

Methodology for estimating catch, revenue, and effort for Pacific Coast groundfish bottom trawl EFH and RCA areas

1 BACKGROUND

The Pacific Fishery Management Council (Council) began a periodic review of groundfish essential fish habitat (EFH) in 2010, as required by the NMFS regulatory guidance (50 CFR 600.815). In 2013, the Council issued a request for proposals for potential changes to the EFH provisions of the groundfish Fishery Management Plan (FMP). Concurrently, the Council began a process to reevaluate the trawl rockfish conservation area (RCA) after the 2011 implementation of the catch share system. At its September 2014 meeting, the Council opted to combine the EFH revisions and trawl RCA adjustments into a single fishery management plan (FMP) amendment. The Council established the scope of the action at its April 2015 meeting, and adopted a preliminary range of alternatives at its September 2015 meeting. In 2016, the Council selected a set of alternatives for further analysis and identified some as preliminary preferred alternatives. The Council is scheduled to select their final preferred alternatives in June 2017.

The EFH/RCA Project Team is working to assess the impacts of the Council’s range of alternatives, including an estimation of socioeconomic impacts, and requests guidance from the Scientific and Statistical Committee’s Economic Subcommittee. This document contains a description of the current set of alternatives, a proposed methodology to assess impacts, a description of the data that are being used to estimate revenue, catch, and effort, and concerns regarding data limitations.

2 EFH AND RCA ALTERNATIVES

Amendment 28 proposes to:

- 1) Revise the current bottom trawl EFH Conservation Areas¹ (EFHCAs), using updated information, to minimize adverse effects of fishing on EFH; and
- 2) Modify the groundfish trawl RCA to provide greater access to target species while continuing to minimize catch of overfished groundfish species and other non-groundfish species.

The proposed alternatives are described in this section, and summarized in Table 1.

¹ EFHCAs are distinct areas of restricted fishing activities. Some EFHCAs are closed to all bottom contact fishing, and some are closed only to bottom trawling. Amendment 28 only considers modifications to those EFHCAs that are closed to bottom trawling.

Table 1. Summary of EFH and RCA alternatives as revised per the November 2016 meeting and Council action. Only subject Areas 1 through 3 are listed.²

Subject Area	Alternatives						
1. EFHCA changes (re-openings and new closures)	1.a No Action <i>(PPA for WA)</i>	1.b Collaborative	1.c Oceana, et al. (with modifications in SoCal bight, in F4b sup CDFW report)	1.d MTC (pg 32) : 1. Nehalem bank/shale pile 2. Popcorn 3. Garibaldi reef 4. Stonewall bank 5. Daisy bank/Nelson isl (as modified by GAP) 6. Heceta bank (as modified by GAP)	1.e Garibaldi reef South (from “None” in F4a Project Team Report appendix table F4-a)	1.f Rittenburg bank modifications in NMS report	1.g Potato Bank correction
2. New EFHCAs within current RCAs (WA only)	2.a No Action	2.b Add new EFHCAs within the trawl RCA based on presence of priority habitats <i>(WA only)</i>					
3. Adjustments to Trawl RCA	3.a No Action <i>(PPA for WA)</i>	3.b Remove the Trawl RCA (PPA for OR&CA)	3.c Remove Trawl RCA and Implement Discrete area closures for overfished species <i>(WA only)</i>	3.d Remove Trawl RCA and Implement Block area closures for overfished species and non-overfished species (PPA for OR&CA)			

² The project team has developed an interactive website to view the EFH proposals; however, EFH items 1.d through 1.g, and the RCA alternatives have not yet been added to the interactive map. The mapping tool allows the user to see the habitat data for the proposed EFHCAs that are proposed to be closed or opened. The interactive web tool is at <http://www.soundgis.com/efh/efh2016-metrics/>, and the video tutorial for how to use the web tool is at <https://youtu.be/pglUTca-tVw>

2.1.1 Subject Area 1 - EFHCA changes (re-openings and new closures)

2.1.1.1 *Alternative 1a: No Action*

The no action alternative would maintain the current EFHCAs that prohibit bottom trawling. There are 34 EFHCAs that are included in the scope of Amendment 28 that are closed to bottom trawling but allow other types of bottom contact gear. There are 18 other EFHCAs that are not in the scope of amendment 28 and are therefore not included in the description of No Action. See link for map: http://www.pcouncil.org/wp-content/uploads/2016/10/Fig1_EFHCAs.pdf

2.1.1.2 *Alternative 1b: Collaborative Group Proposal*

The Collaborative proposal includes proposed adjustments (both reopenings and closures) to several existing EFHCAs, as well a number of new stand-alone closures. In all, there are 43 proposed closed areas and 16 proposed reopened areas. In addition, the proposal recommends removing the RCA. See link for map: http://www.pcouncil.org/wp-content/uploads/2016/10/Fig2_Collaborative_1page_ptr_3panel.png.

