Exploration of two fishery-independent surveys to inform groundfish stock distribution between federal and state jurisdictional waters off the U.S. West Coast

Sean E. Matson[a] and Eric J. Ward[b]

[a]NOAA Fisheries, West Coast Region, Sustainable Fisheries Division, Groundfish Branch

[b]NOAA Fisheries, Northwest Fisheries Science Center, Conservation Biology Division

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Background and introduction

The Pacific Fishery Management Council is beginning Phase II of an effort to refine stock and stock complex definitions within the Pacific Coast Groundfish Fishery Management Plan (FMP). One important part of this effort is to grapple with federal and state jurisdictional implications and resulting transboundary aspects of managing groundfish stocks. Using guidance from the Magnuson-Stevens Act and federal groundfish regulations, this can be approached by determining whether a stock fits to the definition of the "stocks in need of federal conservation and management" (50 CFR 600.305(c)), as the federal government only has the authority to manage fisheries and stocks within the federal Exclusive Economic Zone (EEZ).

One component which could aid determination of which stocks are in need of federal conservation and management is whether the stocks "*predominantly occur* in federal waters" (MSA § 302(h)(1)). The term "predominantly" will need to be quantified by the Council, as the MSA does not define it.

When discussing population distribution, we refer to where the fish *occur*, rather than where they are *caught* by the fishery. We have conducted a separate analysis of fishery catch distribution between jurisdictions, which is presented in a different document under this agenda item.

To address questions of stocks spatial distributions (where the fish *occur*), we have focused on two prominent ongoing NMFS groundfish surveys off the West Coast as sources of fishery-independent data, which include the West Coast Groundfish Bottom Trawl Survey and the NWFSC hook and line survey in the California Bight. It should be noted that none of the groundfish surveys on the West Coast were designed for, nor appear particularly amenable to, informing questions of stock distribution among jurisdictions throughout the coast. For these surveys we summarized spatial distribution of sampling effort, estimated stratified abundance indices for selected species (in federal versus state waters) using Template Model Builder (TMB) (Kristensen et al. 2016) via the R package Species Distribution Models with (sdmTMB) (Anderson et al. 2022), and calculated jurisdictional proportions of survey abundances estimated for selected species, to facilitate evaluation upon potential usefulness of fishery-independent data in a jurisdictional distribution analysis.

Effort distributions by jurisdiction for two NMFS groundfish surveys

West Coast Groundfish Bottom Trawl Survey

The West Coast Groundfish Bottom Trawl Survey (hereafter bottom trawl survey) has been conducted annually since 2003 (no survey was conducted in 2020 due to Covid-19 pandemic). The survey consistently covers depths between 55 and 1280 m (30 and 700 fm) and the latitudinal range between 32°34' and 48°22' N. latitude. The survey is based on a random-grid design, and four industry-chartered vessels per year are assigned an approximately equal number of randomly selected grid cells. The survey methods are most recently described in detail in Keller et al. (2017).

The bottom trawl survey covers areas of the shelf and slope of the U.S. West Coast (between 30 to 700 fathoms), but by design, very little of the nearshore. Table 1 and Figure 1 summarize effort in the bottom trawl survey as area swept per jurisdiction (federal and state waters) and proportions off the coast of each West Coast state, with the distribution skewed heavily toward federal waters as expected. The mean annual proportion of area swept within federal jurisdiction ranged from 92 percent (coefficient of variation, CV = 1.4%) off California to 98 percent off Oregon (CV = 1.3%), and 100 percent off the Washington coast (CV = 0.4%). California showed the highest proportion of area swept in state waters of between six and 10 percent, with Oregon varying between zero and four percent, and Washington between zero and one percent.

Table 2 summarizes effort in the bottom trawl survey as haul counts per jurisdiction (federal and state waters) and proportions, off the coast of each West Coast state. The mean annual proportion of haul counts within federal jurisdiction practically mirrored those of area swept, ranging from 91 percent (CV = 1.8%) off California to 98 percent off Oregon (CV = 1.5%), and 100 percent off the Washington coast (CV = 0.5%). California again showed the highest proportional effort in state waters, as haul as haul counts, between 6 and 12 percent. Examples of survey haul distribution are shown in Figure 3 (off Oregon) and Figure 4 off southern California. Sample sites of the NWFSC hook and line survey in the Southern California Bight are shown in Figure 5.

Sampling was more balanced between jurisdictions off California, potentially balanced enough to be useful for an analysis (Table 1, Table 2, Figure 1). Proportional effort in Oregon state waters was very small, and there was zero catch in state waters for a large percentage of the species seen in the survey overall. Washington showed consistently 100 percent annual effort in federal waters, or very nearly so. It is questionable whether Oregon or Washington data from the WCGBTS would meaningfully inform an analysis.

NWFSC Hook and Line Survey for the Southern California Bight

The Southern California Shelf Rockfish Hook and Line Survey (hereafter hook and line survey) began in 2003, sampling commercially and recreationally important shelf rockfish species over untrawlable habitats in the Southern California Bight, at approximately 200 fixed sites each year. Table 3 coarsely summarizes effort in the hook and line survey in the California Bight, between 2012 and 2022, as number of hooks, and hook hours per jurisdiction (federal and state waters), off California. Figure 2 shows annual survey effort as proportions of annual sum hook-hours, by jurisdiction.

Table 3 shows much higher annual proportions of effort within state jurisdiction for the hook and line survey than for the bottom trawl survey (as expected), but also shows much more evenly distributed effort between jurisdictions (and lower proportions in state waters) than expected (Table 3, Figure 2). The mean annual proportion of hook-hours in federal jurisdiction was 0.745 with a CV of six percent; while the mean for state jurisdiction was 0.255 with a CV of 18 percent.

Sufficient spatial cross-area overlap in survey coverage is crucial for a jurisdictional analysis, and is perhaps the most notable challenge. At the same time, values of estimated proportional distributions between jurisdictions would be contextual/specific to the surveys used, and would depend upon the spatial (longitudinal/depth) range of coverage of each one, whether used individually or combined in an analysis. This could also make it challenging to set an objective overall threshold for the term "predominant". Combining information among vastly different surveys into one analysis would require taking into account those differences via covariates, some type of standardization, or other means.

Preliminary analysis of abundance distribution between state and federal waters for selected species in two NMFS groundfish surveys

We estimated jurisdictionally stratified (federal versus state waters) abundance indices within each state, for several deeper nearshore and shallow shelf groundfish species, selected based on survey data availability. These selected species included copper rockfish, olive rockfish, lingcod, and yellowtail rockfish. Several other nearshore groundfish species, including China rockfish and quillback rockfish, were investigated as potential candidates. However, China rockfish was not present (caught) in either survey, while quillback rockfish had insufficient for analysis bottom trawl survey samples and was not present (caught) in the hook and line survey. The observation counts per grid and station for species included in this analysis are summarized in Tables 4 for the bottom trawl survey and longline survey, respectively.

Methods

Abundance indices were estimated separately for state waters, federal waters and also combined area within each state (California, Oregon and Washington). Geostatistical models of biomass density were fit to survey data using Template Model Builder (TMB) (Kristensen et al. 2016) via the R package Species Distribution Models with TMB (sdmTMB) (Anderson et al. 2022). After being reviewed by the Council's Scientific and Statistical Committee (SSC) in 2022, sdmTMB has become the de facto tool for index standardization on the U.S. West Coast, and is being similarly used in other regions in the USA. Spatiotemporal models constructed with sdmTMB can account for spatial variability not explained by covariates in the model, by including spatial and spatiotemporal processes as Gaussian random fields (Thorson et al. 2015). The sdmTMB package is also flexible in that it allows for a variety of distribution families to model observation error: Tweedie, delta-binomial, delta-gamma, and mixture distributions. For the analysis described here, we conducted a number of model comparisons across model structures and distribution families, but results are only shown for the model that led to the best diagnostics, e.g., similar distributions of theoretical normal quantiles and model quantiles, high precision, lack of extreme predictions that are incompatible with the life history, and low Akaike information criterion (AIC).

For the bottom trawl survey, we used a spatial mesh resolution that is similar to the meshes used in West Coast stock assessments (approximately 500 knots for well sampled species). We largely replicated the index standardization methodology used in assessments (and archived at https://github.com/pfmc-assessments/indexwc). However we chose to use slightly different meshes, using the 'cutoff' argument to sdmTMB::make_mesh() instead of specifying the number of mesh knots (we used a cutoff distance that resulted in the same number of knots, however). Our cutoff distances were 50km for copper rockfish, 17km for lingcod, and 25km for yellowtail (greater cutoff distances correspond to coarser meshes, or less complex spatial fields). Two additional differences from recent assessments are that we did not filter observations by depth strata (all data was used here), and we used trawl survey data updated through 2023.

For each species, we constructed a series of models which differed in (1) their observation family, (2) whether spatial fields were included or not, and (3) how spatiotemporal fields were included (whether they were included at all, and if so, whether they should be modeled as independent of each other, or modeled as an autoregressive process). We treated total catch (kg) as the response variable, and used the log of effort as an offset (area swept in km^2). All models included fixed year effects and a pass factor variable (explaining intra-annual variation). Species with less positive catches are generally better modeled with a Tweedie distribution, while more data rich species may be better modeled with a delta model (the latter includes twice as many parameters, because of sub models for the presence-absence and positive components). After finding the single model with the best diagnostics, we generated predictions and indices of abundance for all regions. Our prediction grid is the same grid that has previously been described for survey design, consisting of 4 km^2 cells (Keller et al. 2017). Grid centroids were then calculated, and the centroids were located/assigned to jurisdiction (federal or state) using ArcGIS Pro, according to polygon. Like in recent assessments, we generated indices using the get_index() function in sdmTMB.

For the hook and line survey analysis, we extended the methods described above, but made several minor changes. First, our mesh was slightly different, using a cutoff distance of 20km for all species. Second, we used total catch (in numbers) as the response variable, with a delta-truncated negative binomial distribution used as the family. The delta (hurdle) model accounts for the zero-inflated nature of the data and overdispersion in catch counts by separating the presence-absence process from the count process. As a metric of effort, we used the product of the number of drops (1-5) times the number of hooks (1-5) times the number of anglers (1-3). As with the trawl survey analysis, effort was log-transformed to serve as an offset in the model. For each of the three species, we explored alternative formulations of spatiotemporal effects (representing interannual variation in the spatial process, not explained by other covariates). The three species in our analysis supported three different formulations of spatiotemporal fields: lingcod models only converged when spatiotemporal effects were not included ("off"), models of olive rockfish only converged when spatiotemporal fields were modeled as a random walk ("rw"), and models of copper rockfish only converged when spatiotemporal effects were modeled as independent and identically distributed ("iid"). All models also included random effects in anglers (crew) allowing different individuals to have different catchability; catchability effects were assumed to be constant over time, and individuals whose effects were not identifiable were aggregated into an 'average angler' category. All of these choices are the same as models presented to the SSC during the methodology review of sdmTMB in 2022. Additional descriptions of these data, and alternative modeling can be found in Kuriyama et al. (2019) and Harms et al. (2010).

We used the full hook and line dataset to generate a prediction grid, representing 201 sites (45 in state waters). We assumed the area around each location to be the same (1km^2; this choice can be adjusted, but ultimately does not affect the trend through time). Predictions were made for the 'average angler' category, with an effort metric of 75 (representing the maximum number of drops, hooks, and anglers). Predictions were made from each fitted model above to the same prediction grid, then summed within each year to estimate the total number of fish. This index represents the expected number of fish that would be caught by a group of average anglers employing maximum survey effort.

