PRELIMINARY DRAFT ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENTAL APPENDICES D-1 AND D-2

APPENDIX D-1
Data Source Selection Process for Catch, Revenue, and Protected Resources

Goal

Select data source time frame(s) for the EFH openings and closures and RCA reopenings that will provide the best balance between spatial coverage (i.e., coastwide vs something more limited), representativeness of fishing behavior (past effort, catch, and revenue) of groundfish bottom trawl vessels, and robust observer data with protected species information. This information will assist the Team to qualitatively assess impacts of each alternative under Amendment 28. The data sets selected need to be comprehensive for the Team to analyze impacts to fish resources, economic impacts, and impacts to protected species.

Data Source Selected

The Team decided to use two base periods for the analysis: 1997-2001 and 2011-2014. Table 1 provides the data sets used when analyzing each alternative. In our decision to use these data sets, we considered the pre and post disaster time periods, implementation of regulatory prohibition of roller gear, drastic declines in trip limits, available observer data, logbook completeness, if logbooks contained both start and end point locations, and summarizing trawl effort. We also provide state-managed data sources we used for the impact analysis.

Data Source Time Periods We Considered

The Team evaluated several possible time periods to analyze:

1. 1994-1998 (5 years) - GAP recommendation; Advantage is that it was prior to the disaster declaration. Disadvantage is that the fishery used large roller gear and operated under a very different regulatory scenario.
2. 1997-2001 (5 years) – Advantage is prior to both RCA and EFH implementation, includes years with roller gear (i.e., 1998, 1999), and includes three years pre-disaster and two years post-disaster. Disadvantage is it doesn't reflect effort in southern areas south of 36 degrees.
3. 1994-2001 (8 years) – Advantage covers entire time period and is more robust data set, is coast wide information (including areas south of 36 degrees). Disadvantage is that it does not contain start and end point tow locations from 1994 to 1996 and single point estimates for tow locations limits spatial confidence.
4. 2000-2001 (2 years) – Advantage is that it uses the most recent years prior to RCA and EFH implementation, includes the highest level of complete tows (set/up points), is post-disaster, and the fishery did not use roller gear. Disadvantage is that it is only two years of data and no observer coverage data.
5. 2002-2005 (4 years) – Advantage is that it contains more recent data for EFH areas proposed to be opened outside RCA, observers are present on trips (approx. 10 -15% coverage). Disadvantage that it does not provide data for areas inside the RCA and less comprehensive observer coverage for protected species.

6. 2011-2014 (4 years) – Advantage is that it is the most recent observer data for EFH areas outside the RCA that are proposed to be closed, and provides basic fishery information for No Action description. 100% observer coverage provides most comprehensive info for protected species. Disadvantage that it does not provide data for areas inside the RCA or EFHCAs.

Table 1. Summary of Commercial Trawl Data Sources for Analysis of EFH and RCA Alternatives. Note: Data used in our analysis are logbook tow locations (starting point location only), logbook tow duration in hours trawled, landings on fish tickets, 2015 inflation-adjusted ex-vessel values, and WCGOP protected species interaction data. All data is from either PacFIN or NMFS West Groundfish Observer Program.

Alternative	Data Sources
Subject Area 1: EFH Conservation Areas Alternatives	
No Action - (Maintain 2015 Trawl RCA and Maintain Closed Areas - EFHCAs, CCA, all other BTCs)	Logbook records and fish ticket data 2011-2014[1]
Alt 1a through 1f	
● For New EFH Closures Outside RCA	Logbook records and fish ticket data 2011-2014
● For EFH Areas to be Reopened Outside RCA	Logbook records and fish ticket data 1997 - 2001
● For New EFH Closures Inside RCA[2]	Chapter 4: No Analysis since RCA is closed Chapter 5: Conduct integrated analysis with Logbook and Fish Tickets data 1997 - 2001
● For EFH Areas to be Reopened Inside RCA[2]	Chapter 4: No Analysis since RCA is closed Chapter 5: Conduct integrated analysis with Logbook and Fish Tickets data 1997 - 2001
Alt 1g New EFHCAs within the RCA based on Priority Habitats (WA only)	Logbook records and fish ticket data 1997 – 2001
Subject Area 2:Trawl RCA Alternatives	
No Action – (Maintain 2015 Trawl RCA and Maintain Closed Areas - EFHCAs, CCA, all other BTCs)	Logbook records and fish ticket data 2011-2014[1]
2a. Eliminate RCA	Logbook records and fish ticket data 1997 – 2001
<u>Discrete Area Closures</u> **2b. Remove RCA and Implement DAC (Washington only)**	Logbook records and fish ticket data 2011-2014 for areas outside RCA; Logbook records and fish ticket data 1997 - 2001 for areas inside RCA
<u>Block Area Closures</u> **2c. Remove RCA and Implement BAC**	Logbook records and fish ticket data 2011-2014 for areas outside RCA; Logbook records and fish ticket data 1997 - 2001 for areas inside RCA

[1] Tribal fishery data inside the U&A is included under the No Action data set; when calculating percentage of coastwide the denominator includes No Action data.

