Supplement 1: Testing model with alternative boundaries between states

To test the sensitivity of our results to the use of ocean basins as the states of our model, we tested an alternative form of the model with different boundaries between states based on the IWC management areas (Figure S1.1). In this model, IWC areas II&III were one state, areas IV&V were another, and areas VI&I were the third. The catch and mark recovery data, as well as the abundance estimates were assigned to these states following a similar process for the ocean basins outlined in the main text. Catches before 1913 (which do not have location data) were assumed to be in areas I, II, and III, since most of the early catches occurred in these areas. In this model, the abundance estimates from the JARPA and JARPAII surveys were in a single state (areas IV&V) and therefore only a single q parameter was calculated.

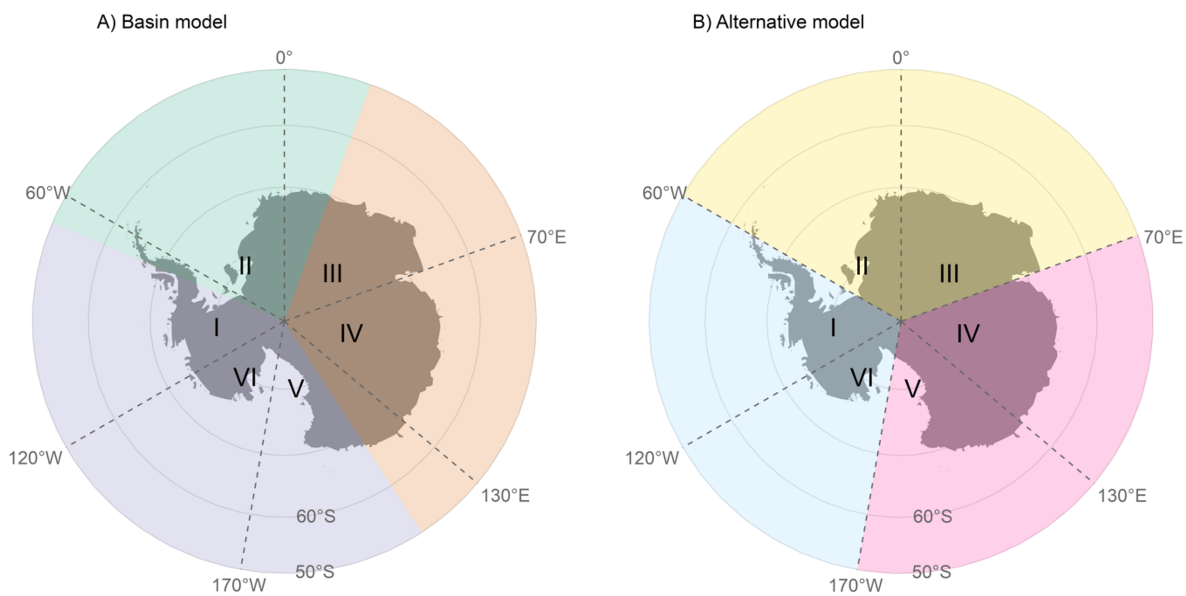

Figure S1.1. State designations used in multi-state mark recovery model for the model using ocean basins (A) and the alternative model (B) as well as the included IWC management areas.

We estimated high rates of movement between the three states used in this model, with the lowest estimated rate of movement of 0.107 (0.005 – 0.390) from areas II&III to areas VI&I. Estimated movement in the other direction, however, was high (0.382, 95% CI: 0.167–0.432). Annual movement rates among the other states were high, with medians greater than 0.14 (Figure S1.2).

