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Supplemental Information for:
Using spatial capture-recapture methods to estimate long-term spatiotemporal variation of a wide-ranging marine species

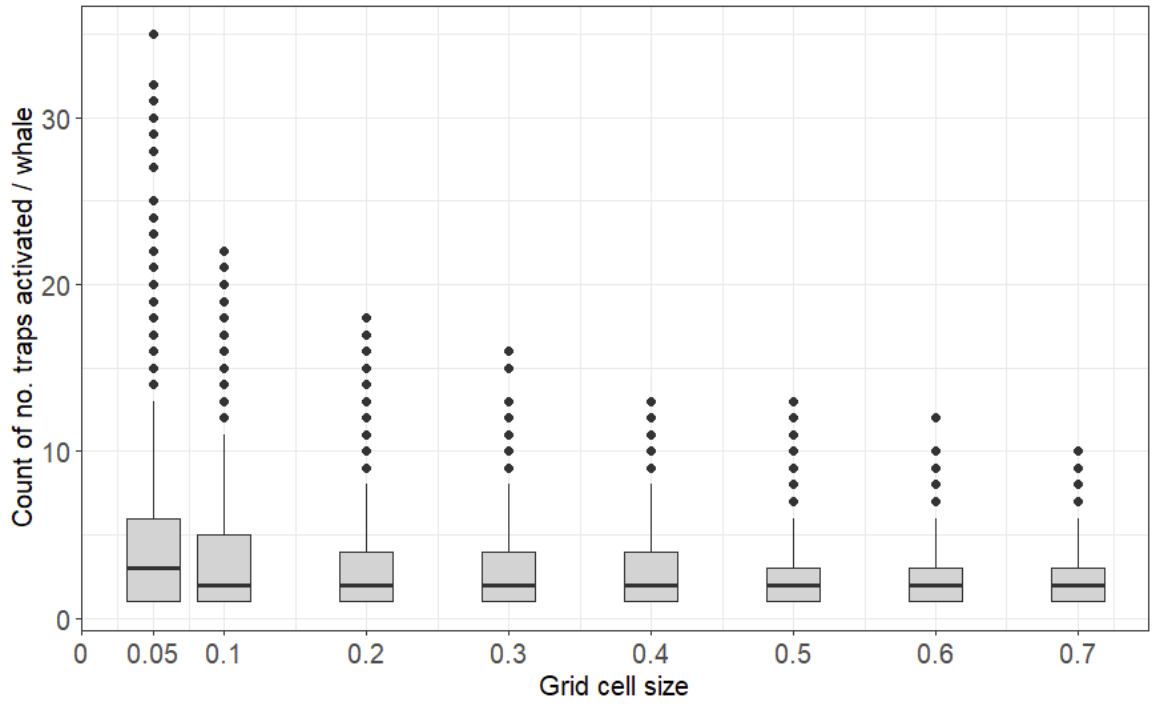

Figure S1. A cell size of 0.4 (equivalent to ~ 44km) gave markedly more spatial information than larger sizes (in terms of number of different traps an individual was captured in) but there was no significant additional gain in spatial information between the cell sizes of 0.2 and 0.4. From cell size 0.1 and below there was additional spatial resolution, but the computation required for this number of traps was infeasible.

