Initial Proposal (Proposed Action, Alternatives, and Considerations) for Restructuring Groundfish Stock Complexes

Background

The Magnuson-Stevens Act (MSA) was reauthorized in 2006 with a mandate to end overfishing. National Standard 1 (NS1) guidelines, the National Marine Fisheries Service (NMFS) guidance on how to meet the conservation objectives of the MSA, were revised in 2009 in response to the MSA reauthorization. The revised NS1 guidelines proposed a harvest management framework that specified a number of management reference points and precautionary buffers to reduce the risk of overfishing (i.e., exceeding the level of harvest estimated to achieve maximum sustainable yield (MSY)). The revised NS1 guidelines recommended specification of an overfishing limit (OFL), the MSY harvest level; a buffer between the OFL and the acceptable biological catch (ABC) to account for scientific uncertainty in estimating the OFL; and the annual catch limit (ACL), which may be set equal to the ABC or lower to accomplish other objectives. These precepts and other recommendations from the revised NS1 guidelines were incorporated in the groundfish fishery management plan (FMP) under Amendment 23, which was implemented in 2011.

The revised NS1 guidelines and Amendment 23 also incorporated a framework for managing stock complexes, which are aggregations of stocks managed in a single unit under harvest specifications decided for the complex in its entirety. Stocks managed in a complex should be sufficiently similar in geographic distribution, life history, and vulnerabilities to the fishery such that the impact of management actions on the stocks is similar. At the time a stock complex is established, the FMP should provide a full and explicit description of the proportional composition of each stock in the stock complex, to the extent possible. Stocks may be grouped into complexes for various reasons, including where stocks in a multispecies fishery cannot be targeted independent of one another and MSY cannot be defined on a stock-by-stock basis; where there is insufficient data to measure their status relative to status determination criteria (SDC); or when it is not feasible for fishermen to distinguish individual stocks among their catch. The vulnerability of stocks to the fishery should be evaluated when determining if a particular stock complex should be established or reorganized, or if a particular stock should be included in a complex.

Stock complexes may be comprised of: one or more indicator stocks, each of which has SDC and ACLs, and several other stocks; several stocks without an indicator stock, with SDC and an ACL for the complex as a whole; or one of more indicator stocks, each of which has SDC and management objectives, with an ACL for the complex as a whole. An indicator stock is a stock with measurable SDC that can be used to help manage and evaluate more poorly-known stocks that are in a stock complex. If an indicator stock is used to evaluate the status of a complex, it should be representative of the typical status of each stock within the complex, due to similarity in vulnerability. If the stocks within a stock complex have a wide range of vulnerability, they should be reorganized into different stock complexes that have similar vulnerabilities; otherwise, the indicator stock should be chosen to represent the more vulnerable stocks within the complex. In instances where an indicator stock is less vulnerable than other members of the complex, management measures need to be more conservative so that the more vulnerable members of the complex are not at risk from the fishery. More than one indicator stock can be selected to provide more information about the status of the complex. When indicator stock(s) are used, periodic re-evaluation of available quantitative or qualitative information (e.g., catch trends, changes in vulnerability,

fish health indices, etc.) is needed to determine whether a stock is subject to overfishing, or is approaching (or in) an overfished condition. Under the proposed action, more consideration will be needed to understand how to best use indicator stocks in managing stock complexes.

Proposed Action

Using the "best available scientific information," the proposed action is to restructure the current groundfish stock complexes that comprise species of more equivalent ecological distributions, more equivalent vulnerabilities to overfishing, and that are caught together in the fishery. This action would align stock complexes to more closely comport with NS1 guidelines and the tenets of the FMP.

The proposed action also considers adding a few non-FMP species into the FMP. Considerations for adding new species are they are caught in the groundfish fishery in amounts that may not be considered incidental and adding species that are landed together with FMP species in general market categories facilitates estimating harvest specifications for the complex using approved catch-based methods.

The proposed action also considers designating some FMP stocks as Ecosystem Component (EC) species. EC species are not in the fishery and therefore not actively managed. EC species are not targeted in any fishery and are not generally retained for sale or personal use. EC species are not determined to be subject to overfishing, approaching an overfished condition, or overfished, nor are they likely to become subject to overfishing or overfished in the absence of conservation and management measures. While EC species are not considered to be in the fishery, the Council should consider measures for the fishery to minimize bycatch and bycatch mortality of EC species consistent with National Standard 9, and to protect their associated role in the ecosystem. EC species do not require specification of reference points but should be monitored to the extent that any new pertinent scientific information becomes available (e.g., catch trends, vulnerability, etc.) to determine changes in their status or their vulnerability to the fishery. The candidate species for an EC designation under the proposed action contribute no or negligible catch to the estimated catch-based OFLs used to determine harvest specifications.

The proposed action also considers removing some species from the FMP because they are not in the fishery. In cases where there is uncertainty whether candidate species are in the fishery or not, the proposed action is to designate such species as EC species.

The proposed action considers different ways to restructure stock complexes for six different species groups. In some cases, the relative productivity and vulnerability of component stocks is the key attribute for alternative stock complexes (e.g., nearshore and slope rockfish complexes) and in other cases, the depth distributions of component stocks is the key attribute (e.g., shelf rockfish, flatfish, elasmobranchs, and roundfish complexes). While consideration of aligning stocks managed in alternative complexes is done for all complexes, the productivity and vulnerability attributes of component stocks in the nearshore and slope rockfish complexes are the main factor in proposing alternative complexes since some of those stocks have the highest vulnerability to overfishing of all FMP stocks.

Purpose and Need

The purpose of the proposed action is to conserve and manage Pacific Coast groundfish fishery resources to prevent overfishing, to rebuild overfished stocks, to ensure conservation, to facilitate long-term protection of essential fish habitat (EFH), and to realize the full potential of the Nation's fishery resources (MSA §2(a)(6)) by restructuring current stock complexes. The harvest specifications for stock complexes are set consistent with the harvest management framework described in Chapter 4 of the Groundfish FMP.

There is a need to evaluate and consider changes to the current structure of stock complex groupings to ensure that the species in each complex are sufficiently similar in geographic distribution, life history, and vulnerabilities to the fishery such that management impacts are similar.

Potential Stock Complex Alternatives

The alternatives described here are intended to evaluate aggregations of species that represent a better management alignment of species according to their ecological distributions, interactions with the fishery, and relative vulnerabilities to overfishing. Alternatives are stratified into six major species groups (Nearshore Rockfish, Shelf Rockfish, Slope Rockfish, Flatfishes, Roundfishes, and Elasmobranchs). Considerations for restructuring stock complexes for these six groups of species can be decided independently and are thus presented and analyzed independently.

There are considerations for incorporating new species into the FMP since they are caught in the groundfish fishery in relatively high amounts analogous to catches of closely related FMP species. Incorporating these species into the FMP will also enable more accurate estimates of OFLs for some FMP species using the data-poor catch-based methods employed for unassessed species. This is because some of these species are landed in market categories representing an aggregation of similar species with little or no species composition data available to differentiate landing to species (e.g., Pacific grenadier landed in an "unspecified grenadiers" market category).

There are also considerations for designating some species as EC species, as well as removing some species from the FMP. There is a consideration for removing species from the FMP in cases where the species does not occur on the West Coast and has no catch history (e.g., dusky rockfish) or is solely caught in state-managed fisheries (e.g., leopard shark). Stocks that are not targeted and have a negligibly small catch history (e.g., calico rockfish) are candidates for an EC designation.

The Groundfish Management Team (GMT) scored the relative productivity and susceptibility of species to being caught in the fishery in a Productivity and Susceptibility Assessment (PSA) to score their relative vulnerability to potential overfishing (PFMC and NMFS 2012). Productivity and vulnerability scores from the GMT PSA analysis are used in the analysis of effects of managing FMP stocks in alternative stock complexes.

The West Coast Groundfish Observer Program also developed a database (2003-2011) and the GMT developed an analysis using that database of annual removal data to evaluate a component stock's catch contribution to an OFL estimate for a stock complex. While there is concern for component stocks that contribute an inordinately larger catch contribution to the complex (i.e., inflator stocks), this concern is accentuated when there is high interannual variation in those catches. The presence of inflator stocks in a complex can risk overfishing of other stocks in the complex since it inflates the complex OFL. This is especially concerning for those stocks in the complex with high vulnerability to overfishing. The GMT analysis of catch data probes those effects for proposed alternative stock complexes. Two important concepts are the scale of removals and the ratio of stock removal to overall stock complex removals. An ideal stock complex would a) avoid removals above any component OFLs; b) not have large scale differences in the OFL components; therefore, allowing for potential overages; and c) if large scale differences are apparent, consistent removal ratios indicating a consistent contribution of catches to the complex is desired. The GMT identified several removal-based metrics to help evaluate these standards for status quo and proposed alternative complexes:

1) *Maximum and minimum cumulative removals of the status quo alternative.* These measures evaluate scale and are calculated as differences between stock-specific cumulative removals for years 2003-2011 and the sum of component OFLs (assumed

at the 2013 OFL value in each year). Large maximum values indicate the complex has allowed overfishing relative to the 2013 OFL. Large minimum values indicate "inflator species"— species that add a large amount of latent component OFL that could be applied to other species in the complex. Both of these are indicators that a complex is misaligned as far as catch being applied to component species. For each complex, one is looking for low maximum and minimum values.

2) *Evenness*: Evenness is another measure of scale that quantifies the inequality/imbalance among the component OFLs in a given stock complex. Pielou's measure of evenness (Jost 2010) was used and is calculated as H'/ln(S) where H' is Shannon-Weiner diversity index (Krebs 1999) and S is the number of stocks in the complex. A value of 1 indicates every stock contributes equally; a value of 0 means one stock contributes everything. Evenness is reported for annual catches (with the median value over all years reported) and for the 2013 OFL. Values closest to 1 are desired.

3) *Slope of removal ratios*: This measure looks at how many stocks demonstrate non-significant trends in the slope of stock catch/total complex catch for each year. A simple linear model is used to fit the time series of removal ratios, with a conservative p-value < 0.1 indicating slopes significantly different than 0. The number of stocks with slope non-significantly different than 0 are reported, so values closest to 1 (1 meaning all stocks in a complex have constant removal ratios) is desired.

The analysis of effects also considers how alternative stock complexes may interact with the management system. There are formal allocations for some of these species which has a direct effect on how well the rationalized trawl sectors and other sectors of the groundfish fishery are managed to accomplish the conservation and socioeconomic objectives of the MSA and FMP.

Some of the affected stocks are scheduled for assessment this year, either as full assessments (aurora rockfish, rougheye rockfish, and Pacific Sanddabs) or as data-moderate assessments (brown rockfish, China rockfish, copper rockfish, English sole, rex sole, sharpchin rockfish, stripetail rockfish, vermilion rockfish, and yellowtail rockfish). These stocks are all managed in status quo stock complexes with the exception of English sole and yellowtail rockfish north of 40º10' N lat., which are managed with stock-specific harvest specifications. The Council's final preferred alternative for stock complexes could affect management of these stocks in one of three ways: 1) continue management using status quo aggregations in stock complexes, 2) move one or more of these stocks from a status quo complex to a new, reorganized complex, or 3) move one or more of these stocks out of a status quo complex to be managed with stock-specific harvest specifications. Each of these options has different management implications that are explored in this document.

Description of the Alternatives

Status Quo Rockfish

There are six status quo rockfish complexes stratified in three depth groups (nearshore, shelf, and slope) and two areas (north and south of 40º10' N lat.) (Table 1 and Table 2, respectively).

Table 1. Status quo rockfish stocks and stock complexes north of 40°10' N lat.

