

SUPPLEMENTAL MATERIALS FOR

Using Bayesian models to estimate humpback whale entanglements in the U.S. west coast sablefish pot fishery

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Supplemental Text: Fish Ticket Data Processing

For total fleet-wide (observed + unobserved) bycatch estimation, the landed amount of each species or species group is the only proxy effort metric measured for the entire fleet. Thus, the retained landing information from sales receipts (known as fish tickets) is crucial for fleet-wide total bycatch estimation for the commercial groundfish fisheries on the U.S. west coast. Fish tickets are trip-aggregated sales receipts for market categories that may represent single or multiple species. Fish ticket landing receipts are completed by buyers in each port for each delivery of fish by a vessel. Fish tickets are issued to buyers by a state agency and must be returned to the issuing agency for processing. Fish tickets are designed by the individual states (Washington, Oregon, and California) with slightly different formats by state. In addition, each state conducts species-composition sampling at the ports for numerous market categories that are reported on fish tickets. Fish ticket and species-composition data are submitted by state agencies to the PacFIN regional database.

Annual fish ticket landings data, with state species composition sampling applied, were retrieved from the PacFIN database and subsequently divided into various sectors of the groundfish fishery. Observer and fish ticket data processing steps are described in detail in Appendix B of the annual groundfish mortality report (Somers et al. 2021). All data processing steps specific to this report are described in the bycatch estimation methods in the main text.

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Supplemental Tables

Table S1: The number of observed pots (total) and the number and percentage of pots lost in the LE and OA sablefish pot fishery.

Year	LE observed pots (#)			OA observed pots (#)		
	total	lost	%	total	lost	%
2003	9017	0	0.00%	345	0	0.00%
2004	5378	0	0.00%	1950	0	0.00%
2005	13822	0	0.00%	835	0	0.00%
2006	10708	0	0.00%	666	0	0.00%
2007	5816	0	0.00%	624	0	0.00%
2008	13638	0	0.00%	833	0	0.00%
2009	3883	0	0.00%	540	0	0.00%
2010	11294	39	0.35%	648	2	0.31%
2011	9029	9	0.10%	831	6	0.72%
2012	14218	20	0.14%	610	5	0.82%
2013	1934	4	0.21%	590	1	0.17%
2014	7561	75	0.99%	686	4	0.58%
2015	11329	13	0.11%	604	8	1.32%
2016	21219	11	0.05%	687	15	2.18%
2017	7852	23	0.29%	1249	3	0.24%
2018	18424	11	0.06%	892	18	2.02%
2019	17518	6	0.03%	637	0	0.00%

