al. (2023).

A regional lead with cetacean expertise oversaw the identification, delineation, and scoring of the West Coast BIAs, engaging with additional subject matter experts (SMEs) as needed to ensure all available data and necessary expertise were included for all cetacean taxa. Four types of BIAs were defined (Table S1): feeding areas (F-BIAs), reproductive areas (R-BIAs), migratory routes (M-BIAs), and small and resident populations (S-BIAs). Each BIA was delineated only for the times and areas for which direct information exists on a particular cetacean species, population, or stock. Any reliable published or unpublished information from scientific research, Indigenous or local knowledge, or community science, including both data and personal observations, were considered valid. F-BIAs, R-BIAs, or M-BIAs indicate where a substantial portion of a species "*preferentially* feeds"; "*selectively* mates, gives birth, or is found with neonates or calves"; or within which "a *substantial* portion" is known to migrate, respectively, and likely include less than 100% of the area and time in which the associated activity occurs. In contrast, BIA boundaries for small resident populations aim to include 100% of the population. Intentional "buffers" or other "precautionary" additions of area or time were not allowed. Similarly, predictions of potential habitat alone were insufficient to support a BIA delineation. BIAs were delineated within or adjacent to the U.S. Exclusive Economic Zone (EEZ); however, the BIA was not truncated if it extended past the U.S. EEZ. When a BIA spanned more than one region, region leads worked together to delineate and score the BIA as a "transboundary" BIA. Transboundary BIAs are included in only one region's metadata, generally the region containing the larger area of the BIA.

All candidate BIAs were scored and labeled using five metrics: Intensity, Data Support, Importance, Boundary Certainty, and Spatiotemporal Variability (Table S2). All scoring metrics except Spatiotemporal Variability were assigned an integer value ranging from 1 ("low") to 3 ("high"). For each candidate BIA, Intensity and Data Support were independently scored using scoring rules specific to each BIA type. Then, Intensity and Support scores were combined to determine an overall Importance score using a single Importance Score matrix (Figure S1) for all BIA types. Candidate BIAs with an Importance score of 0 were added to a list of watch list areas for future consideration. Some S-BIAs with an Importance score of 1 were also included in the watch list; this was necessary because the quantitative Intensity scoring protocols produce an Intensity score of 3 for a species with a small abundance and range, precluding an Importance score of 0 even when the supporting data are insufficient. Boundary Certainty and Spatiotemporal Variability (dynamic, ephemeral, or static) were assigned to each BIA, using the same rules across BIA types, and independent of the Intensity and Data Support scores.

Reproductive Areas (**R-BIA**)	Areas and times within which a particular species selectively mates, gives birth, or is found with neonates or calves.
Feeding Areas (**F-BIA**)	Areas and times within which aggregations of a particular species preferentially feed. These either may be persistent in space and time or associated with ephemeral features that are less predictable but are located within a larger area that can be delineated.
Migratory Routes (**M-BIA**):	Areas and times within which a substantial portion of a species is known to migrate; the route is spatially restricted.
Small and Resident Population (**S-BIA**)	Areas and times within which small and resident populations occupy a limited geographic extent.

Table S1. Definitions of BIA types.

Score/Metric	Description	Possible scores/indicators
Intensity	Comparative significance of an area to the species in the context of the species' range and size, and the definition of the BIA type. Considers the strength and type of characteristics that underlie an area's identification as a BIA.	**1, 2, or 3**. Higher number = more intense characteristics
Data Support	Distinguishes meaningful differences in the information used to support the identification and scoring of a BIA. Considers the quantity, quality, and type of information, and associated uncertainties, upon which the BIA delineation depends.	**1, 2, or 3**. Higher number = more/higher quality supporting information
IMPORTANCE	Combines the Intensity and Support scores as depicted in Importance Matrix.	**1, 2, or 3**. Higher number = higher overall importance
Boundary Certainty	Characterizes the degree of certainty in the location and timing of the boundary.	**1, 2, or or 3**. Higher number = more certainty
Spatiotemporal Variability	Characterizes spatiotemporal variability of the BIA using one of three descriptors.	(**s**)tatic, (**e**)phemeral, or (**d**)ynamic.

Table S2. Descriptions of the five metrics used to score and label BIAs.

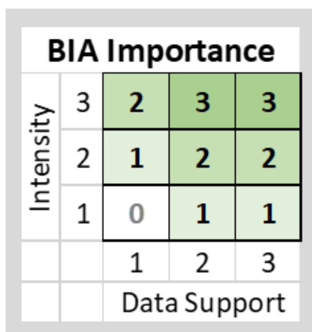

Figure S1. Matrix used to combine Intensity and Support to score Importance.

The definition of a BIA unit was expanded for this BIA II process. In the simplest case, a BIA unit corresponds to a single polygon and one continuous period within which a species engages in a particular biologically important activity, or it corresponds to the range of a small resident population. However, it is possible that multiple polygons of the same type of BIA for a species could exist in a single region and period. In that case, a cluster of BIA polygons could be delineated, scored, and labeled as a single unit, regardless of whether they share common boundaries, as long as the scores for all metrics were identical across all polygons in the cluster. Another new feature of this BIA II process was the option to identify "hierarchical" BIAs for cases in which high-resolution information are available and it is appropriate and helpful to identify a gradation in animal use (Intensity), available information (Data Support), Boundary Certainty, or ecological characteristics (Spatiotemporal Variability) across a broader area. For example, in some cases data may support a single core area (a "child" BIA) identified within the larger "parent" BIA. In other cases, one or more clusters of identically scored polygons may appropriately be identified as a child BIAs within a larger parent BIA. For R-, F-, and M-BIAs, the Intensity score for the parent BIA must be less than the highest Intensity score among the child BIAs. For S-BIAs, when hierarchical scoring is used to identify core habitat within the population's range, the Intensity score may be the same for the core habitat (the child BIA) and the overall range (the parent BIA), as S-BIAs have quantitative scoring protocols and the parent BIA could score a 3. Potential child BIAs could not be added to the watch list, as any potential child BIA would inherently qualify as a BIA since it is within the parent BIA.

A label was generated for each individual BIA unit for metadata purposes. Labels were generated using information on the BIA type (S-, R-, F-, or M-BIA); Importance, Spatiotemporal Variability, and Boundary Certainty scores; region code (EC = East Coast, GOM = Gulf of Mexico, WC = West Coast, HI = Hawaiʻi, GOA = Gulf of Alaska, ABS = Aleutian Islands and Bering Sea, ARC = Arctic); identification number; and suffix that indicates hierarchical (0 followed by alphabetical index of child BIAs, e.g., -0ab for parent and -a and -b for child BIAs, respectively) or non-hierarchical structure (0).