Rockfish Stocks	Stock Complexes N of 40°10'		
	Minor NS RF	**Minor Shelf RF**	**Minor Slope RF**
Overfished Stocks	Black and yellow	Bronzespotted	Aurora
Canary	Blue	Bocaccio	Bank
Darkblotched	Brown	Chameleon	Blackgill
POP N of 40°10'	China	Chilipepper	Redbanded
Yelloweye	Copper	Cowcod	Rougheye
Non-overfished Stocks	Gopher	Dusky	Sharpchin
Black rockfish (OR-CA)	Grass	Dwarf-red	Shortraker
Black rockfish (WA)	Kelp	Flag	Splitnose
Longspine thornyhead N and S of 34°27'	Olive	Freckled	Yellowmouth
Shortbelly	Quillback	Greenblotched	
Shortspine thornyhead N and S of 34°27'	Treefish	Greenspotted	
Widow		Greenstriped	
Yellowtail N of 40°10'		Halfbanded	
		Harlequin	
		Honeycomb	
		Mexican	
		Pink	
		Pinkrose	
		Puget Sound	
		Pygmy	
		Redstripe	
		Rosethorn	
		Rosy	
		Silvergray	
		Speckled	
		Squarespot	
		Starry	
		Stripetail	
		Swordspine	
		Tiger	
		Vermilion	

Table 2. Status quo rockfish stocks and stock complexes south of 40º10' N lat.

Rockfish Stocks	Stock Complexes S of 40°10'		
	Minor NS RF	**Minor Shelf RF**	**Minor Slope RF**
Overfished Stocks	**Shallow NS Species**	Bronzespotted	Aurora
Bocaccio S of 40°10'	Black and yellow	Chameleon	Bank
Canary	China	Dusky	Blackgill
Cowcod S of 40°10'	Gopher	Dwarf-red	Pacific ocean perch
Darkblotched	Grass	Flag	Redbanded
Yelloweye	Kelp	Freckled	Rougheye
Non-overfished Stocks	**Deeper NS Species**	Greenblotched	Sharpchin
Black rockfish (OR-CA)	Blue	Greenspotted	Shortraker
Chilipepper S of 40°10'	Brown	Greenstriped	Yellowmouth
Longspine thornyhead N and S of 34º27'	Calico	Halfbanded	
Shortbelly	Copper	Harlequin	
Shortspine thornyhead N and S of 34º27'	Olive	Honeycomb	
Splitnose S of 40°10'	Quillback	Mexican	
Widow	Treefish	Pink	
		Pinkrose	
		Pygmy	
		Redstripe	
		Rosethorn	
		Rosy	
		Silvergray	
		Speckled	
		Squarespot	
		Starry	
		Stripetail	
		Swordspine	
		Tiger	
		Vermilion	
		Yellowtail	
		Swordspine	
		Tiger	
		Vermilion	

Nearshore Rockfish

One action alternative is considered for restructuring the nearshore rockfish stock complexes based on the relative productivity and vulnerability to overfishing of affected stocks (Table 3 and Table 4). Honeycomb rockfish is currently managed in the southern shelf rockfish complex. However, the depth distribution of honeycomb rockfish ranks it ecologically as a nearshore rockfish (Table 3). The proposed alternative for honeycomb rockfish is to designate it as an EC species since it contributes no historical catch to the catch-based OFL. In the event honeycomb rockfish is not designated as an EC species, there should be consideration for managing this stock in the Southern Nearshore Rockfish complex.

Table 3. Nearshore rockfish stocks ranked by relative productivity. Productivity (P) and vulnerability (V) scores are from the GMT's PSA analysis.

Stock	P	Relative P	V	Relative V
Kelp rockfish	1.94	High	1.59	Low
Black-and-yellow rockfish	1.89	High	1.7	Low
Olive rockfish	1.69	High	1.87	Med
Treefish rockfish	1.67	High	1.73	Low
Brown rockfish	1.61	High	1.99	Med
Grass rockfish	1.61	High	1.89	Med
Gopher rockfish	1.56	High	1.76	Low
Blue rockfish	1.39	Low	2.01	High
Copper rockfish	1.36	Low	2.27	Highest
Honeycomb rockfish	1.36	Low	1.97	Med
Black rockfish	1.33	Low	1.94	Med
China rockfish	1.33	Low	2.23	Highest
Quillback rockfish	1.31	Low	2.22	Highest

Table 4. Alternative 1 nearshore stocks and stock complexes aggregated by relative vulnerability (strikeout denotes a stock moving from a status quo category; italics denotes a stock moving into a new category).

Nearshore Rockfish Stocks	Stock Complexes			
	N of 40°10'		S of 40°10'	
	Nearshore RF	Vul. Nearshore RF	Nearshore RF	Vul. Nearshore RF
Non-overfished Stocks Black rockfish (OR-CA) Black rockfish (WA)	~~Black and yellow~~ a/ Blue Brown ~~China~~ ~~Copper~~ ~~Gopher~~ a/ Grass ~~Kelp~~ a/ Olive ~~Quillback~~ Treefish	*China* *Copper* *Quillback*	**Shallow NS Species** Black and yellow ~~China~~ Gopher Grass ~~*Honeycomb*~~ b/ Kelp **Deeper NS Species** Blue Brown ~~Calico~~ b/ ~~Copper~~ Olive ~~Quillback~~ Treefish	*China* *Copper* *Quillback*

a/ Remove from complex since there is no or low presence.

b/ Specify as an Ecosystem Component species.

Analysis of the Nearshore Rockfish Alternatives

Nearshore Rockfish North of 40º10' N lat.

The catch histories of species in the status quo Minor Nearshore Rockfish North complex does not show problematic component OFL overages (Table 5), but does indicate the presence of an inflator stock. Blue rockfish is the inflator stock in the Minor Nearshore Rockfish North complex, which presents an overfishing risk for the more vulnerable stocks in the complex (i.e., China, copper, and quillback rockfish) (Figure 1). The OFL evenness is improved in the status quo complex by simply removing the

species from the complex that have no or low presence north of 40º10' N lat. or are proposed for an EC species designation (Table 4 and Table 5). Alternative 1 shows a trade-off between greatly improving evenness and removal ratios for vulnerable species, while decreasing the performance of these measures in the non-vulnerable complex. Taking this species out of this complex would greatly improve complex evenness and removal ratios. Managing blue rockfish with stock-specific harvest specifications would also reduce risk of overfishing the stock which has a relatively high vulnerability. Blue rockfish has the fourth highest vulnerability score in the status quo complex behind China, copper, and quillback rockfish. Another alternative not explored in this analysis would be adding blue rockfish to the Vulnerable Northern Nearshore Rockfish Complex as described under Alternative 1. However, it would still be an inflator stock in the vulnerable complex if it were managed there and would create a greater risk of overfishing the other vulnerable species.

Nearshore Rockfish South of 40º10' N lat.

The catch histories of species in the status quo Minor Nearshore Rockfish South complex do not show problematic component OFL overages (Table 5), but does indicate the presence of inflator stocks (gopher, blue, brown, copper, and olive rockfish) (Figure 2). None of the evenness metrics are improved in the status quo complex by simply removing the species from the complex that have no or low presence north of 40º10' N lat. or are proposed for an EC species designation (Table 4 and Table 5). Overall, alternative 1 provides the best improvement in evenness and removal ratios, while taking into consideration better management of vulnerable species.

Table 5. Summary of status quo (SQ) and proposed nearshore rockfish complexes in relation to several removal-based diagnostics. See text for descriptions of each measure.

Complex	Alternative	P	Cumulative removal difference (mt)		Evenness		Ratios
			Maximum	Minimum	$Removals_{median}$	OFL	%Slope = 0
Nearshore North	SQ	-	2	-262	0.56	0.59	0.56
	SQ - EC spp.	-	1	-262	0.63	0.66	0.57
	Alt. 1	+			0.18	0.25	0.25
	Alt. 1 V	+			**0.98**	**0.88**	**0.67**
Nearshore South	SQ	-	0	-2340	0.74	0.80	0.67
	SQ - EC spp.	-	0	-2340	0.74	0.80	0.67
	Alt. 1	+			**0.79**	**0.84**	0.50
	Atl. 1 V	+			0.78	0.44	**1.00**

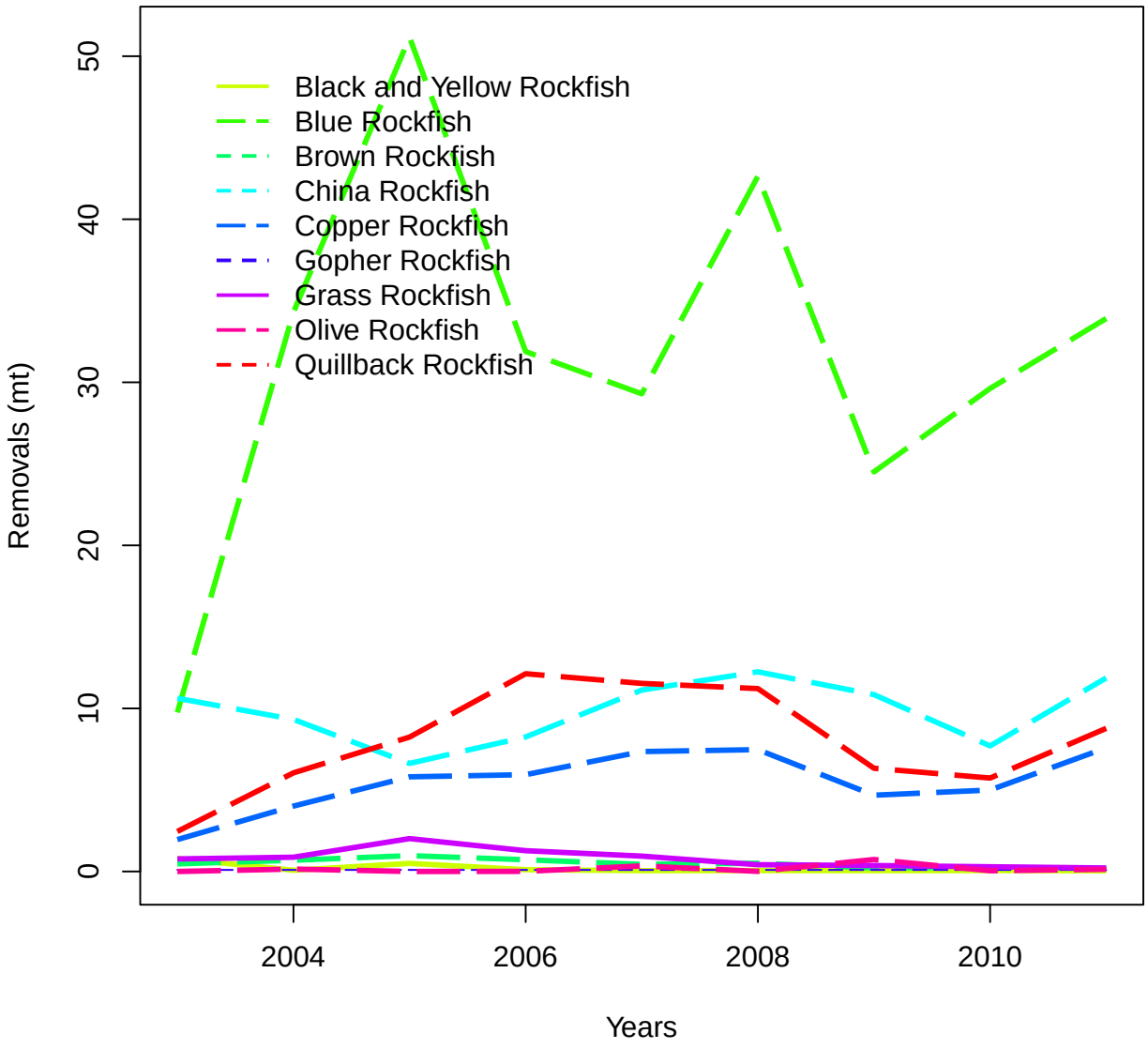

Figure 1. Annual total mortality (minus research catches) of nearshore rockfish stocks in the Minor Nearshore Rockfish North stock complex, 2003-2011.