2.1.1.3 *Alternative 1c: Oceana et al Proposal*

This coastwide alternative includes a total of 61 proposed closures and 7 proposed re-openings. The proposal does not include a recommendation regarding modification of the trawl RCA; however the proposals included consideration of future RCA modifications when they identified proposed EFHCA changes. See link for map: http://www.pcouncil.org/wp-content/uploads/2016/10/Fig3_Oceana_1page_ptr_3panel.png

2.1.1.4 *New Alternatives 1.d through 1.g*

New alternatives were added subsequent to the November 2016, reflecting Council decisions to include consideration of several discrete EFHCAs in the suite of alternatives. Links for maps and other information regarding these proposals are included in Table 1 above.

2.1.2 Subject Area 2. New EFHCAs within the current trawl RCA (Washington Only)

2.1.2.1 *Alternative 2a: No Action*

This alternative would not establish any new areas closed to bottom trawling for the purposes of protecting EFH within the current trawl RCA based on the presence of priority habitats. Several current EFHCAs overlap with the trawl RCA, and those EFHCAs would also remain in place, unless modified by Council action. This alternative is not mutually exclusive with Alternatives 1b (Collaborative) and 1c (Oceana et al.), each of which contain EFHCAs within the trawl RCA.

2.1.2.2 *Alternative 2b: Add new EFHCAs within the trawl RCA based on presence of priority habitats (Washington only)*

This alternative only applies to areas off Washington, outside of Tribal UAs. It would identify new EFHCAs inside the boundaries of the 2015 trawl RCA, in areas where priority habitats are present. Alternative 2b is not mutually exclusive with Alternatives 1b (Collaborative) and 1c (Oceana et al.), each of which contain EFHCAs within the trawl RCA. See link for map however only the area off Washington would be adoptable by the Council for implementation:

http://www.pcouncil.org/wp-content/uploads/2016/10/Fig4_PriorityHabs_1page_ptr_3panel1.png

2.1.3 Subject Area 3. Adjustments to the trawl RCA

Vessels that are subject to trawl RCA restrictions may not fish in the trawl RCA, or operate in the trawl RCA for any purpose other than transiting. Trawl RCA boundaries are set primarily to minimize incidental catch of overfished rockfish by eliminating fishing in areas where, and times when, those overfished species are likely to co-occur with healthier target stocks of groundfish. The action being considered here would modify the trawl RCA and modify areas where vessels using groundfish bottom trawl gear can fish.

2.1.3.1 Alternative 3a: No Action

Under the No Action alternative, the trawl RCA configuration would remain as it was in 2015. There would be no changes to the 2015 trawl RCA boundaries aside from routine inseason adjustments available to reduce catch of a particular species or species complex while maximizing catch of target species.

2.1.3.2 Alternative 3b: Remove the Trawl RCA

The first action alternative (3b) would eliminate the entire trawl RCA south of the Tribal U&A, thereby allowing bottom trawling to take place in areas within the current trawl RCA that are not otherwise closed to fishing. For example, EFHCAs that are within the current trawl RCA would not be reopened to bottom trawling through this alternative.

2.1.3.3 Alternative 3c: Remove the Trawl RCA, but Close Discrete Areas to Protect Overfished Groundfish Species (Washington Only)

Under this alternative the trawl RCA would be removed off Washington in areas south of the Tribal U&As to the Washington/Oregon border, and discrete area closures (based on potential catch of overfished species) would be available either pre-season or in-season to be implement as needed. A map of the discrete area closures originally proposed under this alternative can be found at http://www.pcouncil.org/wp-content/uploads/2016/10/Fig5_DAC_1page_ptr_3panel.png. The Project Team is reevaluating the methodology for generating the closures based on feedback at the November Council meeting. The SSC provided comments in its supplemental report ([Agenda Item F.4.b, Supplemental SSC Report](#), November 2016).

2.1.3.4 Alternative 3d: Remove the Trawl RCA, but Establish Block Area Closures to Protect Overfished Species (Groundfish and Non-Groundfish)

Under alternative 3d, the trawl RCA south of the Tribal U&A would be removed and the fishing area off the West Coast out to 700 fm would be divided into a grid of 20 separate areas, using depth contours and existing latitude coordinates in regulation. These areas, referred to as block area closures (BACs), could be implemented pre-season or in-season to reduce catch of a particular species or species complex, while maximizing target species catch. At the time of a closure, a single block, multiple blocks, part of a block, or all 20 blocks would be available to close, depending on the issue and conservation need. See link for map: http://www.pcouncil.org/wp-content/uploads/2016/10/Fig6_BAC_1page_ptr_3panel.png.

2.1.4 Affected Fisheries

Bottom trawl gear is used in the limited entry (LE) trawl fishery under the Shorebased IFQ program (catch share program). The gear is also used in several state-managed fisheries that operate in federal waters (called non-groundfish trawl vessels) and include California halibut,

pink shrimp, ridgeback prawn, spot prawn, and sea cucumber. Groundfish and non-groundfish bottom trawl fisheries currently operating in areas proposed to be closed by EFHCAs could be negatively impacted. Conversely, reopening of EFHCAs may allow increased access to fishing grounds for groundfish and non-groundfish bottom trawl vessels.

The Project Team is working to gather logbook and fish ticket information to assess the impacts on state-managed fisheries. At this time, we have excluded the data for these fisheries from our analysis until we can obtain enough information to quantitatively and qualitatively examine the impacts.

