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# Pre-COSEWIC review of Yelloweye Rockfish (*Sebastes ruberrimus*) along the Pacific coast of Canada: biology, distribution and abundance trends

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## Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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## ABSTRACT

This review presents data on Yelloweye Rockfish (*Sebastes ruberrimus*) for use in a COSEWIC status report. Yelloweye Rockfish was listed as a species of “Special Concern” by COSEWIC in 2008. This species occurs from the Aleutian Islands in Alaska to Baja California, including all coastal BC waters. Two designatable units are found in BC: the “inside” population occupying the inside waters between Vancouver Island and mainland BC, and the “outside” population occurring in all other BC waters. Yelloweye are found primarily in depths from 20 m to around 300 m coastwide. The inside population occurs over an approximate area of 14,267 km$^2$, while the outside population occur over an approximate area of 108,035 km$^2$. The maximum length of Yelloweye Rockfish caught in BC is 84 cm, and the maximum weight is 10.9 kg. British Columbia Yelloweye are aged to a maximum of 121 years, with an estimated age of 17 when 50% of individuals are mature. Natural mortality is estimated at 0.038. Average generation time is similar between the inside and outside populations, 42.8 and 42.6 years, respectivley. Yelloweye Rockfish are caught in commercial, recreational and First Nations fisheries in BC. Quotas have been reduced since 2001 to a current overall sector total of 110 t. In 2006 100% monitoring was implemented for BC fisheries. Research surveys have increased for groundfish in BC over the last 10 years providing abundance indices to represent population trends. These time series are still relatively short and will benefit from continuing surveys.

# 1. INTRODUCTION

## 1.1. PURPOSE

Yelloweye Rockfish (*Sebastes ruberrimus*) was originally assessed as a species of special concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2008 (COSEWIC 2008). The purpose of this paper is to summarize current biological data, fishery data, and survey index trends relevant to the COSEWIC re-assessment for Yelloweye Rockfish in Canadian waters. Results of this report will be made available to COSEWIC, the authors of the species status report, and the co-chairs of the applicable COSEWIC Species Specialist Subcommittee.

## 1.2. NAME AND CLASSIFICATION

Yelloweye Rockfish is one of at least 42 rockfish species found in Canada's Pacific waters (source: Department of Fisheries and Oceans (DFO) database "GFBio")[1]. Yelloweye Rockfish is also referred to as red snapper, red rock cod, rasphead rockfish, red rockfish, red cod, goldeneye rockfish, and turkey red rockfish (Lamb and Edgell, 1986) and may be confused with other red or yellow rockfish such as Canary Rockfish (*S. pinniger*).

## 1.3. MORPHOLOGICAL DESCRIPTION

Yelloweye Rockfish is one of the largest rockfish reaching a maximum recorded length of 91 cm and a maximum recorded weight of 11.3 kg (Love et al. 2002). It is easily identified by its bright orange to red colouration and bright yellow eyes. Adults usually have a light to white stripe on their lateral line. Juveniles are darker red in colouration than the adults and have two light stripes, one on the lateral line and a shorter one below the lateral line (Mecklenburg et al. 2002). This species has 13 dorsal spines and the fins may have black tips (Kramer and O'Connell, 1995).

## 1.4. GENETIC DESCRIPTION & DESIGNATABLE UNITS (DU)

Two genetically distinct designatable units (DU) of Yelloweye Rockfish exist in BC waters, the "inside" and "outside" units. Yamanaka et al. (2000) conducted a survey of Yelloweye Rockfish in coastal BC and southeast Alaska between 1998 and 2000. Samples were collected from southeast Alaska to Vancouver Island, but all sample sites in BC were off the west coast of Vancouver Island (WCVI) or the west coast of Haida Gwaii (WCHG). No samples were collected from coastal mainland sites, the Strait of Georgia (SOG), Juan de Fuca Strait, Queen Charlotte Strait (QCS) or southern US waters. Analysis of 2500 Yelloweye Rockfish at 13 microsatellite loci showed that these samples were all from a single population with high genetic diversity and a large estimated population size (Yamanaka et al. 2000).

[1] Yelloweye Rockfish commercial and research catch, effort, and biological data are archived by the Groundfish Data Unit (Fisheries and Oceans Canada, Science Branch, Pacific Region) and housed in a number of relational databases. Historical commercial catch and effort data from 1954 – 2006/2007 are housed in GFCatch, PacHarvTrawl, PacHarvHL, and PacHarvSable depending on the fishery and time period. Modern (2006/2007 to present) commercial catch data are housed in GFFOS, a groundfish-specific "view" of the Fishery Operations System (FOS) database (Fisheries and Oceans Canada, Fisheries and Aquaculture Management, Pacific Region). Research survey data and commercial biological data from the 1940s to present are housed in GFBio, the Groundfish Biological Samples database. Data in this report were extracted from the databases in December 2017.

Between 2000 and 2005, samples were obtained from the SOG, QCS, mainland coastal BC, Washington and Oregon and were analysed at 9 of the original 13 loci. Analysis of these later samples showed that Yelloweye samples in the SOG and QCS were genetically distinct from the mainland coastal BC, Washington and Oregon samples (Yamanaka et al. 2006). This suggests a separate population in the inside waters between Vancouver Island and mainland BC (Figure 1) with an effective population size of about 2/3 that of the outside population (Yamanaka et al. 2006).

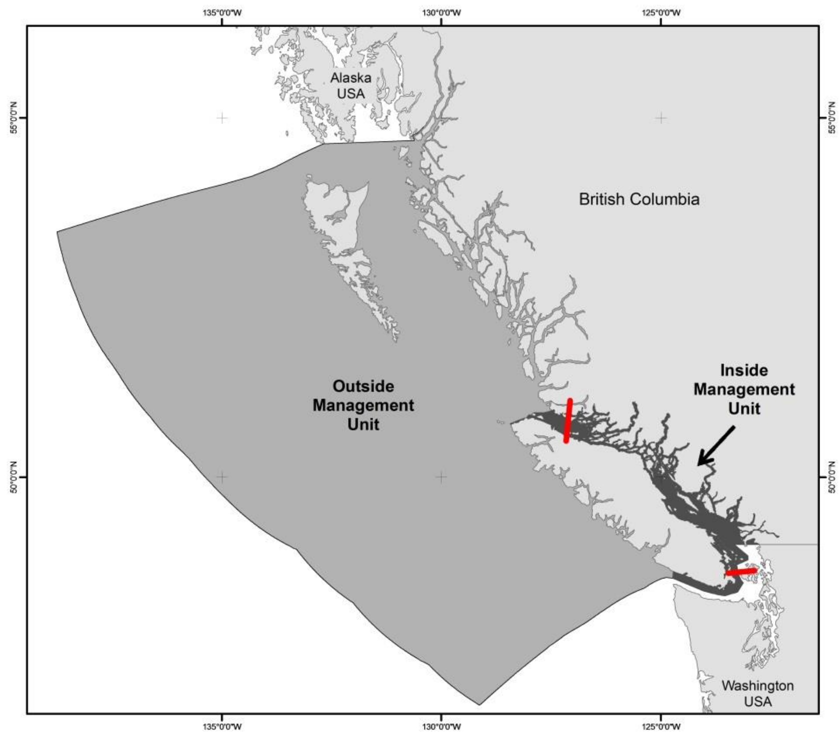



*Figure 1. Yelloweye Rockfish inside (dark gray) and outside (light gray) management units. Red lines show boundaries of the two genetically distinct populations.*

A subsequent genetic study of Yelloweye Rockfish from southeast Alaska to Oregon and including WCHG and WCVI, QCS, the SOG and Washington analysed 2,862 individuals at 9 microsatellite loci (Siegle et al. 2013) further supporting two distinct populations. This work detected a subtle genetic structure that separates a putative population in the Georgia Basin from a panmictic population in the outer coast of BC, which may suggest that there is a dispersal barrier between the Strait of Georgia and the outside waters (Siegle et al. 2013).

The inside unit thus includes QCS, Johnstone Strait (JS) and the SOG (within red lines in Figure 1) and corresponds closely with Pacific Fishery Management Area (PFMA) 4B (dark gray area in Figure 1, management areas 12-20, 28 and 29), although 4B extends out through Juan de Fuca Strait and over northern Vancouver Island. This report treats all data within area 4B as within the inside unit. The outside unit covers all other BC waters.

# 2. DISTRIBUTION

## 2.1. GLOBAL DISTRIBUTION

Yelloweye Rockfish occur from the Aleutian Islands to northern Baja California, off Ensenada (Figure 2, Yamanaka et al. 2006). They are found sheltering in crevices or a few meters above the seafloor at depths of 11-549 m, usually from 91-180 m (Love et al. 2002; Yamanaka et al. 2006).

*Figure 2. Global Distribution of Yelloweye Rockfish (reprinted with permission from Love et al. 2002).*

## 2.2. CANADIAN RANGE

Canadian commercial fishery and survey data indicate that Yelloweye Rockfish are present in all coastal BC waters with the inside population occurring in QCS, JS and the SOG, and the outside population occurring in all other BC waters (Figure 3). Fishing events that captured Yelloweye Rockfish were extracted from GFFOS, GFCatch, PacHarvTrawl, PacHarvHL, and PacHarvSable for commercial data and from research surveys stored in GFBio, for all available years (accessed December 2017). Start locations were plotted on a 4 $km^2$ grid to indicate the presence of Yelloweye Rockfish.

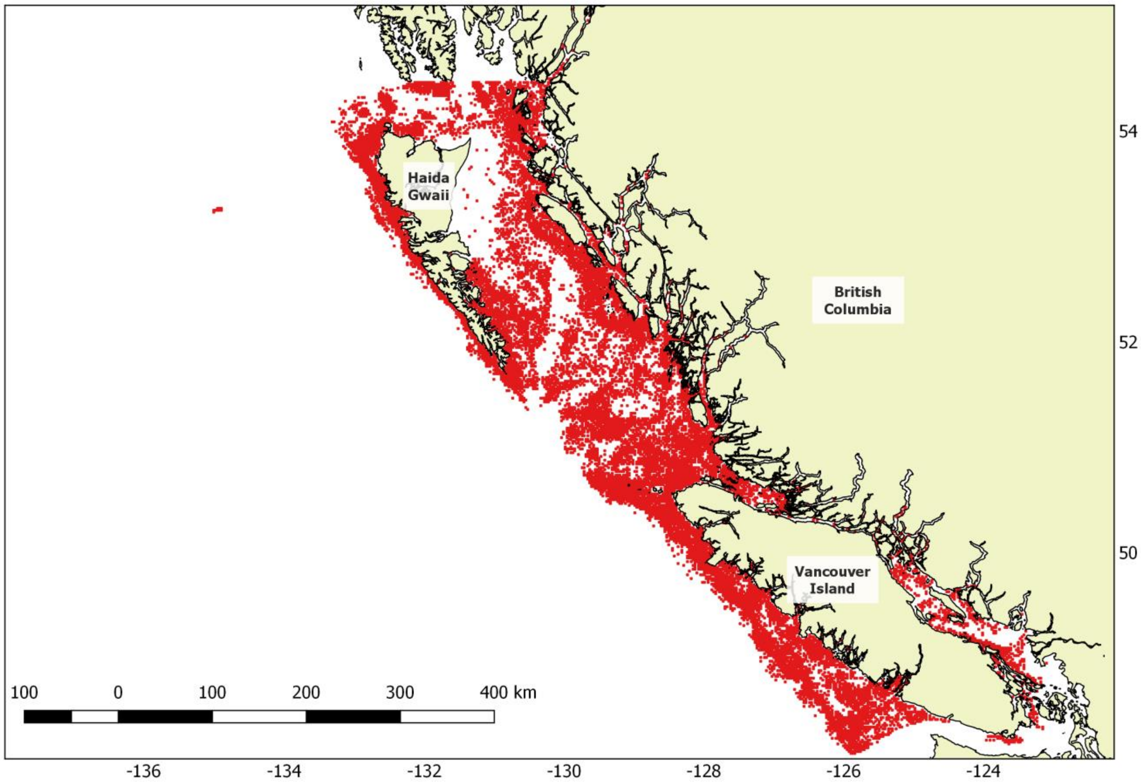



*Figure 3. Distribution of Yelloweye Rockfish in Canadian waters showing the occurrence on a 4 $km^2$ cell-size grid. Data from commercial groundfish fisheries (all gear types; 1982-2017) and research survey data sources (1963-2017).*

## 2.3. HABITAT

### 2.3.1. Habitat Preferences

General habitat preferences for all Yelloweye Rockfish is summarized by Love et al. (2002) to include “areas of high-relief… with vertical walls covered with cloud sponges” for juveniles, and “rocky areas of high relief with refuge space, particularly overhangs, caves, crevices, and boulder piles” for sub adults and adults.

Information on the habitat of Yelloweye Rockfish from BC has come from direct *in situ* observations from submersible and remotely operated vehicle (ROV) video surveys. Yelloweye Rockfish is associated with preferred habitats of rocky substrates with or without encrusting organisms (such as barnacles, tube worms, hydroids) or larger emergent organisms (such as *Metridium* anemones, sponges, sea pens) (Haggarty et al. 2016). This species is generally associated with habitats with greater relief (Richards, 1986) and complexity (Richards 1986; Yamanaka et al. 2006; Haggarty et al. 2016). Yelloweye has been observed among glass sponges and other sponges (Richards, 1986; Yamanaka et al. 2006; Haggarty et al. 2016) where there are crevices that can provide refuge.

## 2.3.2. Depth Distribution

The depth distribution for all Yelloweye Rockfish is reported as 11-549 m, typically between 91-180 m, by Love (2011). For BC waters, the depths of all fishing events that captured Yelloweye Rockfish were extracted from all available DFO databases for commercial fisheries and research surveys (listed in Appendix B) for all available years. For survey sets, the depth is the mean depth of the set (or transect in the case of video surveys). If the mean depth is not available, depth is reported as, in preferential order, the start depth, end depth, minimum depth, or maximum depth of a set/transect. For commercial data, the depth is the average of the start and end bottom depths for each set. If the average is not available then the start or end bottom depth of the set is used.

*Table 1. Minimum and maximum survey depths and minimum and maximum depths at which Yelloweye Rockfish (YE) was captured in research surveys.*

| Survey | Min Survey Depth | Min YE Depth | Max Survey Depth | Max YE Depth |
|---|---|---|---|---|
| Hecate Strait Multispecies Assemblage Survey | 18 | 32 | 232 | 137 |
| Hecate Strait Pacific Cod Monitoring Survey | 22 | 46 | 168 | 141 |
| Hecate Strait Synoptic Survey | 19 | 34 | 385 | 208 |
| Queen Charlotte Sound Synoptic Survey | 42 | 45 | 626 | 276 |
| West Coast Vancouver Island Synoptic Survey | 41 | 54 | 988 | 329 |
| West Coast Haida Gwaii Synoptic Survey | 157 | 157 | 1329 | 263 |
| Strait of Georgia Synoptic Survey | 59 | 110 | 395 | 224 |
| Queen Charlotte Sound Shrimp Survey | 35 | 124 | 231 | 212 |
| West Coast Vancouver Island Shrimp Survey | 81 | 99 | 165 | 162 |
| Lingcod Young of Year Trawl Survey | 12 | 61 | 97 | 78 |
| IPHC Longline Survey | 27 | 31 | 464 | 346 |
| PHMA Rockfish Longline Survey - Outside North | 22 | 22 | 262 | 258 |
| PHMA Rockfish Longline Survey - Outside South | 20 | 27 | 260 | 252 |
| Inshore Rockfish Longline Survey (North) | 20 | 20 | 140 | 121 |
| Inshore Rockfish Longline Survey (South) | 35 | 35 | 105 | 105 |
| Strait of Georgia Dogfish Longline Survey | 5 | 37 | 348 | 275 |
| 1995 QC Sound Rockfish Survey | 143 | 152 | 296 | 196 |
| 1996 West Coast VI Rockfish Survey (single survey series) | 150 | 165 | 787 | 196 |
| Jig Surveys | 4 | 6 | 91 | 81 |
| Sablefish Inlet Standardized | 302 | 435 | 832 | 693 |
| Sablefish Offshore Standardized | 161 | 161 | 1397 | 379 |
| Sablefish Stratified Random | 140 | 140 | 1463 | 384 |
| Remotely operated vehicle (ROV) video surveys | 3 | 10 | 343 | 294 |

Some surveys may not cover the entire Yelloweye Rockfish depth range and may thus bias the reported depth distribution. The minimum and maximum survey depths and minimum and maximum depths at which Yelloweye Rockfish was captured in each survey are given in Table 1.

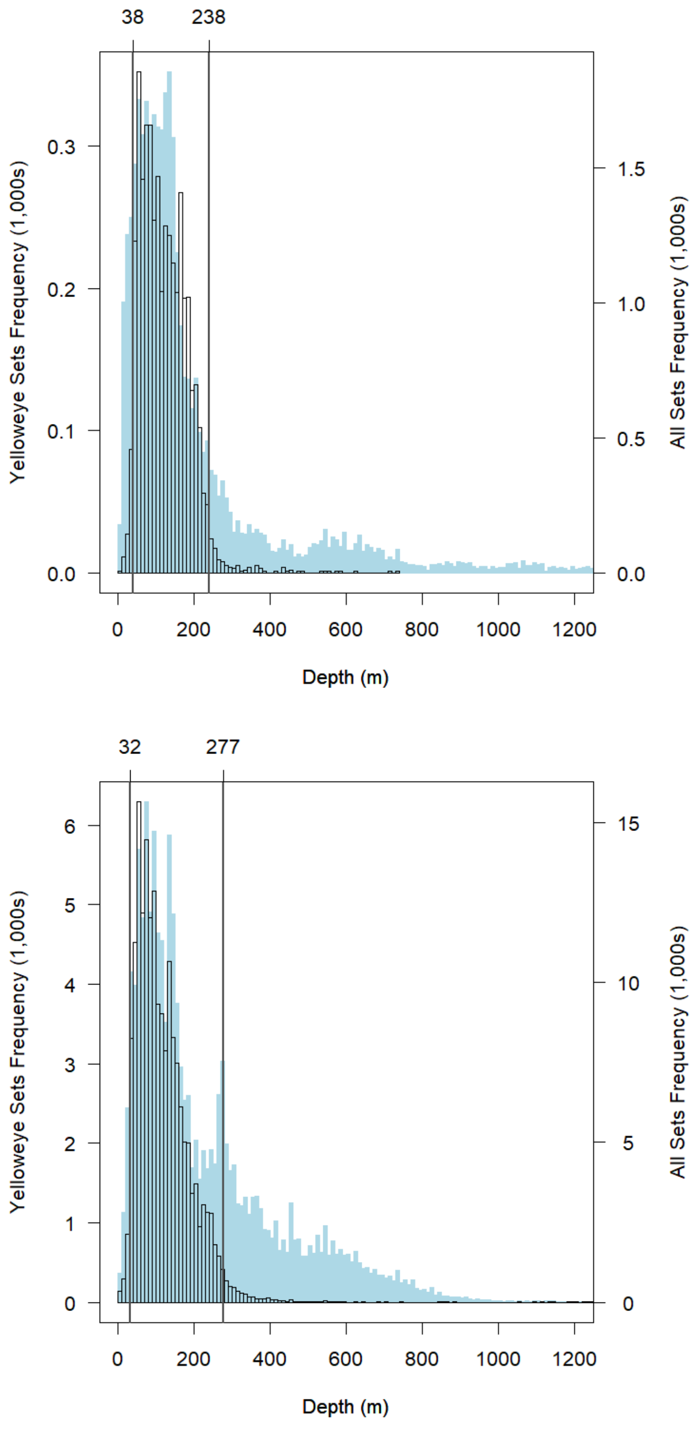



*Figure 4. Depth of capture frequency of Yelloweye Rockfish (open bars) from commercial groundfish fisheries (top panel; all gear types except midwater trawl; 1969-2017) and research surveys (bottom panel; all gear types except midwater trawl; 1944-2017). Blue shading shows depth of all sets.*

Depth observations for survey captures (or observations in visual surveys) show inside Yelloweye Rockfish occur between 2.5% and 97.5% quantiles of 38 and 238 metres (Figure 4, top). Capture of Yelloweye Rockfish in the commercial fishery occurs at depths between the

2.5% and 97.5% quantiles of 32 and 277 metres (Figure 4, bottom). Specific survey and commercial fishery data included are listed in Appendix B.

Visual surveys using ROV video target shallower depths that may be missed by destructive surveys and commercial catches. There are far fewer data points for visual surveys than destructive surveys, and thus the shallower depths may be excluded from the 95% confidence intervals shown above. The depth distribution of Yelloweye Rockfish from ROV survey data suggests that shallower depths are inhabited by both juvenile and adult Yelloweye (Figure 5) (Haggarty et al. 2016).

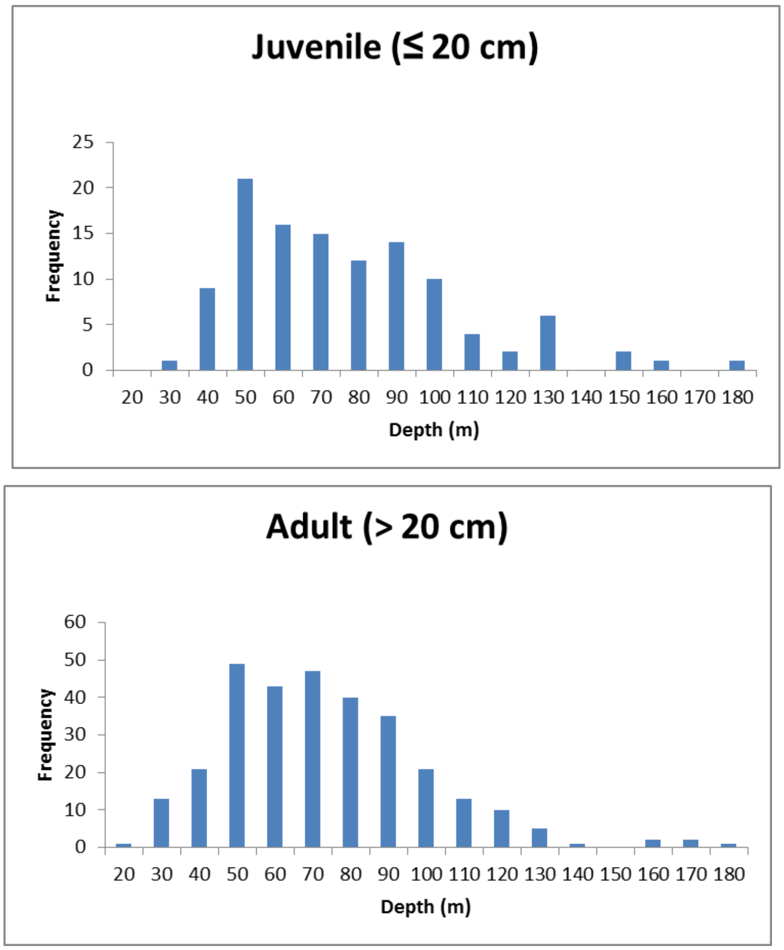



*Figure 5. Depth distribution of adult and juvenile Yelloweye Rockfish seen by remotely operated vehicle video survey.*

### 2.3.3. Habitat Protection

Yelloweye Rockfish is exploited by commercial, recreational and First Nations' fisheries. Several measures are currently in place in BC which protect rockfish habitat: Rockfish Conservation Areas (RCAs), sponge reef closures, bottom trawl boundary, and portions of the Gwaii Haanas National Marine Conservation Area (GHNMCA) Reserve. These measures are detailed in the Fisheries Management section of this document (Section 4.4).

## 2.4. EXTENT OF OCCURENCE & AREA OF OCCUPANCY

The extent of occurrence (EOO) for Yelloweye Rockfish was estimated by drawing a polygon around all recorded locations where it has been captured (or documented in visual surveys) and calculating the area. This includes captures in all fishery sectors (1982 - present) and all fishery-independent surveys (1963 – present), and was done separately for each DU. Area of occupancy (AOO) was estimated using actual catches (commercial and survey) within the extent of occurrence. Summarizing over a 2 km x 2 km grid, this gave an extent of occurrence for inside Yelloweye Rockfish of 14,267 km², with an area of occupancy of 3,956 km² (Figure 6). Extent of occurrence for outside Yelloweye Rockfish was 108,035 km² with an area of occupancy of 49,924 km² (Figure 7).

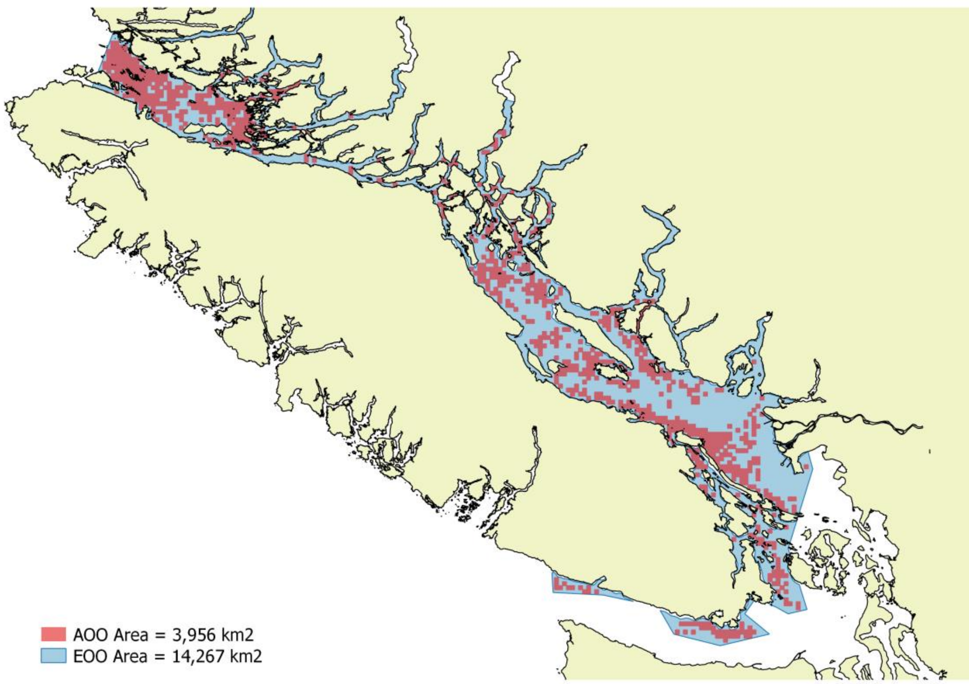



*Figure 6. Extent of Occupancy (EOO) and Area of Occupancy (AOO) of the inside Yelloweye Rockfish DU. See Figure 3 for source data.*

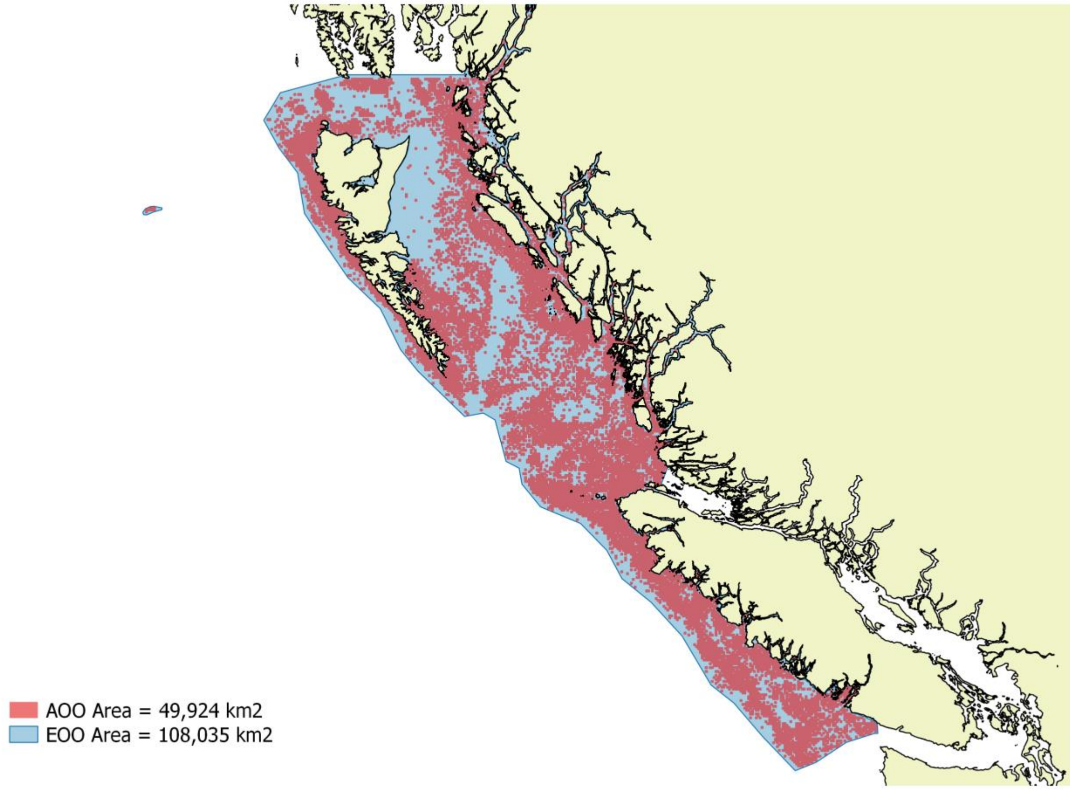



*Figure 7. Extent of Occupancy (EOO) and Area of Occupancy (AOO) of the inside Yelloweye Rockfish DU. See Figure 3 for source data.*

# 3. BIOLOGY

## 3.1. AVAILABLE DATA

Within the Department of Fisheries and Oceans Pacific Biological Station's archive of groundfish biological data, GFBio, there is a fairly consistent collection of Yelloweye Rockfish samples from the early 1980's to the present. In addition, there are a smaller number of samples prior to 1980. Data listed are for those specimens of Yelloweye Rockfish that were identified as male or female and collected information may include length, sex, weight, visual maturity assessments, structures collected for age determination, and ages determined by the break and burn or break and bake methods. There are a number of samples where sex was not determined and these have been omitted from the data summary.