Annual jurisdictional proportions were calculated for each state as the estimated abundance index value in federal waters divided by the total estimate for the corresponding state. The same was done for the lower and upper confidence limits, plus and minus two standard errors in order to express uncertainty surrounding the proportions.

Results and Discussion

Abundance indices for copper rockfish, olive rockfish, lingcod, and yellowtail rockfish, estimated for state waters, federal waters and combined area within each state via sdmTMB using data from bottom trawl survey and hook and line survey are presented in Figures 6 through 9 and in Appendix B.

Annual proportions of groundfish within federal jurisdiction by species and state, calculated using abundance indices from the bottom trawl survey and hook and line survey are shown in Figures 10-11 and in Tables 5-6. Results generally show higher mean proportions of groundfish abundance in the federal area and greater uncertainty around proportion estimates from the bottom trawl survey than from the hook and line survey (Table 6 and Figure 11).

Within the results from the bottom trawl survey analysis, California showed both lower mean proportions of abundance in federal waters compared to other states, and also exhibited more variability in those proportions among species, between 0.772 and 0.930. The proportion of fish in federal waters off California was the highest for yellowtail rockfish, a shelf species (mean = 0.930; C.I. = 0.415-1.0), intermediate for lingcod, which is a straddling shelf/nearshore species (mean = 0.919; C.I. = 0.653-1.0), and the lowest for copper rockfish, a deeper nearshore species (mean = 0.772; C.I. = 0.231-1.0). These proportional estimates off California from the bottom trawl survey ranked among species according to expectations (i.e. highest for shelf species, lowest for nearshore), based on species life history and their known depth distribution (Love 2011, PFMC 2018, Matson and Gertseva 2020), although confidence intervals overlapped appreciably.

Off Oregon and Washington, bottom trawl survey analysis results showed higher mean proportions of species abundance in federal waters than those off California, and a narrower range of variability in those proportions among species, between 0.971 and 1.0. Off Oregon, the mean proportion of yellowtail rockfish (shelf species) in federal waters was 0.971 (C.I. = 0.489-1.0), the mean proportion of lingcod (straddling shelf/nearshore species) was 0.990 (C.I. = 0.708-1.0), and 1.0 for copper rockfish (C.I. = 0.125-1.0, a deeper nearshore species). Off Washington, the mean proportion of yellowtail rockfish in federal waters was 1.0 (C.I. = 0.554-1.0), and 0.998 (C.I. = 0.661-1.0) for lingcod. Copper rockfish off Washington was omitted from estimating proportions due to extremely low abundance index values (<<1kg)).

Proportions of species abundance in federal waters estimated from the Southern California Bight hook and line survey were more variable among species than those estimated from the bottom trawl survey, and were better aligned with general expectations according to species depth occurrences. Mean proportion of estimated abundance in the federal area for copper rockfish was 0.568 (C.I. = 0.403-0.805), for lingcod 0.739 (C.I. = 0.496-0.996), and for olive rockfish 0.748 (C.I. = 0.427-1.0, Table 6 and Figure 11).

Usability of both the bottom trawl survey and hook and line survey to infer proportional groundfish abundance between state and federal jurisdictions is constrained by several factors.

The results from the bottom trawl survey likely reflect survey spatial coverage, which consists of greater than 92 percent federal area along the coast (92, 98, and nearly 100 percent off California, Oregon and Washington, respectively). The footprint for the bottom trawl survey may be too skewed toward the shelf/slope area to reliably estimate many deeper nearshore species, while the number of observations is prohibitively low to estimate indices for shallower species, such as China rockfish and quillback rockfish. Together, these factors highlight limitations in using the bottom trawl survey to inform proportional abundance distribution of groundfish stocks between state and federal jurisdictions.

Although the hook and line survey appears to be a more viable source of information for the task, both considering its depth coverage through the nearshore, and the plausibility of the resulting jurisdictional proportion estimates themselves (which were in closer agreement with literature, and showed reasonable contrast among the selected species), the latitudinal range of the survey is limited to only a small area off the California coast. This constrains the applicability of the hook and line survey data toward the larger effort to inform coastwide stock definitions.

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Tables

Table 1. Summary of survey effort as sums of annual area swept (hauls with non-hake groundfish), and as proportions by jurisdiction and state, for years 2012-2022, in the West Coast Groundfish Bottom Trawl Survey. The survey was not conducted in the year 2020 due to the Covid-19 pandemic.

Year	Jurisdiction	Area swept (ha)			Proportion (w/in state)			
		CA	OR	WA	CA	OR	WA	Coastwide
2012	Federal	610.9	315.1	215.0	0.91	0.96	1.00	0.94
2012	State	61.5	11.7	0.0	0.09	0.04	0.00	0.06
2013	Federal	420.3	231.3	145.8	0.92	0.97	0.99	0.95
2013	State	37.8	6.6	1.6	0.08	0.03	0.01	0.05
2014	Federal	589.8	358.6	200.5	0.91	1.00	1.00	0.95
2014	State	55.8	1.7	0.0	0.09	0.00	0.00	0.05
2015	Federal	678.4	334.2	188.2	0.93	0.97	1.00	0.95
2015	State	47.7	10.2	0.0	0.07	0.03	0.00	0.05
2016	Federal	654.3	376.3	175.9	0.93	0.99	1.00	0.95
2016	State	52.9	5.1	0.0	0.07	0.01	0.00	0.05
2017	Federal	663.5	360.7	192.6	0.93	0.98	0.99	0.95
2017	State	49.0	7.5	1.6	0.07	0.02	0.01	0.05
2018	Federal	709.4	354.9	188.8	0.92	0.99	1.00	0.95
2018	State	61.1	4.2	0.0	0.08	0.01	0.00	0.05
2019	Federal	319.8	168.9	118.3	0.94	1.00	1.00	0.97
2019	State	19.0	0.0	0.0	0.06	0.00	0.00	0.03
2021	Federal	636.2	339.5	192.1	0.90	0.96	1.00	0.93
2021	State	71.2	12.6	0.0	0.10	0.04	0.00	0.07
2022	Federal	570.4	359.4	115.8	0.91	0.99	1.00	0.94
2022	State	58.4	3.1	0.0	0.09	0.01	0.00	0.06
Mean Federal		585	320	173	0.92	0.98	1.00	0.95
Mean State Territorial		51	6	0	0.08	0.02	0.00	0.05
CV Federal		20%	20%	19%	1%	1%	0%	1%
CV State		27%	65%	200%	16%	66%	203%	19%

Table 2. Summary of survey effort as annual haul counts, (hauls with non-hake groundfish), and as proportions by jurisdiction and state, for years 2012-2022, in the West Coast Groundfish Bottom Trawl Survey. The survey was not conducted in the year 2020 due to the Covid-19 pandemic.

Year	Jurisdiction	Haul count			Proportion (each state and coastwide)			
		CA	OR	WA	CA	OR	WA	Coastwide
2012	Federal	351	178	121	0.90	0.96	1.00	0.93
2012	State	41	7	0	0.10	0.04	0.00	0.07
2013	Federal	227	133	82	0.90	0.97	0.99	0.94
2013	State	24	4	1	0.10	0.03	0.01	0.06
2014	Federal	337	197	114	0.91	0.99	1.00	0.95
2014	State	34	1	0	0.09	0.01	0.00	0.05
2015	Federal	357	171	107	0.92	0.97	1.00	0.95
2015	State	29	6	0	0.08	0.03	0.00	0.05
2016	Federal	350	209	97	0.91	0.99	1.00	0.95
2016	State	33	3	0	0.09	0.01	0.00	0.05
2017	Federal	353	205	110	0.92	0.98	0.99	0.95
2017	State	32	5	1	0.08	0.02	0.01	0.05
2018	Federal	361	199	103	0.90	0.99	1.00	0.94
2018	State	38	3	0	0.10	0.01	0.00	0.06
2019	Federal	177	95	66	0.94	1.00	1.00	0.97
2019	State	11	0	0	0.06	0.00	0.00	0.03
2021	Federal	338	188	106	0.88	0.96	1.00	0.92
2021	State	44	8	0	0.12	0.04	0.00	0.08
2022	Federal	321	204	69	0.89	0.99	1.00	0.94
2022	State	38	2	0	0.11	0.01	0.00	0.06
Mean Federal		317.2	177.9	97.5	0.91	0.98	1.00	0.94
Mean State		32.4	3.9	0.2	0.09	0.02	0.00	0.06
CV Federal		20%	21%	19%	2%	1%	0%	1%
CV State		29%	67%	211%	18%	68%	214%	21%

Table 3. Summary of survey effort as sums of annual hook-hours, and as proportion by jurisdiction, for years 2012-2022, in the Southern California Shelf Rockfish Hook and Line Survey. The survey was not conducted in the year 2020 due to the Covid-19 pandemic.

Year	Jurisdiction	Hook count	Hook-hours	Proportion by jurisdiction	
				p(hook count)	p(hook-hours)
2012	Federal	5,820	360.3	0.659	0.654
2012	State	3,015	190.3	0.341	0.346
2013	Federal	5,767	374.2	0.661	0.647
2013	State	2,963	204.2	0.339	0.353
2014	Federal	8,638	521.2	0.730	0.723
2014	State	3,197	199.8	0.270	0.277
2015	Federal	10,641	662.3	0.766	0.773
2015	State	3,243	194.2	0.234	0.227
2016	Federal	10,159	646.5	0.755	0.758
2016	State	3,305	206.6	0.245	0.242
2017	Federal	10,987	670.7	0.769	0.749
2017	State	3,295	224.3	0.231	0.251
2018	Federal	11,412	681.2	0.777	0.766
2018	State	3,274	208.4	0.223	0.234
2019	Federal	11,498	741.0	0.777	0.761
2019	State	3,306	232.8	0.223	0.239
2021	Federal	11,273	755.1	0.781	0.770
2021	State	3,170	225.4	0.219	0.230
2022	Federal	11,201	769.4	0.773	0.766
2022	State	3,289	235.0	0.227	0.234
Mean Federal		9,740	618.2	0.745	0.737
Mean State		3,206	212.1	0.255	0.263
CV Federal		22%	23%	6%	6%
CV State		4%	7%	18%	17%

Table 4. Summary of observations per species for each survey, as number of non-zero estimates per year (2004-2023). The minimum, maximum, and mean observations across years are included in the table.

Survey	Species	Type	Min obs.	Max obs.	Mean obs.
West Coast Groundfish Bottom Trawl	Copper rockfish	Deep nearshore	3	19	9.1
	Lingcod	Shelf/deep nearshore	124	267	209.2
	Quillback rockfish	Deep nearshore	2	9	3.84
	Yellowtail rockfish	Shelf	27	80	46.45
	Olive rockfish	Deep nearshore	1	3	1.67
	China rockfish	Deep nearshore	0	0	0.00
Southern California Shelf Rockfish Hook and Line	Copper rockfish	Deep nearshore	25	109	67.39
	Lingcod	Shelf/deep nearshore	12	115	52.11
	Quillback rockfish	Deep nearshore	0	0	0.00
	Olive rockfish	Deep nearshore	3	80	35.89
	China rockfish	Nearshore	0	0	0.00

Table 5. Mean annual proportions (among years 2004-2023) of groundfish survey abundance within federal jurisdiction, generated from the **West Coast Groundfish Bottom Trawl Survey**. The federal area proportion estimate, lower, and upper confidence limits are expressed as a proportion of the total estimate. Confidence limits = estimate ± 2 S.E. Copper rockfish off Washington was omitted from proportions due to extremely low index values (<1kg/year).