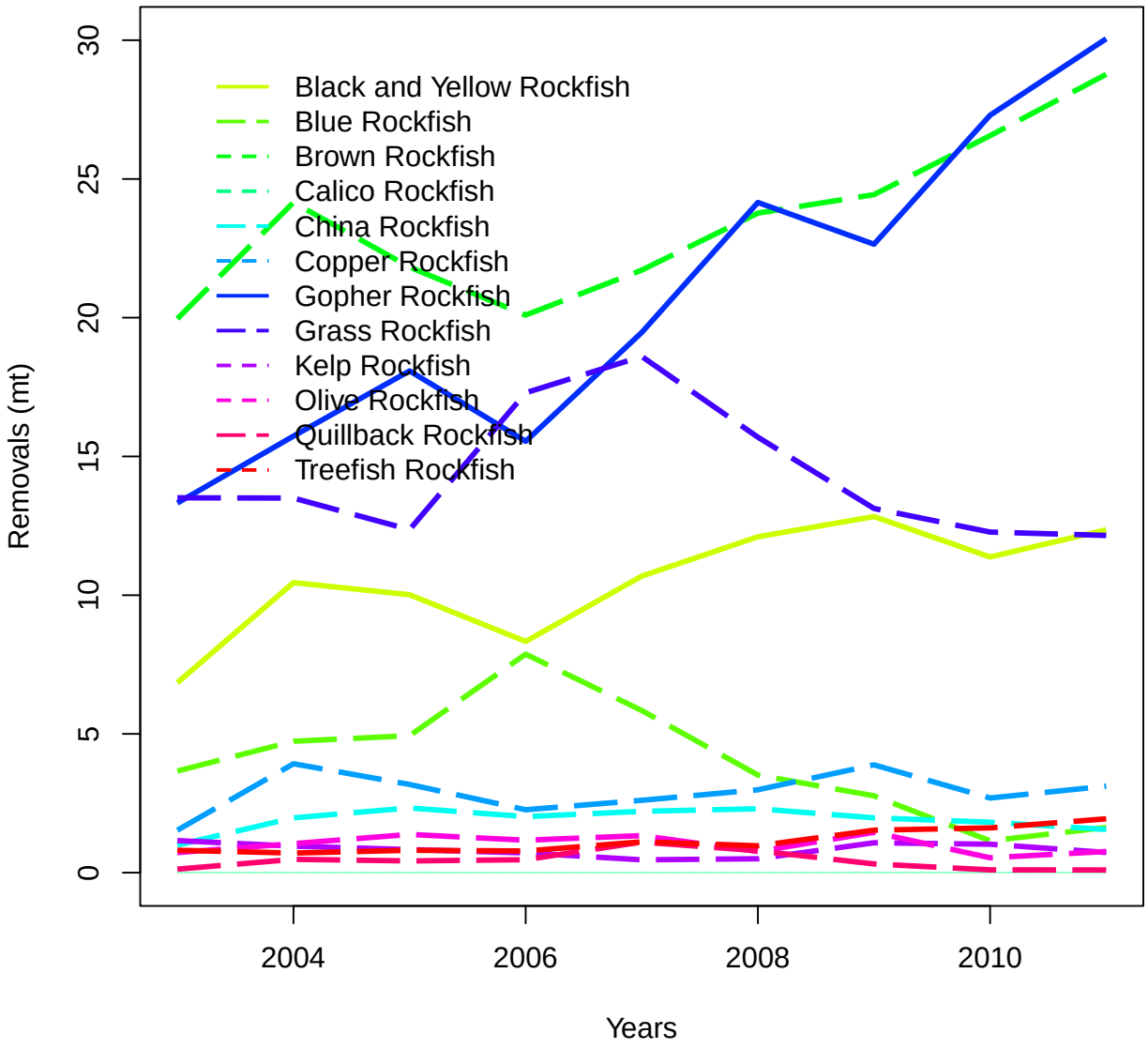

Figure 2. Annual total mortality (minus research catches) of nearshore rockfish stocks in the Minor Nearshore Rockfish South stock complex, 2003-2011.

Shelf Rockfish

One action alternative (Table 6) is considered for restructuring the shelf rockfish stock complexes based on the depth distributions of component species (Table 7 and Table 8). A number of species in the shelf rockfish complexes are proposed for an EC designation (e.g., freckled rockfish) regardless of the Council's decision to reorganize the shelf rockfish complexes by depth distribution of the component species. A few species are recommended to be removed from the northern or southern complexes (e.g., pygmy rockfish in the north) since there is no or very low presence of the species in the affected area.

Table 6. Alternative 1 shelf rockfish stocks and stock complexes (strikeout denotes a stock moving from a status quo category; italics denotes a stock moving into a new category).

Shelf Rockfish Stocks	Stock Complexes			
	N of 40°10'		S of 40°10'	
	Shallow Shelf RF	Deeper Shelf RF	Shallow Shelf RF	Deeper Shelf RF
Overfished Stocks Bocaccio S of 40°10' Canary Cowcod S of 40°10' Yelloweye	Chilipepper ~~Dwarf-red~~ a/ Flag ~~Freckled~~ a/ ~~Greenspotted~~ a/ ~~Halfbanded~~ a/ ~~Pygmy~~ b/ Rosy Speckled Squarespot ~~Starry~~ a/ ~~Swordspine~~ a/ Vermilion	~~Bank~~ a/ ~~Bronzespotted~~ a/ Bocaccio ~~Chameleon~~ a/ ~~Cowcod~~ a/ ~~Dusky~~ b/ ~~Greenblotched~~ a/ Greenstriped ~~Harlequin~~ b/ ~~Mexican~~ a/ ~~Pink~~ a/ ~~Pinkrose~~ a/ ~~Puget Sound~~ b/ Redstripe Rosethorn Silvergray Stripetail Tiger	~~Dwarf-red~~ b/ Flag ~~Freckled~~ a/ Greenspotted ~~Halfbanded~~ a/ ~~Pygmy~~ a/ Rosy Speckled Squarespot ~~Starry~~ b/ ~~Swordspine~~ b/ Vermilion Yellowtail	*Bank* Bronzespotted ~~Chameleon~~ a/ ~~Dusky~~ a/ Greenblotched Greenstriped ~~Harlequin~~ a/ Mexican Pink ~~Pinkrose~~ b/ ~~Puget Sound~~ a/ Redstripe Rosethorn Silvergray Stripetail ~~Tiger~~ b/
Non-overfished Stocks Chilipepper S of 40°10' Longspine thornyhead N and S of 34°27' ~~Shortbelly~~ a/ Shortspine thornyhead N and S of 34°27' Widow Yellowtail N of 40°10'				

a/ Remove from complex since there is no or low presence.
b/ Specify as an Ecosystem Component species.

Table 7. Shallow shelf rockfish stocks ranked by depth group and relative productivity. Productivity (P) and vulnerability (V) scores are from the GMT's PSA analysis.

Stock	P	Relative P	V	Relative V
Halfbanded rockfish	2	High	1.26	Low
Dwarf-red rockfish	1.83	High	1.54	Low
Chilipepper	1.83	High	1.35	Low
Freckled rockfish	1.78	High	1.44	Low
Pygmy rockfish	1.78	High	1.42	Low
Calico rockfish	1.75	High	1.46	Low
Rosy rockfish	1.61	High	1.89	Med
Squarespot rockfish	1.61	High	1.86	Med
Greenspotted rockfish	1.39	Low	1.98	Med
Speckled rockfish	1.33	Low	2.1	High
Flag rockfish	1.33	Low	1.97	Med
Swordspine rockfish	1.33	Low	1.94	Med
Yellowtail rockfish	1.33	Low	1.88	Med
Canary rockfish	1.28	Low	2.01	High
Starry rockfish	1.25	Low	2.09	High
Vermilion rockfish	1.22	Low	2.05	High
Yelloweye rockfish	1.22	Low	2	High

Table 8. Deeper shelf rockfish stocks ranked by depth group and relative productivity. Productivity (P) and vulnerability (V) scores are from the GMT's PSA analysis.

Stock	P	Relative P	V	Relative V
Shortbelly rockfish	1.94	High	1.13	Low
Puget Sound rockfish	1.89	High	1.35	Low
Mexican rockfish	1.5	High	1.8	Low
Chameleon rockfish	1.39	Low	2.03	High
Darkblotched rockfish	1.39	Low	1.92	Med
Stripetail rockfish	1.39	Low	1.8	Low
Sharpchin rockfish	1.36	Low	2.05	High
Pink rockfish	1.33	Low	2.02	High
Harlequin rockfish	1.31	Low	1.94	Med
Pinkrose rockfish	1.31	Low	1.82	Med
Redstripe Rockfish	1.31	Low	2.16	High
Widow rockfish	1.31	Low	2.05	High
Bocaccio	1.28	Low	1.93	Med
Dusky rockfish	1.28	Low	1.99	Med
Greenblotched rockfish	1.28	Low	2.12	High
Greenstriped rockfish	1.28	Low	1.88	Med
Bank rockfish	1.25	Low	2.02	High
Tiger rockfish	1.25	Low	2.06	High
Bronzespotted rockfish	1.22	Low	2.12	High
Silvergray rockfish	1.22	Low	2.02	High
Rosethorn rockfish	1.19	Low	2.09	High
Cowcod	1.06	Low	2.13	High

Analysis of the Shelf Rockfish Alternatives

Shelf Rockfish North of 40º10' N lat.

The catch histories of species in the status quo Minor Shelf Rockfish North complex do not show problematic component OFL overages (Table 9), but does indicate the presence of a huge inflator stock (greenstriped rockfish) (Figure 3). Evenness is improved in the status quo complex by simply removing the species from the complex that have no or low presence north of 40º10' N lat. or are proposed for an EC species designation (Table 6 and Table 9). The Alternative 1 Deep Shelf complex improves evenness and removal ratios while also aligning better with vulnerability scores, but at the expense of the Shallow Shelf complex, which shows decreased improvement in all measures because chilipepper is the overwhelming contributor to that complex.

Shelf Rockfish South of 40º10' N lat.

The catch histories of species in the status quo Minor Shelf Rockfish South complex do not show problematic component OFL overages (Table 9), but does indicate the presence of a huge inflator stock (yellowtail rockfish) (Figure 4). The removal of the proposed EC stocks from the status quo complex improves all removal-based diagnostics (Table 9). Improvement in OFL evenness and removal ratios are also seen under Alternative 1, although status quo minus the EC stocks seems to give the best overall improvement.

Alternative 1 (both north and south) is structured to consider a further stratification of rockfish complexes by depth. The further depth stratification of the current shelf rockfish complexes into Shallow Shelf and Deeper Shelf complexes might better align the shelf rockfish complexes with the current fishery. Under Rockfish Conservation Area (RCA) management, fisheries are somewhat segregated into nearshore effort

shoreward of the RCA and deeper efforts seaward of the RCA. The species aggregated in the Shallow Shelf Rockfish complex are primarily caught in nearshore fisheries (e.g., recreational, nearshore commercial, and shallow "beach" trawl efforts) in association with many of the nearshore rockfish species. In this regard, it might make sense to manage nearshore and shallow shelf rockfish in a combined complex; however, this is not proposed since it may disrupt the California and Oregon state limited entry systems and allocations in place for nearshore fisheries. The species aggregated in the Deeper Shelf complex are primarily caught in deep water fisheries such as those targeting sablefish in fixed gear fisheries and trawl efforts targeting Dover sole, thornyheads, and sablefish (DTS) species. The species in the Deeper Shelf complex are often caught in association with slope rockfish in deep water fisheries along the shelf-slope break. An alternative that combines the Deeper Shelf and Slope complexes was not proposed. The harvestable surplus of the slope rockfish complexes are formally allocated with long-term sector allocations, while the shelf rockfish complexes are not (sector allocations are made every two years in the biennial process). Combining these assemblages of species may pose some allocation challenges since the Amendment 21 allocations for slope rockfish are significantly different than the 2013-14 allocations for shelf rockfish.

Table 9. Summary of status quo (SQ) and proposed shelf rockfish complexes in relation to several removal-based diagnostics. See text for descriptions of each measure.