Supplemental Figures

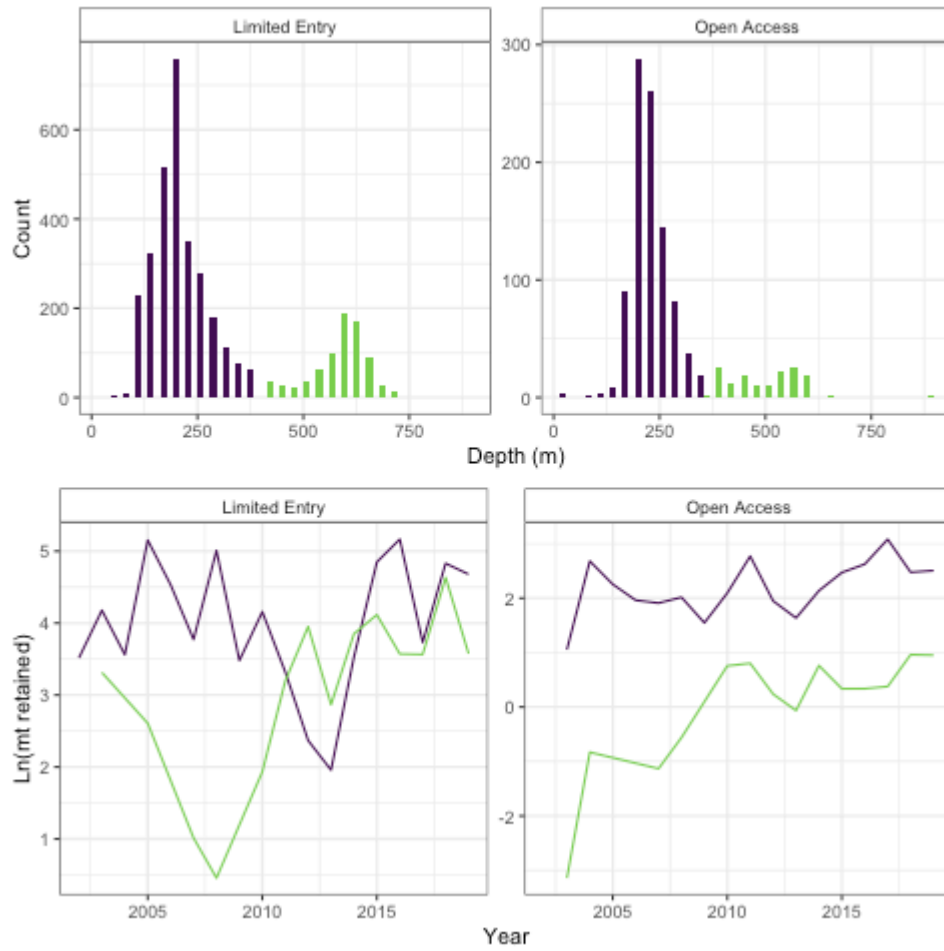


Figure S1. Distribution of observed fishing depth (meters) for the two strata identified in each sector in our analysis (top) and trends in effort (observed metric tons landed) for each sector by depth stratum; fishers are generally increasing effort in deeper areas. Both observed humpback entanglement occurred in the shallow stratum, one per sector, but takes have not been observed in the deeper stratum.

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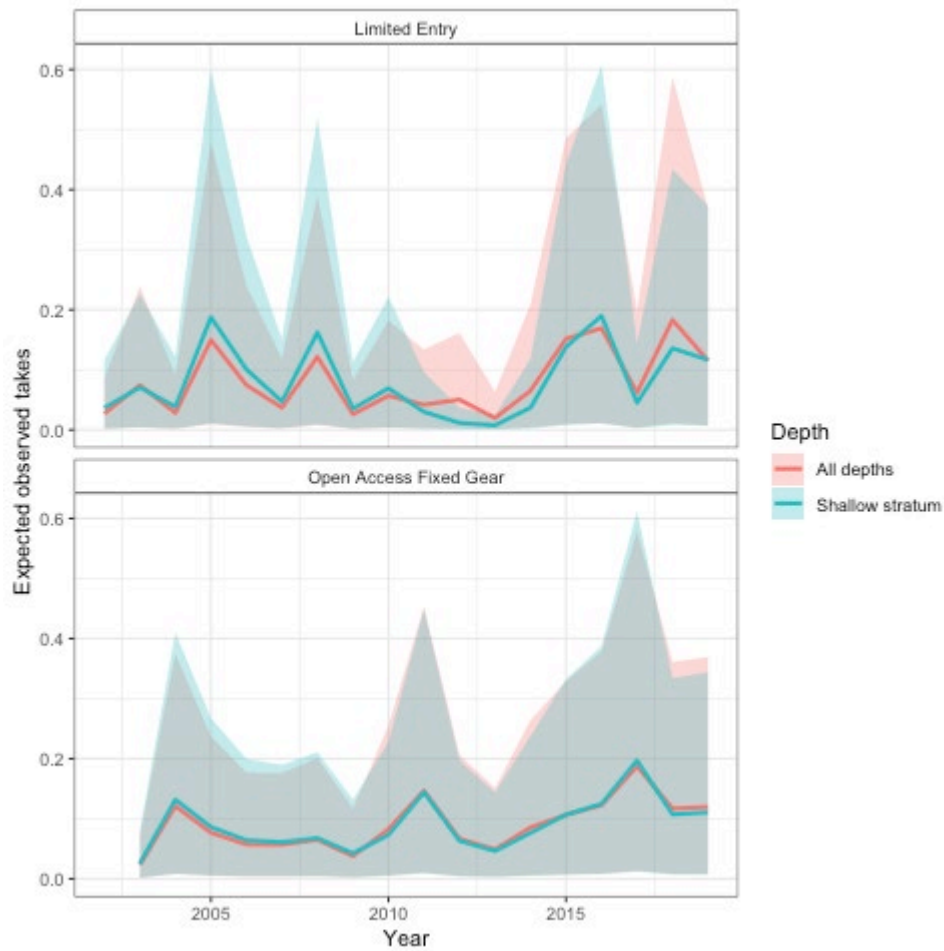