All available survey and commercial samples for all years for the inside DU are listed in Table 2 and Table 3, respectively, and for the outside DU in Table 4 and Table 5, respectively.

All references to biological information in this section refer to data that was extracted from GFBio unless otherwise stated. Data were extracted in December 2017.

*Table 2. Available inside Yelloweye Rockfish biological data from research surveys by year showing the number of samples, lengths, sex, weights, visual maturity assessments, age structures collected (Ages) and aged by the break and burn or break and bake methods. Specific surveys providing data in each data type are listed in Appendix B.*

| Year | Samples | Specimens | Males | Females | Unknown Sex | Lengths | Weights | Maturities | Aged |
|---|---|---|---|---|---|---|---|---|---|
| 1948 | 2 | 2 | 1 | 0 | 1 | 2 | 0 | 2 | 0 |
| 1949 | 1 | 2 | 1 | 1 | 0 | 2 | 0 | 0 | 0 |
| 1950 | 1 | 3 | 0 | 3 | 0 | 3 | 0 | 3 | 0 |
| 1975 | 4 | 6 | 0 | 0 | 6 | 6 | 0 | 6 | 0 |
| 1983 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| 1984 | 64 | 96 | 52 | 44 | 0 | 95 | 7 | 96 | 68 |
| 1985 | 81 | 156 | 84 | 70 | 2 | 150 | 124 | 149 | 117 |
| 1986 | 41 | 56 | 27 | 29 | 0 | 56 | 56 | 56 | 43 |
| 1987 | 20 | 24 | 12 | 12 | 0 | 24 | 24 | 24 | 0 |
| 1988 | 19 | 26 | 12 | 14 | 0 | 23 | 23 | 26 | 0 |
| 1992 | 7 | 8 | 4 | 4 | 0 | 8 | 7 | 8 | 0 |
| 1993 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 |
| 2003 | 41 | 188 | 77 | 107 | 4 | 183 | 181 | 184 | 181 |
| 2004 | 48 | 162 | 75 | 84 | 3 | 161 | 159 | 159 | 146 |
| 2005 | 42 | 276 | 131 | 129 | 16 | 267 | 259 | 260 | 276 |
| 2006 | 21 | 131 | 61 | 68 | 2 | 131 | 131 | 131 | 131 |
| 2007 | 32 | 115 | 52 | 63 | 0 | 115 | 114 | 115 | 115 |
| 2008 | 39 | 208 | 109 | 97 | 2 | 207 | 200 | 201 | 201 |
| 2009 | 6 | 22 | 7 | 15 | 0 | 22 | 22 | 22 | 8 |
| 2010 | 57 | 321 | 167 | 153 | 1 | 321 | 321 | 321 | 153 |
| 2011 | 49 | 275 | 131 | 142 | 2 | 273 | 273 | 273 | 264 |
| 2012 | 40 | 171 | 82 | 87 | 2 | 170 | 169 | 168 | 169 |
| 2013 | 32 | 223 | 106 | 117 | 0 | 222 | 223 | 223 | 220 |
| 2014 | 44 | 191 | 97 | 93 | 1 | 191 | 190 | 191 | 156 |
| 2015 | 41 | 236 | 114 | 115 | 7 | 232 | 230 | 229 | 209 |
| 2016 | 43 | 257 | 125 | 131 | 1 | 257 | 257 | 256 | 0 |
| **Total** | **777** | **3,157** | **1,528** | **1,579** | **50** | **3,123** | **2,971** | **3,105** | **2,457** |

*Table 3. Available inside Yelloweye Rockfish biological data from commercial fishery samples by year showing the number of samples, lengths, sex, weights, visual maturity assessments, age structures collected (Ages) and aged by the break and burn or break and bake methods. Specific fisheries by gear type providing data in each data type are listed in Appendix B.*

| Year | Samples | Specimens | Males | Females | Unknown Sex | Lengths | Weights | Maturities | Aged |
|---|---|---|---|---|---|---|---|---|---|
| 1980 | 1 | 40 | 0 | 0 | 40 | 0 | 0 | 0 | 37 |
| 1985 | 3 | 28 | 0 | 2 | 26 | 2 | 0 | 2 | 5 |
| 1986 | 2 | 3 | 2 | 1 | 0 | 3 | 3 | 3 | 0 |
| 1988 | 3 | 226 | 110 | 116 | 0 | 222 | 222 | 226 | 225 |
| 1989 | 6 | 99 | 43 | 37 | 19 | 97 | 72 | 80 | 74 |
| 1990 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 |
| 1992 | 8 | 15 | 5 | 10 | 0 | 15 | 0 | 0 | 0 |
| 1993 | 7 | 23 | 15 | 7 | 1 | 23 | 7 | 7 | 0 |
| 1994 | 4 | 56 | 30 | 26 | 0 | 55 | 49 | 50 | 50 |
| 1998 | 2 | 7 | 4 | 3 | 0 | 7 | 6 | 7 | 0 |
| 2000 | 6 | 62 | 25 | 17 | 20 | 46 | 46 | 2 | 2 |
| 2004 | 2 | 50 | 30 | 20 | 0 | 50 | 0 | 0 | 0 |
| 2005 | 6 | 211 | 100 | 111 | 0 | 211 | 130 | 0 | 0 |
| 2006 | 1 | 50 | 28 | 22 | 0 | 50 | 50 | 0 | 0 |
| 2007 | 6 | 242 | 99 | 140 | 3 | 240 | 207 | 33 | 0 |
| 2008 | 6 | 266 | 125 | 141 | 0 | 265 | 265 | 0 | 0 |
| **Total** | **64** | **1,379** | **616** | **654** | **109** | **1,287** | **1,058** | **411** | **393** |

*Table 4. Available outside Yelloweye Rockfish biological data from research surveys by year showing the number of samples, lengths, sex, weights, visual maturity assessments, age structures collected (Ages) and aged by the break and burn or break and bake methods. Specific surveys providing data in each data type are listed in Appendix B.*

| Year | Samples | Specimens | Males | Females | Unknown Sex | Lengths | Weights | Maturities | Aged |
|---|---|---|---|---|---|---|---|---|---|
| 1945 | 4 | 26 | 0 | 1 | 25 | 26 | 0 | 25 | 0 |
| 1967 | 10 | 18 | 8 | 10 | 0 | 18 | 0 | 18 | 0 |
| 1968 | 4 | 8 | 1 | 7 | 0 | 8 | 0 | 8 | 0 |
| 1969 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 |
| 1970 | 6 | 76 | 35 | 41 | 0 | 76 | 0 | 76 | 0 |
| 1979 | 2 | 134 | 50 | 0 | 84 | 50 | 0 | 50 | 84 |
| 1980 | 12 | 170 | 77 | 92 | 1 | 170 | 0 | 165 | 100 |
| 1981 | 11 | 201 | 103 | 98 | 0 | 201 | 0 | 201 | 199 |
| 1986 | 2 | 2 | 0 | 0 | 2 | 2 | 0 | 0 | 0 |
| 1987 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| 1989 | 23 | 67 | 24 | 37 | 6 | 67 | 15 | 16 | 0 |
| 1991 | 14 | 27 | 14 | 9 | 4 | 27 | 0 | 23 | 0 |
| 1992 | 5 | 11 | 6 | 5 | 0 | 11 | 0 | 0 | 0 |
| 1993 | 4 | 11 | 0 | 0 | 11 | 11 | 0 | 0 | 0 |
| 1995 | 13 | 22 | 15 | 7 | 0 | 22 | 10 | 10 | 0 |
| 1997 | 42 | 1,399 | 489 | 852 | 58 | 1,399 | 0 | 1,341 | 1,340 |
| 1998 | 84 | 1,894 | 990 | 842 | 62 | 1,894 | 36 | 1,785 | 1,772 |
| 1999 | 2 | 38 | 18 | 20 | 0 | 38 | 0 | 0 | 38 |
| 2000 | 26 | 638 | 304 | 334 | 0 | 635 | 335 | 443 | 468 |
| 2001 | 17 | 42 | 13 | 29 | 0 | 42 | 21 | 20 | 1 |
| 2002 | 47 | 2,076 | 1,072 | 1,002 | 2 | 2,067 | 346 | 2,023 | 2,020 |
| 2003 | 134 | 2,905 | 1,808 | 1,092 | 5 | 2,902 | 98 | 2,899 | 2,819 |
| 2004 | 116 | 1,399 | 766 | 628 | 5 | 1,395 | 156 | 1,391 | 1,200 |
| 2005 | 115 | 1,194 | 629 | 519 | 46 | 1,193 | 36 | 1,060 | 1,028 |
| 2006 | 228 | 3,867 | 1,920 | 1,828 | 119 | 3,866 | 51 | 3,744 | 3,707 |
| 2007 | 228 | 3,537 | 1,631 | 1,659 | 247 | 3,537 | 40 | 3,244 | 3,215 |
| 2008 | 243 | 3,737 | 1,832 | 1,865 | 40 | 3,737 | 98 | 3,530 | 3,452 |
| 2009 | 232 | 4,047 | 1,945 | 1,810 | 292 | 4,047 | 2,995 | 3,695 | 3,573 |
| 2010 | 230 | 4,308 | 2,086 | 2,139 | 83 | 4,303 | 3,149 | 4,203 | 1,012 |
| 2011 | 222 | 4,361 | 1,834 | 2,015 | 512 | 4,233 | 2,503 | 3,734 | 899 |
| 2012 | 226 | 3,608 | 1,639 | 1,876 | 93 | 3,603 | 2,193 | 3,394 | 926 |
| 2013 | 56 | 99 | 55 | 44 | 0 | 99 | 98 | 85 | 0 |
| 2014 | 199 | 2,705 | 1,315 | 1,338 | 52 | 2,704 | 2,546 | 2,651 | 941 |
| 2015 | 234 | 2,967 | 1,425 | 1,515 | 27 | 2,967 | 2,967 | 2,937 | 526 |
| 2016 | 203 | 2,945 | 1,335 | 1,540 | 70 | 2,943 | 2,942 | 2,883 | 0 |
| 2017 | 8 | 13 | 5 | 8 | 0 | 13 | 13 | 13 | 0 |
| **Total** | **3,004** | **48,554** | **23,445** | **23,262** | **1,847** | **48,308** | **20,648** | **45,668** | **29,320** |

*Table 5. Available outside Yelloweye Rockfish biological data from commercial fishery samples by year showing the number of samples, lengths, sex, weights, visual maturity assessments, age structures collected (Ages) and aged by the break and burn or break and bake methods. Specific fisheries by gear type providing data in each data type are listed in Appendix B.*

| Year | Samples | Specimens | Males | Females | Unknown Sex | Lengths | Weights | Maturities | Aged |
|---|---|---|---|---|---|---|---|---|---|
| 1979 | 1 | 84 | 0 | 0 | 84 | 0 | 0 | 0 | 84 |
| 1986 | 1 | 260 | 107 | 153 | 0 | 260 | 0 | 260 | 259 |
| 1988 | 2 | 105 | 36 | 68 | 1 | 97 | 97 | 104 | 100 |
| 1989 | 6 | 624 | 299 | 243 | 82 | 620 | 286 | 542 | 327 |
| 1990 | 4 | 366 | 213 | 143 | 10 | 358 | 171 | 290 | 128 |
| 1991 | 8 | 307 | 157 | 150 | 0 | 304 | 215 | 307 | 201 |
| 1992 | 65 | 3,999 | 443 | 524 | 3,032 | 3,996 | 342 | 403 | 869 |
| 1993 | 27 | 512 | 204 | 308 | 0 | 507 | 189 | 428 | 169 |
| 1994 | 29 | 1,916 | 785 | 1,096 | 35 | 1,907 | 637 | 1,021 | 827 |
| 1995 | 27 | 1,669 | 372 | 442 | 855 | 1,667 | 412 | 651 | 185 |
| 1996 | 19 | 1,221 | 550 | 626 | 45 | 1,177 | 434 | 1,185 | 88 |
| 1997 | 17 | 854 | 373 | 481 | 0 | 851 | 623 | 811 | 0 |
| 1998 | 1 | 50 | 25 | 25 | 0 | 50 | 0 | 0 | 0 |
| 1999 | 55 | 2,553 | 1,183 | 1,364 | 6 | 2,531 | 766 | 2,229 | 1,642 |
| 2000 | 8 | 919 | 353 | 444 | 122 | 902 | 787 | 804 | 803 |
| 2001 | 4 | 242 | 127 | 115 | 0 | 242 | 100 | 152 | 100 |
| 2002 | 29 | 1,034 | 608 | 426 | 0 | 1,033 | 5 | 44 | 0 |
| 2003 | 1 | 29 | 17 | 12 | 0 | 29 | 29 | 0 | 0 |
| 2004 | 6 | 281 | 137 | 144 | 0 | 281 | 50 | 96 | 123 |
| 2005 | 3 | 153 | 53 | 100 | 0 | 151 | 98 | 20 | 77 |
| 2006 | 1 | 50 | 22 | 28 | 0 | 50 | 50 | 0 | 25 |
| 2007 | 1 | 30 | 16 | 14 | 0 | 30 | 30 | 25 | 0 |
| 2010 | 1 | 50 | 21 | 29 | 0 | 49 | 49 | 0 | 25 |
| **Total** | **316** | **17,308** | **6,101** | **6,935** | **4,272** | **17,092** | **5,370** | **9,372** | **6,032** |

## 3.2. LENGTH-WEIGHT RELATIONSHIP

In inside BC waters the maximum length recorded for Yelloweye Rockfish is 75.9 cm for males and 76.9 for females. The maximum length for outside Yelloweye Rockfish for both males and females is 84 cm. The maximum recorded weight for inside Yelloweye Rockfish is 8.1 kg for males and 8.0 kg for females. The maximum recorded weight for outside Yelloweye Rockfish is 9.3 kg for males and 10.9 kg for females. Size and age structure of Yelloweye and other rockfish have been shown to be truncated under high fishing pressure for the central BC coast which also influences fecundity as larger females show an increasing number of eggs per unit of body weight (McGreer and Frid 2017).

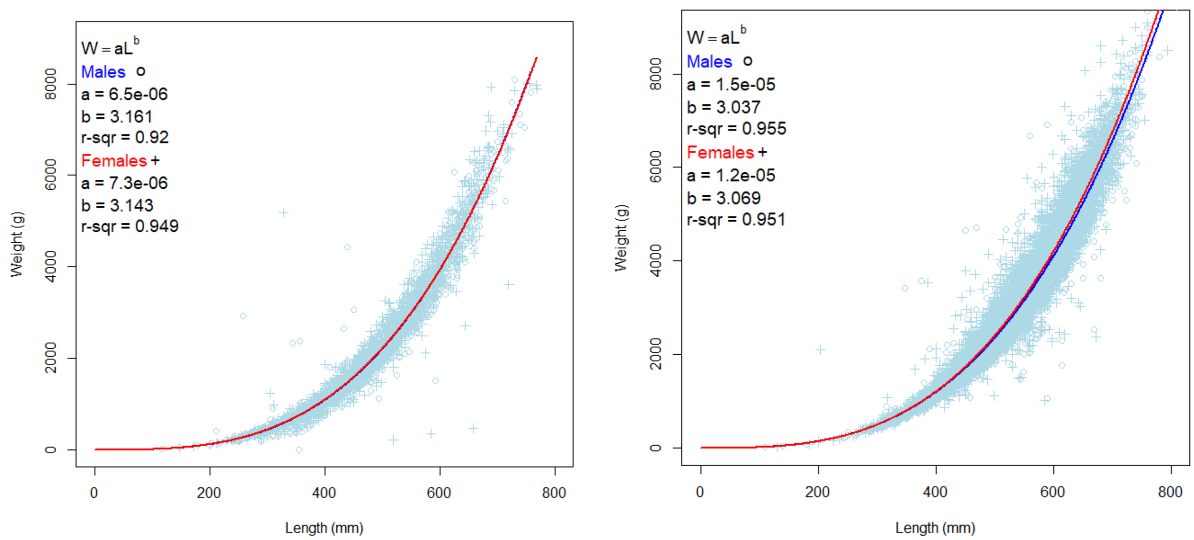



*Figure 8. Length-weight regression by sex for Yelloweye Rockfish using a lognormal linear model. Left panel shows the Inside DU; data from commercial groundfish fisheries, 1986-2008, and research surveys, 1984-2016. Right panel shows the Outside DU; data from commercial groundfish fisheries, 1988-2010, and research surveys, 1989-2017. Male regression lines are blue; females red. Male plotting symbols are open circles; females are crosses.*

Data to derive the length-weight relationship were selected from GFBio including commercial and survey samples with minimal qualifications, i.e., data from all Yelloweye Rockfish samples identified as either male or female with valid lengths and weights were extracted. Research surveys and fisheries by gear type contributing to the length-weight dataset used here are listed in Appendix B.

All available lengths and weights were used and it was assumed that all measurements are independent of collection method, area, and fishery. The data were fit to a linear model of log length versus log weight. The relationships for inside and outside Yelloweye Rockfish were very similar, and were also very similar for males and females indicating that there does not appear to be sex-specific difference or a DU-specific difference in allometric growth (Figure 8).

## 3.3. AGE AND GROWTH

Age data for Yelloweye Rockfish, using the break and burn method, are available from 1979-2015 (Table 2-Table 5). Age structures (otoliths) for 2016 to the present have been collected but ages have not yet been determined. Yelloweye Rockfish is long-lived with ages of up to 115 years for males and 121 years for females recorded in BC, both of which were collected in the outside DU (GFBio) (inside Yelloweye, Figure 9; outside Yelloweye, Figure 10). Maximum age for Yelloweye Rockfish in the inside DU is 90 for males and 98 for females. Proportions-at-age of Yelloweye Rockfish are shown by year and sex for the inside DU from research samples (Figure 11), outside DU from research samples (Figure 12), inside DU from dockside monitoring samples (Figure 13) and outside DU from dockside monitoring samples (Figure 14). Directed Pacific Halibut Management Association (PHMA) longline surveys began in 1997 after which greater numbers of Yelloweye Rockfish were aged. Research surveys and fisheries by gear type contributing to the age dataset used here are listed in Appendix B.

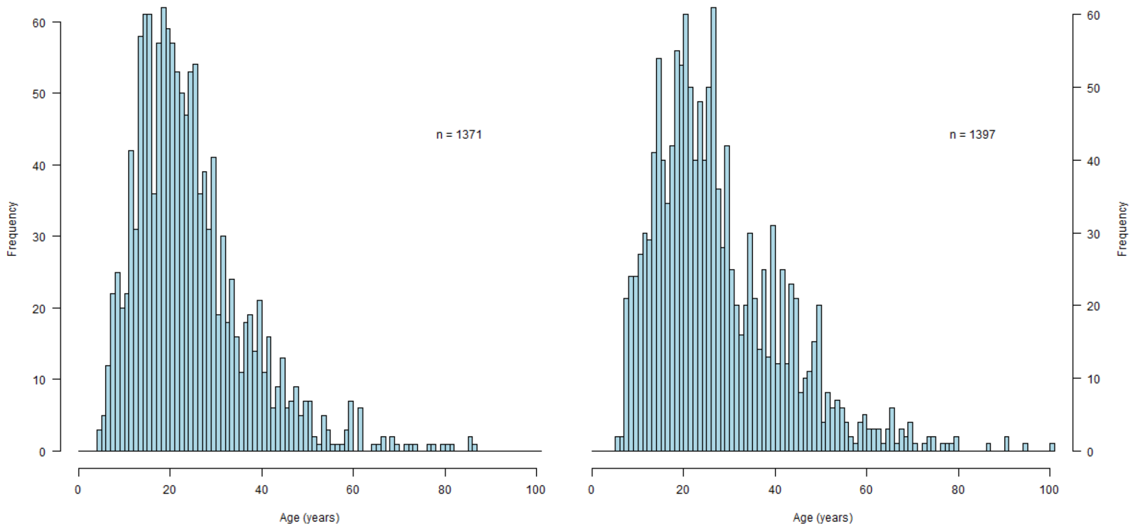



*Figure 9. Age distribution for inside Yelloweye Rockfish. Left panel shows males, right panel shows females. Data from commercial groundfish fisheries, 1980-2000, and research surveys, 1984-2015.*

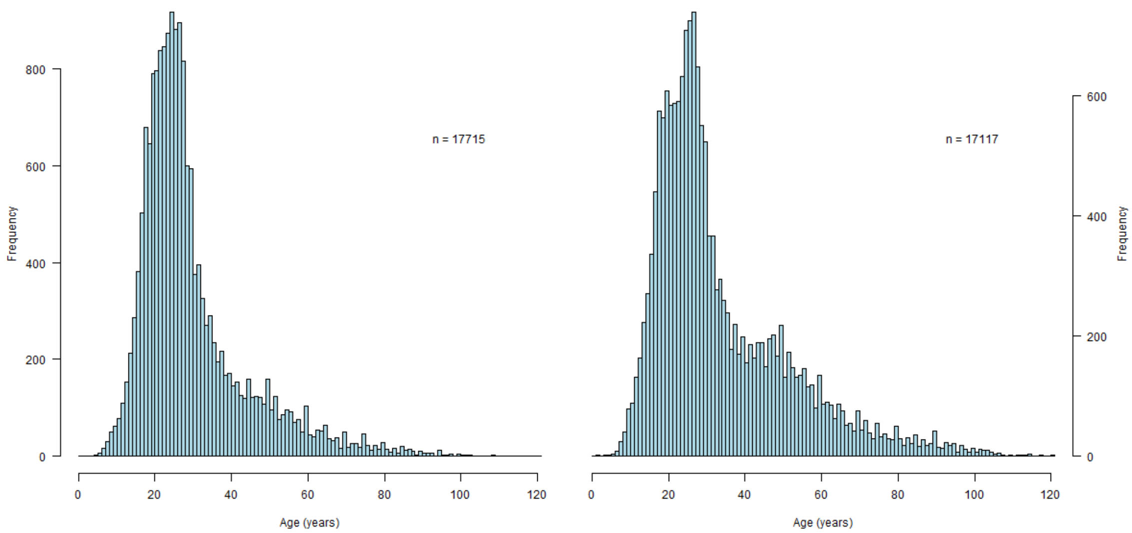



*Figure 10. Age distribution for outside Yelloweye Rockfish. Left panel shows males, right panel shows females. Data from commercial groundfish fisheries, 1979-2010, and research surveys, 1979-2015.*

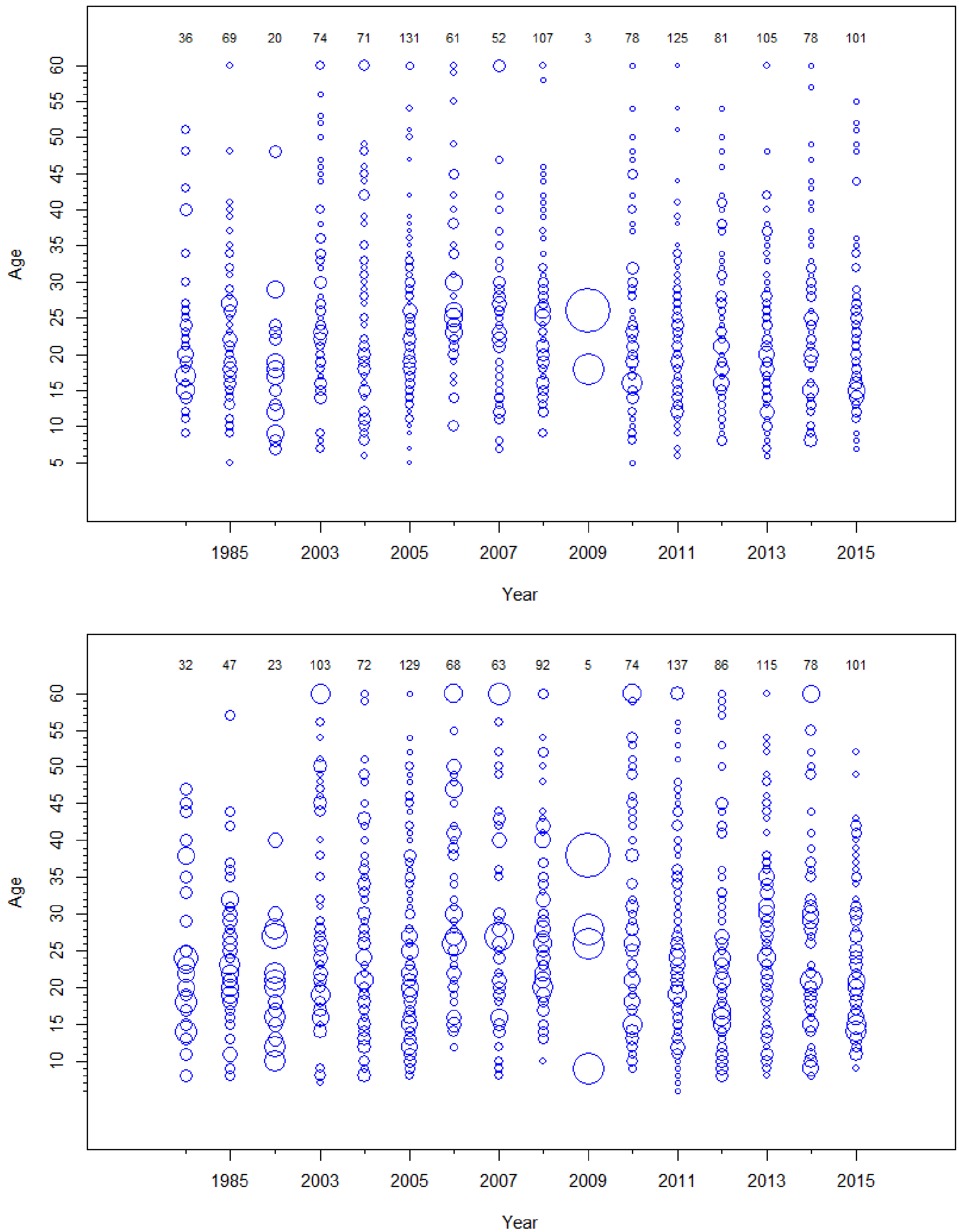



*Figure 11. Yelloweye Rockfish proportions-at-age by year and sex for the inside DU from research surveys. The radius of each circle is scaled relative to the proportion-at-age. The top panels show males while the bottom panels show females. Ages greater than or equal to 60 are pooled into a single age class. Sample size is specified at the top for each year.*

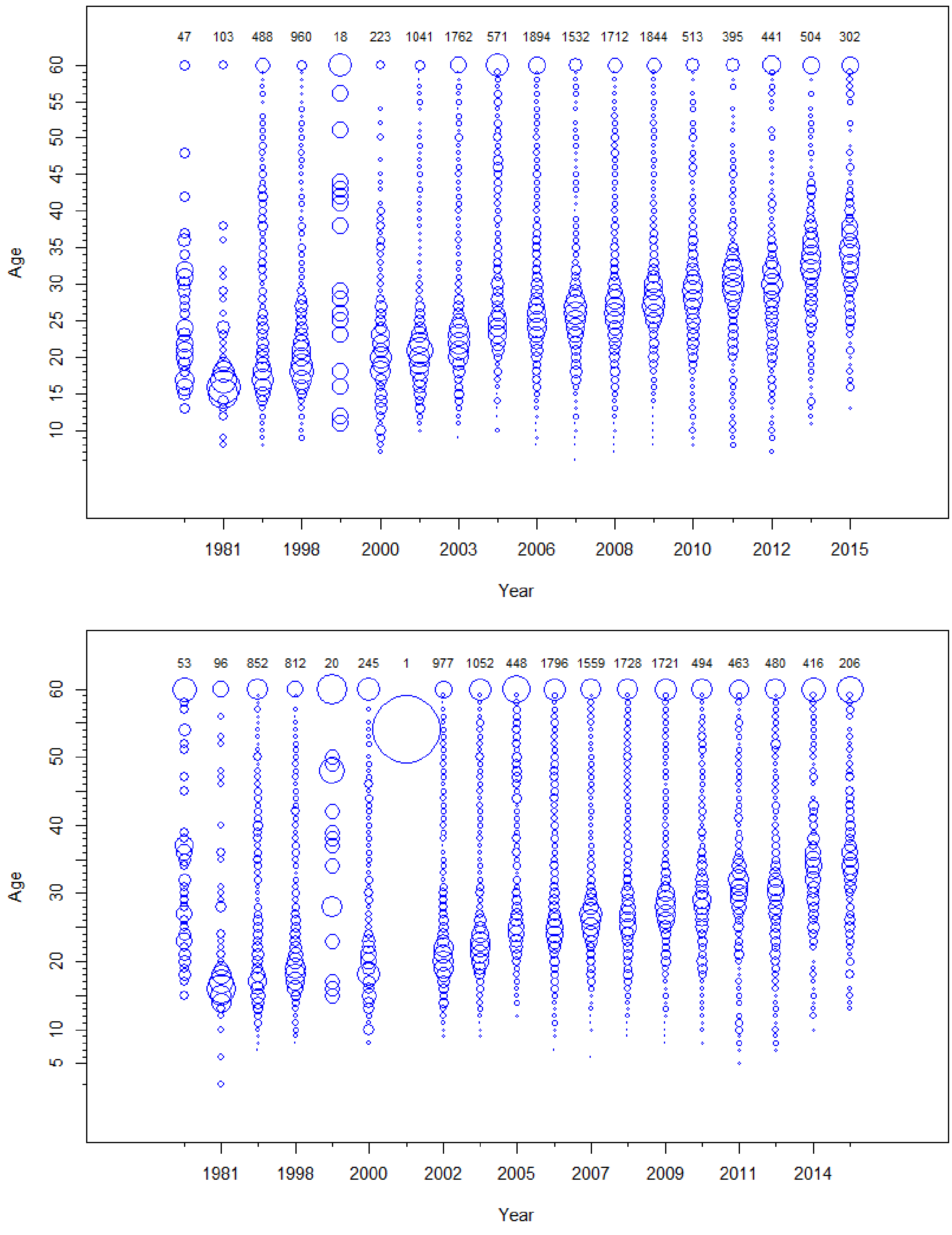



*Figure 12. Yelloweye Rockfish proportions-at-age by year and sex for the outside DU from research surveys. The radius of each circle is scaled relative to the proportion-at-age. The top panels show males while the bottom panels show females. Ages greater than or equal to 60 are pooled into a single age class. Sample size is specified at the top for each year.*