Complex	Alternative	P	Cumulative removal difference (mt)		Evenness		Ratios
			Maximum	Minimum	$Removals_{median}$	OFL	%Slope = 0
Shelf North	SQ	-	0	-10841	0.53	0.45	0.83
	SQ - EC spp.	-			0.65	0.53	0.77
	Alt. 1 shallow	-			0.34	0.20	0.33
	Alt. 1 deep	+			**0.70**	**0.60**	**0.86**
Shelf South	SQ	-	1	-11218	0.46	0.48	0.80
	SQ - EC spp.	-			**0.50**	**0.51**	0.88
	Alt. 1 shallow	-			0.39	0.54	0.86
	Alt. 1 deep	+			0.17	0.40	**1.00**

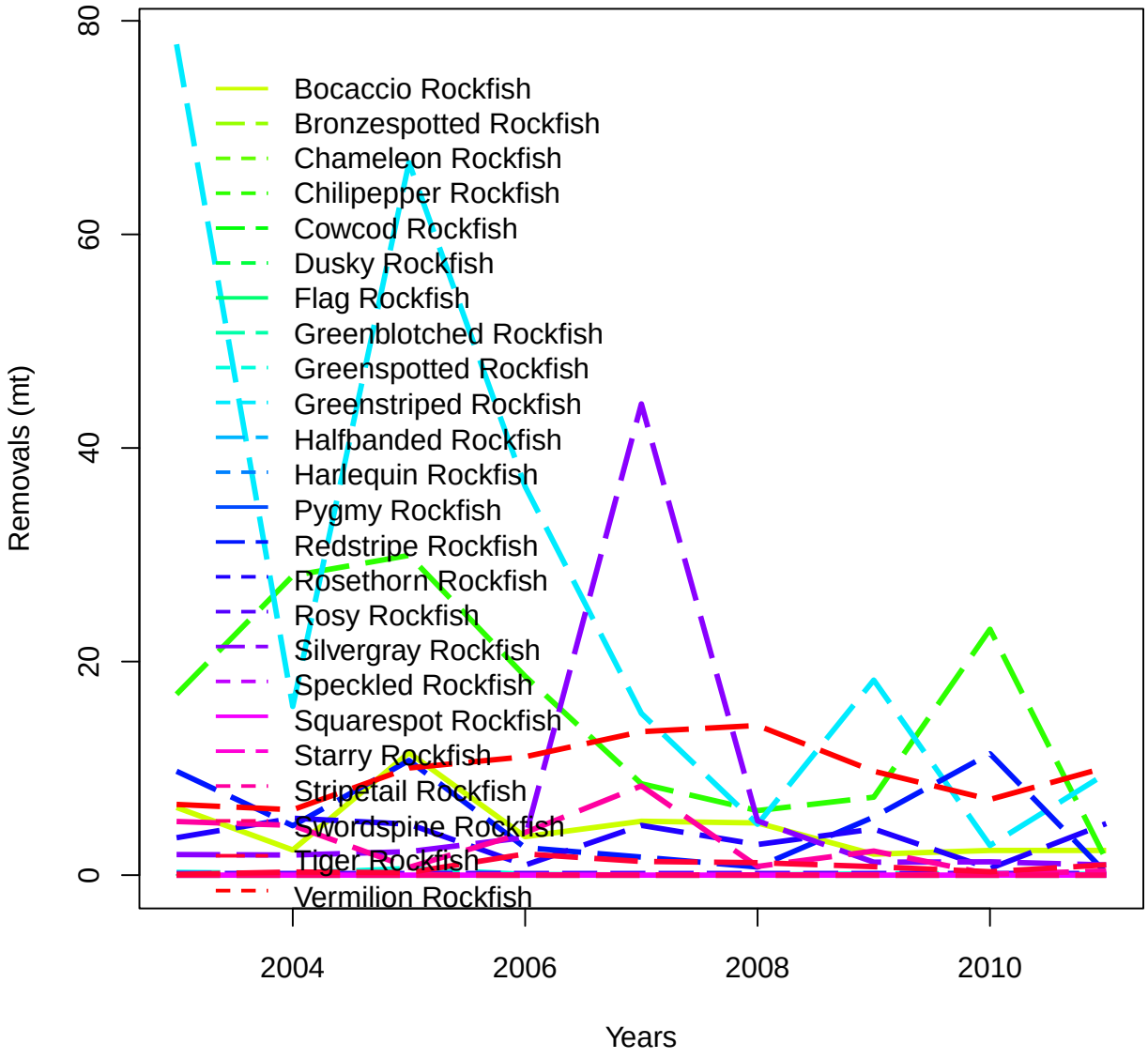

Figure 3. Annual total mortality (minus research catches) of shelf rockfish stocks in the Minor Shelf Rockfish North stock complex, 2003-2011.

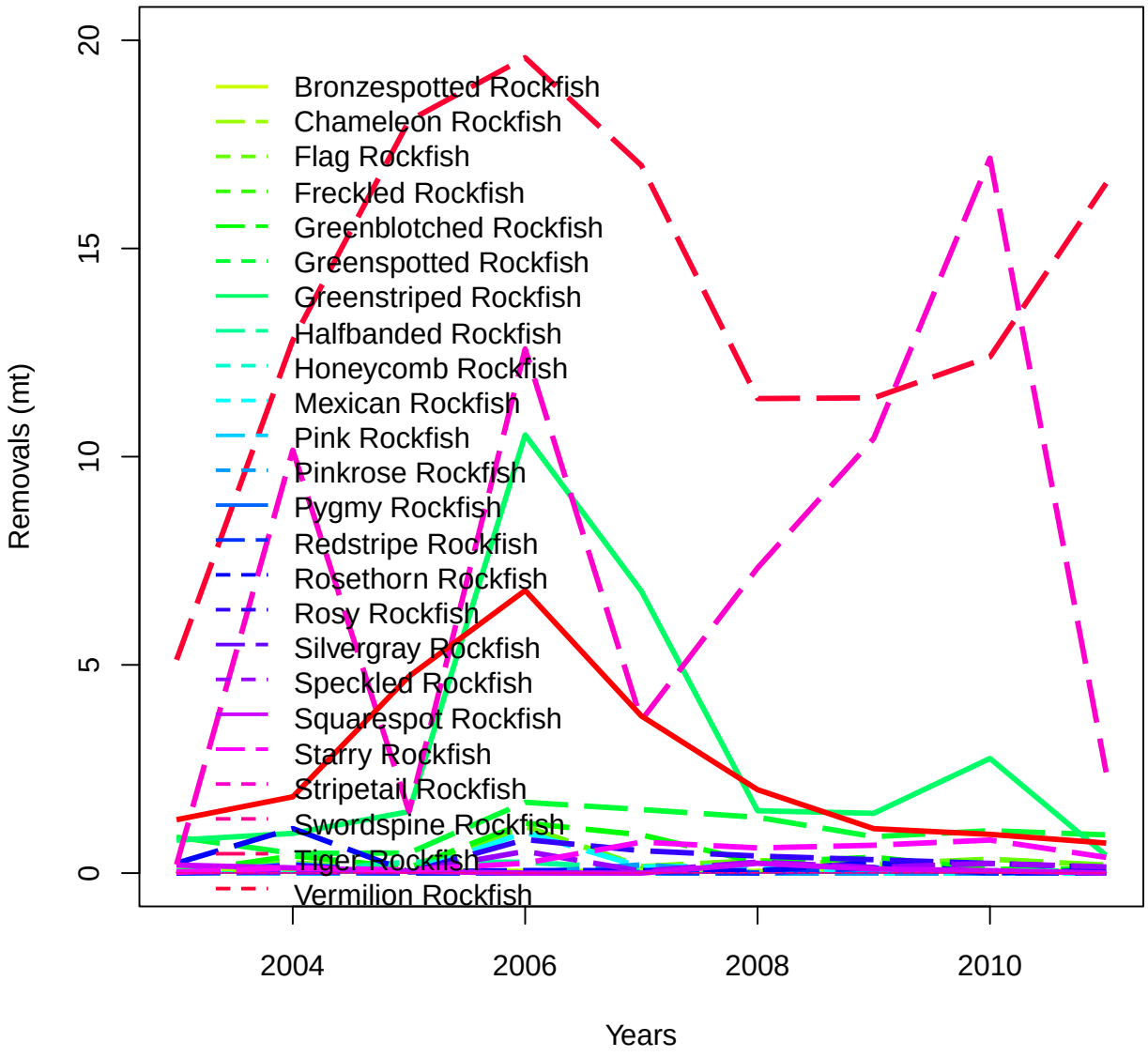

Figure 4. Annual total mortality (minus research catches) of shelf rockfish stocks in the Minor Shelf Rockfish South stock complex, 2003-2011.

Slope Rockfish

The slope rockfish complexes contain species with different relative vulnerabilities to overfishing, including two species with the highest vulnerabilities scored (rougheye and shortraker rockfish) and two species with very high vulnerabilities (aurora and blackgill rockfish) (Table 10). Two alternatives are considered to better manage these high vulnerability species in a more precautionary manner. Slope rockfish alternative 1 contemplates managing a vulnerable slope rockfish complex north of 40º10' N lat. by aggregating blackgill, rougheye, and shortraker rockfish (Table 11). Slope rockfish alternative 2 contemplates managing vulnerable slope rockfish complexes north and south of 40º10' N lat. with aurora, blackgill, rougheye, and shortraker comprising these two complexes (Table 12). Both alternatives consider removing a component species from a northern or southern complex due to lack of presence (e.g., bank rockfish in the north) regardless of whether the Council decides to restructure the slope rockfish complexes based on relative vulnerabilities of component species. Alternative 2 also contemplates removing bank rockfish from the southern slope rockfish complex and moving it to the southern shelf or southern deeper shelf rockfish complex since it is more present on the shelf than the slope (Table 7 and Table 10).

Table 10. Slope rockfish stocks ranked by relative productivity. Productivity (P) and vulnerability (V) scores are from the GMT's PSA analysis.

Stock	P	Relative P	V	Relative V
Yellowmouth rockfish	1.61	High	1.96	Med
Longspine Thornyhead	1.47	High	1.54	Low
Pacific ocean perch	1.44	High	1.69	Low
Aurora rockfish	1.33	Low	2.1	High
Shortspine thornyhead	1.33	Low	1.8	Low
Redbanded Rockfish	1.28	Low	2.02	High
Splitnose rockfish	1.28	Low	1.82	Med
Blackgill rockfish	1.22	Low	2.08	High
Shortraker rockfish	1.22	Low	2.25	Highest
Blackspotted rockfish	1.17	Low	1.97	Med
Rougheye rockfish	1.17	Low	2.27	Highest

Table 11. Alternative 1 slope rockfish stocks and stock complexes (strikeout denotes a stock moving from a status quo category).

Slope Rockfish Stocks	Stock Complexes		
	N of 40°10'		S of 40°10'
	Slope RF	Blackgill/Rougheye/Shortraker RF	Slope RF
Overfished Stocks Darkblotched POP N of 40º10' **Non-overfished Stocks** Longspine thornyhead N and S of 34º27' Shortspine thornyhead N and S of 34º27' Splitnose S of 40°10'	Aurora ~~Bank~~ a/ ~~Blackgill~~ Redbanded ~~Rougheye~~ Sharpchin ~~Shortraker~~ Splitnose Yellowmouth	Blackgill Rougheye Shortraker	Aurora ~~Bank~~ b/ Blackgill ~~POP~~ a/ Redbanded ~~Rougheye~~ c/ Sharpchin ~~Shortraker~~ c/ Yellowmouth

a/ Remove from complex since there is no or low presence.
b/ Move to Southern Shelf Rockfish or Southern Deeper Shelf Rockfish complex.
c/ Specify as an Ecosystem Component species.

Table 12. Alternative 2 slope rockfish stocks and stock complexes aggregated by relative vulnerability (strikeout denotes a stock moving from a status quo category).