[2] For the Chapter 4 analysis of proposed EFH areas to be closed or opened inside the RCA we assume the RCA remains intact and fishing activity is still prohibited. Therefore, the Chapter 4 analysis will assume there is no impact on the ex-vessel revenue or catch within the RCA. Under the Chapter 5 analysis, we qualitatively discuss the integrated effect of making EFH changes and RCA changes at the same time.

Pre and Post Disaster Data, Regulatory Actions Information, & Observer Data Availability

Inclusion of pre disaster time-period in the 1997-2001 data set would increase the available data for inside the RCA and prior to implementation of EFHCAs. We considered that the trip limits were larger in that time period and that fishing on the continental shelf would be included. By including this information, we would expect specific fishing grounds for economically important species to be revealed on a map to provide past fishing patterns and inform a qualitative analysis of relative importance of areas inside the RCA or EFHCAs that are proposed to be opened or closed. This allows us to summarize past effort in light of potential future fishing grounds.

In the past there were major regulatory changes and milestones in the groundfish fishery that influence our choice of years (Table 2). The fishing footprint is larger from 1997 to 2001 because large roller gear was allowed from 1997-1999 (i.e., provides greater access to rocky areas), we used this data set to qualitatively examine the extent of the fishery and where vessels may return if access is granted in the future with large roller gear. This will provide context to areas that may be fished inside the RCA and under the proposed EFHCA openings where this gear is allowed. We also wanted to use data that includes the prohibition of roller gear (2000-2001) to incorporate data that reflects the fleet's response and area of operation under the new regulations. We also considered picking a historical period of years that have regulations similar to current gear regulations (prohibition of roller gear); however, this would truncate the time period for the analysis to only 2000-2001. This data set was not robust for the analysis. Data sets

Table 2. Regulatory Milestones, 1994 – 2006.

Year	Regulatory Milestone
1994	Limited entry permits issued
1999	Bocaccio, lingcod, and Pacific ocean perch declared overfished
2000	Groundfish disaster declaration Regulations define small and large footrope, effectively prohibiting use of large roller gear (>19 inches). Trip limits became gear specific
2002	WCGOP begins observations in the trawl fishery Coastwide RCA implemented Trip limits become area specific (e.g., shoreward RCA, seaward RCA) Large footrope prohibited shoreward of the RCA
2003	Trawl buyback program implemented, fleet reduced by 1/3
2004	Vessel Monitoring System implemented
2005	Selective flatfish trawl gear required shoreward of the RCA, north of 40°10′ N. lat
2006	EFHCAs implemented

In our decision to use 2011 to 2014 data, we looked for data that would best represent the No Action alternative yet include comprehensive observer coverage data (100% monitoring) to assess protected species impacts. More recent fish ticket information for 2015 was available at the time of our analysis; however, the WCGOP data set for protected species observations were only available through 2014. Therefore, we truncated the fish ticket data set to 2014 to reflect this. We believe this data set reflects what is currently happening in the bottom trawl fishery and is the most recent available information to assess proposed closures outside the RCA and represent protected species interactions under the No Action alternative.

In our decision to use 2011 to 2014 and 1997-2001, we looked for the most comprehensive data sets that would represent best available information coastwide for each time period to summarize fishery landings and effort, and analyze where the fishery may target economically important species if the areas were opened. A GIS plot shows different catch densities along the coast in major time periods Figure 1. Pre 1998 data represents coastwide activity best and has the greatest spatial coverage, particularly south of 40°10´. Current IFQ spatial coverage south of 40°10´ is greater than in the 1998-2001 (or 2000-2001) time period.

