

“HOTSPOT ANALYSIS” FOR ESSENTIAL FISH HABITAT ALTERNATIVES

Methods

Trawl gear haul level catch data from the shorebased IFQ sector from 2011 to 2014 were obtained from the West Coast Groundfish Observer Program (WCGOP). A catch-per-unit-effort metric was computed as catch (landings plus discards) in metric tons divided tow duration in fractional hours for the following species: blackgill rockfish, bocaccio rockfish, darkblotched rockfish, cowcod, petrale sole, Pacific Ocean perch, rougheye rockfish, shortraker rockfish, and yelloweye rockfish. (Catch attributed to the shortraker/rougheye category was apportioned to the individual species categories based on the proportion of the total catch in rougheye and shortraker species categories.)

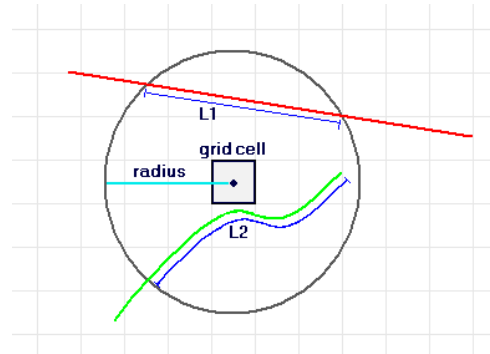
WCGOP also provided a polyline feature class data set representing straight line distances between set and haul back positions for each tow. In ArcGIS 10.3.1 for Desktop, tables with the tow level CPUE metric for each species were joined to the tow line data set using HAUL_ID as the key field. Procedures recommended by WCGOP were followed to generate raster data sets for each species based on the CPUE metric. The following tools were used:

- **Line Density** was used to generate rasters from the polyline feature class using the CPUE as the population field, an output cell size of 200 sq. km, and a search radius of 5,000 sq. km.
- **Line Statistics** was used to estimate the number of unique vessels represented in each raster cell to screen for data confidentiality based on the “rule of three.” DRVID (unique vessel identifier field) was used to generate a second raster for each species using the VARIETY statistic, which counts unique values within the search radius. The same values for cell size and search radius were used as with the Line Density tool.
- The **Raster Calculator** tool was used to generate a third raster excluding confidential data using the formula $CON(RASTER2 \geq 3, 1, 0) * RASTER1$ where RASTER1 contains the CPUE values and RASTER2 contains the DRVID counts. The

How Line Density Works (Arc GIS Help)

The Line Density tool calculates the density of linear features in the neighborhood of each output raster cell. Density is calculated in units of length per unit of area.

Conceptually, a circle is drawn around each raster cell center using the search radius. The length of the portion of each line that falls within the circle is multiplied by its Population field value. These figures are summed, and the total is divided by the circle's area. The figure below illustrates this concept:



A raster cell and the circular neighborhood used to determine the length for the line density

In the illustration above, a raster cell is shown with its circular neighborhood. Lines L1 and L2 represent the length of the portion of each line that falls within the circle. The corresponding population field values are V1 and V2. Thus:

$$\text{Density} = ((L1 * V1) + (L2 * V2)) / (\text{area_of_circle})$$

CON function variables are Condition, Value If True, Value If False.

To represent “hotspots” in the maps, the resulting rasters were classified into five quintiles and only the top quintiles (top 20% of values) for each species are displayed on the maps.

Caveats

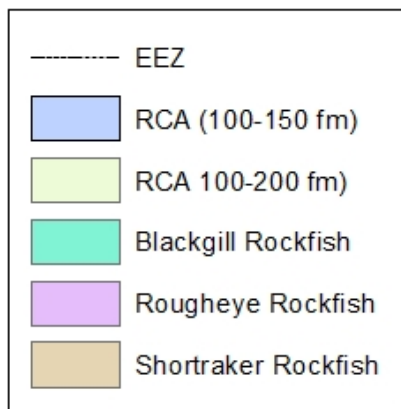
The CPUE metric was calculated across all the trawl gear types recorded in the data set so differences in catchability between gear types is not compensated for. The table below shows the proportion of catch by species and gear type

SPECIES	GROUND FISH TRAWL, SMALL FOOTROPE	GROUND FISH TRAWL, LARGE FOOTROPE	DANISH/ SCOTTISH SEINE	OR SET BACK FLATFISH NET- PINEAPPLE TRAWL	GRAND TOTAL
BLACKGILL ROCKFISH	36.9%	62.9%	0.0%	0.2%	100.0%
BOCACCIO ROCKFISH	63.4%	21.9%	11.6%	3.1%	100.0%
COWCOD ROCKFISH	39.7%	25.8%	25.9%	8.6%	100.0%
DARKBLOTCHED ROCKFISH	3.3%	90.5%	0.0%	6.2%	100.0%
PACIFIC OCEAN PERCH	1.6%	97.1%	0.0%	1.3%	100.0%
PETRALE SOLE	18.2%	56.9%	2.3%	22.6%	100.0%
ROUGHEYE ROCKFISH	3.7%	92.6%	0.0%	3.7%	100.0%
SHORTRAKER ROCKFISH	6.4%	87.6%	0.0%	6.0%	100.0%
SHORTRAKER/ROUGH EYE ROCKFISH	0.0%	100.0%	0.0%	0.0%	100.0%
YELLOWEYE ROCKFISH	50.6%	19.2%	0.0%	30.3%	100.0%
GRAND TOTAL	17.3%	60.7%	2.0%	20.0%	100.0%

The line density tool uses interpolation. As result, some portions of the “hotspot” representations occurs within Rockfish Conservation Areas (RCAs) where no fishing actually occurred. In addition, since these areas were not excluded for the line density calculation, actual densities outside of RCAs may be underrepresented.