Slope Rockfish Stocks	Stock Complexes			
	N of 40°10'		S of 40°10'	
	Slope RF	Vul. Slope RF	Slope RF	Vul. Slope RF
Overfished Stocks Darkblotched POP N of 40º10' **Non-overfished Stocks** Longspine thornyhead N and S of 34º27' Shortspine thornyhead N and S of 34º27' Splitnose S of 40°10'	~~Aurora~~ ~~Bank~~ a/ ~~Blackgill~~ Redbanded ~~Rougheye~~ Sharpchin ~~Shortraker~~ Splitnose Yellowmouth	Aurora Blackgill Rougheye Shortraker	~~Aurora~~ ~~Bank~~ b/ ~~Blackgill~~ ~~POP~~ a/ Redbanded ~~Rougheye~~ Sharpchin ~~Shortraker~~ Yellowmouth	Aurora Blackgill Rougheye Shortraker

a/ Remove from complex since there is no or low presence.
b/ Move to Southern Shelf or Southern Deeper Shelf complex.

Analysis of the Slope Rockfish Alternatives

Slope Rockfish North of 40º10' N lat.

The catch histories of species in the status quo Minor Slope Rockfish North complex indicate big concerns in both OFL overages (e.g., aurora and rougheye rockfishes) (Table 13) and inflator species (e.g., rougheye and splitnose rockfish) (Figure 5). The removal of the proposed EC stocks from the status quo complex shows little improvement. Alternative 2 seems to give the best overall increase in performance among evenness and removal ratios.

Alternatives 1 and 2 better align the more vulnerable stocks and therefore present less risk to these stocks than status quo.

Slope Rockfish South of 40º10' N lat.

The catch histories of species in the status quo Minor Slope Rockfish South complex shows less concern over component OFL overages than the north (Table 13), but it also shows significant inflator species (e.g., bank and blackgill rockfishes) (Figure 6). The removal of the proposed EC stocks from the status quo complex species does not improve the complex. While Alternative 2 improves removal ratios, the status quo complex seems overall the best of these proposed complexes. All complexes show relatively poor evenness because of the inclusion of blackgill. Removal of blackgill could improve any of the proposed alternatives.

Alternative 2 does better align the more vulnerable stocks and therefore presents less risk to these species than status quo or Alternative 1, both of which do not aggregate the vulnerable stocks in their own complex. Since rougheye and shortraker are rarely if ever caught south of 40º10' N lat., the Alternative 2 Vulnerable Slope Rockfish complex is mainly comprised of aurora and blackgill rockfish. Blackgill would be an inflator stock in that complex compelling a precautionary ACL contribution for blackgill in the future if the Southern Vulnerable Slope Rockfish complex is created. Although it wasn't proposed in this analysis, Alternative 1 may be more informative if aurora and blackgill were pulled out of the southern complex and managed with stock-specific harvest specifications. Blackgill was assessed in 2011 with a depletion ratio placing this stock in the precautionary zone. Aurora, which has one of the highest vulnerability scores analyzed, will be assessed in 2013. Since there are concerns with both aurora and blackgill, this different structure for Alternative 1 should be considered.

Table 13. Summary of status quo (SQ) and proposed slope rockfish complexes in relation to several removal-based diagnostics. See text for descriptions of each measure.

Complex	Alternative	P	Cumulative removal difference (mt)		Evenness		Ratios
			Maximum	Minimum	$Removals_{median}$	OFL	%Slope = 0
Slope North	SQ	-	784	-7338	0.63	0.57	0.40
	SQ - EC spp.	-	784	-7338	0.65	0.57	0.44
	Alt. 1	-			**0.74**	0.64	0.40
	Alt 1 V	+			0.37	0.50	0.50
	Alt. 2	+			0.60	**0.70**	0.50
	Alt 2 V	+			0.51	0.62	**0.60**
Slope South	SQ	-	6	-4640	**0.47**	**0.38**	0.80
	SQ - EC spp.	-	-5	-1402	0.36	**0.38**	0.60
	Alt. 1	-			0.32	0.30	0.75
	Alt. 2	+			0.14	0.15	**1.00**
	Alt 2 V	+			0.33	0.21	0.60

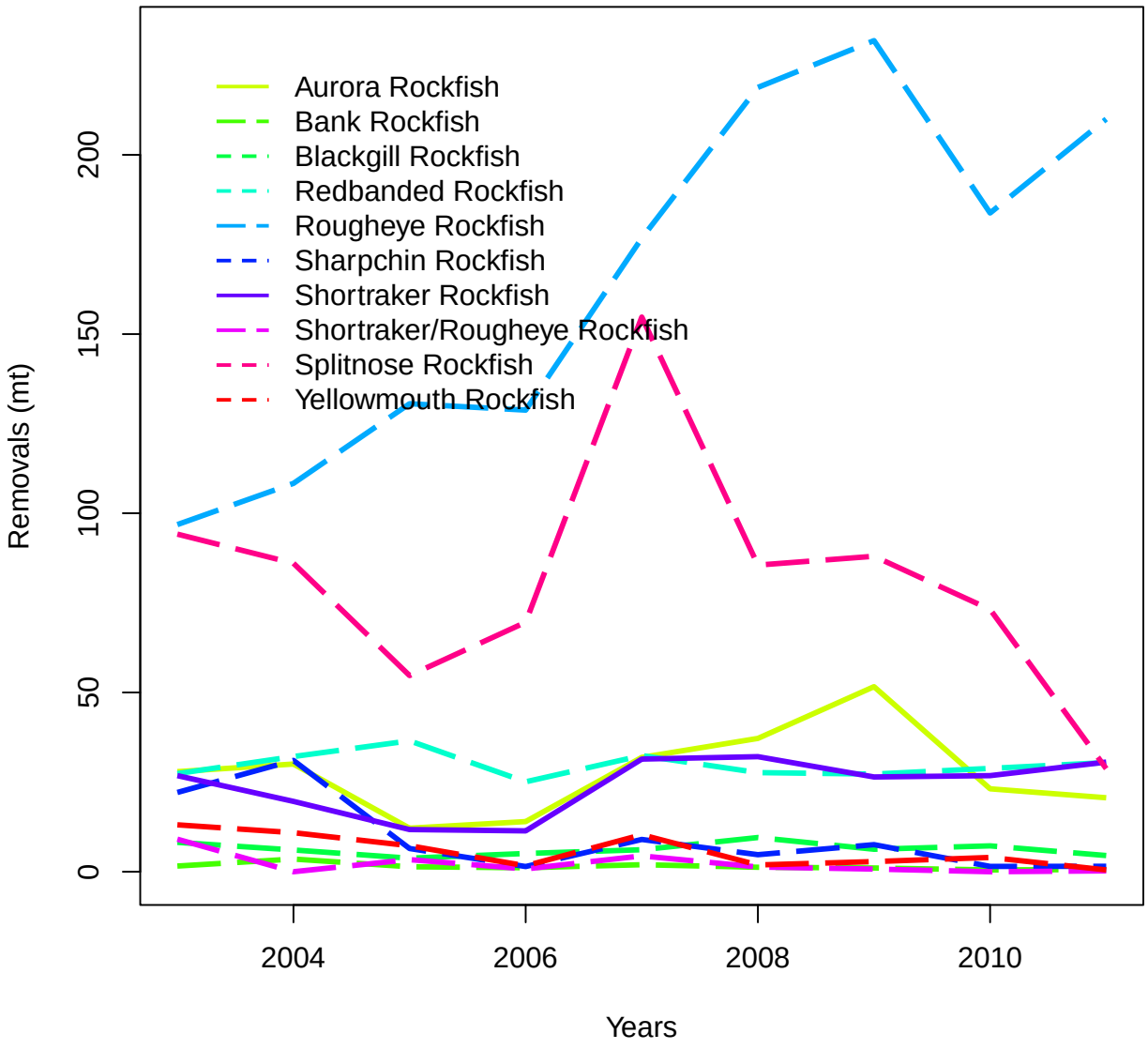

Figure 5. Annual total mortality (minus research catches) of slope rockfish stocks in the Minor Slope Rockfish North stock complex, 2003-2011.

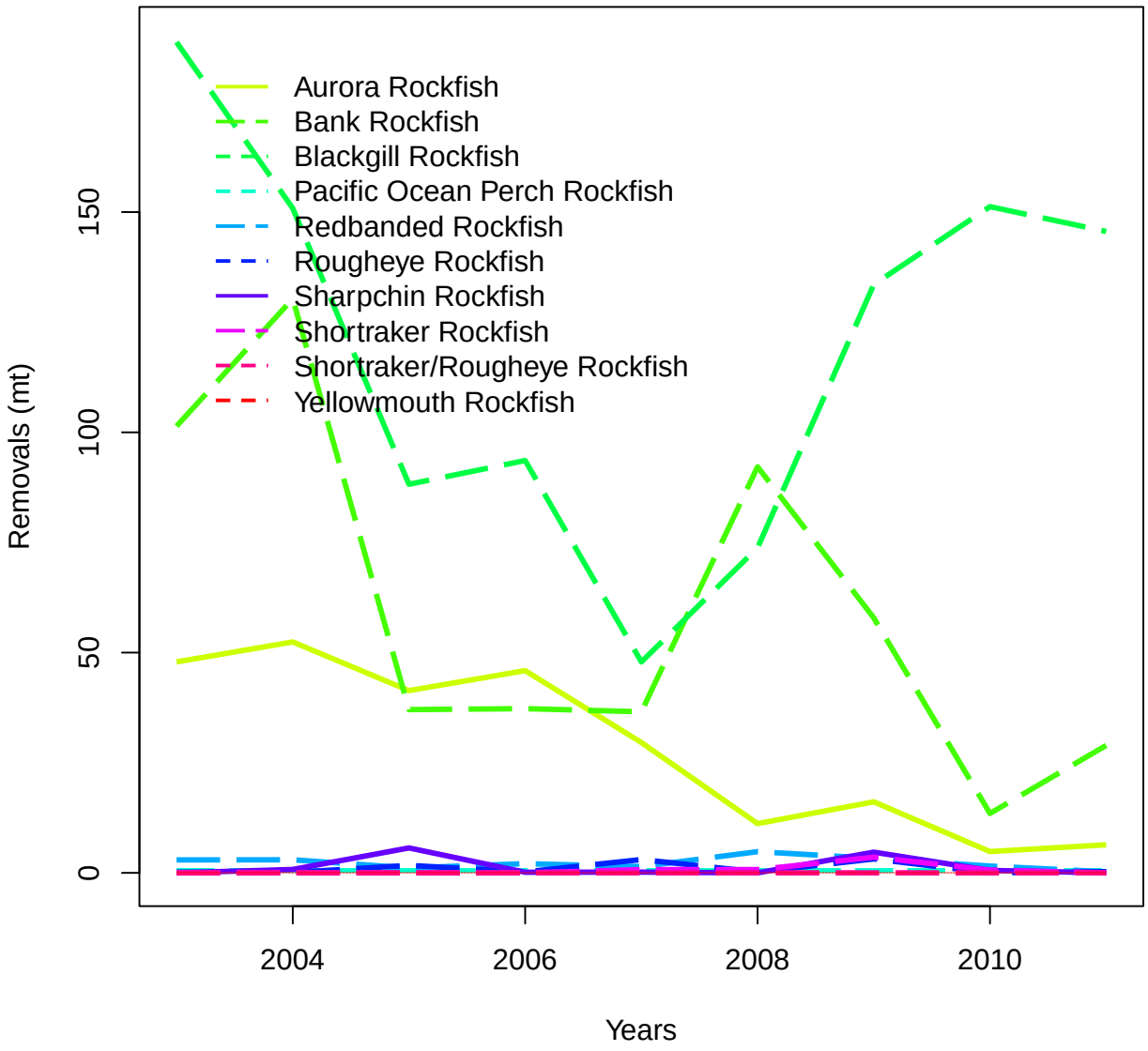

Figure 6. Annual total mortality (minus research catches) of slope rockfish stocks in the Minor Slope Rockfish South stock complex, 2003-2011.