Nearly all BIAs delineated for the West Coast relied on qualitative metrics for the Intensity score, which was based on such factors as the frequency of use, size, duration of use of the BIA, or the density or relative abundance of the population that uses each respective BIA type. Justification for Intensity scores for large whale BIAs often involved both biological information (e.g., extensive migratory movements from breeding grounds to feeding grounds off the West Coast, duration of feeding season) and ecological information (intensified areas of use for feeding based on ecologically favorable conditions). The behavior and population structure of each species was also factored into the scoring process. For example, some species (e.g., humpback whales) exhibit a high degree of site fidelity to specific feeding areas within the West Coast region (Calambokidis et al., 1996). As such, individuals are unlikely to move outside of those focal areas, and the West Coast at large, to other regions that may have been a recognized F-BIA for that species (e.g., Gulf of Alaska). The number and size of other BIAs delineated for a species is one factor to consider into the Intensity score (Harrison et al., 2023), but such behaviors (site fidelity) and/or population structure (e.g., regional-specific stocks) often made this factor irrelevant to scoring BIAs in our region. For the two S-BIAs (harbor porpoise and killer whales), Intensity scores were determined through the S-BIA Intensity scoring matrix which incorporates standardized quantitative criteria on abundance and range size (Harrison et al., 2023). Abundance estimates specific to each population were taken directly from the most recent and appropriate literature (e.g., from publications or NOAA Stock Assessment Reports). The size of each S-BIA was calculated using the *sf* package (Pebesma, 2018) to determine range size scores. For all BIAs, scores for Data Support, Importance, and Boundary Certainty were informed by the quality and quantity of supporting information, data and methods biases, and current knowledge gaps that were relevant to each score type (detailed in Harrison et al., 2023).

References

Harrison, J., Ferguson, M.C., New, L., Cleary, J., Curtice, C. DeLand, S. et al. (2023), Biologically important areas for cetaceans within U.S. and adjacent waters: Updates and the application of a new scoring system. Front. Mar. Sci.

Van Parijs, S.M., Curtice, C., and Ferguson, M. (Eds.). (2015). Biologically Important Areas for Cetaceans within U.S. waters. Aquatic Mammals (Special Issue) 41(1). Doi: 10.1578/AM.41.1.2015.1

S2. Detailed Methods for West Coast BIAs

S2.1 Large whale satellite tag data: Pre-processing

Whale feeding home ranges used as a data layer in the F-BIA delineation process were based off Oregon State University (OSU) and Marine Ecology and Telemetry Research (MarEcoTel) satellite tag deployments for blue, fin, humpback, and PCFG gray whales (Table S3; Mate et al., 2018; Irvine et al., 2014; Palacios et al., 2020; Lagerquist et al., 2019; Scales et al., 2017). All Argos positions from the satellite tags were pre-processed following OSU's custom track editing protocol in Mate et al. (2018) and Palacios et al. (2020). First, locations on land and Argos locations with a location quality class (LC) of Z (poorest) were removed. The remaining locations were filtered as follows: lower-quality LCs (0, A, or B) were excluded if they were received within 20 minutes of higher-quality locations (1, 2, or 3). Travel speeds between the remaining locations were calculated and where the speed between two locations exceeded a species-specific speed (12 km/h for blue and fin whales, 14 km/h for humpback whales, 15 km/h for gray whales), the location resulting in the shortest track was retained and the other discarded (Mate et al., 2018; Palacios et al., 2020).

Edited Argos tracks were then processed through a Bayesian switching state-space model (SSSM) using the package *bsam* (Jonsen et al., 2017) developed by Jonsen et al. (2005) to regularize tracks while also accounting for Argos positional uncertainty and movement dynamics of the whales. This model also estimates two movement behavior modes based on mean turning angles and autocorrelation in speed and direction: "transiting" (mode 1) and "area-restricted searching (ARS; mode 2) (Jonsen et al., 2005). For all whales, behavioral state values greater than 1.75 were characterized as ARS locations and those lower than 1.25 were characterized as transiting (Bailey et al., 2009; Irvine et al., 2014; Mate et al., 2018; Palacios et al., 2020; Lagerquist et al., 2019). Specific details on model formulation are provided in Mate et al. (2018), Palacios et al. (2020), Irvine et al. (2014), and Lagerquist et al. (2019). For the more recent humpback whale tag deployments (2016-2019), locations were fitted to the more contemporary hierarchical version of the SSSM (hSSSM; Jonsen, 2016). The model is structurally similar to the conventional SSSM, but differs in that it estimates parameters that inform behavior modes for all tracks simultaneously rather than separately; this process allows for greater precision when estimating behavior modes and for analyzing movement behaviors across a sample population (Jonsen, 2016). A summary of the models applied to each species tag dataset and the number of locations estimated per dataset is provided in Table S4.

Table S3. Summary of tag deployments used in the U.S. West Coast BIA delineations.

BIA	Deployment locality*	# Depl. [1]	Span of years with deployments[2]	# Unique years with deployments	Median (range) deployment duration (days)[3]	Species-specific notes
Blue whale F-BIA						
	Northern CA	2	1998	1	61 (61-61)	
	Central CA	26	1998-2016	5	79 (37-504)	
	Southern CA	82	1999-2017	9	83 (30-273)	
	Total	110	1998-2017	12	79 (30-504)	
Fin whale F-BIA						
	CA	71	2006-2017	10	28 (3.1-293)	
	OR	1	2018	1	108 (NA)	
	WA	7	2010-2013	4	24 (4.1-81)	
	Total	79	2006-2018	11	27 (3.1-293)	
Humpback whale F-BIA						
	WA	21	2018-2019	2	45 (31-121)	
	Northern CA-OR	8	2005-2018	3	35 (30-103)	
	CA	12	2004-2017	2	57 (36-94)	
	Total	41	2004-2019	5	46 (30-121)	
PCFG Gray whale F-BIA						
	Northern CA	16	2009-2013	3	67 (43-229)	
	Central OR	7	2009-2012	2	73 (26-383)	
	Total	23	2009-2013	3	72 (26-383)	
Southern Resident killer whale S-BIA						
	WA inland waters	5	2012-2016	4	31 (3-95)	Pods: J, K, L
	WA outer coast	2	2015-2016	2	25 (3-93)	Pods: L
	OR	1	2013	1	7.8 (NA)	Pods: L
	Total	8	2012-2016	5	29 (3-95)	Pods: J, K, L

**CA = California; OR = Oregon; WA = Washington*

[1]For Southern Resident killer whales: three deployments were excluded from KDE analyses due to limited deployment duration (3 days; 2 tracks: one 2012 WA inland waters and one 2016 WA outer coast) and pseudoreplication (1 track: 2013 OR)

[2]Years listed represent years of deployment; some satellite tags with long transmission durations may have extended into subsequent years outside of those listed

[3]F-BIA home ranges were derived from locations that occurred during the feeding season; deployment duration represents the full track (both migratory and feeding) duration, where applicable

Table S4. Summary of SSSM model types and outputs for each large whale species tag dataset incorporated in the BIA delineation process.