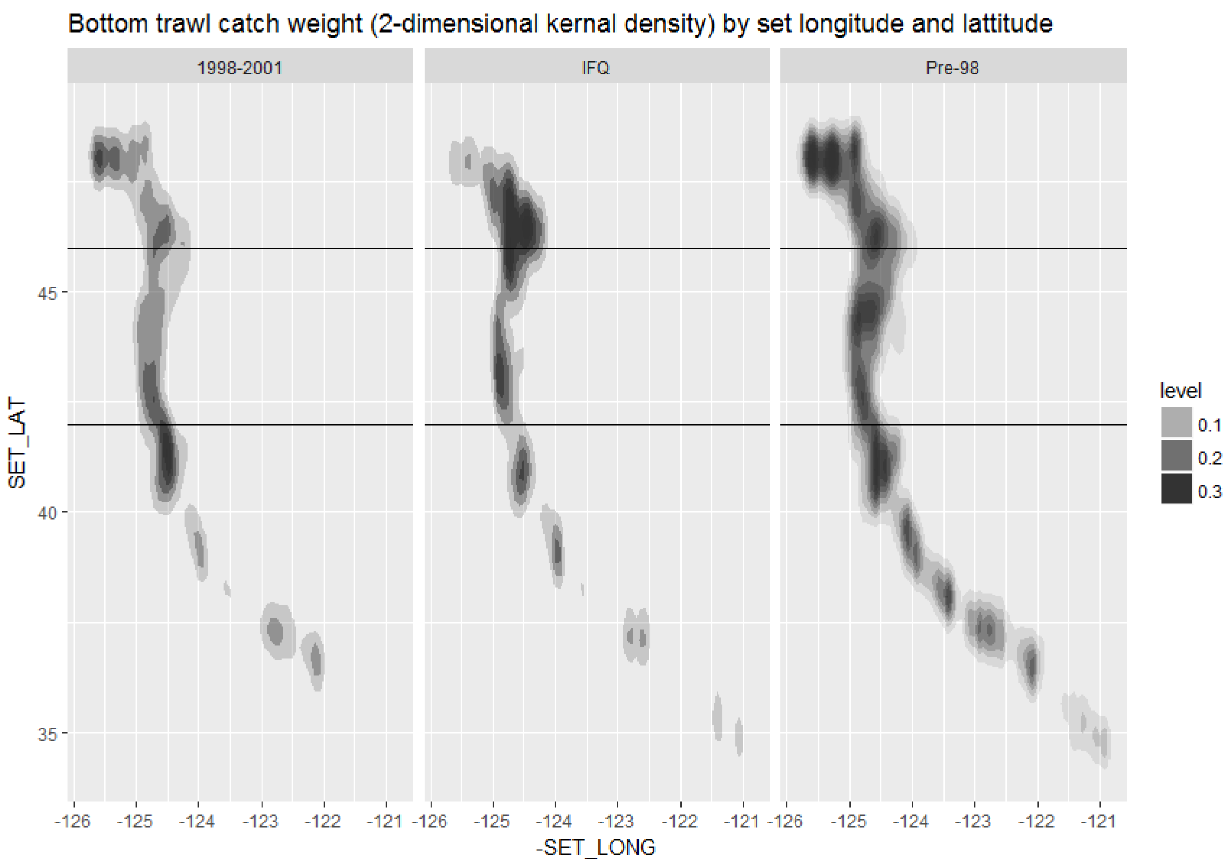

Figure 1. Bottom trawl catch density along West Coast for major time periods.

We considered picking years that have the greatest spatial coverage to provide the most information about the potential for catch to be restored. For example, from 1998-2001 there was less effort south of 36 degrees than from 1994-1998. If we use data from 1997-2001 we will have little to say about the restored catch south of 36 degrees. However, trawling effort south of 36 degrees has been less frequent since 1998. Data after 1997 may better inform our analysis of the alternatives when discussing areas that the fishery may return to if they are opened, or areas that may no longer be available their relative importance to the fishery. Therefore, we chose 1997-2001 rather than 1994-1998.

Logbook Completeness and Matching Fish Ticket Analysis

We evaluated completeness of logbook reporting. Specifically we examined whether all trips had matching fish tickets and if logbooks included both start and end points. Our goal was to choose the years in which completeness for these two criteria was highest (i.e., most representative of the fleet).

Regarding fish ticket and logbook completeness, the Team explored how many fish tickets have matching logbooks, those that do not have matches, and those that have matches but have discrepancies from 1998 to 2006. Figure 1 shows an increase in the percentage of fish tickets that match. In all time periods the matches are greater than 73%, with recent years (2004-2006) greater than 80%. There's no difference between 1998-2001 (avg. 18%) and 2000-2001 (avg. 18%). EFH closures were implemented in mid-2006, as such some analysis truncates the data to 2006. We concluded that completeness is not a factor in selecting one of these time periods over another.