3 METHODS

PROCESS FOR ANALYZING ALTERNATIVES

The EFH/RCA Project Team developed the following approach to assess potential socioeconomic impacts of the spatial management changes on harvesters and fishing communities.

The Council requested that the Project Team initially focus on developing an impact analysis for each Subject Area as shown in Table 1, to allow the Council, if desired, to recommend implementation of an alternative from only one Subject Area. For example, the Council could choose to recommend implementation of an EFH alternative and choose not to modify the trawl RCA. Therefore, we will assess impacts from RCA and EFH alternatives independently, examining the impacts of each Subject Area and its respective alternatives without consideration of alternatives for other Subject Areas.

However, the Council may choose to implement a set of alternatives from each Subject Area. Therefore, we will also discuss the integrated effects of making EFH changes and RCA changes at the same time. Recognizing the many potential combinations, we will not attempt to assess all possible permutations of openings and closures of individual areas across alternatives. Instead, we will analyze the effects of the EFHCA alternatives (Subject Areas 1 and 2) against a scenario of complete removal of the trawl RCA. This will allow the Council to view the integrated effects of potential changes to both EFHCAs and the trawl RCA.

3.1.1 Qualitative Methodology Informed by a Quantitative Indicators

We propose a primarily qualitative methodology to examine impacts to fishery participants, informed by snapshot estimations of historical and IFQ catch, ex-vessel revenues, and fishing effort (measured in tow miles) in areas affected by each alternative. The analysis will start with a qualitative discussion about how individuals, ports, the bottom trawl sector, and businesses may be impacted by implementation of RCA and EFH alternatives, including an examination of potential behavioral responses. We will include changes in geographic distributions of fishing effort over baseline and current periods, and catch weight to indicate the relative importance of

various fishing grounds, but can only speculate about spatial adjustments by the fleet in response to the management change.

The Project Team cannot quantify (e.g., via a projection model) future catch, revenue, or effort under each alternative, or quantify compensatory spatial shifts in effort. Since the fleet size has been reduced, vessel harvest rates and efficiencies have changed, and fishery regulations have altered participation, effort, and areas fished, the Project Team thinks that there isn't sufficient data to develop predictive models. In addition, it's likely that any models that are based on the data we have would be misleading.

Vessel operators and owners are likely to experience negative and positive impacts from being forced to shift effort away from recent fishing grounds, particularly as 100 percent observer coverage mandates increase variable costs associated with time on the water, fuel costs change, the implementation of electronic monitoring to lower costs, and other variable expenses. The Project Team does not have either the data or an appropriate model to quantify net impacts. Instead, we describe only the levels of effort, catch, and revenue using observer data from the 2011-2014 fishery in areas proposed closed, and use logbook records to estimate effort, catch, and revenue in the 1998-2001 and 2002-2005 periods. The use of the spatial data and the time period is dependent on whether we are discussing RCA changes or EFH changes and what the most appropriate time period should be used for the analysis (See Section 3.1.2).

To inform this qualitative analysis, we will estimate past catch, ex-vessel revenues, and fishing effort (as distance towed) for each area proposed to be opened or closed under each alternative. In order to reflect concerns about shifts in markets, the fishery, and geographic distribution of vessels, we plan on presenting each area metric as a percentage of:

- 1) Economically important species (target and limiting species)
- 2) Species groups (i.e. rockfish, roundfish, etc.)
- 3) Port group bottom trawl landings for the period, or
- 4) coast-wide bottom trawl for the period.

Providing fishing activity as a percentage gives an understanding of the relative importance of certain areas in terms of ports and the coast wide fishery if they were to be reopened or closed to fishing.

3.1.2 Selection for Periods of Quantitative Indicators

We will use historical fishery data (fishing activity prior to implementation of RCA and EFH closures in 1998-2001 and 2002-2005³, respectively) and more recent fishery data (fishing activity post implementation of RCA/EFH closures and rationalization in 2011-2014) to create snapshots of the catch, ex-vessel revenues, and fishing effort for each alternative (See Table 2).

³ The EFHCAs were implemented in June 2006 and as such the initial analysis proposed including 2006 for the data series. However, it was later decided that using a partial year of data was inappropriate.

In 1998, several rockfish species were declared overfished and the Pacific Fishery Management Council (Council) implemented more restrictive trips trip limits to reduce catch. Starting in in 2002, National Marine Fisheries Service (NMFS) implemented the Rockfish Conservation Area (RCA) to further protect overfished species. This action created a seasonally adjusted, coastwide closure to bottom trawl activity that follows depth contours on the ocean floor between 100 and 200 fathoms. This action gave the Council and NMFS the ability to implement depth-based and latitude-based closures, ranging between 75 and 250 fm. Also in 2002, the West Coast Groundfish Observer Program (WCGOP) began observing trawl vessels at a rate of 14-24 percent of all trips from 2002-2010. This provided managers with biological samples and estimates of total catch including discarded fish for each haul. Starting in 2011, management of the groundfish trawl fishery changed from cumulative landing limits (i.e., command and control measures to reduce catch) to individual fishing quotas (IFQ) and the Council increased the at-sea observation rates to 100 percent. In 2006, the Council established Essential Fish Habitat Conservation Areas (EFHCAs), in various areas coastwide, inside and outside the RCA to protect fish habitat. The EFHCAs also prohibit bottom trawl activity and other bottom contact activity. Subsequent to implementation of the RCA and EFHCAs measures several overfished species were rebuilt to sustainable levels.