Tag dataset	Model	# locations estimated	Reference
Blue whales (all)	SSSM	1 per day	Mate et al. (2018), Irvine et al. (2014)
Fin whales (all)	SSSM	1 per day	Mate et al. (2018)
Humpback whales (before 2016)	SSSM	1 per day	Mate et al. (2018), Palacios et al. (2020)
Humpback whales (2016-2019)	hSSSM	3 per day	Palacios et al. (2020)
PCFG gray whales	SSSM	2 per day	Lagerquist et al. (2019)

S2.2 Large whale satellite tag data: Home range analysis

The feeding home range layers used were focused on whale space use during the feeding season. As such, prior to home range analyses, the migration portion of each whale's track was removed (where applicable). The migration portion of each track was defined as the segment of each hSSSM/SSSM track where behavioral model remained as transiting during southward or northward movement for the remainder of the deployment period or until the whale reached a breeding ground. Feeding home ranges were then generated for the feeding range resident portions of the track. For blue, fin, and humpback whales (Mate et al., 2018; Palacios et al., 2020; Irvine et al., 2014), a least-squares cross-validation bandwidth selection method was applied to estimate the kernel home ranges, using the package *adehabitatHR* (Calenge, 2006, 2017). For PCFG gray whales (Lagerquist et al., 2019), feeding home ranges were estimated using the local convex hull utilization distribution generator (LoCoH; Getz et al., 2007). This method directly draws upon the spatial structure of the data, allowing for hard boundaries and irregular exclusionary areas in the environment, which is ideal for gray whales as they are often found very close to shore (Getz et al., 2007; Lagerquist et al., 2019). For all whales, the 90 percent home range (HR) isopleth was produced for each track and portions of the isopleth that overlapped with land were removed (Mate et al., 2018; Palacios et al., 2020; Irvine et al., 2014, Lagerquist et al., 2019).

S2.3 Southern Resident killer whale satellite tag data: processing and kernel density methods

Kernel density estimation (KDE) was used to generate a utilization distribution (UD) of the sample population (Worton, 1989), and a 50% isopleth of the UD was used to represent the core range of SRKWs during the months covered by satellite tag deployments. Location data were available from eight deployments on SRKWs from 2012 through 2016; tags were deployed during winter months (Table S3; Hanson et al., 2018). These methods are the same used for the Hawaiʻi region by Kratofil et al. (2023). Briefly, Kalman-smoothed Argos location data were first processed through the Douglas Argos Filter (Douglas et al., 2012) via Movebank (Kranstauber et al., 2011) to remove erroneous locations, and subsequently fit to a continuous-time correlated random walk model and predicted at a 4-hour timestep via *crawl* (Johnson et al., 2008; Johnson and London, 2018). Locations were re-routed around land (land polygon with added 50-m distance band) using the *pathroutr* package (London, 2021). Although locations were obtained more frequently than this 4-hour interval, kernel density analyses are sensitive to spatial autocorrelation; as such, a 4-hour step was used to attempt to mitigate spatial autocorrelation. Two tracks were excluded from kernel density analysis due to limited data that may inflate tagging locality bias (3 days of data), and an additional track was excluded as this individual traveled in concert with one another tagged SRKW throughout its deployment (the shorter of the two tracks was excluded to reduce pseudoreplication). The final analytical sample size was five tracks (3,944 filtered Argos locations). All tag locations were pooled together, and the contribution of each tag's location was weighted to the overall kernel density based on deployment length. The KDE was re-scaled so it integrated to 1 (Hauser et al., 2014; Hill et al., 2019), such that locations from shorter deployments would have less weight than those with longer deployments. Kernel densities were estimated using the bivariate plug-in bandwidth (or smoothing parameter) matrix (Duong and Hazelton, 2003, 2005; Duong, 2007) accessed through the *ks* package for R (Duong, 2021). The location weighting was completed using the weights argument within the *ks* package (Duong, 2021).

S2.4 Area calculations

The area of each BIA was calculated using the *st_area* function within the *sf* package in R (Pebesma, 2018). This function calculates the geodetic area of an *sf* spatial polygon in the units of the coordinate reference system (CRS) specified for the spatial polygon. For all West Coast BIAs, the North America Equal Area CRS (ESRI:102008) was specified for the polygons; the measurement units for this CRS are in meters. The calculated area of the BIA polygons (in meters) were converted to kilometers for reporting purposes. For BIAs that had more than one spatial polygon, the total area of the BIA was represented as the sum of the areas of all spatial polygons comprising the BIA.

S2.5 Large whale sighting-seafloor depth frequency distributions

We defined inner (shoreward) boundaries of the F-BIAs by depth contours, which were informed by the frequency distributions of CRC small boat survey sighting locations across seafloor depth bins. More specifically, we used these distributions to identify transition points in the proportion of sightings across depth bins that would indicate the relative distribution that each BIA reflects (i.e., broader distribution for parent and concentrated for core); these transition points generally aligned with the 0.95 quantile and 0.55 quantile of the sighting depth distribution for each species. This approach was applied to the blue whale, fin whale, and humpback whale F-BIAs (Figures S2-S4). We did not apply this approach to the gray whale F-BIAs (PCFG and Sounders), as they are commonly found very close to shore, and a depth contour inner boundary was not entirely necessary.