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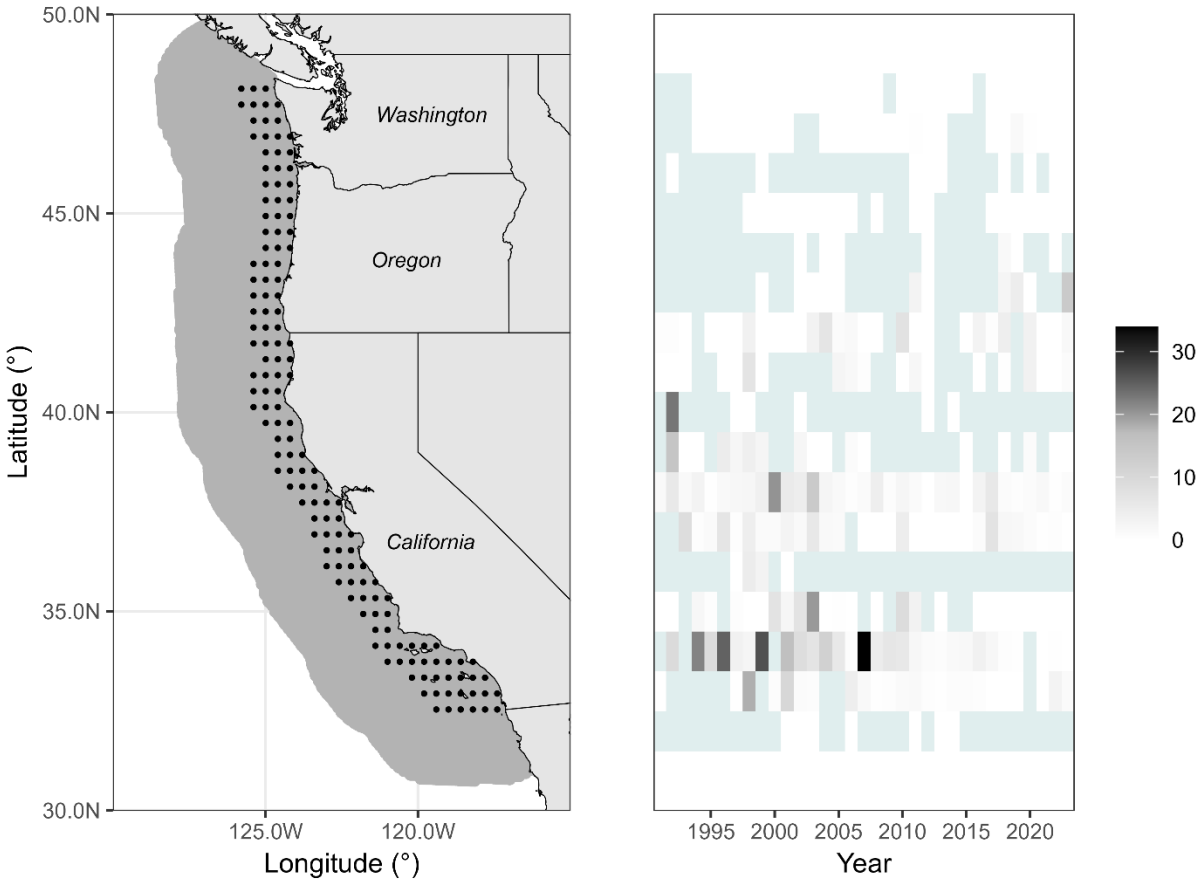

Figure S2. Left: Map of study area. Darker grey area represents the state-space or mask (S) (see Model definition), trap locations are marked by black dots. Right: Encounters per unit effort summary by each degree of latitude; scale bar describes encounters per unit effort where white is no encounters and darker greys indicate more encounters. The light blue indicates no effort.

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Table S1. Summary of model selection via Akaike's Information Criterion (AIC) used to determine number of knots applied to the smooth term of s(latitude, year) on density. The smallest allowable k value for a 2-dimensional smooth is k=4, so we tested values at intervals of two between k=4 and k=10 (maximum k value that converged).

Number of knots	Number of parameters	AIC	ΔAIC	AIC weight
10	17	24157.54	0.00	1.00
8	15	24194.76	3.25	0.00
6	13	24234.99	77.61	0.00
4	11	24317.00	159.54	0.00

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Table S2. Summary of Fletcher's c-hat variance inflation factor values for each session (Fletcher 2012).

Session	Year	c-hat
1	1991	40.55
2	1992	57.25
3	1993	27.88
4	1994	65.61
5	1995	28.64
6	1996	48.96
7	1997	31.07
8	1998	17.30
9	1999	47.99
10	2000	37.05
11	2001	81.17
12	2002	33.01
13	2003	25.16
14	2004	32.63
15	2005	11.45
16	2006	73.88
17	2007	77.62
18	2008	14.00
19	2009	70.20
20	2010	27.94
21	2011	21.65
22	2012	9.34
23	2013	10.58
24	2014	24.05
25	2015	28.73
26	2016	24.49
27	2017	29.26
28	2018	9.65
29	2019	11.44
30	2020	11.92
31	2021	15.62
32	2022	6.78
33	2023	28.37