The spatial data (logbook information from fishermen) and the associated catch by haul that will be used are identified in Table 2. The location data for each time period is taken directly from fisherman's logbooks. However the catch composition and ex-vessel revenue data for each haul comes from two different sources. The catch data from 1998-2001 and 2002-2005 and 1998-2001 is taken from fisherman's logbooks and fish ticket data and does not include discard information. The catch data 2011-2014 is from observations made by the WCGOP matched to fish tickets; WCGOP observers record location and retained information from captain's logbook and provide estimates of discards to complete the data set.

Table 2. Summary of Commercial Trawl Data Sources for EFH/RCA Alternatives.

Alternative	Data Source for Tow Location and Tow Distance	Catch Composition	Ex-vessel Value
EFH Conservation Areas Alternatives			
No Action	Logbook data via WCGOP records data 2011-2014	WCGOP data 2011-2014	WCGOP data and Fish Tickets data 2011-2104
Alt 1b and 1c: (Collab & Oceana et al Proposals)			
<ul style="list-style-type: none"> For New EFH Closures Outside RCA¹ 	Logbook data via WCGOP records 2011-2014	WCGOP 2011-2014	WCGOP data and Fish Tickets 2011-2014
<ul style="list-style-type: none"> For EFH Areas to be Reopened Outside RCA¹ 	Logbook data 2002-2005	Logbook 2002-2005	Logbook and Fish Tickets 2002-2005
<ul style="list-style-type: none"> For New EFH Closures Inside RCA¹ 	Step 1 No Analysis since RCA is closed ² Step 2 Conduct integrated analysis with Logbook data 1998-2001	Step 1 No Analysis since RCA is closed ² Step 2 Conduct integrated analysis with Logbook data 1998-2001	Step 1 No Analysis since RCA is closed ² Step 2 Conduct integrated analysis with Logbook and Fish Ticket 1998-2001
<ul style="list-style-type: none"> For EFH Areas to be Reopened Inside RCA¹ 	Step 1 No Analysis since RCA is closed ² Step 2 Conduct integrated analysis with Logbook data 1998-2001	Step 1 No Analysis since RCA is closed ² Step 2 Conduct integrated analysis with Logbook data 1998-2001	Step 1 No Analysis since RCA is closed ² Step 2 Conduct integrated analysis with Logbook and Fish Tickets 1998-2001
Alt 2b New EFHCAs within the RCA based on Priority Habitats (WA only)	Logbook data 1998-2001	Logbook data 1998-2001	Logbook and Fish Tickets 1998-2001

Trawl RCA Alternatives			
No Action- Current Trawl RCA (maintaining RCA)	Logbook data via WCGOP records 2011-2014	WCGOP data 2011-2014	WCGOP and fish tickets 2011-2014
3b. Eliminate RCA	Logbook data 1998-2001 (areas inside current RCA)	Logbook data 1998-2001	Logbook data and Fish Tickets 1998-2001
<u>Discrete Area Closures</u>			
3c. Implement DAC (Washington only)	WCGOP data 2011-2014 for areas outside current RCA, and 1998-2001 for areas inside RCA	WCGOP data 2011-2014 and 1998-2001	WCGOP data and Fish Tickets 2011-2014 and 1998-2001
<u>Block Area Closures</u>			
3d. Implement BAC (PPA for OR/CA)	WCGOP data 2011-2014 (areas outside current RCA), and 1998-2001 for areas inside RCA	WCGOP data 2011-2014 and 1998-2001	WCGOP data and Fish Tickets 2011-2014

/1 For proposed EFH areas to be closed or opened inside the RCA we assume the RCA remains intact and fishing activity is still prohibited. Therefore, this part of the analysis will assume there is no impact on the ex-vessel revenue or catch within the RCA. A separate analysis will be conducted to qualitatively discuss the integrated effect of making EFH changes and RCA changes at the same time.

/2 State managed fisheries (pink shrimp, ridgeback prawn, CA halibut, and sea cucumber) that operate in areas proposed for EFHCAs may be impacted. An analysis of impacts to those fisheries will need to be conducted using other location data sources.

4 THE DATA

LOGBOOK, CATCH AND REVENUE DATA

4.1.1 Logbook Data and Trawl Effort

All bottom trawl vessels are required to carry state logbooks and record locations of every haul, which is then reported to PacFIN. Logbook data includes set and up locations for each haul, as well as fish ticket adjusted estimates of weight by species/grouping/market category. Compliance varies by state and over time and ~3.2 percent of total hauls were eliminated from the sample due to missing spatial information.

To isolate the logbook data for the limited entry bottom trawl groundfish effort for which the proposed actions and analysis applies to we:

- Removed midwater trawls
- Removed Puget Sound trawls
- Removed open access trawls (those without a listed permit)
- Removed potential LE California halibut tows, defined as hauls where 1) the target was California halibut and more than 150 lbs. of California halibut was landed or 2) the target was nearshore mix, sand sole, or other flatfish, and the tow took place in less than 30 fathoms and south of 40°10' N. latitude.