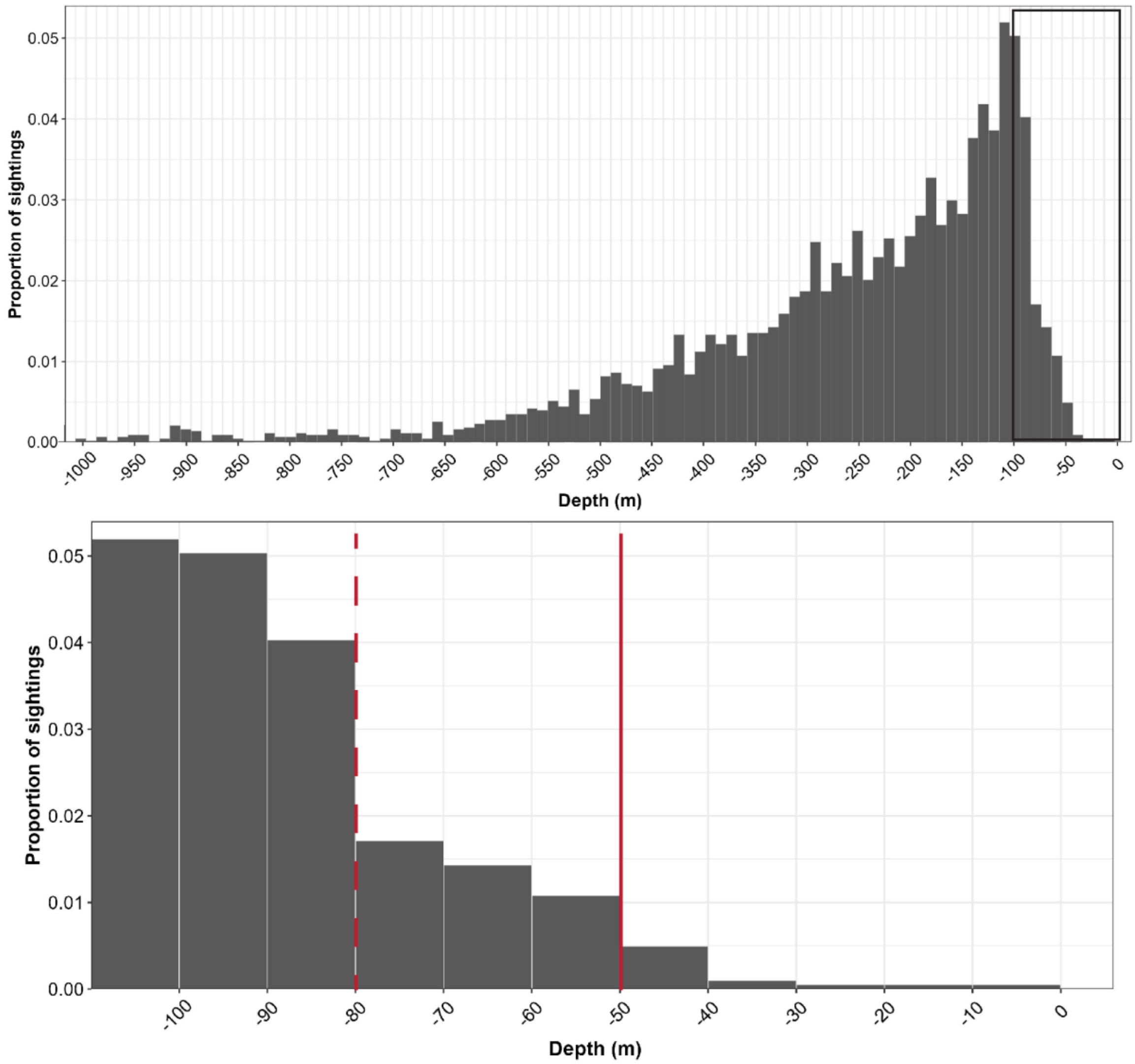

Figure S2. Seafloor depth distributions of blue whale sightings (n=4,395; CRC only, feeding/milling behaviors only) within 1,000 meters depth (top) and within 100 meters depth (bottom). The black rectangle on top panel shows the range of values that are plotted in the bottom panel. Red vertical lines on the bottom panel show the depth bin used as the inner (shoreward) boundary for the parent BIA (solid line, 50 meters) and core BIA (dashed line, 80 meters).

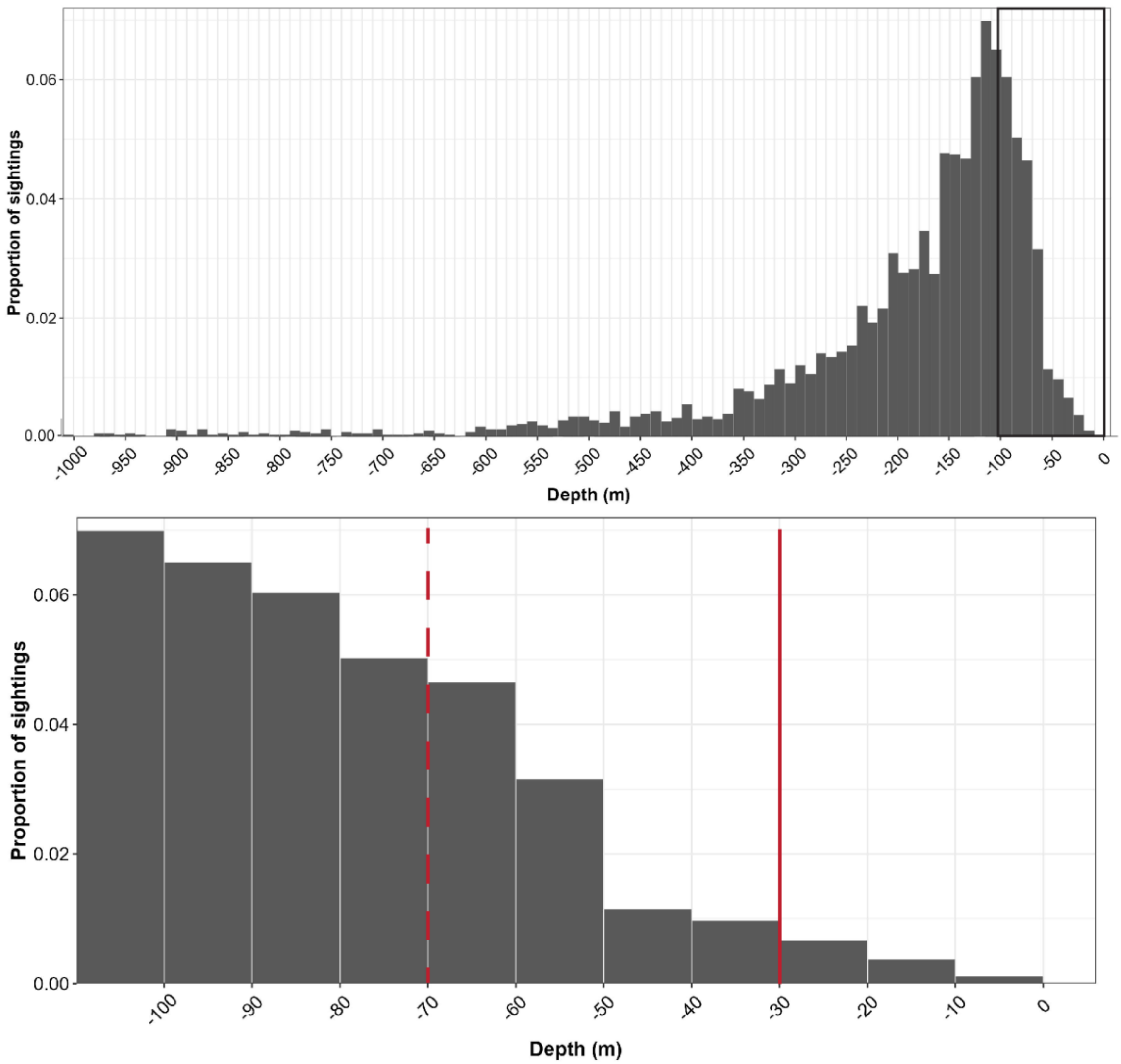

Figure S3. Seafloor depth distributions of humpback whale sightings (n=4,777; CRC only, feeding/milling behaviors only) within 1,000 meters depth (top) and within 100 meters depth (bottom). The black rectangle on top panel shows the range of values that are plotted in the bottom panel. Red vertical lines on the bottom panel show the depth bin used as the inner (shoreward) boundary for the parent BIA (solid line, 30 meters) and core BIA (dashed line, 70 meters).