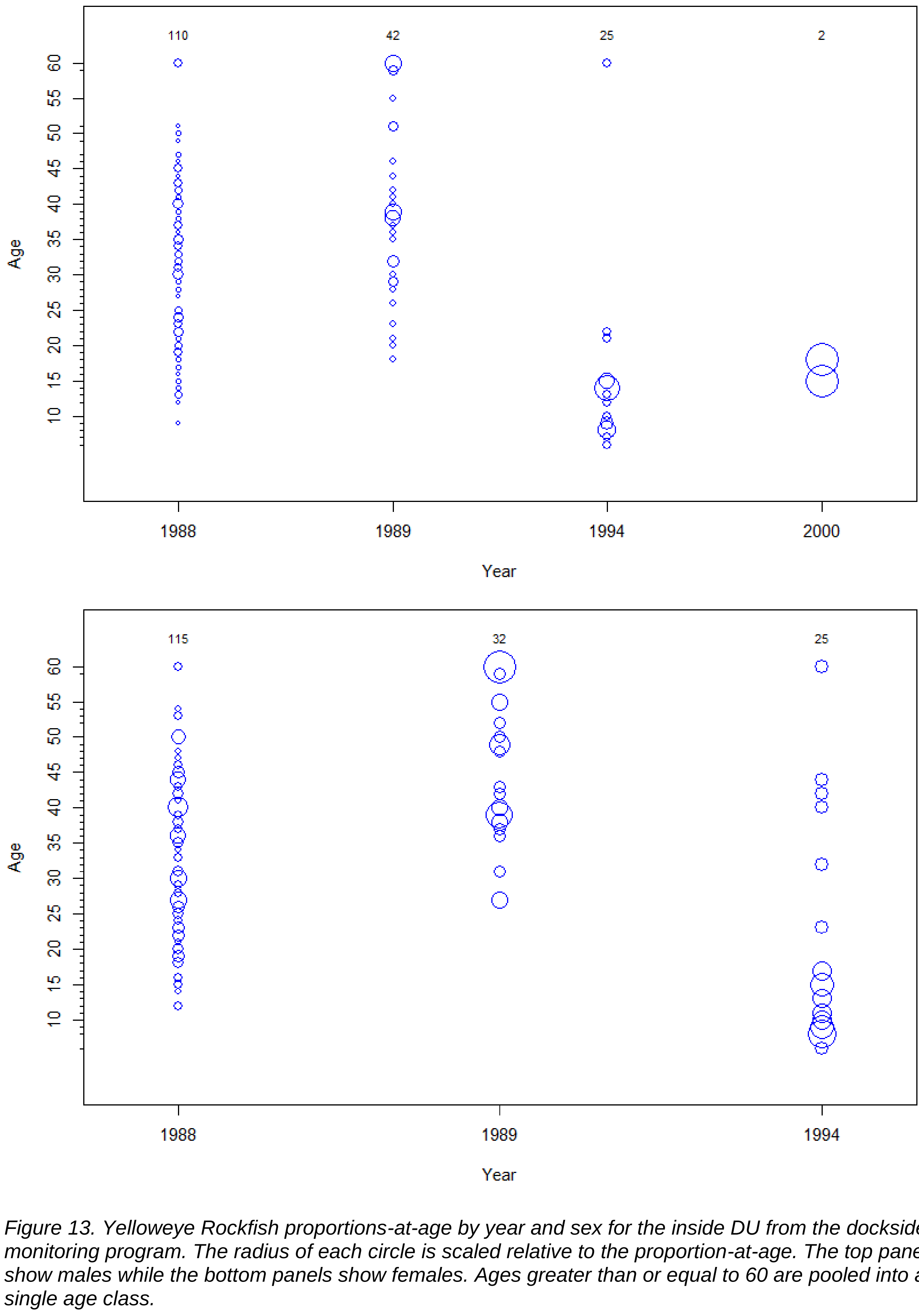



*Figure 13. Yelloweye Rockfish proportions-at-age by year and sex for the inside DU from the dockside monitoring program. The radius of each circle is scaled relative to the proportion-at-age. The top panels show males while the bottom panels show females. Ages greater than or equal to 60 are pooled into a single age class.*

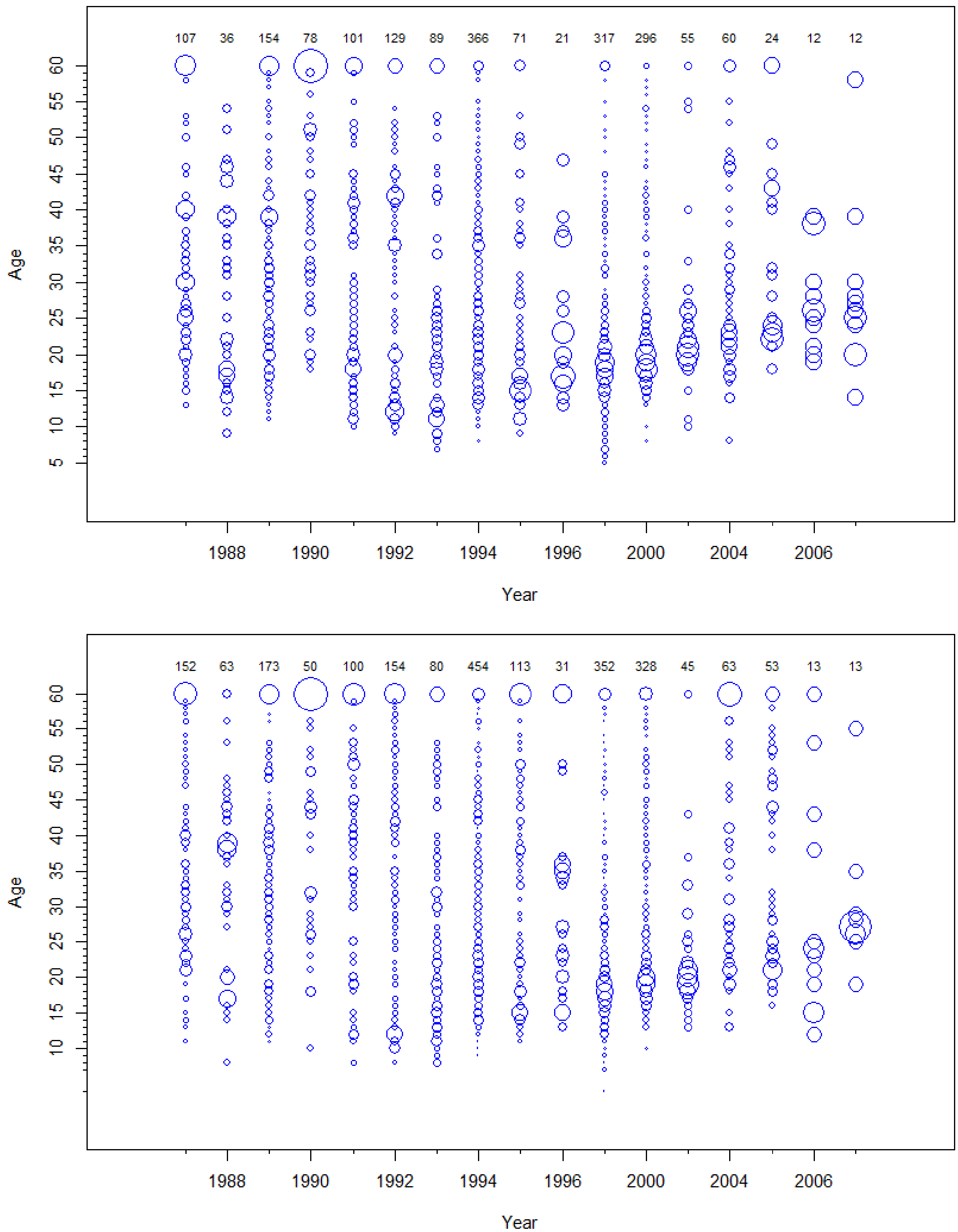



*Figure 14. Yelloweye Rockfish proportions-at-age by year and sex for the outside DU from the dockside monitoring program. The radius of each circle is scaled relative to the proportion-at-age. The top panels show males while the bottom panels show females. Ages greater than or equal to 60 are pooled into a single age class.*

Length-age pairs for male and female Yelloweye Rockfish were examined separately for each DU for the estimation of von Bertalanffy growth parameters.

The parameterisation of the von Bertalanffy growth model is (from Edwards et al. 2017):

$$L_{a,s} = L_{\infty,s}\left(1 - e^{-\kappa_s\left(a - t_{0,s}\right)}\right)$$

Where $L_{a,s}$ = average length (cm) of an individual with sex *s* at age *a*,

$L_{\infty,s}$ = average length (cm) of an individual with sex *s* at maximum age,

$k_s$ = growth rate coefficient for sex *s*,

$t_{0,s}$ = age at which the average length is 0 for sex *s*.

A non-linear von Bertalanffy model was applied to each sex for each DU, and parameter estimates of the models were fairly similar. Model fits and parameter estimates are provided in Figure 15 (left panel shows the inside population and right panel shows the outside population). For inside Yelloweye Rockfish, females grow larger than males (average length at maximum age of $L_\infty$ of 70 cm vs 65 cm) and grow slower (von Bertalanffy growth rate coefficient $k_s$ of 0.029 vs 0.043). For outside Yelloweye, males grow larger than females (average length at maximum age of $L_\infty$ of 68 cm vs 66 cm) and grow faster (von Bertalanffy growth rate coefficient $k_s$ of 0.048 vs 0.042). Boxplots of age groups (Figure 16, left shows inside population and right shows outside population) highlight some of the variability in the age data.

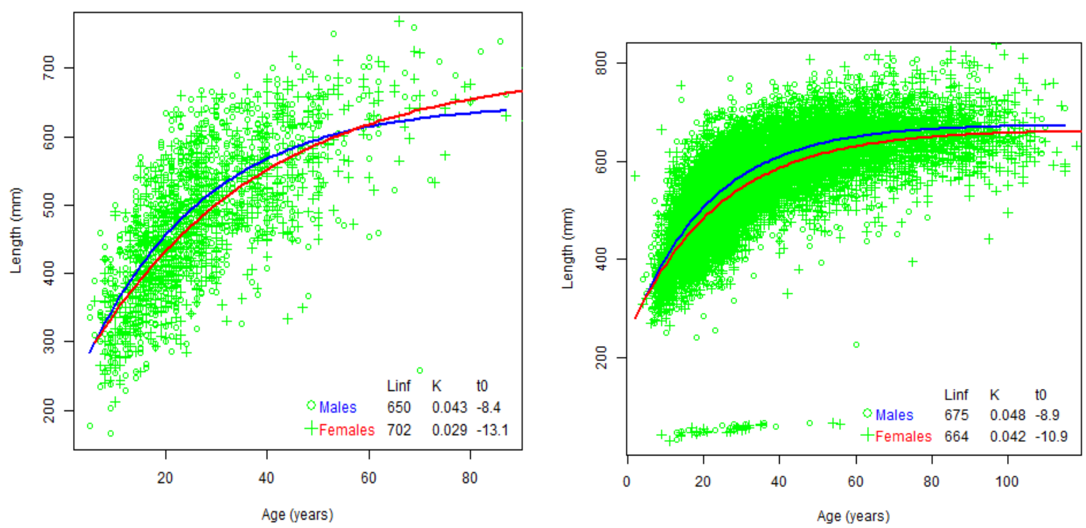



*Figure 15. Yelloweye Rockfish length-at-age for inside (left; data from commercial groundfish fisheries, 1988-2000, and research surveys, 1984-2015) and outside (right; data from commercial groundfish fisheries, 1986-2010, and research surveys, 1980-2015) fitted using the von Bertalanffy growth equation.*

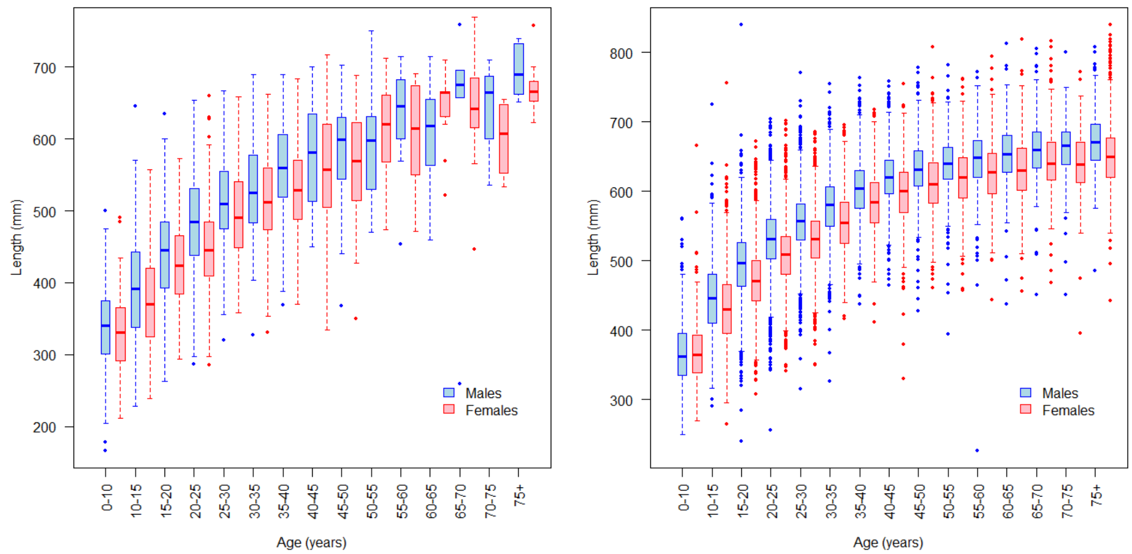



*Figure 16. Yelloweye Rockfish length-at-age for inside (left; data from commercial groundfish fisheries, 1988-2000, and research surveys, 1984-2015) and outside (right; data from commercial groundfish fisheries, 1986-2010, and research surveys, 1980-2015). Boxplots of length by sex at 5-year age categories. The horizontal line in the middle of each box denotes the median with the rest of the box above and below the median representing the interquartile range. The dashed vertical lines above and below each box represent 1.5 x the interquartile range.*

## 3.4. MATURITY AND MORTALITY RATES

In order to examine age at maturity, records were extracted from GFBio for specimens that were identified as male or female with a valid maturity code and age was determined using the break and burn and break and bake methods. Individuals collected between April and June were used in creating maturity curves because in these months it is easier to distinguish between immature and mature individuals (Figure 17). A double-normal function was fit to the observed proportions mature to smooth the observations (as in Edwards et al. 2014, 2017):

$$m_{a,s} = \begin{cases} e^{-(a-\mu_s)^2 / \nu_{sL}}, & a \le \mu_s \\ 1, & a > \mu_s \end{cases}$$

where, $m_{a,s}$ = maturity at age a for sex $s$,

$\mu_s$ = age at full maturity for sex $s$,

$\nu_{sL}$ = variance for the left limb of the maturity curve for sex $s$.

For inside Yelloweye Rockfish, age at 50% maturity for males was 14.2 years from commercial samples and 21.3 years from research samples. Age at 50% maturity for inside females was 14.2 years for commercial samples and 18.7 years for research samples. For outside Yelloweye Rockfish, age at 50% maturity for males was 15.2 years from commercial samples and 21.2 years from research samples. Age at 50% maturity for outside females was 16.2 years for commercial samples and 16.4 years for research samples.

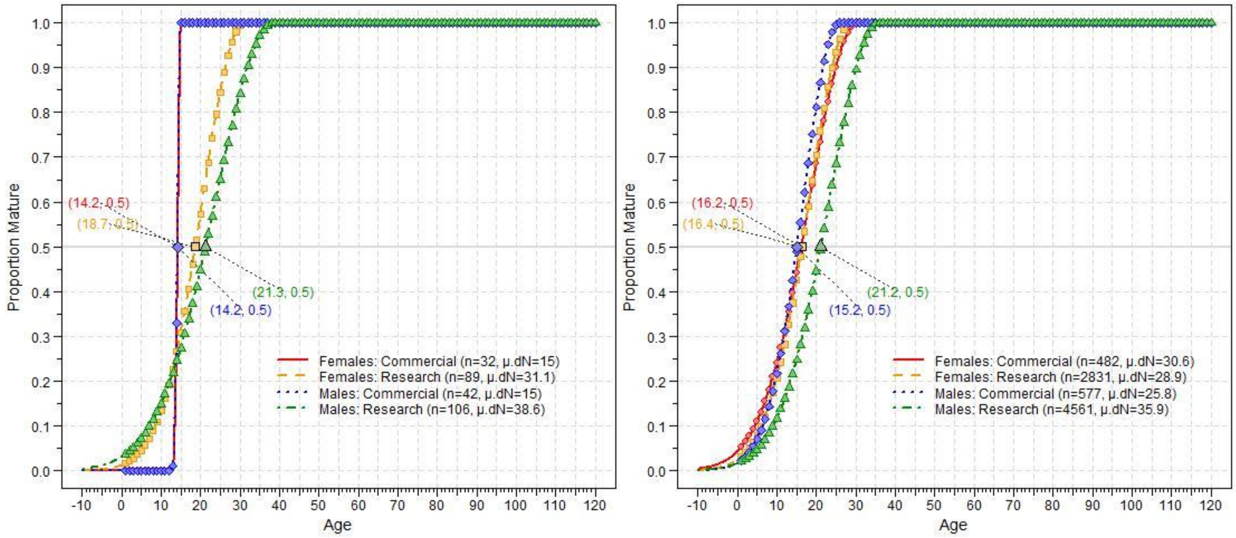



*Figure 17. Yelloweye Rockfish maturity ogives by sex and commercial/research for inside (left; data from commercial groundfish fisheries, 1988-2000, and research surveys, 1984-2015) and outside (right; data from commercial groundfish fisheries, 1986-2005, and research surveys, 1980-2015).*

The estimate of total mortality for the inside population of Yelloweye ranges from 0.036 to 0.057, while total mortality estimates for the outside population range from 0.027 to 0.045 depending on models used (Yamanaka et al. 2006; Yamanaka et al. 2012). A 2001 US Yelloweye assessment suggested a total mortality rate of 0.04 as a compromise between estimates (Wallace 2001). In a recent US assessment (Taylor and Wetzel 2011), natural mortality was estimated at 0.045 for males and 0.046 for females. Natural mortality was estimated at 0.038 using Hoenig's method by Yamanaka et al. (2018) and is used here in calculations of generation time.

## 3.5. GENERATION TIME

Using the values for natural mortality (*M*) calculated using Hoenig's method in Yamanaka et al. (2017) and the estimates of age at 50% maturity calculated above yields generation time estimates of 40.5-45.0 years:

Using age at 50% maturity from females from the commercial and research data sets and natural mortality (age at 50% maturity + 1/M), generation time is:

| | |
|---|---|
| Inside Females: | Outside Females: |
| 14.2 + 1/0.038 = 40.5 yrs. | 16.2 + 1/0.038 = 42.5 yrs. |
| 18.7 + 1/0.038 = 45.0 yrs. | 16.4 + 1/0.038 = 42.7 yrs. |

# 4. FISHERIES AND CATCH SUMMARIES

## 4.1. COMMERCIAL FISHERIES

Yelloweye Rockfish is primarily caught by hook and line gear types in commercial, recreational and First Nations fisheries coastwide (Yamanaka and Lacko 2001) with some catch by trawl in the outside area. The commercial hook and line fishery has accounted for 95-99% of outside Yelloweye Rockfish catch by calendar year since 1996 (Figure 18 bottom,

Table 7), while the recreational fisheries have accounted for variable proportions of all catch, with equivalent or greater removals than the commercial hook and line fisheries for inside Yelloweye Rockfish in recent years (see Table 6, Figure 18 top, and Figure 19) .

In Haigh and Yamanaka (2011), a catch reconstruction of Yelloweye Rockfish is presented for the commercial sectors from 1918 to 2006 for the hook and line fleet and to 2007 for the trawl fleet. This reconstruction was updated in the most recent inside and outside Yelloweye Rockfish stock assessments (Yamanaka et al. 2012, and Yamanaka et al. 2018, respectively). The reconstruction of historic catch for both trawl and hook and line commercial fisheries is based largely on estimation from applying ratios of Yelloweye Rockfish in current catches to ‘total rockfish’ or ‘rockfish other than Pacific Ocean Perch’ in historic catches. More recent catches since the beginning of 100% observer coverage in the trawl fishery in 1996 and in the hook and line fishery since 2006 required little or no estimation. Note that there may be some uncertainty in identification of Yelloweye Rockfish prior to 100% observer coverage, but there is high confidence in observer identification of Yelloweye and other rockfish since observer coverage was implemented for each fleet.

Commercial landings for Yelloweye Rockfish are estimated from aggregated species landing statistics from a variety of sources over time. The reconstruction of Yelloweye Rockfish catches for the trawl fishery involved partitioning landings of “Other” rockfish (ORF) to area of capture (4B, 3C, 3D, 5A, 5B, 5C, 5D, 5E) and then calculating Yelloweye Rockfish landings as a proportion of the ORF landings. Full details are provided in Haigh and Yamanaka (2011). More recent landings of Yelloweye Rockfish were available in the catch databases. With the onset of full observer coverage in the trawl fishery in 1996 there was confidence that the full catch amounts (landings and discards) were being accounted for.

The catch reconstruction for Yelloweye Rockfish from the hook and line fisheries was based on calculating Yelloweye Rockfish catches from the ZN fishery which tended to target rockfish, the Halibut fishery which targeted Halibut, as well as the Schedule II fishery which targeted primarily dogfish and Lingcod.

Hook and line discards are not included in the reconstruction until each fishery became licensed, prior to which it is assumed that Yelloweye Rockfish was retained and landed. The reconstruction from the Halibut and Dogfish/Lingcod hook and line fisheries attempted to account for the discards of Yelloweye Rockfish as a ratio of the amount of Halibut or dogfish landed. In 2006, the Pilot Groundfish Integration Project was introduced and required 100% retention of all rockfish and it is assumed that the landings from 2006 onwards represent the total Yelloweye Rockfish catch for all hook and line vessels.

These methods have been refined since the initial reconstruction was published in 2011 for inclusion in the most recent inside and outside Yelloweye Rockfish stock assessments (Yamanaka et al. 2012, 2018). The reconstructed catch estimates presented in the assessments are presented here and updated to 2016 using modern catch data sources (in Table 6 for inside Yelloweye Rockfish and in Table 7 for outside Yelloweye Rockfish). Modern catch data from 2006 forward are considered complete and robust since 100% catch monitoring and groundfish fishery integration were implemented. Sensitivity analyses of stock assessment model results to either half or double the reconstructed pre-2006 catches were run and showed model results similar to the reference run (Yamanaka et al. 2018).

The inside commercial catch of Yelloweye Rockfish decreased from a peak of around 170 t from 1988-1990 to approximately 10 t or less annually since 2006 (Figure 18 top). Outside commercial catch of Yelloweye Rockfish increased to a peak of around 2000 tonnes in 1990 after which catch has declined to relatively stable amounts less than 300 t since 2006 (Figure 18 bottom).

*Table 6. Reconstructed inside Yelloweye Rockfish commercial groundfish catch history in tonnes by fishing sector and in total from 1918 to 2007 and updated to 2016 with data from the Fishery Operations System (FOS). † Note that in 2002 commercial fishing effort in the inside DU was greatly reduced in protest of total allowable catch reductions (Yamanaka et al. 2012). H&L Rockfish = Hook and Line Rockfish (ZN) licence.*

| Year | Trawl | Halibut | Sablefish | Dogfish/Lingcod | H & L Rockfish | Total |
|---|---|---|---|---|---|---|
| 1918 | 0.0 | 5.8 | 0.0 | 8.3 | 14.9 | 29.0 |
| 1919 | 0.0 | 14.4 | 0.0 | 20.4 | 36.9 | 71.8 |
| 1920 | 0.0 | 7.3 | 0.0 | 10.3 | 18.5 | 36.0 |
| 1921 | 0.0 | 6.3 | 0.0 | 8.9 | 16.0 | 31.2 |
| 1922 | 0.0 | 7.8 | 0.0 | 11.1 | 20.0 | 38.9 |
| 1923 | 0.0 | 7.6 | 0.0 | 10.8 | 19.4 | 37.8 |
| 1924 | 0.0 | 8.6 | 0.0 | 12.2 | 22.0 | 42.9 |
| 1925 | 0.0 | 7.4 | 0.0 | 10.5 | 19.0 | 36.9 |
| 1926 | 0.0 | 8.5 | 0.0 | 12.0 | 21.7 | 42.2 |
| 1927 | 0.0 | 8.5 | 0.0 | 12.0 | 21.7 | 42.2 |
| 1928 | 0.0 | 8.7 | 0.0 | 12.4 | 22.3 | 43.4 |
| 1929 | 0.0 | 11.3 | 0.0 | 16.1 | 29.0 | 56.4 |
| 1930 | 0.0 | 10.3 | 0.0 | 14.5 | 26.2 | 51.0 |
| 1931 | 0.0 | 6.7 | 0.0 | 9.5 | 17.2 | 33.5 |
| 1932 | 0.0 | 7.6 | 0.0 | 10.8 | 19.5 | 38.0 |
| 1933 | 0.0 | 3.8 | 0.0 | 5.3 | 9.6 | 18.7 |
| 1934 | 0.0 | 4.4 | 0.0 | 6.3 | 11.3 | 22.0 |
| 1935 | 0.0 | 5.7 | 0.0 | 8.1 | 14.5 | 28.3 |
| 1936 | 0.0 | 6.2 | 0.0 | 8.7 | 15.8 | 30.7 |
| 1937 | 0.0 | 4.8 | 0.0 | 6.8 | 12.3 | 24.0 |
| 1938 | 0.0 | 16.2 | 0.0 | 22.9 | 41.3 | 80.3 |
| 1939 | 0.0 | 3.2 | 0.0 | 4.5 | 8.2 | 15.9 |
| 1940 | 0.0 | 3.5 | 0.0 | 4.9 | 8.9 | 17.3 |
| 1941 | 0.0 | 2.1 | 0.0 | 3.0 | 5.5 | 10.6 |
| 1942 | 0.0 | 4.9 | 0.0 | 7.0 | 12.6 | 24.5 |
| 1943 | 0.0 | 28.3 | 0.0 | 40.0 | 72.3 | 140.6 |
| 1944 | 0.0 | 42.0 | 0.0 | 59.5 | 107.4 | 208.9 |
| 1945 | 0.0 | 45.1 | 0.0 | 63.9 | 115.3 | 224.4 |
| 1946 | 0.0 | 30.3 | 0.0 | 42.9 | 77.4 | 150.6 |
| 1947 | 0.0 | 9.7 | 0.0 | 13.8 | 24.8 | 48.3 |
| 1948 | 0.0 | 14.8 | 0.0 | 20.9 | 37.8 | 73.5 |
| 1949 | 0.0 | 19.7 | 0.0 | 27.9 | 50.3 | 97.8 |
| 1950 | 0.0 | 8.4 | 0.0 | 11.9 | 21.4 | 41.7 |
| 1951 | 0.0 | 18.1 | 0.0 | 25.6 | 46.2 | 89.8 |
| 1952 | 0.0 | 10.0 | 0.0 | 14.2 | 25.6 | 49.8 |
| 1953 | 0.0 | 9.4 | 0.0 | 13.4 | 24.1 | 46.9 |
| 1954 | 0.0 | 7.5 | 0.0 | 10.6 | 19.1 | 37.1 |
| 1955 | 0.0 | 7.1 | 0.0 | 10.1 | 18.2 | 35.5 |
| 1956 | 0.0 | 3.4 | 0.0 | 4.8 | 8.7 | 17.0 |
| 1957 | 0.0 | 5.9 | 0.0 | 8.4 | 15.1 | 29.4 |
| 1958 | 0.0 | 8.6 | 0.0 | 12.1 | 21.9 | 42.7 |
| 1959 | 0.0 | 8.8 | 0.0 | 12.5 | 22.6 | 43.9 |
| 1960 | 0.0 | 7.2 | 0.0 | 10.1 | 18.3 | 35.6 |
| 1961 | 0.0 | 5.3 | 0.0 | 7.6 | 13.7 | 26.6 |
| 1962 | 0.0 | 8.6 | 0.0 | 12.2 | 22.1 | 43.0 |
| 1963 | 0.0 | 6.6 | 0.0 | 9.3 | 16.9 | 32.8 |
| 1964 | 0.0 | 4.0 | 0.0 | 5.6 | 10.2 | 19.8 |
| 1965 | 0.0 | 3.6 | 0.0 | 5.1 | 9.2 | 17.8 |
| 1966 | 0.0 | 2.9 | 0.0 | 4.1 | 7.4 | 14.3 |
| 1967 | 0.0 | 4.5 | 0.0 | 6.3 | 11.4 | 22.1 |

| Year | Trawl | Halibut | Sablefish | Dogfish/Lingcod | H & L Rockfish | Total |
|---|---|---|---|---|---|---|
| 1968 | 0.0 | 4.8 | 0.0 | 6.8 | 12.3 | 23.9 |
| 1969 | 0.0 | 5.6 | 0.0 | 7.9 | 14.2 | 27.8 |
| 1970 | 0.0 | 6.8 | 0.0 | 9.7 | 17.5 | 34.0 |
| 1971 | 0.0 | 5.8 | 0.0 | 8.3 | 14.9 | 29.0 |
| 1972 | 0.0 | 6.5 | 0.0 | 9.1 | 16.5 | 32.1 |
| 1973 | 0.0 | 7.9 | 0.0 | 11.2 | 20.3 | 39.4 |
| 1974 | 0.0 | 3.9 | 0.0 | 5.5 | 10.0 | 19.5 |
| 1975 | 0.0 | 3.1 | 0.0 | 4.4 | 8.0 | 15.6 |
| 1976 | 0.0 | 3.8 | 0.0 | 5.4 | 9.7 | 18.9 |
| 1977 | 0.1 | 10.7 | 0.0 | 15.1 | 27.3 | 53.3 |
| 1978 | 0.2 | 12.0 | 0.0 | 17.0 | 30.6 | 59.8 |
| 1979 | 0.0 | 19.2 | 0.7 | 27.1 | 49.0 | 96.0 |
| 1980 | 0.0 | 13.9 | 0.0 | 19.6 | 35.4 | 68.9 |
| 1981 | 0.0 | 16.5 | 0.0 | 23.3 | 42.1 | 81.8 |
| 1982 | 5.9 | 22.0 | 0.0 | 14.0 | 13.0 | 54.9 |
| 1983 | 7.9 | 23.3 | 0.0 | 13.6 | 6.6 | 51.5 |
| 1984 | 30.1 | 27.1 | 0.0 | 8.4 | 9.4 | 75.1 |
| 1985 | 68.5 | 34.1 | 0.0 | 7.6 | 9.9 | 120.0 |
| 1986 | 53.2 | 41.2 | 0.0 | 11.1 | 30.8 | 136.3 |
| 1987 | 26.6 | 33.0 | 0.0 | 22.8 | 48.2 | 130.6 |
| 1988 | 60.8 | 38.7 | 0.0 | 26.7 | 46.7 | 172.9 |
| 1989 | 54.7 | 35.9 | 0.0 | 25.0 | 57.7 | 173.3 |
| 1990 | 65.4 | 36.7 | 0.0 | 18.7 | 52.8 | 173.5 |
| 1991 | 35.0 | 37.5 | 0.0 | 8.0 | 64.5 | 145.0 |
| 1992 | 19.9 | 13.9 | 0.0 | 2.5 | 7.3 | 43.6 |
| 1993 | 11.4 | 15.5 | 0.0 | 7.8 | 20.6 | 55.3 |
| 1994 | 10.6 | 21.9 | 0.0 | 4.1 | 83.6 | 120.2 |
| 1995 | 11.0 | 0.7 | 0.0 | 16.7 | 32.1 | 60.4 |
| 1996 | 0.0 | 3.9 | 0.0 | 0.4 | 21.5 | 25.9 |
| 1997 | 0.0 | 5.0 | 0.0 | 2.9 | 13.0 | 20.9 |
| 1998 | 0.0 | 6.3 | 0.0 | 3.0 | 22.8 | 32.1 |
| 1999 | 0.0 | 1.6 | 0.0 | 2.4 | 16.0 | 19.9 |
| 2000 | 0.0 | 0.7 | 0.0 | 1.3 | 22.5 | 24.5 |
| 2001 | 0.0 | 0.9 | 0.0 | 3.1 | 23.5 | 27.5 |
| 2002 | 0.0 | 0.1 | 0.0 | 3.7 | 3.3 | 7.2 |
| 2003 | 0.0 | 0.1 | 0.0 | 6.8 | 3.7 | 10.6 |
| 2004 | 0.0 | 0.2 | 0.0 | 6.6 | 2.9 | 9.7 |
| 2005 | 0.0 | 0.0 | 0.0 | 8.5 | 2.3 | 10.9 |
| 2006 | 0.0 | 0.5 | 0.0 | 3.4 | 1.2 | 5.1 |
| 2007 | 0.0 | 1.3 | 0.0 | 3.7 | 2.9 | 7.9 |
| 2008 | 0.0 | 2.2 | 0.0 | 2.8 | 2.5 | 7.5 |
| 2009 | 0.0 | 0.9 | 0.0 | 2.8 | 2.1 | 5.8 |
| 2010 | 0.0 | 1.1 | 0.0 | 2.5 | 0.6 | 4.2 |
| 2011 | 0.0 | 1.2 | 0.0 | 1.5 | 2.6 | 5.3 |
| 2012 | 0.0 | 1.2 | 0.0 | 1.3 | 1.5 | 4.0 |
| 2013 | 0.0 | 0.3 | 0.0 | 1.3 | 1.0 | 2.6 |
| 2014 | 0.0 | 1.0 | 0.0 | 0.6 | 0.7 | 2.3 |
| 2015 | 0.0 | 0.2 | 0.0 | 1.7 | 0.3 | 2.2 |
| 2016 | 0.0 | 0.4 | 0.0 | 0.6 | 0.2 | 1.2 |