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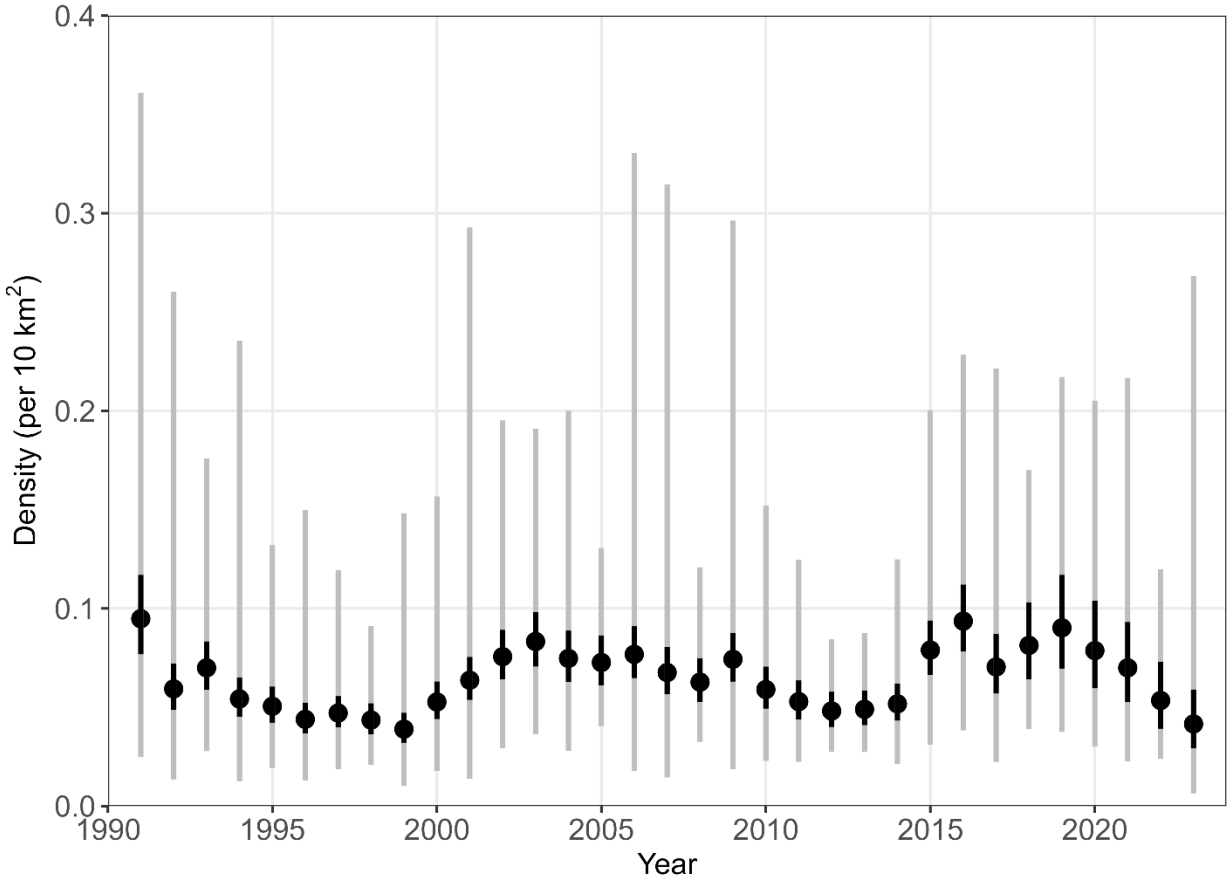

Figure S3. Session specific estimates of eastern North Pacific blue whale density (black points), with 95% confidence intervals from the fitted model (black lines) and adjusted 95% confidence intervals based on Fletcher's c-hat values (grey lines, Table S2) to demonstrate maximum possible uncertainty if the data are overdispersed relative to the Poisson distribution. It should be noted this variance adjustment is a crude measure, and worst case scenario, as it ignores the complexity of our observation model, which was specifically adjusted to account for heterogeneity (Pledger 2000). We also note that these predications are made using the average Y coordinate which allows the interval inflation to be added in secr (Efford 2024). As such, these densities are not exactly the same as the figure 2 in the main text which is the sum over all pixels with corresponding uncertainty.