State	Species	Lower p(federal)	Estimate p(federal)	Upper p(federal)
CA	Copper rockfish	0.231	0.772	1.000
	Lingcod	0.653	0.919	1.000
	Yellowtail rockfish	0.415	0.930	1.000
OR	Copper rockfish	0.125	1.000	1.000
	Lingcod	0.708	0.990	1.000
	Yellowtail rockfish	0.489	0.971	1.000
WA	Lingcod	0.661	0.998	1.000
	Yellowtail rockfish	0.554	1.000	1.000

Table 6. Mean annual proportions (among years 2004-2022) of groundfish survey abundance within federal jurisdiction, generated from the **Southern California Shelf Rockfish Hook and Line Survey**. The federal area proportion estimate, lower, and upper confidence limits are expressed as a proportion of the total estimate. Confidence limits = estimate ± 2 S.E.

Species	Lower p(federal)	Estimate p(federal)	Upper p(federal)
Copper rockfish	0.403	0.568	0.805
Lingcod	0.496	0.739	0.996
Olive rockfish	0.427	0.748	1.000

Figures

Figure 1. Summary of survey effort as proportions of annual sum area swept by jurisdiction (green = federal, blue = state) and state, for years 2012-2022, in the West Coast Groundfish Bottom Trawl Survey. The survey was not conducted in the year 2020 due to the Covid-19 pandemic.

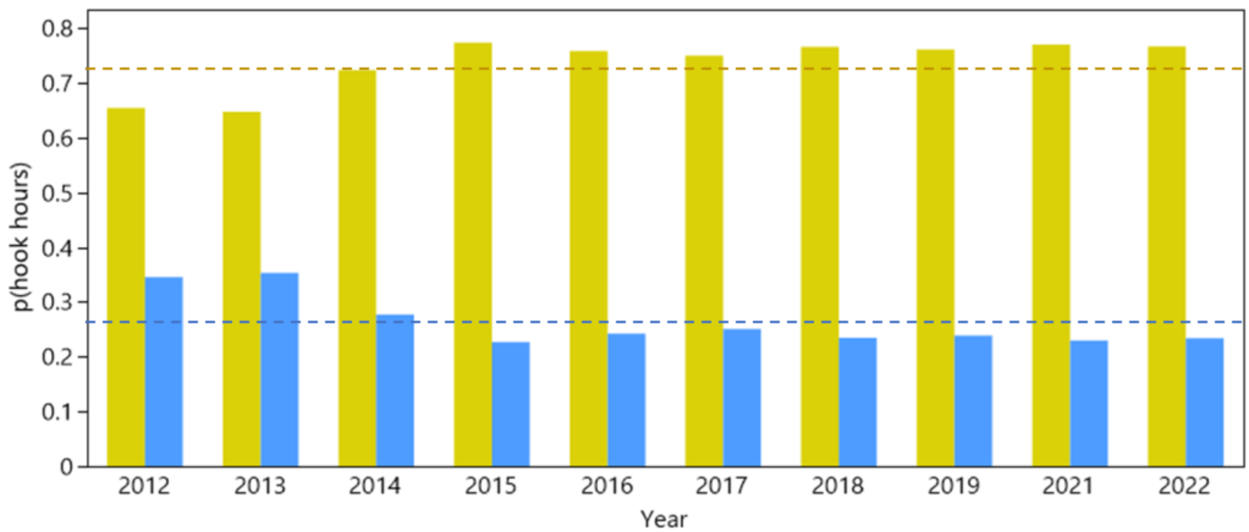

Figure 2. Summary of annual survey effort as proportions of annual sum hook-hours, by jurisdiction (yellow = federal, blue = state), for years 2012-2022, in the Southern California Shelf Rockfish Hook and Line Survey. The survey was not conducted in the year 2020 due to Covid-19 the pandemic.

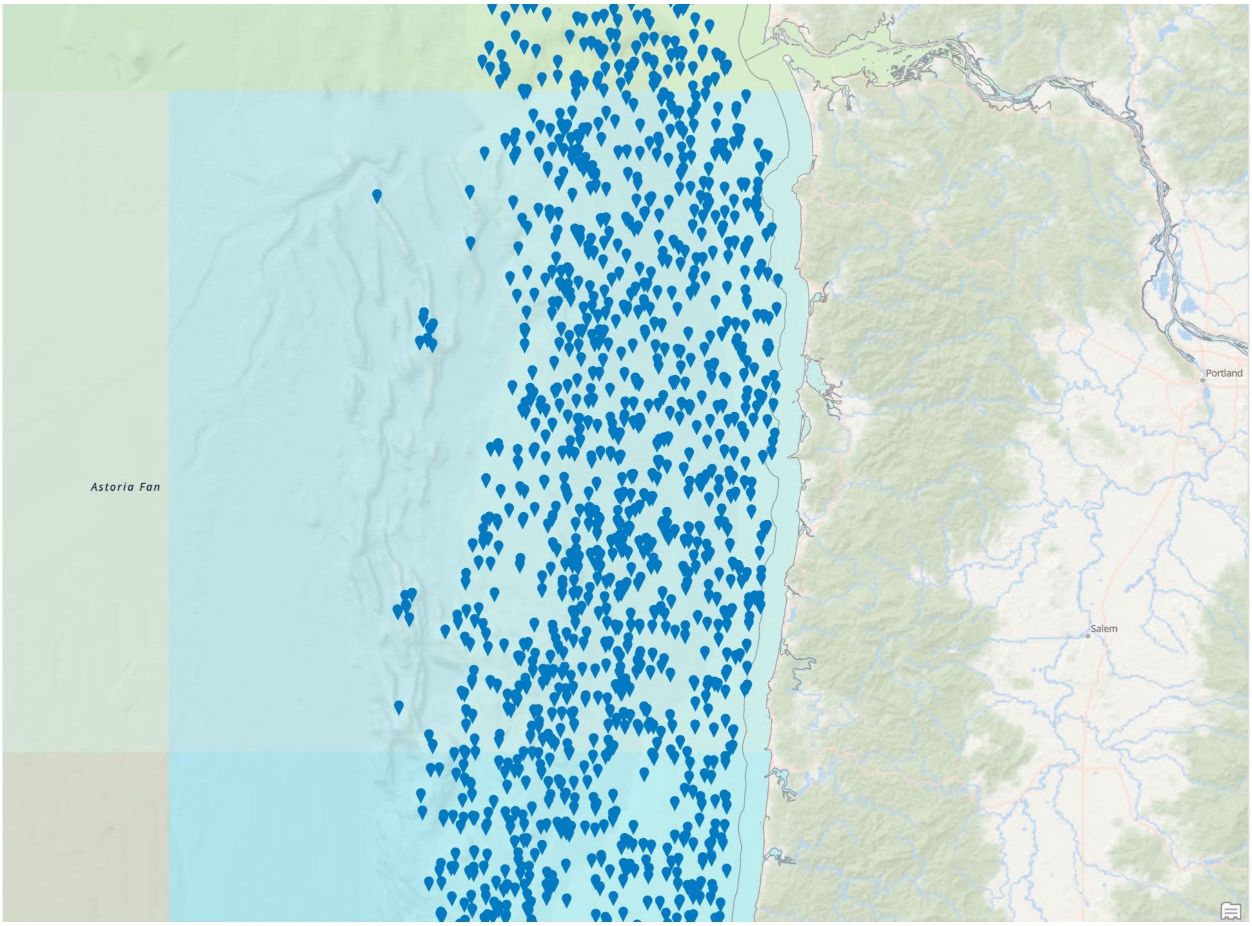

Figure 3. West Coast Groundfish Bottom Trawl Survey haul location distribution off N. and Central Oregon, with comparatively lower numbers of survey hauls in state waters. State territorial waters boundary is visible as a narrow grey line, close to shore; the EEZ boundary is far to the West, off map. Scale is approximately 1:1.3M.

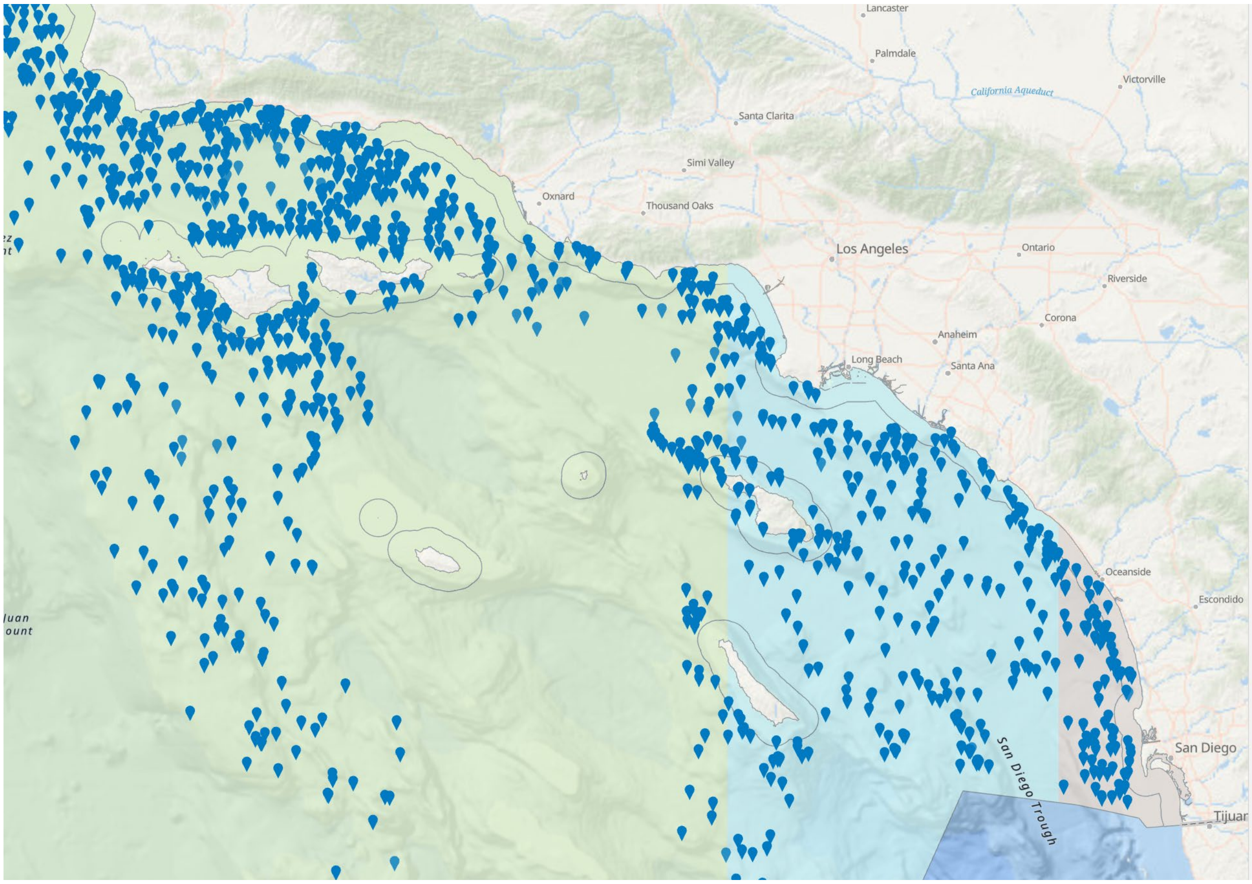

Figure 4. West Coast Groundfish Bottom Trawl Survey haul location distribution off S. California, with comparatively higher numbers of survey hauls in state waters. State territorial waters boundary is visible as a narrow grey line, close to shore; the EEZ boundary is far to the West, off map. Scale is approximately 1:1.3M.