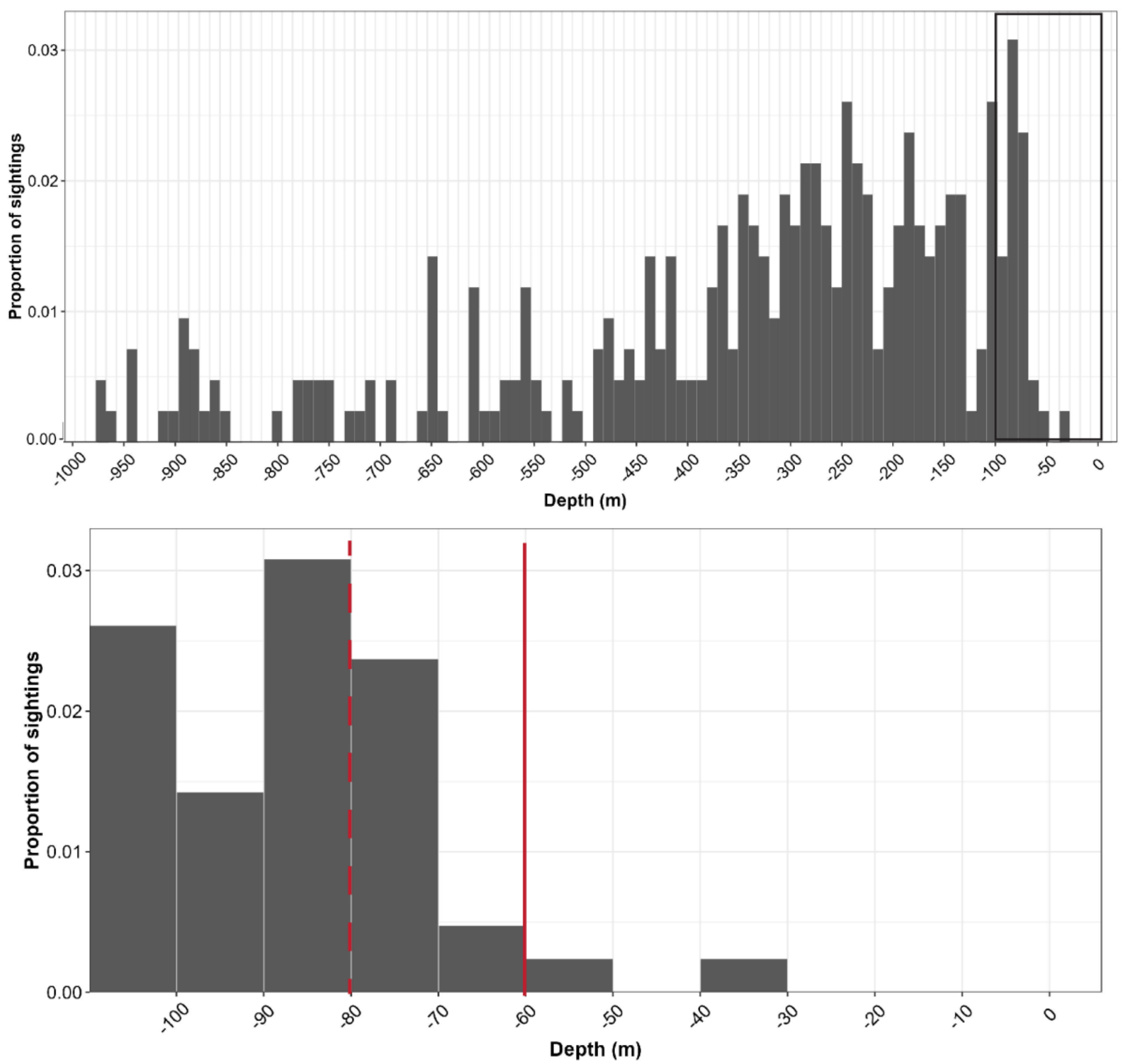

Figure S4. Seafloor depth distributions of fin whale sightings (n=422; CRC only, feeding/milling behaviors only) within 1,000 meters depth (top) and within 100 meters depth (bottom). The black rectangle on top panel shows the range of values that are plotted in the bottom panel. Red vertical lines on the bottom panel show the depth bin used as the inner (shoreward) boundary for the parent BIA (solid line, 60 meters) and core BIA (dashed line, 80 meters).

2.6 Evaluation of large whale spatial distribution of sightings with calves

For the large whale species that use the West Coast for feeding, we conducted an assessment of the spatial distribution of sightings of calves compared to sightings with no calves to determine whether differences warrant the delineation of an additional reproductive BIA (i.e., areas where there is disproportionate calf occurrence). For gray whales, there is substantial supporting information on the disproportion use of nearshore waters by migrating cow/calf pairs that is published in the literature, and thus we used this published information to delineate a R-BIA for gray whales (i.e., no separate assessment). For the remaining large whales, we used CRC small boat sighting data for this assessment as the other data sources used in F-BIA delineation did not contain information on calf presence/absence for each sighting. We only undertook this assessment for blue whales and humpback whales as these were the only two species with large sample sizes from which we could more confidently infer differences in the distribution of calves from non-calf groups. We used depth and distance from shore as the metrics for comparison and also mapped the locations of sightings to visually compare the distribution of the two sighting types (Figures S5-S10). Seafloor depth was determined for each sighting location using the GEBCO gridded bathymetry raster[1] and the *stars* package in R (Pebesma and Bivand, 2023) to extract depth values. Distance from shore was calculated using the *sf* package (Pebesma, 2018). Kolmogorov Smirnov tests were conducted on the depth and distance from shore distributions to identify any statistical differences in the two distributions. Distance to shore was calculated as the distance from the sighting location to the mainland, and thus excluded smaller islands (e.g., in the Southern California Bight).

Blue whales

For blue whales, there was only weak evidence for differences in depth (calf sightings mean depth: 265 meters; non-calf sightings mean depth: 300 meters; Kolmogorov-Smirnov test p-value = 0.4208) and distance from shore distributions (calf sightings mean distance from shore: 28.0 kilometers; non-calf sightings mean distance from shore: 30.7 kilometers; Kolmogorov-Smirnov test p-value = 0.9445) between the two sighting types and thus no R-BIA was justified for blue whales.

Summary statistics on depths (in meters): feeding/milling behaviors, Jun-Nov only

	n	**mean**	**median**	**sd**	**max**
Calves	101	265	195	187	924
No calves	4,294	300	214	391	4,662

Kolmogorov Smirnov test: p-value = 0.4208

Summary statistics on distance from shore (kilometers): feeding/milling behaviors, Jun-Nov only

	n	**mean**	**median**	**sd**	**max**
Calves	101	28.0	20.7	25.7	150
No calves	4,294	30.7	30.1	26.1	365