Figure S2. Estimated posterior distribution of the expected number of observed takes, given the estimated bycatch rate for each sector and the observed effort. As a sensitivity analysis, the bycatch rate is estimated using observed effort from all depths (red), and observed effort from the shallower depths only (blue) where takes were observed. The solid line represents the posterior mean, and the shaded region represents 95% credible intervals.

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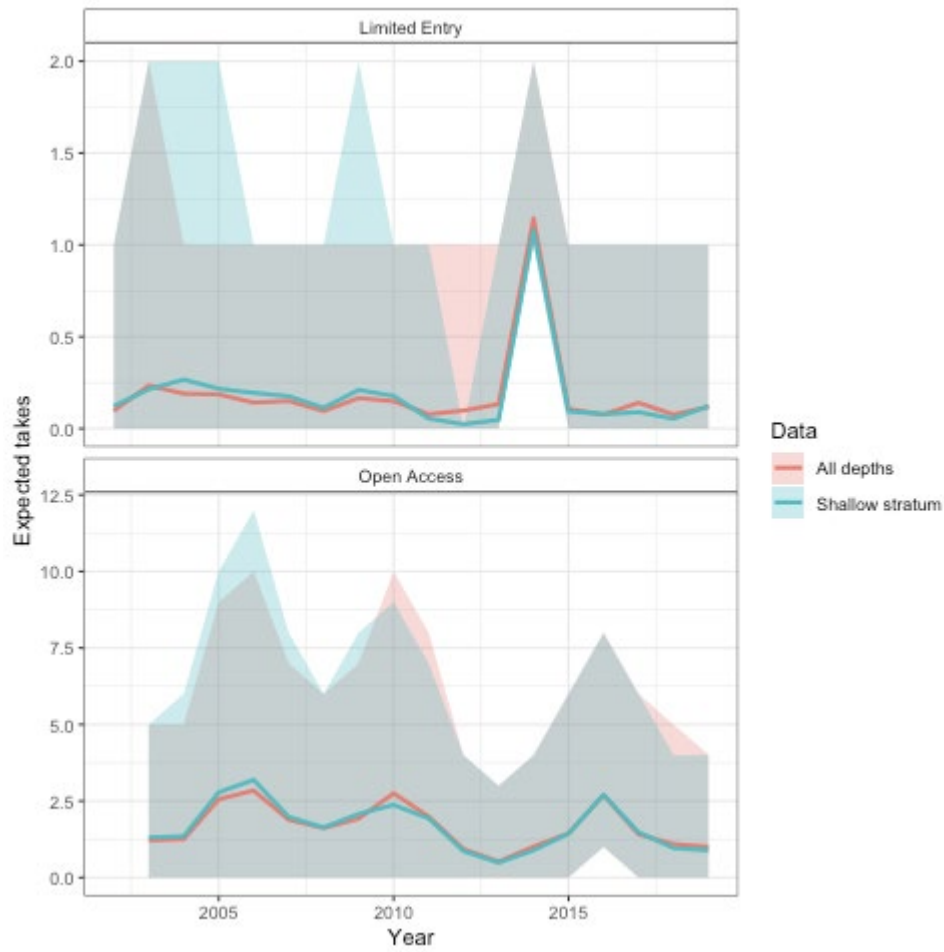


Figure S3. Estimated posterior distribution of the expected number of total takes (observed + unobserved), given the estimated bycatch rate, observed effort, and observer coverage for each sector. As a sensitivity analysis, the bycatch rate is estimated using observed effort from all depths (red), and observed effort from only the shallower depths (blue) where takes were observed. The solid line represents the posterior mean and shaded region represents 95% credible intervals.

