GROUNDFISH

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TABLE OF CONTENTS

TABLES AND FIGURES

OVERVIEW

Groundfish abundance trends are generally upward or stable, though the underlying population structure, which builds more slowly than overall spawning biomass, shows most stocks are below indicator target levels.

EXECUTIVE SUMMARY

Groundfish are an important component of the California Current. Over 46 indicators of groundfish population size and population condition were evaluated for use on the 90+ groundfish stocks of the California Current during 2012 (Cope et al. 2013). We used two indicators of groundfish population size: 1) biomass of groundfish relative to either the estimate of unfished biomass (when a stock assessment is available) or trends in the survey time series, and 2) the number of assessed species below management thresholds. Additionally, two indicators of groundfish population condition were selected: 1) the proportion of the population mature (using ages or size in the absence of ages), and 2) the 95% cumulative age or length of the population. We summarized the status of stocks (based on biomass trends) and population demographic condition (as measured by the percentage of mature individuals and of maximum age or size) for 36 groundfishes; the remaining species did not have sufficient data to determine their status at this time. We found that most assessed groundfishes are above the biomass limit reference point, and thus are not overfished (Figure GF 1; Table GF 1). The three assessed stocks currently in an overfished state are all rockfishes. All assessed groundfishes are below their target catch, thus overfishing is not occurring in these stocks. With respect to population condition measures, we discovered that age or length structure tended to show more changes (usually declines) over time than the proportion that is sexually mature. We also found that non-elasmobranch groundfishes tended to exhibit the most changes over time in both measures, with rockfishes being most sensitive to demographic changes. The development of additional data-limited methods may allow more species to be included in future iterations of the IEA.

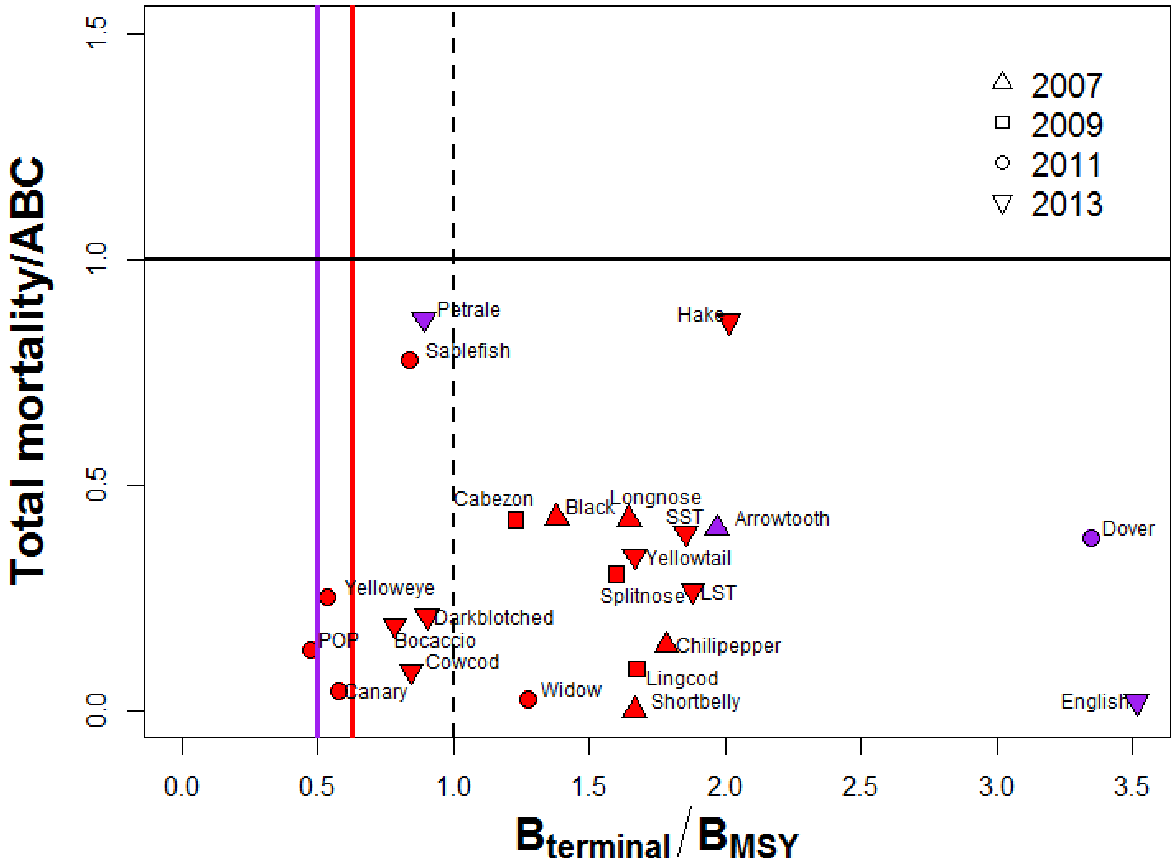

Figure GF1. Stock status plot relative to being overfished (x-axis) and overfishing (y-axis) for all species assessed since 2007 that were not managed in a stock complex at the time of the assessment. Vertical broken line indicates the target biomass reference point. Vertical solid line indicates the limit reference point indicating an overfished status (red for elasmobranchs, rockfishes, and roundfishes; purple for flatfishes). Horizontal line indicates overfishing wherein total mortality exceeds the allowable biological catch (ABC). For example, sablefish is below the target (black vertical broken line), but above the limit (red vertical solid line) biomass target, and below the overfishing limit (horizontal solid line). Symbols indicate the terminal year of the assessment in which the reference points are determined.

Table GF1. Results for each stock evaluated for each of two status indicators: 1) Biomass and 2) Population structure. Two sources of information were used: 1) Stock assessments and 2) Northwest Fisheries Science Center (NWFSC) shelf-slope trawl survey, when assessments were not available, or older than 2007. "Depletion" refers to the relative change in spawning biomass; "5-year trend" is the trend in the last 5 years of the time series (details found in the text). "B final year" is the biomass value in the final year compared to the 5-year average. "Prop. mature" is proportion of the population mature relative to the beginning of the time series; "95% cum." refers to the 95% cumulative age or length of the population relative to the beginning of the time series. +: above target limit or increasing over last 5 years; ●: between target and limit or stable; -: below limit or decreasing. Blank spaces indicate no information reported.

		Biomass				Population structure			
		Assessment		NWFSC Survey		Assessment		NWFSC Survey	
Taxa	Stock	Depletion	5-yr trend	B final year	5-yr trend	Prop. mature	95% cum. age	Prop. mature	95% cum. lt.
Elasmobranch	Longnose skate	+	●	●	●	●	-	●	●
	Spiny dogfish	+	●			●	-		
	Spotted ratfish			●	●			+	●
Flatfishes	Arrowtooth flounder	+	+	●	+	-	-	-	-
	Dover sole	+	●			●	●		
	English sole	+	+			+	-	-	●
	Flathead sole			●	●			●	●
	Pacific sanddab			●	+			●	●
	Petrale sole	●	●			-	-		
	Rex sole	+	+					●	●
Rockfishes	Aurora	+	●			-	●		
	Black	+	+			-	-		
	Blackgill	●	●			-	-		
	Bocaccio	●	+			-	-		
	Canary	-	●			-	-		
	Chilipepper	+	●	●	●	●	-	-	+
	Cowcod	-	●			-	-		
	Darkblotched	●	+			-	-		
	Greenspotted	●	+			-	-		
	Greenstriped	+	+			●	-		
	Pacific Ocean perch	-	●			-	-		
	Redstripe			+	●			-	●
	Rougheye	+	+			●	●		
	Shaprchin	+	+						
	Shortbelly			●	●			●	●
	Splitnose	+	+			-	-		
	Stripetail			●	●			●	●
	Widow	+	+			●	-		
	Yelloweye	-	●			-	-		
	Yellowtail			●	●			●	●
Thornyheads	Longspine	+	+			●	●		
	Shortspine	+	-			●	●		
Roundfishes	Cabezon	+	+			-	-		
	Lingcod	+	+			-	-		
	Pacific Hake	+	+						
	Sablefish	●	-			●	●		

DETAILED REPORT

BACKGROUND - GROUNDFISH

Groundfish are generally defined as a community of fishes that are closely associated with the ocean bottom. In the CCLME, some of the better known species include the rockfishes (Scorpaenidae), flatfishes (Pleuronectidae and Bothidae), sculpins (Cottidae), Pacific hake (*Merluccius productus*), sablefish (*Anoplopoma fimbria*), greenlings and lingcod (Hexagrammidae), skates (Rajidae), and benthic sharks (PFMC 2008). Similar to most fishes, many groundfish species have a planktonic larval and young-of-year life history stage in which young fish inhabit surface waters and feed on a diet of zooplankton. After a few months in the plankton, most species settle to the bottom, generally moving to deeper waters and they age/grow. Groundfish vary across a wide range of trophic levels and inhabit all types of habitats (e.g., rocky, sandy, muddy, kelp) from the intertidal zone to the abyss and have generally variable recruitment, often mature late, and are long lived.

This community of fishes constitutes a large biomass in the CCLME and provides the economic engine for coastal communities in Washington, Oregon, and California. The Pacific Fishery Management Council (PFMC) manages a subset of groundfish species that are typically captured during fishing operations along the U.S. West Coast. Those species caught in the Pacific groundfish trawl fishery were worth approximately $40 million in 2009 (NOAA Press Release 2010). Thus, understanding how groundfish populations fare over time is of great interest to ecosystem managers and the coastal communities that derive much of their wealth from this assemblage of fishes.

INDICATOR SELECTION

Forty six potential indicators of groundfish population size and condition were evaluated using the ecological literature as a basis for their rankings (for detailed methods, see Levin and Schwing 2011, Cope et al. 2013). For population size, the top ranked indicators included: 1) biomass of groundfish relative to either the estimate of unfished biomass (when a stock assessment is available) or trends in the NWFSC annual groundfish trawl survey time series, and 2) the number of assessed species below management thresholds (Table GF 2). For groundfish population condition, the selected indicators were: 1) the proportion of the population mature (using ages or size in the absence of ages) and 2) the 95% cumulative age or length of the population (Table GF 2). These indicators are described briefly below.

Table GF2. Top indicators for groundfish population size (attribute 1) and population condition (attribute 2).

Attribute	Indicator	Definition and source of data	Time series	Sampling frequency
Population Size	Groundfish biomass	Tier 1: Modeled estimates of spawning biomass as measured by stock depletion from assessments beginning in 2007 as methods have been most stable during the 2007 – present. Tier 2: Relative biomass estimates as measured by the trend in the NWFSC annual survey	Tier 1: Variable by species Tier 2: 2003-2011	Annual estimate from both Tier 1 and 2 indicators
Population Size	Number of assessed species below management thresholds	Number of species below the PFMC overfished level and currently subject to rebuilding plans	N/A	Biannual rebuilding analyses
Population Condition	Population age (or size) structure	Tier 1: Modeled estimates of age structure (or size structure in the absence of age) from assessments beginning in 2007 as methods have been most stable during the 2007 – present. Tier 2: Age structure (or size structure in the absence of age) from the NWFSC annual survey	Tier 1: Variable by species Tier 2: 2003-2011	Annual estimate from both Tier 1 and 2 indicators

ATTRIBUTE 1 -POPULATION SIZE

CHANGE IN GROUNDFISH BIOMASS

Groundfish biomass was used relative to either the estimate of the unfished biomass from a stock assessment or trends in relative abundance from the survey time series (stock depletion):

a. Tier 1: Modeled estimates of stock depletion based on estimates of spawning biomass from assessments beginning in 2007 as earlier assessments are out of date.

b. Tier 2: Trends in stock depletion based on relative biomass estimates from the NWFSC annual trawl survey.

NUMBER OF ASSESSED SPECIES BELOW MANAGEMENT THRESHOLDS

Two tiers are specified for biomass of groundfish as a measure of abundance. Stock assessments provide the best available estimates of spawning stock biomass and depletion, because they integrate all of the available data on each stock over the full exploitation history of each stock. In the absence of a stock assessment, the NWFSC annual survey relative biomass index provides the best information available to estimate trends in the stock size, albeit over a shorter time series in comparison to the stock assessments. As stock assessments are generally updated on a 2-6 year cycle, for stock assessments that do not extend beyond 2007 the IEA is providing both the time series of spawning stock biomass from the assessment as well as the trend in biomass from the survey. As hake cannot be monitored for trends via the NWFSC annual bottom trawl survey due to likely annual changes in availability to the survey gear, the hake acoustic relative survey biomass is used as an alternative. The number of species below management thresholds was chosen because it is an easy measure of species or stocks that have typically been doing poorly in the past, but we recognize that documents (Miller et al. 2009) already exist that communicate this information. Thus this indicator may not be necessary in a final status report of the CCLME.

ATTRIBUTE 2 - POPULATION CONDITION

METRICS OF POPULATION AGE (OR SIZE IN THE ABSENCE OF AGE) STRUCTURE

a. Tier 1: Modeled estimates of age structure (or size structure in the absence of age) from assessments beginning in 2007 as earlier assessments are out of date.

b. Tier 2: Age structure (or size structure in the absence of age) from the NWFSC annual survey

These indicators are among the top indicators evaluated. Rebuilding timeline was not chosen as one of the final indicators because it is only available for species which have been formally considered overfished; thus it is only useful for a small number of species that are already below the target reference point. Using age structure accounts for many of the ecological processes that would affect age at maturity, so age at maturity is eliminated from the final indicator suite. Where available age structure is used as the indicator; however, size structure has been used in lieu of age structure where age data are not available. Size structure was not in the top quartile for population condition indicators, but it is the top-ranked indicator in the second quartile.

POPULATION AGE OR SIZE STRUCTURE

The mean age or size of all species caught in either fishery-independent surveys, fishery-dependent surveys, or landings is thought to be a useful and simple indicator to evaluate the overall effects of fishing (e.g., changes in rates of mortality) on an ecosystem (Fulton et al. 2005, Link 2005, Coll et al. 2009). Age and size-based metrics respond to fishing impacts because age and body size determines the vulnerability of individuals, populations, and communities (Jennings and Dulvy 2005). Others contend that there are very few examples where length-based analysis leads to useful management advice, in part because of the need for age and gear selectivity information, and because size related changes in distribution will influence data (Hilborn and Walters 1992). Additionally, older individuals tend to be more fecund and some fish species produce larvae that have a higher survival rates than larvae from younger fish (Berkeley 2004, Bobko and Berkeley 2004). Age and size based metrics are thought to better support medium-term rather than year-to-year management evaluation, because the response to management actions often cannot be quantitatively interpreted for contributing causal factors without extensive additional research (Jennings and Dulvy 2005).

Fish population age and size structure has been linked to scientifically defined reference points or progress targets. Some have based these on a decline in mean size of greater than 30% (warning or precautionary threshold) or greater than 50% (limiting reference point), the latter of which was chosen because it corresponds to an observed doubling in the time series of length after fishing has decreased (Link 2005). Others suggest that practical issues currently preclude the development and adoption of firm reference points for size-based indicators, although an appropriate target would be a reference direction that is consistent with a decline in the overall human impacts of fishing on the community, and thereby on the ecosystem (Jennings and Dulvy 2005). Similar reference points could be defined for mean population age.

The principal attraction of size-based metrics is the widespread availability of species size and abundance data collected during ongoing monitoring programs (Jennings and Dulvy 2005). Many monitoring programs collect a more limited but potentially more informative set of age data. The AFSC triennial survey and NWFSC annual survey have collected size data from a large array of species, and age data from a more limited set of species. The NWFSC annual survey collects up to 100 length measurements, sex determinations, and individual weights, and up to 25 age structures per trawl haul for key species, and more recently for all groundfish species of management concern (Keller et al. 2008). There are well recognized gear-selectivity issues associated with age and size data (Hilborn and Walters 1992) and ideally indicators should be calculated for age and size classes that are well selected by the gear. Fish population age and size structure has been used as an indicator in a variety of other ecosystems, including the Celtic Sea (Blanchard et al. 2005), northeastern U.S. continental shelf (Link and Brodziak 2002), and eastern Bering Sea (AFSC 2009).

STATUS AND TRENDS: GROUNDFISH

MAJOR FINDINGS

Stock status (based on biomass trends) and population demographic condition (as measured by proportion mature and of maximum age or size) were summarized for 36 groundfish species (Table GF3). Most assessed groundfishes were above the biomass limit reference point, and are thus not overfished (Figure GF2). The three assessed stocks currently in an overfished state are all rockfishes. All assessed groundfishes are below their target catch, thus overfishing is not occurring in these stocks. Regarding population condition measures, age or length structure tended to show more changes, usually declines, over time than proportion mature. Non-elasmobranch groundfishes tended to see the most changes over time in both measures, with rockfishes being most sensitive to demographic changes.

Table GF3. List of groundfish for which indicators were calculated. This list is composed of species in assemblages identified in Cope and Haltuch (2012), species with quantitative stock assessments completed from 2007-2013, and species that are well surveyed by the NWFSC annual trawl survey. Note that due to limited data availability, yelloweye rockfish would be removed from this species list without the results of a current stock assessment. Pacific hake would also be removed from this list without a current stock assessment because the trawl survey data alone are subject to changes in hake availability over time. However, as hake is currently assessed every year, hake should remain on the species list.

Species	Scientific name	Assessment Years
Longnose skate	*Raja rhina*	2007
Spiny dogfish	*Squalus acanthias*	2011
Spotted Ratfish	*Hydrolagus colliei*	
Arrowtooth flounder	*Atheresthes stomias*	2007
Dover sole	*Microstomus pacificus*	2011
English sole	*Parophrys vetulus*	2013
Flathead sole	*Hippoglossoides elassodon*	
Pacific Sanddab	*Citharichthys sordidus*	2013
Petrale sole	*Eopsetta jordani*	2009, 2011, 2013
Rex sole	*Glyptocephalus zachirus*	
Aurora rockfish	*Sebastes aurora*	2013
Black rockfish	*Sebastes melanops*	2007
Blackgill rockfish	*Sebastes melanostomus*	2011
Bocaccio rockfish	*Sebastes paucispinis*	2007, 2009, 2011, 2013
Canary rockfish	*Sebastes pinniger*	2007, 2009, 2011
Chilipepper rockfish	*Sebastes goodei*	2007
Cowcod	*Sebastes levis*	2013
Darkblotched rockfish	*Sebastes crameri*	2007, 2009, 2011, 2013
Greenspotted rockfish	*Sebastes chlorostictus*	2011
Greenstriped rockfish	*Sebastes elongatus*	2009
Pacific Ocean Perch	*Sebastes alutus*	2007, 2009, 2011
Redstripe rockfish	*Sebastes proriger*	
Rougheye rockfish	*Sebastes aleutianus*	2013
Sharpchin rockfish	*Sebastes zacentrus*	
Shortbelly rockfish	*Sebastes jordani*	2007
Splitnose rockfish	*Sebastes diploproa*	2009
Stripetail rockfish	*Sebastes saxicola*	
Widow rockfish	*Sebastes entomelas*	2007, 2009, 2011
Yelloweye rockfish	*Sebastes ruberrimus*	2007, 2009, 2011

Yellowtail rockfish	*Sebastes flavidus*	
Longspine Thornyhead	*Sebastolobus altivelis*	2013
Shortspine Thornyhead	*Sebastolobus alascanus*	2013
Cabezon	*Scorpaenichthys marmoratus*	
Lingcod	*Ophiodon elongatus*	2009
Pacific hake	*Merluccius productus*	2007-2013
Sablefish	*Anoplopoma fimbria*	2011

ATTRIBUTE 1 -POPULATION SIZE

SUMMARY

Biomass trajectories are a commonly used indicator of fisheries population dynamics and show the details of how population biomass has changed over time. Trends in the time series of abundance smooth out the dynamics to offer a directional summary of the changes. And while absolute biomass trends can be used, it is more common to consider the change in biomass relative to unfished condition, termed "depletion". A stock in considered more depleted when this ratio is relatively smaller, and less depleted when it is relatively larger. This ratio has particular meaning in groundfish management, where status reference points are based on depletion. For groundfishes other than flatfishes, the target depletion is 40% of unfished levels and the limit reference point (the value under which stocks are considered overfished) is 25% unfished levels. For the flatfishes, the target and limit reference points are 25% and 12.5%, respectively. All subsequent biomass measures are the mature female biomass, also called "spawning biomass", which is the commonly used biomass metric of age-structured stock assessments.