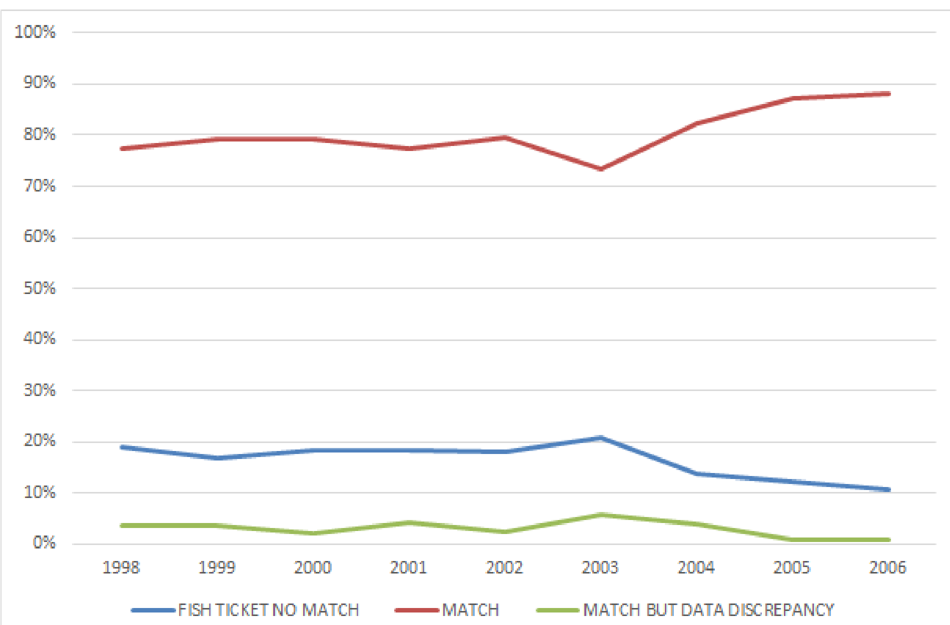

Figure 1. Percentage of matching logbooks and fish tickets, 1998 to 2006.

Start and End Point Logbook Analysis

When selecting logbook data for the analysis, the Team wanted to ensure that both time periods selected (1997-2001 and 2011-2014) had similar tow location data (both start and end points). The Team assumed that logbook data included both start and end points for both data sets and it could assign catch to tows. However, we discovered that earlier time periods lacked end point locations (Table 3). Therefore, the Team decided to use only set point location data for both time periods and assigned catch (logbook adjusted fish ticket data) to each start tow point.

Prior to 2000, many logbooks had start points but did not include end points. Washington logbooks began including end points in 2000. Oregon logbooks included end points after 1999, and California after 1997 (Table 3). The Team also looked for the percentage of fish tickets that matched with logbooks but either had no spatial data, no end point, or included both start and end point to gauge completeness of the data set.

Table 3. Historical bottom trawl logbook spatial data completeness/coverage, as a percentage of landed metric tons of (dahl-sector 4 bottom trawl) groundfish by agency and year, 1994-2001[3].

State	Year	Percent of fish tickets with no logbook spatial data	Percent fish tickets with no haul end point spatial data	Percent fish tickets with both start and end spatial data
CA	1994	2%	98%	0%
	1995	1%	99%	0%
	1996	2%	98%	0%
	1997	2%	0%	98%
	1998	3%	1%	96%
	1999	3%	1%	96%

[3] Code for selecting groundfish tows and fish tickets from PacFIN: select landing_year, ft.AGENCY_CODE, case when set_lat between 32.6 and 49 and set_long>117 then 'SetPoint' else 'NoSet' end as SETPOINT, case when up_lat between 32.6 and 49 and up_long>117 then 'UpPoint' else 'NoUp' end as UPOINT,sum(ft.EXVESSEL_REVENUE) REV, sum(ft.ROUND_WEIGHT_MTONS) MTONS, sum(tow.DURATION) HOURS from PACFIN_MARTS.COMPREHENSIVE_FT ft left join pacfin.lbk_ftid lb on lb.TICKET_DATE=ft.LANDING_DATE and ft.AGENCY_CODE=lb.AGID and lb.FTID=ft.ftid left join pacfin.lbk_tow tow
on tow.TRIP_ID=lb.TRIP_ID and tow.AGID=lb.AGID where ft.DAHL_GROUNDFISH_CODE='04' and ft.PACFIN_GEAR_CODE<>'MDT' and landing_year<2002 group by landing_year, ft.AGENCY_CODE, case when set_lat between 32.6 and 49 and set_long>117 then 'SetPoint' else 'NoSet' end, case when up_lat between 32.6 and 49 and up_long>117 then 'UpPoint' else 'NoUp' end

State	Year	Percent of fish tickets with no logbook spatial data	Percent fish tickets with no haul end point spatial data	Percent fish tickets with both start and end spatial data
	2000	3%	2%	95%
	2001	4%	0%	96%
OR	1994	7%	93%	0%
	1995	10%	90%	0%
	1996	13%	87%	0%
	1997	4%	96%	0%
	1998	1%	99%	0%
	1999	0%	14%	85%
	2000	0%	16%	84%
	2001	0%	8%	92%
WA	1994	0%	100%	0%
	1995	0%	100%	0%
	1996	0%	100%	0%
	1997	1%	99%	0%
	1998	0%	100%	0%
	1999	0%	100%	0%
	2000	0%	3%	97%
	2001	0%	3%	97%

The discovery that end points were missing for the earlier time periods (prior to 2000 for WA, prior to 1999 for OR, and prior to 1997 for CA) prompted the Team to consider how to assign the catch and revenue data from those hauls to a tow location for our analysis. The Team also wanted the earlier time period data set to be consistent with the 2011- 2014 data set.