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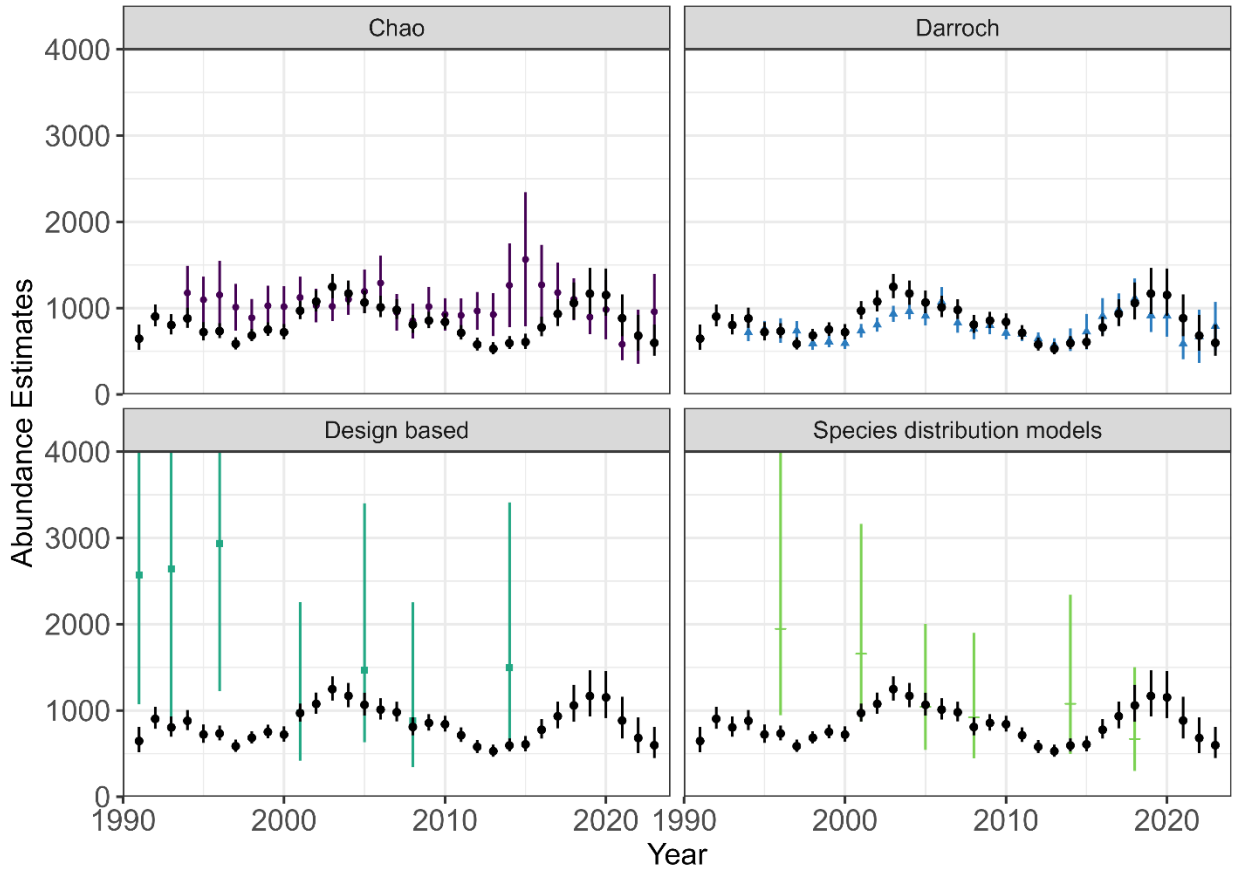

Figure S4. Comparison of SCR abundance estimates (black points on all plots) to estimates generated by other methods based on photo-identification and line-transect data. Error bars represent 2 standard errors for Chao and Darroch estimates and 95% confidence intervals for all others. Y-axis has been truncated to better show variability in the estimates; the upper 95% CI for the design-based estimates are 6,167, 9,508 and 7,048 in 1991, 1993 and 1996, respectively (Barlow 2016). The upper 95% CI for the species distribution model in 1996 is 4,009 (Becker et al. 2020). For Chao and Darroch capture-recapture estimates data were limited to the CRC survey data from the continental USWC only. Chao and Darroch estimates are 4-year rolling estimates (Calambokidis and Barlow 2020).