Ideally one would be able to census a population over a long period of time to get a direct measure of stock status for that period. Such detailed population information is not available for any Pacific coast groundfishes, so the next best source of status information is to use the population biomass estimates from age-structured stock assessments. Age-structured stock assessments combined fishery removals, abundance indices, size composition data, and life history information to reconstruct an estimation of how the population biomass changed over time. Barring the availability of stock assessment information, trends in indices of abundance as measured by a fishery-independent survey (specifically, the annual groundfish trawl survey conducted by the Northwest Fisheries Science Center since 2003) were considered. Of the 90+ groundfish species in the groundfish Fishery Management plan, 36 species had either of these data sources available, and thus were considered for status determination. The current development of data-limited methods (e.g., Cope 2013) may allow more groundfishes to be included in this summary for future iterations of the IEA.

For the analysis of groundfish status, we considered stock assessments from 2007 to 2013 to derive relative biomass trajectories. This was available for 28 of the 36 groundfishes considered. For the remaining 8 stocks, NWFSC trawl survey indices of abundance were used. Stocks with assessments only up until 2007 were also supplemented with the results of the survey abundance. Because the survey indices are limited in temporal coverage, relative trends in abundance rather than depletion are used and the change in index trend compared to the average biomass value and variance over the last 5 years are used instead of depletion reference points. Current population dynamics in the relative biomass trajectories were also evaluated for the last 5 years of the time series. Groundfish stocks were considered in 5 major groups: 1) Elasmobranchs, 2) Flatfishes, 3) Rockfishes, 4) Thornyheads, and 5) Other or Roundfishes. Within the first three groups, depth was used to distinguish three additional ecological categories: 1) nearshore, 2) shelf, and 3) slope. In general, there are very few nearshore representatives given the lack of assessments of nearshore species and the inadequacy of the trawl survey to sample the nearshore environment, so this status analysis is mostly limited to shelf and slope species. Full time series are provided for each series, but the last 5 years are used to determine the most recent trends.

Overall, most assessed groundfishes are above the biomass limit reference point, and are thus not overfished (Figure GF2). The only assessed stocks currently below the overfished status reference point are all rockfishes. All assessed groundfishes are below their target catch, thus overfishing is not occurring in these stocks. Many of the stocks show biomass around or above the target reference point as well as stable or increasing in the short term (Table GF4).

ELASMOBRANCHS (FIGURES GF3-GF6; TABLE GF4)

Assessed elasmobranch stocks are all above target depletion levels, while all stocks presented show stable population dynamics over the last 5 years.

FLATFISHES (FIGURES GF7-GF14; TABLE GF4)

Two of the three assessed flatfishes were above the target depletion level with one between the target and limit status reference levels. All of the species showed either increasing or stable population dynamics over that past 5 years. The shelf stock represented were either above target and/or demonstrated stable dynamics over the last five years. There is some indication that rex sole is in a slightly downward trend over the last five years, but is currently within the stable limit.

ROCKFISHES (FIGURES GF15-GF35; TABLE GF4)

All categories of rockfishes show a similar pattern of historical declines with contemporary population increases. Black rockfish (Figure GF15) is the only representative of the nearshore rockfish complex, and it shows a recent increase with the population above the target level. Because of the diversity of life histories and fisheries interactions in the nearshore environment, black rockfish cannot be used as a proxy for the other species. The shelf species also show increasing or steady populations in recent years. A recent assessment of Cowcod; (Figure GF20) suggests that what was once thought to be a drastically reduced population was only moderately reduced, and is now increasing. Slope species, with generally higher longevities, show a variety of population responses and tend to have below targeted level status.

THORNYHEADS (FIGURES GF36-GF37; TABLE GF4)

Thornyheads, while a target of recent live-fish enterprises, have not demonstrated major declines from pre-exploitation levels, both species indicate relative biomass is well above target reference points.

ROUNDFISHES (FIGURES GF38-GF41; TABLE GF4)

The roundfishes category is an amalgam of species with very different life histories and adult habitat. The group tends to be at around the target biomass levels with increasing population trajectories, except for sablefish (Figure GF41), which is both below target and trending downward.

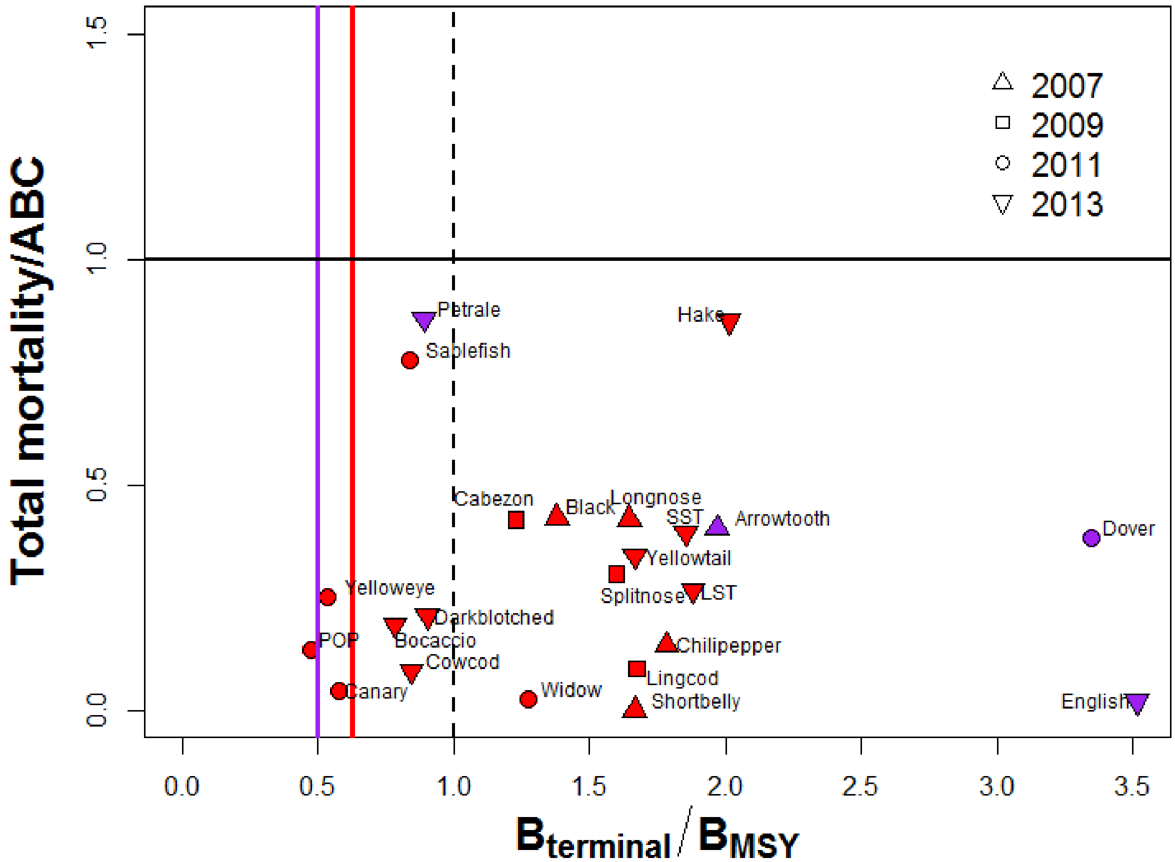

Figure GF2. Stock status plot relative to being overfished (x-axis) and overfishing (y-axis) for all species assessed since 2007. Vertical broken line indicates the target biomass reference point. Vertical solid line indicates the limit reference point indicating an overfished status (red for elasmobranchs, rockfishes, and roundfishes; purple for flatfishes). Horizontal blue line indicates overfishing wherein total mortality exceeds the allowable biological catch (ABC). Symbols indicate the terminal year of the assessment in which the reference points are determined.

Table GF4. Results for each stock evaluated for each of two status indicators: 1) Biomass and 2) Population structure. Two sources of information were used: 1) Stock assessments and 2) Northwest Fisheries Science Center (NWFSC) shelf-slope trawl survey, when assessments were not available, or older than 2007. "Depletion" refers to the ratio of spawning biomass in the most current year relative to initial population spawning biomass ; "5-year trend" is the trend in the last 5 years of the time series (details found in the text). "B final year" is the biomass value in the final year compared to the 5-year average. "Prop. mature" is proportional of the population mature relative to the beginning of the time series; "95% cum." refers to the 95% cumulative age or length of the population relative to the beginning of the time series. +: above target limit or increasing over last five years; ●: between target and limit or stable; -: below limit or decreasing. Blank spaces indicate no information reported.

		Biomass				Population structure			
		Assessment		NWFSC Survey		Assessment		NWFSC Survey	
Taxa	Stock	Depletion	5-yr trend	B final year	5-yr trend	Prop. mature	95% cum. age	Prop. mature	95% cum. lt.
Elasmobranch	Longnose skate	+	●	●	●	●	-	●	●
	Spiny dogfish	+	●			●	-		
	Spotted ratfish			●	●			+	●
Flatfishes	Arrowtooth flounder	+	+	●	+	-	-	-	-
	Dover sole	+	●			●	●		
	English sole	+	+			+	-	-	●
	Flathead sole			●	●			●	●
	Pacific sanddab			●	+			●	●
	Petrale sole	●	●			-	-		
	Rex sole	+	+					●	●
Rockfishes	Aurora	+	●			-	●		
	Black	+	+			-	-		
	Blackgill	●	●			-	-		
	Bocaccio	●	+			-	-		
	Canary	-	●			-	-		
	Chilipepper	+	●	●	●	●	-	-	+
	Cowcod	-	●			-	-		
	Darkblotched	●	+			-	-		
	Greenspotted	●	+			-	-		
	Greenstriped	+	+			●	-		
	Pacific Ocean perch	-	●			-	-		
	Redstripe			+	●			-	●
	Rougheye	+	+			●	●		
	Shaprchin	+	+						
	Shortbelly			●	●			●	●
	Splitnose	+	+			-	-		
	Stripetail			●	●			●	●
	Widow	+	+			●	-		
	Yelloweye	-	●			-	-		
	Yellowtail			●	●			●	●
Thornyheads	Longspine	+	+			●	●		
	Shortspine	+	-			●	●		
Roundfishes	Cabezon	+	+			-	-		
	Lingcod	+	+			-	-		
	Pacific Hake	+	+						
	Sablefish	●	-			●	●		

SPECIFIC TIME SERIES

INTERPRETING BIOMASS TIME SERIES PLOTS

Green area is above the relative target spawning biomass, red is below the limit relative target spawning biomass, and yellow is between the target and limit values. Gray shaded area indicates the last 5 years. Significant population increases were defined as more than 1% per year, while significant decreases were more than -1% a year. No change was less than 1% either way per year. A 1% threshold was chosen arbitrarily and would lead to a minimum of a 10% increase in a decade's time. If an assessment was done in 2007 or not available, current survey trends were provided when available. Because the survey data time series is significantly shorter than the stock status time series, two different measures of relative change and trend are used. The mean (solid line) and +/- 1 standard deviation (broken lines) for the full trawl survey time series is calculated and shown in green. A linear trend is fit to the last five years and the change in biomass over that trend is compared to 1 standard deviation from the mean. The average biomass for the last 5 years is also calculated and compared to the full time series mean.

ELASMOBRANCHS (N=3)

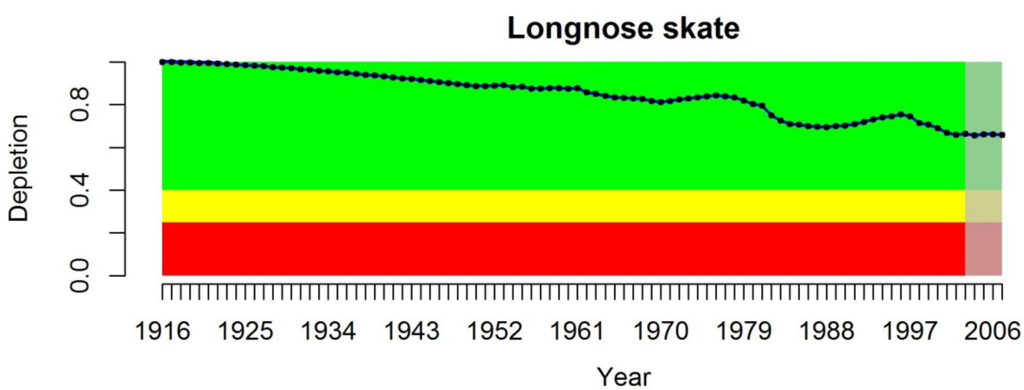

Figure GF3. Relative abundance trajectory 1916-2007 for longnose skate.

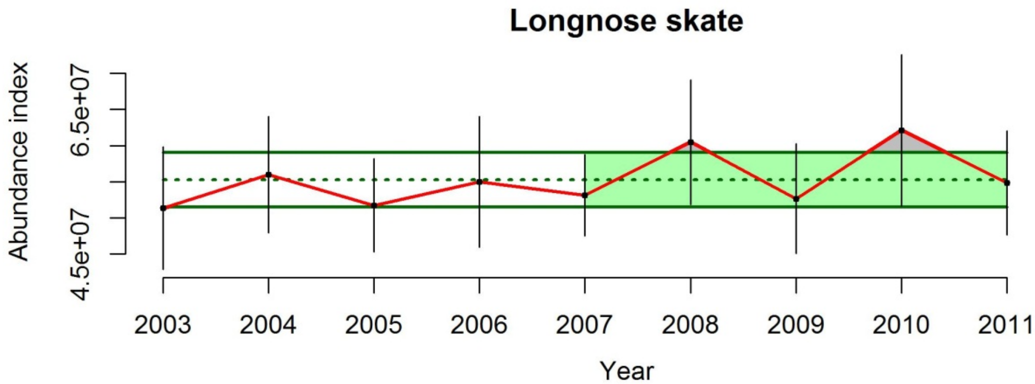

Figure GF4. Trawl survey design-based estimates of longnose skate biomass for years 2003-2011.

Summary: Longnose skate has shown a slow decline over the length of the time series, but with stable population dynamics in the most recent 5 years. Relative biomass appears to have maintained a level above the target biomass in all years.

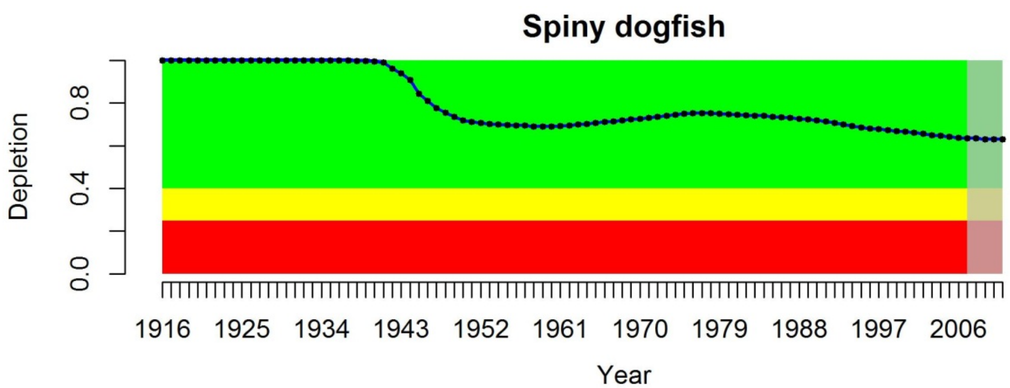

Figure GF5. Relative abundance trajectory 1916-2011 for spiny dogfish.

Summary: After an initial steep decline in the 1940s, relative spiny dogfish abundance has slowed in decline or remained stable in recent years. The population appears to have been above the target relative biomass reference point in all years.

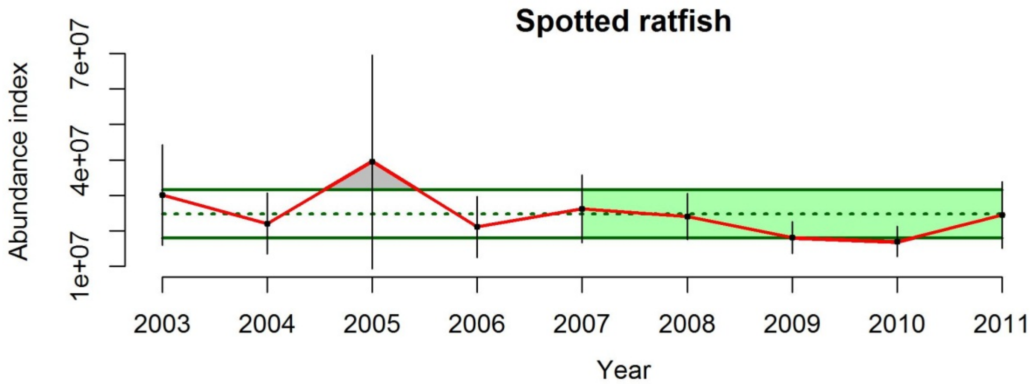

Figure GF6. Trawl survey design-based estimates of spotted ratfish biomass for years 2003-2011.

Summary: No stock assessment for spotted ratfish is available, so no baseline information can be interpreted for this stock at this time. For the most recent years, spotted ratfish appear to have a stable population abundance.

FLATFISHES (N=7)

Shelf

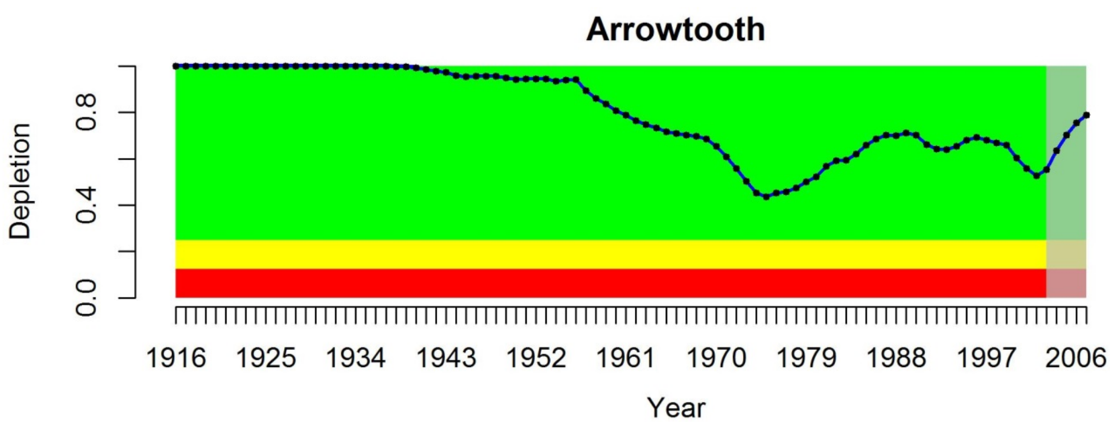

Figure GF7. Relative abundance trajectory 1916-2007 for arrowtooth flounder.

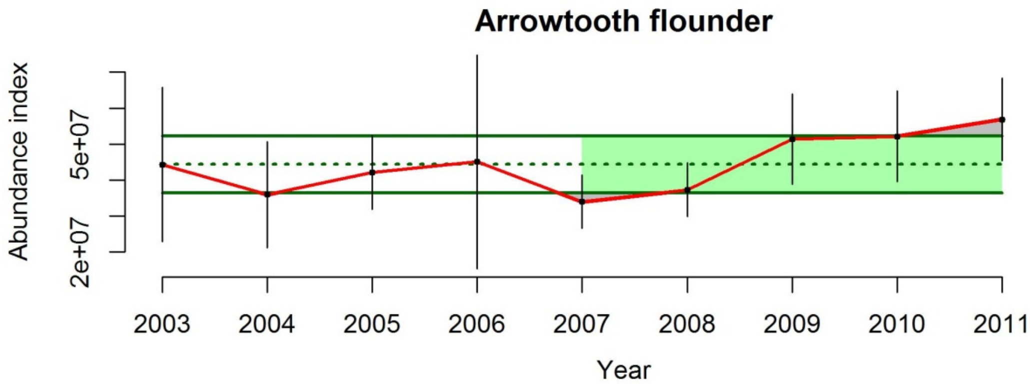

Figure GF8. Trawl survey design-based estimates of arrowtooth flounder biomass for years 2003-2011.