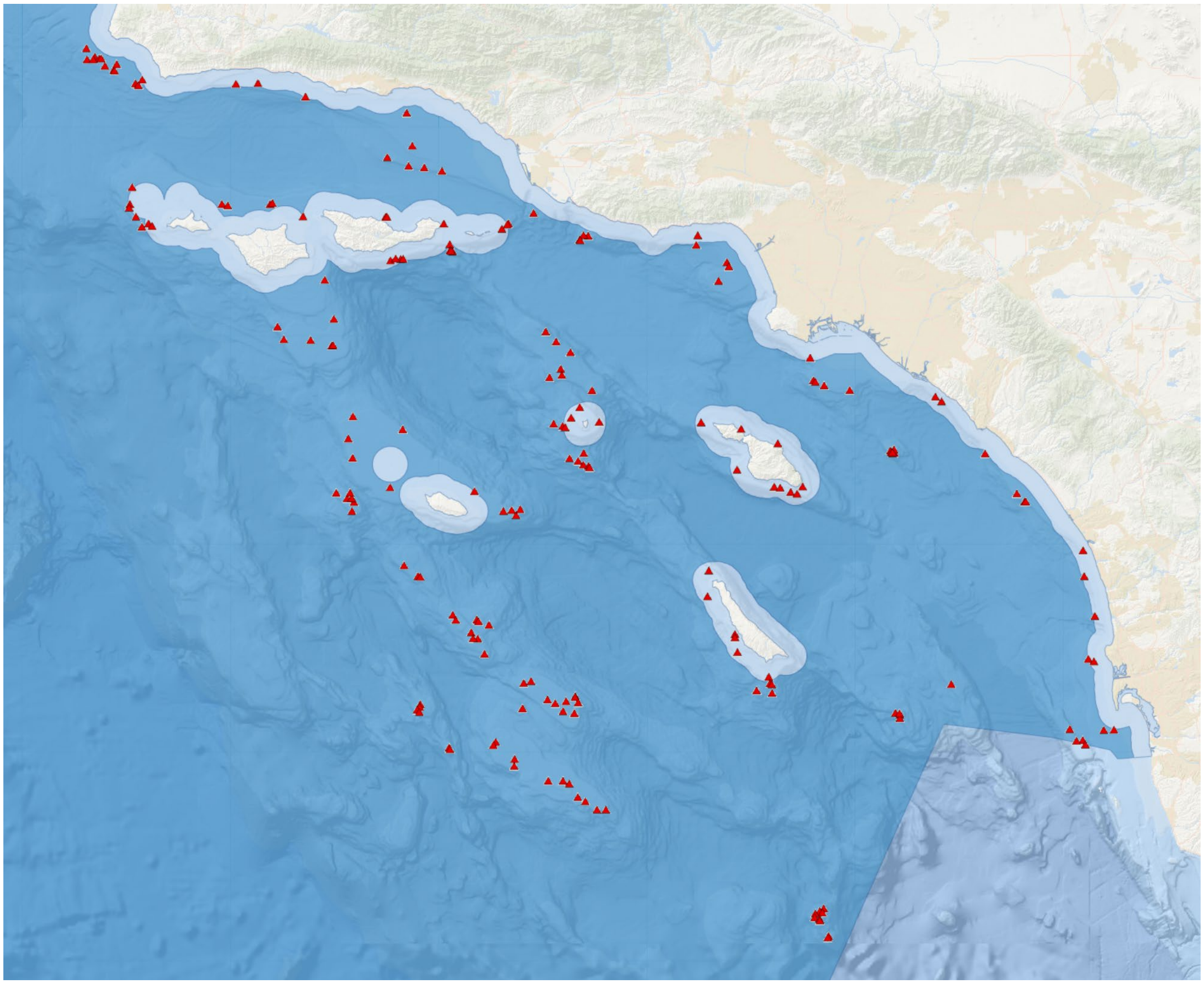

Figure 5. Sample sites of Southern California Shelf Rockfish Hook and Line Survey (red triangles), with state (light blue) and federal (dark blue) jurisdictions (FRAM Data Warehouse).

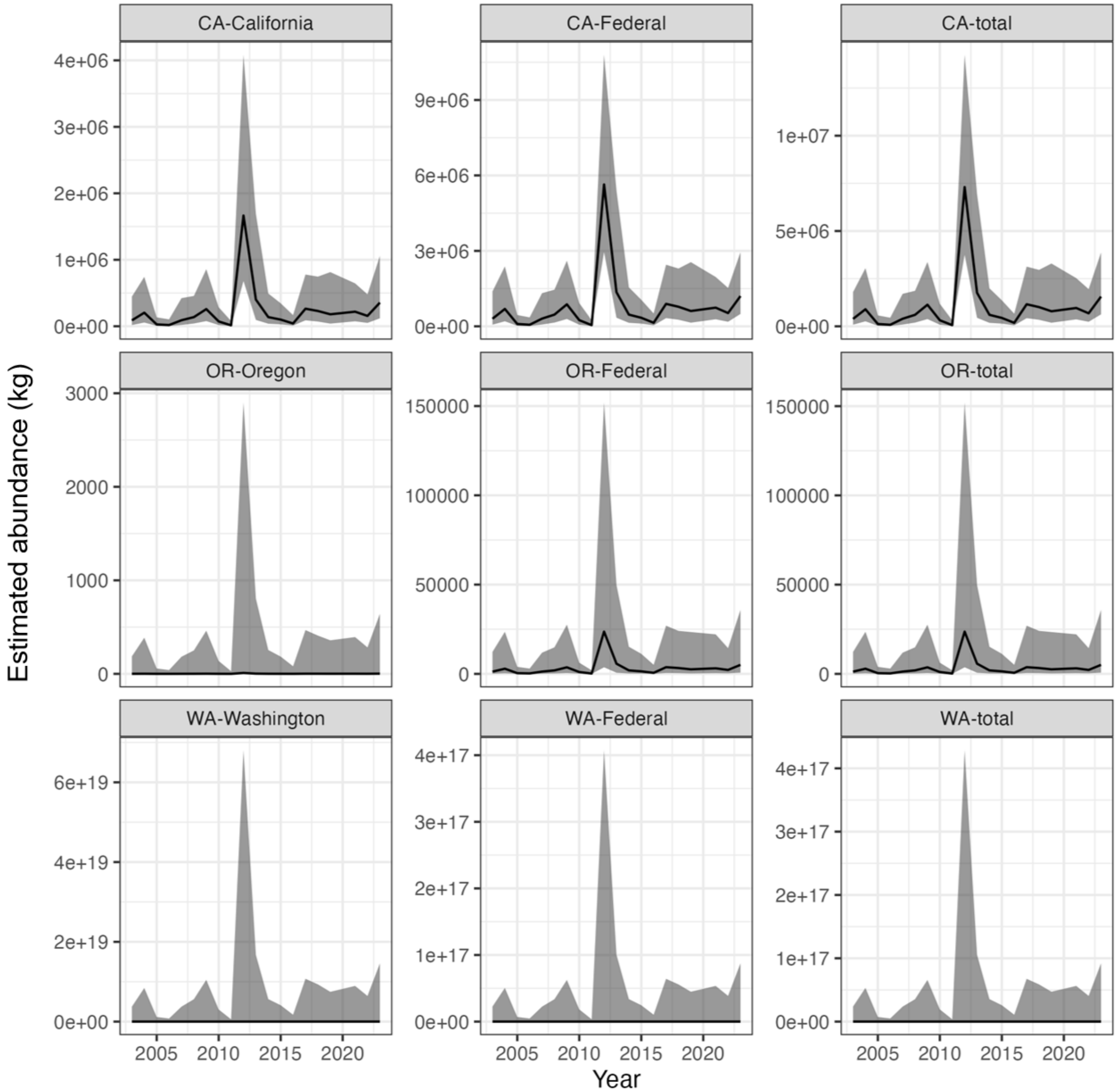

Figure 6. Jurisdictionally stratified (state or federal jurisdiction within state) abundance index estimates (kg ±2 S.E.) for **copper rockfish**, generated from the West Coast Groundfish Bottom Trawl Survey, using package sdmTMB. Copper rockfish off Washington was omitted from proportions due to extremely low index values (average <1kg/year).

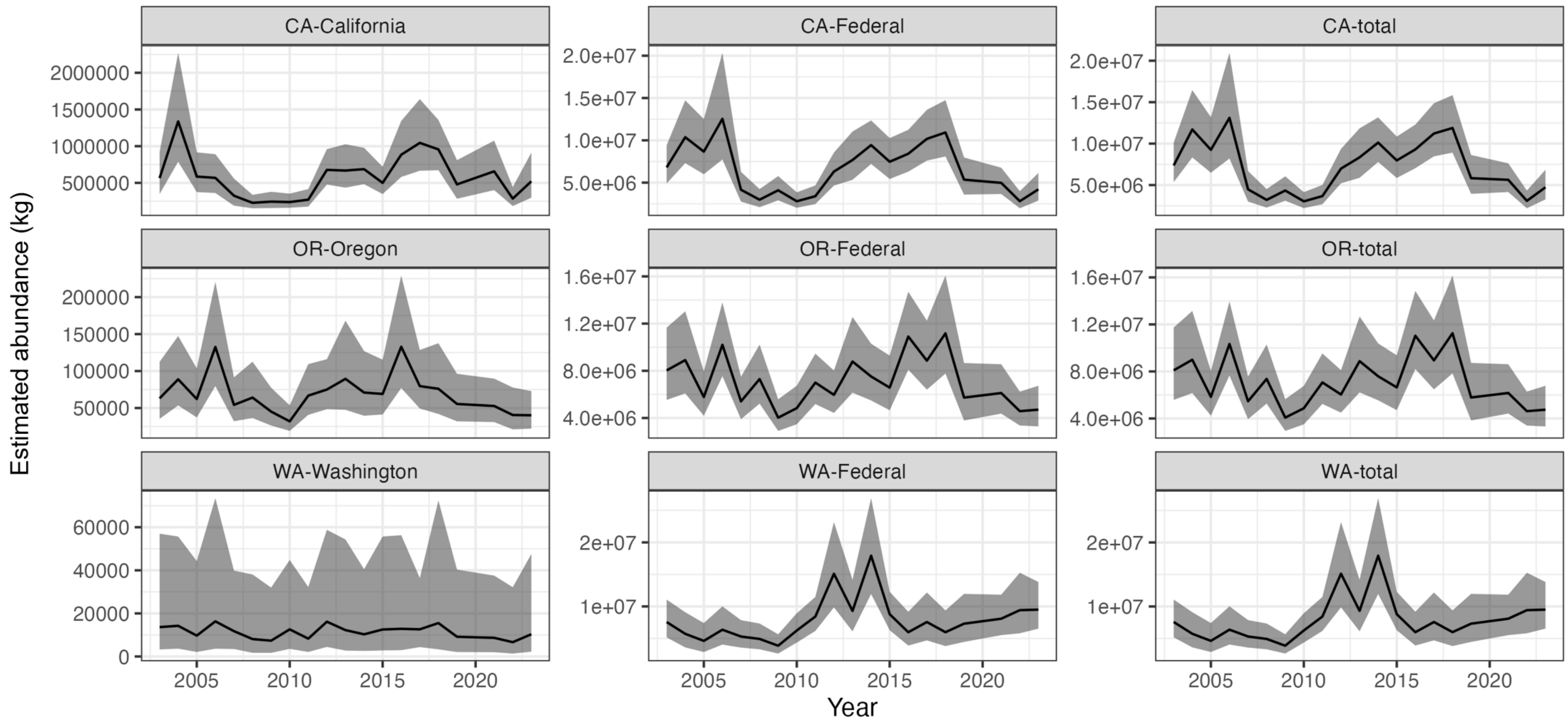

Figure 7. Jurisdictionally stratified (state or federal jurisdiction within state) abundance index estimates (kg ±2 S.E.) for **lingcod**, generated from the West Coast Groundfish Bottom Trawl Survey, using package sdmTMB.