Flatfish

Flatfish stocks are currently managed with stock-specific harvest specifications or within the Other Flatfish complex. Flatfish stocks have relatively high productivities and are therefore not as vulnerable to overfishing (Table 14). The stocks managed in the Other Flatfish complex are all of relatively close vulnerability scores but do vary in their depth distributions. Flatfish alternatives contemplate adding two non-FMP species (slender sole and deepsea sole) into the FMP and the creation of two flatfish complexes into shallow and deeper species groups.

Table 14. Flatfish stocks (non-FMP stocks in bold) ranked by depth group and relative productivity. Productivity (P) and vulnerability (V) scores are from the GMT's PSA analysis.

Depth group	Stock	P	Relative P	V	Relative V
Nearshore	Curlfin sole	2.45	High	1.23	Low
	Butter Sole	2.45	High	1.18	Low
	Pacific sanddab	2.4	High	1.25	Low
	Sand sole	2.35	High	1.23	Low
	Starry flounder	2.15	High	1.04	Low
Shelf	Flathead sole	2.3	High	1.26	Low
	Slender sole	2.25	High	1.14	Low
	English Sole	2.25	High	1.19	Low
	Rock sole	1.95	Low	1.42	Low
	Petrale sole	1.7	Low	1.94	Med
Slope	**Deepsea sole**	2.3	High	1.34	Low
	Rex sole	2.05	Low	1.28	Low
	Arrowtooth flounder	1.95	Low	1.21	Low
	Dover sole	1.8	Low	1.54	Low

Status Quo – Flatfish

There is one status quo flatfish stock complex comprised of unassessed species (Table 15).

Table 15. Status quo flatfish stocks and stock complex.

Flatfish Stocks	Stock Complex
	Other Flatfish
Overfished Stocks	Butter sole
Petrale sole	Curlfin sole
Non-overfished Stocks	Flathead sole
Arrowtooth flounder	Pacific sanddab
Dover sole	Rex sole
English sole	Rock sole
Starry flounder	Sand sole

Alternative 1 – Flatfish

Flatfish alternative 1 contemplates adding two non-FMP species (deepsea sole and slender sole) to the current Other Flatfish stock complex (Table 16).

Table 16. Alternative 1 flatfish stocks and stock complex (bold denotes non-FMP stocks proposed to be incorporated in the FMP).

Flatfish Stocks	Stock Complex
	Other Flatfish
Overfished Stocks	Butter sole
Petrale sole	Curlfin sole
Non-overfished Stocks	**Deepsea sole**
Arrowtooth flounder	Flathead sole
Dover sole	Pacific sanddab
English sole	Rex sole
Starry flounder	Rock sole
	Sand sole
	Slender sole

Alternative 2 – Flatfish

Flatfish alternative 2 contemplates adding two non-FMP species (deep sea sole and slender sole) to the FMP and creating two flatfish stock complexes defined by depth group (Table 17). Flatfish alternative 2 also would bring arrowtooth flounder into the Deep Flatfish stock complex as an indicator stock.

Table 17. Alternative 2 flatfish stocks and stock complexes (bold denotes non-FMP stocks incorporated in FMP, italics denotes stocks moving from stock-specific management to a complex, strikeout denotes a stock moving from a status quo category).

Flatfish Stocks	Stock Complexes	
	Shallow Flatfish	**Deep Flatfish**
Overfished Stocks	Butter sole	*Arrowtooth flounder*
Petrale sole	Curlfin sole	**Deep sea sole**
Non-overfished Stocks	Flathead sole	Rex sole
~~Arrowtooth flounder~~	Pacific sanddab	
Dover sole	Rock sole	
English sole	Sand sole	
Starry flounder	**Slender sole**	

Analysis of the Flatfish Alternatives

The status quo Other Flatfish complex has small overages (Table 18), but massive inflator species (rex sole and sand sole) (Figure 7). Alternative 1 has the most overall improvement in removal-based diagnostics over status quo, although the Alternative 2 Shallow Flatfish complex shows the best improvement in removal ratios. Evenness is generally poor for all complexes.

The status quo and action flatfish alternatives are satisfactory in terms of relatively close correspondence of estimated productivities and vulnerabilities of component stocks (Table 14 and Table 18). However, the ecological and depth distributions of component stocks are dissimilar. Flatfish alternative 2 seeks to stratify new complexes by depth distribution by creating a Shallow Flatfish and a Deep Flatfish complex . Arrowtooth flounder would be added to the Deep Flatfish complex as an indicator stock for managing that

complex since it is an assessed stock. Two other stocks (rex sole and Pacific sanddabs) are scheduled for assessment in 2013 and, if the assessments are endorsed and adopted, could be indicator stocks for alternative flatfish complexes.

Both flatfish alternatives contemplate adding two non-FMP species (slender sole and deepsea sole) into the FMP. Both species have relatively high west coast catches (Figure 7) and are thus considered to be in the groundfish fishery. Managing these two stocks in the FMP would reduce the risk of potential overfishing of these two stocks.

The depth-based complexes under alternative 2 may be more risk-averse in preventing potential overfishing. Harvest specifications in each complex could be better tailored to the fishery with Shallow Flatfish catches primarily occurring shoreward of RCAs and Deep Flatfish catches primarily occurring seaward of the RCA.

Flatfish stocks managed in the status quo Other Flatfish complex are trawl-dominant with over 90 percent of historical landings from bottom trawl gear (PFMC 2010). The formal sector allocations for the Other Flatfish complex decided under Amendment 21 are 90 percent trawl and 10 percent non-trawl, with a set-aside from the trawl allocation specified biennially for the at-sea whiting sectors. The Amendment 21 allocations are the default for restructured flatfish complexes and should meet the needs of the fishery under the proposed flatfish stock complex alternatives since the two species proposed for FMP management under the action alternatives are also predominantly caught in bottom trawls. There could be consideration for a different initial allocation of quota shares to IFQ permits than used to allocate quota for the Other Flatfish complex under alternative 2 since vessels specializing in shallow water efforts (i.e., beach trawlers) are more likely to catch shallow flatfish than deep flatfish and vessels specializing in deep water efforts are more likely to catch deep flatfish. However, once quota share trading and sales are allowed, quota shares will distribute according to the needs of the permit holders.

Table 18. Summary of status quo (SQ) and proposed flatfish complexes in relation to several removal-based diagnostics. See text for descriptions of each measure.

Alternative	P	Cumulative removal difference (mt)		Evenness		Ratios
		Maximum	Minimum	$Removals_{median}$	OFL	%Slope = 0
SQ	+	61	-39730	0.51	**0.50**	0.43
Alt 1	+			**0.52**	0.44	0.56
Alt 2 shallow	+			0.46	0.26	**0.71**
Alt 2 deep	+			0.43	0.49	0.33

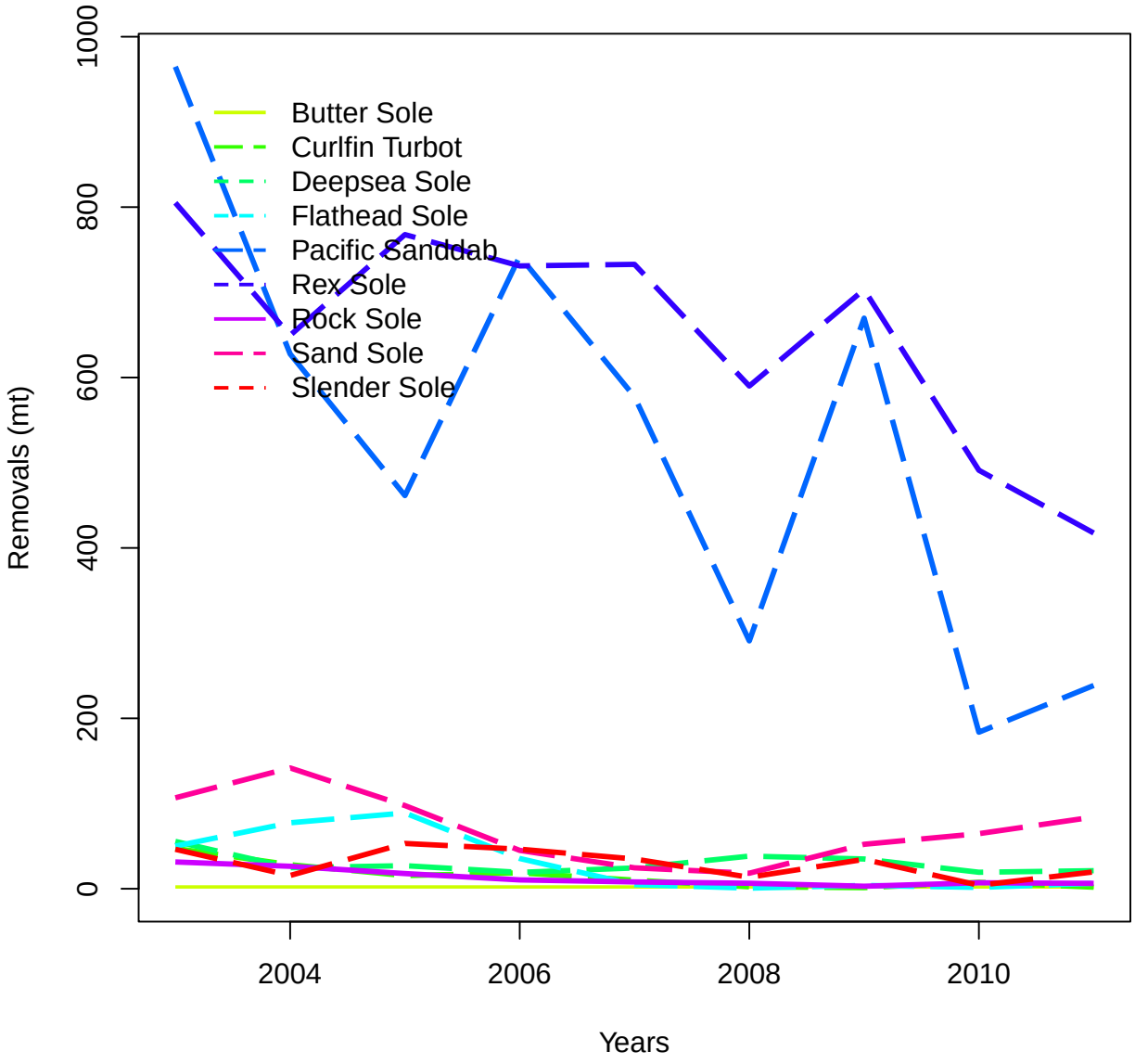

Figure 7. Annual total mortality (minus research catches) of flatfish stocks in the Other Flatfish stock complex, including the two non-FMP species (deepsea sole and slender sole) proposed to be added under the action alternatives, 2003-2011.

Elasmobranchs

The species comprising the Other Fish complex have disparate life histories, ecological relationships, distributions, and vulnerabilities to overfishing (Table 19). All the action alternatives contemplate a complete restructuring of the status quo Other Fish complex since that aggregation of disparate stocks does not meet the purpose and need to manage stocks with similar distributions, similar fishery interactions, similar life histories, and similar vulnerabilities to potential overfishing.

The elasmobranch alternatives contemplate managing elasmobranchs either in separate skate and miscellaneous elasmobranch complexes (Alternatives 1 and 2) or together in aggregate complexes

(Alternatives 3 and 4). Skates and the other miscellaneous elasmobranch species are further managed in shallow and deep groups (Alternatives 2 and 4) according to the depth groups shown in Table 19.

The elasmobranch alternatives also offer consideration for specifying some of the component species as EC species (e.g., soupfin shark) or removing some stocks from the FMP (e.g., leopard shark). The alternatives also contemplate moving some species from stock-specific harvest management into a complex to serve as an indicator stock for managing the complex (e.g., longnose skate) and moving a stock from management in a complex to single stock management (e.g., spiny dogfish).

Table 19. Elasmobranch stocks (non-FMP stocks in bold) ranked by depth group and relative productivity. Productivity (P) and vulnerability (V) scores are from the GMT's PSA analysis.