Summary: Arrowtooth flounder demonstrated its greatest decline from the 1950s to the 1970s. It has since increased and continues to show increase in the most recent years. At no point has it been recorded to have gone below the target relative biomass.

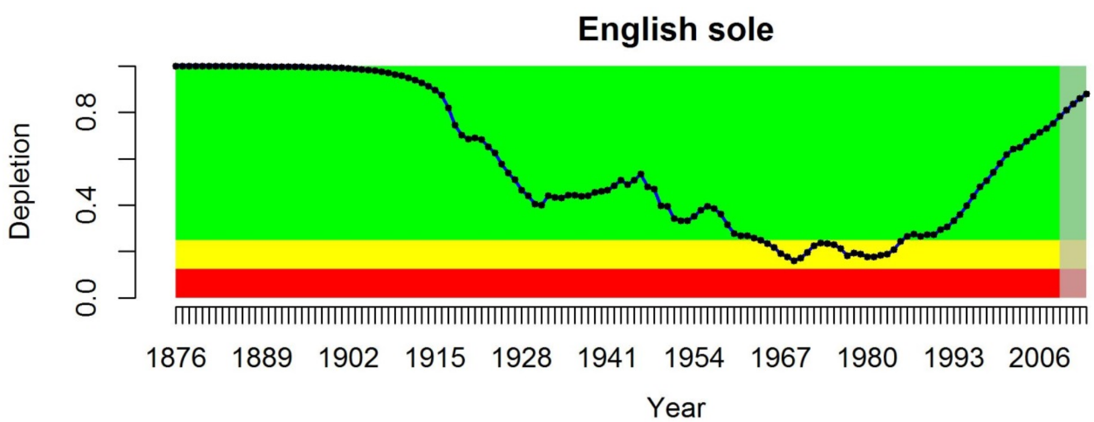

Figure GF9. Relative abundance trajectory 1876-2013 for English sole.

Summary: English sole demonstrated large declines in the early 20th-century, at times dropping below the target relative biomass level. Recent years indicate a large increase, with an increasing trend in the last 5 years.

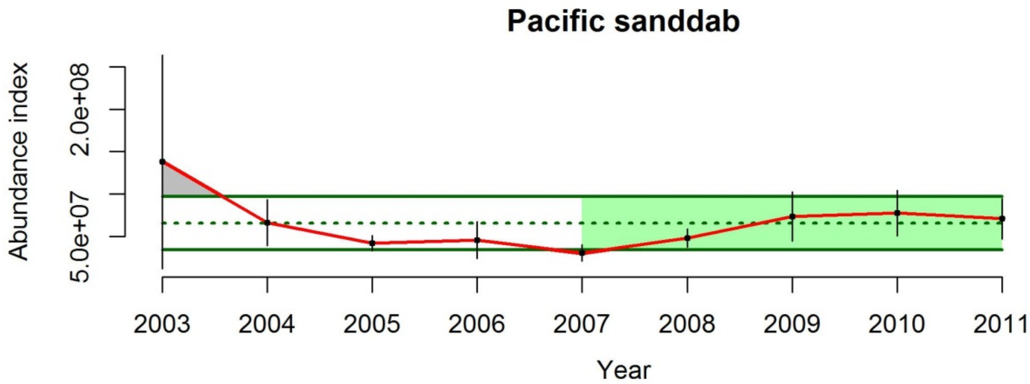

Figure GF10. Trawl survey design-based estimates of English sole biomass for years 2003-2011.

Summary: No stock assessment is available for Pacific sanddab, so no baseline information on abundance exists. Recent years indicate an increasing trend in survey abundance.

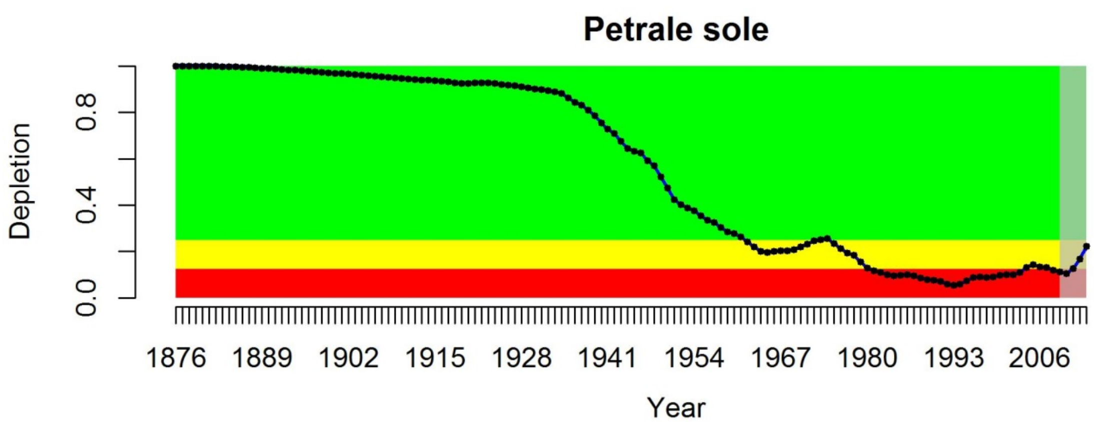

Figure GF11. Relative abundance trajectory 1876-2013 for Petrale sole.

Summary: Petrale sole abundance dropped sharply from the late 1930s to the 1950s, with a steady decline through the 1990s, bringing the population below the relative biomass limit. Recent years have shown an uptick with a steady population over the last 5 years.

Slope

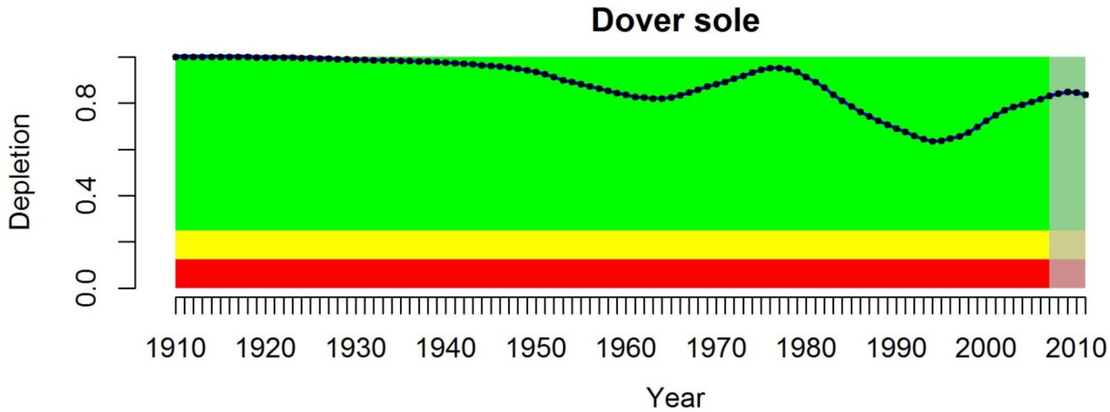

Figure GF12. Relative abundance trajectory 1910-2011 for Dover sole.

Summary: Dover sole populations have shown only slight declines over the time series. Relative biomass has stayed above target levels in all years and is steady over the last 5 years.

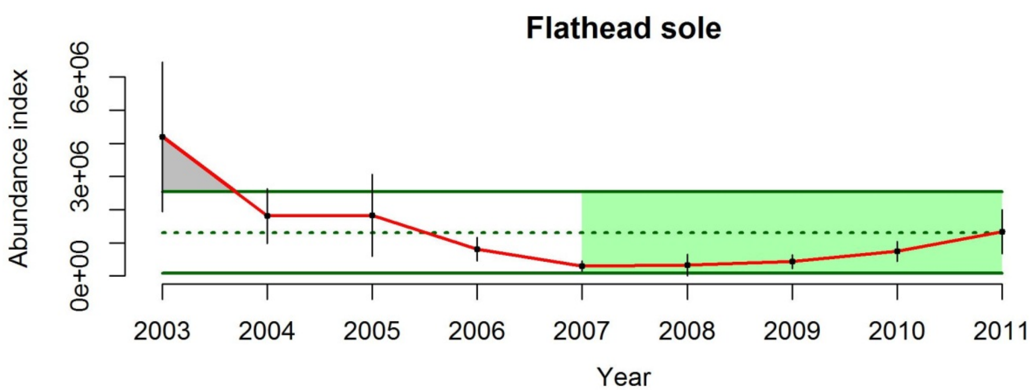

Figure GF13. Trawl survey design-based estimates of flathead sole biomass for years 2003-2011.

Summary: No flathead sole assessment is available, so no baseline information on abundance exists. Recent years indicate a steady trend in survey abundance.

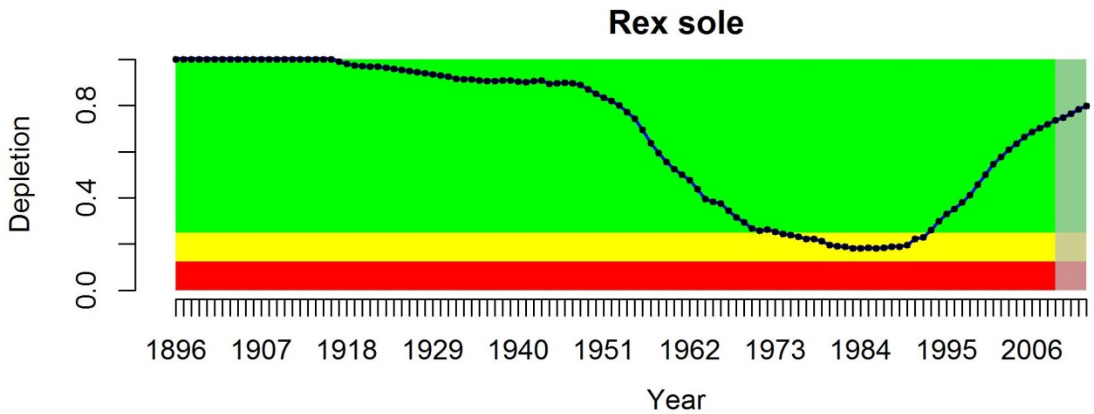

Figure GF14. Relative abundance trajectory 1896-2013 for rex sole.

Summary: Rex sole demonstrated large declines in the 1970s, even dropping below the limit reference point for relative biomass level. Recent years indicate a large increase, with an increasing trend in the last 5 years.

ROCKFISHES (N=21)

Nearshore

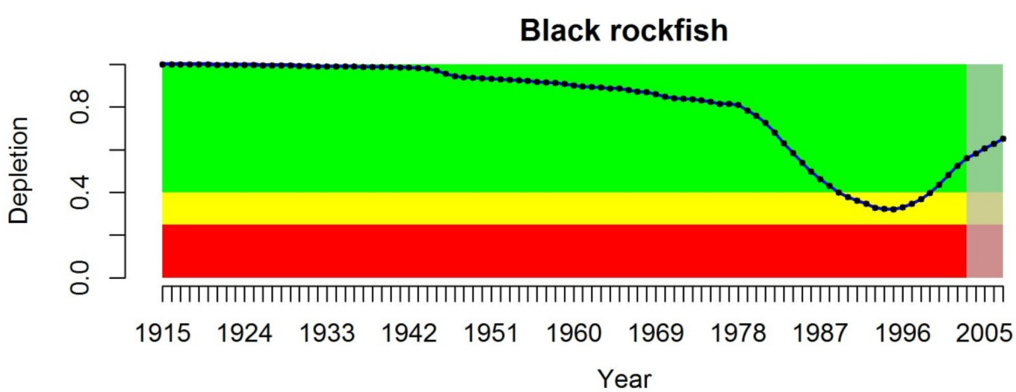

Figure GF15. Relative abundance trajectory 1916-2009 for black rockfish.

Summary: Black rockfish shows a consistent decline until the late 1990s, where in the population starts to grow. Relative biomass dropped below the target relative biomass level for most of the 1990s. Recent years show an increasing trend in population abundance.

Shelf

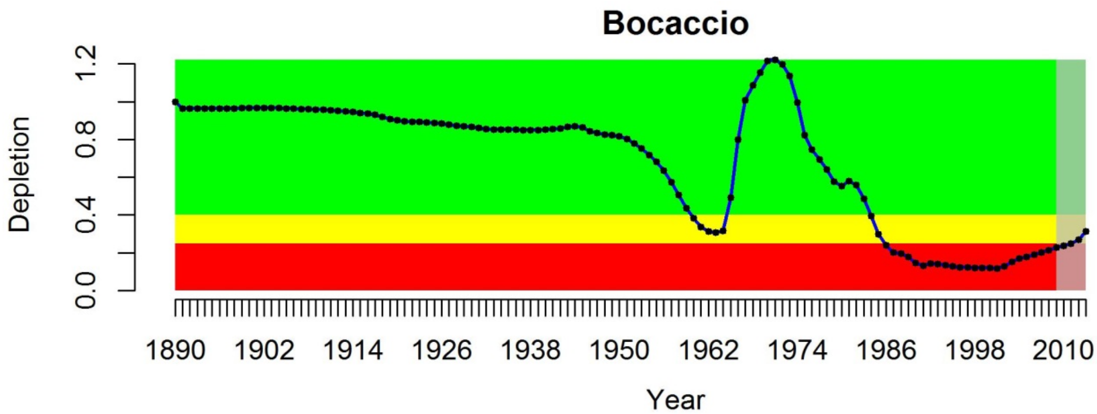

Figure GF16. Relative abundance trajectory 1890-2011 for bocaccio.

Summary: Bocaccio abundance has been highly dynamic over the time series, dropping to levels below the relative biomass limit in recent years. The population trend over that last 5 years is increasing.

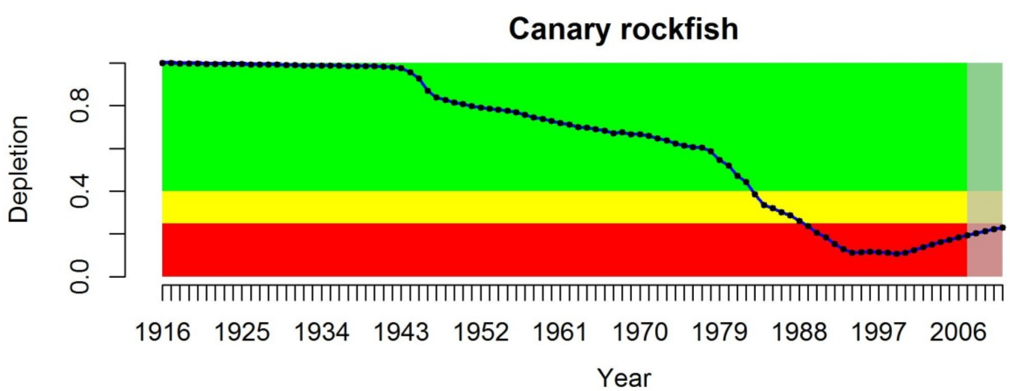

Figure GF17. Relative abundance trajectory 1916-2011 for canary rockfish.

Summary: Large declines in population abundance have been witnessed in canary rockfish, enough to drop the relative abundance below the relative biomass limit. Recent years show very slow growth and an overall stable population.

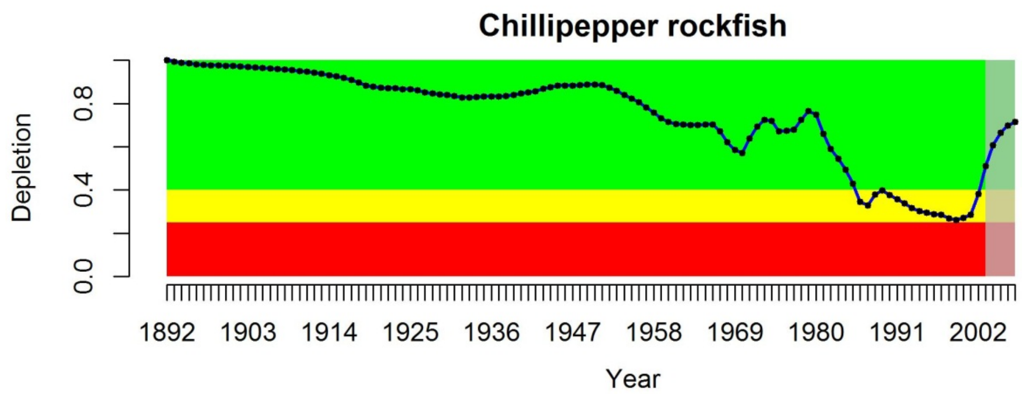

Figure GF18. Relative abundance trajectory 1892-2011 for chilipepper.

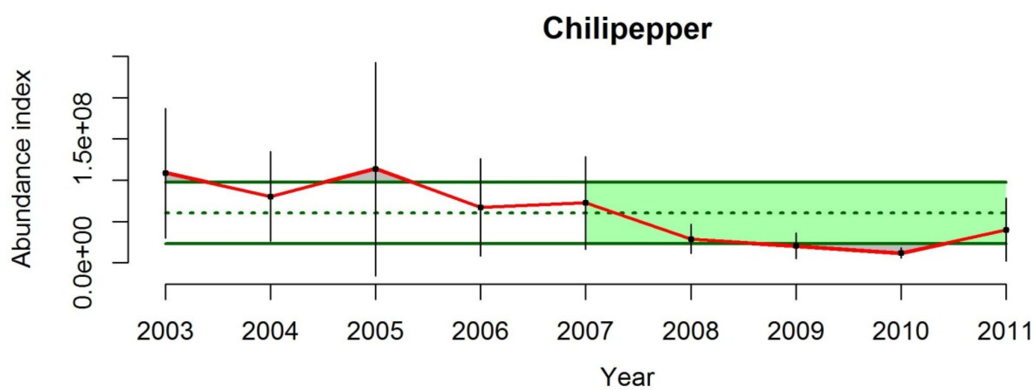

Figure GF19. Trawl survey design-based estimates of chilipepper biomass for years 2003-2011.

Summary: Chilipepper biomass declined below the relative biomass target limit after 1980, then increased substantially in the 2000s. The short-term trawl survey information indicates a stable population in recent years.

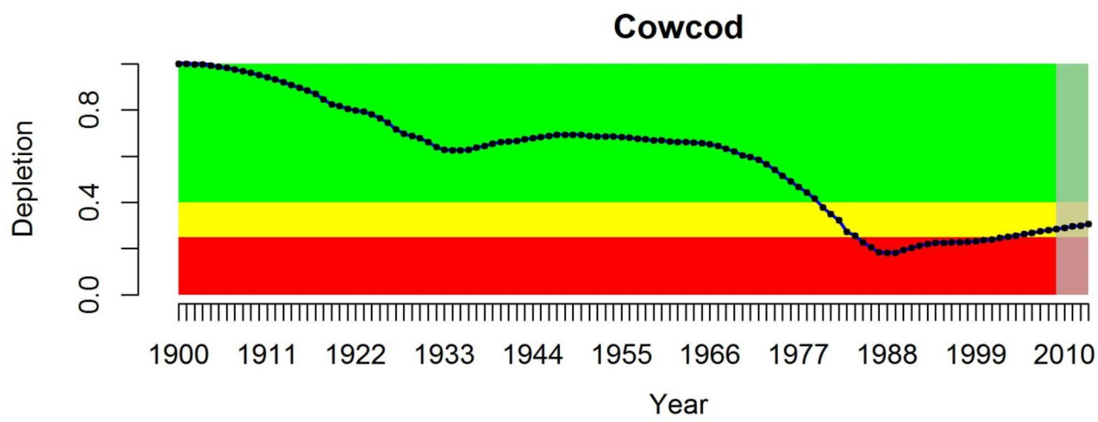

Figure GF20. Relative abundance trajectory 1900-2013 for cowcod.

Summary: The view of cowcod relative biomass has changed greatly since the past assessment in 2011. Once thought to be well below the limit reference point with very slow growth, the new status trends show a stock in the precautionary zone of relative biomass, with an increasing trend over the last five years, and only a small historical period of being below the relative biomass limit reference point.