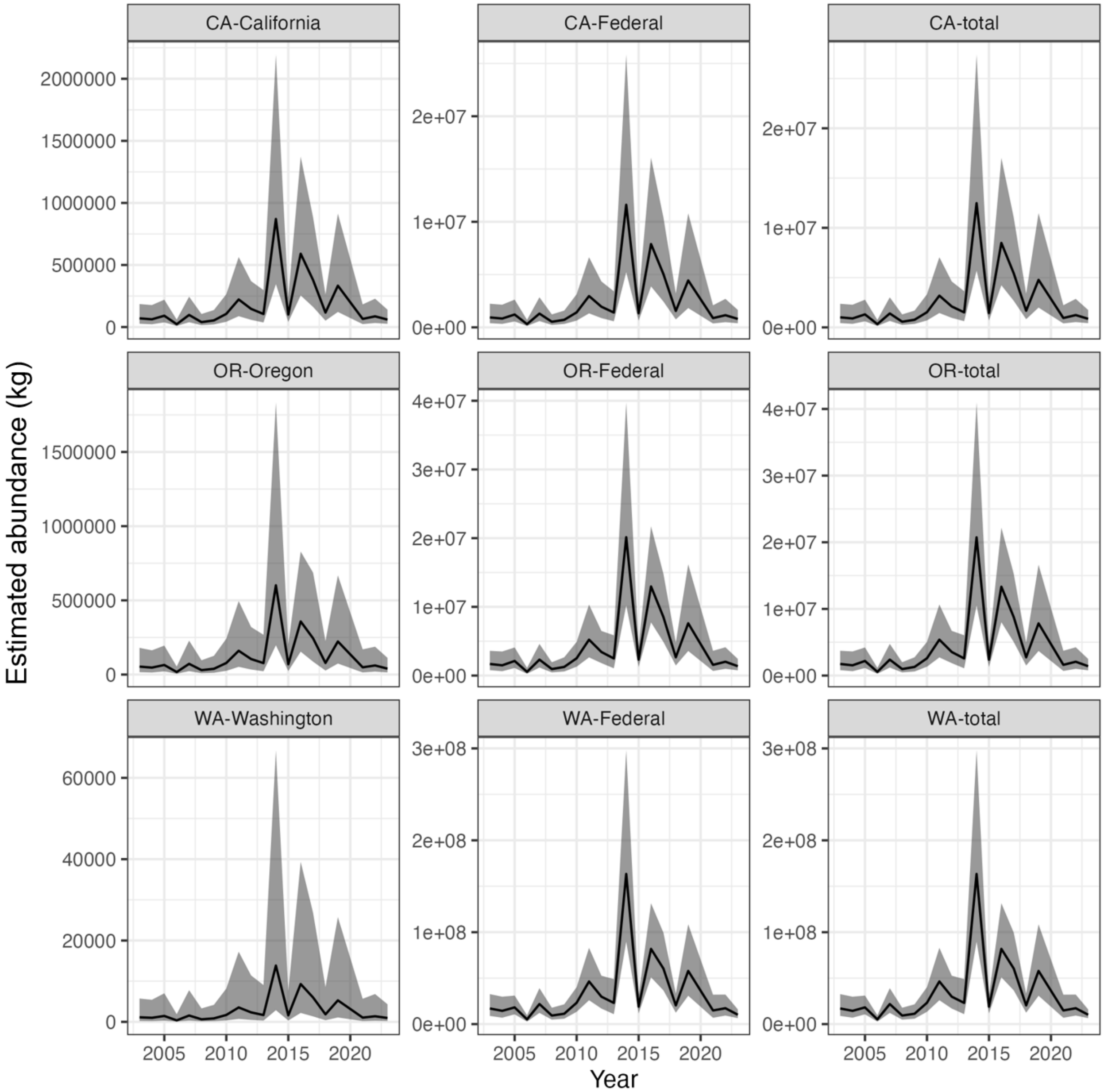

Figure 8. Jurisdictionally stratified (state or federal jurisdiction within state) abundance index estimates (kg ±2 S.E.) for **yellowtail rockfish**, generated from the West Coast Groundfish Bottom Trawl Survey, using package sdmTMB.

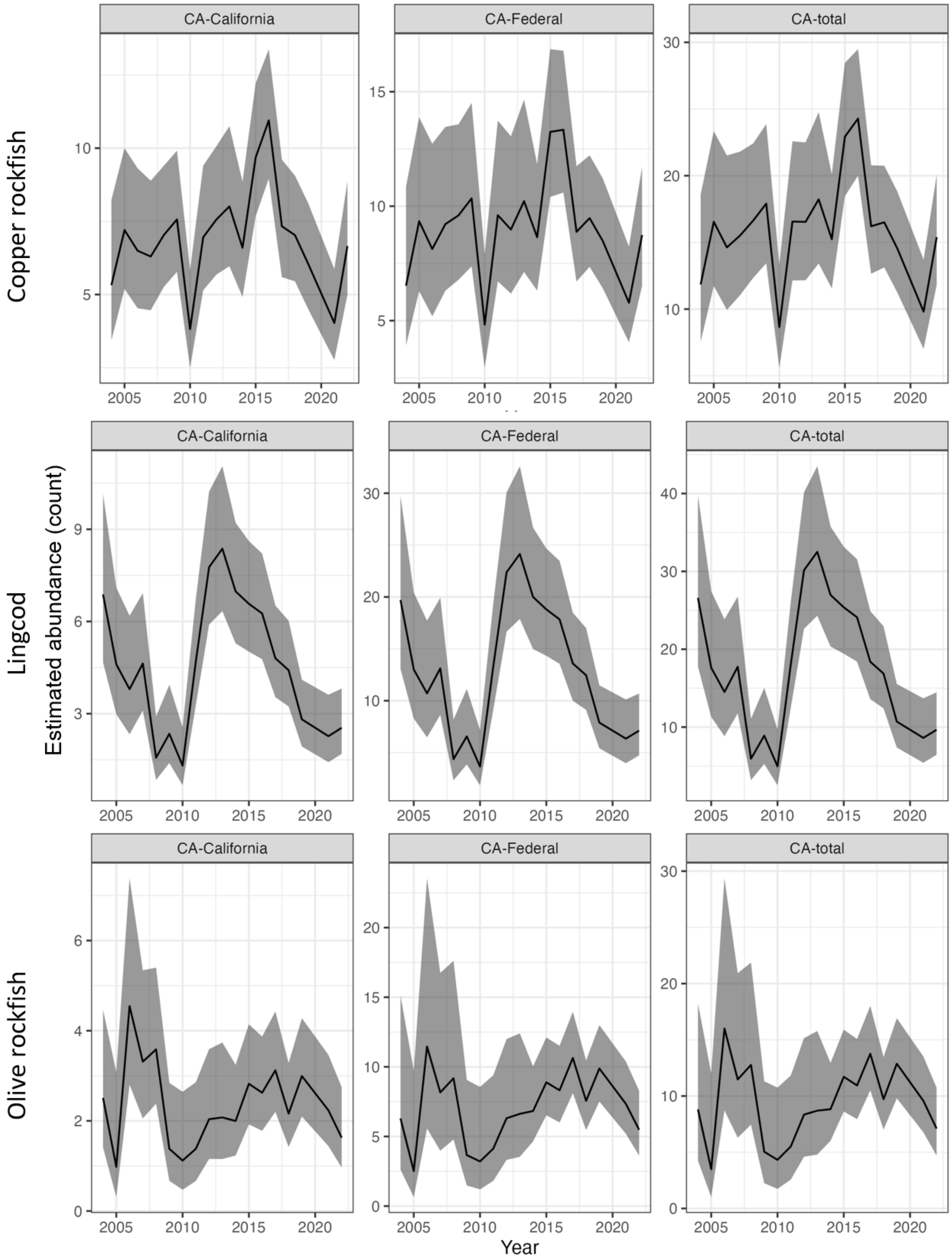

Figure 9. Jurisdictionally stratified (state or federal jurisdiction within state) abundance index estimates for **copper rockfish, lingcod, and olive rockfish**, generated from the Southern California Shelf Rockfish Hook and Line Survey, using package sdmTMB. This index represents the expected number of fish that would be caught by a group of average anglers employing maximum survey effort.