*Table 7. Reconstructed outside Yelloweye Rockfish commercial groundfish catch history in tonnes by fishing sector and in total from 1918 to 2007 and updated to 2016 with catches from the Fishery Operations System (FOS). H&L Rockfish = Hook and Line Rockfish (ZN) licence.*

| Year | Trawl | Halibut | Sablefish | Dogfish/Lingcod | H&L Rockfish | Total |
|---|---|---|---|---|---|---|
| 1918 | 0.0 | 18.0 | 0.0 | 0.3 | 8.6 | 26.8 |
| 1919 | 0.0 | 6.6 | 0.0 | 0.2 | 4.1 | 10.9 |
| 1920 | 0.0 | 5.1 | 0.0 | 0.1 | 2.9 | 8.2 |
| 1921 | 0.0 | 1.6 | 0.0 | 0.1 | 1.1 | 2.8 |
| 1922 | 0.0 | 3.5 | 0.0 | 0.1 | 2.4 | 6.1 |
| 1923 | 0.0 | 1.7 | 0.0 | 0.1 | 1.1 | 2.9 |
| 1924 | 0.0 | 2.0 | 0.0 | 0.1 | 1.3 | 3.4 |
| 1925 | 0.0 | 1.8 | 0.0 | 0.0 | 1.0 | 2.9 |
| 1926 | 0.0 | 3.9 | 0.0 | 0.1 | 2.1 | 6.1 |
| 1927 | 0.0 | 5.9 | 0.0 | 0.1 | 3.2 | 9.3 |
| 1928 | 0.0 | 4.7 | 0.0 | 0.1 | 2.7 | 7.5 |
| 1929 | 0.0 | 5.6 | 0.0 | 0.1 | 3.0 | 8.7 |
| 1930 | 0.0 | 3.2 | 0.0 | 0.1 | 1.7 | 5.0 |
| 1931 | 0.0 | 1.7 | 0.0 | 0.1 | 1.1 | 2.8 |
| 1932 | 0.0 | 0.8 | 0.0 | 0.0 | 0.5 | 1.4 |
| 1933 | 0.0 | 0.5 | 0.0 | 0.0 | 0.3 | 0.8 |
| 1934 | 0.0 | 0.6 | 0.0 | 0.0 | 0.4 | 1.0 |
| 1935 | 0.0 | 2.6 | 0.0 | 0.0 | 1.3 | 3.9 |
| 1936 | 0.0 | 4.5 | 0.0 | 0.1 | 2.3 | 6.9 |
| 1937 | 0.0 | 0.8 | 0.0 | 0.0 | 0.4 | 1.2 |
| 1938 | 0.0 | 5.4 | 0.0 | 0.2 | 3.7 | 9.3 |
| 1939 | 0.0 | 0.3 | 0.0 | 0.0 | 0.3 | 0.6 |
| 1940 | 0.0 | 0.3 | 0.0 | 0.0 | 0.2 | 0.6 |
| 1941 | 0.0 | 2.1 | 0.0 | 0.0 | 1.3 | 3.4 |
| 1942 | 0.1 | 2.7 | 0.0 | 0.1 | 2.2 | 5.1 |
| 1943 | 0.4 | 7.9 | 0.0 | 0.3 | 6.5 | 14.9 |
| 1944 | 0.2 | 10.9 | 0.0 | 0.3 | 8.9 | 20.2 |
| 1945 | 1.8 | 13.6 | 0.0 | 0.3 | 9.2 | 25.0 |
| 1946 | 0.9 | 18.0 | 0.0 | 0.4 | 10.9 | 30.1 |
| 1947 | 0.4 | 2.9 | 0.0 | 0.1 | 2.1 | 5.4 |
| 1948 | 0.7 | 4.6 | 0.0 | 0.1 | 3.3 | 8.7 |
| 1949 | 0.9 | 6.4 | 0.0 | 0.2 | 4.5 | 11.9 |
| 1950 | 0.9 | 2.5 | 0.0 | 0.1 | 1.7 | 5.1 |
| 1951 | 0.9 | 14.8 | 0.0 | 0.3 | 9.0 | 25.0 |
| 1952 | 0.8 | 9.3 | 0.0 | 0.2 | 5.9 | 16.3 |
| 1953 | 0.7 | 11.7 | 0.0 | 0.3 | 8.0 | 20.7 |
| 1954 | 0.9 | 12.2 | 0.0 | 0.3 | 8.6 | 22.0 |
| 1955 | 0.9 | 8.7 | 0.0 | 0.3 | 7.6 | 17.5 |
| 1956 | 0.6 | 7.6 | 0.0 | 0.3 | 7.1 | 15.5 |
| 1957 | 0.8 | 14.9 | 0.0 | 0.6 | 12.1 | 28.3 |
| 1958 | 0.9 | 8.0 | 0.0 | 0.4 | 9.1 | 18.3 |

| Year | Trawl | Halibut | Sablefish | Dogfish/Lingcod | H&L Rockfish | Total |
|---|---|---|---|---|---|---|
| 1959 | 1.2 | 9.5 | 0.0 | 0.5 | 10.1 | 21.2 |
| 1960 | 1.1 | 16.3 | 0.0 | 0.6 | 14.0 | 32.0 |
| 1961 | 1.3 | 16.4 | 0.0 | 0.7 | 16.0 | 34.5 |
| 1962 | 1.8 | 25.5 | 0.0 | 1.0 | 22.1 | 50.4 |
| 1963 | 1.3 | 28.1 | 0.0 | 0.8 | 20.1 | 50.3 |
| 1964 | 1.0 | 11.1 | 0.0 | 0.4 | 10.0 | 22.5 |
| 1965 | 1.1 | 11.3 | 0.0 | 0.4 | 9.1 | 21.9 |
| 1966 | 1.4 | 11.9 | 0.0 | 0.4 | 10.0 | 23.7 |
| 1967 | 1.2 | 18.7 | 0.0 | 0.6 | 14.5 | 35.0 |
| 1968 | 1.6 | 10.3 | 0.0 | 0.4 | 9.7 | 22.0 |
| 1969 | 2.7 | 22.5 | 0.0 | 0.6 | 16.6 | 42.4 |
| 1970 | 2.2 | 45.8 | 0.0 | 1.1 | 29.2 | 78.2 |
| 1971 | 2.1 | 33.5 | 0.0 | 0.6 | 18.5 | 54.6 |
| 1972 | 2.5 | 44.8 | 0.0 | 1.2 | 30.2 | 78.7 |
| 1973 | 2.7 | 30.2 | 0.0 | 0.7 | 17.5 | 51.1 |
| 1974 | 1.7 | 51.7 | 0.0 | 1.2 | 28.8 | 83.4 |
| 1975 | 1.4 | 61.3 | 0.0 | 1.3 | 34.3 | 98.3 |
| 1976 | 2.0 | 40.7 | 0.0 | 0.9 | 23.1 | 66.8 |
| 1977 | 2.3 | 57.2 | 0.0 | 1.3 | 32.3 | 93.1 |
| 1978 | 3.2 | 65.9 | 0.0 | 1.3 | 34.5 | 104.9 |
| 1979 | 14.5 | 85.8 | 0.0 | 2.0 | 48.9 | 151.2 |
| 1980 | 9.0 | 80.4 | 0.0 | 1.8 | 44.0 | 135.2 |
| 1981 | 5.8 | 60.8 | 0.0 | 1.4 | 32.6 | 100.6 |
| 1982 | 2.0 | 27.5 | 0.0 | 17.7 | 0.8 | 48.0 |
| 1983 | 1.8 | 18.7 | 0.0 | 26.8 | 4.9 | 52.3 |
| 1984 | 37.4 | 31.3 | 0.0 | 44.7 | 35.4 | 148.9 |
| 1985 | 8.9 | 72.6 | 0.0 | 85.9 | 69.8 | 237.2 |
| 1986 | 13.4 | 147.3 | 0.0 | 177.6 | 396.8 | 735.1 |
| 1987 | 31.6 | 235.2 | 0.0 | 225.4 | 455.5 | 947.7 |
| 1988 | 15.9 | 220.9 | 0.0 | 286.4 | 324.4 | 847.5 |
| 1989 | 36.6 | 402.9 | 0.0 | 222.4 | 298.8 | 960.7 |
| 1990 | 48.4 | 424.9 | 0.0 | 135.7 | 1106.4 | 1715.5 |
| 1991 | 32.2 | 273.5 | 0.0 | 193.7 | 1011.1 | 1510.4 |
| 1992 | 38.5 | 242.1 | 0.0 | 103.3 | 709.1 | 1093.1 |
| 1993 | 45.3 | 524.4 | 0.0 | 34.3 | 956.5 | 1560.6 |
| 1994 | 81.7 | 278.4 | 0.0 | 56.4 | 591.4 | 1007.9 |
| 1995 | 45.9 | 384.3 | 1.5 | 109.4 | 560.0 | 1101.1 |
| 1996 | 16.5 | 274.5 | 1.1 | 28.2 | 426.1 | 746.4 |
| 1997 | 17.5 | 240.6 | 1.5 | 21.1 | 435.2 | 715.9 |
| 1998 | 13.5 | 326.5 | 2.3 | 23.8 | 427.3 | 793.4 |
| 1999 | 14.1 | 192.4 | 2.2 | 33.7 | 307.4 | 549.9 |
| 2000 | 14.2 | 295.0 | 1.1 | 38.9 | 247.4 | 596.6 |
| 2001 | 11.3 | 303.7 | 1.4 | 18.7 | 221.0 | 556.1 |
| 2002 | 10.4 | 246.0 | 1.4 | 14.3 | 144.4 | 416.5 |

| Year | Trawl | Halibut | Sablefish | Dogfish/Lingcod | H&L Rockfish | Total |
|---|---|---|---|---|---|---|
| 2003 | 12.0 | 217.3 | 1.2 | 25.9 | 83.8 | 340.2 |
| 2004 | 8.6 | 205.0 | 1.9 | 17.5 | 64.5 | 297.6 |
| 2005 | 9.2 | 204.3 | 3.8 | 15.5 | 84.5 | 317.4 |
| 2006 | 8.1 | 135.6 | 0.1 | 7.4 | 20.3 | 171.4 |
| 2007 | 6.7 | 165.5 | 1.0 | 16.3 | 38.1 | 227.5 |
| 2008 | 6.7 | 220.3 | 0.8 | 16.7 | 58.8 | 303.2 |
| 2009 | 8.1 | 173.9 | 0.3 | 18.8 | 50.5 | 251.6 |
| 2010 | 11.5 | 157.5 | 0.5 | 12.5 | 60.9 | 242.8 |
| 2011 | 8.4 | 168.6 | 4.1 | 10.5 | 68.6 | 260.1 |
| 2012 | 7.6 | 189.7 | 2.1 | 11.8 | 67.4 | 278.6 |
| 2013 | 4.5 | 173.3 | 3.5 | 8.2 | 64.3 | 253.8 |
| 2014 | 5.0 | 150.0 | 0.7 | 7.1 | 71.7 | 234.4 |
| 2015 | 3.8 | 168.3 | 1.1 | 10.7 | 79.3 | 263.3 |
| 2016 | 2.6 | 107.5 | 1.4 | 9.0 | 35.5 | 156.0 |

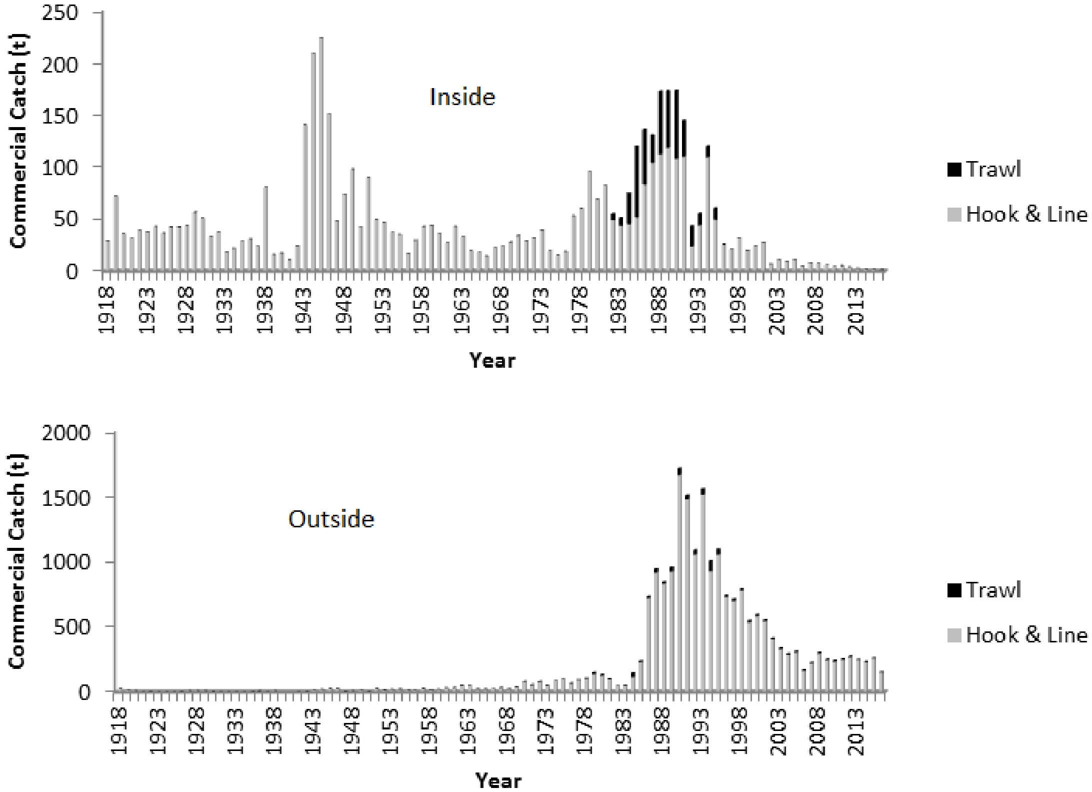



*Figure 18. Total commercial catch by trawl and hook and line gear for inside (top) and outside (bottom) Yelloweye Rockfish. Data for years 1918 to 2007 reconstructed for the inside DU by Yamanaka et al. (2012) and for the outside DU by Yamanaka et al. (2018) and updated to 2016 extracted from GFFOS database.*

## 4.2. FIRST NATIONS FISHERIES

There is no complete record of Yelloweye Rockfish catch by First Nations Fisheries. Yamanaka et al. (2012) estimated First Nation fishery takes of inside Yelloweye Rockfish by applying a consumption rate to population estimates for First Nations people who reside near, and have access to, Yelloweye Rockfish (Table 8).

For the outside Yelloweye Rockfish stock assessment, Food, Social and Ceremonial (FSC) landings from commercial groundfish dual fishing trips were used as the basis of First Nations catch estimates, and were included with commercial catches since 2006 (Yamanaka et al. 2018). Note that this approach may be incomplete, missing other FSC catches not captured in the dual fishing trip records.

*Table 8. Reconstruction of First Nations catch of inside Yelloweye Rockfish in the most recent assessment by Yamanaka et al. (2012) based on estimated consumption rate and population size.*

| Year | Population | Catch (t) | Year | Population | Catch (t) |
|---|---|---|---|---|---|
| **1918** | 3092 | 0.7 | **1963** | 10568 | 2.4 |
| **1919** | 3092 | 0.7 | **1964** | 10600 | 2.4 |
| **1920** | 3092 | 0.7 | **1965** | 10631 | 2.5 |
| **1921** | 3092 | 0.7 | **1966** | 10663 | 2.5 |
| **1922** | 3092 | 0.7 | **1967** | 10694 | 2.5 |
| **1923** | 3092 | 0.7 | **1968** | 10726 | 2.5 |
| **1924** | 3092 | 0.7 | **1969** | 10757 | 2.5 |
| **1925** | 3092 | 0.7 | **1970** | 10789 | 2.5 |
| **1926** | 3092 | 0.7 | **1971** | 10820 | 2.5 |
| **1927** | 3092 | 0.7 | **1972** | 10926 | 2.5 |
| **1928** | 3092 | 0.7 | **1973** | 11032 | 2.6 |
| **1929** | 3092 | 0.7 | **1974** | 11138 | 2.6 |
| **1930** | 3092 | 0.7 | **1975** | 11244 | 2.6 |
| **1931** | 3092 | 0.7 | **1976** | 11350 | 2.6 |
| **1932** | 3405 | 0.8 | **1977** | 11456 | 2.7 |
| **1933** | 3718 | 0.8 | **1978** | 11562 | 2.7 |
| **1934** | 4031 | 0.9 | **1979** | 11668 | 2.7 |
| **1935** | 4344 | 1 | **1980** | 11774 | 2.7 |
| **1936** | 4657 | 1.1 | **1981** | 12007 | 2.7 |
| **1937** | 4969 | 1.1 | **1982** | 12244 | 2.8 |
| **1938** | 5282 | 1.2 | **1983** | 12511 | 2.8 |
| **1939** | 5595 | 1.3 | **1984** | 12687 | 2.9 |
| **1940** | 5908 | 1.3 | **1985** | 12950 | 2.9 |
| **1941** | 6221 | 1.4 | **1986** | 13728 | 3.1 |
| **1942** | 6376 | 1.4 | **1987** | 15689 | 3.6 |
| **1943** | 6530 | 1.5 | **1988** | 16883 | 3.8 |
| **1944** | 6685 | 1.5 | **1989** | 17620 | 4 |
| **1945** | 6839 | 1.6 | **1990** | 18526 | 4.2 |
| **1946** | 6994 | 1.6 | **1991** | 19209 | 4.4 |
| **1947** | 7148 | 1.6 | **1992** | 19977 | 4.5 |
| **1948** | 7303 | 1.7 | **1993** | 20574 | 4.7 |
| **1949** | 7457 | 1.7 | **1994** | 21047 | 4.8 |
| **1950** | 7612 | 1.7 | **1995** | 21564 | 4.9 |
| **1951** | 7766 | 1.8 | **1996** | 21943 | 5 |
| **1952** | 8040 | 1.8 | **1997** | 22446 | 5.1 |
| **1953** | 8314 | 1.9 | **1998** | 22895 | 5.2 |
| **1954** | 8588 | 1.9 | **1999** | 23328 | 5.3 |
| **1955** | 8862 | 2 | **2000** | 23745 | 5.4 |
| **1956** | 9136 | 2.1 | **2001** | 24131 | 5.5 |
| **1957** | 9409 | 2.1 | **2002** | 24480 | 5.6 |
| **1958** | 9683 | 2.2 | **2003** | 25105 | 5.7 |
| **1959** | 9957 | 2.3 | **2004** | 25995 | 5.9 |
| **1960** | 10231 | 2.3 | **2005** | 11774 | 2.7 |
| **1961** | 10505 | 2.4 | **2006** | 12007 | 2.7 |
| **1962** | 10537 | 2.4 | **2007** | 12244 | 2.8 |

## 4.3. RECREATIONAL FISHERIES

Its large size and relatively shallow preferred depths make Yelloweye Rockfish an important species to the recreational fishery. While it is often a primary target of individual anglers, it is more frequently encountered as incidental catch in the pursuit of Lingcod and Halibut in the north coast and west coast Vancouver Island recreational fisheries (Yamanaka et al. 2006). The recreational catch can account for nearly equivalent or greater removals than commercial catch for the inside DU.

Records from creel surveys and lodge reports cover a portion of each year, which is estimated to include 95% of the total annual catch. These records indicate large variations in the recorded Yelloweye Rockfish catches from 2000-2016 (Figure 19). Data tables summarizing recreational catch on the west coast of Vancouver Island, east coast of Vancouver Island (Major statistical area 4B with Area 11 reported separately as it is split between the two DUs; Table A2), the central coast by area (Table A3) and the North Coast Areas 1 and 2 and Areas 3 and 4 (Tables A4 and A5) are provided in Appendix A. See Figure 20 for fishery areas. There may be some uncertainty in Yelloweye Rockfish identification in creel surveys. However, since 2000, training in identification of rockfish species has been provided and the creel surveys and lodge reports are considered reliable.

Note that there may be some uncertainty in the data for Areas 1 and 2. Data for this area is rolled up from lodge logbook records and creel surveys which capture both lodge and independent/charter catches. As there is only partial coverage by the creel survey in Area 2W (10-15%), some independent and/or charter catches may be missing. Also note that data presented for Areas 1 and 2 are for all rockfish up to 2015, and for 2016 and 2017 are separated into Yelloweye and other Rockfish.

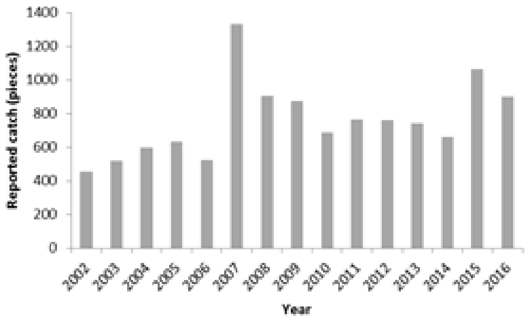
In addition to the creel surveys and lodge reports, since July of 2012 there has been an internet survey of recreational fishing (iRec) and *preliminary uncalibrated estimates* of Yelloweye Rockfish catches are presented with Creel records by area and summarized coastwide in Appendix A (Table A1).

The iRec data are presented with the following disclaimer:

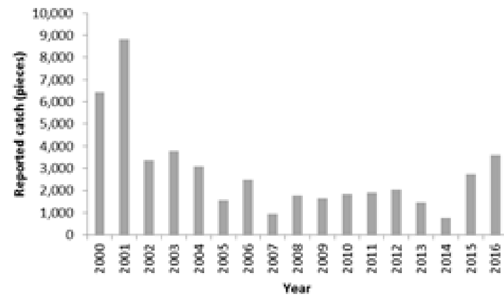
*"These iREC data are based on responses to an internet survey of tidal water licence holders. The responses are self-reported without any direct data verification. Although the survey design protects against certain biases, response data and resulting estimates are still subject to a variety of biases." (Rob Houtman, DFO, Nanaimo, BC, pers. comm.)*

A calibration procedure has been developed to scale iRec data to creel data (DFO 2015), but calibrated data still include biases and uncertainties; for example, non-response bias, uncertainties including a lack of creel surveys in some areas for calibration, and lack of catch estimates for methods other than boat-based angling. Data presented here are uncalibrated.

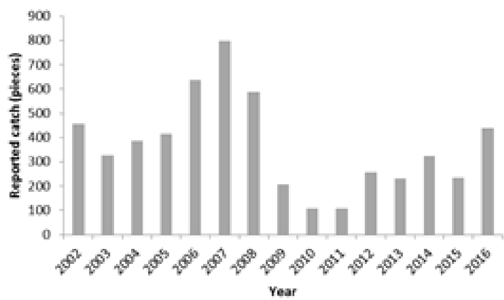
Current levels of recreational catch remain lower than the highest catches from around 2006-2008 (outside) and 2000-2001 (inside). In inside waters, recent catch has increased from around 2,000 pieces in 2010 to 3,000 pieces in 2016. In the outside area, recent catch has increased from 2010 levels of around 9,000 pieces to around 11,000 pieces in 2016 (Figure 19).



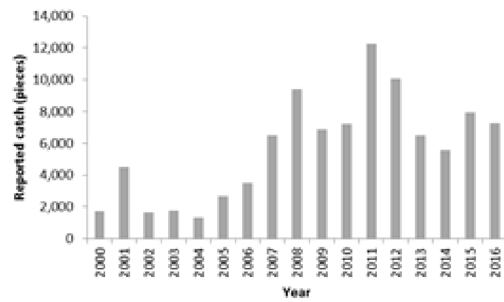

Area 7



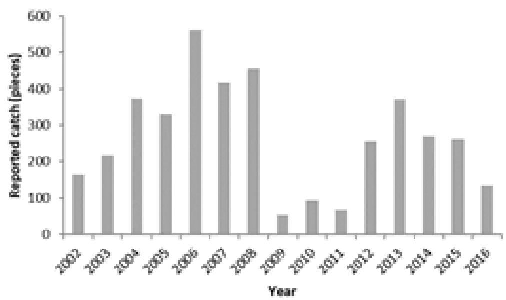

4B (except Area 11)



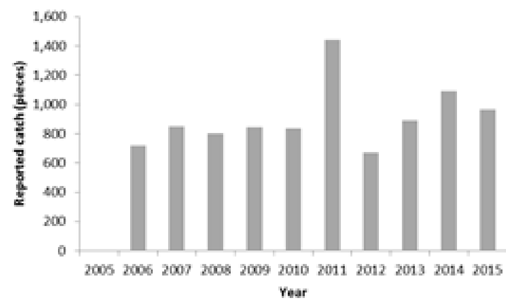

Area 8



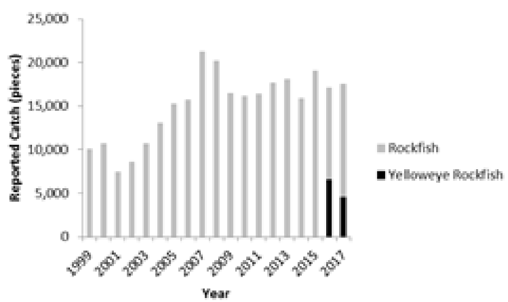

WCVI



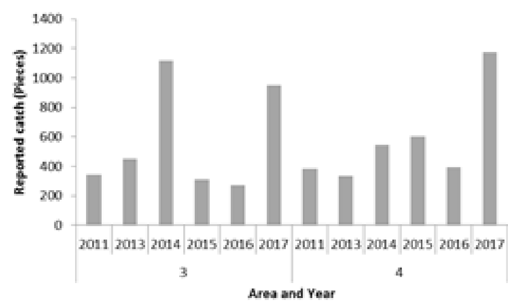

Area 9




Area 11




Areas 1 and 2




Areas 3 and 4

*Figure 19. Recreational catch by area reported in Creel surveys and Lodge Reports. Note different years on horizontal axis.*

## 4.4. FISHERIES MANAGEMENT

There are seven distinct commercial groundfish sector groups, Groundfish trawl, Halibut, Sablefish, Inside Rockfish, Outside Rockfish, Lingcod, and Dogfish, which are managed according to the measures set out in the Groundfish Integrated Fisheries Management Plan (DFO 2017). Area specific quotas, based on combinations of Pacific Fisheries Management Areas (PFMA) (Figure 20) are listed in Table 9.