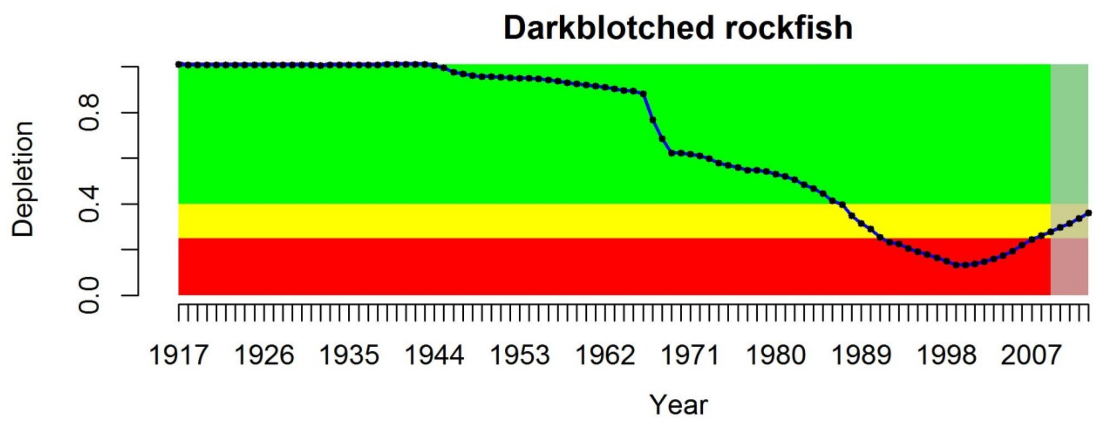

Figure GF21. Relative abundance trajectory 1910-2013 for darkblotched rockfish.

Summary: Darkblotched rockfish showed historical declines in population below relative biomass limits, but recent years show population increase above the limit, nearing the rebuilding target relative biomass.

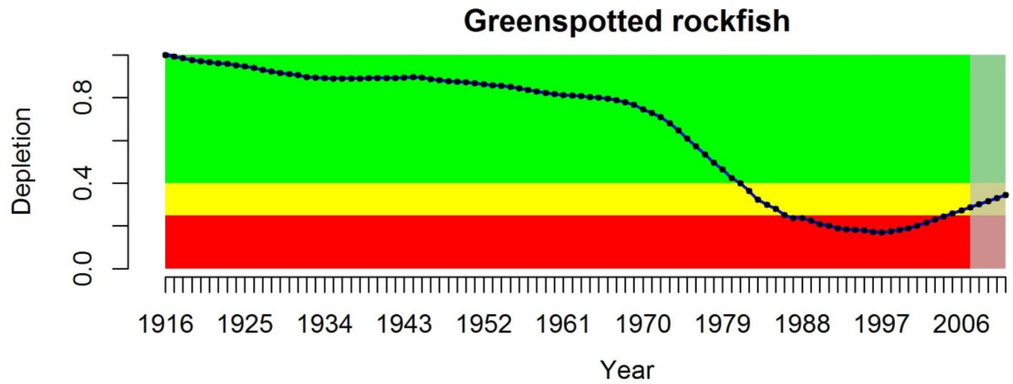

Figure GF22. Relative abundance trajectory 1916-2011 for greenspotted rockfish.

Summary: Greenspotted rockfish abundance historically dropped below the limit reference point, but is recently increasing and near the target relative biomass level.

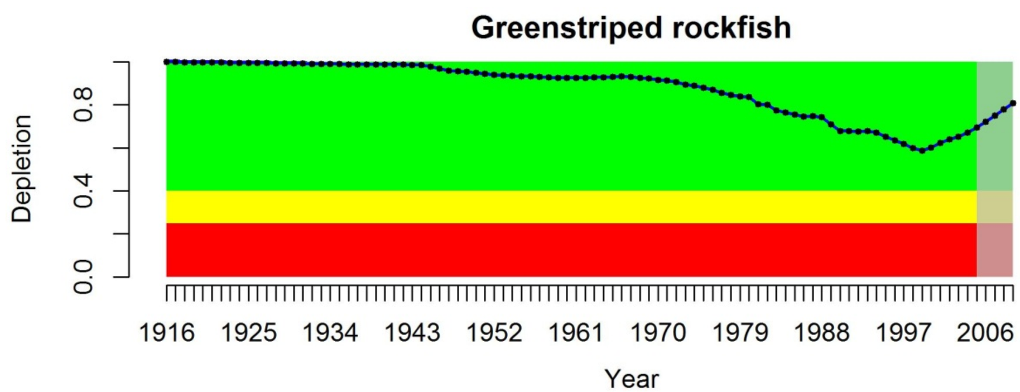

Figure GF23. Relative abundance trajectory 1910-2011 for greenstriped rockfish.

Summary: Greenstriped rockfish has stayed above the target relative biomass level with increasing biomass in the most recent years.

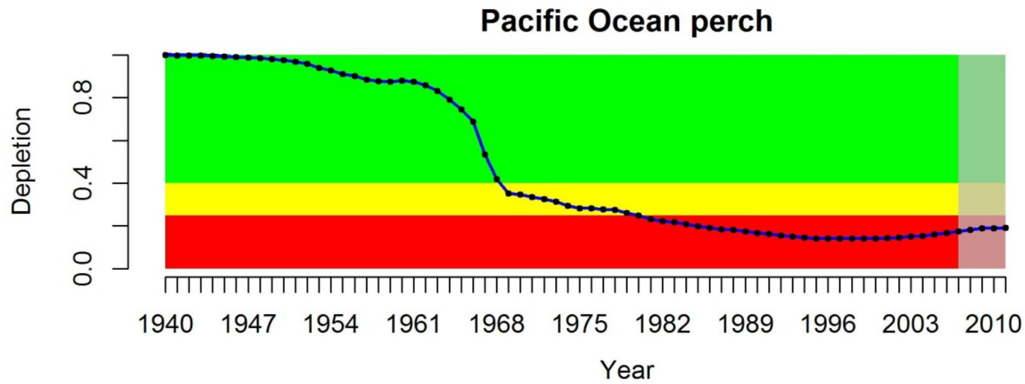

Figure GF24. Relative abundance trajectory 1940-2011 for Pacific Ocean perch.

Summary: Pacific Ocean perch biomass has shown a large historical decline and is currently below the relative biomass limit, though the population is steady in the most recent years.

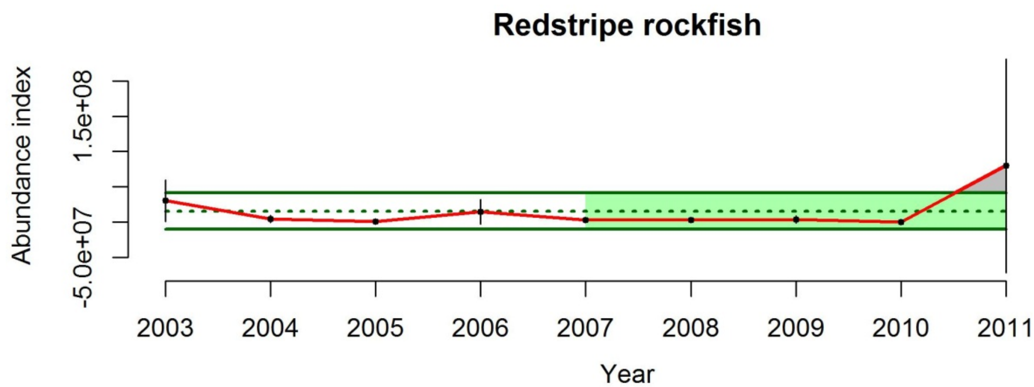

Figure GF25. Trawl survey design-based estimates of restripe rockfish biomass for years 2003-2011.

Summary: No redstripe rockfish assessment is available, so no baseline information on abundance exists. Recent years indicate a stable trend in survey abundance (the last relatively high point has large uncertainty).

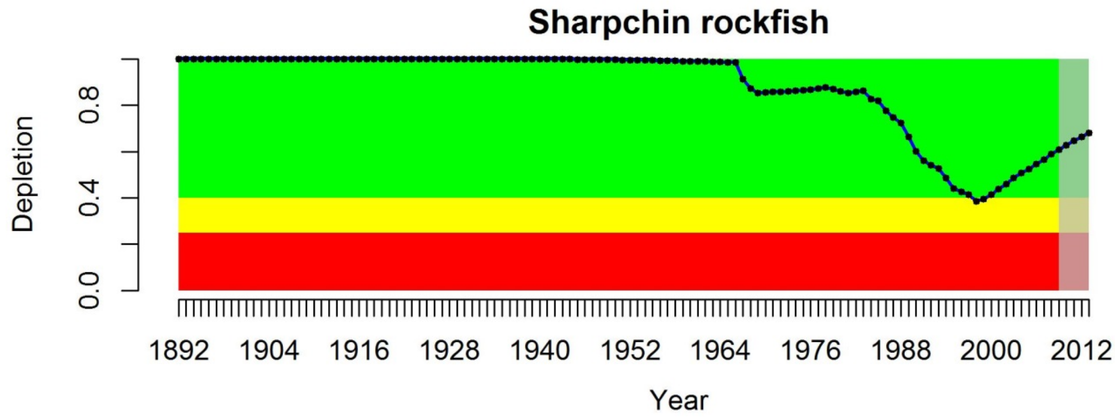

Figure GF26. Relative abundance trajectory 1892-2013 for sharpchin rockfish.

Summary: Sharpchin rockfish has not had a targeted fishery, but demonstrated historical declines in the 1980s. The population has subsequently increased and is well above the target relative biomass.

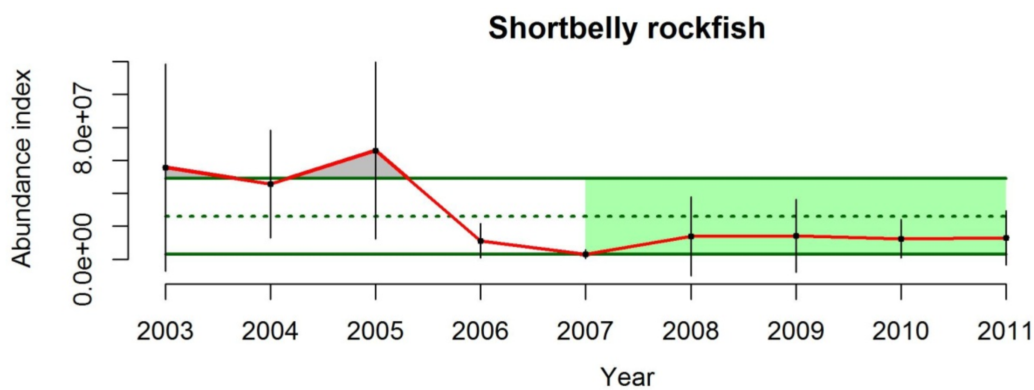

Figure GF27. Trawl survey design-based estimates of shortbelly rockfish biomass for years 2003-2011.

Summary: No shortbelly rockfish assessment is available, so no baseline information on abundance exists. Recent years indicate a stable trend in survey abundance.

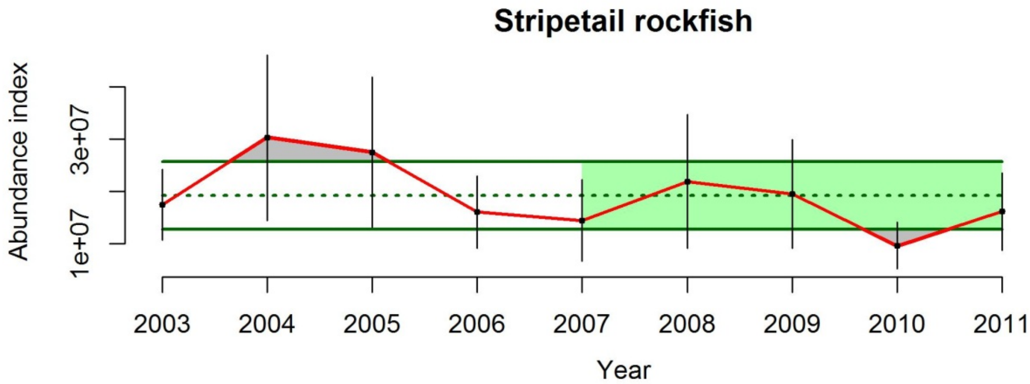

Figure GF28. Trawl survey design-based estimates of stripetail rockfish biomass for years 2003-2011.

Summary: No stripetail rockfish assessment is available, so no baseline information on abundance exists. Recent years indicate a stable trend in survey abundance.

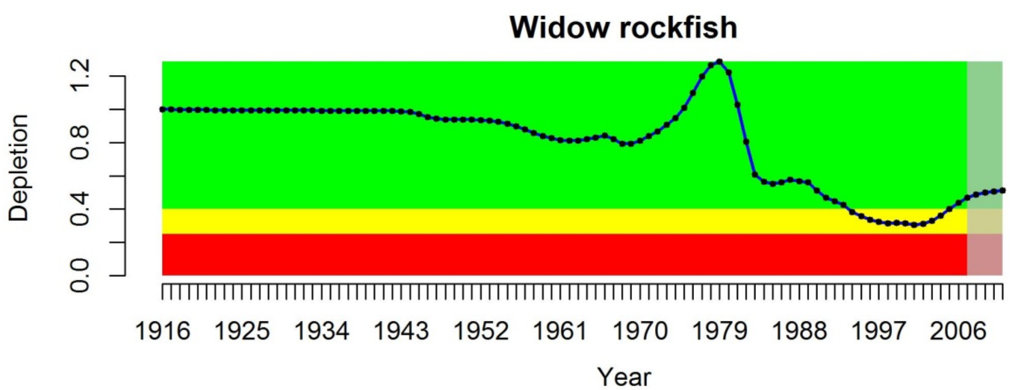

Figure GF29. Relative abundance trajectory 1916-2011 for widow rockfish.

Summary: Widow rockfish historically declined to below the target relative biomass level, but is currently increasing and is above the target.

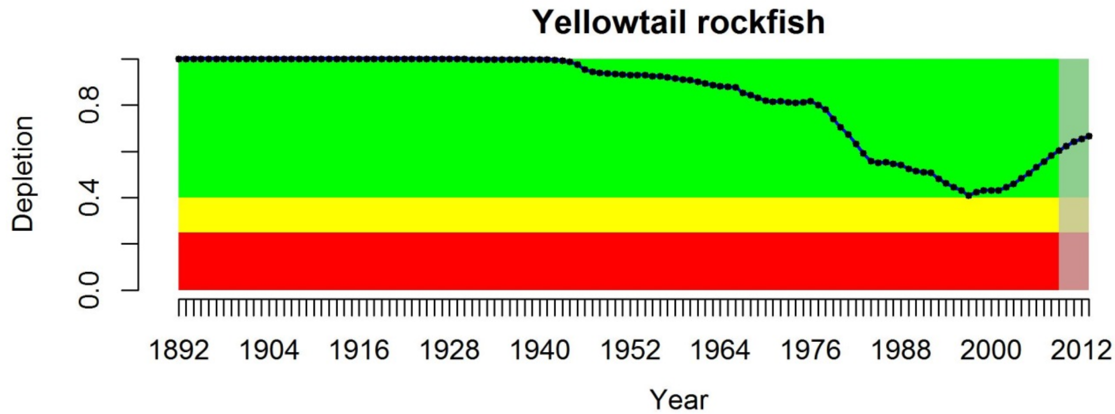

Figure GF30. Relative abundance trajectory 1891-2013 for yellowtail rockfish.

Summary: Yellowtail rockfish show similar temporal declines as other shelf rockfishes, but not the same extent. Yellowtail rockfish remain well above the relative target biomass levels and are increasing.

Slope

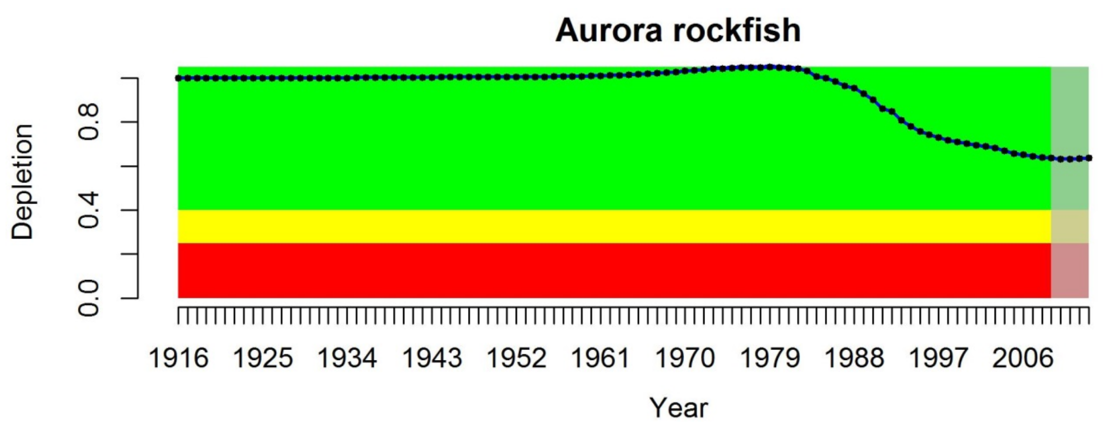

Figure GF31. Relative abundance trajectory 1916-2013 for aurora rockfish.

Summary: Aurora rockfish has not been a consistent or widespread fishery target and thus has shown little decline over the last century or removals. The biomass is steady and above the target relative biomass.

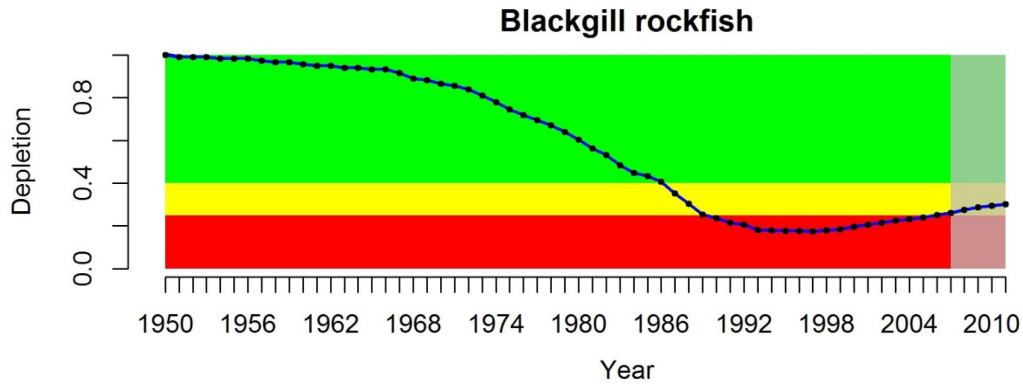

Figure GF32. Relative abundance trajectory 1950-2011 for blackgill rockfish.

Summary: Blackgill rockfish show a historical decline below the limit relative abundance reference point with a slight increase over the last 10 years. The last 5 years show a stable population.

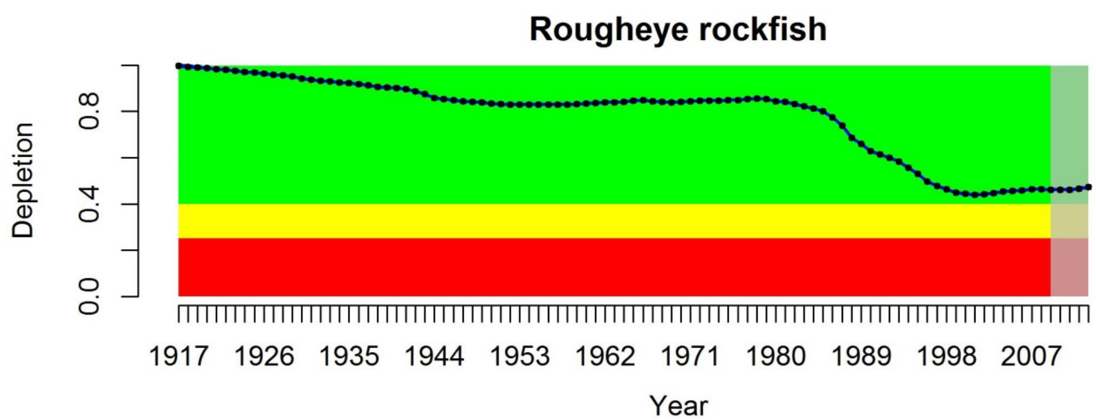

Figure GF33. Relative abundance trajectory 1917-2013 for rougheye rockfish.

Summary: Rougheye rockfish demonstrates the typical rockfish population trajectory, with declines in the 1980s and stabilizing to increasing trends in the most recent years. Assessment results indicate that the rougheye rockfish stock is near, but above the relative biomass target level.