Kolmogorov Smirnov test: p-value = 0.9445

[1] https://www.gebco.net/data_and_products/gridded_bathymetry_data/

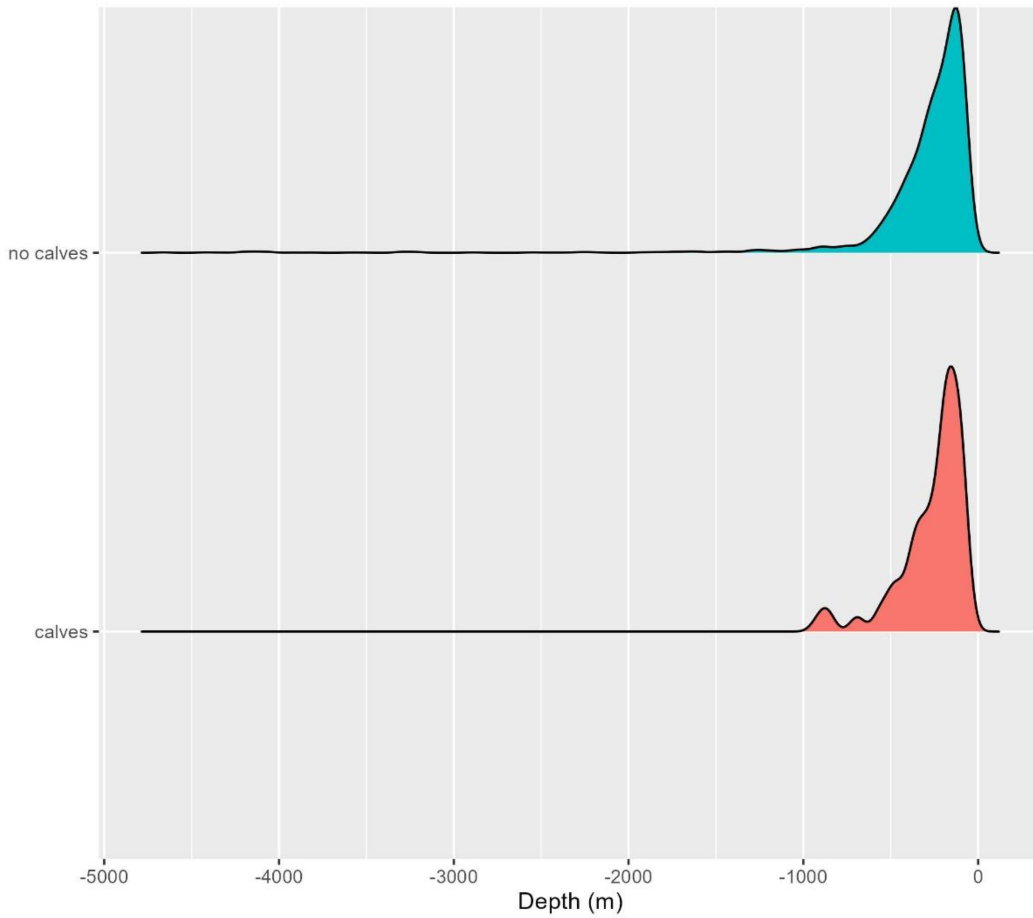

Figure S5. Density distribution of blue whale sightings by seafloor depth (meters) for sightings without calves (top curve) and sightings with calves (bottom curve).

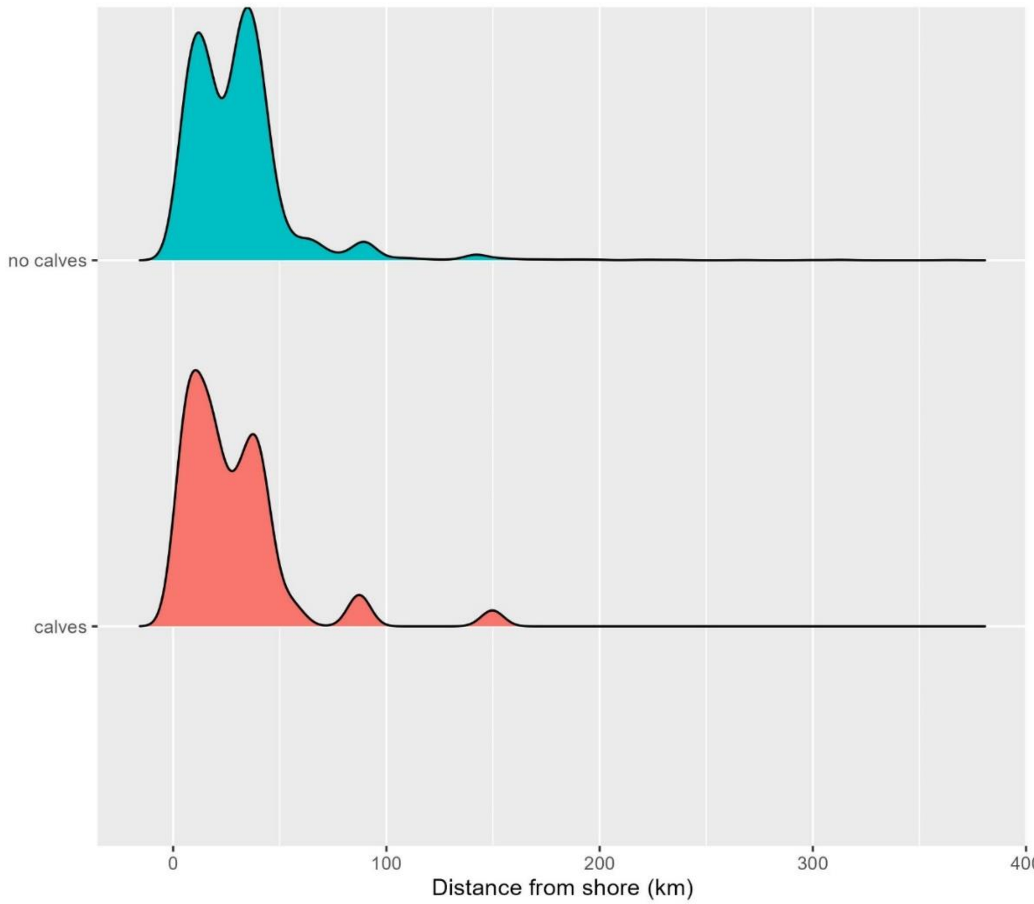

Figure S6. Density distribution of blue whale sightings by distance from shore (kilometers) for sightings without calves (top curve) and sightings with calves (bottom curve).