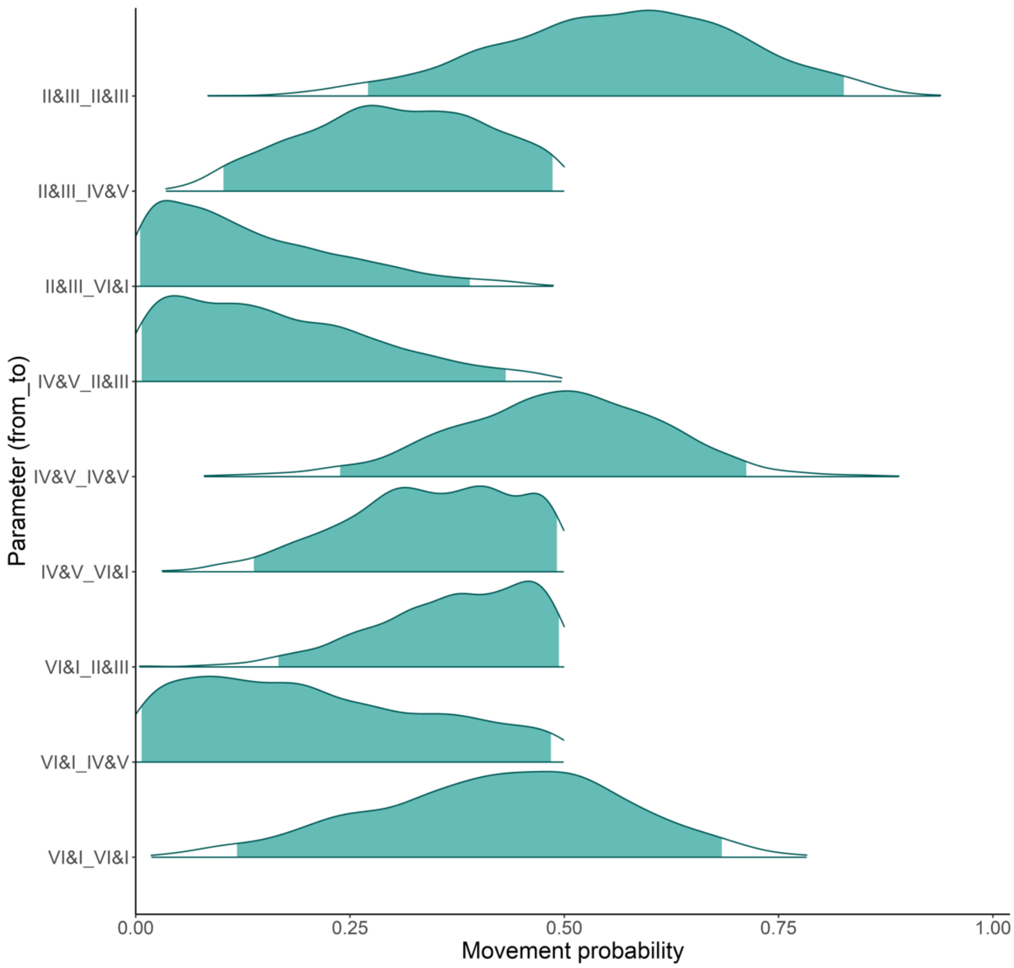

Figure S1.2. Posterior distributions and 95% credible intervals (shading) for the movement probabilities among the three states in the alternative model. The probability of remaining in each state was calculated by subtraction.

The estimate of carrying capacity (*K*) was 13 % larger in this model than in the basin model, and the estimate of *r* was 34 % smaller, but the credible intervals of these parameters overlap in both models (Table S1.1). The differences in these estimated are likely explained by the wider posteriors in this model compared to the basin model, indicating the parameter estimates from this model are more uncertain. The wide posteriors are likely a result very little information in the data for areas VI&I, since there are no JARPA abundance estimates for these areas, and the number of annual Antarctic blue whale catches in these areas were generally less than 2000 per year.

Table S1.1. Parameter estimates (median and 95% credible intervals) from the alternative model. In this model, state A was IWC management areas II&III, state B was areas IV&V, and state C was areas VI&I.

Parameter	Description	Median	2.5%	97.5%
r	Intrinsic growth	0.061	0.031	0.096
K	Carrying capacity (Total)	212862	178402	257974
K_A	Carrying capacity (A)	81278	56119	114535
K_B	Carrying capacity (B)	70875	40240	104692
K_C	Carrying capacity (C)	59317	33924	96787
$m_{A\rightarrow A}$	Movement	0.574	0.271	0.826
$m_{B\rightarrow A}$	Movement	0.145	0.007	0.432
$m_{C\rightarrow A}$	Movement	0.382	0.167	0.494
$m_{A\rightarrow B}$	Movement	0.305	0.102	0.486
$m_{B\rightarrow B}$	Movement	0.496	0.239	0.712
$m_{C\rightarrow B}$	Movement	0.188	0.007	0.485
$m_{A\rightarrow C}$	Movement	0.107	0.005	0.390
$m_{B\rightarrow C}$	Movement	0.352	0.138	0.491
$m_{C\rightarrow C}$	Movement	0.433	0.118	0.684
l	Mark loss	0.962	0.943	0.975
θ	Overdispersion	0.820	0.268	270.301
q_B	JARPA coverage (B)	0.286	0.170	0.466

Supplement 2: Model results with Matsuoka & Hakamada (2014) abundance estimates

In an additional model run, the model was fit to previously published abundance estimates for the JARPA and JARPAII surveys (Matsuoka & Hakamada 2014) instead of those published by Hamabe et al. (2023) in order to test the sensitivity of our results to the differences in these estimates. Matsuoka & Hakamada (2014) provide estimates for IWC areas IIIE-VIW (35°E - 145°W) though only areas IV and V were surveyed in all years. Therefore, for this sensitivity test, we used estimates from years where all areas were surveyed (1995/96–2008/09). Since the surveys covered different IWC areas in different years, the year of the estimate for each basin was calculated as a weighted average of the years of the corresponding IWC areas. Coefficients of variation (CVs) were calculated by converting the CVs of individual estimates into variances, taking a weighted average of the variances, and then converting the averaged variances back into CVs (Table S2.1).