Depth group	Stock	P	Relative P	V	Relative V
Shallow	Longnose skate	1.53	High	1.68	Low
	Aleutian skate	1.42	High	1.71	Low
	Big skate	1.37	High	1.99	Med
	Brown catshark	1.37	High	1.84	Med
	Leopard shark	1.26	High	2	High
	Spiny dogfish	1.11	Low	2.13	High
	Soupfin shark	1.11	Low	2.02	High
Deep	**Black/roughtail skate**	1.45	High	1.68	Low
	Bering/sandpaper skate	1.37	High	1.8	Low
	California skate	1.21	Low	2.12	High

Status Quo – Elasmobranchs

The elasmobranch stocks in the FMP, including those managed in the status quo Other Fish complex, are depicted in Table 20.

Table 20. Status quo elasmobranch stocks and stock complex.

Elasmobranch Stocks	Stock Complex
	Elasmobranchs in the Other Fish Complex
Non-overfished Stocks Longnose skate	Big skate California skate Leopard shark Ratfish Soupfin shark Spiny dogfish

Alternative 1 – Elasmobranchs

Elasmobranch alternative 1 contemplates eliminating the Other Fish complex and managing those stocks in two complexes (Skate and Miscellaneous Elasmobranchs) (Table 21). Alternative 1 also contemplates adding non-FMP species to the FMP (Aleutian skate, Bering/sandpaper skate, black/roughtail skate, and all other endemic skates to the Skates complex). Longnose skate would be added to the Skates complex as an indicator stock. All endemic skates other than Aleutian skate, Bering/sandpaper skate, big skate, black/roughtail skate, California skate, and longnose skate would be designated EC species. Soupfin shark would also be designated an EC species.

Table 21. Alternative 1 elasmobranch stocks and stock complexes (bold denotes non-FMP stocks proposed to be incorporated in the FMP, italics denotes stocks moving from stock-specific management to a complex, strikeout denotes a stock moving from a status quo category).

Elasmobranch Stocks	Stock Complexes		
	~~Elasmobranchs in the Other Fish Complex~~	**Skates**	**Misc. Elasmobranchs**
Non-overfished Stocks ~~Longnose skate~~	~~Big skate~~ ~~California skate~~ ~~Leopard shark~~ a/ ~~Ratfish~~ ~~Soupfin shark~~ b/ ~~Spiny dogfish~~	**Aleutian skate** **Bering/sandpaper skate** Big skate **Black/roughtail skate** California skate *Longnose skate* **All other skates**	Ratfish Spiny dogfish

a/ Remove from FMP.
b/ Specify as an Ecosystem Component species.

Alternative 2 – Elasmobranchs

Elasmobranch alternative 2 is the same as alternative 1, except the Skates complex is divided into two depth-based complexes (Shallow Skates and Deep Skates) (Table 22).

Table 22. Alternative 2 elasmobranch stocks and stock complexes (bold denotes non-FMP stocks proposed to be incorporated in the FMP, italics denotes stocks moving from stock-specific management to a complex, strikeout denotes a stock moving from a status quo category).

Elasmobranch Stocks	Stock Complexes			
	~~**Other Fish**~~	**Shallow Skates**	**Deep Skates**	**Misc. Elasmobranchs**
Non-overfished Stocks ~~Longnose skate~~ - -	~~Big skate~~ ~~California skate~~ ~~Leopard shark~~ a/ ~~Ratfish~~ ~~Soupfin shark~~ b/ ~~Spiny dogfish~~	**Aleutian skate** Big skate *Longnose skate* **All other skates**	**Bering/sandpaper skate** **Black/roughtail skate** California skate	Ratfish Spiny dogfish

a/ Remove from FMP.
b/ Specify as an Ecosystem Component species.

Alternative 3 – Elasmobranchs

Elasmobranch alternative 3 contemplates eliminating the Other Fish complex and managing those stocks in one Elasmobranch complex (Table 23). Elasmobranch alternative 3 also contemplates adding non-FMP species to the FMP (Aleutian skate, Bering/sandpaper skate, black/roughtail skate, all other endemic skates, and brown catshark to the Elasmobranch complex). All endemic skates managed in the Elasmobranchs complex other than Aleutian skate, Bering/sandpaper skate, big skate, black/roughtail skate, and California skate would be designated EC species. Soupfin shark would also be designated an EC species. Spiny dogfish would be managed with stock-specific harvest specifications.

Table 23. Alternative 3 elasmobranch stocks and stock complexes (bold denotes non-FMP stocks proposed to be incorporated in the FMP, italics denotes stocks moving from stock-specific management to a complex or vice versa, strikeout denotes a stock moving from a status quo category).

Elasmobranch Stocks	Stock Complexes	
	~~**Elasmobranchs in the Other Fish Complex**~~	**Elasmobranchs**
Non-overfished Stocks Longnose skate *Spiny dogfish* -	~~Big skate~~ ~~California skate~~ ~~Leopard shark~~ a/ ~~Ratfish~~ ~~Soupfin shark~~ b/ ~~Spiny dogfish~~	**Aleutian skate** **Bering/sandpaper skate** Big skate **Black/roughtail skate** California skate **All other skates** **Brown catshark** Ratfish

a/ Remove from FMP.
b/ Specify as an Ecosystem Component species.

Alternative 4 – Elasmobranchs

Elasmobranch alternative 4 is the same as alternative 3, except the Elasmobranchs complex is divided into two depth-based complexes (Shallow Elasmobranchs and Deep Elasmobranchs) (Table 24).

Table 24. Alternative 4 elasmobranch stocks and stock complexes (bold denotes non-FMP stocks proposed to be incorporated in the FMP, italics denotes stocks moving from stock-specific management to a complex, strikeout denotes a stock moving from a status quo category).

Elasmobranch Stocks	Stock Complexes		
	~~**Elasmobranchs in the Other Fish Complex**~~	**Shallow Elasmobranchs**	**Deep Elasmobranchs**
Non-overfished Stocks Longnose skate *Spiny dogfish* -	~~Big skate~~ ~~California skate~~ ~~Leopard shark~~ a/ ~~Ratfish~~ ~~Soupfin shark~~ b/ ~~Spiny dogfish~~	**Aleutian skate** Big skate **All other skates** **Brown catshark** Ratfish	**Bering/sandpaper skate** **Black/roughtail skate** California skate

a/ Remove from FMP.
b/ Specify as an Ecosystem Component species.

Analysis of the Elasmobranch Alternatives

The actual status quo alternative for this group of species is the Other Fish complex. However, this complex is so misaligned and poorly constructed with disparate species of different life histories, different distributions, different productivities, and different vulnerabilities that analyzing the Other Fish complex as a viable alternative was not even contemplated. Therefore, the status quo complex alternative for elasmobranchs analyzed in this document is comprised of only the elasmobranchs that are currently managed in the Other Fish complex (Table 20). Given this, status quo shows huge overages of component OFLs (e.g., big skate and ratfish, and species with OFL contributions of 0) (Table 25) and one huge inflator species (spiny dogfish) (Figure 8). As a result, evenness is poor in any alternative that contains either spiny dogfish or species with no OFL contribution (i.e., most of the skates). Alternative 1 shows the best improvement in removal ratios, while Alternative 3 shows the best improvement in removal evenness. Overall, Alternatives 1 and 4 arguably provide the best balance of improvement in both evenness and removal ratios over status quo.

In terms of aggregating stocks with similar productivities (and vulnerabilities), status quo and Alternative 3 fail in that the component stocks are mismatched for those attributes (Table 25). Alternative 1 matches the Miscellaneous Elasmobranchs suitably, but aggregating all the endemic skates in one complex mismatches their relative productivities and vulnerabilities. Alternatives 2 and 4 aggregate elasmobranchs by their depth distributions and better align component stocks with similar productivities and vulnerabilities.

Table 25. Summary of status quo (SQ) and proposed elasmobranch complexes in relation to several removal-based diagnostics. See text for descriptions of each measure.

Alternative	P	Cumulative removal difference (mt)		Evenness		Ratios
		Maximum	Minimum	$Removals_{median}$	OFL	%Slope = 0
SQ	-	1881	-6800	0.43	**0.20**	0.17
Alt 1 skates	-			0.43	0.00	**0.55**
Alt 1 ratdog	+			0.31	0.00	0.33
Alt 2 shallow skates	+			0.39	0.00	0.50
Alt 2 deep skates	+			0.53	0.00	0.33
Alt 2 ratdog	+			0.31	0.00	0.33
Alt 3	-			**0.62**	0.00	0.42
Alt 4 shallow elasmos	+			0.57	0.00	0.44
Alt 4 deep elasmos	+			0.53	0.00	0.33

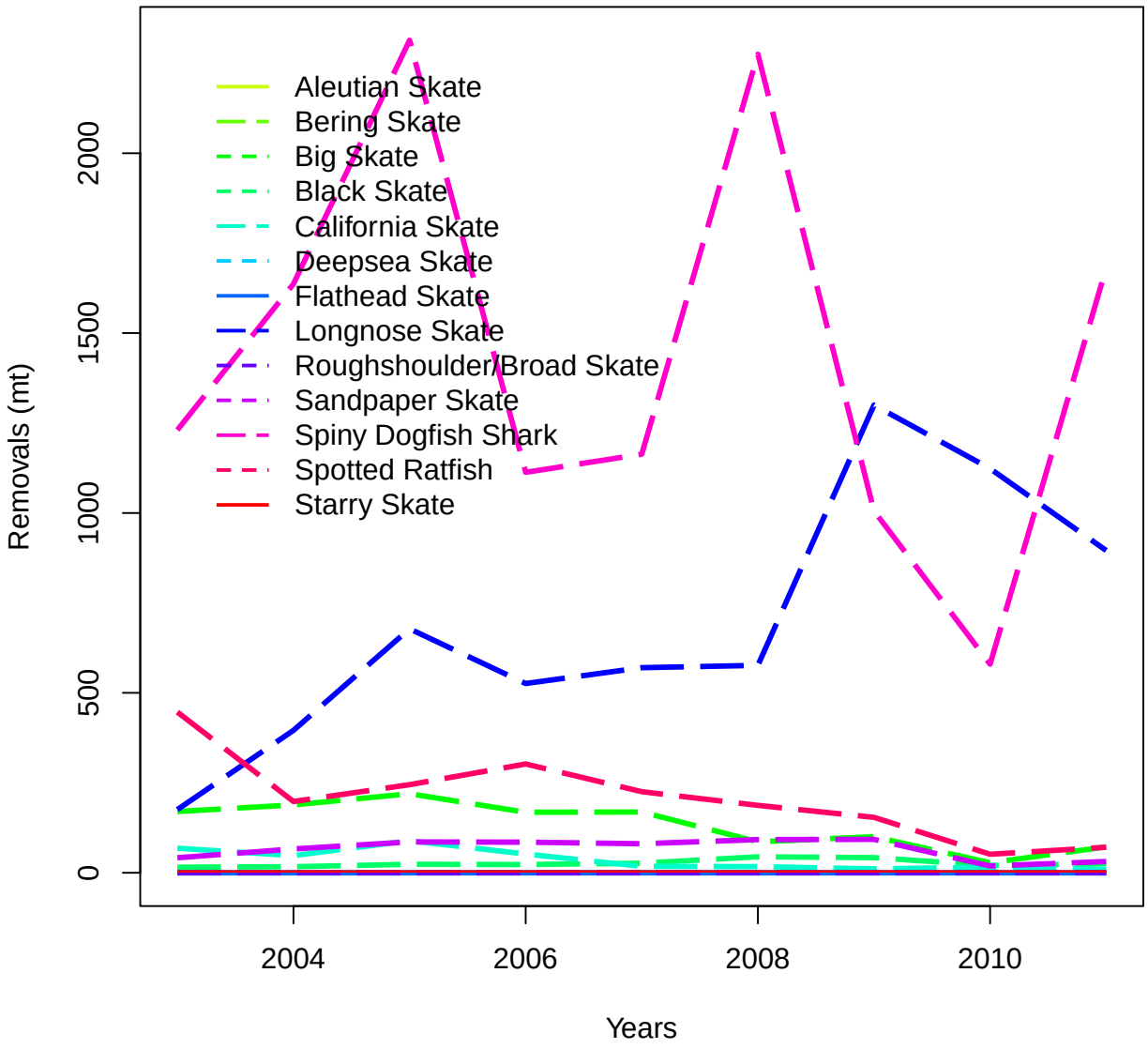

Figure 8. Annual total mortality (minus research catches) of elasmobranch stocks in the Other Fish stock complex, including the addition of the non-FMP species proposed under the action alternatives, 2003-2011.