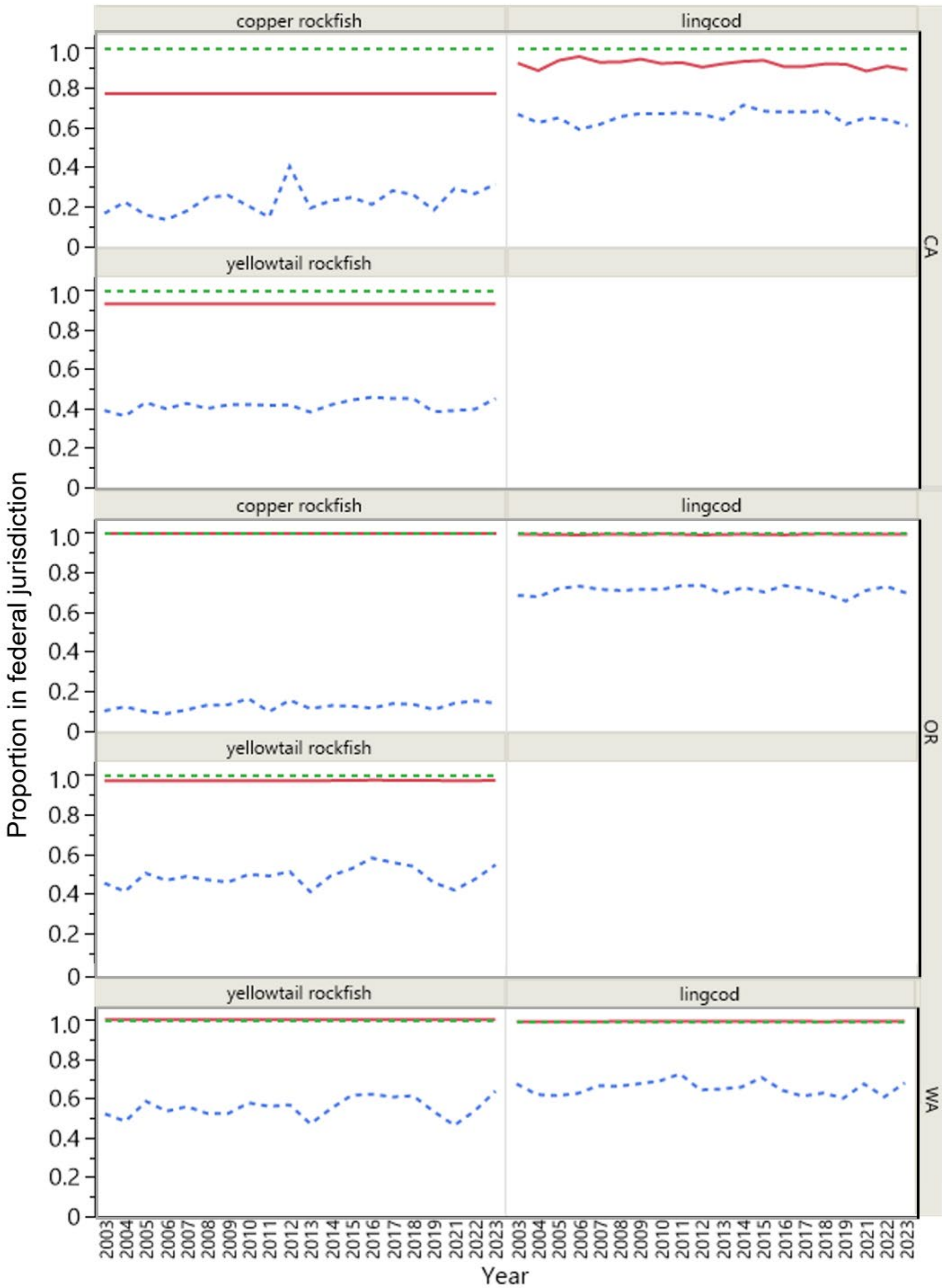

Figure 10. Estimated annual proportions of groundfish survey abundance by species and state within federal jurisdiction, generated from the West Coast Groundfish Bottom Trawl Survey. The federal area proportion estimate (solid line), lower, and upper confidence limits (dashed lines) are expressed as a proportion of the total estimate. Confidence limits are the estimate ± 2 S.E.

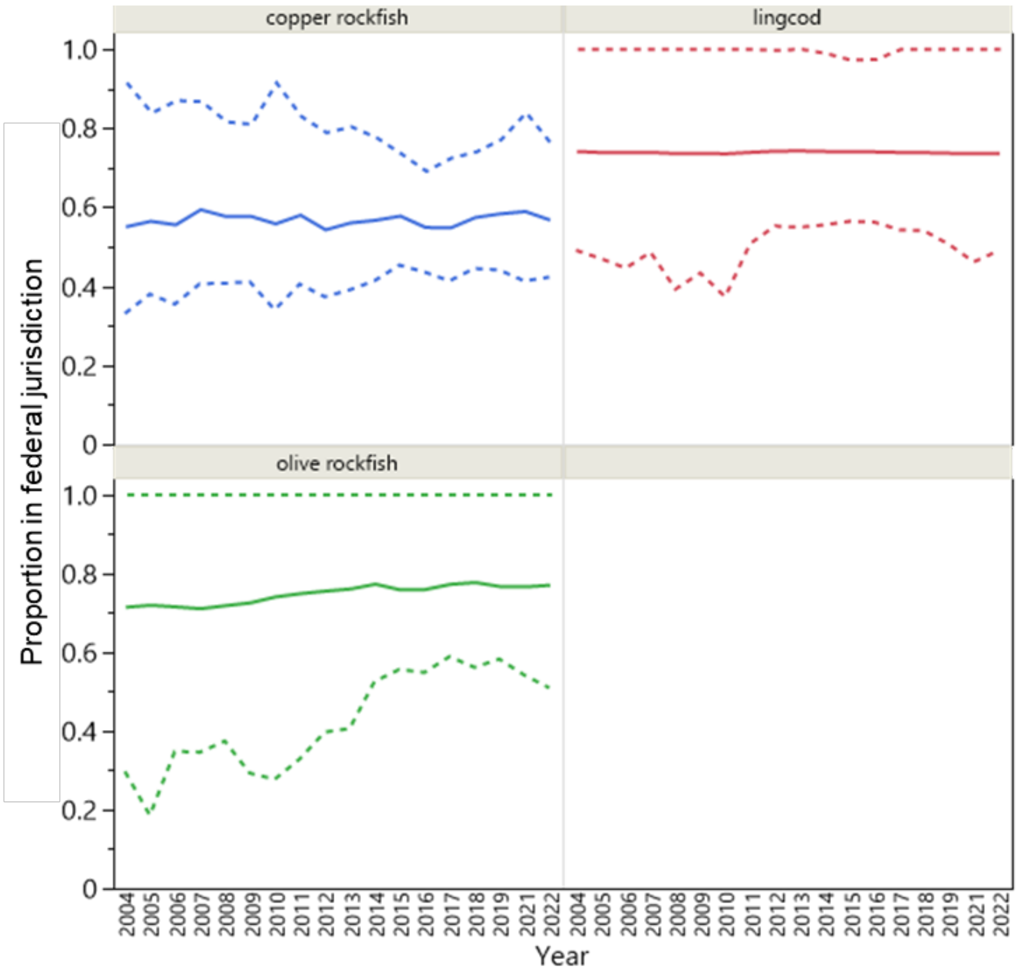

Figure 11. Estimated annual proportions of groundfish survey abundance within federal jurisdiction, generated from the Southern California Shelf Rockfish Hook and Line Survey. The federal area proportion estimate (solid line), lower, and upper confidence limits (dashed lines) are expressed as a proportion of the total estimate. Confidence limits are the estimate ± 2 S.E.

Appendix A. Relevant information from the Magnuson-Stevens Act, and federal regulation, for stock determination (Kent et al. slides)

Objective: to determine the stocks in need of federal conservation and management, where;

> Stock - "a species, subspecies, geographical grouping, or other category of fish capable of management as a unit." – 16 U.S.C. 1802 MSA §3(42)
>
> Fishery - "one or more stocks of fish that can be treated as a unit for purposes of conservation and management and which are identified on the basis of geographical, scientific, technical, recreational, and economic characteristics; and any fishing for such stocks" – 16 U.S.C. 1802 MSA §3(13)
>
> 50 CFR 600.305(c)(1) "[...] Any stocks that are predominately caught in Federal waters and are overfished or subject to overfishing, or likely to become overfished or subject to overfishing, are considered to require conservation and management."

Ten guideline factors to consider when determining stocks in need of federal conservation and management (50 CFR 600.305(c)(1)). The first three are being considered main factors.

> (i) The stock is an important component of the marine environment.
>
> (ii) The stock is caught by the fishery.
>
> (iii) Whether an FMP can improve or maintain the condition of the stock.
>
> (iv) The stock is a target of a fishery.
>
> (v) The stock is important to commercial, recreational, or subsistence users.
>
> (vi) The fishery is important to the Nation or to the regional economy.
>
> (vii) The need to resolve competing interests and conflicts among user groups and whether an FMP can further that resolution.
>
> (viii) The economic condition of a fishery and whether an FMP can produce more efficient utilization.
>
> (ix) The needs of a developing fishery, and whether an FMP can foster orderly growth.
>
> (x) The extent to which the fishery is already adequately managed by states, by state/Federal programs, or by Federal regulations pursuant to other FMPs or international commissions, or by industry self-regulation, consistent with the requirements of the Magnuson-Stevens Act and other applicable law.

Appendix B. Jurisdictionally stratified abundance estimates and proportions for the two surveys examined.

B.1. Jurisdictionally stratified abundance estimates, and proportions for selected species in the **West Coast Groundfish Bottom Trawl Survey**. The federal area proportion estimate, lower, and upper confidence limits are expressed as a proportion of the total estimate. Confidence limits are the estimate ± 2 S.E.

Species	State	Year	Federal lower	Federal estimate	Federal upper	Total est.	p(Fed) lower	p(Fed) estimate	p(Fed) upper
copper rockfish	CA	2003	65,175	300,378	1,384,386	389,081	0.168	0.772	1.000
copper rockfish	CA	2004	200,418	690,557	2,379,371	894,481	0.224	0.772	1.000
copper rockfish	CA	2005	19,246	92,853	447,959	120,272	0.160	0.772	1.000
copper rockfish	CA	2006	10,954	62,341	354,790	80,751	0.136	0.772	1.000
copper rockfish	CA	2007	71,063	306,066	1,318,219	396,449	0.179	0.772	1.000
copper rockfish	CA	2008	148,681	465,411	1,456,863	602,849	0.247	0.772	1.000
copper rockfish	CA	2009	292,840	873,888	2,607,837	1,131,950	0.259	0.772	1.000
copper rockfish	CA	2010	64,695	244,134	921,269	316,228	0.205	0.772	1.000
copper rockfish	CA	2011	8,955	46,646	242,983	60,420	0.148	0.772	1.000
copper rockfish	CA	2012	2,948,052	5,640,439	10,791,720	7,306,079	0.404	0.772	1.000
copper rockfish	CA	2013	341,410	1,358,318	5,404,143	1,759,434	0.194	0.772	1.000
copper rockfish	CA	2014	139,242	464,613	1,550,289	601,814	0.231	0.772	1.000
copper rockfish	CA	2015	108,798	338,902	1,055,667	438,981	0.248	0.772	1.000
copper rockfish	CA	2016	38,678	140,415	509,759	181,880	0.213	0.772	1.000
copper rockfish	CA	2017	325,732	892,954	2,447,919	1,156,646	0.282	0.772	1.000
copper rockfish	CA	2018	263,013	777,388	2,297,727	1,006,954	0.261	0.772	1.000
copper rockfish	CA	2019	145,258	608,771	2,551,349	788,544	0.184	0.772	1.000
copper rockfish	CA	2021	280,368	741,525	1,961,204	960,499	0.292	0.772	1.000
copper rockfish	CA	2022	181,757	526,647	1,525,979	682,168	0.266	0.772	1.000
copper rockfish	CA	2023	492,163	1,203,418	2,942,554	1,558,792	0.316	0.772	1.000
copper rockfish	OR	2003	130	1,261	12,272	1,262	0.103	1.000	1.000
copper rockfish	OR	2004	357	2,899	23,544	2,900	0.123	1.000	1.000
copper rockfish	OR	2005	39	390	3,925	390	0.099	1.000	1.000