The management of these commercial sector groups is integrated, with all groups subject to 100% at-sea monitoring and 100% dockside monitoring, individual vessel accountability for all catch (both retained and released), individual transferable quotas (ITQ), and reallocation of these quotas between vessels and fisheries to cover catch of non-directed species. At sea monitoring is accomplished with an at-sea observer onboard to verify and record the catch by species or an electronic monitoring system on board which captures sensor data and video footage. The dockside monitoring program provides further validation of landings by a dockside validator at designated ports. Catch quotas for Yelloweye Rockfish declined dramatically between 2001 and 2002 when the Inshore Rockfish Conservation Plan was implemented; by 50% in the outside area and 75% in the inside area and remained relatively stable until 2015 (Table 9). Changes to commercial rockfish fishery management are listed in Yamanaka and Logan (2010); their table is included here as Table 10 updated to include changes until present. Changes to recreational rockfish fishery management are listed in Table 11. Though Yelloweye Rockfish is still a directed species in the ZN fishery, it has become more of an “avoidance fishery” with the reduced quota leading to shifts in fisher behaviour to avoid areas with higher concentrations of Yelloweye.

*Rebuilding Plan*

In 2016 a rebuilding plan for outside Yelloweye Rockfish was implemented with the goal of rebuilding outside Yelloweye to out of the critical zone within 15 years (DFO 2017). Stepped reductions of commercial TAC were planned over three years (2016-2017 to 2018-2019) towards a mortality cap of 100 tonnes. The TAC was reduced from 277 to 173 tonnes between 2015 and 2016, and from 173 to 110 between 2016 and 2017, with a further reduction planned for the 2018/2019 season. There were also slight adjustments made to the spatial apportionment of the TAC among groundfish management areas to account for population trends in each area and to spread the catch out over the coast to reduce fishing pressure in individual areas.

The current overall commercial TAC for Yelloweye Rockfish is 110 t in 2017 (Table 9) with 64.34% to HL rockfish harvesters (ZN-outside license), 33.12% to Pacific Halibut harvesters (L license) and 2.54% of the quota allocated to trawl (T license). Catches in all fleets are constrained by an annual quota and vessel-specific quotas.

Management changes were also made to the recreational rockfish fishery regulations as part of the rebuilding plan. Groundfish catches in the recreational fishery are constrained by a “bag limit” (for “all rockfish” combined, and Yelloweye Rockfish limits) which varies by area. In 2016 recreational daily catch limits were reduced from 3 to 2 Yelloweye Rockfish per person in the north (Haida Gwaii, North Coast and Central Coast) and from 2 to 1 Yelloweye Rockfish in the South Coast. Recreational limits of all rockfish were reduced in 2017 from 5 to 3 in the north and from 3 to 2 in the south. These and other changes to recreational fishery management are listed in Table 11.

In addition to management by quotas, there also several specific measures in place that protect rockfish and bottom habitat including Rockfish Conservation Areas (RCAs), glass sponge reef closures, the freezing of the bottom trawl fishery boundaries, and the designation of the Gwaii Haanas National Marine Park Reserve (Figure 21).

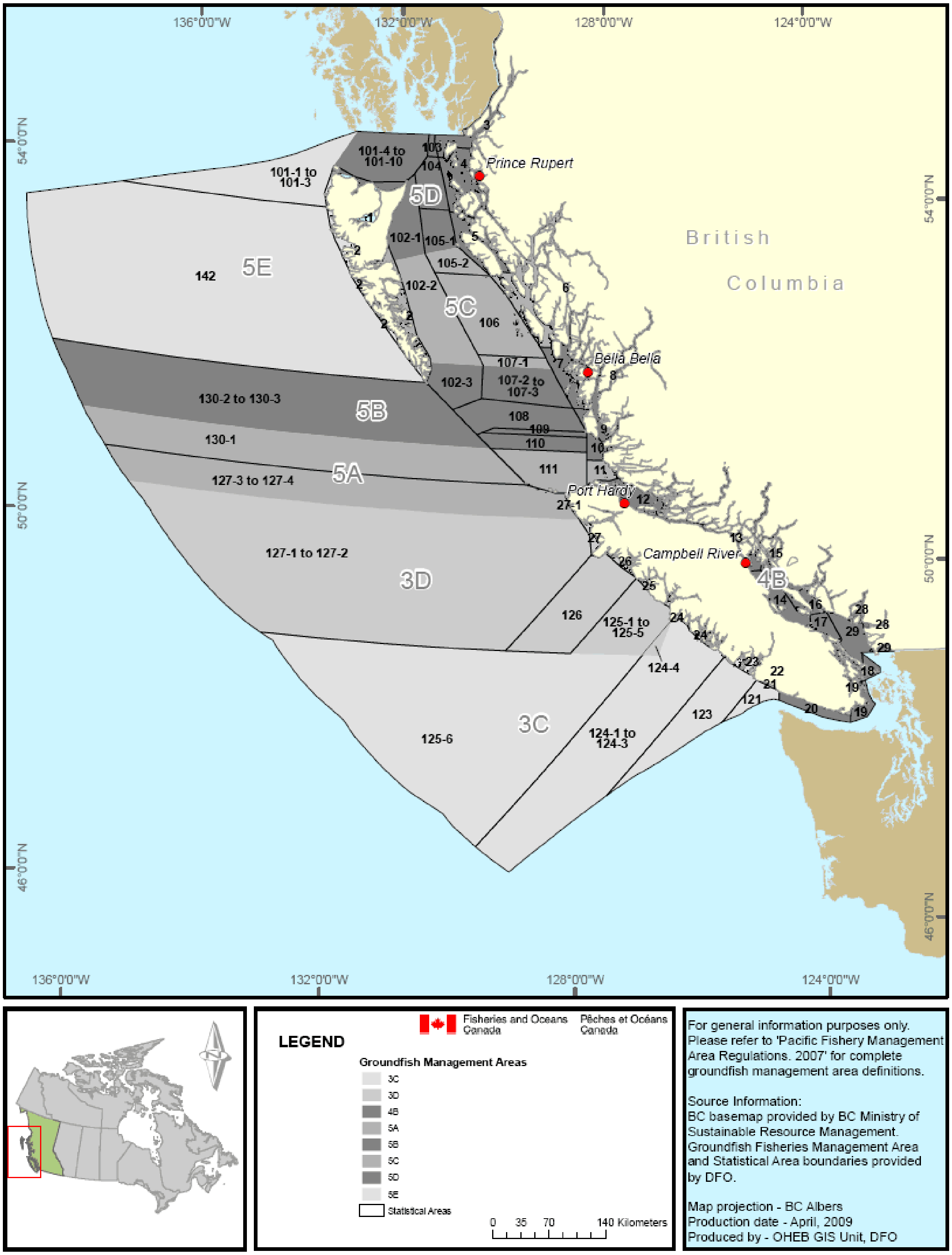



*Figure 20. Pacific Fisheries Management Areas*

*Table 9. Yelloweye Rockfish quota (tonnes) for fishing sector by fishing year and area, 2004-2017*

| Year | | Area | | | | | |
|---|---|---|---|---|---|---|---|
| | | 3C, 3D,5A | 5B | 5C, 5D | 5E | 4B | Sector Total |
| **2017** | **Trawl** | 1 | 1 | 1 | 1 | 0 | **3** |
| | **Hook and line** | 25 | 19 | 25 | 27 | 7 | **107** |
| | **Total** | 26 | 20 | 26 | 28 | 7 | **110** |
| **2016** | **Trawl** | 1 | 1 | 1 | 2 | 0 | **5** |
| | **Hook and line** | 46 | 37 | 33 | 44 | 7 | **168** |
| | **Total** | 47 | 38 | 34 | 46 | 7 | **173** |
| **2015** | **Trawl** | 2 | 2 | 2 | 2 | 0 | **7** |
| | **Hook and line** | 79 | 56 | 61 | 66 | 7 | **270** |
| | **Total** | 81 | 58 | 63 | 68 | 7 | **277** |
| **2014** | **Trawl** | 2 | 2 | 2 | 2 | 0 | **7** |
| | **Hook and line** | 81 | 58 | 62 | 68 | 7 | **277** |
| | **Total** | 83 | 60 | 64 | 70 | 7 | **284** |
| **2013** | **Trawl** | 2 | 2 | 2 | 2 | 0 | **7** |
| | **Hook and line** | 81 | 58 | 62 | 68 | 7 | **277** |
| | **Total** | 83 | 60 | 64 | 70 | 7 | **284** |
| **2012** | **Trawl** | 2 | 2 | 2 | 2 | 0 | **7** |
| | **Hook and line** | 81 | 58 | 62 | 68 | 7 | **277** |
| | **Total** | 83 | 60 | 64 | 70 | 7 | **284** |
| **2011** | **Trawl** | 2 | 2 | 2 | 2 | 0 | **7** |
| | **Hook and line** | 81 | 58 | 62 | 68 | 7 | **277** |
| | **Total** | 83 | 60 | 64 | 70 | 7 | **284** |
| **2010** | **Trawl** | 2 | 2 | 2 | 2 | 0 | **7** |
| | **Hook and line** | 81 | 58 | 62 | 68 | 7 | **277** |
| | **Total** | 83 | 60 | 64 | 70 | 7 | **284** |
| **2009** | **Trawl** | 2 | 2 | 2 | 2 | 0 | **7** |
| | **Hook and line** | 81 | 58 | 62 | 68 | 7 | **277** |
| | **Total** | 83 | 60 | 64 | 70 | 7 | **284** |
| **2008** | **Trawl** | 2 | 2 | 2 | 2 | 0 | **7** |
| | **Hook and line** | 81 | 58 | 62 | 68 | 7 | **277** |
| | **Total** | 83 | 60 | 64 | 70 | 7 | **284** |
| **2007** | **Trawl** | 2 | 2 | 2 | 1 | 0 | **7** |
| | **Hook and line** | 81 | 58 | 62 | 68 | 7 | **277** |
| | **Total** | 83 | 60 | 64 | 70 | 7 | **284** |
| **2006** | **Trawl** | 2 | 2 | 2 | 1 | 0 | **7** |
| | **Hook and line** | 81 | 58 | 63 | 68 | 7 | **277** |
| | **Total** | 83 | 60 | 64 | 70 | 7 | **284** |
| **2005** | **Trawl** | 7 | | | | 0 | **7** |
| | **Hook and line** | 223 | | | | 6 | **229** |
| | **Total** | 230 | | | | 6 | **236** |
| **2004** | **Trawl** | 7 | | | | 0 | **7** |
| | **Hook and line** | 223 | | | | 6 | **229** |
| | **Total** | 230 | | | | 6 | **236** |

*Table 10. Chronology of British Columbia inshore rockfish fishery management actions by area – updated from Yamanaka and Logan (2010). Asterisks denote management milestones (TAC = total allowable catch; RCA = rockfish conservation area)*

| Year | Area | Management action |
|---|---|---|
| **<1986** | Coastwide | Unrestricted fishery |
| **1986** | Coastwide | Introduced a category ‘‘ZN’’ license* for the directed hook-and-line rockfish fishery with a voluntary logbook program |
| | Inside | Feb 15 to Apr 15 closure |
| **1987** | Inside | Jan 1 to Apr 15 closure |
| | Inside | Provisional 75-metric-ton quota, area 12 |
| **1988** | Inside | Year-round commercial closure, area 13 Discovery Pass |
| | Inside | Jan 1 to Apr 30 closure |
| **1990** | Inside | Jan 1 to Apr 30 and Nov 1 to Dec 31 closure |
| | Outside | Provisional 650-metric-ton quota |
| | Outside | Portions closed, area 7 |
| | Outside | Jan 1 to Apr 30 closed west coast of Vancouver Island |
| **1991** | Coastwide | Area licensing, * 592 inside and 1,591 outside |
| | Inside | Trawl closure |
| | Inside | Live rockfish fishery only |
| | Inside | Jan 1 to May 14 closure, with no incidental rockfish catch allowances |
| | Inside | 2–3-d opening in area 13 Discovery Pass |
| | Outside | Rotational closure was initiated in area 7 |
| **1992** | Coastwide | Limited-entry licensing program was announced |
| | Inside | Limited-entry licensing with 74 eligible inside licenses |
| | Outside | Limited-entry licensing with 183 eligible outside licenses |
| **1993** | Coastwide | TAC quota management* for ‘‘red snapper’’ and ‘‘other rockfish’’ by five management regions |
| **1994** | Coastwide | Region/time closures |
| | Coastwide | User-pay logbook program |
| | Coastwide | Trip limits for trawl species |
| | Coastwide | Incidental catch allowances |
| | Coastwide | User-pay dockside monitoring program* |
| **1995** | Coastwide | Aggregate species quota management for yelloweye rockfish, quillback rockfish, copper rockfish, china rockfish, and tiger rockfish |
| | Coastwide | Monthly fishing periods, monthly fishing period limits, annual landing options, and annual trip limits |
| | Coastwide | Relinquishment of period limit overages |
| **1996** | Coastwide | Change to species quotas, * yelloweye rockfish TAC, aggregate 1&2 TAC (quillback rockfish, copper rockfish, china rockfish, and tiger rockfish) |
| **1997** | Coastwide | Initiate 5% quota allocation for research purposes |
| **1998–1999** | Outside | 92% of commercial rockfish TAC allocated to the trawl sector, 8% to hook-and-line sector |
| | Inside | 100% of commercial rockfish TAC allocated to the hook-and-line sector |
| **1999–2000** | Coastwide | 10% at-sea observer coverage |

| Year | Area | Management action |
| --- | --- | --- |
| **1999–2000** | Coastwide | Quillback rockfish, copper rockfish, china rockfish, tiger rockfish TAC reduced by 25% |
| | Coastwide | Selected area closures: rockfish protection areas, closed fishing areas to commercial groundfish hook-and-line gear types* |
| **2000–2001** | Coastwide | Allocation of rockfish species between the Pacific Halibut and hook-and-line sectors |
| **2001–2002** | Inside | Limited amount of at-sea observer coverage |
| | Outside | License option elections before fishing season, monthly fishing period limits |
| **2002–2003** | Inside | 75% reduction of inshore rockfish TAC from 2001* |
| | Outside | 50% reduction of inshore rockfish TAC from 1997–1998* |
| | Coastwide | Expansion of catch monitoring programs |
| | Coastwide | Introduced 1% interim areas of restricted fishing, closed to all commercial groundfish fisheries (both hook-and-line and trawl gear types) |
| **2004–2005** | Coastwide | RCAs expanded to 8% of rockfish habitats |
| **2005–2006** | Inside | RCAs expanded to 28% of rockfish habitats |
| | Coastwide | Introduce groundfish license integration pilot program: 100% catch monitoring* |
| **2006–2007** | Outside | RCAs expanded to 15% of rockfish habitats |
| | Coastwide | Introduce groundfish integrated fishery management program* |
| | Outside | Yelloweye Rockfish TAC set at 284 tonnes for all commercial fisheries |
| **2010** | Outside | Implemented Gwaii Haanas National Marine Conservation Area interim management plan and zoning plan |
| **2012** | Coastwide | Introduce trawl fishery boundaries in consultation with industry* |
| **2015** | Inside | Implemented Strait of Georgia/Howe Sound glass sponge reef closures |
| **2015-2016** | Outside | Yelloweye Rockfish TAC reduced by 39 % |
| **2016-2017** | Outside | Introduced Yelloweye Rockfish rebuilding plan: Yelloweye Rockfish commercial TAC reduced to 173 tonnes* |
| | Outside | Recreational daily limits for Yelloweye was reduced from 3 to 2 per person in the north and central coast region and from 2 to 1 in the south coast region |
| **2017** | Outside | Implemented Hecate Strait/Queen Charlotte Strait glass sponge reef closures |
| **2017-2018** | Outside | Yelloweye Rockfish commercial TAC reduced by 41%* |

*Table 11. Chronology of British Columbia inshore rockfish recreational fishery management and Yelloweye Rockfish-specific management actions by area.*

| Year | DU | Area | Management action |
|---|---|---|---|
| **1986** | Both | Coastwide | 8 rockfish daily bag limit per person implemented. |
| **1992** | Inside | Strait of Georgia | Daily limit reduced to 5 rockfish per person in Areas 12 to 19, 28 and 29 and Subareas 20-4 and 20-7. |
| **2002** | Inside | 4B | Inshore Rockfish Conservation Strategy - Daily limit reduced to 1 rockfish in Areas 12 to 19, 28 and 29 and Subareas 20-5 to 20-7. |
| | Outside | North (Haida Gwaii, North and Central Coast) | Inshore Rockfish Conservation Strategy - Daily limit reduced to 5 rockfish in Areas 1 to 10, 101 to 111 and 130 to 142. Yelloweye daily limit of 3. |
| | Outside | South Coast (WCVI) | Inshore Rockfish Conservation Strategy - Daily limit reduced to 3 rockfish in Areas 11, 21 to 27 and 121 to 127 and Subareas 20-1 to 20-4. Yelloweye daily limit of 2. |
| **2002-2007** | Both | Coastwide | Rockfish Conservation Areas (RCAs) established - RCAs closed to fin fish harvest in recreational fishery. |
| **2006** | Inside | 4B | Inshore rockfish recreational fishery closed in Areas 13 to 19, 28 and 29 from October 1. |
| **2007** | Inside | 4B | Inshore rockfish recreational fishery closed October 1-May 31 in Areas 13 to 19 and Subarea 29-5. Areas 28 and 29 (except Subarea 29-5) remain closed until further notice. |
| **2008-2016** | Inside | 4B | Inshore rockfish recreational fishery open May 1-September 30 in Areas 13 to 19, and Subareas 20-5 to 20-7 and 29-5. Areas 28 and 29 (except Subarea 29-5) remain closed. |
| **2016** | Outside | North (Haida Gwaii, North and Central Coast) | Outside Yelloweye Rebuilding Plan - Daily Yelloweye limit reduced to 2, all rockfish limit remains at 5 in Areas 1 to 10, 101 to 110 and 130 to 142. |
| | Outside | South Coast (WCVI) | Outside Yelloweye Rebuilding Plan - Daily Yelloweye limit reduced to 1, all rockfish limit remains at 3 in Areas 11, 21 to 27, 111, 121 to 127 and Subareas 20-1 to 20-4. |
| **2017** | Inside | 4B | Areas 13 to 19 and Subareas 12-1 to 12-13, 12-15 to 12-48, 20-5 to 20-7 and 29-5 open June 1 to September 30. Area 28 and 29 (except for Subarea 29-5) remain closed. |
| | Outside | North (Haida Gwaii, North and Central Coast) | Daily rockfish limit reduced to 3, Yelloweye limit remains at 2. Clearly defined closed times (November 16 to March 31). |
| | Outside | South Coast (WCVI) | Daily rockfish limit reduced to 2, Yelloweye limit remains at 1 in Areas 11, 21 to 27, 111, 121 to 127 and Subareas 20-1 to 20-4. Clearly defined closed times (November 16 to March 31). |

*RCAs*

Between 2002 and 2007 a network of 164 RCAs were established along the BC coast in order to reduce mortality of inshore rockfish (includes five rockfish species: Yelloweye Rockfish *Sebastes ruberrimus,* Copper Rockfish *S. caurinus,* Quillback Rockfish *S. maliger,* China Rockfish *S. nebulosus,* and Tiger Rockfish *S. nigrocinctus*). RCAs were developed in consultation with stakeholders and are used as a spatial management tool to protect a portion of the rockfish population from harvest. RCAs are aimed at protecting rockfish by identifying rockfish habitat and closing a portion of these habitats to commercial and recreational harvesting activities that target or lead to significant bycatch of rockfishes (commercial bottom trawl and hook and line, Sablefish trap and salmon troll fisheries and recreational hook and line for groundfish, salmon trolling, jigging or mooching and spearfishing) (Haggarty 2014). Currently, RCAs protect approximately 28% of inside rockfish habitat and 15% of outside rockfish habitat (Yamanaka and Logan 2010).

Surveys were conducted in 2009-2011 using non-destructive ROV video to visually assess rockfish status within and adjacent to 47 RCAs. A total of 424 transects were completed in the RCAs and adjacent areas (Haggarty 2015; Haggarty et al. 2016, 2017). Results from the surveys showed little to no difference in rockfish status within RCAs compared with adjacent areas since they were implemented. Rockfish are long-lived and may take longer to show effects within RCAs. These surveys are intended to be replicated in the future to examine the efficacy of the RCAs.

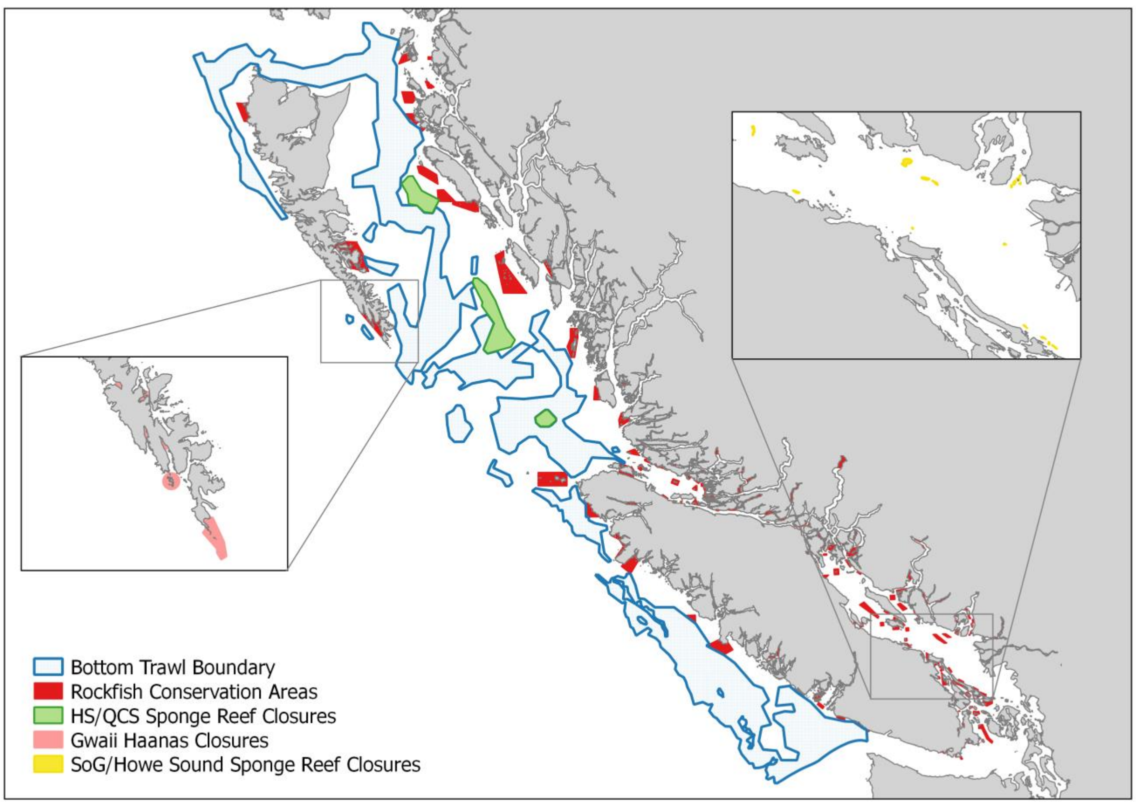



*Figure 21. Areas designated as closed to all or some fishing in BC.*

Lack of compliance with fishery regulations can reduce success of management plans aimed at reducing fishing mortality (Milazzo 2012). A recent study examined compliance with RCA regulations within the BC recreational fishery. Haggarty et al. (2015) looked at fishing effort in 77 RCAs before, during and after establishment, and found no difference in fishing effort after establishment in 83% of the RCAs, and found that effort increased in five of the examined RCAs. Low compliance with RCA regulations may result from a lack of awareness of where the RCAs are and what the regulations are (Haggarty et al. 2016; Lancaster et al. 2015; Lancaster et al. 2017), and may play a role in limiting the effectiveness of the RCAs in rebuilding of rockfish populations (Haggarty et al. 2015).

Figure 22 shows commercial catch for five years before (1997-2001) and the most recent five years after (2012-2017) the RCAs were implemented. RCAs will remain closed into the future to support the rebuilding of inshore rockfish stocks.

*Glass sponge reef closures*

Sponge reef closures in the Strait of Georgia (SOG)/Howe Sound and Hecate Strait (HS)/Queen Charlotte Sound (QCS) restrict fishing activity as a conservation measure for delicate glass sponge reefs and associated communities which also benefit rockfish and their habitat (Figure 21). The HS/QCS closures were first implemented for only the groundfish trawl fishery in 2002, were expanded in size and gear restrictions in 2006/2007, and were designated as a Marine Protected Area (MPA) covering an area of approximately 2,410 square kilometers in February 2017. The MPA is closed to all commercial bottom contact fishing activities for prawn, shrimp, crab and groundfish including hook and line for groundfish, and to midwater trawl for hake. The core protection zones, which include the reefs, a portion of the subsoil, and the water column directly above the reefs, are closed to all commercial, recreational and First Nations fishing. Commercial bottom trawl tows on the BC coast are shown in Figure 23 for five years before the HS/QCS sponge reef closures were established (1997-2001, top) and from after the closures were expanded until the trawl fishery boundary freeze was established (2008-April 2, 2012, bottom).

The SoG/Howe Sound closures were established in 2015 prohibiting all commercial and recreational bottom contact fishing activities in 9 designated areas totalling 27 square kilometers, and also went into effect for all First Nation Food, Social and Ceremonial bottom-contact fisheries in 2016.

*Bottom trawl fishery boundary*

In 2012, the bottom trawl fishery boundaries (the “trawl footprint”) were frozen to protect bottom habitat from disturbance by trawl gear. It was established within previously trawled areas covering 21% less area than the historically trawled area (1996-2011) (Wallace et al. 2015). This boundary was established through discussions amongst industry, the Department of Fisheries and Oceans (DFO) and NGO’s between 2010 and 2012 as a conservation measure; specifically concerning seafloor habitat including coral and sponge reef complexes. This boundary prevents bottom trawl activity in rockfish habitat that lies outside of the fishable area.

Commercial trawl tows before (2008-April 2, 2012) and after (April 3, 2012-November 2017) the boundary was established are presented in Figure 24.

*Gwaii Haanas National Marine Conservation Area Reserve*

In 2010 the marine area around Gwaii Haanas was designated as a National Marine Conservation Area Reserve. This area is currently managed under the Interim Management Plan and Zoning Plan which identifies six areas that are closed to commercial and recreational fishing: (Burnaby Narrows, Louscoone estuary, Flamingo estuary, Gowgaia estuary, Cape Saint James, and Sgang Gwaay) (DFO 2017). The Government of Canada and the Haida Nation are working collaboratively to develop a comprehensive long-term management plan and zoning concept for the Gwaii Haanas marine area.