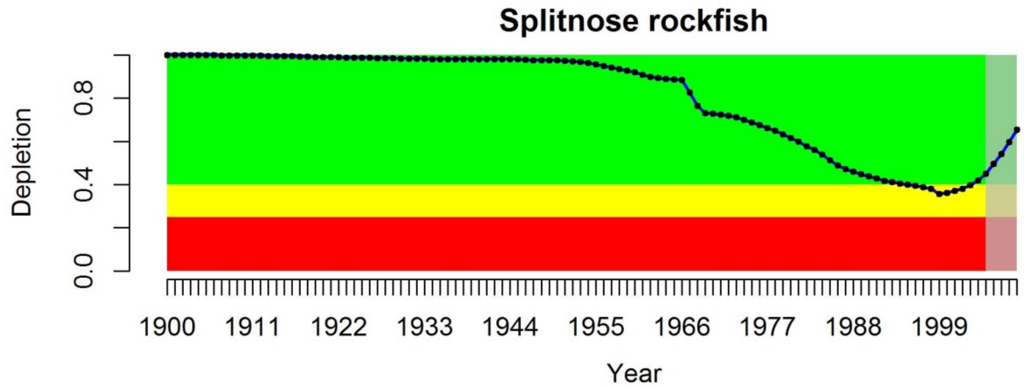

Figure GF34. Relative abundance trajectory 1910-2011 for splitnose rockfish.

Summary: The splitnose rockfish population declined to below the target relative biomass in the late 1990s, but is currently increasing.

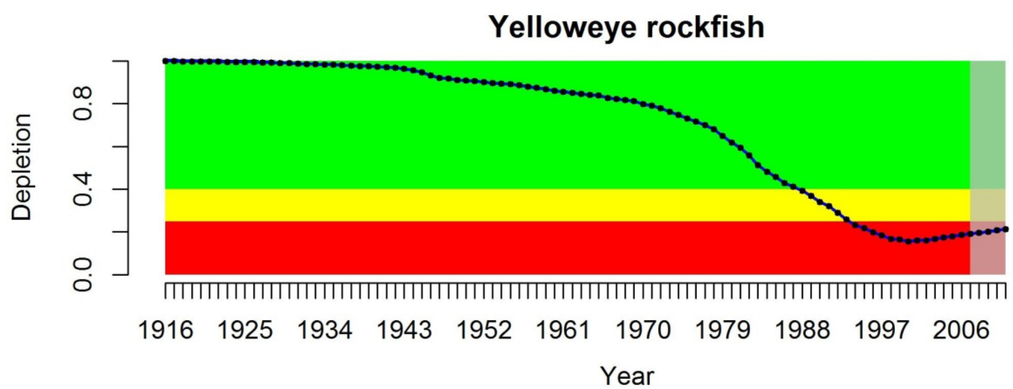

Figure GF35. Relative abundance trajectory 1916-2011 for yelloweye rockfish.

Summary: Yelloweye rockfish declined to below the limit relative biomass level and has stayed below since. Currently, the population is stable.

THORNYHEADS (N=2)

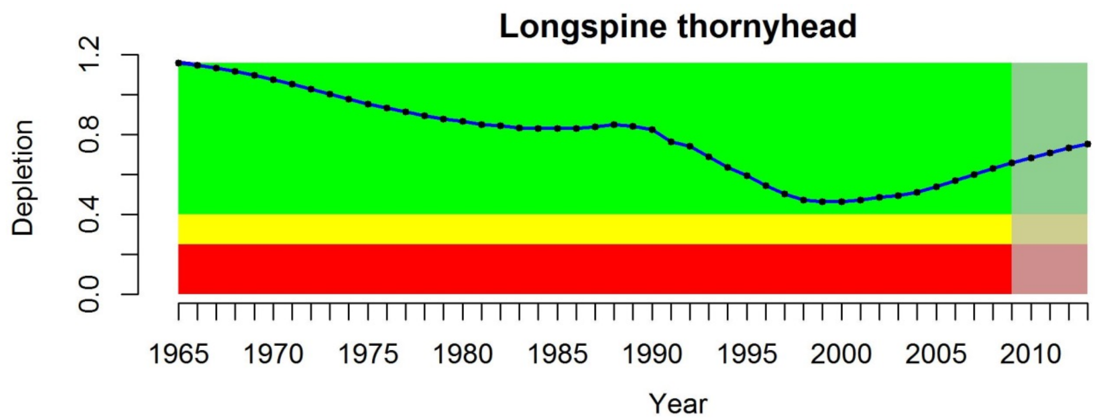

Figure GF36. Relative abundance trajectory 1965-2013 for longspine thornyhead.

Summary: Longspine thornyhead show initial declines, followed by several recent years of increasing relative population size. The population seems to have never dropped below the relative biomass target.

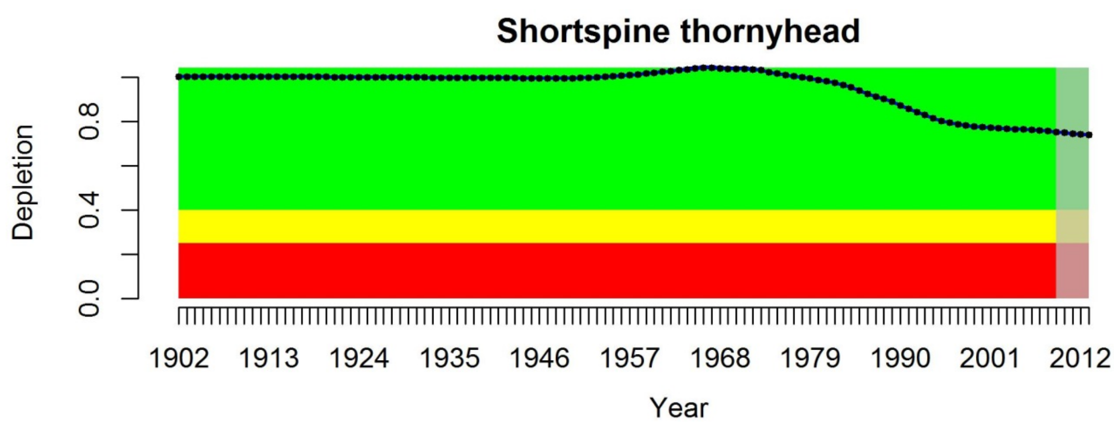

Figure GF37. Relative abundance trajectory 1902-2013 for shortspine thornyhead.

Summary: Longspine thornyhead show recent, but slow, population decline. The population seems to have never dropped below the relative biomass target.

ROUNDFISHES (N=4)

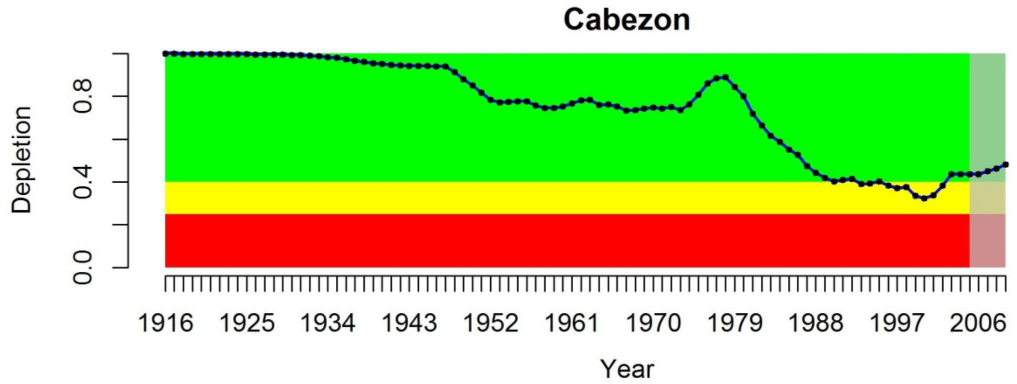

Figure GF38. Relative abundance trajectory 1910-2011 for cabezon.

Summary: Cabezon biomass had declined over the time series to below the relative biomass target level, but has since increased over the most recent years.

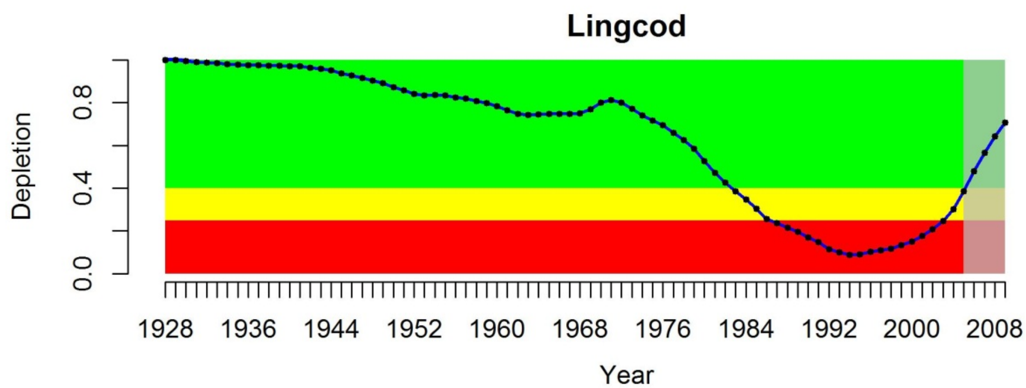

Figure GF39. Relative abundance trajectory 1910-2011 for lingcod.

Summary: Lingcod biomass had declined over the time series to below the relative biomass limit reference point, but has since increased over the most recent years.

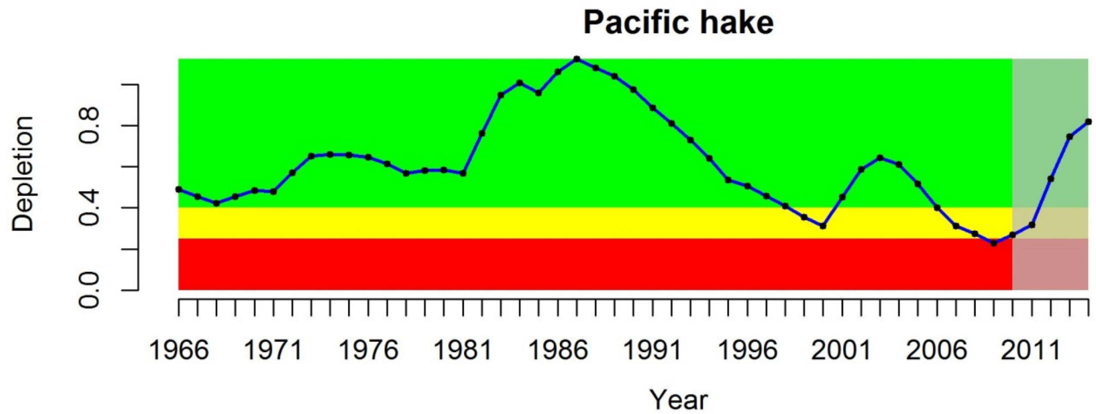

Figure GF40. Relative abundance trajectory 1910-2011 for Pacific hake.

Summary: Pacific hake biomass is very dynamic and is currently above the target relative biomass reference point with a recent increasing biomass trend.

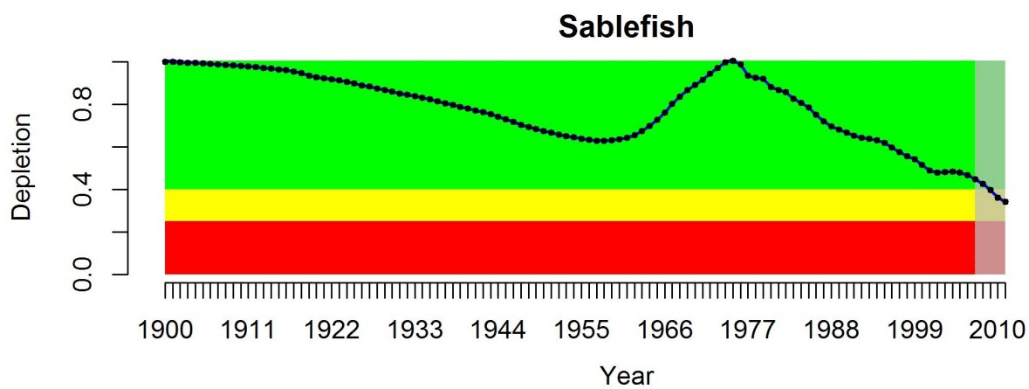

Figure GF41. Relative abundance trajectory 1910-2011 for sablefish.

Summary: Sablefish biomass is very dynamic and is currently below the target relative biomass reference point with a recent decreasing biomass trend.

ATTRIBUTE 2 - POPULATION CONDITION

SUMMARY

The first groundfish population condition indicator uses female mature biomass as a status indicator, but biomass is a broad term that obscures other important information (e.g. age and size compositions). In order to capture this additional population dimension, demographic structure of each stock is considered as another status indicator. Proportion maturity gives the percent of the population mature in a given year. The 95% age or length cumulative value indicates at which age or length 95% of the population is below, and thus is a measure of age/length truncation or expansion. All of the above values can be compared to the earliest value in the time series to indicate if they have changed over time. Female age and lengths are used exclusively to be comparable to the spawning biomass in the abundance trends indicator.

As with biomass, stock assessments are used as the primary source of information for maturity and age structure. If no stock assessment was available, trawl survey length compositions were used. Analyses of stocks with their most recent stock assessment in 2007 were also supplemented by the trawl length compositions. The same species grouping used in the abundance indicators are also used to organize stock results. Note that indicators of population age or size structure were not estimated for three species for the following reasons: Pacific hake length data were not deemed reliable, length data were not used in the sharpchin rockfish assessment, and no age/length data were available for shortbelly rockfish.

Overall, age or length structure tended to show more changes over time than proportion mature (Table GF4). Long-term time series comparisons generally showed declines in these indicators, whereas short-term comparisons demonstrated more stability (Table GF4), suggesting most change happened earlier in the fishery histories of these stocks. Non-elasmobranch groundfishes tended to show the most changes over time in both measures, with rockfishes being most sensitive to demographic changes (Table GF4). Though it is reasonable to expect these age/length-based indicators to be sensitive to yearly recruitment fluctuations, particularly large recruitments, changes in these indicators seemed more consistent with declines in spawning biomass, and thus deeper population structure changes, than recruitment variability.

ELASMOBRANCHS (FIGURES GF42-GF45; TABLE GF4)

Age or length structure showed little change in these elasmobranchs, but maturity did change in species with long time series. All measures were stable in the most recent years.

FLATFISHES (FIGURES GF46-GF54; TABLE GF4)

Flatfishes on the shelf showed decreases over time in both measures, while the deeper slope species showed little change over time in either measure.

ROCKFISHES (FIGURES GF55-GF74; TABLE GF4)

Rockfishes showed a general decline in both measures through time, regardless of the adult habitat. Chilipepper (Figure GF59) and rougheye (Figure GF72) are exceptions which show little change over the entire time series. Greenstriped (Figure GF63) and widow rockfish (Figure GF68) show contemporary measures have increased near initial conditions after historical declines. Stripetail (Figure GF67) and yellowtail rockfish (Figure GF68) show little change in the trawl survey lengths, but there is no historical baseline to interpret these values. Overall, rockfishes were the most sensitive species group to demographic changes.

THORNYHEADS (FIGURES GF75-GF76; TABLE GF4)

Thornyheads show little change in either population measure over the period of each stock assessment.

ROUNDFISHES (FIGURES GF77-GF79; TABLE GF4)

Two of three roundfishes (cabezon and lingcod, both shallow egg-layers with nest-guarding males) showed declines in both measures, whereas sablefish showed little change over time. Lingcod has shown recent increases in both measures.

SPECIFIC TIME SERIES

ELASMOBRANCHS (N=3)

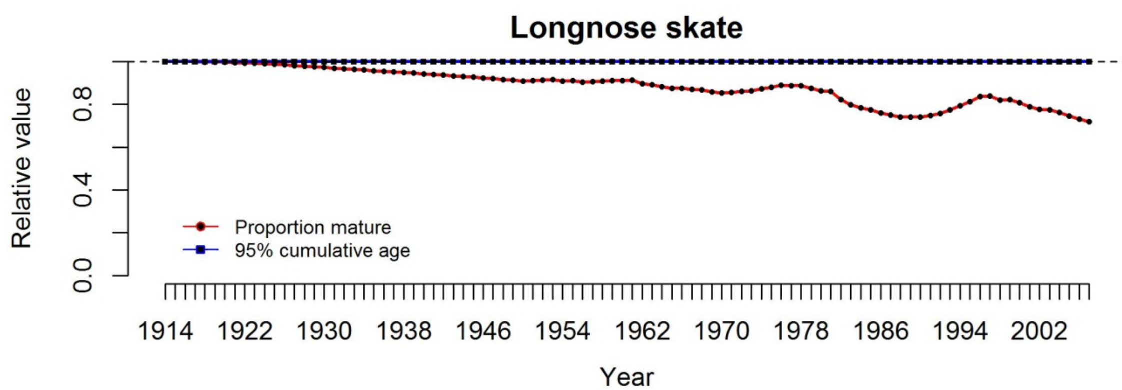

Figure GF42. Proportion of the longnose skate population mature (red) and at the 95% cumulative age (blue) relative to the first year (1916) of the time series.

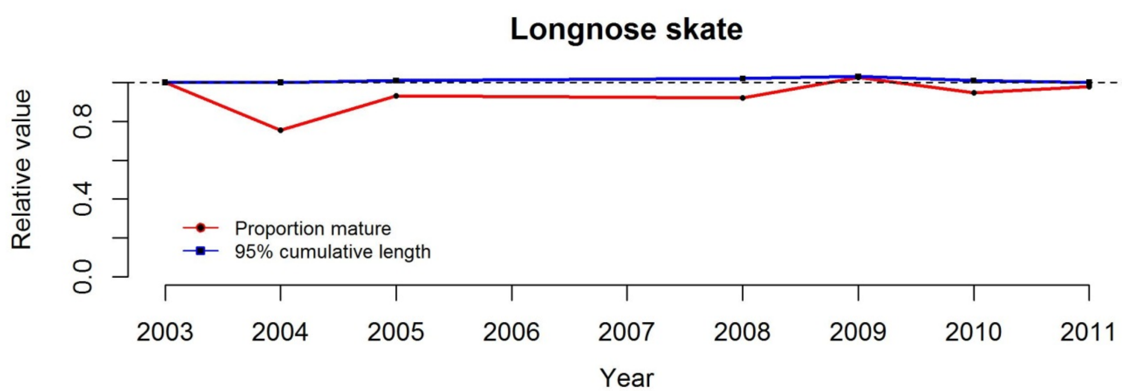

Figure GF43. Proportion of the longnose skate population mature (red) and at the 95% cumulative length (blue) relative to the first year (2003) of the trawl survey time series.

Summary: Longnose skate have shown no decline in the proportion of the oldest ages and largest lengths, but proportion mature has declined somewhat over the length of the time series.

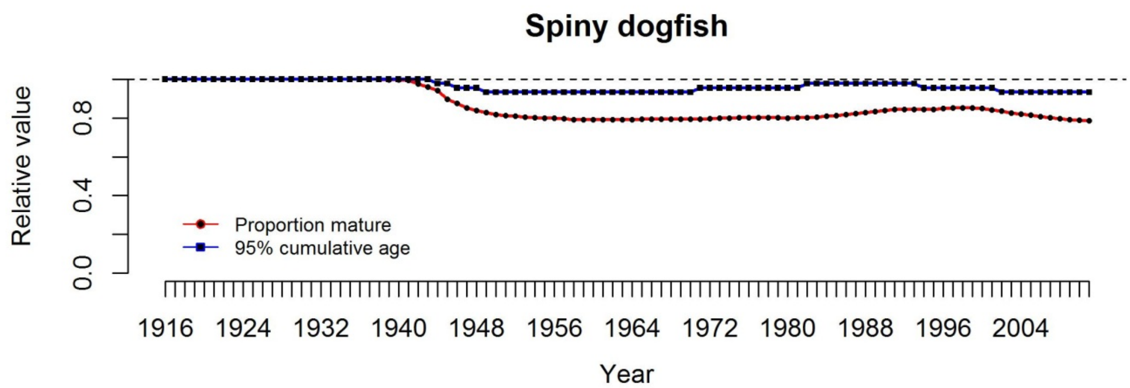

Figure GF44. Proportion of the spiny dogfish population mature (red) and at the 95% cumulative age (blue) relative to the first year (1916) of the time series.