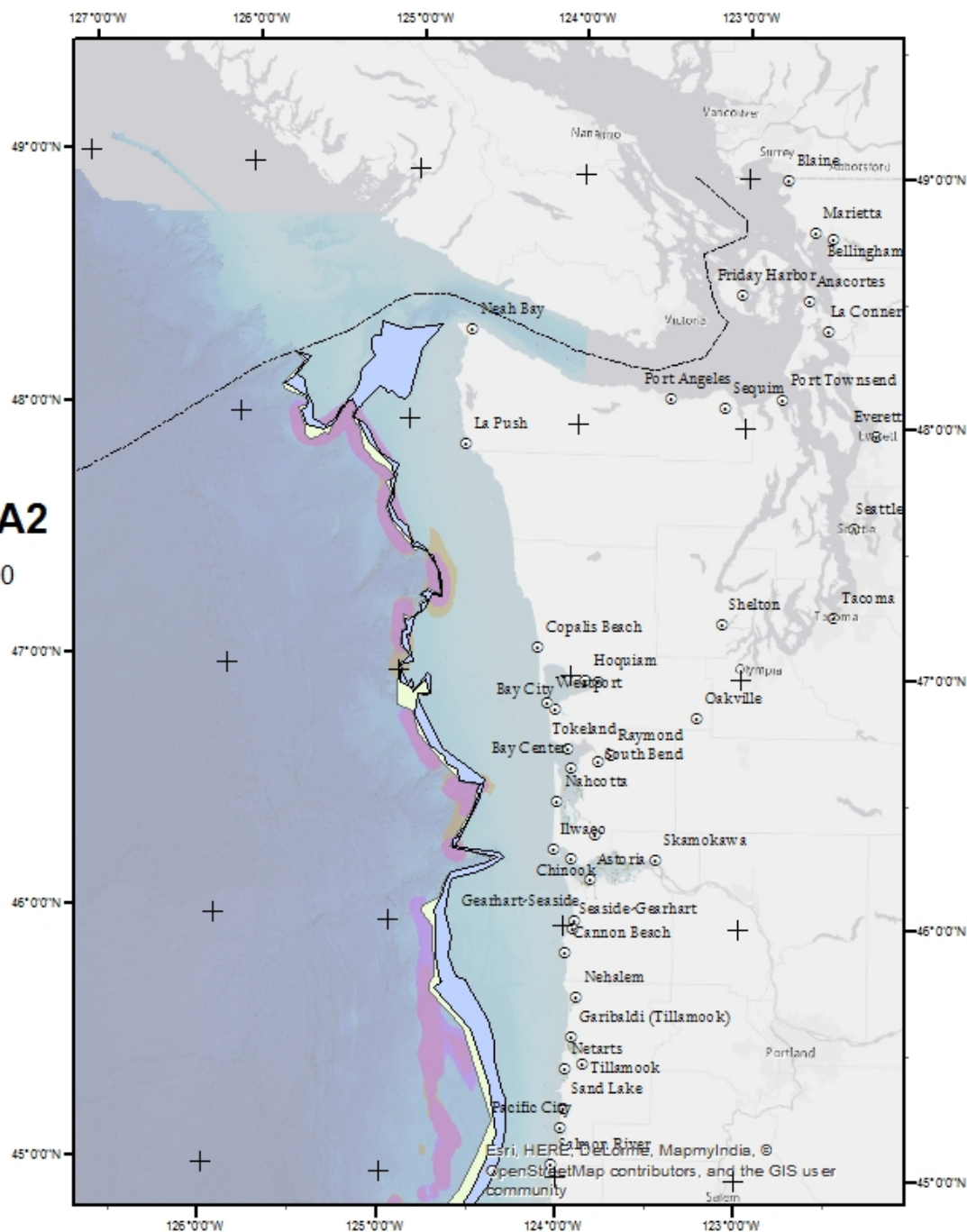
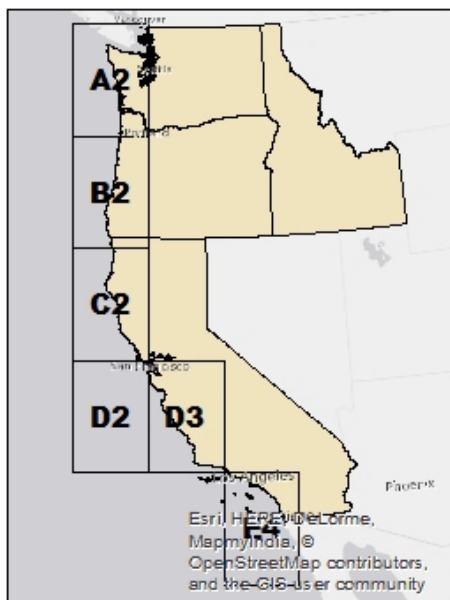
The following pages display results in for non-overfished species (blackgill rockfish, roughey rockfish, and shortraker rockfish) and overfished species (boccaccio rockfish, darkblotched rockfish, cowcod, petrale sole, Pacific Ocean perch, and yelloweye rockfish) separately. Map series for each comprise six panels covering the entire West Coast.

"Trawl Hotspots" Selected Groundfish Species

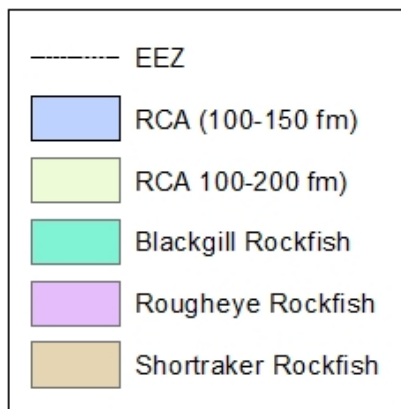


Map Panel: A2

Scale: 1:2,668,100

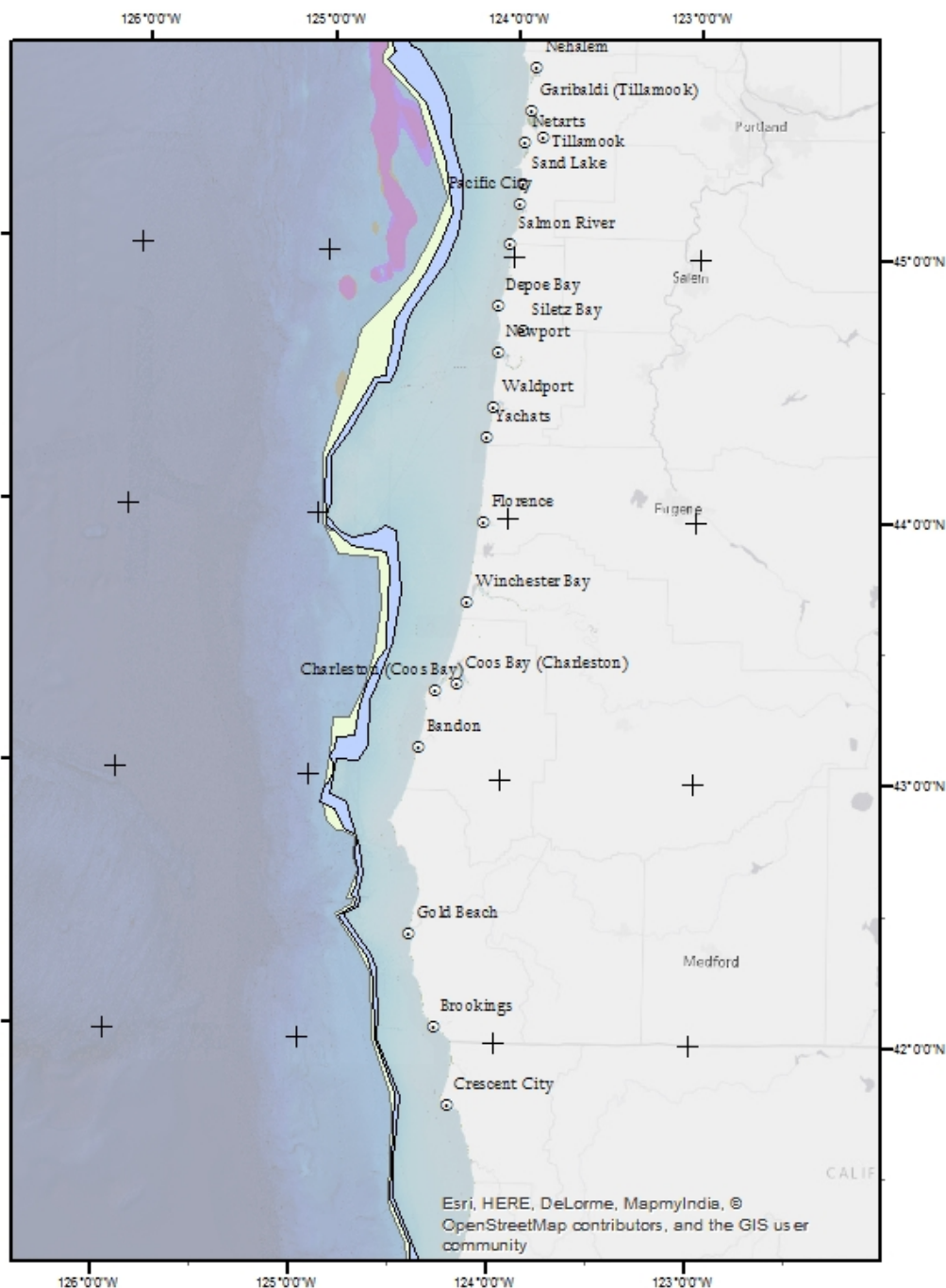
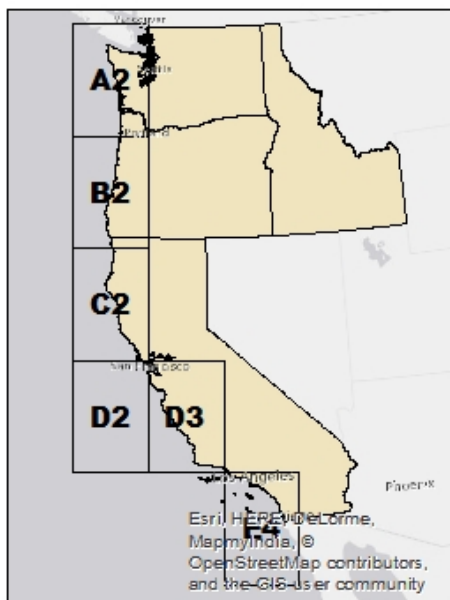