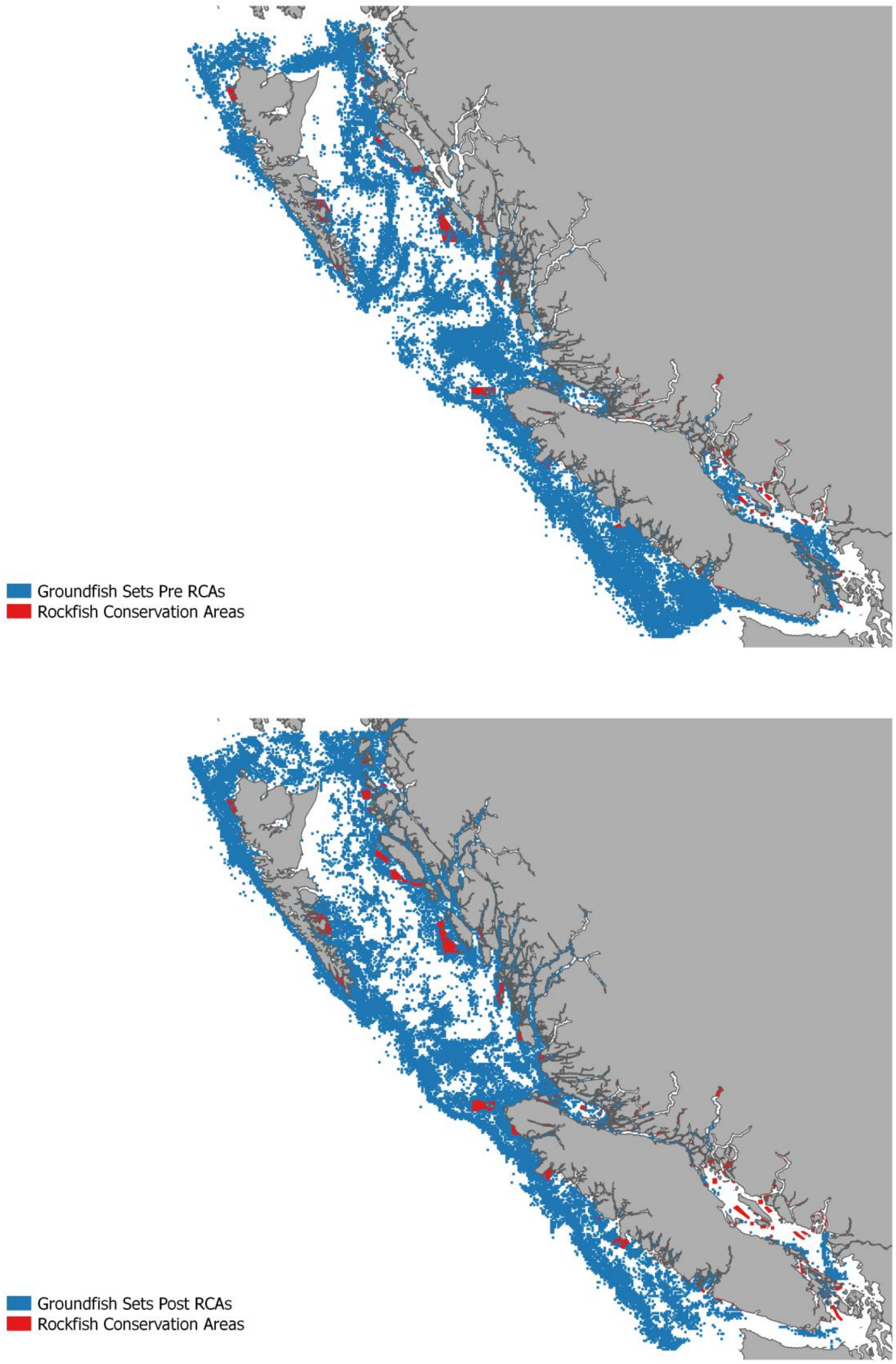



*Figure 22. Commercial groundfish sets before (top; 1997-2001) and after (bottom; 2013-2017) implementation of Rockfish Conservation Areas.*

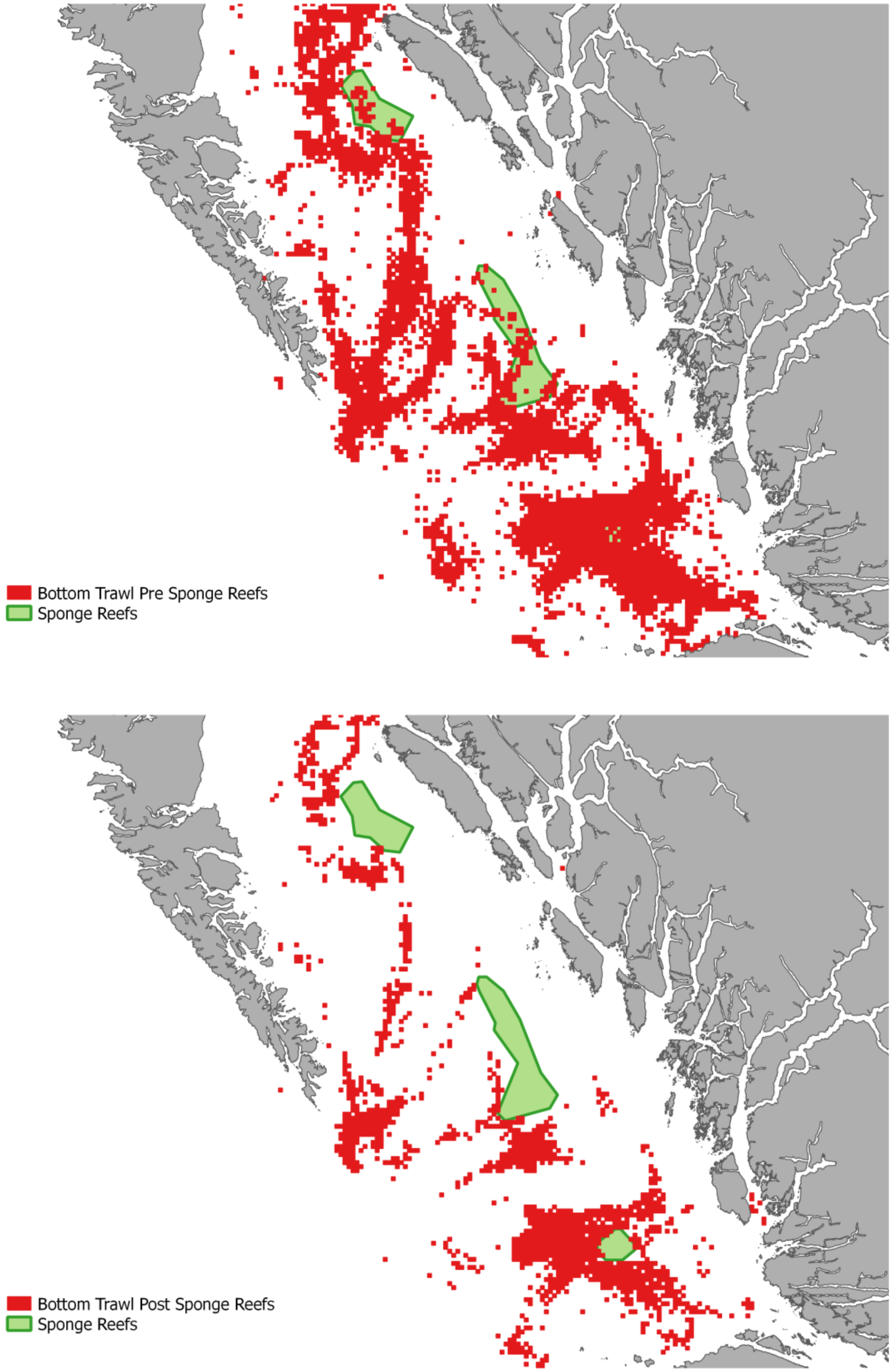



*Figure 23. Commercial bottom trawl tows before (top; 1997-2001) and after (bottom; 2008-2012) implementation of Hecate Strait/Queen Charlotte Sound glass sponge reef closures. The closures were implemented in 2002 and expanded in 2007.*

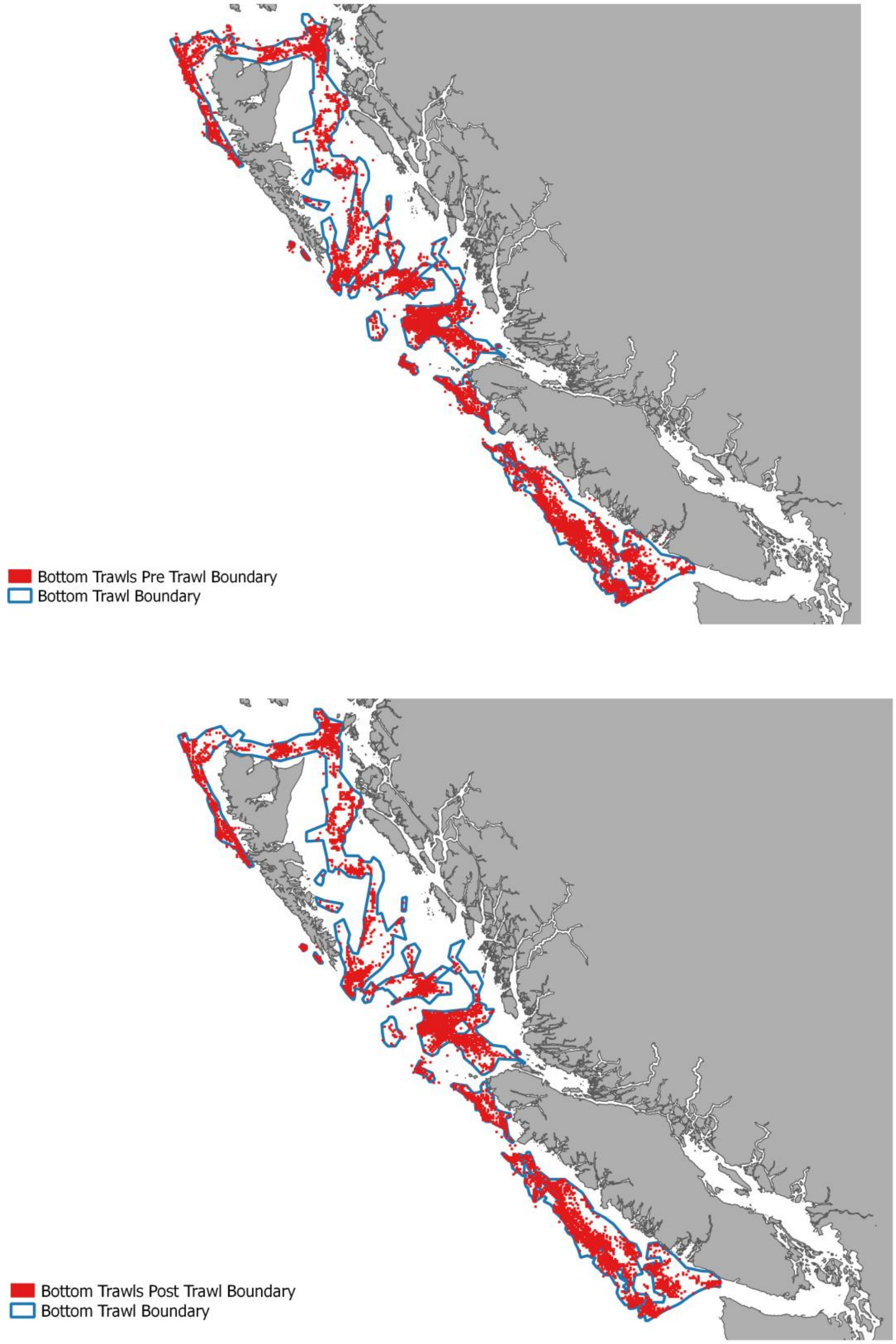



*Figure 24. Commercial bottom trawl tows before (top; 2007-2011) and after (bottom; 2013-2017) the April 2012 establishment of the bottom trawl boundary.*

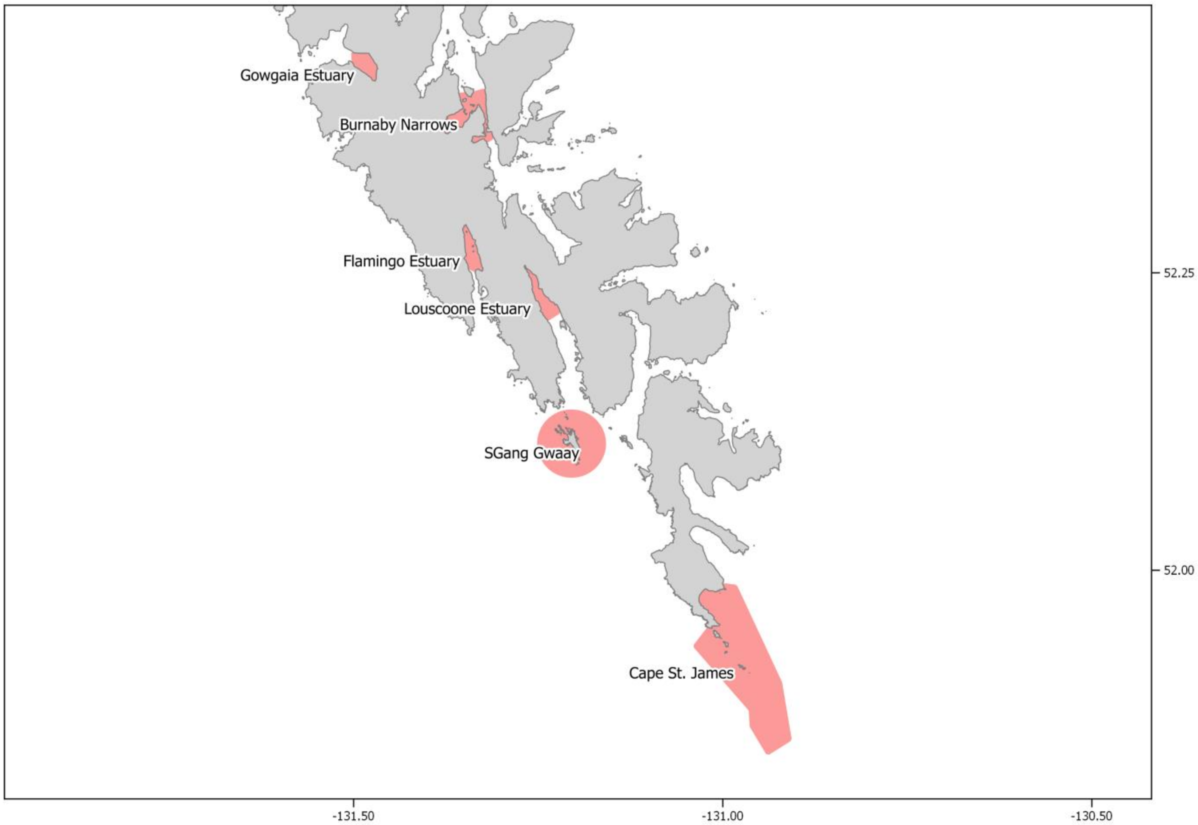



*Figure 25. Gwaii Haanas National Marine Conservation Area Reserve – six areas closed to commercial and recreational fishing in the Interim Management Plan and Zoning Plan.*

# 5. POPULATION TRENDS

The most recent stock assessments for each of the Yelloweye Rockfish DU's show population trends up to 2010 for the inside and up to 2014 for the outside. These trends are summarised below. Additional years of data have been collected for the population indices included in each assessment model since the assessments were completed. The additional years of commercial catch data are included in Table 7 for the inside DU and Table 8 for the outside DU. Available surveys for use in assessments are listed in Table 12 for the inside DU and Table 13 for the outside DU with details on why any surveys were not included in the stock assessments and biases associated with those surveys that were included. Data from the surveys included in the assessment models and updated to 2016 are presented for each DU including relative indices calculated as outlined in section 5.2.

## 5.1. AVAILABLE SURVEYS

Table 12 and Table 13 provide a listing of the available surveys that were examined for the inside and outside DU's, respectively. Several surveys did not encounter Yelloweye Rockfish or encountered very few and were excluded; these include the Hecate Strait multispecies assemblage survey, West Coast Haida Gwaii synoptic survey, West Coast Vancouver Island shrimp survey, the standardized Sablefish surveys, Historic Goose Island Gully survey, and the west coast Vancouver Island thornyhead survey. Other surveys were not considered in the stock assessment due to design considerations. The Strait of Georgia synoptic bottom trawl survey has only been conducted in two years and so does not provide a significant time series; it is therefore not included in the inside Yelloweye stock assessments or this review. The Jig Survey was conducted with inconsistent target species, gear type, areas and depths and could not be amalgamated into a single survey series; it was therefore not included in the stock assessment and is not considered in this review.

*Table 12. Inside area available surveys (YE = Yelloweye Rockfish). Shaded lines indicate survey series not included in most recent stock assessment.*

| Survey | First Year | Last Year | # Years | # Years w/ YE | # Sets | # Sets w/ YE | Gear type | Used in 2010 Inside Stock Assessment | Rationale if not used in Assessment/ *Biases* |
|---|---|---|---|---|---|---|---|---|---|
| IRF Longline Survey (North) | 2003 | 2016 | 8 | 8 | 426 | 221 | Longline | Yes | *Max survey depth 100 m.* |
| IRF Longline Survey (South) | 2005 | 2015 | 5 | 5 | 289 | 135 | Longline | Yes | *Max survey depth 100 m.* |
| Strait of Georgia Dogfish Longline Survey | 1986 | 2014 | 6 | 6 | 312 | 87 | Longline | Yes | *Focused on Dogfish fishing areas.* |
| Strait of Georgia Bottom Trawl Survey | 2012 | 2015 | 2 | 2 | 93 | 10 | Groundfish bottom trawl | No | Only conducted in two years – not a long enough time series. |
| Jig Survey | 1984 | 2004 | 9 | 8 | 1630 | 196 | Longline | No | Inconsistent target species, gear type and areas or depths surveyed. |

*Table 13. Outside area available surveys (YE = Yelloweye Rockfish). Shaded lines indicate survey series not included in most recent stock assessment.*

| Survey | First Year | Last Year | # Years | # Years w/ YE | # Sets | # Sets w/ YE | Gear type | Used in 2015 Outside Stock Assessment | Rationale if not used in Assessment/ *Biases* |
|---|---|---|---|---|---|---|---|---|---|
| Queen Charlotte Sound Synoptic Survey | 2003 | 2015 | 8 | 8 | 1908 | 233 | Groundfish bottom trawl | Yes | *Preferred YE rocky bottom habitat more difficult to trawl without damaging gear.* |
| West Coast Vancouver Island Synoptic Survey | 2004 | 2016 | 7 | 7 | 985 | 128 | Groundfish bottom trawl | Yes | *Preferred YE rocky bottom habitat more difficult to trawl without damaging gear.* |
| Hecate Strait Synoptic Survey | 2005 | 2015 | 6 | 6 | 1000 | 30 | Groundfish bottom trawl | Yes | *Preferred YE rocky bottom habitat more difficult to trawl without damaging gear.* |
| West Coast Haida Gwaii Synoptic Survey | 2006 | 2016 | 7 | 6 | 764 | 20 | Groundfish bottom trawl | No | Encountered few YE. |
| West Coast Vancouver Island Shrimp Survey | 1975 | 2016 | 40 | 22 | 3120 | 31 | Shrimp trawl | No | Encountered few YE; depth strata not appropriate as they are outside the majority of the depth range for YE. |
| Queen Charlotte Sound Shrimp Survey | 1998 | 2016 | 17 | 12 | 1169 | 33 | Shrimp trawl | Yes | *Depth strata not designed for YE.* |

| Survey | First Year | Last Year | # Years | # Years w/ YE | # Sets | # Sets w/ YE | Gear type | Used in 2015 Outside Stock Assessment | Rationale if not used in Assessment/ *Biases* |
|---|---|---|---|---|---|---|---|---|---|
| IPHC Longline Survey | 2003 | 2016 | 12 | 12 | 2035 | 775 | Longline | Yes | *Some lines have more skates (= longer set) which may end up in different habitat with potentially different catch. Aimed at and timed for catching Halibut.* |
| PHMA Longline Survey - Outside North | 2006 | 2015 | 5 | 5 | 951 | 692 | Longline | Yes | Initially designed for YE and Quillback Rockfish in their preferred habitat. |
| PHMA Longline Survey - Outside South | 2007 | 2016 | 5 | 5 | 920 | 549 | Longline | Yes | Initially designed for YE and Quillback Rockfish in their preferred habitat. |
| Hecate Strait Multispecies Assemblage Survey | 1984 | 2003 | 11 | 8 | 1110 | 21 | Groundfish bottom trawl | No | Encountered few YE. |
| Sablefish Inlet Standardized | 1995 | 2015 | 21 | 2 | 418 | 2 | Trap | No | Not designed to capture YE; too deep for YE and wrong gear type. Encountered few YE. |
| Sablefish Offshore Standardized | 1990 | 2010 | 21 | 3 | 1040 | 8 | Trap | No | Not designed to capture YE; too deep for YE and wrong gear type. Encountered few YE. |
| Sablefish Stratified Random | 2003 | 2016 | 14 | 14 | 1256 | 85 | Trap | No | Not designed to capture YE; too deep for YE and wrong gear type. |
| Yelloweye Rockfish Charter Longline Survey | 1997 | 2003 | 4 | 4 | 16222 | 5303 | Longline | No | Designed to determine if differences could be detected between specific sites with different fishing histories. |
| Goose Island Gully Survey | 1967 | 1995 | 9 | 7 | 460 | 21 | Groundfish bottom trawl | No | Encountered few YE. |
| West Coast Vancouver Island Thornyhead Survey | 2001 | 2003 | 3 | 0 | 198 | 0 | Groundfish bottom trawl | No | Encountered no YE. |

## 5.2. ANALYTICAL METHODS

The following provides the methodology for the calculation of relative indices in this review each survey used in the most recent Yelloweye Rockfish inside and outside stock assessments. Catch and effort data for strata $i$ in year $y$ yield catch per unit effort (CPUE) values $U_{yi}$. Note that these are not absolute values, but indices only for the purpose of examining trends among years.

### 5.2.1. Trawl Surveys

For trawl surveys, given a set of data $\{C_{yij}, E_{yij}\}$ for tows $j = 1, \ldots, n_{yi}$

Eq. 1 $$U_{yi} = \frac{1}{n_{yi}} \sum_{j=1}^{n_{yi}} \frac{C_{yij}}{E_{yij}},$$

where $C_{yij}$ = catch (kg) in tow $j$, stratum $i$, year $y$;

$E_{yij}$ = effort (h) in tow $j$, stratum $i$, year $y$;

$n_{yi}$ = number of tows in stratum $i$, year $y$.

CPUE values $U_{yi}$ convert to CPUE densities $\delta_{yi}$ (kg/km$^2$) using:

Eq. 2 $$\delta_{yi} = \frac{1}{vw} U_{yi},$$

where $v$ = average vessel speed (km/h);

$w$ = average net width (km).

Alternatively, if vessel information exists for every tow, CPUE density can be expressed

Eq. 3 $$\delta_{yi} = \frac{1}{n_{yi}} \sum_{j=1}^{n_{yi}} \frac{C_{yij}}{D_{yij} w_{yij}},$$

where $C_{yij}$ = catch weight (kg) for tow $j$, stratum $i$, year $y$;

$D_{yij}$ = distance travelled (km) for tow $j$, stratum $i$, year $y$;

$w_{yij}$ = net opening (km) for tow $j$, stratum $i$, year $y$;

$n_{yi}$ = number of tows in stratum $i$, year $y$.

The annual relative index is then the sum of the product of CPUE densities and bottom areas across $m$ strata:

Eq. 4 $$B_y = \sum_{i=1}^{m} \delta_{yi} A_i = \sum_{i=1}^{m} B_{yi},$$

where $\delta_{yi}$ = mean CPUE density (kg/km$^2$) for stratum $i$, year $y$;

$A_i$ = area (km$^2$) of stratum $i$;

$B_{yi}$ = biomass (kg) for stratum $i$, year $y$;

$m$ = number of strata.

The variance of the survey relative index $V_y$ ($kg^2$) follows:

Eq. 5 $$V_y = \sum_{i=1}^{m} \frac{\sigma_{yi}^2 A_i^2}{n_{yi}} = \sum_{i=1}^{m} V_{yi} ,$$

where $\sigma_{yi}^2$ = variance of CPUE density ($kg^2/km^4$) for stratum $i$, year $y$;

$V_{yi}$ = variance of the relative index ($kg^2$) for stratum $i$, year $y$.

The coefficient of variation (CV) of the annual relative index for year $y$ is

Eq. 6 $$CV_y = \frac{\sqrt{V_y}}{B_y} .$$

### 5.2.2. Longline Surveys

For longline survey data, the relative abundance index is calculated as described for other longline surveys in Lochead and Yamanaka, 2004 and Yamanaka et al. 2007.

For longline surveys, given a set of data $\{C_{yij}, E_{yij}\}$ for sets $j = 1, \ldots, n_{yi}$

Eq. 1 $$\delta_{yi} = \frac{1}{n_{yi}} \sum_{j=1}^{n_{yi}} \frac{C_{yij}}{D_{yij} w_{yij}} ,$$

where $C_{yij}$ = catch weight (number of fish) for set $j$, stratum $i$, year $y$;

$D_{yij}$ = number of hooks * hook spacing† (km) for set $j$, stratum $i$, year $y$;

$w_{yij}$ = arbitrary distance of 30 feet 0.009144 km (km) for set $j$, stratum $i$, year $y$;

$n_{yi}$ = number of sets in stratum $i$, year $y$.

The annual relative index is then the sum of the product of CPUE densities and bottom areas across $m$ strata:

Eq. 2 $$B_y = \sum_{i=1}^{m} \delta_{yi} A_i = \sum_{i=1}^{m} B_{yi} ,$$

where $\delta_{yi}$ = mean CPUE density (number of fish/$km^2$) for stratum $i$, year $y$;

$A_i$ = area ($km^2$) of stratum $i$;

$B_{yi}$ = abundance (number of fish) for stratum $i$, year $y$;

$m$ = number of strata.

The variance of the survey relative index $V_y$ ((number of fish)$^2$) follows:

Eq. 3 $$V_y = \sum_{i=1}^{m} \frac{\sigma_{yi}^2 A_i^2}{n_{yi}} = \sum_{i=1}^{m} V_{yi} ,$$

where $\sigma_{yi}^2$ = variance of CPUE density ((number of fish)$^2$/km$^4$) for stratum $i$, year $y$;

$V_{yi}$ = variance of the relative index ((number of fish)$^2$) for stratum $i$, year $y$.

The coefficient of variation (CV) of the annual relative index for year $y$ is

Eq. 4 $$CV_y = \frac{\sqrt{V_y}}{B_y}.$$

† *Hook spacing for IPHC surveys is 18 feet or 0.0054864 km; for PHMA and inshore rockfish surveys is 8 feet or 0.0024384 km.*

## 5.3. INSIDE DU

### 5.3.1. Stock Assessment Summary

The most recent stock assessment for the inside Yelloweye Rockfish DU in 2010 used a state space Bayesian surplus production model (BSP) to estimate stock abundance. This model included historic annual catch biomass from all fisheries reconstructed from 1918-2014, commercial CPUE and research survey catch indices from the spiny dogfish research longline survey and seven areas of the inshore rockfish research longline survey (Yamanaka et al. 2012). These surveys are detailed below in Section 0 with the updated survey data collected since the assessment was completed. Model runs and sensitivity analyses are fully described in the 2010 stock assessment (Yamanaka et al. 2012).

The model appears to fit the stock data well, and suggests a stock biomass in 2010 for inside Yelloweye of 780 tonnes, 12% (CV 0.43) of the initial biomass of 6466 t in 1918 (Yamanaka et al. 2012). Stock biomass trends are shown in Figure 26 and model output is summarized in Table 14.

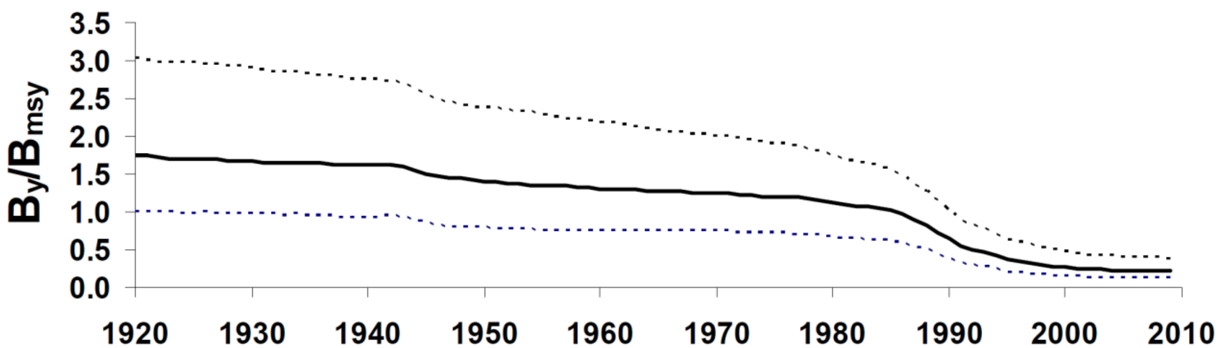



*Figure 26. (from Yamanaka et al. (2012)).Time series estimates for the reference case BSP model of stock biomass relative to 50% of stock size in 1918 ($B_y$/ $B_{MSY}$) inside Yelloweye Rockfish. Posterior medians (solid lines) and 80% probability intervals (dotted lines) are shown.*

*Table 14. (from Yamanaka et al. (2012)). For the reference case Bayesian surplus production model (BSP) run, the posterior median, standard deviation (SD), coefficient of variation (CV) (standard deviation/ mean) for key parameters and stock status indicators for inside yelloweye rockfish. $K_0$ is the equilibrium stock size in absence of fishing. r is the maximum rate of population increase in absence of fishing. The maximum sustainable yield (MSY) reflects the maximum sustainable total biomass that can be captured by fishermen. $B_{2009}$ and $C_{2009}$ are the recruited stock biomass and catch biomass in 2009, RepY is the replacement yield in 2009. $F_{MSY}$ refers to the fishing mortality rate at MSY. $B_{init}$ is the stock biomass in the first year of the model, i.e., 1918. Biomass values are in tons. q is the constant of proportionality for each different stock trend index. LL refers to research longline survey. CCPUE refers to the standardized commercial catch per unit effort index. Recr_g is the catchability coefficient to predict recreational catches from recreational fishing effort.*

| **Variable** | **Median** | **SD** | **CV** |
|---|---|---|---|
| $K_0$ (t) | 7385 | 3201 | 0.40 |
| r | 0.027 | 0.014 | 0.48 |
| MSY (t) | 50 | 20 | 0.38 |
| $B_{2009}$ (t) | 780 | 391 | 0.46 |
| $B_{init}$ (t) | 6466 | 2787 | 0.40 |
| $B_{2009}/K$ | 0.108 | 0.047 | 0.41 |
| $B_{init}/K$ | 0.872 | 0.186 | 0.21 |
| $B_{2009}/B_{init}$ | 0.123 | 0.057 | 0.43 |
| $F_{2009}/F_{MSY}$ | 1.38 | 1.18 | 0.70 |
| $C_{2009}$/RepY | 0.78 | 0.62 | 0.66 |
| RepY (t) | 19 | 10 | 0.49 |
| q - dogfish LL | 0.00065 | 0.00017 | 0.26 |
| q - rockfish LL Area 12 | 0.0110 | 0.0036 | 0.31 |
| q - rockfish LL Area 13 | 0.024 | 0.0079 | 0.31 |
| q - rockfish LL Area 14 | 0.030 | 0.0100 | 0.32 |
| q - rockfish LL Area 15 | 0.035 | 0.0117 | 0.32 |
| q - rockfish LL Area 17 | 0.0152 | 0.0051 | 0.32 |
| q - rockfish LL Area 16 | 0.0156 | 0.0052 | 0.32 |
| q - rockfish LL Area 28 | 0.0036 | 0.0012 | 0.32 |
| q - CCPUE 86-90 | 0.00071 | 0.00014 | 0.19 |
| q - CCPUE 95-01 | 0.00119 | 0.00037 | 0.30 |
| q - CCPUE 03-05 | 0.00046 | 0.00015 | 0.31 |
| Recr_g | 0.00190 | 0.00042 | 0.22 |
| $P(B_{2009} > 0.4B_{MSY})$ | 0.048 | - | - |
| $P(B_{2009} > 0.8B_{MSY})$ | 0.001 | - | - |

### 5.3.2. Updates to data included in Stock Assessment

Since the 2010 stock assessment for inside Yelloweye Rockfish was conducted, six more years of catch and survey data have been collected. Historic annual commercial catch is presented in Table 6 and Figure 18 updated to 2016. Descriptions and updated survey catch summaries are presented for the following surveys included in the inside Yelloweye Rockfish stock assessment:

1. Inside Rockfish Longline Survey – North
2. Inside Rockfish Longline Survey – South
3. Strait of Georgia Dogfish Survey

#### 5.3.2.1. Inshore Rockfish Longline Survey

The inshore rockfish longline surveys are conducted within management area 4B. These surveys were designed to provide fishery independent indices of abundance together with biological samples to improve the assessment of Yelloweye and Quillback Rockfish for the 4B management region. They began in the northern Strait of Georgia in PFMA areas 12 and 13 in 2003 and 2004, and now alternate years to cover the northern (areas 12 and 13) and southern (areas 14-20, 28, 29) portions of the inside waters. Survey areas are divided into two depth strata in these shallower waters, 41-70 m and 71-100, targeting hard-bottom areas. Survey blocks (2 km x 2 km) are randomly selected in each statistical area, and one longline set is fished in each survey block.