The Team considered several options to develop end points for the missing data so that data could be used to proportionally assign catch throughout the tow path (i.e., catch inside and outside a closed area could be assigned throughout the tow path based on the amount of the tow inside and outside the area proposed to be opened or closed). The Team considered the following options to develop missing end points or assign catch:

- Derive tow path based on bathymetry - Preliminary analysis in CA by SWFSC shows tows follow bathymetry contours
- Use circle approach, assumes equal prob. of catch - Most likely overestimates the area from which the catch was taken, less certainty about how much of the tow occurred in the polygon
- Use circle approach with kernel density idea - Same as above
- Estimate the missing end points - Look at historical data and determine the direction that the majority of the tows go after being set (e.g., north), assume all tows went that direction

After careful consideration of these methods, the Team decided that the uncertainty added to the data and the added effort by the Team to develop one of these methods did not add enough benefits to the overall analysis.

Therefore, the Team considered several approaches to address the uncertainty in using only a start point location:

1. Make an educated guess about which tow direction was most likely, and use an average tow length to estimate the area from which the catch came;
2. Buffer the points by drawing a circle around each start point and apportion the catch where the circle intersects a polygon;
3. Follow the depth contours based on the depth at the starting point of the tow;
4. Buffer the polygons themselves by one, two, or three miles, and include any points that fall within that buffer; and
5. Use only the starting points, recognizing that some may fall just inside a polygon while some may fall just outside a polygon.

The Team considered the five approaches above, and agreed that #5 above was the best option. This approach assumes that with thousands of data points over the two time periods (167,504 tows), that location bias and the assignment of catch, revenue and protected species interactions to a single point will largely balance each other out. We were not able to examine the data set for bias. The other four approaches would require significant amounts of work, and are very speculative in approach.

Trawl Effort Information

Since the available logbook data sets are limited to start points, trawl effort is defined as the total hours of trawl tows rather than miles towed. Total hours trawled are summarized for proposed closures or reopenings in the habitat, fish resources sections. Trawl effort in the proposed closures would be displaced, as it is assumed that the fishery would shift to other areas, and trawl effort in the proposed reopenings would be restored.

Predicting the effort that would be restored by the reopenings or displaced by closings is very difficult because of the limitations and availability of data, and changes to the fishery that have occurred since the EFHCAs and trawl RCAs were first implemented, in particular the catch shares program. Therefore, we cannot quantify the amount of trawl hours that may be shifted to other areas as a result of proposed closures and openings. The total hours can only provide the past and recent effort in an area to help show the relative importance of an area and the past and present impact to habitats in the area.

State-Managed Fisheries Data Source

Pink shrimp, California halibut, ridgeback prawn, and sea cucumber trawl are bottom trawl fisheries; therefore, the Team needed to qualitatively analyze the impacts of the alternatives. The Team worked with NMFS and state representatives in California to gather information about where these fisheries operate. The pink shrimp fishery operates coastwide; therefore, a trawl footprint created by NMFS was provided to the Team to examine overlap of the area of operation for the fishery and proposed EFH closures and openings (data is for years 2009-2013). Similarly, CDFW provided recent fishery operations info for California halibut, ridgeback prawn, and sea cucumber trawling to show where these fisheries are operating in state and federal waters off California (data is for years 2011-2017). Again, we analyzed the overlap of these fisheries and proposed EFH closures and openings. No revenue information was used because we were are not able to assign catch and revenue at a fine enough scale to inform an analysis.

APPPENDIX D-2
Discrete Area Closure Methodology/Hotspot Analysis

At the November, 2016 Council meeting the EFH/RCA project team presented a team report regarding the method for development of draft discrete area closures (DAC) for overfished species in the Council's groundfish fishery management plan to support the Amendment 28 analysis. During the November meeting, the Council refined the range of alternatives by eliminating consideration of DACs off the coasts of Oregon and California and recommended further analysis of DACs off the coast of Washington outside of the Tribal U & A.

During this meeting, Council staff also presented the analysis to the SSC showing the method and results for identifying DACs. The SSC rejected the method because the statistical algorithm utilized by the ArcGIS "hot spot" tool properties and analysis were not fully understood (Agenda Item F.4.b, Supplemental SSC Report, November 2016). The SSC recommended using the results of habitat suitability probability (HSP) modeling or a geostatistical hurdle approach such as that developed by Dr. Jim Thorson to identify hot spots.