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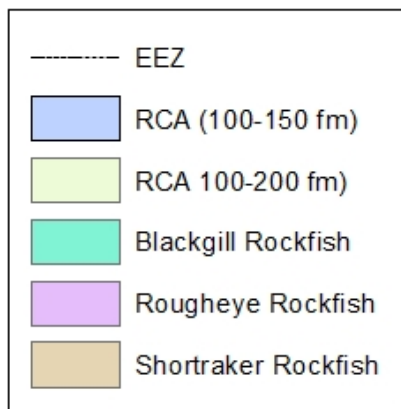


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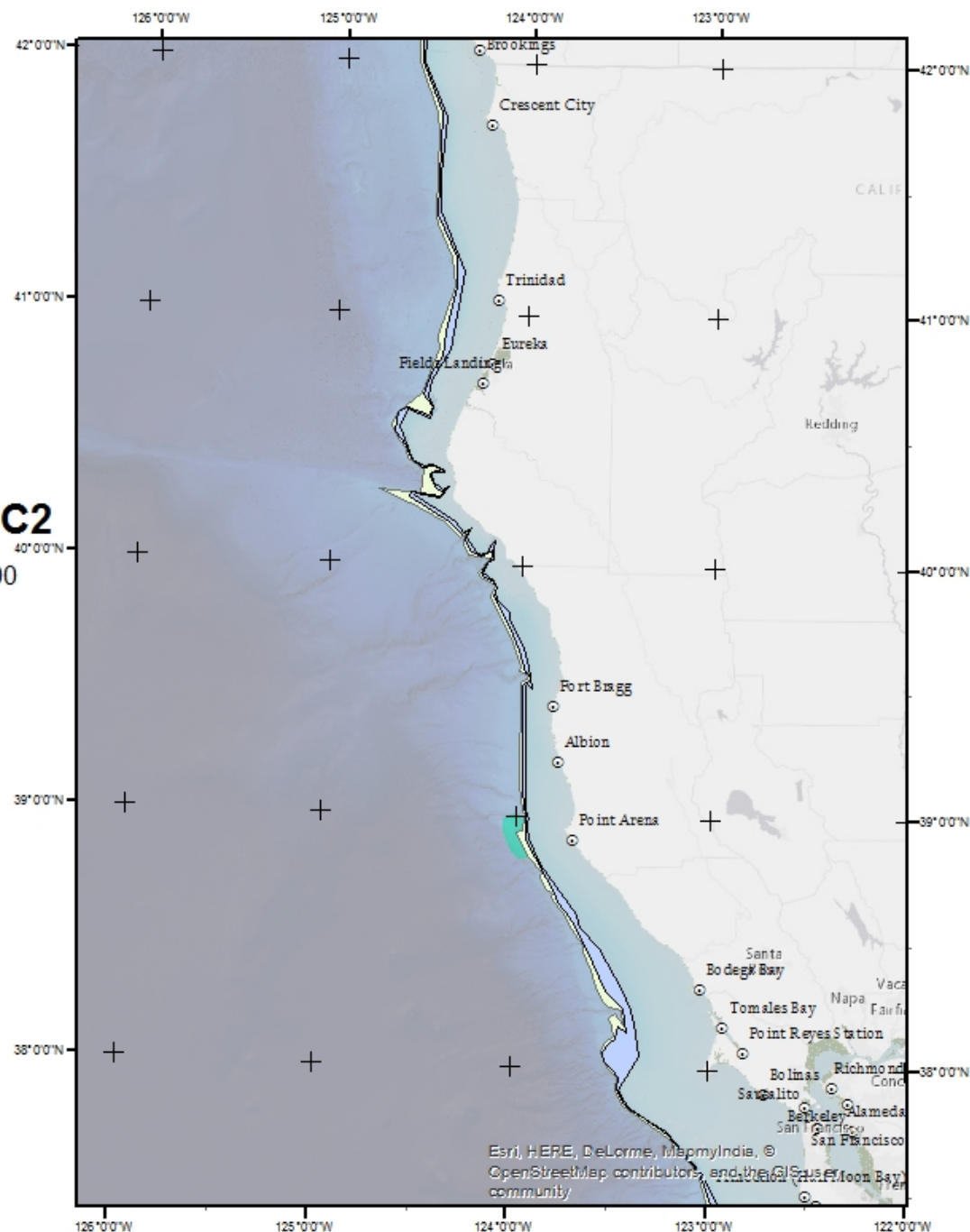
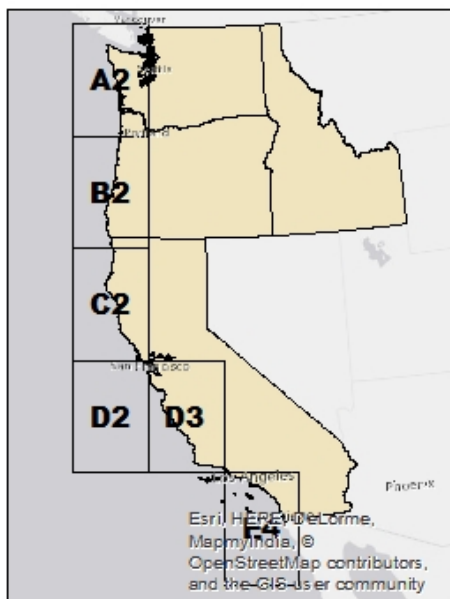


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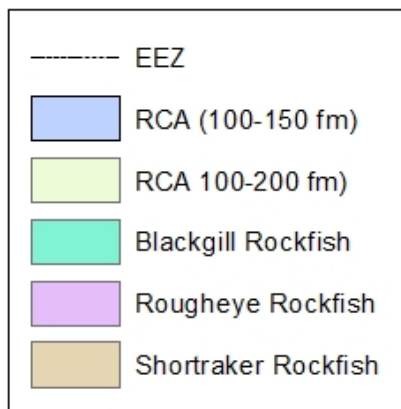