Trawl effort is defined in this analysis as the total miles of trawling that occur inside and outside proposed closures and reopenings. We calculated trawl distances by assuming a straight line between the logbook set and up points, described in Appendix A. Vessels do not travel in a straight line so we explored other methods to calculate tow length (See Appendix A). Upon initial review we found that other methods were time consuming and may not provide a significant, value-added product with the limited schedule and resources.

Trawl effort in the proposed closure areas would be displaced, as it is assumed that the fishery would shift to other areas, while reopened areas may see an increase in trawl effort. Impacts on the spatial distribution of trawl effort are uncertain. Displaced fishing effort would be informed by WCGOP data between 2011 and 2014. Restored fishing opportunity would similarly be qualitatively discussed by using, where appropriate, logbook data from two data sets: 1998-2001 and 2002-2005.

In our initial analysis of the potential impacts of changes to the RCA, we use logbook and fish ticket data from the years 1998-2001 to estimate historical catch and ex-vessel revenue in the RCA areas proposed to be reopened. To assess the potential impacts of changes in the EFH, we similarly rely on logbook data, but use 2002 - 2005, which is the most recent time period before EFHCAs were implemented. We used state logbook data (queried from PacFIN) from limited entry bottom trawl trips where tows intersect RCA or EFHCAs that are proposed to be closed or

reopened. As noted earlier, all tows are spatially represented by a straight line connecting the start point to the up point. These straight tow lines are spatially subset (clipped) with the RCA or EFHCA alternative boundaries to estimate the proportion of each tow within the RCA or EFHCA proposed polygon. This proportion is used as a scaling factor to estimate how much catch and revenue in a haul should be associated with a proposed area, which is further described in Section 4.1.3.

4.1.2 Fish Tickets

The state agencies (CA, OR, WA) supply data on the amount of fish landed at authorized dealers through the fish ticket system. One complication is that dealers often purchase fish in categories driven by the market for ease of identifying the fish at a broader level than species. To address these imprecise groupings and to identify contamination within the categories, the states implemented a port sampling program to subsample purchased fish to elucidate the true composition of the purchased fish and to identify their area of catch. The subsampled data are used to create species composition and area composition proportions, which are calculated and applied at strata supported by the data. Once data from each state is sent to PacFIN, data are checked for errors and converted into a consistent format. For example, each state uses its own codes for gears and species, which PacFIN standardizes. Data from various sources are also combined to create value added data. This includes adding vessel or permit information associated with a landing to the fish ticket data.

Fish ticket data (queried from PacFIN) used in this analysis include vessel number, landing year (including periods 1998-2005 and 2011-2014), fish ticket ID-number, PacFIN species code, ex-vessel revenue, and landed weight. We match both the logbook and observer haul level data to fish tickets, using a unique trip id and fish ticket ID, to derive the ex-vessel revenue for trips associated with hauls in areas identified for potential closures or reopening.

4.1.3 Catch composition

This metric estimates the catch that could be displaced by closures and the potential added opportunity (percent of total coastwide catch and revenue estimated to come from the given areas) through reopenings and is based on the proportion of each tow that occurred in a polygon. To quantify the catch from the area of the proposed closures outside the RCA, we will use data collected by the WCGOP for years 2011–2014, including discards. To estimate catch, we will use, as appropriate, fishery-dependent catch data (state logbooks and PacFIN fish tickets) from 1998-2001 (for analyzing EFHCA changes inside the RCA and trawl RCA changes) and 2002-2005 (for analyzing EFHCA changes outside the RCA).

Fish ticket data is proportioned to the haul-level data based on estimated catch in a given haul. For example, consider a fish ticket that landed 20 mt of sablefish and is associated with 4 hauls. The logbook records that one haul caught 7 mt of sablefish, one haul caught 3 mt, and the other two caught no sablefish. We would proportion 14 mt to the first haul, 6 mt to the second, and none to the final two. We then used the proportion of a haul within a polygon to estimate the catch that should be associated with a given proposed area. For example, if a particular tow caught 2 mt of flatfish, and 60 percent of that tow occurred in a particular polygon, then we assumed that 1.2 mt of the flatfish were caught in that polygon. Catch was estimated for five

species groups: (1) rockfishes, (2) flatfishes, (3) roundfishes, (4) sharks, and (5) other species, and includes discards when observer data was used but not when logbook data is used (See Appendix B for species list).

4.1.4 Observer Data

In 2011, the catch share program was implemented in the bottom trawl fishery, mandating 100 percent observer coverage in the fleet. This level of coverage allowed us to provide a more holistic picture of total (retained and discarded) catch in the areas of interest, where the logbook data only provides information about retained catch. WCGOP sampling focuses on the discarded portion of the catch, but also includes data on fishing effort and interactions with protected resources. Observers record estimates of fishing location and retained amount and composition based on the captain’s logbook; we use the estimated retained weights in each haul to proportion out the total catch on the associated fish tickets.