This section documents the final methodology used to develop the DACs off Washington. The Project Team used two models developed by the Northwest Fisheries Science Center (NWFSC) and by the National Centers for Coastal Ocean Science (NCCOS). Both models are more recent than the HSP, and incorporate more recent data. Both the NWFSC and NCCOS models are based on fisheries independent survey data. The NCCOS uses exclusively data from the NWFSC trawl survey while the NWFSC incorporated data from the trawl survey and some visual submersible surveys. Both approaches use spatial regression approaches and habitat variables to explain both the occurrence and abundance of each species, to generate areas of high probability of occurrence, for darkblotched rockfish, Pacific Ocean perch, and yelloweye rockfish. Cowcod and bocaccio are not included, as they are not found in waters off the Washington coast. Darkblotched and yelloweye rockfish probabilities are based on NWFSC model results, while Pacific Ocean perch probabilities are results of NCCOS model. Hot spots identified from fishery-dependent and independent data are overlaid on this model for reference (Figure 1). Additional details are described in pages 75-119 of the NMFS Synthesis Report (Agenda Item D.6.b, NMFS Report, April 2013).

Grid cells in Figure 1 representing yelloweye rockfish occurrence greater than 0.25 are few and dispersed. This is a result of infrequent catches in trawl survey catches and renders estimates based on probability of occurrence (PO) and hotspot identification unreliable. As also indicated in Figure 1, there is little correlation between yelloweye rockfish PO and hot spots identified from catch data. It is also worth noting that yelloweye rockfish occurrences based on PO greater than 0.25 do not correlate well with current RCA closures.

By contrast, modeling PO for darkblotched rockfish (Figure 2) results in a wide band of occurrences greater than 0.25 and there is a strong correlation between occurrences and increasing depth. Pacific Ocean perch is intermediate in terms of the number and clustering of grid cells with probabilities greater than 0.25 (Figure 1). These grid cells overlap with the two overlapping hotspots for Pacific Ocean perch and darkblotched just north of 46°30´ N. latitude.

Because there is an intermediate level of numbers and grouping of Pacific Ocean perch, the identification of DACs could be reasonably considered. For illustrative purposes, Figure 3 shows an example of DACs identified to encompass Pacific ocean perch, Yelloweye rockfish, and darkblotched rockfish clusters relative to PO greater than 0.25. In addition, Figure 3 shows the PO of 80 percent of the maximum for darkblotched rockfish. The DACs in Figure 3 were created empirically, based on the overlap of the results.