Map Panel: C2

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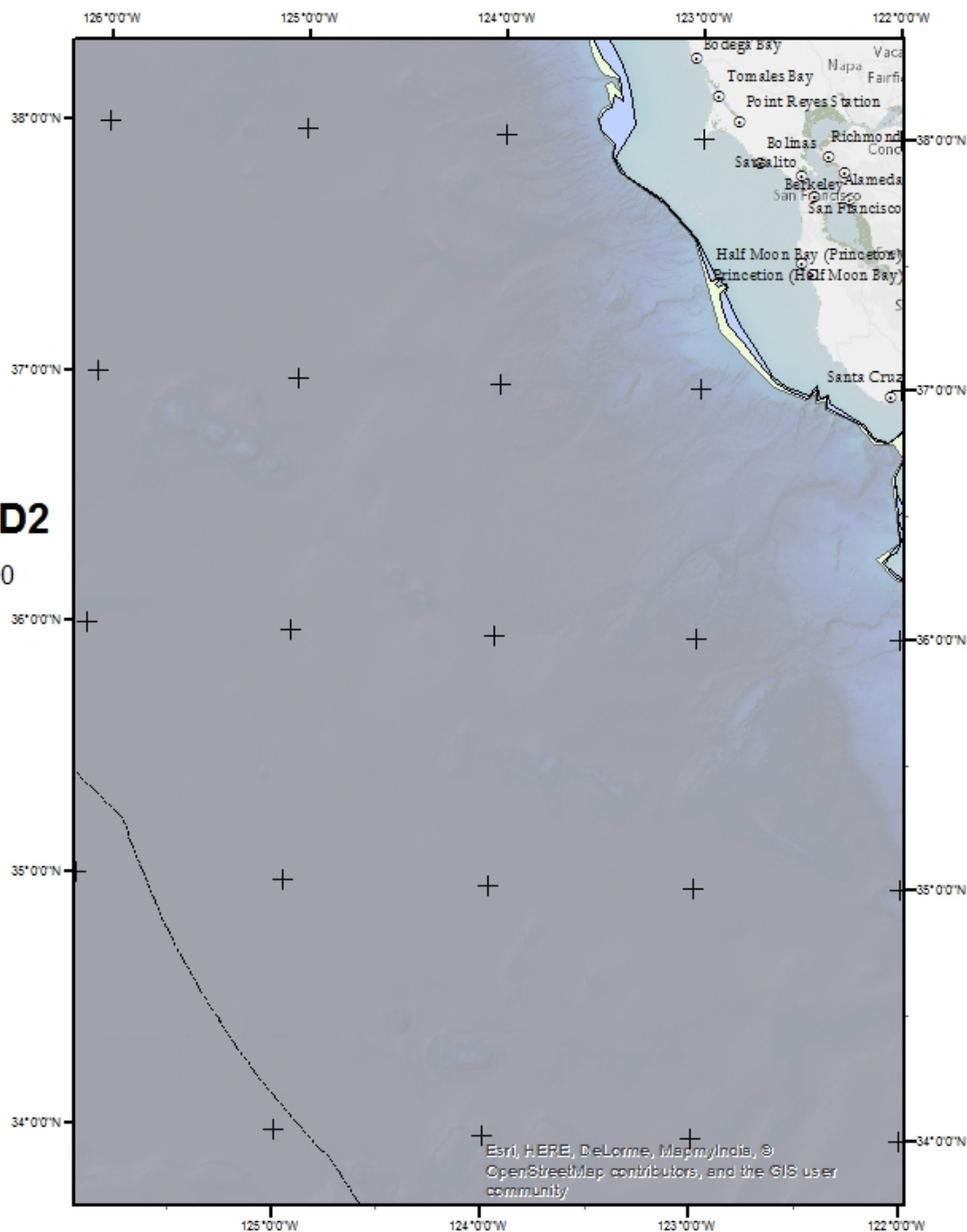
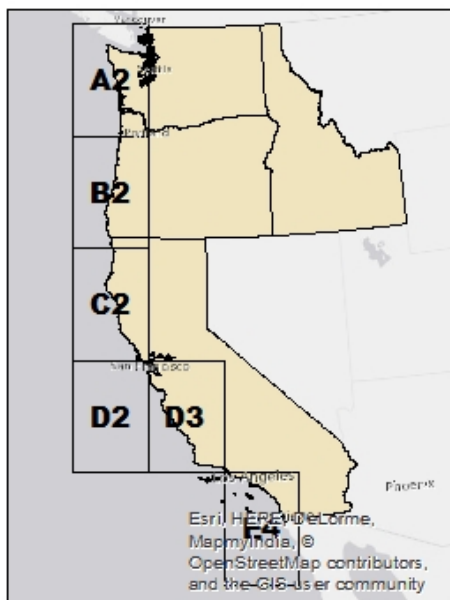


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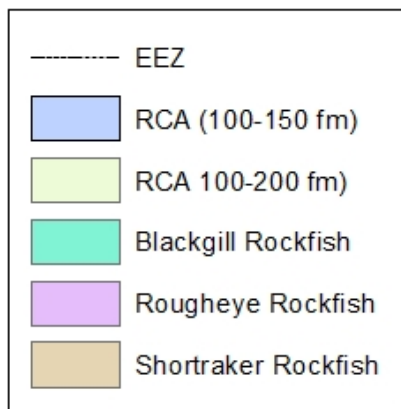


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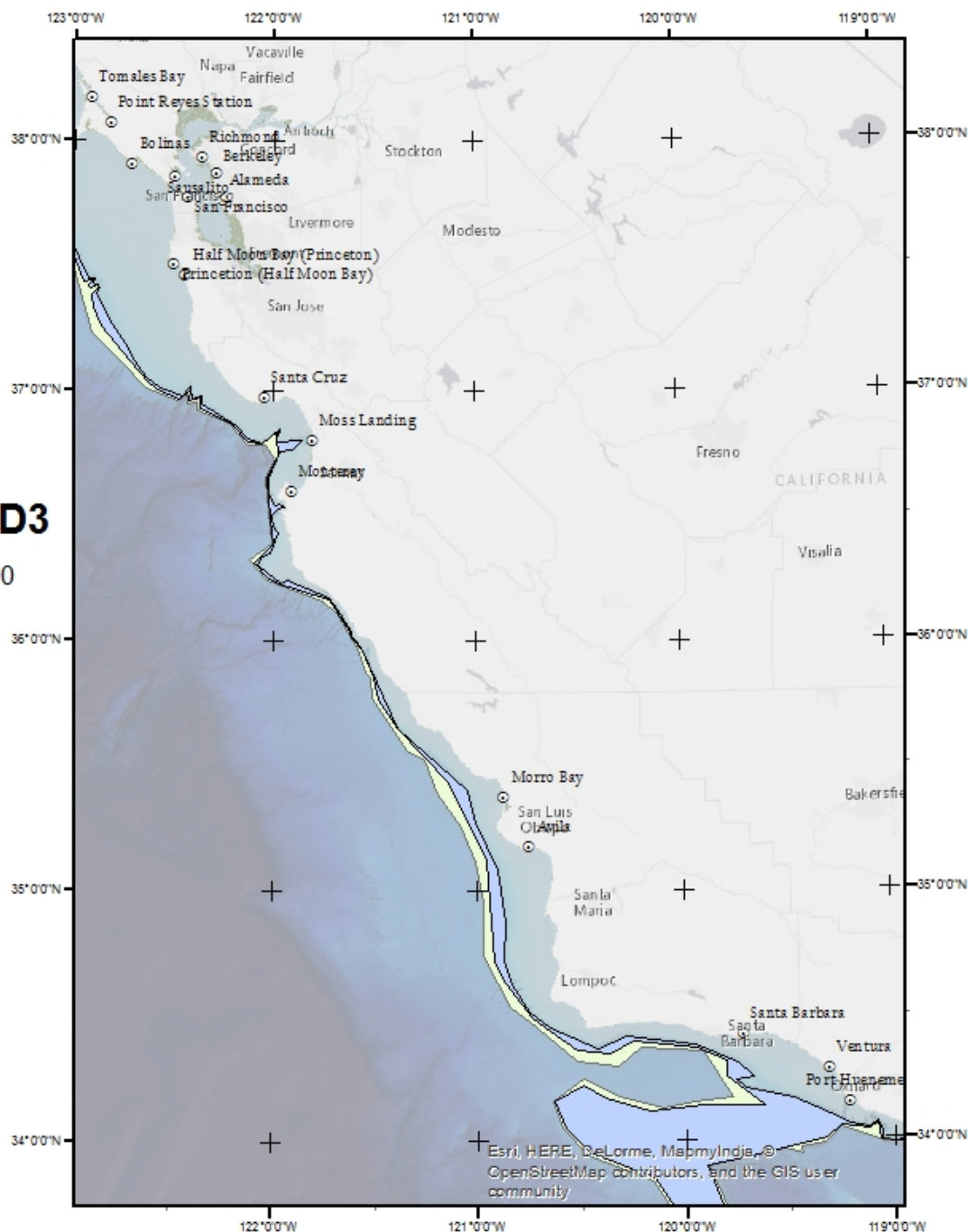
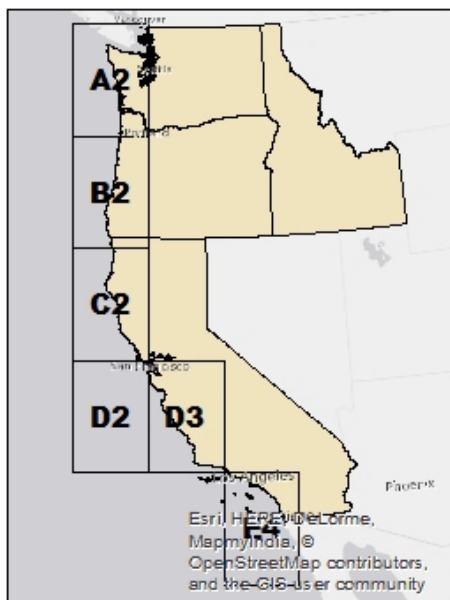