Species	State	Year	Federal lower	Federal estimate	Federal upper	Total est.	p(Fed) lower	p(Fed) estimate	p(Fed) upper
copper rockfish	OR	2006	23	262	2,974	262	0.088	1.000	1.000
copper rockfish	OR	2007	139	1,285	11,872	1,286	0.108	1.000	1.000
copper rockfish	OR	2008	257	1,954	14,876	1,955	0.131	1.000	1.000
copper rockfish	OR	2009	489	3,669	27,534	3,670	0.133	1.000	1.000
copper rockfish	OR	2010	168	1,025	6,259	1,025	0.164	1.000	1.000
copper rockfish	OR	2011	19	196	1,989	196	0.098	1.000	1.000
copper rockfish	OR	2012	3,692	23,681	151,876	23,691	0.156	1.000	1.000
copper rockfish	OR	2013	652	5,703	49,865	5,705	0.114	1.000	1.000
copper rockfish	OR	2014	251	1,951	15,182	1,951	0.128	1.000	1.000
copper rockfish	OR	2015	180	1,423	11,229	1,423	0.127	1.000	1.000
copper rockfish	OR	2016	68	590	5,078	590	0.116	1.000	1.000
copper rockfish	OR	2017	521	3,749	26,975	3,751	0.139	1.000	1.000
copper rockfish	OR	2018	442	3,264	24,081	3,265	0.135	1.000	1.000
copper rockfish	OR	2019	279	2,556	23,429	2,557	0.109	1.000	1.000
copper rockfish	OR	2021	438	3,113	22,140	3,115	0.141	1.000	1.000
copper rockfish	OR	2022	339	2,211	14,416	2,212	0.153	1.000	1.000
copper rockfish	OR	2023	713	5,052	35,785	5,055	0.141	1.000	1.000
lingcod	CA	2003	4,910,373	6,799,969	9,416,714	7,365,160	0.667	0.923	1.000
lingcod	CA	2004	7,302,309	10,370,430	14,727,645	11,708,607	0.624	0.886	1.000
lingcod	CA	2005	5,997,740	8,665,610	12,520,182	9,251,164	0.648	0.937	1.000
lingcod	CA	2006	7,736,691	12,542,593	20,333,840	13,110,561	0.590	0.957	1.000
lingcod	CA	2007	2,757,878	4,158,622	6,270,814	4,483,680	0.615	0.928	1.000
lingcod	CA	2008	2,100,657	2,983,762	4,238,118	3,211,608	0.654	0.929	1.000
lingcod	CA	2009	2,908,959	4,097,173	5,770,733	4,341,155	0.670	0.944	1.000
lingcod	CA	2010	2,030,315	2,797,830	3,855,485	3,036,254	0.669	0.921	1.000
lingcod	CA	2011	2,470,206	3,396,412	4,669,899	3,667,416	0.674	0.926	1.000
lingcod	CA	2012	4,650,379	6,307,931	8,556,291	6,984,605	0.666	0.903	1.000
lingcod	CA	2013	5,336,955	7,675,435	11,038,560	8,343,223	0.640	0.920	1.000

Species	State	Year	Federal lower	Federal estimate	Federal upper	Total est.	p(Fed) lower	p(Fed) estimate	p(Fed) upper
lingcod	CA	2014	7,207,756	9,435,441	12,351,631	10,122,241	0.712	0.932	1.000
lingcod	CA	2015	5,435,028	7,469,564	10,265,705	7,969,463	0.682	0.937	1.000
lingcod	CA	2016	6,300,127	8,416,496	11,243,804	9,299,945	0.677	0.905	1.000
lingcod	CA	2017	7,606,448	10,171,894	13,602,595	11,216,879	0.678	0.907	1.000
lingcod	CA	2018	8,097,320	10,927,669	14,747,342	11,883,537	0.681	0.920	1.000
lingcod	CA	2019	3,591,696	5,351,636	7,973,952	5,831,069	0.616	0.918	1.000
lingcod	CA	2021	3,656,498	4,974,158	6,766,651	5,631,004	0.649	0.883	1.000
lingcod	CA	2022	1,974,040	2,805,868	3,988,215	3,091,201	0.639	0.908	1.000
lingcod	CA	2023	2,882,079	4,209,327	6,147,795	4,730,502	0.609	0.890	1.000
lingcod	OR	2003	5,533,570	8,031,500	11,657,031	8,094,571	0.684	0.992	1.000
lingcod	OR	2004	6,084,633	8,907,066	13,038,720	8,995,882	0.676	0.990	1.000
lingcod	OR	2005	4,193,649	5,778,054	7,961,064	5,840,215	0.718	0.989	1.000
lingcod	OR	2006	7,545,703	10,201,599	13,792,304	10,334,215	0.730	0.987	1.000
lingcod	OR	2007	3,900,461	5,408,543	7,499,715	5,462,789	0.714	0.990	1.000
lingcod	OR	2008	5,216,711	7,300,801	10,217,490	7,364,910	0.708	0.991	1.000
lingcod	OR	2009	2,907,515	4,028,985	5,583,023	4,074,187	0.714	0.989	1.000
lingcod	OR	2010	3,472,157	4,835,705	6,734,731	4,867,709	0.713	0.993	1.000
lingcod	OR	2011	5,181,860	6,998,547	9,452,140	7,065,340	0.733	0.991	1.000
lingcod	OR	2012	4,430,161	5,963,335	8,027,104	6,038,329	0.734	0.988	1.000
lingcod	OR	2013	6,145,051	8,785,911	12,561,691	8,875,363	0.692	0.990	1.000
lingcod	OR	2014	5,489,045	7,517,325	10,295,083	7,588,247	0.723	0.991	1.000
lingcod	OR	2015	4,654,442	6,575,358	9,289,049	6,644,406	0.701	0.990	1.000
lingcod	OR	2016	8,093,303	10,905,416	14,694,631	11,038,274	0.733	0.988	1.000
lingcod	OR	2017	6,406,777	8,859,472	12,251,127	8,939,095	0.717	0.991	1.000
lingcod	OR	2018	7,767,888	11,174,115	16,073,974	11,250,157	0.690	0.993	1.000
lingcod	OR	2019	3,790,106	5,729,418	8,661,031	5,784,926	0.655	0.990	1.000
lingcod	OR	2021	4,372,571	6,115,587	8,553,412	6,168,361	0.709	0.991	1.000
lingcod	OR	2022	3,364,192	4,580,455	6,236,437	4,620,999	0.728	0.991	1.000

Species	State	Year	Federal lower	Federal estimate	Federal upper	Total est.	p(Fed) lower	p(Fed) estimate	p(Fed) upper
lingcod	OR	2023	3,290,493	4,705,699	6,729,570	4,745,876	0.693	0.992	1.000
lingcod	WA	2003	5,174,228	7,567,168	11,066,778	7,580,812	0.683	0.998	1.000
lingcod	WA	2004	3,603,150	5,723,227	9,090,747	5,737,464	0.628	0.998	1.000
lingcod	WA	2005	2,885,707	4,622,220	7,403,701	4,631,913	0.623	0.998	1.000
lingcod	WA	2006	4,046,246	6,362,813	10,005,666	6,379,120	0.634	0.997	1.000
lingcod	WA	2007	3,575,857	5,301,629	7,860,289	5,313,391	0.673	0.998	1.000
lingcod	WA	2008	3,307,786	4,924,920	7,332,650	4,933,008	0.671	0.998	1.000
lingcod	WA	2009	2,647,130	3,867,356	5,650,057	3,874,697	0.683	0.998	1.000
lingcod	WA	2010	4,356,958	6,238,341	8,932,127	6,250,937	0.697	0.998	1.000
lingcod	WA	2011	6,176,932	8,422,804	11,485,253	8,431,078	0.733	0.999	1.000
lingcod	WA	2012	9,851,820	15,104,694	23,158,337	15,120,851	0.652	0.999	1.000
lingcod	WA	2013	6,113,412	9,302,065	14,153,866	9,314,308	0.656	0.999	1.000
lingcod	WA	2014	11,943,149	17,925,750	26,905,175	17,936,043	0.666	0.999	1.000
lingcod	WA	2015	6,284,692	8,786,211	12,283,419	8,798,751	0.714	0.999	1.000
lingcod	WA	2016	3,891,830	5,973,699	9,169,227	5,986,538	0.650	0.998	1.000
lingcod	WA	2017	4,700,924	7,564,951	12,173,881	7,577,567	0.620	0.998	1.000
lingcod	WA	2018	3,811,868	5,978,237	9,375,802	5,993,755	0.636	0.997	1.000
lingcod	WA	2019	4,463,953	7,307,176	11,961,330	7,316,334	0.610	0.999	1.000
lingcod	WA	2021	5,519,592	8,082,930	11,836,702	8,091,589	0.682	0.999	1.000
lingcod	WA	2022	5,810,659	9,417,031	15,261,690	9,423,678	0.617	0.999	1.000
lingcod	WA	2023	6,537,937	9,504,943	13,818,416	9,515,270	0.687	0.999	1.000
yellowtail rockfish	CA	2003	393,164	937,882	2,237,294	1,007,975	0.390	0.930	1.000
yellowtail rockfish	CA	2004	324,294	834,053	2,145,104	896,440	0.362	0.930	1.000
yellowtail rockfish	CA	2005	561,589	1,214,690	2,627,316	1,305,737	0.430	0.930	1.000
yellowtail rockfish	CA	2006	130,127	303,566	708,175	326,280	0.399	0.930	1.000
yellowtail rockfish	CA	2007	596,078	1,302,497	2,846,099	1,399,976	0.426	0.930	1.000
yellowtail rockfish	CA	2008	226,443	526,984	1,226,409	566,388	0.400	0.930	1.000
yellowtail rockfish	CA	2009	320,149	712,574	1,586,017	765,948	0.418	0.930	1.000

Species	State	Year	Federal lower	Federal estimate	Federal upper	Total est.	p(Fed) lower	p(Fed) estimate	p(Fed) upper
yellowtail rockfish	CA	2010	641,670	1,418,850	3,137,336	1,525,077	0.421	0.930	1.000
yellowtail rockfish	CA	2011	1,324,365	2,965,949	6,642,320	3,188,143	0.415	0.930	1.000
yellowtail rockfish	CA	2012	877,537	1,953,022	4,346,594	2,099,376	0.418	0.930	1.000
yellowtail rockfish	CA	2013	575,243	1,401,911	3,416,564	1,506,861	0.382	0.930	1.000
yellowtail rockfish	CA	2014	5,221,350	11,611,355	25,821,589	12,482,121	0.418	0.930	1.000
yellowtail rockfish	CA	2015	635,810	1,336,676	2,810,121	1,436,911	0.442	0.930	1.000
yellowtail rockfish	CA	2016	3,879,068	7,895,493	16,070,565	8,486,210	0.457	0.930	1.000
yellowtail rockfish	CA	2017	2,443,443	5,043,721	10,411,176	5,421,943	0.451	0.930	1.000
yellowtail rockfish	CA	2018	750,320	1,550,905	3,205,706	1,667,241	0.450	0.930	1.000
yellowtail rockfish	CA	2019	1,829,117	4,443,142	10,792,921	4,776,431	0.383	0.930	1.000
yellowtail rockfish	CA	2021	366,383	875,003	2,089,699	940,475	0.390	0.930	1.000
yellowtail rockfish	CA	2022	489,802	1,149,600	2,698,191	1,235,764	0.396	0.930	1.000
yellowtail rockfish	CA	2023	387,295	799,335	1,649,738	859,293	0.451	0.930	1.000
yellowtail rockfish	OR	2003	792,209	1,688,338	3,598,146	1,741,856	0.455	0.969	1.000
yellowtail rockfish	OR	2004	635,472	1,491,796	3,502,051	1,538,593	0.413	0.970	1.000
yellowtail rockfish	OR	2005	1,105,952	2,126,853	4,090,145	2,191,334	0.505	0.971	1.000
yellowtail rockfish	OR	2006	261,905	541,462	1,119,416	558,372	0.469	0.970	1.000
yellowtail rockfish	OR	2007	1,169,190	2,319,275	4,600,652	2,391,507	0.489	0.970	1.000
yellowtail rockfish	OR	2008	459,993	945,075	1,941,697	974,850	0.472	0.969	1.000
yellowtail rockfish	OR	2009	596,262	1,258,352	2,655,625	1,297,023	0.460	0.970	1.000
yellowtail rockfish	OR	2010	1,294,272	2,517,770	4,897,861	2,595,750	0.499	0.970	1.000
yellowtail rockfish	OR	2011	2,646,806	5,228,928	10,330,067	5,389,194	0.491	0.970	1.000
yellowtail rockfish	OR	2012	1,813,586	3,430,677	6,489,653	3,535,220	0.513	0.970	1.000
yellowtail rockfish	OR	2013	1,056,490	2,489,666	5,867,007	2,566,873	0.412	0.970	1.000
yellowtail rockfish	OR	2014	10,207,374	20,138,896	39,733,540	20,740,414	0.492	0.971	1.000
yellowtail rockfish	OR	2015	1,260,861	2,321,476	4,274,262	2,390,961	0.527	0.971	1.000
yellowtail rockfish	OR	2016	7,745,996	12,973,120	21,727,592	13,330,822	0.581	0.973	1.000
yellowtail rockfish	OR	2017	4,895,591	8,513,902	14,806,492	8,757,920	0.559	0.972	1.000