Observer program analysts provide fish-ticket adjusted haul data summarized at the species-level, for hauls that intersect RCA/EFHCA proposed closed areas. We excluded hauls that were unsampled and those that did not meet data quality standards for this analysis, an average of 0.5 percent of hauls in each year.⁴ WCGOP data was used to estimate total catch, which includes both discards and the fish-ticket adjusted retained weight.⁵

4.1.5 Ex-vessel value of the catch

This metric estimates the average annual fleet-wide catch and revenue that may be displaced by closures or added through reopenings, as a percentage of coastwide catch and revenue. After matching fish tickets to haul-level logbook or observer data, we calculated ex-vessel revenues on a per trip basis. We calculated an average price (revenue per landed weight) by species reported over all fish tickets associated with each trip. We then multiplied this price by the estimated haul-level retained derived from the proposed reopened or closed areas.

In all spatial datasets described, we defined species groupings based on matching species code across WCGOP and PacFIN data, information on species includes PacFIN market categories, and the location of catch for species managed by area.

4.1.6 Deflator Index

To calculate an average revenue over the four-year sample periods, we adjusted nominal ex-vessel prices to real dollars using the St. Louis Fed Implicit Price Deflator Index⁶, with 2015 as the base year.

⁴ See: Somers, K.A., Y.-W. Lee, J.E. Jannot, & J. McVeigh. 2016. FOS coverage rates, 2002-2015. Last updated: 16 August 2016. NOAA Fisheries, NWFSC Observer Program, 2725 Montlake Blvd E., Seattle, WA 98112.

http://www.nwfsc.noaa.gov/research/divisions/fram/observation/data_products/sector_products.cfm#ob

⁵ More information on these data sources and processing can be found here:

Somers, K.A., Y.-W. Lee, J. Jannot, V. Tuttle, N.B. Riley, and J. McVeigh. 2016. Estimated discard and catch of groundfish species in the 2015 U.S. west coast fisheries. NOAA Fisheries, NWFSC Observer Program, 2725 Montlake Blvd E., Seattle, WA 98112.

⁶ <https://fred.stlouisfed.org/series/GDPDEF>

DATA LIMITATIONS

The Project Team has concerns about the use of historical data, and the use of multiple data sets. Logbook, fish ticket, and observer data used in this analysis span three different time periods. In each time period, the fleet was operating under different sets of catch control regulations and gear restrictions. Since 1998, markets have evolved, potentially reacting to decreased west coast supply under more restrictive management measures, increased imports of seafood to satisfy domestic demand, and the fluctuations in global product prices and demand. Fleet size decreased dramatically over time, due to the disaster status declared in 2000 and resulting restrictive management measures, which included a buyback program initiated in 2003. As expected, the fleet continues to consolidate under the IFQ program. The historical period selected by the project team to represent areas proposed within the RCA (1998-2001) spans the declaration of the disaster status. During this period, effort shifted off the continental shelf into deeper waters and trip limits were drastically reduced.

At the November 2016 Council meeting, members of the GAP suggested analyzing the period prior to 1998 for areas to be opened, as fishing effort was higher and covered a greater area than that in the year immediately preceding and those following the disaster status and buyback period. Table 3 presents the number of vessels fishing in the three years prior to 1998, and the subsequent periods currently used in our analysis as a percentage of that initial level of vessel participation. Trends over all periods indicate a substantial contraction in fleet size across the coast, with consolidation occurring at a faster rate in California and Washington than in Oregon.

Table 4 provides a comparison of time periods and the associated landed weight by PacFin subregions. Due to the management changes described earlier and the differences in number of vessels and distribution of delivery ports for vessels in 1998-2001 and 2002-2005 compared to the 2011-2014 period, the ex-vessel revenues and catch reported from the historical periods should not be interpreted as an estimate of potential gains from areas proposed to be reopened. We present this historical quantitative picture to inform a qualitative discussion about the potential for future landings, revenue, and effort in the absence of recent data for the areas proposed to be reopened.^{7 8}

⁷ The project team considered using trawl survey data, but ultimately determined those data are also too problematic to accurately predict future bottom trawl catch in proposed reopened areas, due to data only coming from summer months and using different gear/selectivity than the fleet.

⁸ Some EFHCAs occur outside the RCA, therefore we are able to use 2011-2014 observer data to speculate on the effects of these areas being closed, expanded, or shifted.

Table 3. Number of vessels with bottom trawl landings by PacFIN subregion 1994-1997, and percent of 1994-1997 levels for time periods used in analysis (1998-2001, 2002-2006, 2011-2014), and for the most recent period available in fish tickets (2015-2016).