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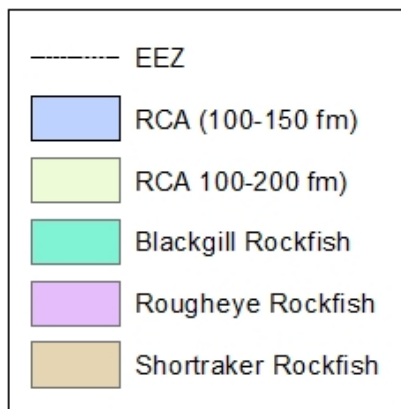


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Scale: 1:2,668,100

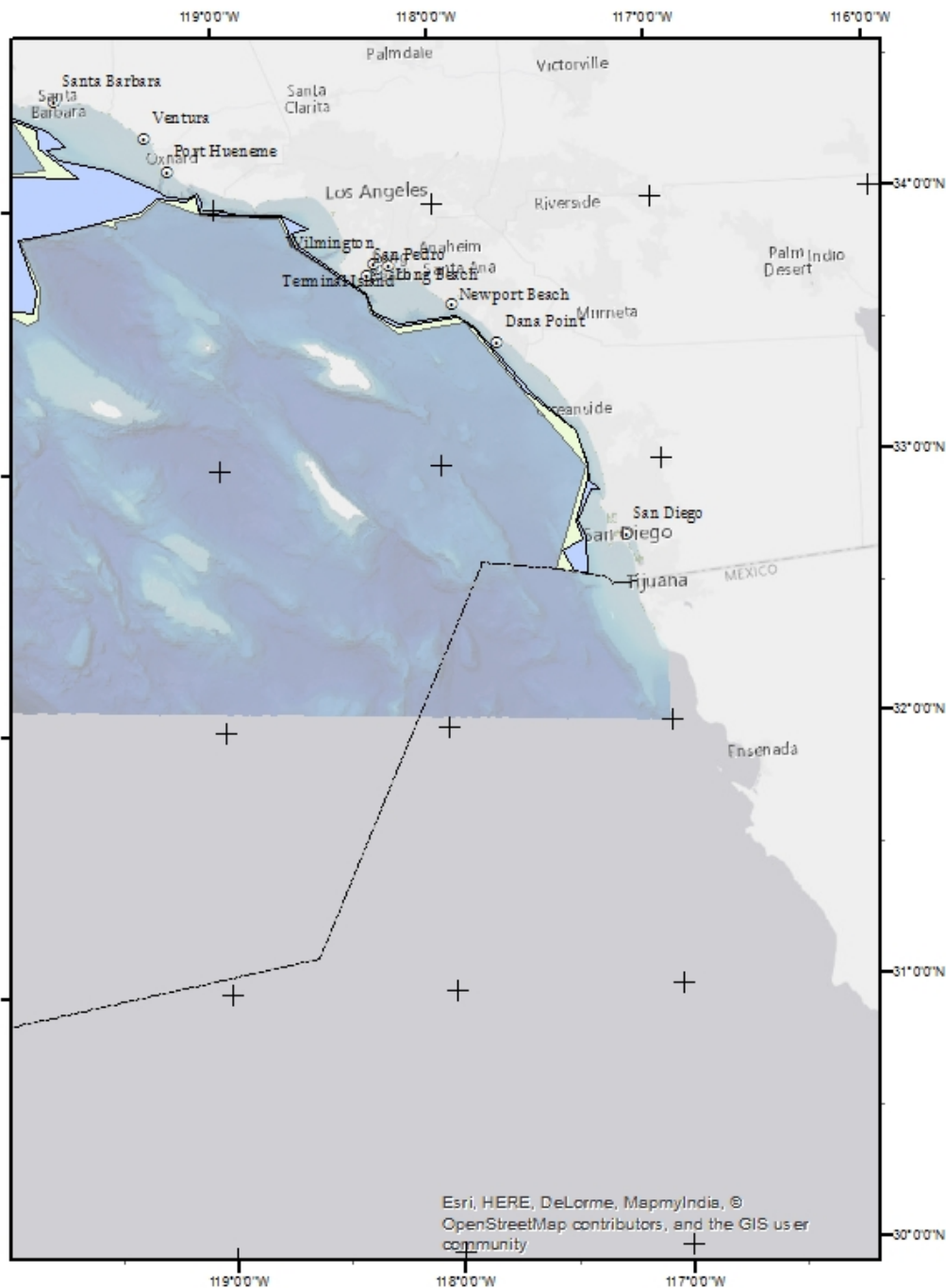
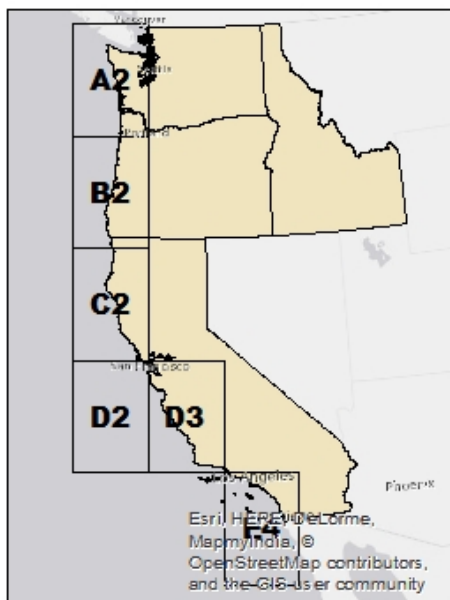