Summary: Spiny dogfish show only small declines in proportion mature and proportion of the oldest ages that have mostly stabilized since the decline in the 1940s.

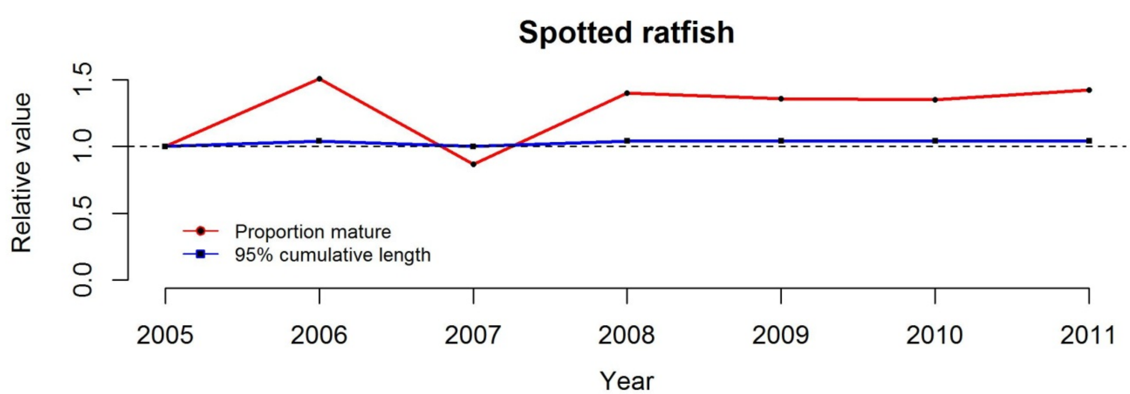

Figure GF45. Proportion of the spotted ratfish population mature (red) and at the 95% cumulative length (blue) relative to the first year (2005) of the trawl survey time series.

Summary: No stock assessment is available for spotted ratfish so no baseline information on demographic structure is available. No declines in either maturity or proportion of the largest sizes are apparent from the trawl survey data.

FLATFISHES (N=7)

Shelf

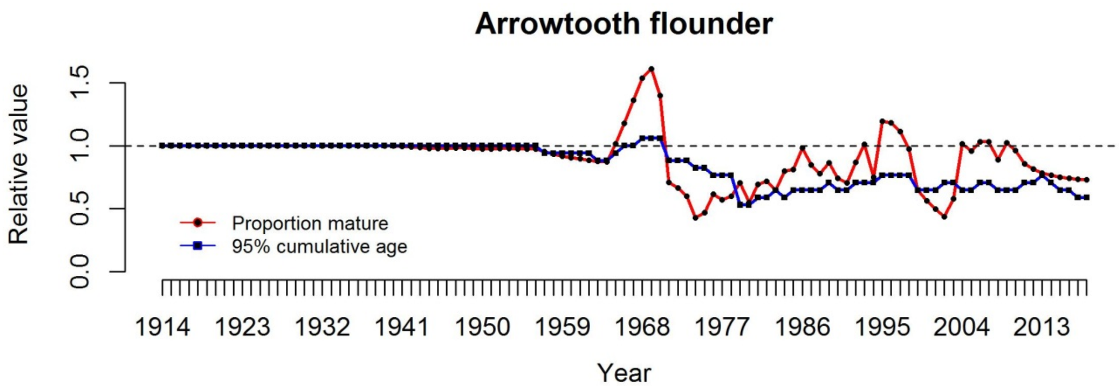

Figure GF46. Proportion of the arrowtooth flounder population mature (red) and at the 95% cumulative age (blue) relative to the first year (1916) of the time series.

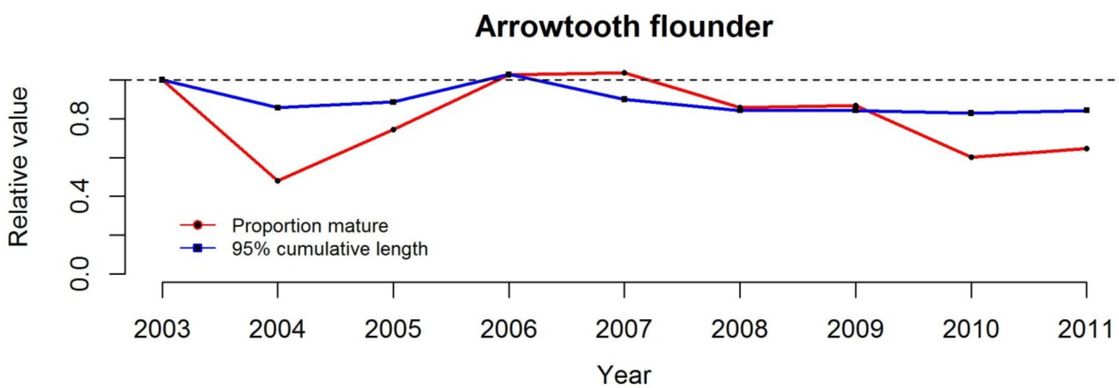

Figure GF47. Proportion of the arrowtooth flounder population mature (red) and at the 95% cumulative length (blue) relative to the first year (2003) of the trawl survey time series.

Summary: Arrowtooth flounder show declines in proportion mature and proportion of the oldest ages and largest lengths over the length of the time series.

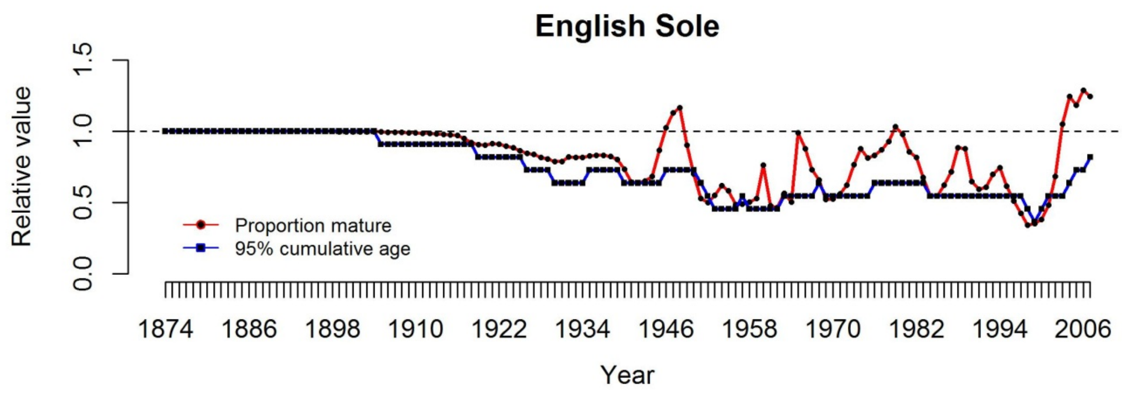

Figure GF48. Proportion of the English sole population mature (red) and at the 95% cumulative age (blue) relative to the first year (1876) of the time series.

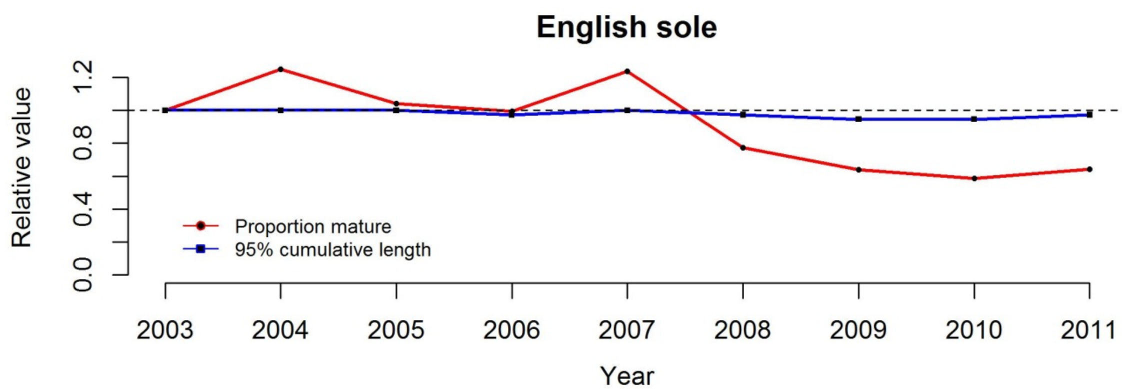

Figure GF49. Proportion of the English sole population mature (red) and at the 95% cumulative length (blue) relative to the first year (2003) of the trawl survey time series.

Summary: English sole show a slight decline in proportion of the oldest ages, but not in proportion mature, over the length of the time series. Recent survey trends in proportion mature are downward.

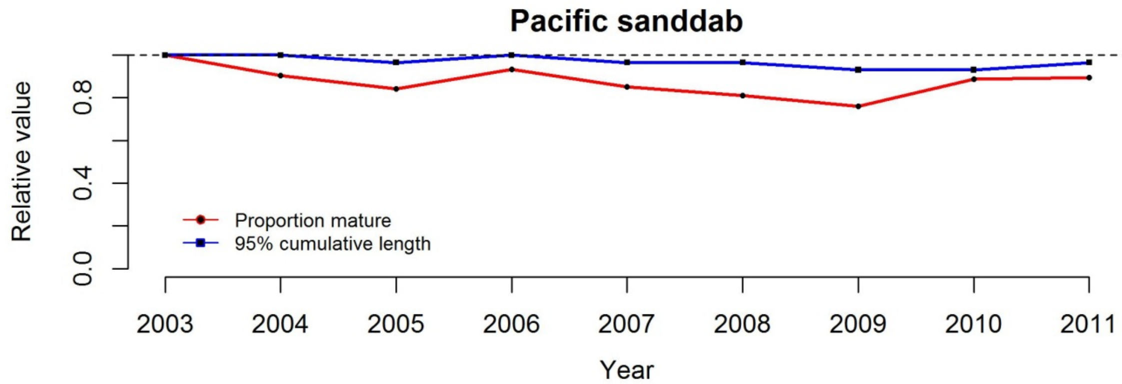

Figure GF50. Proportion of the Pacific sanddab population mature (red) and at the 95% cumulative length (blue) relative to the first year (2003) of the trawl survey time series.

Summary: No stock assessment is available for Pacific sanddab so no baseline information on demographic structure is available. No declines in either maturity or proportion of the largest lengths are apparent from the trawl survey data.

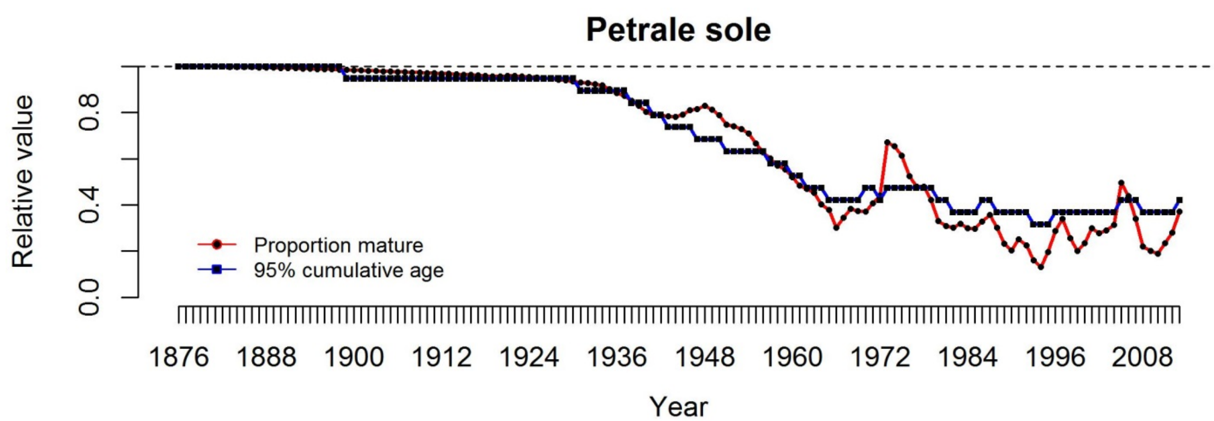

Figure GF51. Proportion of the Petrale sole population mature (red) and at the 95% cumulative age (blue) relative to the first year (1876) of the time series.

Summary: Petrale sole shows notable declines in proportion mature and proportion of the oldest ages over the length of the time series.

Slope

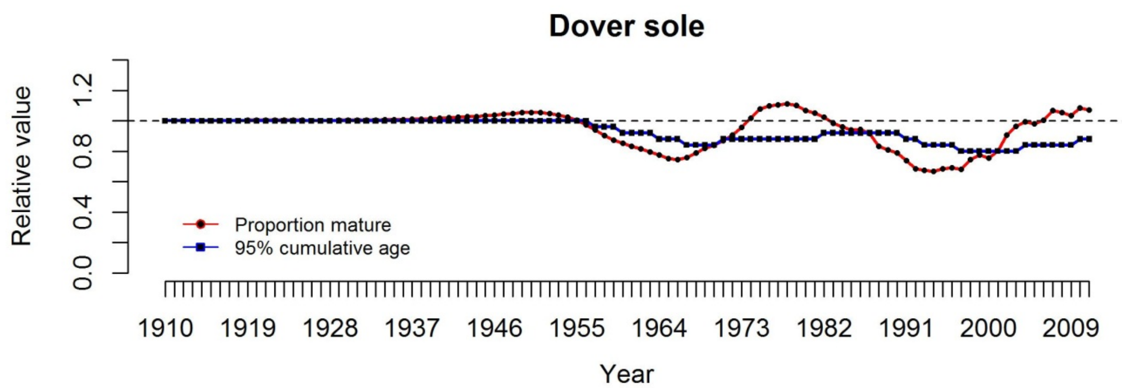

Figure GF52. Proportion of the Dover sole population mature (red) and at the 95% cumulative age (blue) relative to the first year (1910) of the time series.

Summary: Dover sole do not show any notable changes in proportion mature and proportion of the oldest ages and largest lengths over the length of the time series.

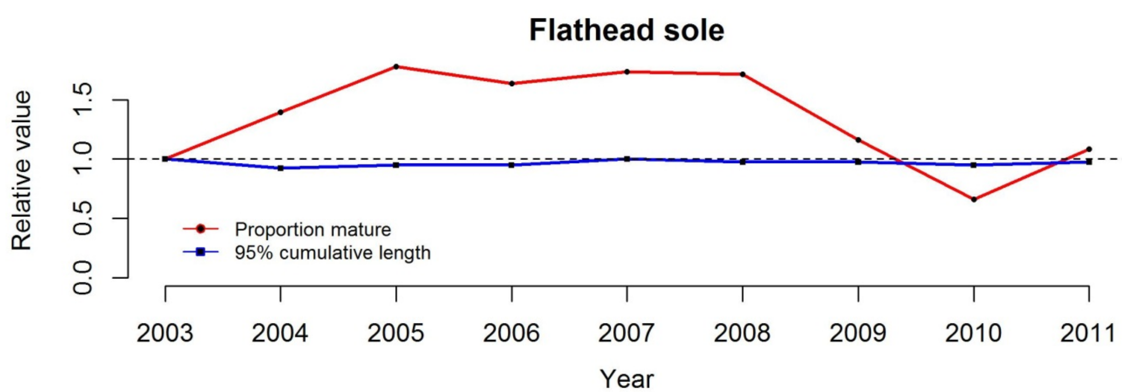

Figure GF53. Proportion of the flathead sole population mature (red) and at the 95% cumulative length (blue) relative to the first year (2003) of the trawl survey time series.

Summary: No stock assessment is available for flathead sole so no baseline information on demographic structure is available. No declines in either maturity or proportion of the largest lengths are apparent from the trawl survey data.

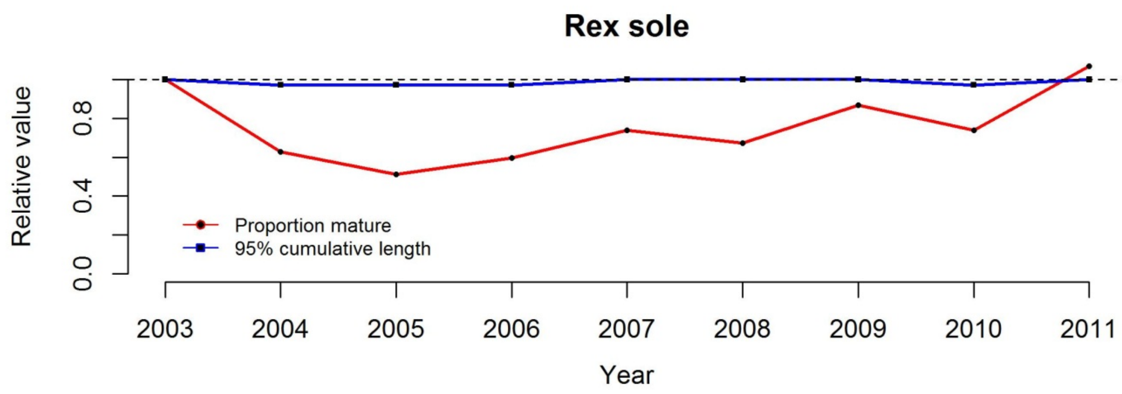

Figure GF54. Proportion of the rex sole population mature (red) and at the 95% cumulative length (blue) relative to the first year (2003) of the trawl survey time series.

Summary: No stock assessment is available for rex sole so no baseline information on demographic structure is available. No declines in either maturity or proportion of the largest lengths are apparent from the trawl survey data.

ROCKFISHES (N=18)

Nearshore

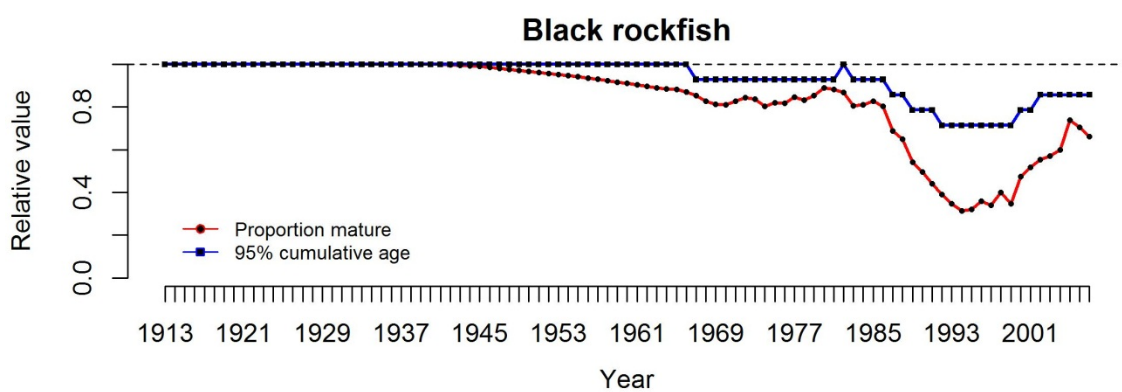

Figure GF55. Proportion of the black rockfish population mature (red) and at the 95% cumulative age (blue) relative to the first year (1916) of the time series.

Summary: Black rockfish show notable declines in proportion mature and slight declines in proportion of the oldest ages over the length of the time series.

Shelf

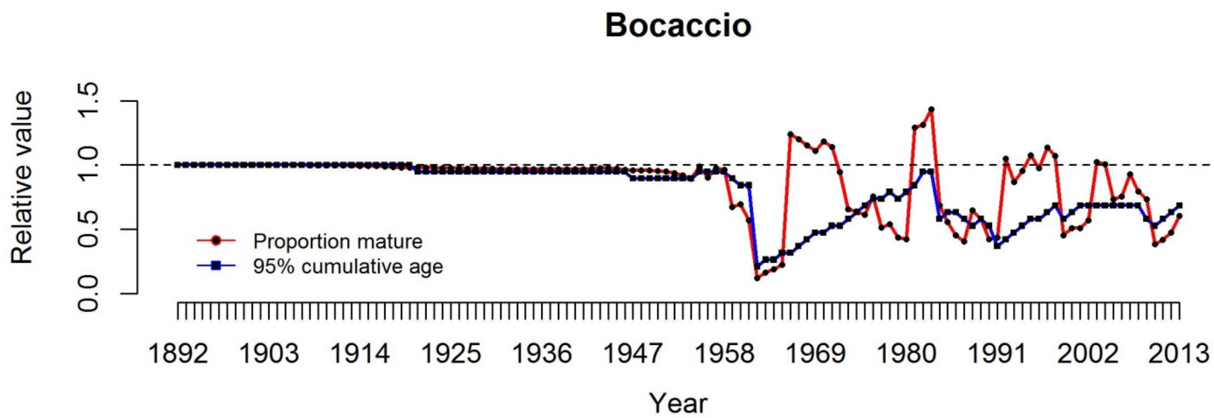

Figure GF56. Proportion of the bocaccio population mature (red) and at the 95% cumulative age (blue) relative to the first year (1895) of the time series.