Table S2.1. Abundance estimates, year, and CV for each basin based on abundance estimates, year, and CV from IWC management areas.

Year	Basin	Abundance	CV	Source
1981	Atlantic	91	0.34	Branch (2007)
1986	Atlantic	210	0.40	Branch (2007)
1996	Atlantic	326	0.35	Branch (2007)
1979	Indian	197	0.25	Branch (2007)
1987	Indian	141	0.28	Branch (2007)
1995	Indian	203	0.18	Matsuoka & Hakamada (2014)
1996	Indian	754	0.16	Branch (2007)
1997	Indian	437	0.19	Matsuoka & Hakamada (2014)
1999	Indian	861	0.17	Matsuoka & Hakamada (2014)
2001	Indian	421	0.15	Matsuoka & Hakamada (2014)
2003	Indian	763	0.13	Matsuoka & Hakamada (2014)
2005	Indian	558	0.16	Matsuoka & Hakamada (2014)
2007	Indian	904	0.17	Matsuoka & Hakamada (2014)
1982	Pacific	278	0.22	Branch (2007)
1988	Pacific	334	0.23	Branch (2007)
1996	Pacific	97	0.24	Matsuoka & Hakamada (2014)
1998	Pacific	148	1.25	Matsuoka & Hakamada (2014)
1999	Pacific	1126	0.14	Branch (2007)
2000	Pacific	227	0.29	Matsuoka & Hakamada (2014)
2002	Pacific	130	0.27	Matsuoka & Hakamada (2014)
2004	Pacific	502	0.31	Matsuoka & Hakamada (2014)
2006	Pacific	106	0.69	Matsuoka & Hakamada (2014)
2008	Pacific	319	0.26	Matsuoka & Hakamada (2014)

Median parameter estimates from the model fit to these data differed by no more than 8% from those from the model fit to the Hamabe et al. (2023) estimates, except the survey coverage parameter (q) which reflect the difference in surveyed area for the two sets of estimates (Table S2.2).

Table S2.2. Median parameter estimates, lower and upper bounds of 95 % credible intervals.

Parameter	*Description*	**Matsuoka & Hakamada (2014)**			**Hamabe et al. (2023)**		
		Median	*2.5%*	*97.5%*	*Median*	*2.5%*	*97.5%*
r	Intrinsic growth	0.091	0.074	0.107	0.086	0.068	0.104
K	Carrying capacity (Total)	181752	168180	197600	186335	170485	204579
K_{Atl}	Carrying capacity (Atlantic)	36481	25539	49824	36817	26057	51417
K_{Ind}	Carrying capacity (Indian)	63302	51472	76804	64654	52440	79403
K_{Pac}	Carrying capacity (Pacific)	81579	67437	97655	83987	68919	101474
$m_{\text{Atl}\to\text{Atl}}$	Movement	0.560	0.208	0.778	0.558	0.198	0.783
$m_{\text{Ind}\to\text{Atl}}$	Movement	0.132	0.029	0.330	0.126	0.027	0.339
$m_{\text{Pac}\to\text{Atl}}$	Movement	0.082	0.010	0.236	0.082	0.009	0.243
$m_{\text{Atl}\to\text{Ind}}$	Movement	0.157	0.006	0.459	0.145	0.006	0.463
$m_{\text{Ind}\to\text{Ind}}$	Movement	0.534	0.328	0.738	0.537	0.321	0.736
$m_{\text{Pac}\to\text{Ind}}$	Movement	0.278	0.141	0.449	0.275	0.133	0.459
$m_{\text{Atl}\to\text{Pac}}$	Movement	0.278	0.053	0.481	0.287	0.040	0.486
$m_{\text{Ind}\to\text{Pac}}$	Movement	0.321	0.145	0.483	0.324	0.144	0.484
$m_{\text{Pac}\to\text{Pac}}$	Movement	0.635	0.446	0.771	0.635	0.444	0.769
l	Mark loss	0.958	0.927	0.974	0.959	0.928	0.973
θ	Overdispersion	0.411	0.196	1.116	0.421	0.192	1.149
q_{Ind}	Survey coverage (Indian)	0.529	0.394	0.709	0.132	0.101	0.174
q_{Pac}	Survey coverage (Pacific)	0.130	0.101	0.168	0.080	0.063	0.101