"Trawl Hotspots" Selected Groundfish Species



Map Panel: E4

Scale: 1:2,668,100

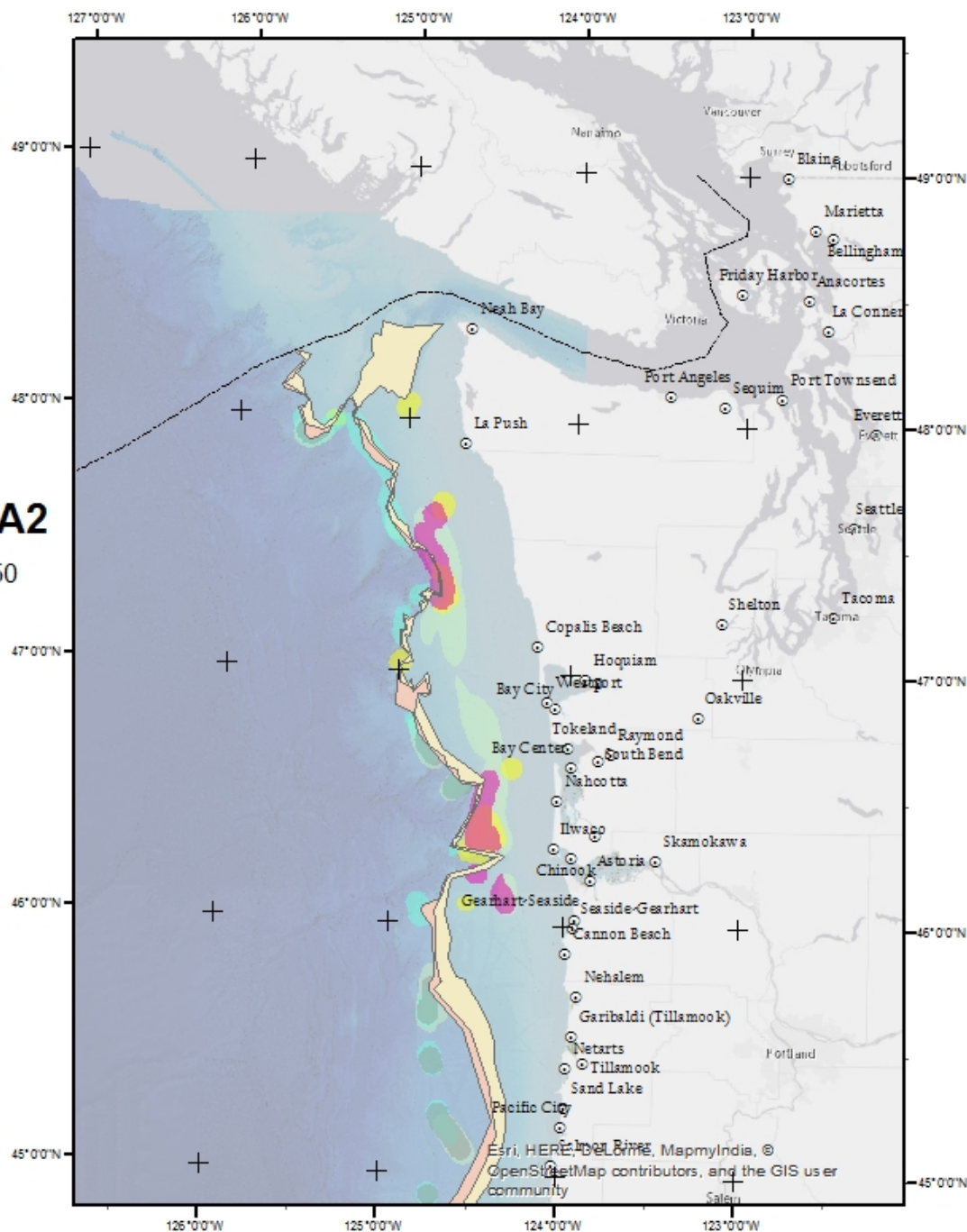
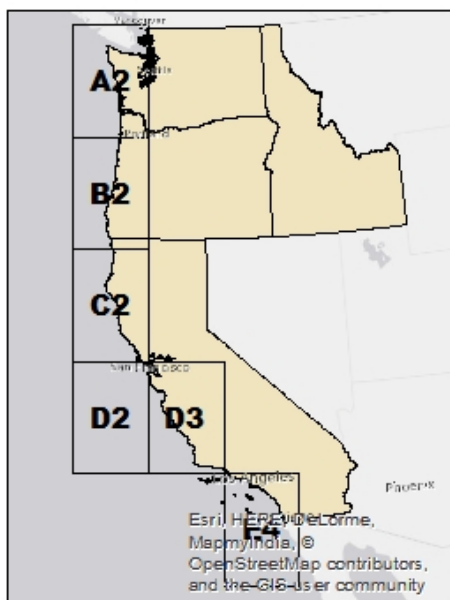


"Trawl Hotspots" Overfished Groundfish Species



Map Panel: A2

Scale: 1:2,663,150

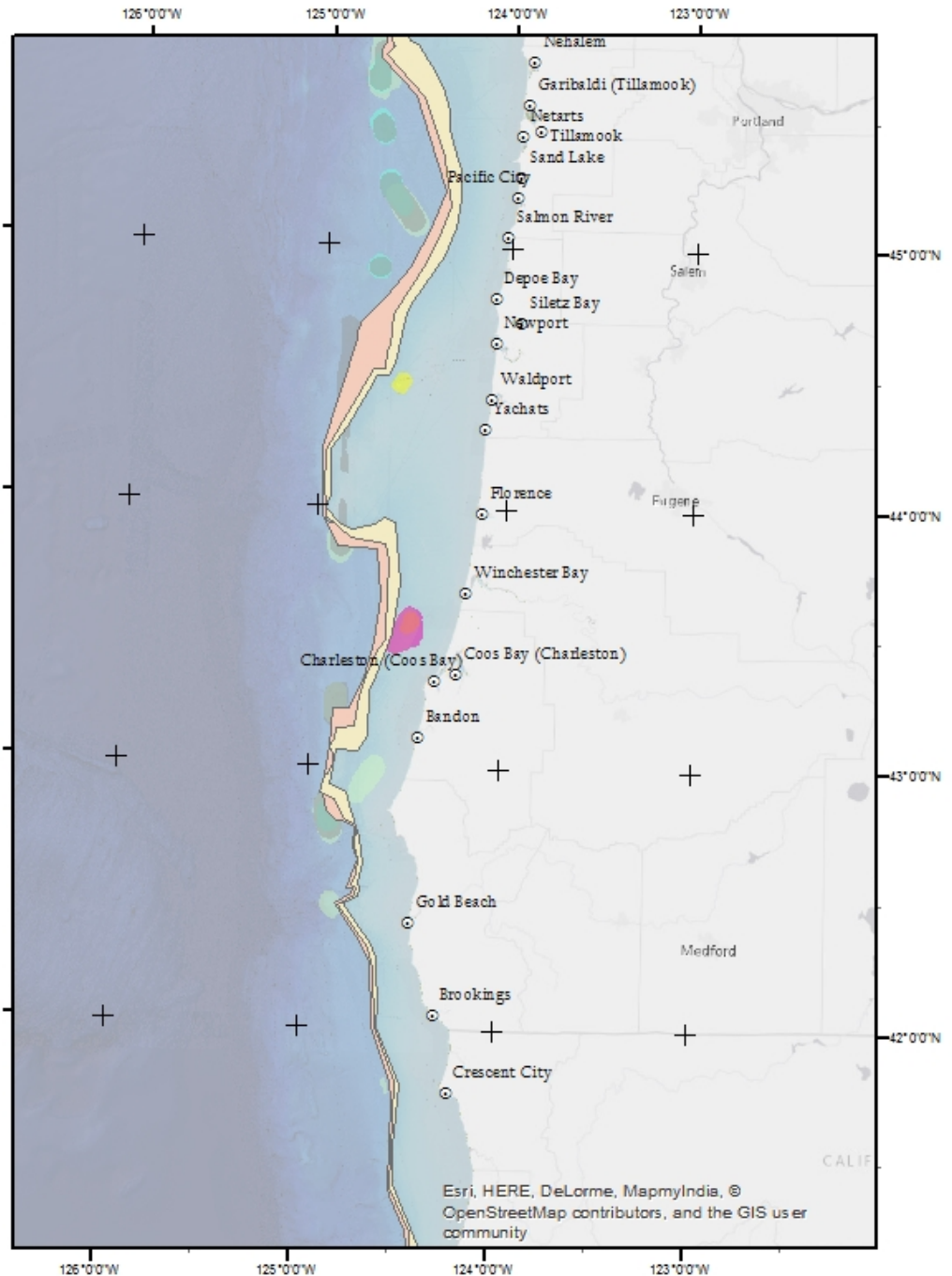
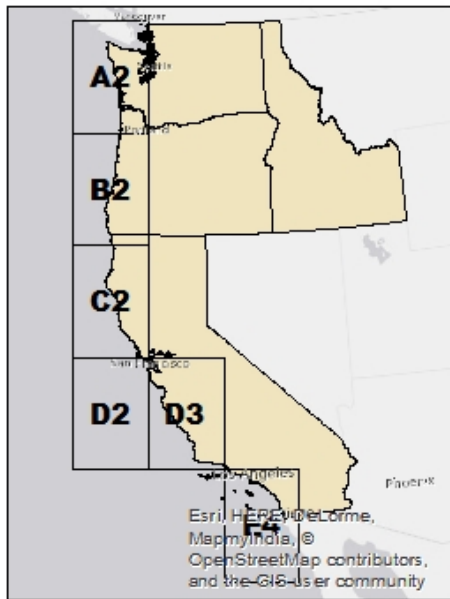