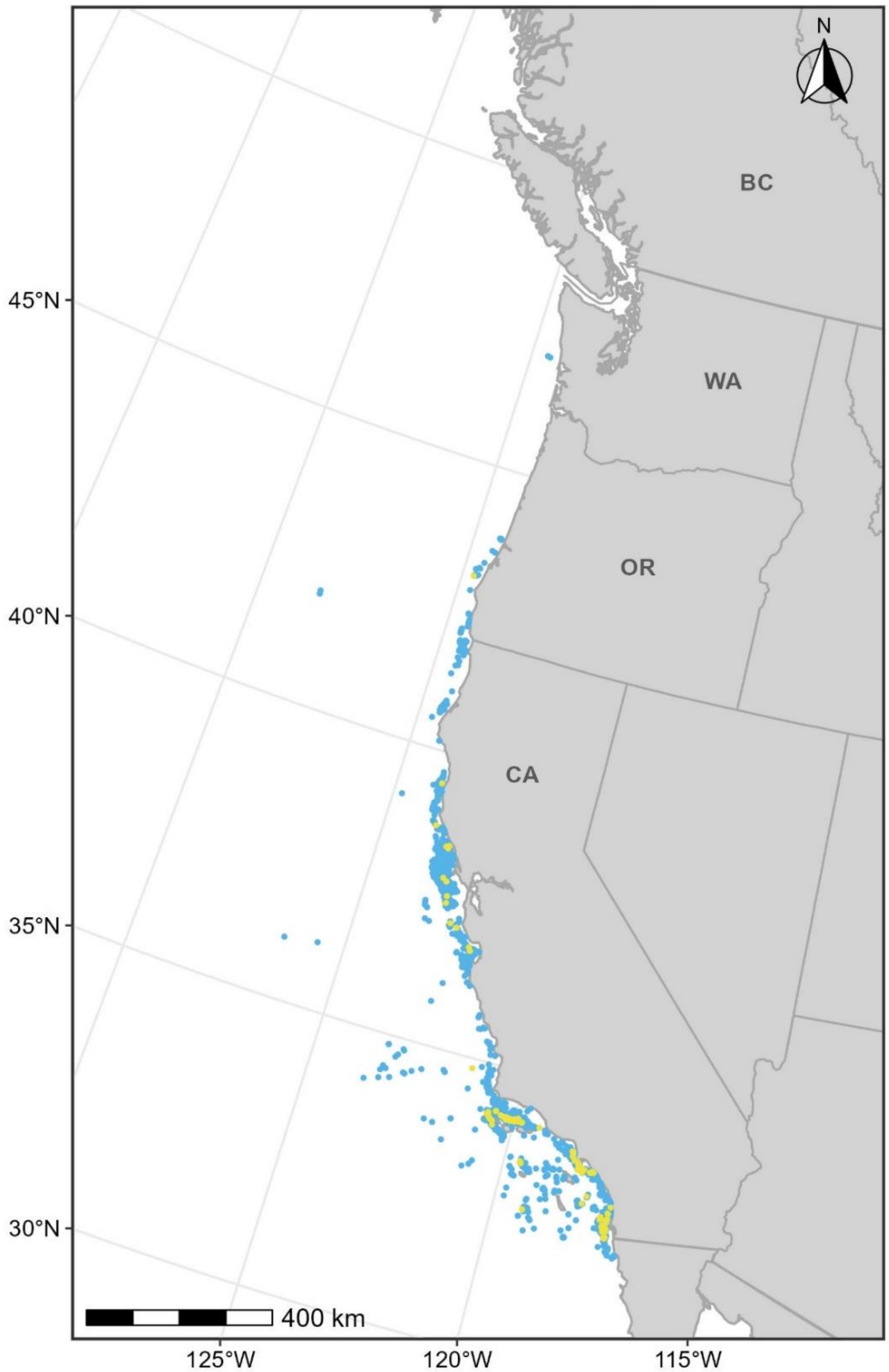

Figure S7. CRC sightings of blue whales without calves (blue points, n=4,294) and with calves (yellow points, n=101) from June to November.

Humpback whales

While a statistical difference was found between the two depth distributions for humpback whales (Kolmogorov Smirnov test p-value = 0.0007), the actual biological difference was minor (calf sightings mean depth = 178 meters; no calf sightings mean depth = 218 meters); the statistical difference was likely driven by a cluster of non-calf sightings that occurred much farther offshore (>3,000 meters deep) than the majority of sightings. There was no statistical difference between the two distributions for distance from shore (Kolmogorov-Smirnov test p-value = 0.9932), with concordant weak evidence for biologically meaningful differences in distance from shore distributions between the two sighting types (calf sightings mean distance from shore = 22.4 kilometers; no calf sightings mean distance from shore = 23.6 kilometers). Therefore, we did not consider an R-BIAs for humpback whales.

Summary statistics on depths (in meters): feeding/milling behavior only, Mar-Nov

	n	**mean**	**median**	**sd**	**max**
Calves	404	178	123	171	1298
No calves	4,373	218	141	281	4,320

Kolmogorov Smirnov test: p-value = 0.0007

Summary statistics on distance to shore (kilometers): feeding/milling behavior only, Mar-Nov

	n	**mean**	**median**	**sd**	**max**
Calves	404	22.4	19.7	14.4	104
No calves	4,373	23.6	21.5	15.4	217

Kolmogorov Smirnov test: p-value = 0.9932

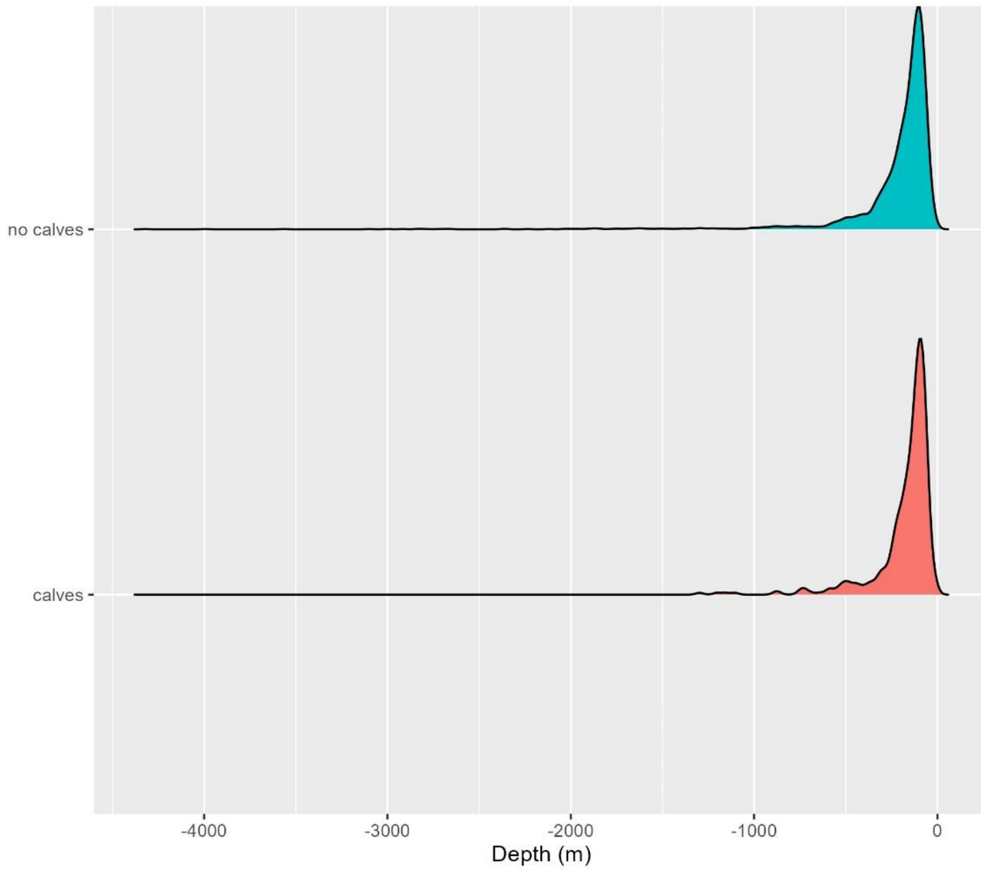

Figure S8. Density distribution of humpback whale sightings by seafloor depth (meters) for sightings without calves (top curve) and sightings with calves (bottom curve).