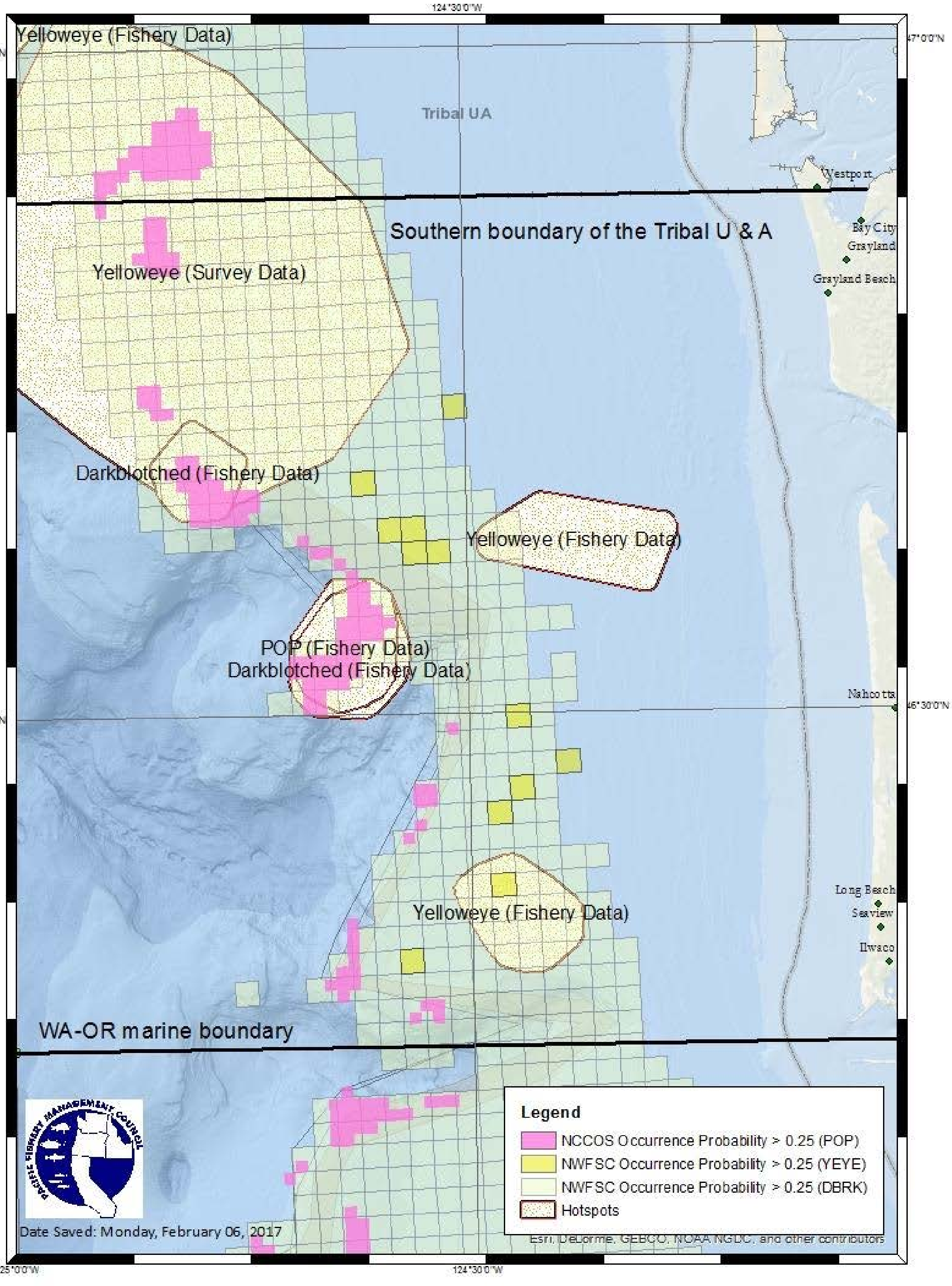

Figure 1. Comparison of hotspots identified from catch data to habitat suitability probability results.

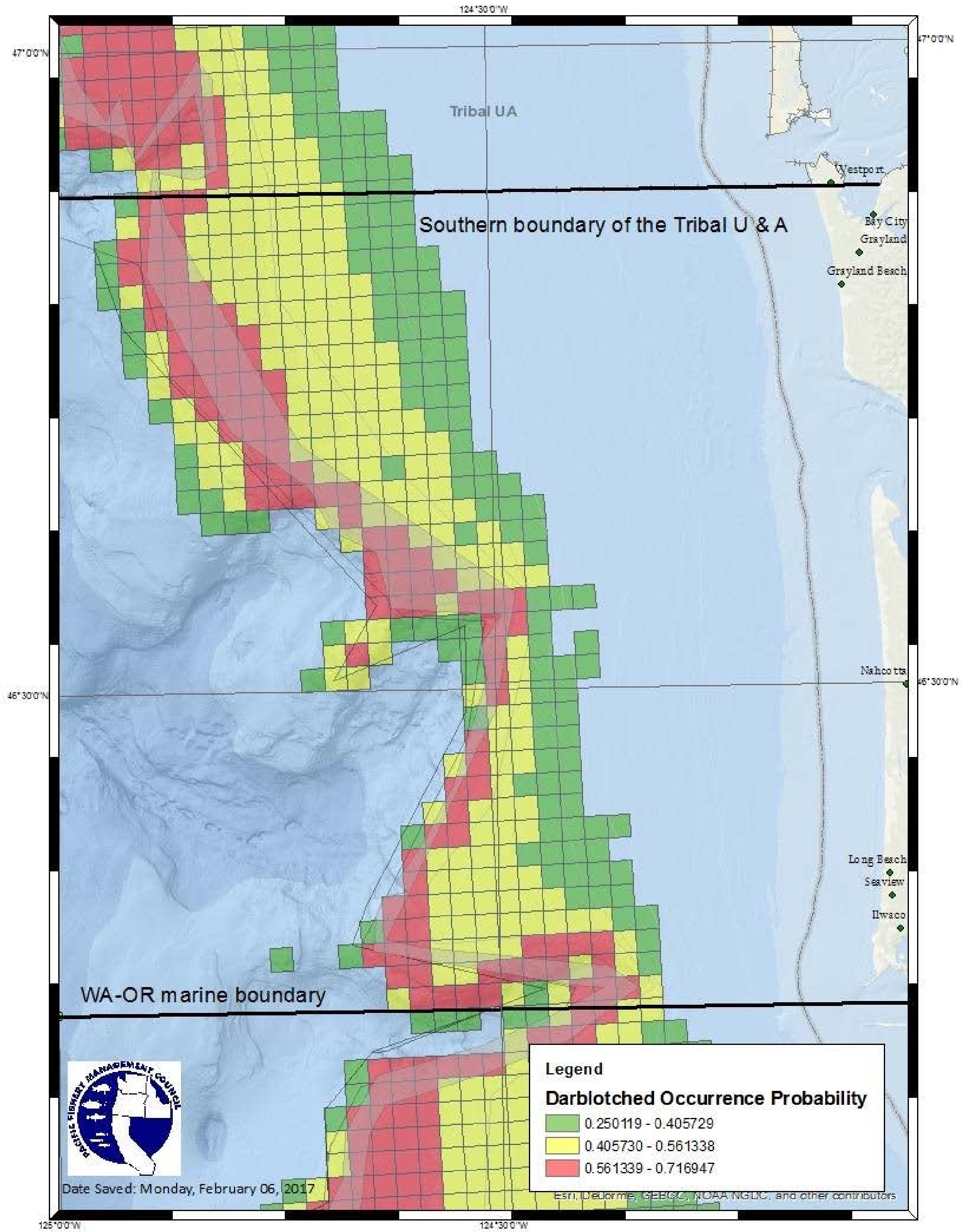

Figure 2. Darkblotched rockfish probability of occurrence with grid cells >0.25 binned in three equal intervals, data is based on NWFSC data.