Roundfish

The species comprising the Other Fish complex have disparate life histories, ecological relationships, distributions, and vulnerabilities to overfishing (Table 26). All the action alternatives contemplate a complete restructuring of the status quo Other Fish complex since that aggregation of disparate stocks does not meet the purpose and need to manage stocks with similar distributions, similar fishery interactions, similar life histories, and similar vulnerabilities to potential overfishing.

The roundfish alternatives contemplate managing roundfish stocks in separate groups that vary by depth and vulnerability to potential overfishing. The roundfish alternatives also offer consideration for specifying some of the component species as EC species (e.g., finescale codling).

Table 26. Roundfish stocks (non-FMP stocks in bold) ranked by depth group and relative productivity. Productivity (P) and vulnerability (V) scores are from the GMT's PSA analysis.

Depth group	Stock	P	Relative P	V	Relative V
Nearshore	California scorpionfish	1.83	High	1.41	Low
	Kelp greenling	1.83	High	1.62	Low
	rock greenling	1.78	High	1.77	Low
	Cabezon	1.72	High	1.68	Low
Shelf	Pacific cod	2.11	High	1.34	Low
	Pacific whiting	2	High	1.69	Low
	Lingcod	1.75	Low	1.55	Low
	Ratfish	1.63	Low	1.72	Low
Slope	**California slickhead**	2.06	High	1.14	Low
	Finescale codling	1.72	High	1.48	Low
	Sablefish	1.61	High	1.64	Low
	Pacific grenadier	1.44	Low	1.82	Med
	Giant grenadier	1.33	Low	1.87	Med

Status Quo – Roundfish

The roundfish stocks in the FMP, including those managed in the status quo Other Fish complex, are depicted in Table 27.

Table 27. Status quo roundfish stocks and stock complexes.

Roundfish Stocks	Stock Complex
	Roundfish in the Other Fish Complex
Non-overfished Stocks	Cabezon (WA)
Cabezon (CA)	Finescale codling
Cabezon (OR)	Kelp greenling
California scorpionfish	Pacific grenadier
Lingcod N and S of 40º10’	
Pacific cod	
Pacific whiting	
Sablefish N and S of 36º	

Alternative 1 – Roundfish

Roundfish alternative 1 contemplates eliminating the Other Fish complex and managing the component roundfish stocks in two complexes (Grenadiers and Nearshore Roundfish) (Table 28). Roundfish alternative 1 also contemplates adding non-FMP species to the FMP (giant grenadier and all other endemic grenadiers to the Grenadiers complex). All endemic grenadiers other than Pacific and giant grenadiers would be specified as EC species. Finescale codling would also be designated an EC species. The Oregon substock of cabezon would be added to the Nearshore Roundfish complex as an indicator stock.

Table 28. Alternative 1 roundfish stocks and stock complexes (bold denotes non-FMP stocks to be incorporated in the FMP, strikeout denotes a stock moving from a status quo category).

Roundfish Stocks	Stock Complexes		
	~~**Roundfish in the Other Fish Complex**~~	**Grenadiers**	**Nearshore Roundfish**
Non-overfished Stocks Cabezon (CA) ~~Cabezon (OR)~~ California scorpionfish Lingcod N and S of 40º10' Pacific cod Pacific whiting Sablefish N and S of 36º	~~Cabezon (WA)~~ ~~California skate~~ ~~Finescale codling~~ a/ ~~Kelp greenling~~ ~~Pacific grenadier~~ - -	Pacific grenadier **Giant grenadier** **All other grenadiers**	Cabezon (WA) *Cabezon (OR)* Kelp greenling **All other greenlings**

a/ Specify as Ecosystem Component species.

Alternative 2 – Roundfish

Roundfish alternative 2 contemplates eliminating the Other Fish complex and managing those stocks in two complexes (Nearshore Roundfish and Deep Roundfish) (Table 29). Roundfish alternative 2 also contemplates adding non-FMP species to the FMP (giant grenadier, all other endemic grenadiers, and California slickhead to the Deep Roundfish complex). Finescale codling would be managed in the Deep Roundfish complex. The California and Oregon substocks of cabezon and California scorpionfish would be added to the Nearshore Roundfish complex as indicator stocks. All endemic grenadiers other the Pacific and giant grenadiers would be designated EC species.

Table 29. Alternative 2 roundfish stocks and stock complexes (bold denotes non-FMP stocks proposed to be incorporated in the FMP, italics denotes stocks moving from stock-specific management to a complex, strikeout denotes a stock moving from a status quo category).

Roundfish Stocks	Stock Complexes		
	~~**Roundfish in the Other Fish Complex**~~	**Nearshore Roundfish**	**Deep Roundfish**
Non-overfished Stocks ~~Cabezon (CA)~~ ~~Cabezon (OR)~~ ~~California scorpionfish~~ Lingcod N and S of 40º10' Pacific cod Pacific whiting Sablefish N and S of 36º	~~Cabezon (WA)~~ ~~California skate~~ ~~Finescale codling~~ ~~Kelp greenling~~ ~~Pacific grenadier~~ -	*Cabezon (CA)* *Cabezon (OR)* Cabezon (WA) *California scorpionfish* Kelp greenling **All other greenlings**	Pacific grenadier **Giant grenadier** **All other grenadiers** **California slickhead** Finescale codling

Analysis of the Roundfish Alternatives

The actual status quo alternative for this group of species is the Other Fish complex. However, this complex is so misaligned and poorly constructed with disparate species of different life histories, different distributions, different productivities, and different vulnerabilities that analyzing the Other Fish complex as a viable alternative was not even contemplated. Therefore, the status quo complex alternative for roundfish analyzed in this document is comprised of only the roundfish stocks that are currently managed in the Other Fish complex (Table 27). Given this, status quo complex demonstrates large inflator species (e.g., Pacific grenadier) (Figure 9). Alternatives 2 and 3 demonstrate the best improvement over status

quo, although this group is still a bit of a mixed species assemblage. The evenness in the Grenadier or Deep Roundfish complex is poor because Pacific grenadier dominates.

All roundfish alternatives consider the addition of non-FMP species, including all grenadiers and all greenlings. Most grenadiers and greenlings landed in West Coast fisheries are landed in general market categories of "unspecified grenadiers" and "unspecified greenlings", respectively; therefore, adding all endemic grenadiers and greenlings to the FMP will allow more accurate OFL estimates using approved catch-based methods. Of the non-FMP grenadiers contemplated for inclusion in the FMP, giant grenadier is present in greater densities than the other endemic grenadiers according to trawl survey CPUEs.

The status quo assemblage of roundfish stocks does not align the relative productivities (and vulnerabilities) of component stocks well due to the lower productivity and higher vulnerability of grenadier (Table 26 and Table 30). All of the action alternatives better align the productivities and vulnerabilities of component stocks since the grenadiers are either managed in their own complex (Alternative 1) or included in an assemblage of deeper roundfish (Alternative 2).

Table 30. Summary of status quo (SQ) and proposed roundfish complexes in relation to several removal-based diagnostics. See text for descriptions of each measure.

Alternative	P	Cumulative removal difference (mt)		Evenness		Ratios
		Maximum	Minimum	$Removals_{median}$	OFL	%Slope = 0
SQ	-	87	-9955	**0.83**	0.48	0.25
Alt 1 cab-greenlings	+			0.36	0.39	0.40
Alt 1 grenadiers	+			0.30	0.00	**0.73**
Alt 2 NS roundfishes	+			0.41	**0.59**	0.67
Alt 2 deep roundfishes	+			0.34	0.00	0.67

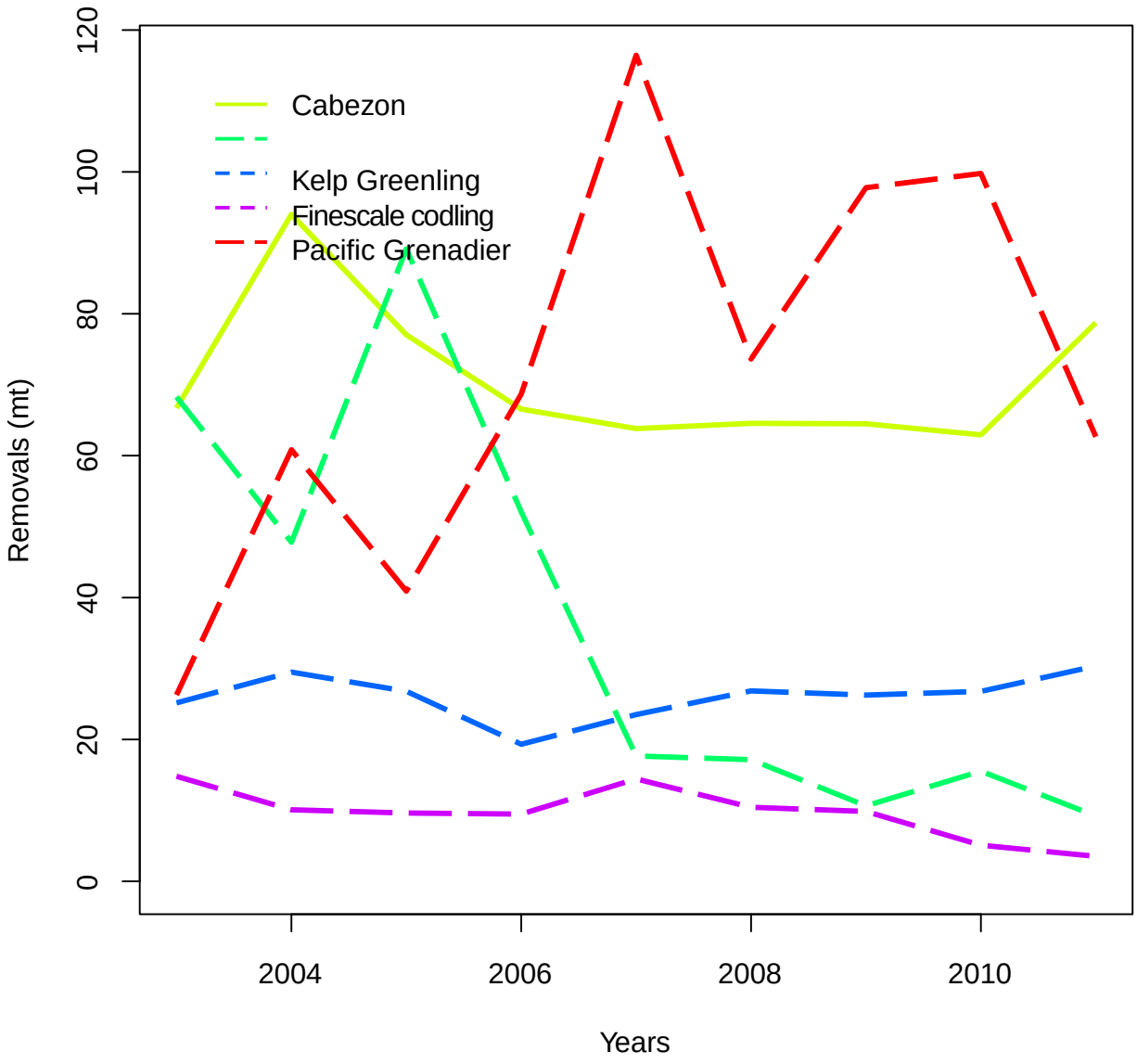

Figure 9. Annual total mortality (minus research catches) of roundfish stocks in the Other Fish stock complex, 2003-2011.

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