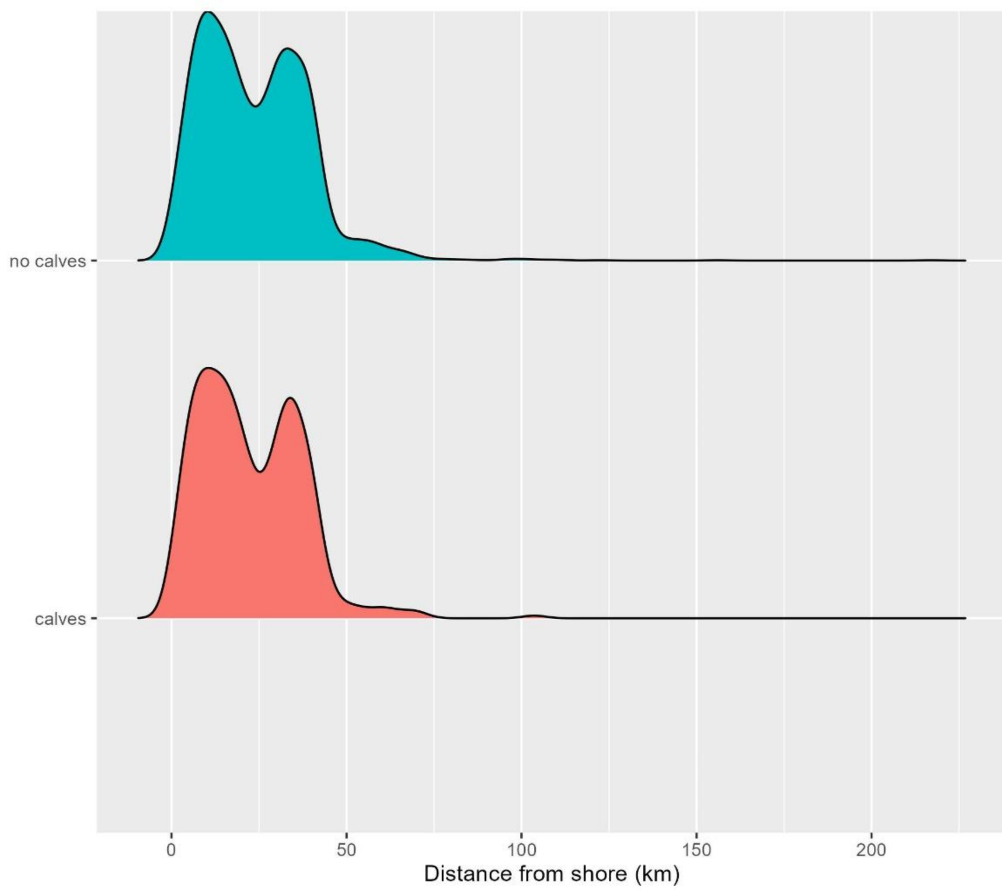

Figure S9. Density distribution of humpback whale sightings by distance from shore (kilometers) for sightings without calves (top curve) and sightings with calves (bottom curve).

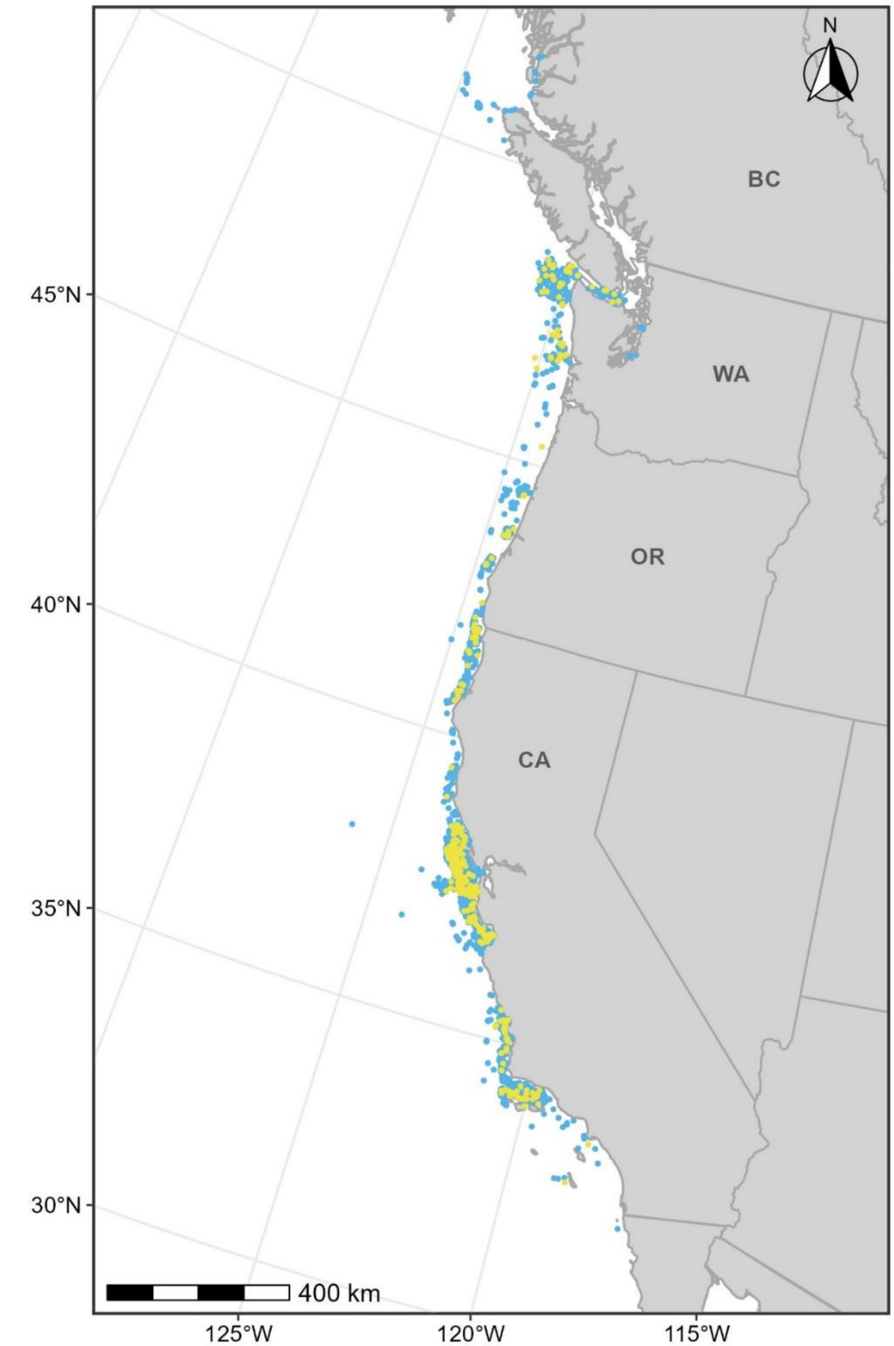

Figure S10. CRC sightings of humpback whales without calves (blue points, n=4,373) and with calves (yellow points, n=404) from March to November.

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