Final DACs were developed by drawing lines along grids cells that would be straight to develop lat/long coordinates that are enforceable (Figure 3). To do this we examined the general overlap between HSP data and available fishery dependent (catch data) or independent data (trawl survey data) to pinpoint areas that had the best correlation. As noted in Figure 1, there are areas that the yelloweye rockfish HSP data do not align with trawl survey and fishery independent data. In this case, we used HSP data to develop one of the DACs since fishery independent data was in close proximity to the HSP grid cells.

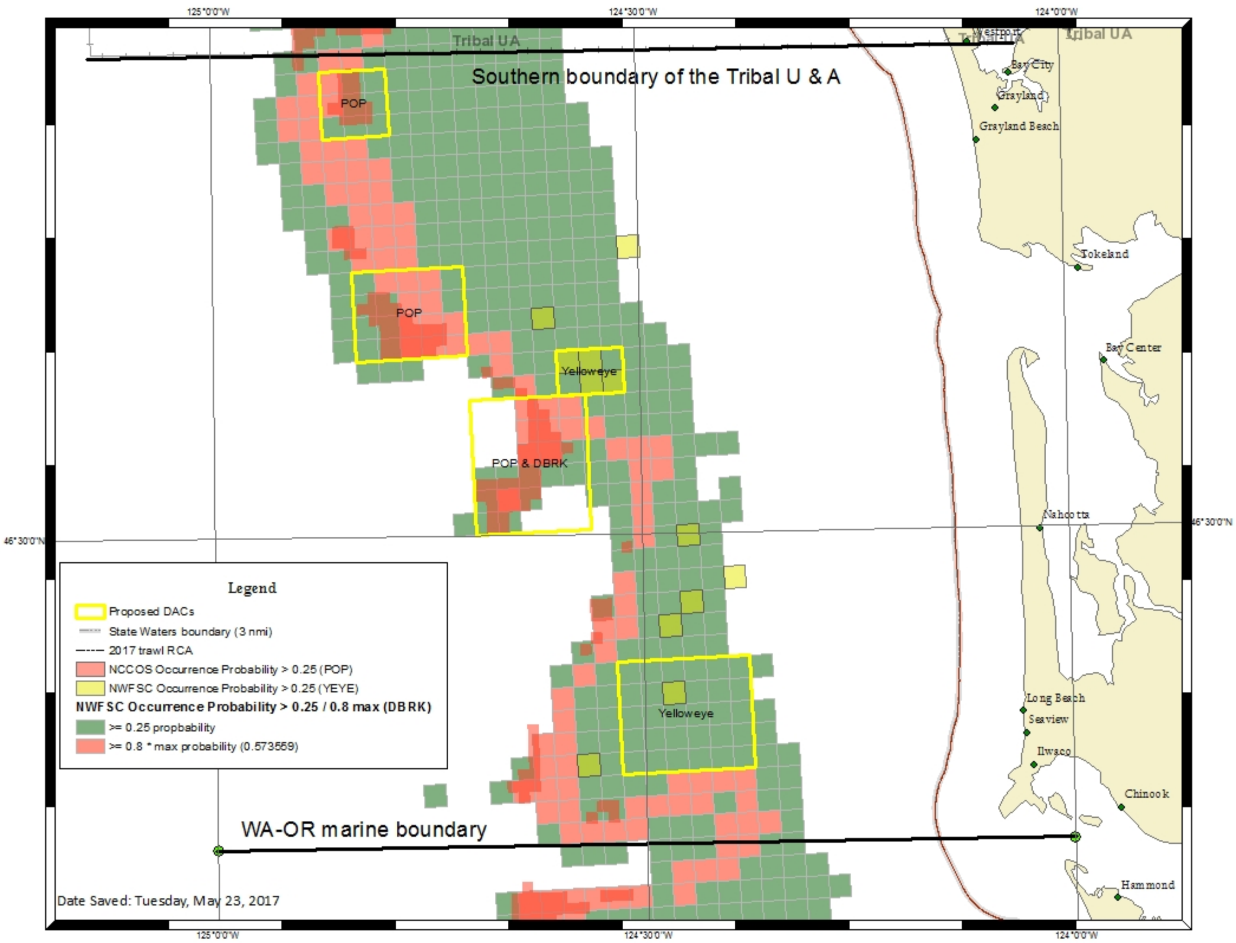

Figure 3. Final DACs used for the Amendment 28 analysis.