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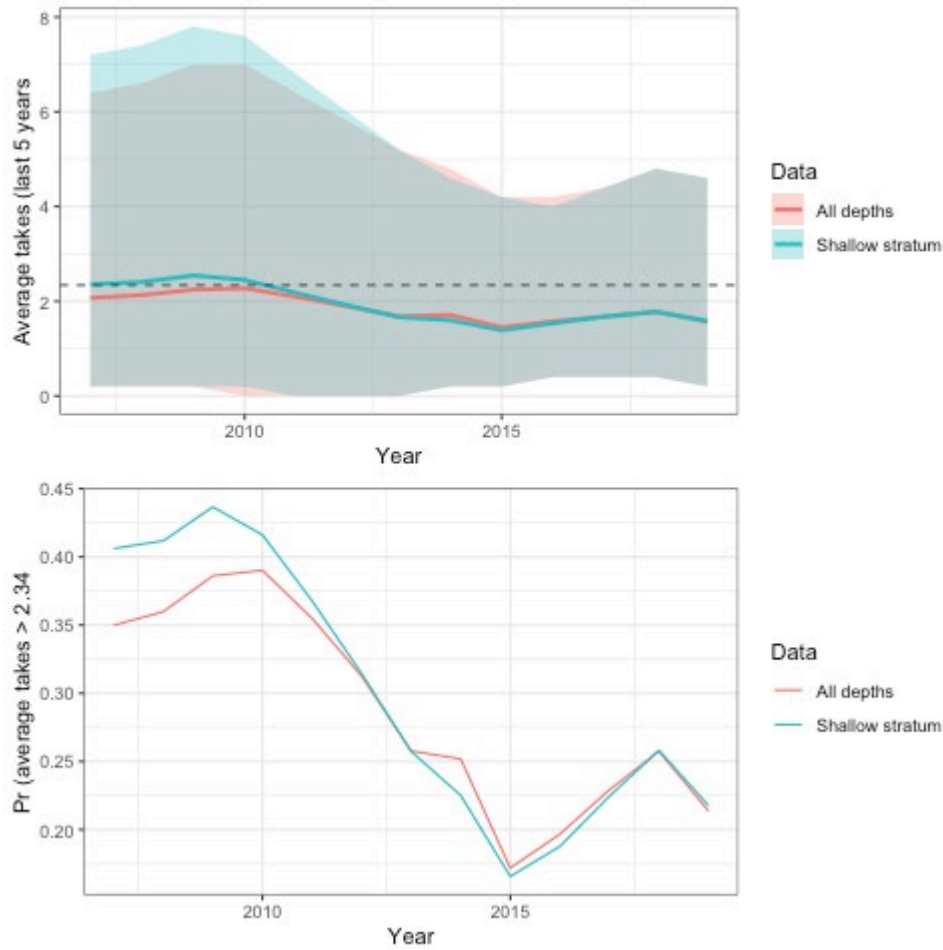


Figure S4. The posterior distribution of the average total takes (5 year average of observed + unobserved; top panel: line = posterior mean, shaded area = 95% CI) and the probability of the average total takes (bottom) exceeding the 2020 Biological Opinion incidental take threshold of 2.34 entanglements per year (dashed line in top panel). Average takes over each 5 year window (observed + estimated unobserved) and probabilities were calculated by combining estimated bycatch rates, observer coverage, and effort across sectors and depth strata. As a sensitivity analysis, the bycatch rate is estimated using observed effort from all depths (red), and observed effort from only the shallower depths (blue) where takes were observed.