State	PacFIN Subregion	Number of Vessels Delivering 1994-1997	Number of Vessels Delivering as a percent of 1994-1997 period			
			1998-2001	2002-2006	2011-2014	2015-2016*
CA	CRESCENT CITY	50	88%	62%	8%	8%
	EUREKA	45	111%	91%	24%	20%
	FORT BRAGG	32	81%	106%	19%	22%
	MONTEREY	28	93%	71%	14%	11%
	SAN FRANCISCO	64	83%	52%	14%	9%
	SAN LUIS OBISPO	32	81%	50%	6%	3%
	SANTA BARBARA	3	100%	33%	0%	0%
OR	ASTORIA-TILLAMOOK	62	81%	82%	37%	29%
	BROOKINGS	31	61%	65%	32%	32%
	COOS BAY	50	82%	64%	40%	36%
	NEWPORT	49	90%	80%	20%	18%
WA	CENTRAL WASHINGTON COAST	43	51%	14%	5%	2%
	NW OLYMPIC PENINSULA	32	47%	50%	0%	0%
	S. WA COAST AND COLUMBIA R.	12	42%	25%	33%	17%
	SAN JUAN	8	25%	0%	0%	0%
	STRAIT OF GEORGIA	20	90%	80%	30%	25%
Coastwide Total for Number of Vessels and Percent Averages		304	81%	75%	26%	21%

*Fish tickets current in PacFIN through November 2016.

Data from comprehensive fish ticket table where DAHL_GROUNDFISH_CODE='04'.

Table 4. Landed weight for bottom trips by PacFIN subregion 1994-1997, and percent of 1994-1997 levels for time periods used in analysis (1998-2001, 2002-2006, 2011-2014), and for the most recent period available in fish tickets (2015-2016).

State	PacFIN Subregion	Landed weight (1000 mt)	Bottom trawl trip weight landed as a % of 1994-1997 period total			
		1994-1997	1998-2001	2002-2006	2011-2014	2015-2016
CA	CA Total	75.5	58 %	42 %	25 %	11 %
	CRESCENT CITY	8.5	9 %	5 %	1 %	0 %
	EUREKA	17.7	16 %	12 %	11 %	6 %
	FORT BRAGG	14.2	11 %	10 %	7 %	3 %
	MONTEREY	9.1	7 %	5 %	2 %	0 %
	SAN FRANCISCO	15.9	10 %	6 %	2 %	0 %
	SAN LUIS OBISPO	10.1	5 %	4 %	2 %	0 %
	SANTA BARBARA	<1	0 %	0 %	0 %	0 %
OR	OR Total	88.9	80 %	66 %	59 %	35 %
	ASTORIA-TILLAMOOK	37.6	36 %	33 %	36 %	22 %
	BROOKINGS	5.9	6 %	4 %	6 %	3 %
	COOS BAY	23.6	22 %	16 %	10 %	3 %
	NEWPORT	21.8	17 %	12 %	7 %	7 %
WA	WA Total	30.3	29 %	23 %	9 %	1 %
	CENTRAL WASHINGTON COAST	12.8	5 %	7 %	1 %	0 %
	NW OLYMPIC PENINSULA	3.9	6 %	5 %	0 %	0 %
	S. WA COAST AND COLUMBIA R.	3.0	2 %	0 %	5 %	0 %
	SAN JUAN	1.7	0 %	0 %	0 %	0 %
	STRAIT OF GEORGIA	8.9	16 %	11 %	3 %	1 %
	Total	194.8	65 %	51 %	36 %	18 %

Regarding data prior to 1998, we suspect that noncompliance with required logbook submissions may be an issue. We are investigating compliance rates to gauge the completeness and usefulness of the 1994-1998 data set.

The project team considered using observer data over both historical and more recent periods in light of concerns about the accuracy and lack of discard information in logbook data. The WCGOP began in 2002 and covered only 14-24 percent of groundfish landings in the fleet from 2002-2010. We determined this limited sample of overall effort was not sufficient to paint a complete picture of all the historical effort in the small, discrete areas of interest. Therefore we did not use the 2002-2010 time period of WCGOP observer data.

We also note that to maintain confidentiality, any descriptions of effort by less than three vessels are excluded from this report. Therefore, we are unable to describe potential impacts of opening or closing in such areas.

5 REQUESTED GUIDANCE FOR METHODOLOGY DEVELOPMENT

The Project Team requests that the SSC Econ Subcommittee provide guidance regarding the proposed methodology and analysis. Specifically we ask:

- Is the overall approach logical?
- Are there more approaches that might allow us to better assess the impacts given analytical staff resource constraints and data limitations?
- What period is best suited for the analysis? Is it best to be consistent with a base year of 1998 to 2001, or to use separate samples to capture the most recent information for each alternative? For example, are the year spans of data we propose to use appropriate for the EFH openings and closures, and are they appropriate for the RCA openings and closures? Should the project team consider moving analysis to 1994-1998 to capture catch data from the pre-disaster, pre-buyback fishery?

Appendix A

Review of Trawl Tow Delineation Methods

Allison Bailey & Curt Whitmire
May/June 2016

The current method used for the EFH Analysis, referred to as the straight-line method, uses the trawl start (set) and end (up) point locations from trawl logbook data or observer data and connects the two locations with a straight-line. It is well understood that this is only an approximation of the tow location, and in many cases, trawlers may not be towing in a straight line.

Based on comments from the GMT at the April 2016 Council Meeting, the EFH project team reviewed alternative methods for delineating trawl tow lines.