Summary: Bocaccio show high variation in the proportion mature and proportion of the oldest ages over the length of the time series. The most recent measure are below historical reference levels. Fluctuations may be due to high but sporadic recruitment.

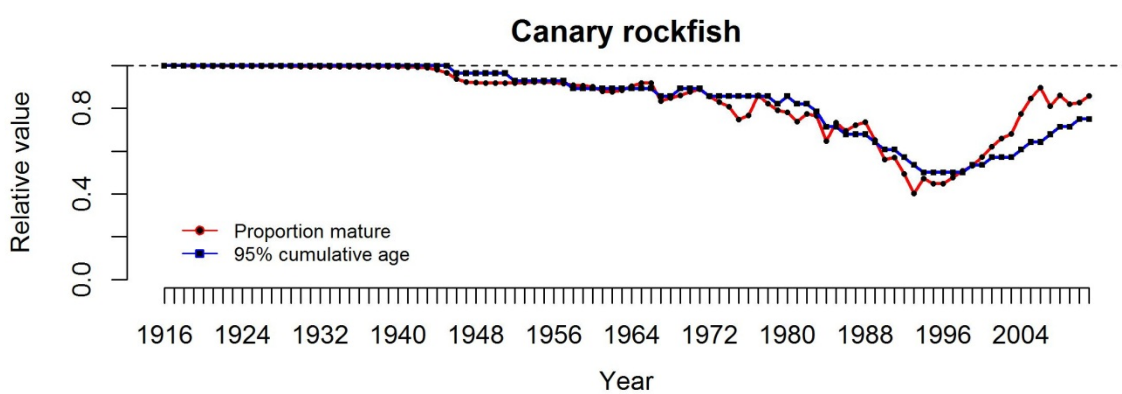

Figure GF57. Proportion of the canary rockfish population mature (red) and at the 95% cumulative age (blue) relative to the first year (1916) of the time series.

Summary: Canary rockfish show declines in proportion mature and proportion of the oldest ages over the length of the time series, but current years demonstrate a building up of both metrics.

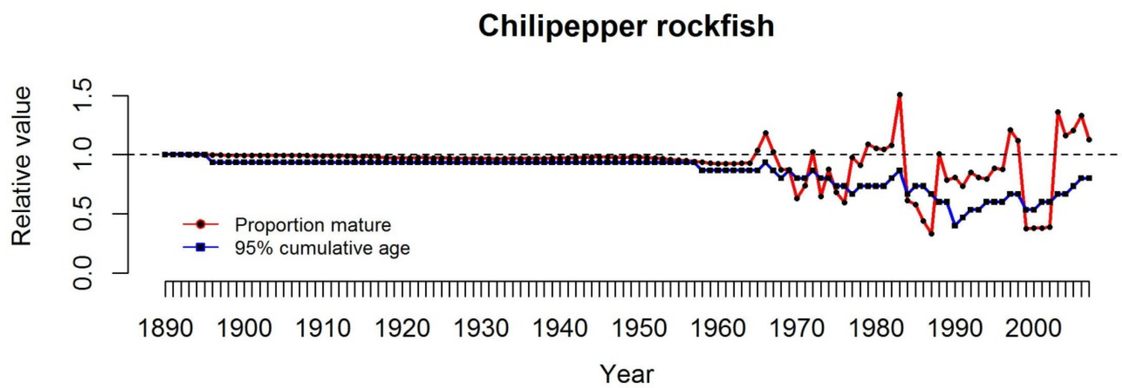

Figure GF58. Proportion of the chilipepper rockfish population mature (red) and at the 95% cumulative age (blue) relative to the first year (1892) of the time series (1892-2007).

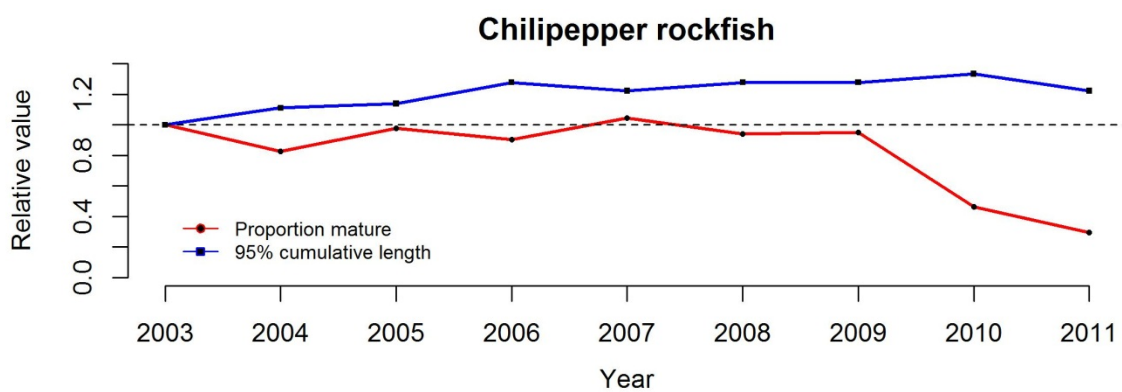

Figure GF59. Proportion of the chilipepper rockfish population mature (red) and at the 95% cumulative length (blue) relative to the first year (2003) of the trawl survey time series (2003-2007).

Summary: Chilipepper rockfish show decreases in proportion mature and proportion of the oldest ages and largest lengths over the length of the time series. The short-term series shows a relative changes consistent with the long-time series when the same relative time frame in considered.

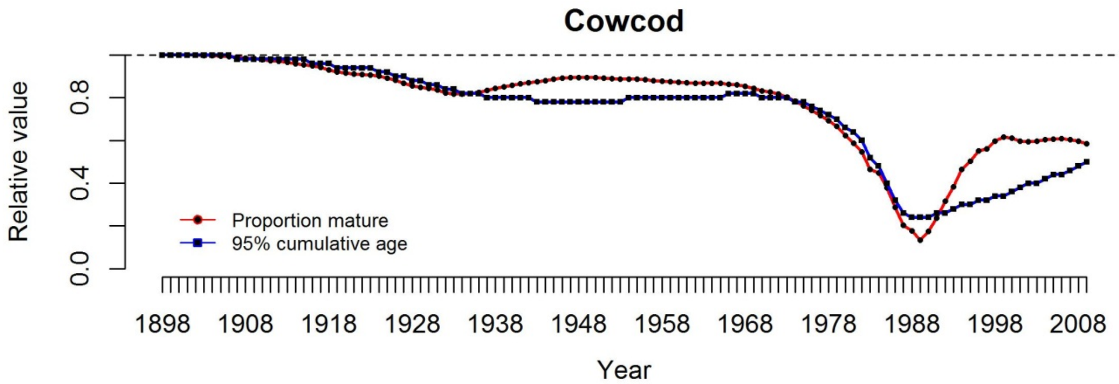

Figure GF60. Proportion of the cowcod population mature (red) and at the 95% cumulative age (blue) relative to the first year (1900) of the time series.

Summary: Cowcod show declines in proportion mature and proportion of the oldest ages over the length of the time series.

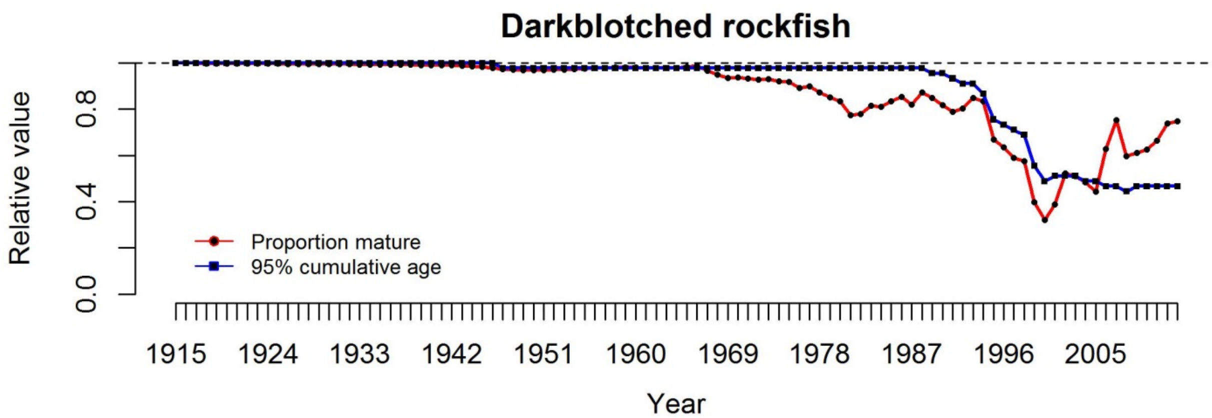

Figure GF61. Proportion of the darkblotched rockfish population mature (red) and at the 95% cumulative age (blue) relative to the first year (1895) of the time series.

Summary: Darkblotched rockfish show declines in proportion mature and proportion of the oldest ages over the length of the time series.

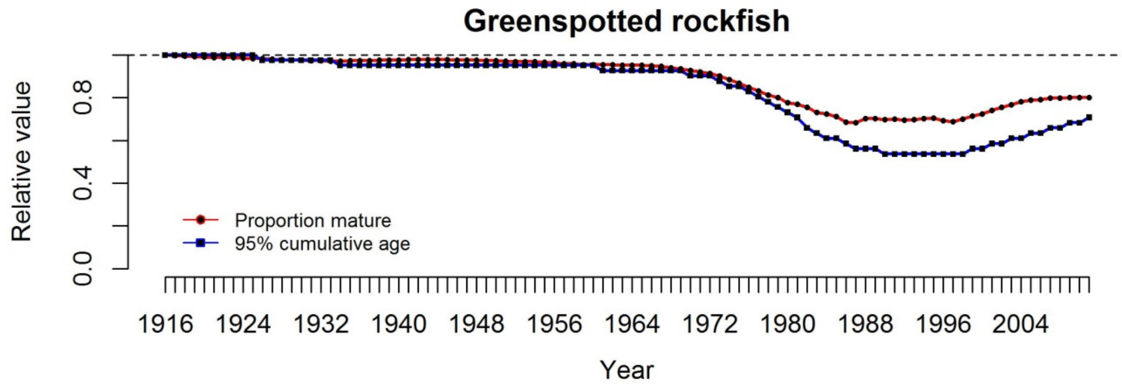

Figure GF62. Proportion of the greenspotted rockfish population mature (red) and at the 95% cumulative age (blue) relative to the first year (1916) of the time series.

Summary: Greenspotted rockfish show declines in proportion mature and proportion of the oldest ages over the length of the time series.

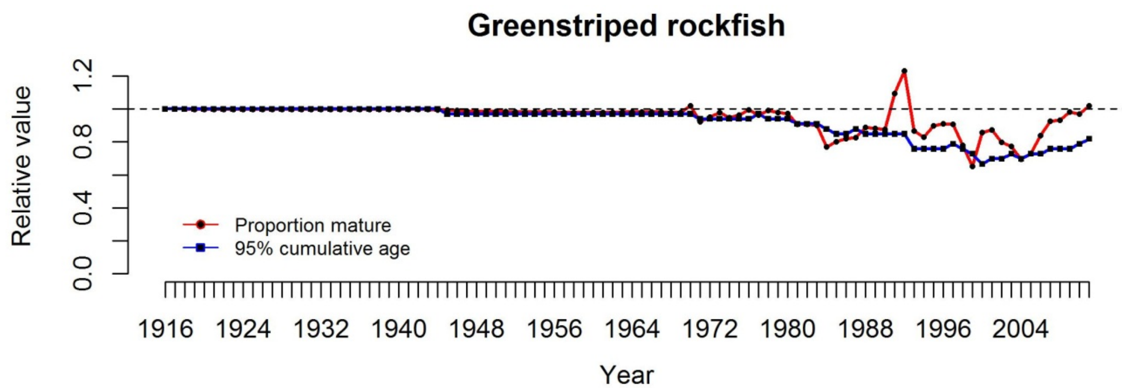

Figure GF63. Proportion of the greenstriped rockfish population mature (red) and at the 95% cumulative age (blue) relative to the first year (1916) of the time series.

Summary: Greenstriped rockfish show little change in proportion mature and proportion of the oldest ages over the length of the time series, with only a small decrease in population structure.

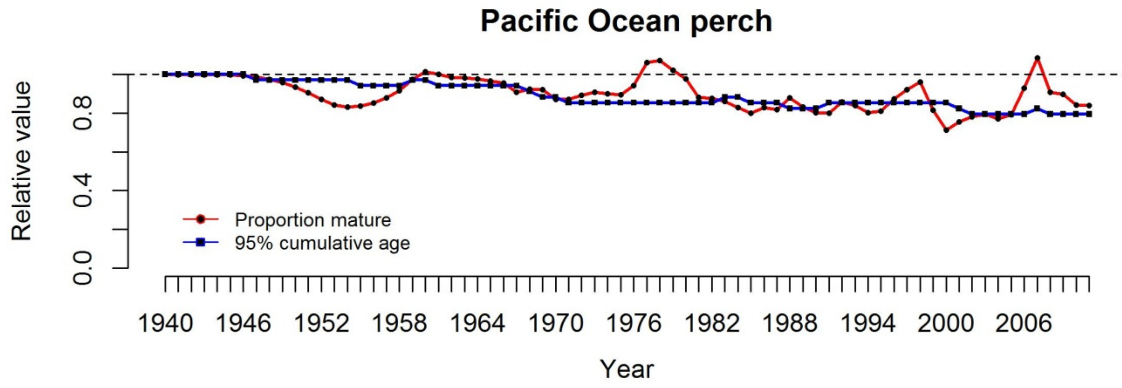

Figure GF64. Proportion of the Pacific Ocean perch population mature (red) and at the 95% cumulative age (blue) relative to the first year (1940) of the time series.

Summary: Pacific Ocean perch show low levels of decline in proportion mature and proportion of the oldest ages over the length of the time series.

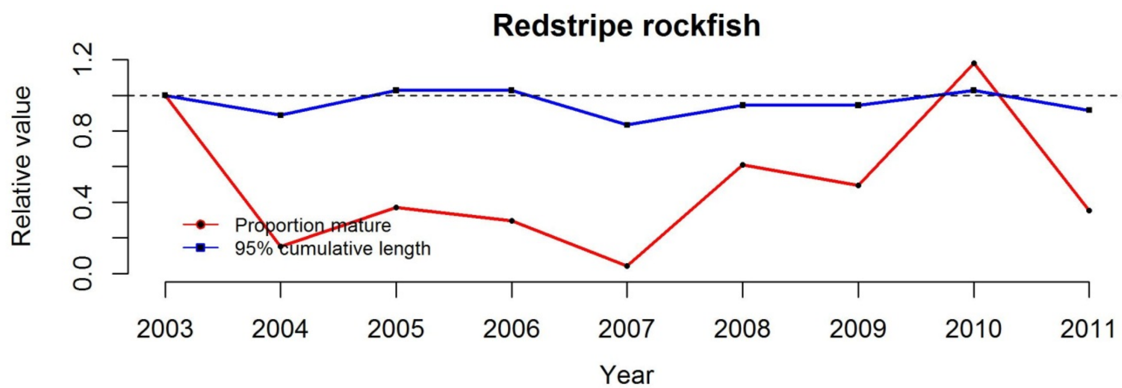

Figure GF65. Proportion of the redstripe rockfish population mature (red) and at the 95% cumulative length (blue) relative to the first year (2003) of the trawl survey time series.

Summary:

No stock assessment is available for redstripe rockfish so no baseline information on demographic structure is available. No declines in proportion of the largest lengths is apparent from the trawl survey data, though proportion of mature individuals is variable across years with a notable decline.

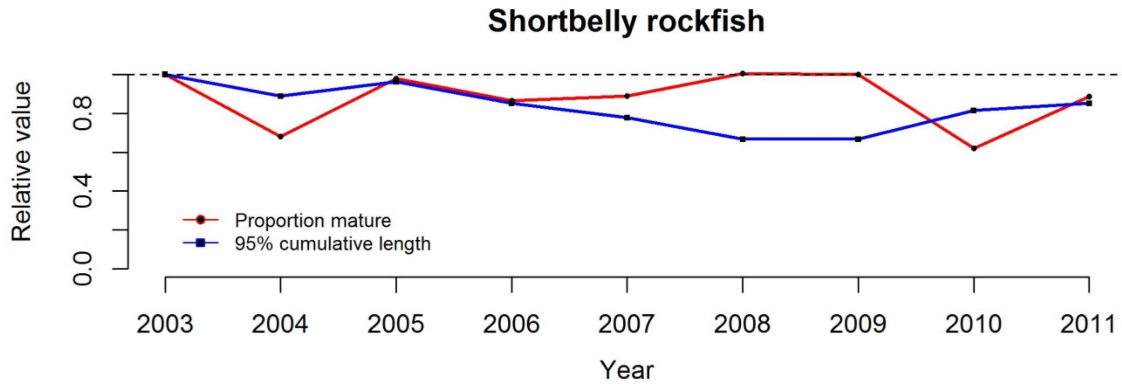

Figure GF66. Proportion of the shortbelly rockfish population mature (red) and at the 95% cumulative length (blue) relative to the first year (2003) of the trawl survey time series.

Summary: Only modest declines in either maturity or proportion of the largest lengths are apparent from the trawl survey data for shortbelly rockfish.

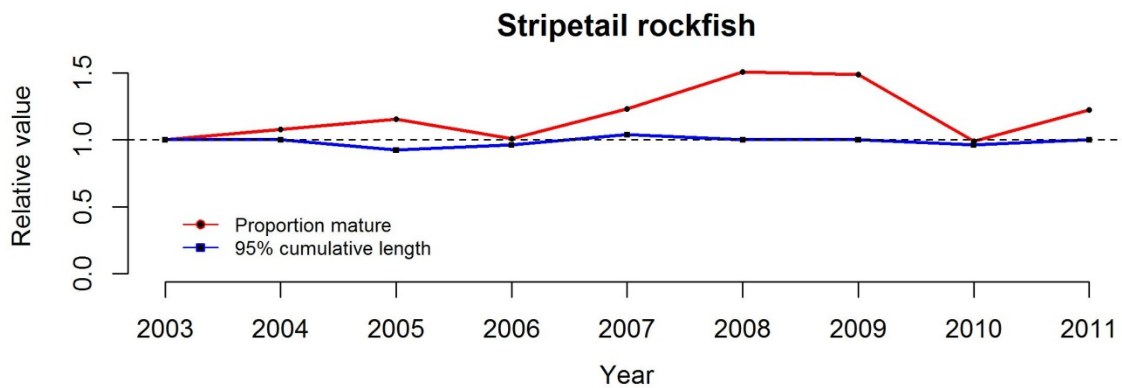

Figure GF67. Proportion of the stripetail rockfish population mature (red) and at the 95% cumulative length (blue) relative to the first year (2003) of the trawl survey time series.

Summary: No stock assessment is available for stripetail rockfish so no baseline information on demographic structure is available. No declines in either maturity or proportion of the largest lengths are apparent from the trawl survey data.