Species	State	Year	Federal lower	Federal estimate	Federal upper	Total est.	p(Fed) lower	p(Fed) estimate	p(Fed) upper
yellowtail rockfish	OR	2018	1,476,316	2,658,743	4,788,214	2,736,739	0.539	0.972	1.000
yellowtail rockfish	OR	2019	3,578,724	7,609,365	16,179,635	7,832,250	0.457	0.972	1.000
yellowtail rockfish	OR	2021	676,131	1,560,740	3,602,714	1,609,483	0.420	0.970	1.000
yellowtail rockfish	OR	2022	984,910	2,014,247	4,119,350	2,075,379	0.475	0.971	1.000
yellowtail rockfish	OR	2023	767,818	1,363,698	2,422,020	1,403,409	0.547	0.972	1.000
yellowtail rockfish	WA	2003	8,871,555	17,006,564	32,601,185	17,007,683	0.522	1.000	1.000
yellowtail rockfish	WA	2004	6,980,411	14,429,339	29,827,160	14,430,334	0.484	1.000	1.000
yellowtail rockfish	WA	2005	10,631,738	18,163,985	31,032,588	18,165,435	0.585	1.000	1.000
yellowtail rockfish	WA	2006	2,754,811	5,149,060	9,624,187	5,149,422	0.535	1.000	1.000
yellowtail rockfish	WA	2007	12,198,536	21,828,644	39,061,219	21,830,199	0.559	1.000	1.000
yellowtail rockfish	WA	2008	4,858,274	9,293,903	17,779,283	9,294,532	0.523	1.000	1.000
yellowtail rockfish	WA	2009	5,907,415	11,276,888	21,526,881	11,277,739	0.524	1.000	1.000
yellowtail rockfish	WA	2010	13,404,205	23,213,388	40,200,921	23,215,082	0.577	1.000	1.000
yellowtail rockfish	WA	2011	25,974,013	46,413,003	82,935,466	46,416,543	0.560	1.000	1.000
yellowtail rockfish	WA	2012	16,905,006	29,830,627	52,639,218	29,832,958	0.567	1.000	1.000
yellowtail rockfish	WA	2013	10,854,553	23,061,633	48,996,849	23,063,306	0.471	1.000	1.000
yellowtail rockfish	WA	2014	89,650,686	163,406,216	297,840,347	163,420,061	0.549	1.000	1.000
yellowtail rockfish	WA	2015	11,680,759	18,971,126	30,811,665	18,972,720	0.616	1.000	1.000
yellowtail rockfish	WA	2016	50,907,988	81,829,265	131,531,983	81,838,563	0.622	1.000	1.000
yellowtail rockfish	WA	2017	36,700,843	60,416,688	99,457,555	60,422,675	0.607	1.000	1.000
yellowtail rockfish	WA	2018	12,464,951	20,322,085	33,131,868	20,323,931	0.613	1.000	1.000
yellowtail rockfish	WA	2019	30,860,219	57,874,560	108,536,647	57,879,849	0.533	1.000	1.000
yellowtail rockfish	WA	2021	6,880,133	14,843,276	32,023,050	14,844,320	0.463	1.000	1.000
yellowtail rockfish	WA	2022	9,280,123	17,266,885	32,127,302	17,268,257	0.537	1.000	1.000
yellowtail rockfish	WA	2023	6,487,922	10,177,880	15,966,475	10,178,831	0.637	1.000	1.000

B.2. Jurisdictionally stratified abundance index estimates, and proportions for selected species in the **Southern California Shelf Rockfish Hook and Line Survey**. The federal area proportion estimate, lower, and upper confidence limits are expressed as a proportion of the total estimate. Confidence limits are the estimate ± 2 S.E.

Survey	Species	Year	Federal lower	Federal estimate	Federal upper	Total est.	p(Fed) lower	p(Fed) estimate	p(Fed) upper
CA H_L	copper rockfish	2004	3.926	6.525	10.844	11.848	0.331	0.550759	0.915336
CA H_L	copper rockfish	2005	6.292	9.344	13.877	16.548	0.380	0.564675	0.838586
CA H_L	copper rockfish	2006	5.193	8.130	12.726	14.626	0.355	0.555814	0.870101
CA H_L	copper rockfish	2007	6.309	9.216	13.463	15.515	0.407	0.594006	0.867730
CA H_L	copper rockfish	2008	6.785	9.596	13.573	16.629	0.408	0.577071	0.816224
CA H_L	copper rockfish	2009	7.372	10.342	14.508	17.908	0.412	0.577470	0.810097
CA H_L	copper rockfish	2010	2.947	4.828	7.909	8.648	0.341	0.558246	0.914581
CA H_L	copper rockfish	2011	6.718	9.607	13.737	16.562	0.406	0.580042	0.829467
CA H_L	copper rockfish	2012	6.182	8.982	13.049	16.541	0.374	0.542994	0.788895
CA H_L	copper rockfish	2013	7.128	10.220	14.653	18.231	0.391	0.560593	0.803732
CA H_L	copper rockfish	2014	6.311	8.642	11.833	15.239	0.414	0.567086	0.776472
CA H_L	copper rockfish	2015	10.407	13.245	16.856	22.926	0.454	0.577725	0.735246
CA H_L	copper rockfish	2016	10.595	13.336	16.787	24.285	0.436	0.549156	0.691246
CA H_L	copper rockfish	2017	6.711	8.878	11.746	16.211	0.414	0.547683	0.724592
CA H_L	copper rockfish	2018	7.353	9.479	12.219	16.506	0.445	0.574243	0.740254
CA H_L	copper rockfish	2019	6.418	8.484	11.216	14.539	0.441	0.583545	0.771427
CA H_L	copper rockfish	2021	4.058	5.781	8.234	9.809	0.414	0.589334	0.839471
CA H_L	copper rockfish	2022	6.520	8.739	11.714	15.396	0.423	0.567633	0.760861
CA H_L	lingcod	2004	13.070	19.713	29.732	26.594	0.491	0.741240	1.000000
CA H_L	lingcod	2005	8.289	13.014	20.432	17.620	0.470	0.738551	1.000000
CA H_L	lingcod	2006	6.473	10.709	17.717	14.506	0.446	0.738239	1.000000
CA H_L	lingcod	2007	8.636	13.117	19.922	17.749	0.487	0.738985	1.000000
CA H_L	lingcod	2008	2.334	4.370	8.182	5.938	0.393	0.735976	1.000000
CA H_L	lingcod	2009	3.864	6.560	11.139	8.906	0.434	0.736640	1.000000
CA H_L	lingcod	2010	1.852	3.645	7.177	4.956	0.374	0.735462	1.000000
CA H_L	lingcod	2011	9.152	13.320	19.386	18.021	0.508	0.739117	1.000000
CA H_L	lingcod	2012	16.654	22.377	30.068	30.145	0.552	0.742316	0.997447
CA H_L	lingcod	2013	17.879	24.142	32.599	32.510	0.550	0.742616	1.000000
CA H_L	lingcod	2014	14.986	19.996	26.681	26.975	0.556	0.741285	0.989094
CA H_L	lingcod	2015	14.329	18.803	24.674	25.379	0.565	0.740897	0.972227

Survey	Species	Year	Federal lower	Federal estimate	Federal upper	Total est.	p(Fed) lower	p(Fed) estimate	p(Fed) upper
CA H_L	lingcod	2016	13.557	17.840	23.476	24.101	0.563	0.740234	0.974078
CA H_L	lingcod	2017	9.995	13.590	18.479	18.392	0.543	0.738912	1.000000
CA H_L	lingcod	2018	9.123	12.456	17.005	16.871	0.541	0.738289	1.000000
CA H_L	lingcod	2019	5.418	7.889	11.485	10.705	0.506	0.736927	1.000000
CA H_L	lingcod	2021	3.980	6.345	10.117	8.614	0.462	0.736629	1.000000
CA H_L	lingcod	2022	4.736	7.117	10.694	9.658	0.490	0.736896	1.000000
CA H_L	olive rockfish	2004	2.620	6.294	15.123	8.804	0.298	0.714954	1.000000
CA H_L	olive rockfish	2005	0.652	2.518	9.727	3.497	0.186	0.720163	1.000000
CA H_L	olive rockfish	2006	5.578	11.455	23.524	16.002	0.349	0.715876	1.000000
CA H_L	olive rockfish	2007	3.977	8.162	16.750	11.475	0.347	0.711276	1.000000
CA H_L	olive rockfish	2008	4.784	9.178	17.605	12.764	0.375	0.719033	1.000000
CA H_L	olive rockfish	2009	1.479	3.661	9.062	5.041	0.293	0.726241	1.000000
CA H_L	olive rockfish	2010	1.201	3.206	8.557	4.325	0.278	0.741243	1.000000
CA H_L	olive rockfish	2011	1.816	4.129	9.392	5.510	0.330	0.749491	1.000000
CA H_L	olive rockfish	2012	3.318	6.308	11.993	8.346	0.398	0.755898	1.000000
CA H_L	olive rockfish	2013	3.538	6.624	12.400	8.700	0.407	0.761370	1.000000
CA H_L	olive rockfish	2014	4.648	6.829	10.034	8.827	0.527	0.773651	1.000000
CA H_L	olive rockfish	2015	6.524	8.888	12.108	11.711	0.557	0.758968	1.000000
CA H_L	olive rockfish	2016	6.009	8.316	11.509	10.940	0.549	0.760115	1.000000
CA H_L	olive rockfish	2017	8.111	10.638	13.952	13.759	0.590	0.773143	1.000000
CA H_L	olive rockfish	2018	5.466	7.559	10.454	9.719	0.562	0.777754	1.000000
CA H_L	olive rockfish	2019	7.509	9.880	12.999	12.874	0.583	0.767441	1.000000
CA H_L	olive rockfish	2021	5.196	7.344	10.379	9.579	0.542	0.766696	1.000000
CA H_L	olive rockfish	2022	3.626	5.480	8.281	7.107	0.510	0.771042	1.000000