"Trawl Hotspots" Overfished Groundfish Species



Map Panel: B2

Scale: 1:2,667,920

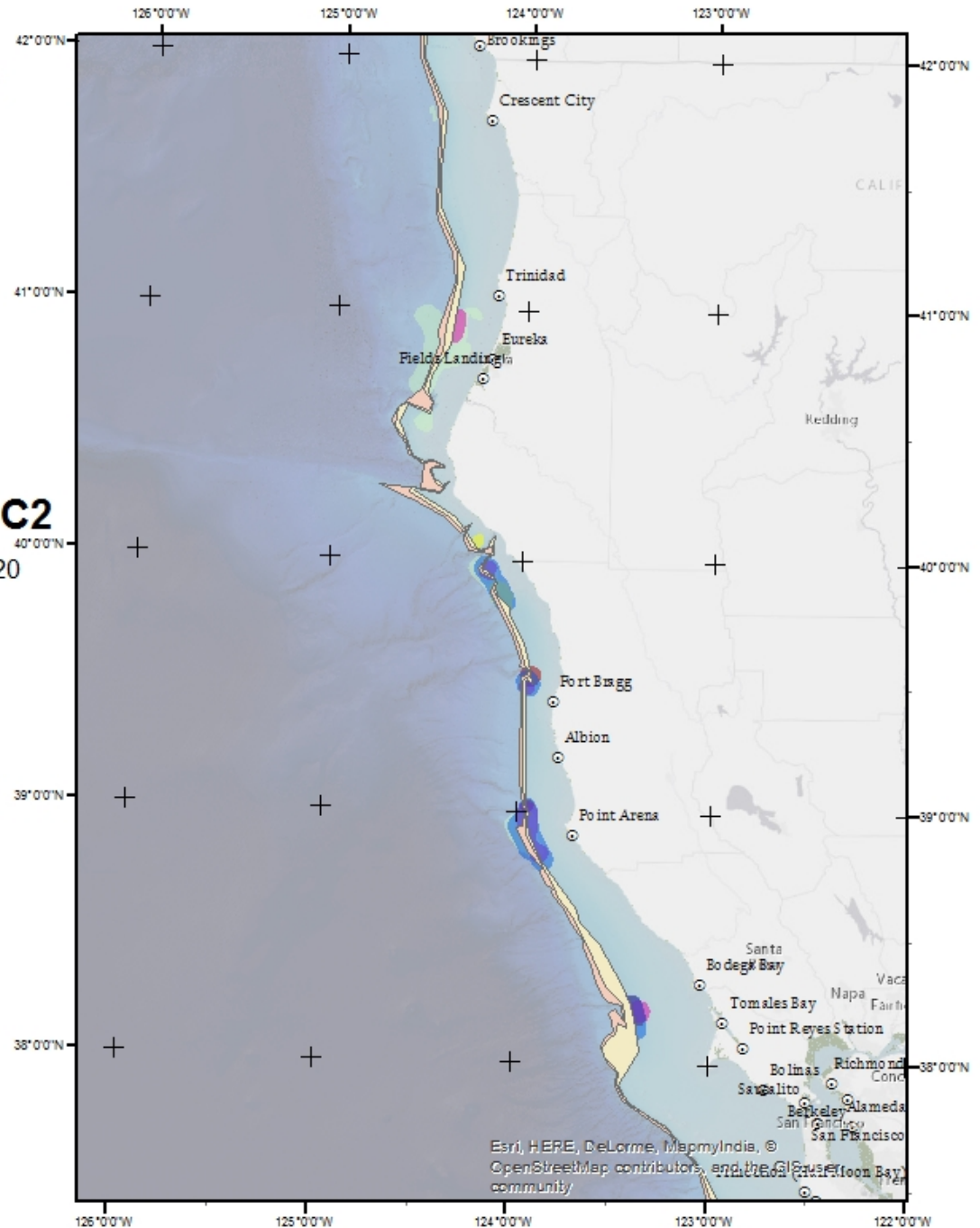
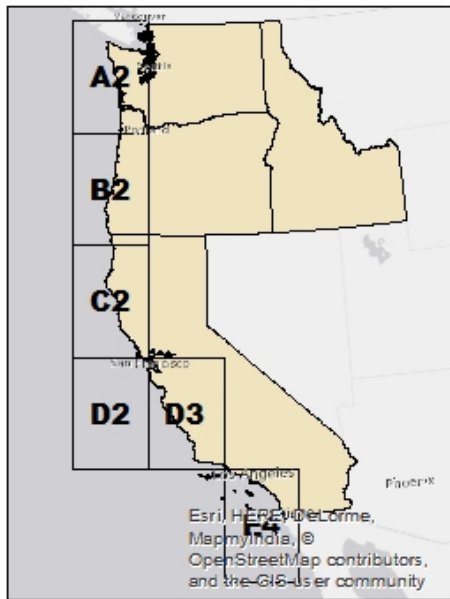