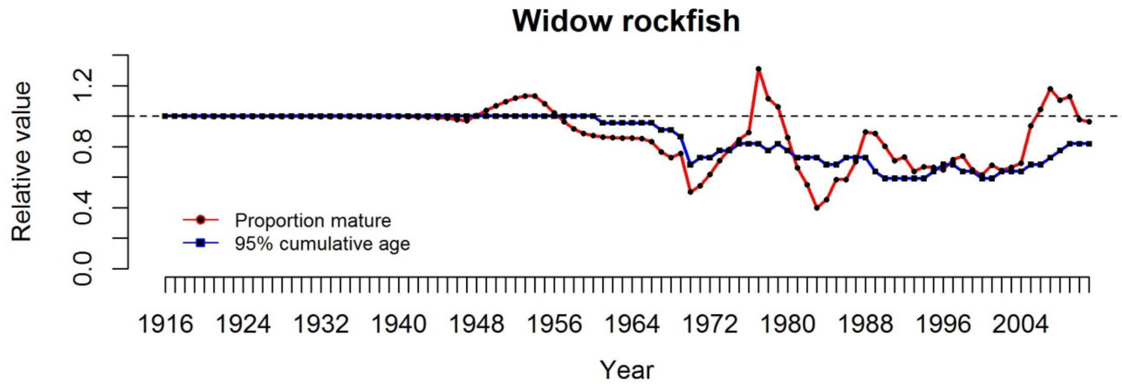

Figure GF68. Proportion of the widow rockfish population mature (red) and at the 95% cumulative age (blue) relative to the first year (1916) of the time series.

Summary: Widow rockfish show no declines in proportion mature and population structure over the length of the time series that has returned or is building back towards historical levels.

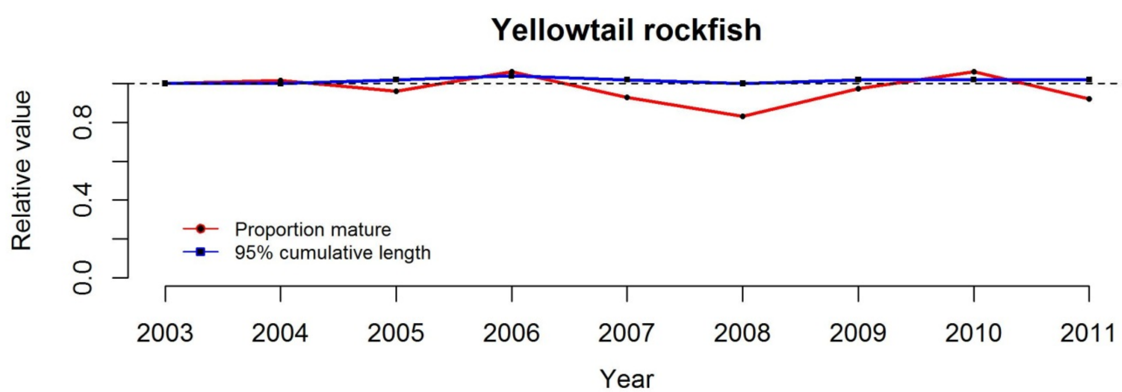

Figure GF69. Proportion of the yellowtail rockfish population mature (red) and at the 95% cumulative length (blue) relative to the first year (2003) of the trawl survey time series.

Summary: No declines in either maturity or proportion of the largest lengths are apparent from the trawl survey data for yellowtail rockfish.

Slope

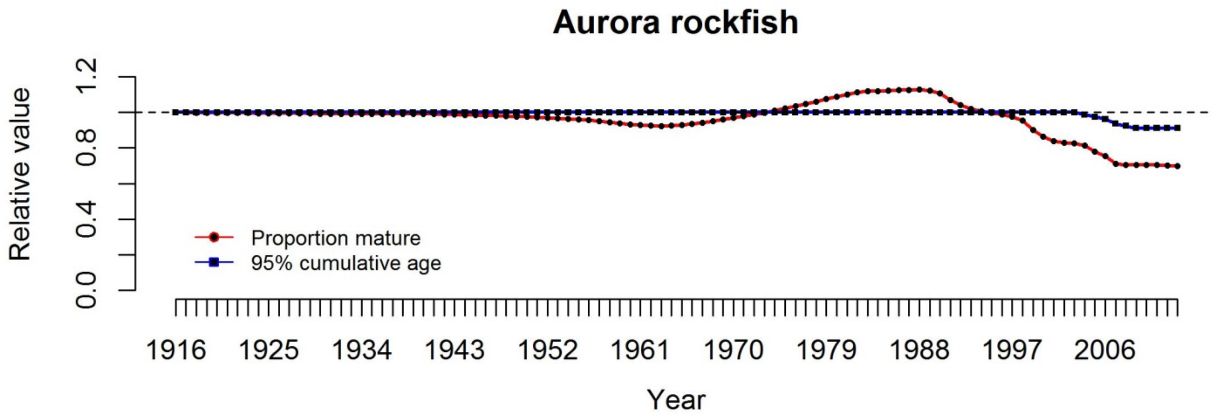

Figure GF70. Proportion of the aurora rockfish population mature (red) and at the 95% cumulative length (blue) relative to the first year (2003) of the trawl survey time series.

Summary: Aurora rockfish shows very little change in cumulative age, with greater decline in the proportion of mature females.

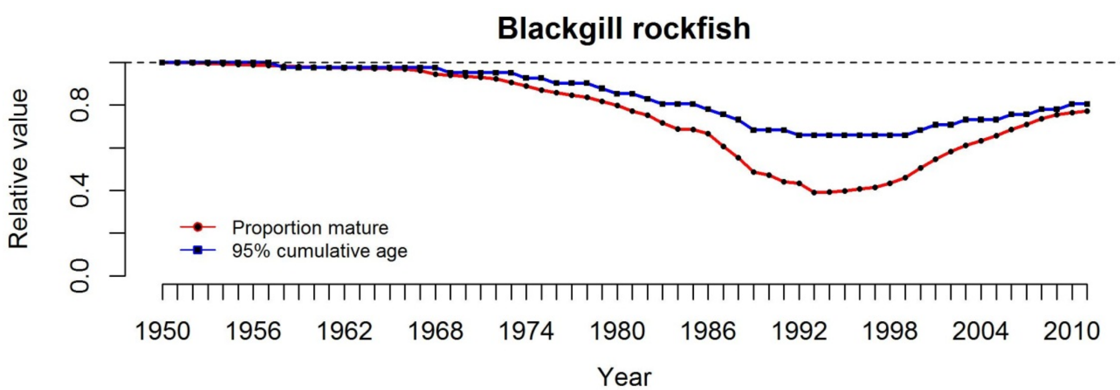

Figure GF71. Proportion of the blackgill rockfish population mature (red) and at the 95% cumulative age (blue) relative to the first year (1950) of the time series.

Summary: Blackgill rockfish show declines in proportion mature and proportion of the oldest ages over the length of the time series.

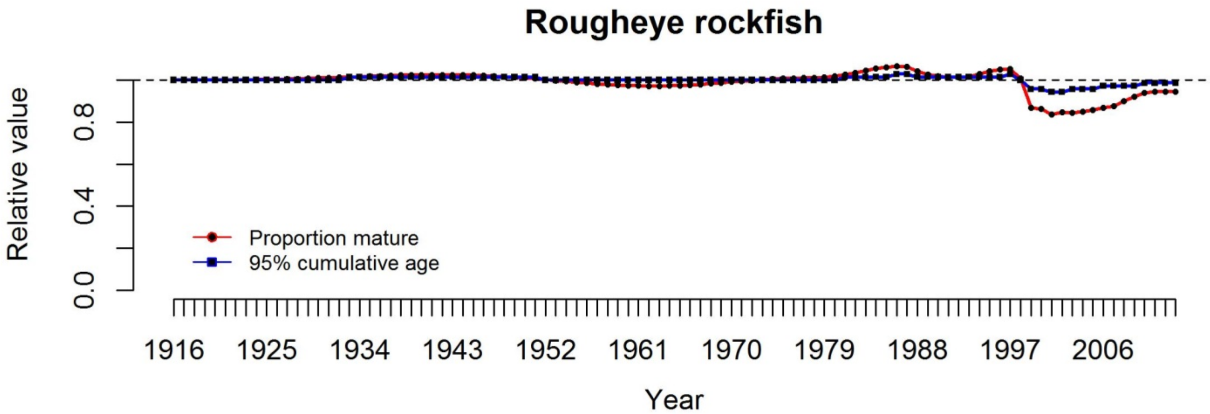

Figure GF72. Proportion of the rougheyerockfish population mature (red) and at the 95% cumulative age (blue) relative to the first year (1950) of the time series.

Summary: Rougheye rockfish show little change in proportion mature and proportion of the oldest ages over the length of the time series.

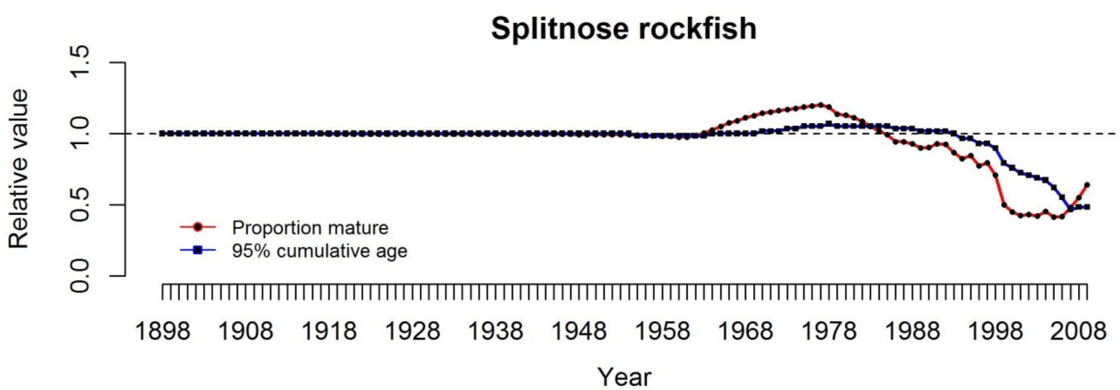

Figure GF73. Proportion of the splitnose rockfish population mature (red) and at the 95% cumulative age (blue) relative to the first year (1900) of the time series.

Summary: Splitnose rockfish show declines in proportion mature and proportion of the oldest ages over the length of the time series.

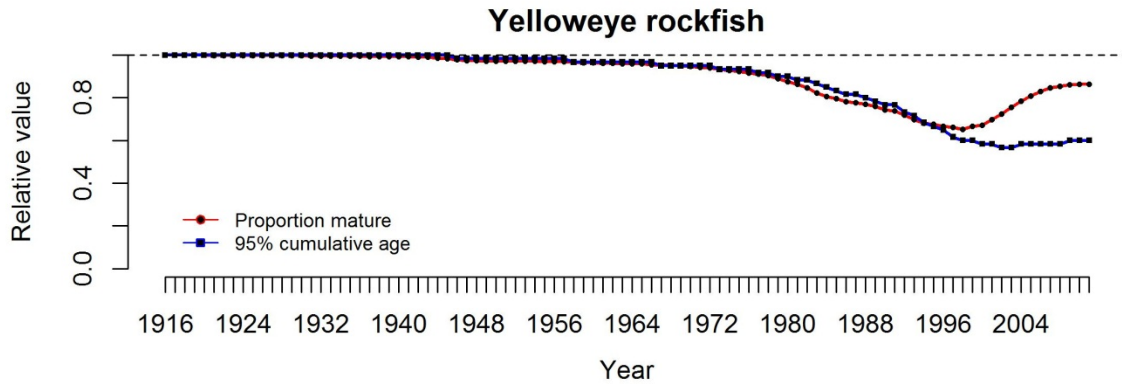

Figure GF74. Proportion of the yelloweye rockfish population mature (red) and at the 95% cumulative age (blue) relative to the first year (1916) of the time series.

Summary: Yelloweye rockfish show declines in proportion mature and proportion of the oldest ages over the length of the time series.

THORNYHEADS (N=2)

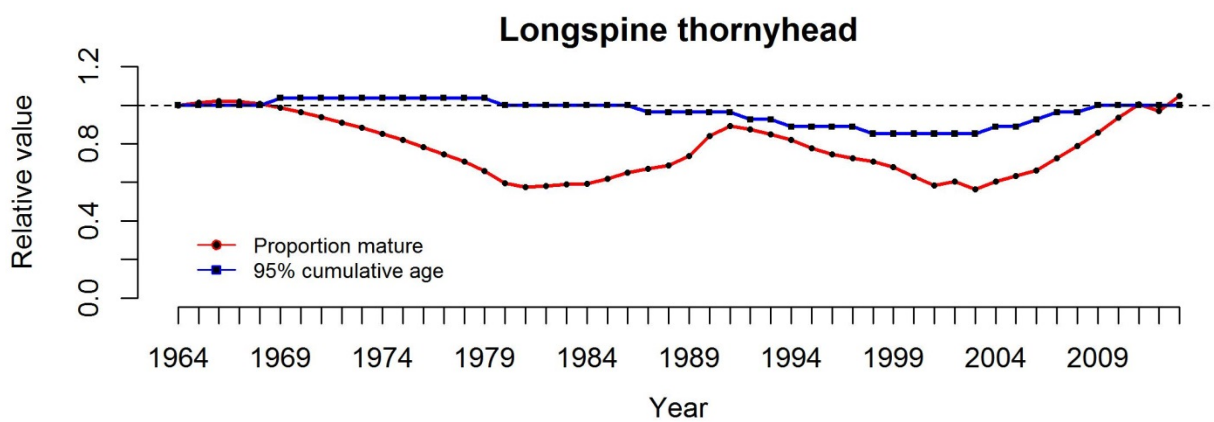

Figure GF75. Proportion of the longspine thornyhead population mature (red) and at the 95% cumulative age (blue) relative to the first year (1916) of the time series.

Summary: Longspine thornyheads have demonstrated .some historical decline in age structure and maturity, but current populations are similar to earlier period population structure.

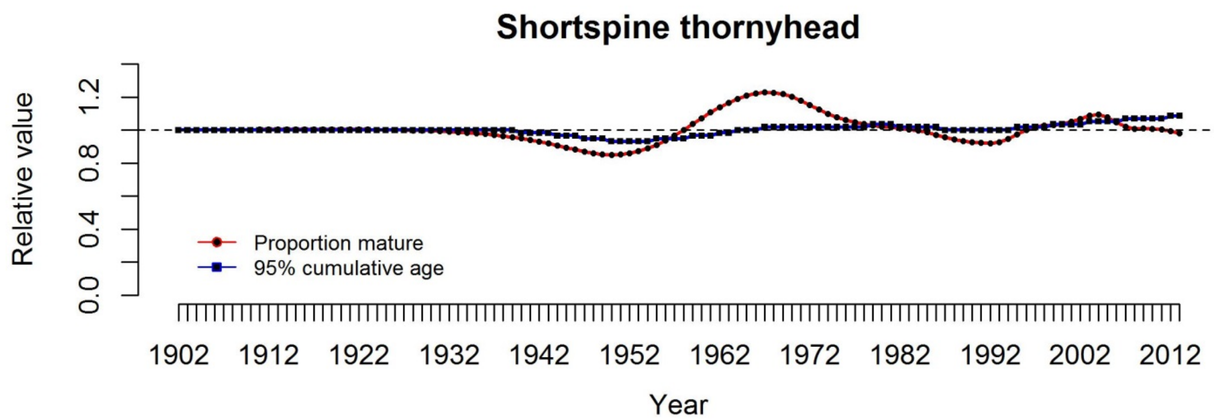

Figure GF76. Proportion of the shortspine thornyhead population mature (red) and at the 95% cumulative age (blue) relative to the first year (1916) of the time series.

Summary: Shortspine thornyheads have demonstrated very little change in age structure and maturity over the measured time period.

ROUNDFISHES (N=3)

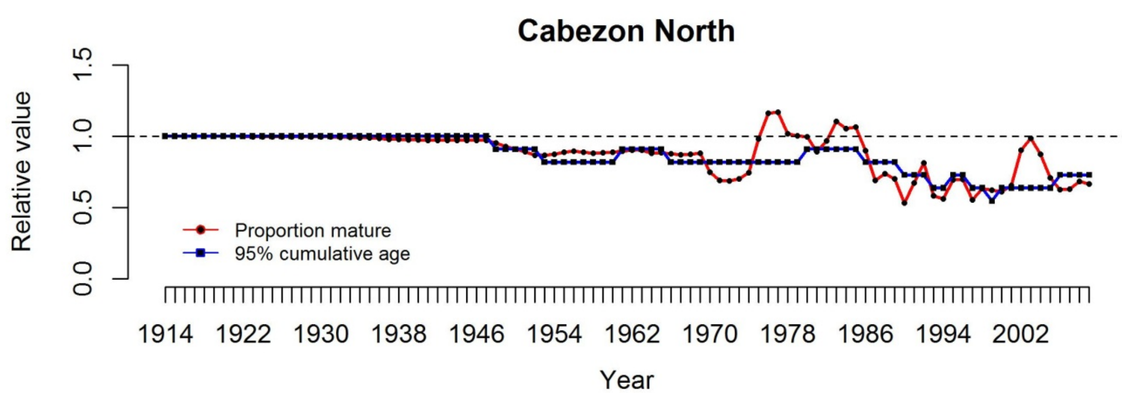

Figure GF77. Proportion of the cabezon population mature (red) and at the 95% cumulative age (blue) relative to the first year (1916) of the time series.

Summary: Cabezon show declines in proportion mature and proportion of the oldest ages over the length of the time series.

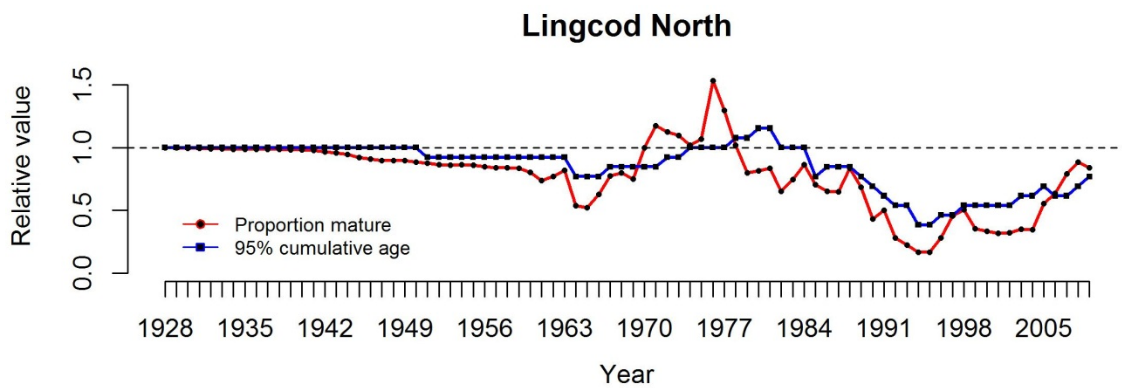

Figure GF78. Proportion of the lingcod population mature (red) and at the 95% cumulative age (blue) relative to the first year (1930) of the time series.

Summary: Lingcod show declines in proportion mature and proportion of the oldest ages that have recently shown increases towards historical levels.

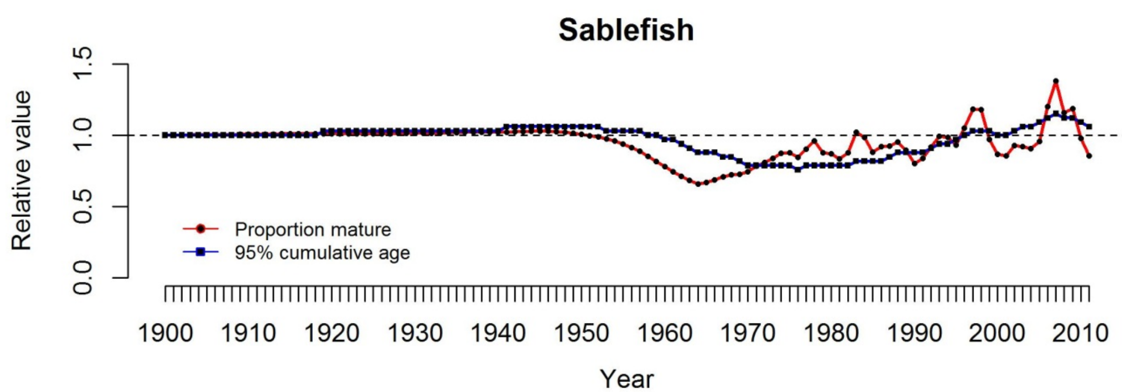

Figure GF79. Proportion of the sablefish population mature (red) and at the 95% cumulative age (blue) relative to the first year (1900) of the time series.

Summary: Sablefish show little change in proportion mature and proportion of the oldest ages over the length of the time series.

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