Snap type longline gear was used for the survey to be consistent with methods used in the commercial hook and line fishery. Each longline set consisted of two skates of groundline, each 1800 feet in length, with gangions attached to the groundline at 8 foot* intervals. Hooks were baited with thawed Argentinean squid. Detailed survey methods are available in Lochead and Yamanaka (2004, 2006 and 2007). Data are separated by northern and southern survey areas here.

All usable sets over the survey series from 2003-2016 are shown in Figure 27 (left panel). Yelloweye Rockfish was captured in patches throughout the survey area, with higher relative catches on the outside of WCVI (which are actually in the outside DU, though all catches within the inside management area 4B are considered with the inside DU in this review) and in Howe Sound and near Texada Island. In both the northern and southern survey areas depth distribution was concentrated between 50 and 90 m with no clear trends over the survey series.

Proportion of sets which captured Yelloweye Rockfish varied between 45-60% in the northern area, and between 40-61% in the southern area except for 2009 which was quite low at 15%. The relative abundance index in the northern area decreased slightly at the beginning of the surveys from 2003 until 2007 before an increase in 2008. The index dropped down again in 2010 to 2014. Since the model was run in 2014, there may have been a slight increase in the northern index in the 2016. In the southern area, the relative abundance index has been variable with an initial decrease from 2005 until 2009, coincident with the low proportion of sets that captured Yelloweye Rockfish in 2009, then increasing to 2011. The most recent index values in 2013 and 2015 stayed similar to those in 2011 (Table 15, Figure 33).

** Note that hook spacing has been misreported as 12 ft for these surveys in some reports; the authors confirmed actual hook spacing of 8 ft with L. Yamanaka, DFO, Pacific Biological Station, December 2017.*

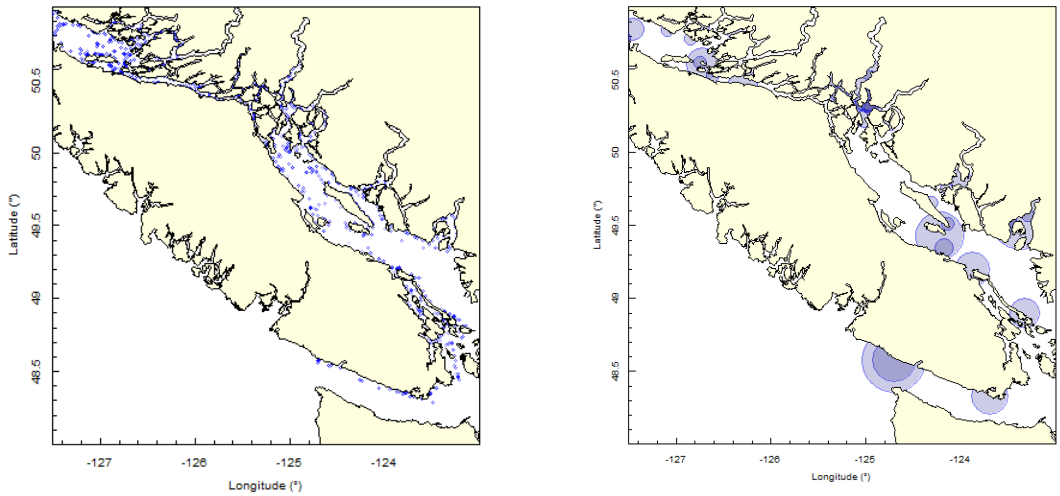



*Figure 27. Inshore Rockfish survey – Left panel showing the locations of all sets in all years, right panel showing survey sets where Yelloweye Rockfish was captured. The size of the circles are proportional to the catch density (largest circle = 4,805 pieces/km$^2$ in Howe Sound in 2015).*

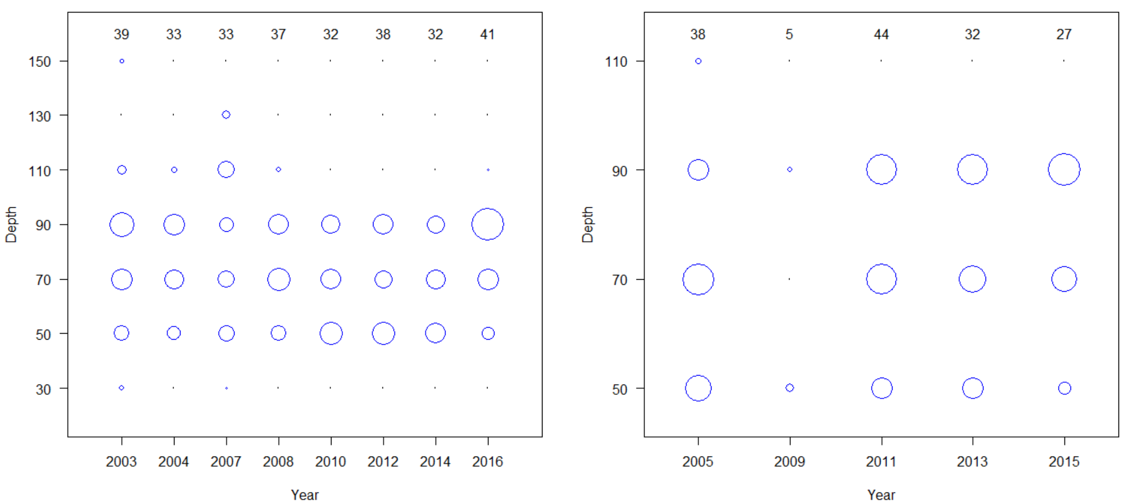



*Figure 28. Distribution of Yelloweye Rockfish catch weights in the Inshore Rockfish survey by 20 m depth interval and year (left panel = north, right panel = south). Number of samples in each year is reported above the bubbles for that year. Depth interval is shown as the center of the interval and is based on the modal bottom depth of the set. The size of the circle is proportional to the catch weight.*

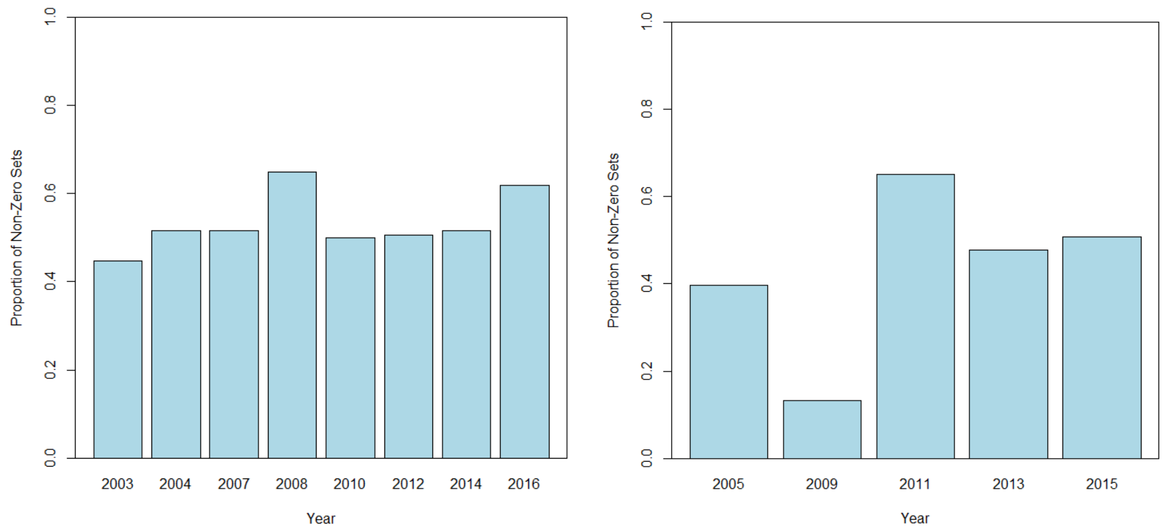



*Figure 29. Proportion of sets by year in the Inshore Rockfish survey where Yelloweye Rockfish was captured (left panel shows northern area, right panel shows southern area).*

*Table 15. Relative abundance index for Yelloweye Rockfish in the Inshore Rockfish survey by year. Index calculations based on pieces. Note that these are relative indices only, not absolute values. Bootstrap bias corrected confidence intervals and CVs are based on 1000 random draws with replacement. The analytic CV s based on the assumption of random tow selection within a stratum.*

| | | | Bootstrap Results | | | |
|---|---|---|---|---|---|---|
| **Area** | **Year** | **Index** | **Mean** | **Lower CI** | **Upper CI** | **CV** |
| **North** | 2003 | 1,284,490 | 1,287,183 | 772,842 | 1,864,626 | 0.22 |
| | 2004 | 1,161,457 | 1,159,037 | 736,451 | 1,673,959 | 0.20 |
| | 2007 | 932,994 | 933,806 | 564,789 | 1,363,861 | 0.22 |
| | 2008 | 1,957,532 | 1,980,423 | 892,213 | 3,509,857 | 0.32 |
| | 2010 | 1,280,564 | 1,276,682 | 831,416 | 1,786,565 | 0.19 |
| | 2012 | 1,123,423 | 1,126,393 | 715,453 | 1,606,912 | 0.20 |
| | 2014 | 1,303,718 | 1,306,574 | 829,858 | 1,828,726 | 0.19 |
| | 2016 | 1,673,221 | 1,661,291 | 1,119,810 | 2,247,976 | 0.18 |
| **South** | 2005 | 1,374,705 | 1,369,125 | 1,045,213 | 1,716,881 | 0.13 |
| | 2009 | 173,820 | 173,548 | 35,162 | 360,059 | 0.47 |
| | 2011 | 2,356,476 | 2,369,640 | 1,590,783 | 3,294,682 | 0.18 |
| | 2013 | 2,077,390 | 2,086,039 | 1,306,850 | 3,031,102 | 0.21 |
| | 2015 | 2,022,124 | 2,011,766 | 1,340,622 | 2,761,728 | 0.18 |

#### 5.3.2.2. Strait of Georgia Dogfish Longline Survey

Spiny dogfish longline surveys are conducted at specific locations, representative of commercial fishing sites, within the Strait of Georgia. Surveys were conducted in 1986, 1989, 2005, 2008, 2011 and 2014. Ten of the same sites were repeated in 1986-2008 and 2014, but due to logistical constraints only nine were repeated in 2011. An additional two sites that were surveyed in earlier years were also repeated in 2014.

From 1986-2005, fishing gear was deployed in five depth strata at random at each site (< 56 m, 56-110 m, 111-165 m, 166-220 m, and >220 m). In 2008, 2011 and 2014 the shallowest stratum was omitted due to time constraints and only the remaining four strata were sampled. Each longline set consisted of 2 groundlines with approximately 500 baited hooks per set until 2005 after which there were approximately 300 baited hooks per set. Each hook was baited with a third of a 6 inch herring. Soak time from when the last hook was deployed until the first main groundline anchor was onboard was 2 hours. Detailed survey methods are described in McFarlane et al. (2005a, 2005b, 2006), King and McFarlane (2009), and King et al. (2012).

Locations of all usable sets are shown in Figure 30 (left panel). The highest relative catch densities of Yelloweye Rockfish occurred west and north of Texada Island (Figure 30, right panel). Depth distribution was primarily between 50 and 170 m with no clear trend (Figure 31).

The proportion of sets which captured Yelloweye Rockfish ranged from approximately 17% to 38% (Figure 32). The relative abundance index increased from 1986 to 1989, then decreased from 1989 to 2005. Relative abundance remained similar in 2008 and 2011, then increased in 2014 (Table 16, Figure 33).

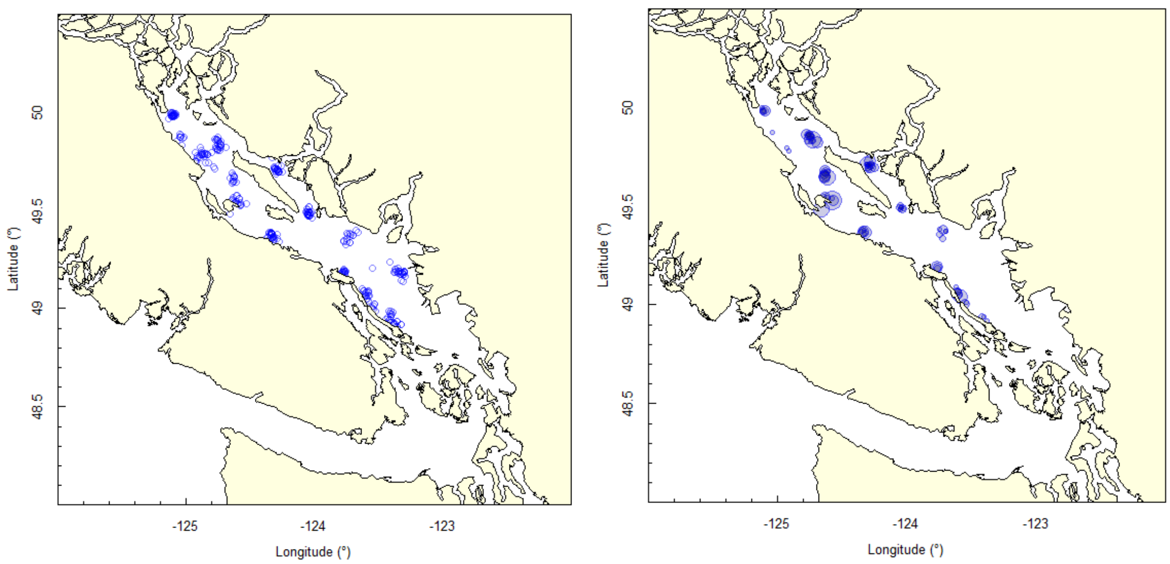



*Figure 30. Strait of Georgia Dogfish Longline survey – Left panel showing the locations of all sets in all years, right panel showing survey sets where Yelloweye Rockfish was captured. The size of the circles are proportional to the catch count (largest circle = 15 pieces in near Hornby Island in 1986).*

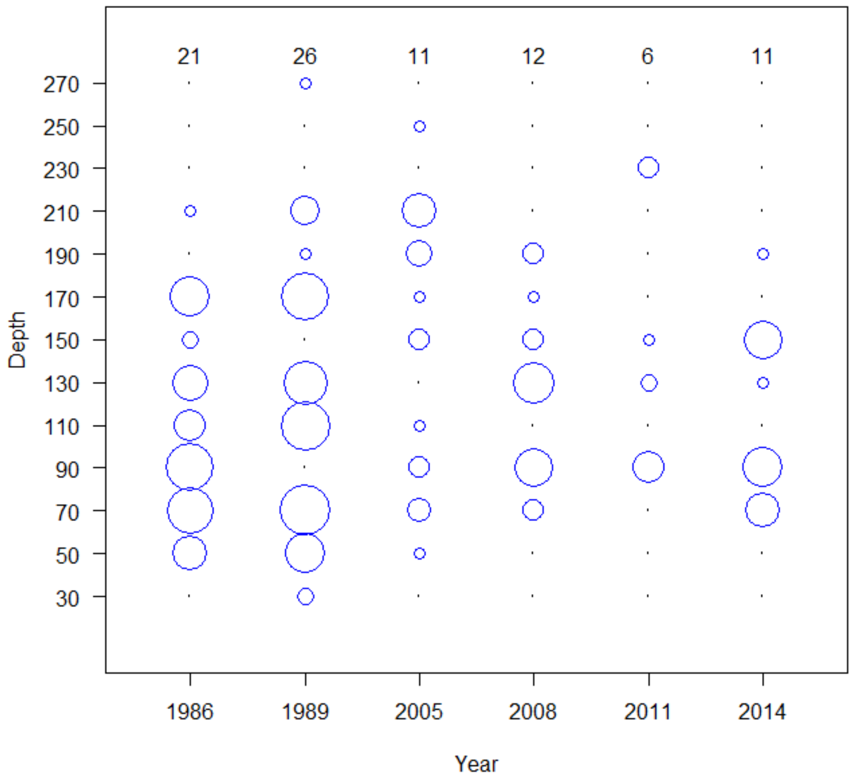



*Figure 31. Distribution of Yelloweye Rockfish catch weights in the Strait of Georgia Dogfish Longline survey by 20 m depth interval and year. Depth interval is shown as the center of the interval and is based on the modal bottom depth of the set. The size of the circle is proportional to the catch weight.*

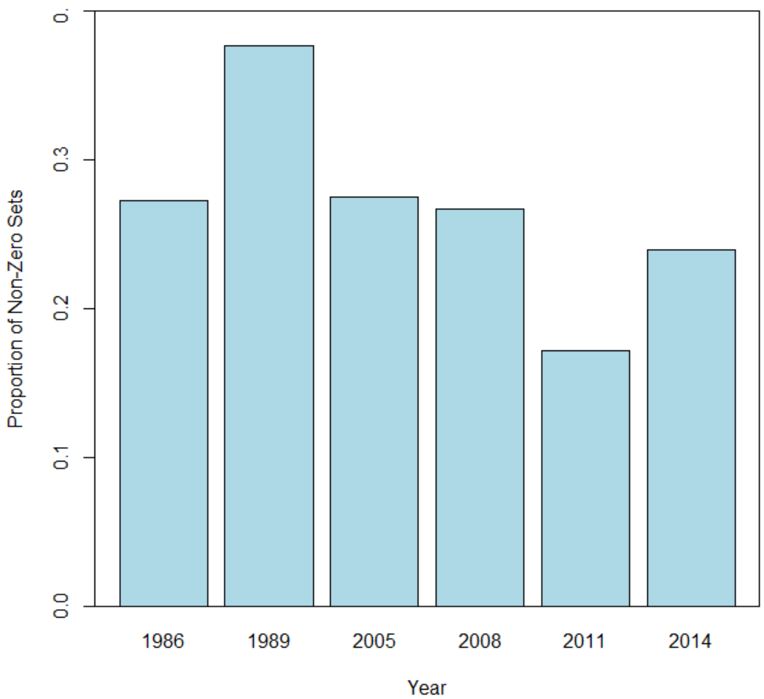



*Figure 32. Proportion of sets by year in the Strait of Georgia Dogfish Longline survey where Yelloweye Rockfish was captured.*

*Table 16. Relative abundance index based on pieces for Yelloweye Rockfish in the Strait of Georgia Dogfish Longline survey by year.  Note these are indices only, not absolute values. Bootstrap bias corrected confidence intervals and CVs are based on 1000 random draws with replacement. The analytic CV s based on the assumption of random tow selection within a stratum.*

| Year | Index | Mean | Lower CI | Upper CI | CV |
|---|---|---|---|---|---|
| 1986 | 74 | 73 | 36 | 114 | 0.27 |
| 1989 | 108 | 108 | 63 | 159 | 0.22 |
| 2005 | 66 | 65 | 35 | 102 | 0.26 |
| 2008 | 82 | 82 | 35 | 130 | 0.30 |
| 2011 | 56 | 57 | 18 | 99 | 0.36 |
| 2014 | 126 | 126 | 52 | 204 | 0.32 |

### 5.3.2.3. Summary of Updated Relative Population Indices

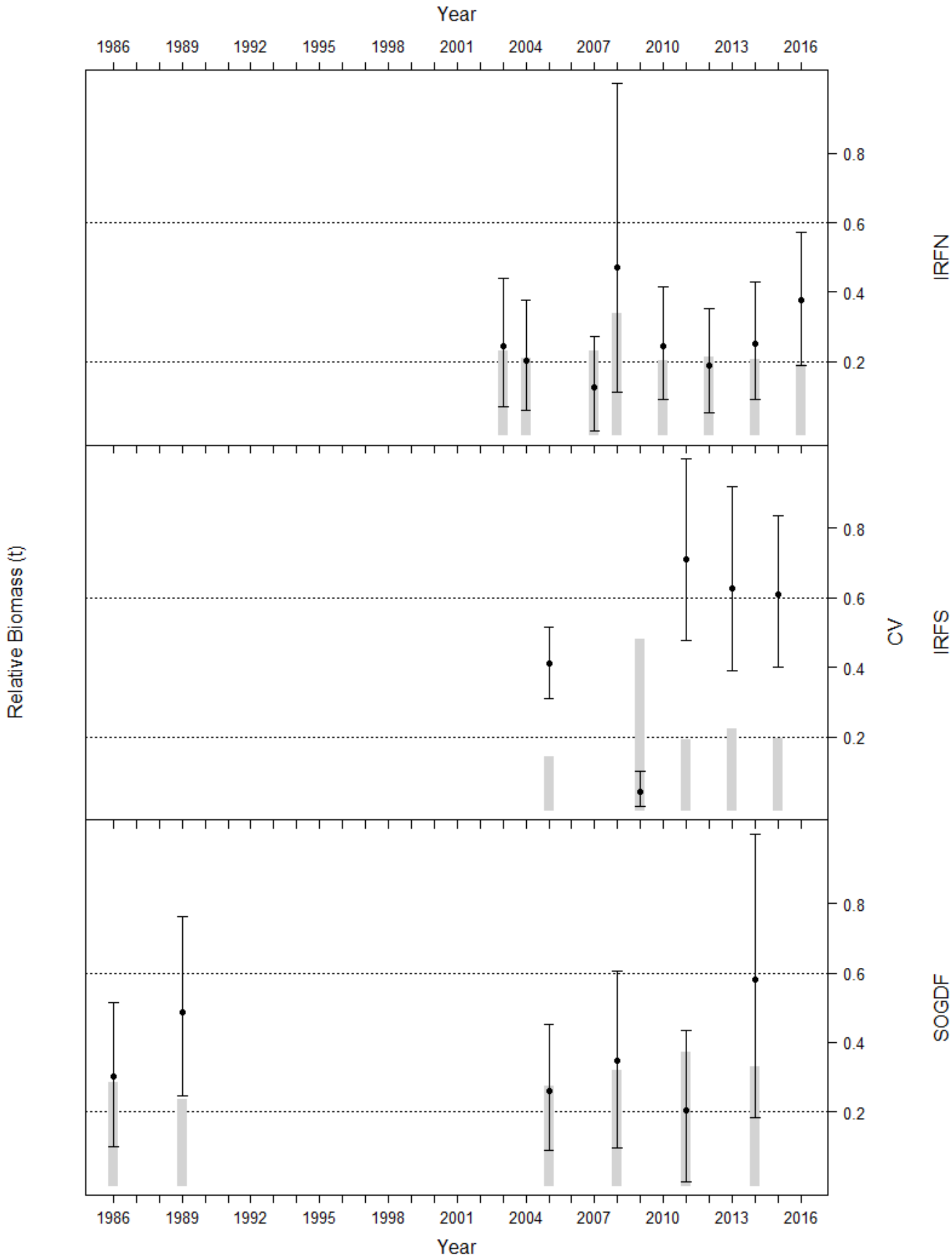



*Figure 33. Relative population indices for three fishery-independent survey series for inside Yelloweye Rockfish. The index values are shown as circles with the vertical lines representing the bootstrap 95% bias-corrected confidence intervals obtained for a sample of size 1,000 drawn with replacement. Grey vertical bars indicate the annual survey coefficient of variation (CV). Reference lines (dotted horizontal lines) are provided at CV=0.2 and CV=0.6 to assist comparing relative observation errors between surveys and years. IRFN = Inshore Rockfish North Survey, IRFS = Inshore Rockfish South Survey, SOGDF = Strait of Georgia Dogfish Longline Survey.*

## 5.4. OUTSIDE DU

### 5.4.1. Stock Assessment Summary

The most recent stock assessment for the outside DU of Yelloweye Rockfish was performed in 2014 using a Bayesian surplus production (BSP) model to estimate stock abundance. The reference case model used catch data derived from historic commercial (hook and line, groundfish trawl, Pacific Salmon troll and Sablefish trap), recreational and First Nations catch records reconstructed back to 1918, life history data to estimate the intrinsic rate of increase (r), and abundance trends derived from research surveys and commercial hook and line catch records (Yamanaka et al. 2018). Due to concerns over the estimated recreational and salmon troll catches in early years and the challenges with fishery dependent abundance indices, a new model run was performed for management advice.

*Table 17. (from Yamanaka et al. (2018)). The 5th, 50th and 95th percentiles from the posterior distributions of quantities for stock status indicators for BC Outside Yelloweye Rockfish. Variables : r is the maximum intrinsic rate of increase, $B_0$ is the average unfished stock size or carrying capacity, MSY is the maximum sustained yield, $B_{MSY}$ is the biomass at MSY, $B_{1918}$ is the biomass in 1918, the start of the model, $B_{2014}$ is the biomass at the beginning of 2014, F is the fishing mortality rate, $REPY_{2014}$ is the replacement yield at the beginning of 2014, $Catch_{2014}$ is the catch in 2014, P is the probability.*

| Variable | Percentile | | |
|---|---|---|---|
| | 5 | 50 | 95 |
| $r$ | 0.021 | 0.051 | 0.082 |
| $B_0$ | 15833 | 21544 | 33972 |
| MSY | 135 | 276 | 422 |
| $B_{MSY}$ | 7917 | 10772 | 16986 |
| $B_{MSY}/B_0$ | 0.5 | 0.5 | 0.5 |
| $B_{1918}$ | 13747 | 21955 | 37694 |
| $B_{2014}$ | 2428 | 3821 | 7138 |
| $B_{2014}/B_{MSY}$ | 0.227 | 0.360 | 0.604 |
| $B_{2014}/B_{1918}$ | 0.104 | 0.182 | 0.33 |
| $F_{MSY}$ | 0.011 | 0.025 | 0.041 |
| $F_{2014}$ | 0.041 | 0.075 | 0.115 |
| $F_{2014}/F_{MSY}$ | 1.695 | 2.913 | 6.050 |
| $REPY_{2014}$ | 80 | 162 | 258 |
| $Catch_{2014}/REPY_{2014}$ >0 | 1.140 | 1.776 | 3.604 |
| $B_{2014}/B_{2002}$ | 0.473 | 0.599 | 0.758 |
| $P(B_{2014} > 0.4B_{MSY})$ | 0.369 | - | - |
| $P(B_{2014} > 0.8B_{MSY})$ | 0.009 | - | - |

For the management advice run the recreational fisheries catch time series was initiated in 1975 (zero catches prior to 1975) and increased exponentially to 2000 at which time species specific data became available. The Salmon troll fishery catch time series prior to 1950 was set to zero, and the fishery dependent abundance index derived from logbook data was excluded in the model run over concerns that management influence and spatial considerations were not accounted for in the construction of the abundance index. Fishery independent survey data included in the model consisted of longline surveys (the IPHC Standard Stock Assessment [SSA] survey and PHMA north and south surveys), three synoptic bottom trawl surveys (Queen Charlotte Sound, Hecate Strait and West Coast Vancouver Island) and the Queen Charlotte Sound shrimp trawl survey. These surveys are detailed below with the updated survey data since the assessment was completed. Model runs and sensitivity analyses are fully described in the 2014 stock assessment (Yamanaka et al. 2018).

The biomass in 2014 ($B_{2014}$) is estimated at 3,821 t (90% credibility interval of 2,428 – 7,138 t), which is 18% (90% credibility interval 10 – 33 %) of the estimated initial biomass ($B_{1918}$) of 21,955 t (90% credibility interval 13,747 – 37,694 t) in 1918 (Yamanaka et al. 2018). Model output is summarized in Table 17 and stock trajectory is shown in Figure 34.