"Trawl Hotspots" Overfished Groundfish Species



Map Panel: C2

Scale: 1:2,667,920

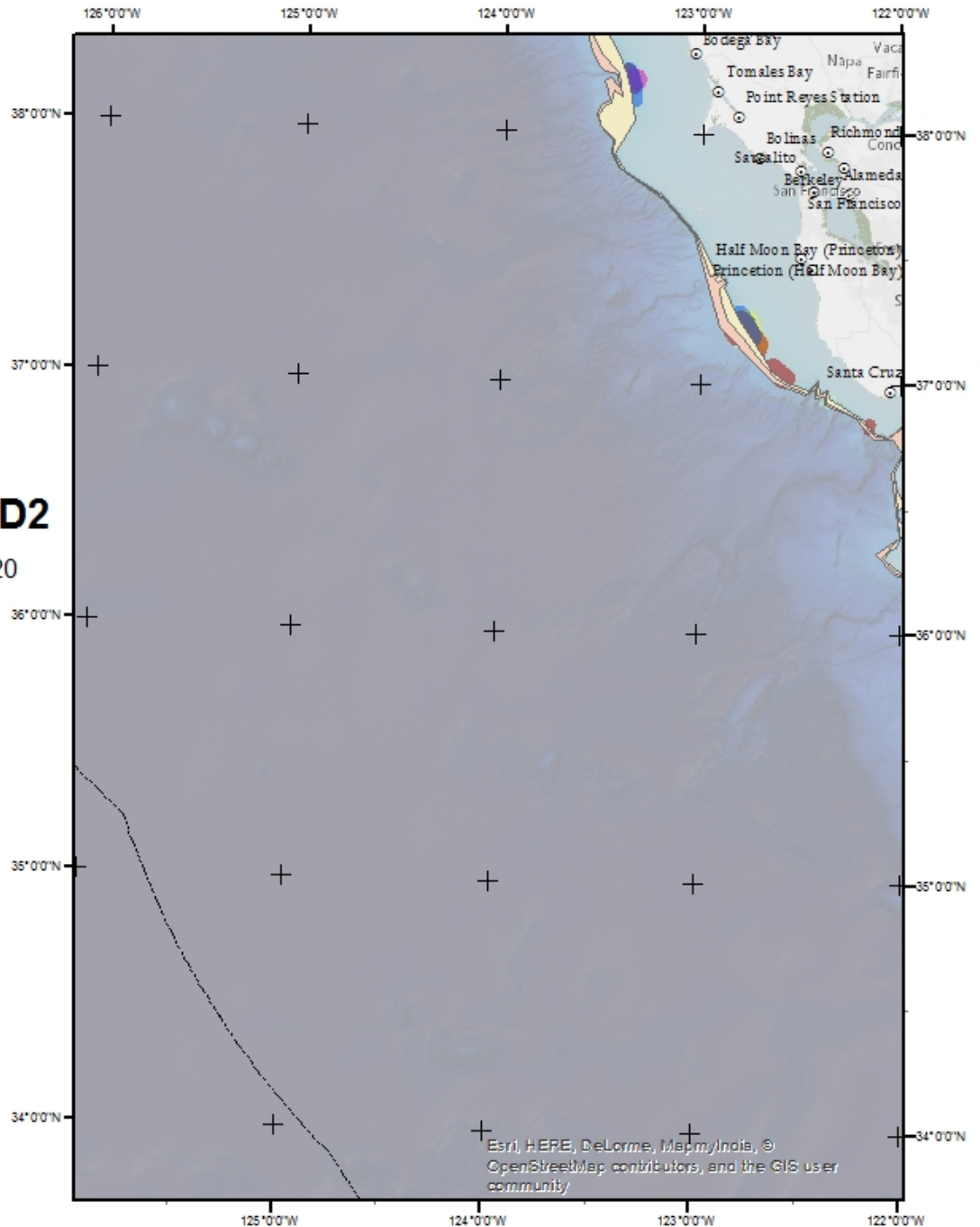
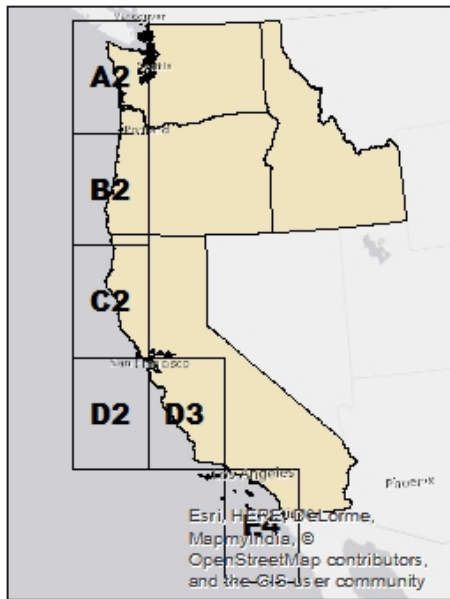


"Trawl Hotspots" Overfished Groundfish Species



Map Panel: D2

Scale: 1:2,667,920

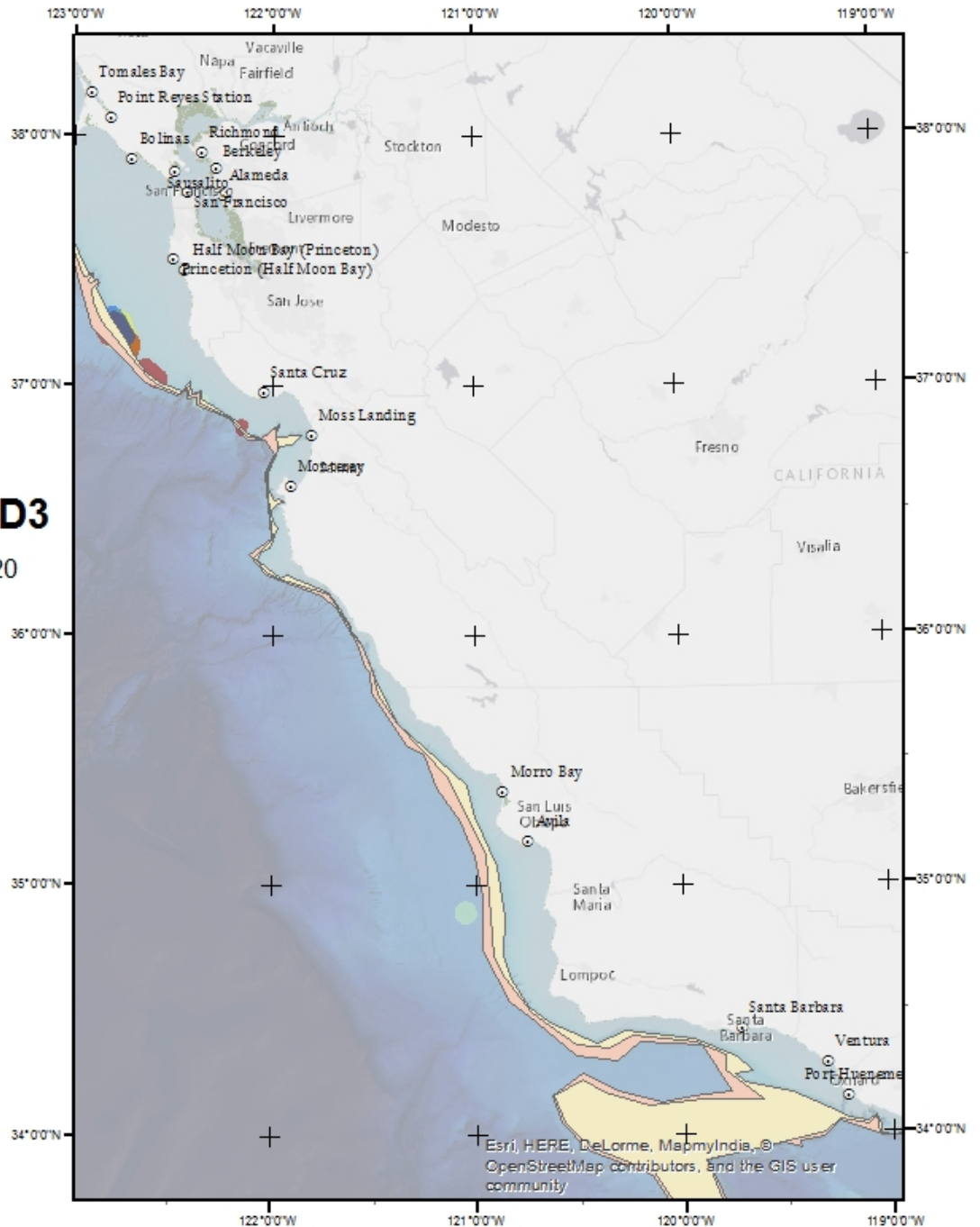
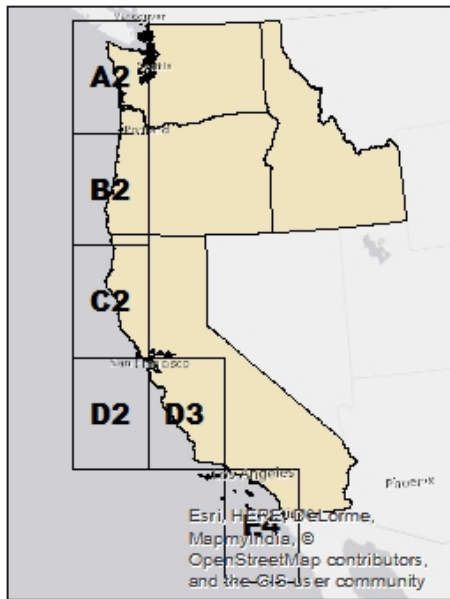


"Trawl Hotspots" Overfished Groundfish Species



Map Panel: D3

Scale: 1:2,667,920



"Trawl Hotspots" Overfished Groundfish Species



Map Panel: E4

Scale: 1:2,667,920