The alternative methods reviewed include:

Bathymetry-derived tow lines

Ellipse-based buffer

Simple buffer

Vessel Monitoring System (VMS) data

Bathymetry-derived Tow Lines

Alice Thomas-Smyth at NMFS, Southwest Fisheries Science Center, has developed a method that uses a least-cost path model to create trawl tow lines that follow bathymetric contours. This method looks promising to create more realistic tow lines, especially in areas around steeper topography, such as canyons. However, the method is extremely time-consuming and computer-processing intensive. Alice estimated it would take several weeks of just computer time to process multiple years of data coastwide. It also relies upon a high resolution bathymetry grid. For the Pacific region, bathymetry data is available at a wide array of spatial resolutions, so we would likely need to use some less than ideal resolution (e.g., 100 m) for data spanning much of the region.

Alice and colleagues used these bathymetry-derived tow lines and straight-line tow lines to compare the level of agreement between positions recorded by Vessel Monitoring System (VMS) and logbook data (Thomas-Smyth, Mamula, Speir, in prep). Interestingly, they found minimal difference when comparing the VMS positions to the bathymetry-derived tow lines versus comparing the VMS to the straight-line tow lines. So, they concluded for their purposes, the more complex approach (bathymetry-derived) did not significantly improve the results over the straight-line approach. This result could vary in different regions and particularly for longer tow lines. Her project includes only tows from vessels operating out of California ports and for four years, 2008-2011.

Alice provided a sample of her bathymetry-derived tow from 2011. We overlaid the EFH proposal boundaries onto the bathymetry-derived tow lines and corresponding tow lines to compare the proportion of the tow that is within the proposal area. There were approximately 2200 tows.

In general, the proportion of a tow that is inside a polygon is greater for the bathymetry-derived tows than the straight-line derived tows, but further analysis is needed to determine if this is significant and to estimate the impact on the output metrics.

Conclusion: The bathymetry-derived tow line method is likely be too time-consuming to complete within the current Council schedule.

Ellipse-based Buffer

Corey Niles at Washington Department of Fish and Wildlife, has developed a method of buffering straight-line tow lines with an ellipse that is derived from the start and end locations, tow duration, and an assumed tow speed of 2.5 knots. This method is an excellent way to visualize the spatial uncertainty in the tow location and is useful for showing trawl density or intensity. However, it does not provide an obvious means to choose an improved tow line location. One could create a range of ellipses around a tow line and then use the outer boundaries of each ellipse as a set of potential tow line locations, but this would provide only a way to potentially quantify the uncertainty, but not necessarily select the most likely tow location.

Conclusion: The ellipse-based buffer method does not provide an approach for identifying an improved tow line location. Therefore, it is not appropriate for use with the current EFH metrics.

Simple Buffer

The simple buffer is conceptually similar to the ellipse-based buffer, but is somewhat easier to implement with standard GIS tools. However, it has the same limitations as the ellipse-based buffer method. In addition, the ellipse-based buffer is conceptually more appropriate because as you get closer to the ends of the tow, the uncertainty in the tow position should decrease.

Conclusion: The simple buffer method has the same limitations as the ellipse-based buffer method. Therefore, it is not appropriate for use with the current EFH metrics. If a buffer method was going to be used, the ellipse-based buffer is preferable.

Vessel Monitoring System Data

- Working with VMS data is known to provide some challenges, including
- Infrequency of position reporting (~ once per hour)
- High data volumes
- No information about whether the vessel is fishing
- Challenges in interpreting data fields
- However, from Alice Thomas-Smyth’s work, it appears that VMS locations can provide a reasonable approximation of the trawl location. She found that most tows have at least 3 or 4 positions for a trawl tow.

Access to VMS data (requested from NOAA OLE) that has time stamp and vessel information would be beneficial. We expect to match the VMS timestamps with the timestamps from the logbook and observer data and extract any points that fall within an identified trawl tow. We can then “connect-the-dots” from the trawl start and end points to include any VMS points in between for an improved delineation of the trawl line location. We could also explore the potential to use calculated tow speeds (i.e., using distance calculated between pings divided by timestamp difference) for validating fishing vs. non-fishing portions of VMS lines.

Conclusion: Data include VMS pings from 2011-2014 for west coast vessels with declaration codes corresponding to bottom trawl (230) and demersal seine (231). Need to explore these data to have a better idea as to how we might use them to better represent tow locations within the context of this review. This analysis is on hold pending resource needs and Council schedule.

Appendix B

Species Categories for EFH/RCA Analysis

ROCKFISH	FLATFISH	ROUNDFISH	SHARKS AND SKATES	OTHER SPECIES
<ul style="list-style-type: none"> · All genera and species of the family Scorpaenidae that occur off Washington, Oregon, and California, including longspine thornyhead, and shortspine thornyhead 	<ul style="list-style-type: none"> · Arrowtooth flounder · Butter sole · Curlfin sole · Dover sole · English sole · Flathead sole · Pacific sanddab · Petrale · Rex sole · Rock sole · Sand sole · Starry flounder 	<ul style="list-style-type: none"> · Cabezon · Lingcod · Kelp greenling · Pacific cod · Pacific whiting · Sablefish 	<ul style="list-style-type: none"> · Big skate · California skate · Leopard shark · Longnose skate · Soupfin shark · Spiny dogfish 	<ul style="list-style-type: none"> · Finescale codling · Pacific rattail · ratfish