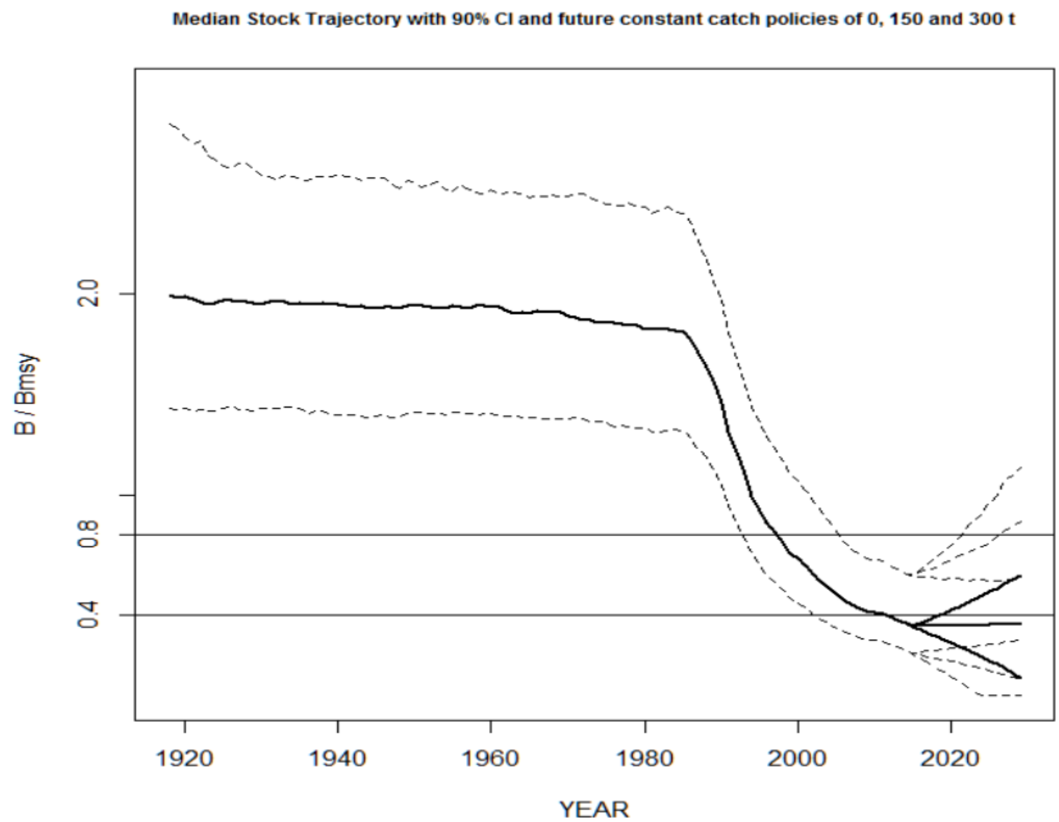



*Figure 34. (from Yamanaka et al. (2018)). Outside Yelloweye Rockfish estimated historical median stock biomass and stock trajectory under various total catch scenarios of 0, 150 and 300 tonnes for the management advice run. Solid lines indicate the median and dashed lines show the 90% credibility intervals. Stock projections from 2015 onward show increases given a 0 t catch policy, little change given a 150 t catch policy and further declines given a 300 t catch policy.*

### 5.4.2. Updates to data included in Stock Assessment

Since the 2014 stock assessment for outside Yelloweye Rockfish was conducted, two more years of catch and survey data have been collected. The catch data from the assessment were updated to 2016 and are presented in Table 7 and Figure 18. Descriptions and updated survey catch summaries are presented for the following surveys included in the outside Yelloweye Rockfish stock assessment:

1. Synoptic Bottom Trawl Surveys
2. IPHC Longline Surveys
3. PHMA Longline Surveys, North and South

#### 5.4.2.1. Synoptic bottom trawl surveys

Fisheries and Oceans, Canada (DFO) together with the Canadian Groundfish Research and Conservation Society implemented a coordinated set of surveys that together cover the continental shelf and upper slope of most of the BC coast. The surveys all follow a random depth stratified design and use the same bottom trawl fishing gear and fishing protocols (Sinclair et al. 2003). The surveys were designed to provide a synopsis of all species available to bottom trawl gear as opposed to focusing on certain species. There are a total of four synoptic surveys: 1 Hecate Strait (HS); 2 West Coast Vancouver Island (WCVI); 3 Queen Charlotte Sound (QCS); and 4 West Coast Haida Gwaii (WCHG) (Figure 35). West Coast Haida Gwaii survey data are not included in the stock assessment as this survey has very low catches of Yelloweye Rockfish. Proportions of tows which caught Yelloweye Rockfish are shown for each survey in Figure 38. Surveys have been conducted on both chartered commercial vessels and government research vessels. The Hecate Strait survey and West Coast Vancouver Island survey have been conducted on the Canadian Coast Guard research trawler *WE Ricker* while the Queen Charlotte Sound survey has been conducted on chartered commercial fishing vessels.

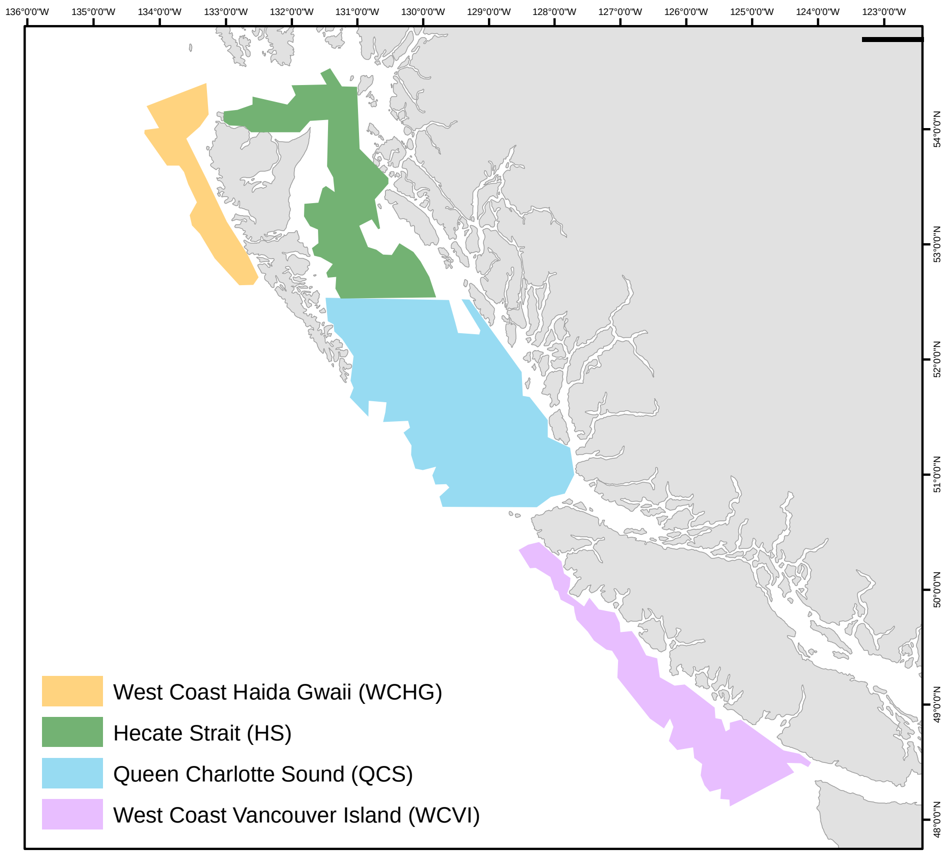



*Figure 35. Synoptic bottom trawl survey areas.*

The primary objective of these surveys is to provide fishery independent abundance indices of as many benthic and near benthic fish species available to bottom trawling as is reasonable. The secondary objective is to collect biological samples and environmental data. These surveys are planned to continue for the foreseeable future.

*Synoptic Survey Descriptions*

Queen Charlotte Sound

This survey has been conducted on a number of chartered commercial trawlers in eight years over the period 2003 to 2015. The survey is conducted in QCS, which lies between the top of Vancouver Island and the southern portion of Moresby Island and extends into the lower part of Hecate Strait between Moresby Island and the mainland (Figure 35). The design divided the survey into two large aerial strata which roughly correspond to the PFMA regions 5A and 5B while also incorporating part of 5C (Figure 20). Valid tow starting positions for all years are shown in Figure 36. Each of these two areas was divided into four depth strata: 50–125 m; 125–200 m; 200–330 m; and 330–500 m. Approximately 300-310 4 $km^2$ blocks are selected randomly among the four depth strata when conducting each survey (Olsen et al. 2009b).

West Coast Vancouver Island

The WCVI synoptic survey has been conducted by the *W.E. Ricker* seven times in the period 2004 to 2016. The survey area is off the west coast of Vancouver Island from approximately 49° 12’ to 50° 36’ North latitude and approximately 124° 48’ to 128° 30’ West longitude (Figure 35). The southern boundary is contiguous with the Canada/U.S. boundary. Valid tow starting positions for all years are shown in Figure 36. The survey has a single aerial stratum, separated into four depth strata: 50-125 m; 125-200 m; 200-330 m; and 330-500 m. Approximately 150 to 180 4 $km^2$ blocks are selected randomly among the four depth strata when conducting each survey (Wyeth et al. 2016).

Hecate Strait

This survey has been conducted in six alternating years over the period 2005 to 2015 in Hecate Strait (HS) between Moresby and Graham Islands and the mainland and in Dixon Entrance at the top of Graham Island (Figure 35). Valid tow starting positions for all years are shown in Figure 36. The study area consists of Hecate Strait, from approximately latitude 52° 40’ N to latitude 54° 40’ N and westward into Dixon Entrance to approximately longitude 133° 00’ W. This survey treats the full spatial coverage as a single aerial stratum divided into four depth strata: 10–70 m; 70–130 m; 130–220 m; and 220–500m (Workman et al. 2008; Olsen et al. 2009a).

*Synoptic surveys summary*

Catches of Yelloweye Rockfish tend to be largest in central QCS and along the shelf off the west coast of southern Vancouver Island (Figure 36).

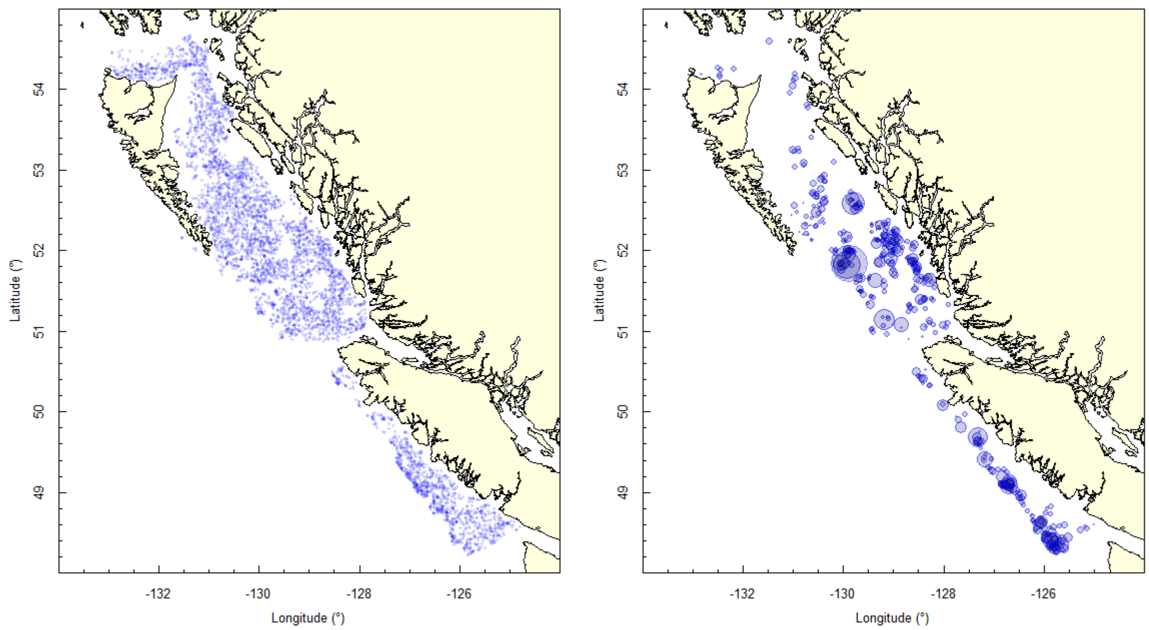



*Figure 36. Synoptic bottom trawl survey tows showing the location of all useable tows in all years (left) and survey tows where Yelloweye Rockfish was captured (right). Circles are proportional to catch density (largest circle=1,675 kg/km² in Queen Charlotte Sound in 2011).*

The distribution of Yelloweye Rockfish catches by depth for both QCS and WCVI is between 110 and 190 m, while it falls a little shallower for HS between 70 and 170 (

Figure 37).

The QCS and WCVI synoptic surveys have had a greater proportion of tows capturing Yelloweye Rockfish than HS, and have also shown high variability in proportion of tows capturing Yelloweye Rockfish varying between 10% and 20% (Figure 38). HS has shown the least variability at 3%-5% over the survey series (Figure 38). The relative biomass indices for the three areas indicate high variability in Yelloweye Rockfish, and may suggest a slight decline over the survey time series (Table 18, Figure 49).

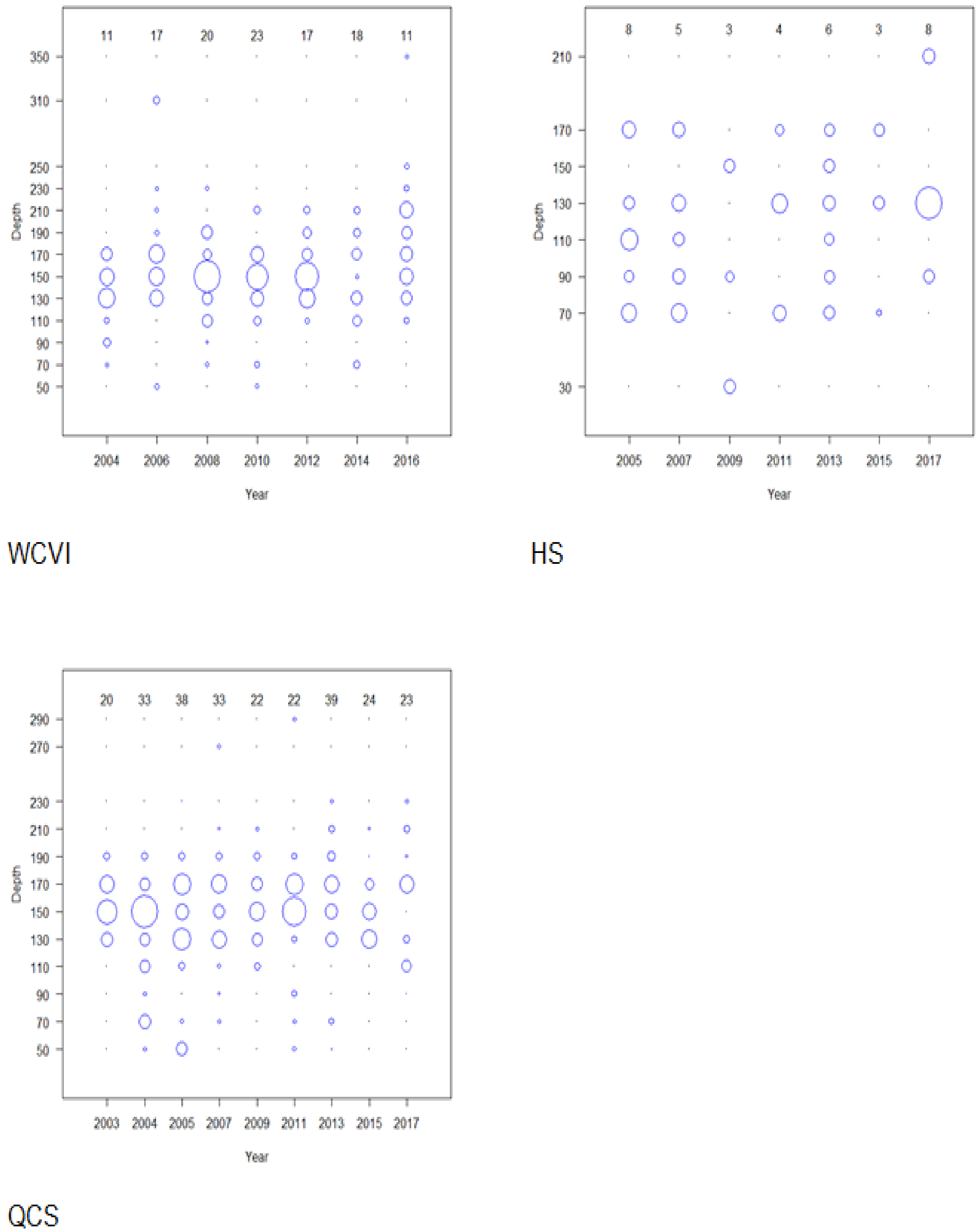



*Figure 37. Depth distribution of Yelloweye Rockfish catch weights by synoptic bottom trawl survey area (HS = Hecate Strait, QCS = Queen Charlotte Sound and WCVI = west coast of Vancouver Island), 20 m depth interval, and year. Depth interval is shown as the center of the interval and is based on the modal bottom depth for the tow. Each panel from left to right shows catches from one of the survey areas. The size of the circle is proportional to the catch weight. Number of samples in each year is displayed above.*

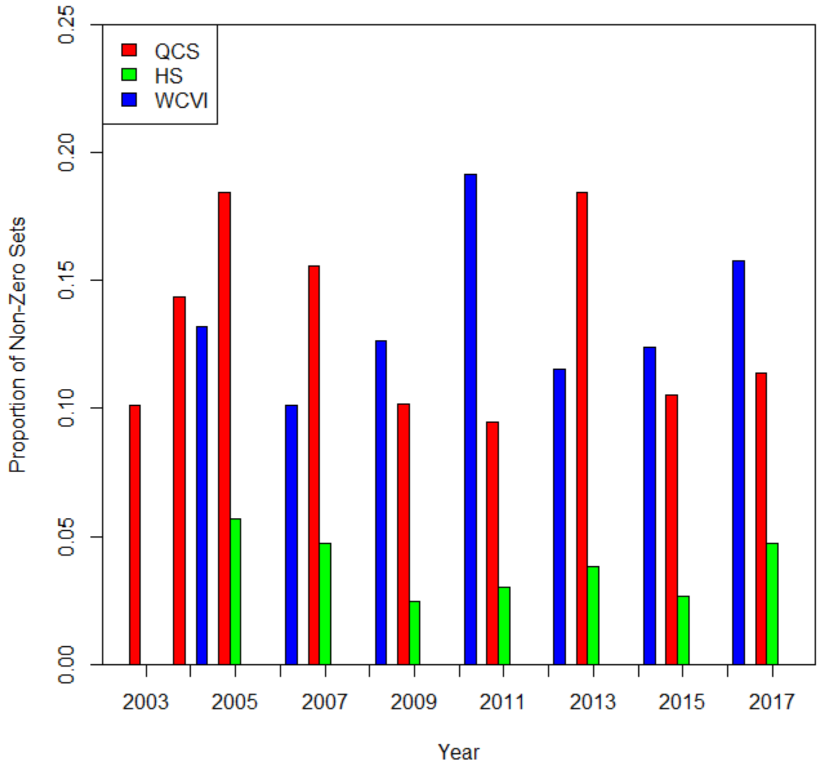



*Figure 38. Proportion of tows by synoptic bottom trawl survey area and year where Yelloweye Rockfish was captured.*

*Table 18. Relative biomass indices for Yelloweye Rockfish by synoptic bottom trawl survey area and year. Units represent kg, however note that these are indices only, not absolute values. Bootstrap bias corrected confidence intervals and CVs are based on 1000 random draws with replacement.*

| | | | Bootstrap Results | | | |
|---|---|---|---|---|---|---|
| **Area** | **Year** | **Index** | **Mean** | **Lower CI** | **Upper CI** | **CV** |
| QCS | 2003 | 199,221 | 199,076 | 67,710 | 385,706 | 0.40 |
| | 2004 | 306,115 | 307,557 | 136,332 | 551,427 | 0.36 |
| | 2005 | 266,959 | 268,669 | 158,112 | 405,640 | 0.24 |
| | 2007 | 131,752 | 133,178 | 80,682 | 192,257 | 0.21 |
| | 2009 | 132,044 | 131,239 | 70,724 | 197,990 | 0.26 |
| | 2011 | 244,748 | 244,207 | 55,431 | 586,646 | 0.57 |
| | 2013 | 158,519 | 160,281 | 100,221 | 227,923 | 0.20 |
| | 2015 | 109,737 | 109,315 | 62,101 | 165,584 | 0.24 |
| | 2017 | 107,012 | 106,948 | 42,608 | 190,122 | 0.37 |
| HS | 2005 | 15,289 | 15,352 | 5,054 | 29,904 | 0.42 |
| | 2007 | 25,325 | 24,943 | 4,624 | 52,595 | 0.47 |
| | 2009 | 10,487 | 10,376 | 0 | 26,199 | 0.65 |
| | 2011 | 13,838 | 13,539 | 2,774 | 28,165 | 0.49 |
| | 2013 | 19,852 | 20,140 | 5,858 | 37,294 | 0.41 |
| | 2015 | 7,048 | 7,064 | 0 | 17,113 | 0.59 |
| | 2017 | 21,765 | 22,005 | 6,130 | 41,631 | 0.41 |
| WCVI | 2004 | 175,022 | 174,057 | 56,690 | 327,174 | 0.40 |
| | 2006 | 89,117 | 88,867 | 45,416 | 142,056 | 0.27 |
| | 2008 | 148,367 | 147,868 | 63,496 | 249,780 | 0.32 |
| | 2010 | 157,051 | 158,438 | 84,626 | 254,891 | 0.27 |
| | 2012 | 143,895 | 143,124 | 64,345 | 237,897 | 0.31 |
| | 2014 | 62,452 | 61,876 | 26,500 | 110,689 | 0.36 |
| | 2016 | 101,494 | 101,649 | 52,116 | 161,169 | 0.27 |

#### 5.4.2.2. Queen Charlotte Sound Shrimp Trawl Survey

The shrimp trawl surveys were not designed to index the coastwide population of Yelloweye Rockfish and the observed trends should be viewed with caution. Furthermore, it can be assumed that the gear and the towing speed (~ 2 knots) result in a low catchability of the Yelloweye Rockfish in that area, and the survey focuses on soft silty bottom which is not the preferred habitat of Yelloweye Rockfish. However, this survey represents a long-term consistent time series on the Canadian west coast and thus merits its inclusion.

This survey covers the lower half of QCS, extending westward from Calvert Island and Rivers Inlet into Goose Island Gully (Figure 39, left panel). Detailed survey design is described in Boutillier et al. 1998 and is summarized here. Areas concentrated on by the shrimp trawl fishery were split into grid cells of 0.5 nautical miles by 0.5 nautical miles. Tows were planned to be 30 minutes duration, but were shortened if they encountered snags or bad bottom. Over 1100 usable tows have been conducted by this survey over the 17 available survey years between 1998 and 2016. Total catch weight of each species was recorded for each set, among other survey sampling, which are used here to calculate proportion of sets that captured outside Yelloweye Rockfish, and biomass indices and distribution by depth for outside Yelloweye.

Catches of Yelloweye Rockfish tend to be distributed along the trench of Goose Island Gully (Figure 39, right panel). The depth range of the survey is approximately 100-230 m, and the depth distribution of Yelloweye Rockfish from this survey falls primarily around 130 m depth (Figure 40). The proportion of tows which captured Yelloweye Rockfish is between zero and 4%. The relative biomass index varied substantially among years, with an estimate of zero in 1998, 2004, 2010, 2011 and 2013 (no Yelloweye caught), a peak in 2002, and indices of roughly half of that in 1999, 2000, 2012; other years fall below half of the 2002 index peak (Table 19).

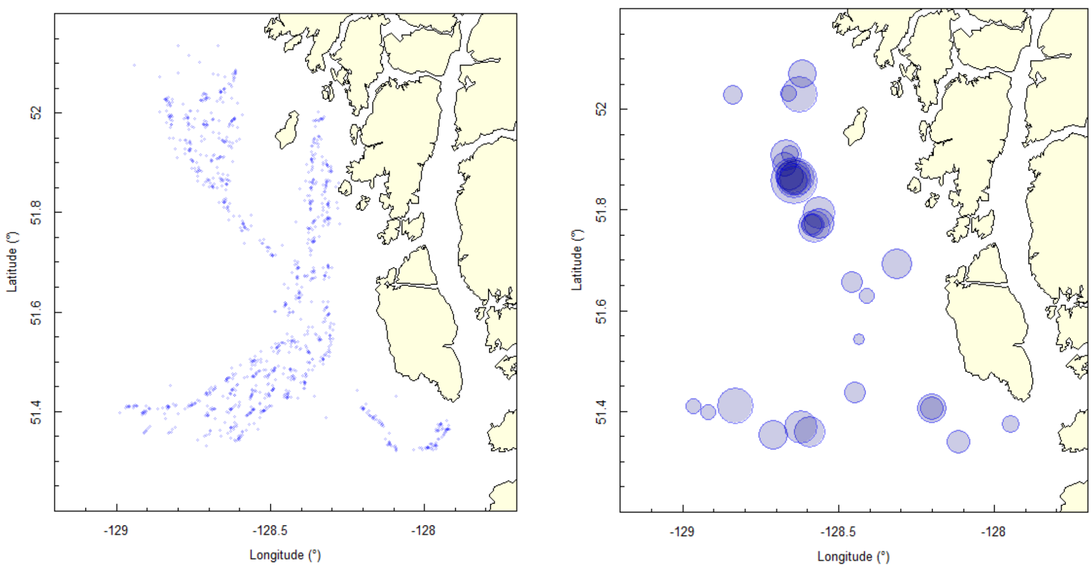



*Figure 39. Shrimp bottom trawl survey tows showing the location of all useable tows in all years (left) and tows where Yelloweye Rockfish was captured. Circles are proportional to catch density (largest circle=101 kg/km2 in 2002).*

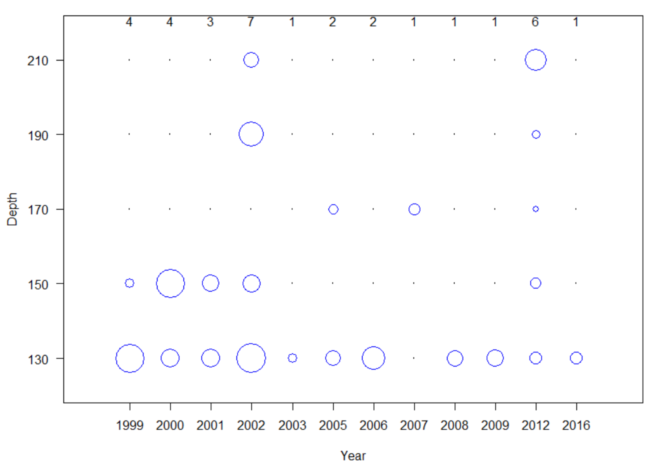



*Figure 40. Distribution of Yelloweye Rockfish catch weights in the QCS Shrimp survey by 20 m depth interval and year. Depth interval is shown as the center of the interval and is based on the modal bottom depth for the tow.*

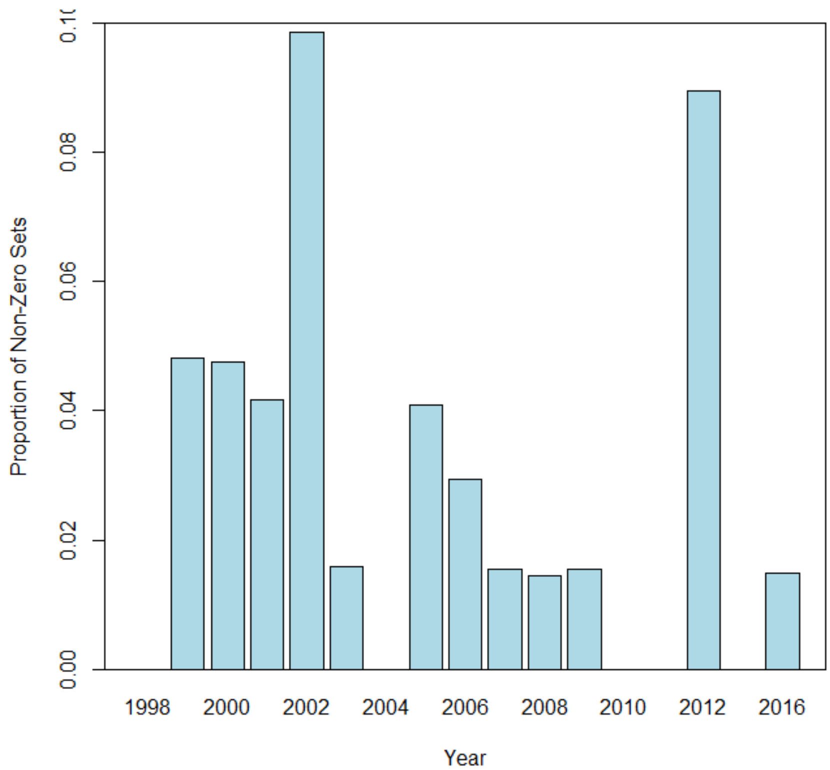



*Figure 41. Proportion of tows by year in the QCS shrimp surveys where Yelloweye Rockfish was captured.*

*Table 19. Relative biomass index estimates for Yelloweye Rockfish in the Queen Charlotte Sound shrimp surveys by area and year. Bootstrap bias corrected confidence intervals and CVs are based on 1000 random draws with replacement.*

| | | | | Bootstrap Results | | |
|---|---|---|---|---|---|---|
| **Area** | **Year** | **Biomass** | **Mean** | **Lower CI** | **Upper CI** | **CV** |
| | 1998 | 0 | 0 | 0 | 0 | 0.00 |
| | 1999 | 12,117 | 12,060 | 2,010 | 27,074 | 0.54 |
| | 2000 | 11,206 | 11,155 | 1,206 | 22,854 | 0.51 |
| | 2001 | 7,842 | 7,795 | 0 | 18,440 | 0.61 |
| | 2002 | 22,844 | 22,986 | 6,373 | 44,162 | 0.43 |
| | 2003 | 814 | 839 | 0 | 2,442 | 0.91 |
| | 2004 | 0 | 0 | 0 | 0 | 0.00 |
| | 2005 | 7,171 | 7,166 | 0 | 19,285 | 0.69 |
| **QCS** | 2006 | 7,070 | 7,247 | 0 | 19,034 | 0.75 |
| | 2007 | 1,558 | 1,570 | 0 | 4,674 | 1.02 |
| | 2008 | 2,955 | 2,890 | 0 | 8,865 | 0.97 |
| | 2009 | 3,252 | 3,141 | 0 | 9,756 | 1.01 |
| | 2010 | 0 | 0 | 0 | 0 | 0.00 |
| | 2011 | 0 | 0 | 0 | 0 | 0.00 |
| | 2012 | 13,844 | 14,109 | 2,387 | 30,746 | 0.52 |
| | 2013 | 0 | 0 | 0 | 0 | 0.00 |
| | 2016 | 2,005 | 1,932 | 0 | 6,014 | 0.91 |

#### 5.4.2.3. IPHC Longline Survey

The International Pacific Halibut Commission’s (IPHC) SSA survey is the longest times series of longline survey data in BC. This survey is a fixed station survey that has been conducted annually, with chartered commercial fishing vessels deploying fixed gear, in Canadian waters (IPHC Area 2B), since 1963 (Figure 43). It provides distribution, biomass, age, growth and maturity data that are used in the annual assessment of Pacific Halibut (*Hippoglossus stenolepis*). In 2003, the IPHC provided the opportunity to deploy an additional technician to enumerate and identify catch to species on a hook by hook basis and to collect biological data on rockfishes during their 2B survey operations (e.g. Flemming et al. 2012). The complete enumeration of species during the SSA survey was recorded in 1995, 1996, and in all survey years beginning in 2003. In the years between 1995 and 2003, and in 2013, regular species composition sampling occurred over the first 20 hooks (20%) on each survey skate of gear. For this summary, data from years from 2003 to 2016 (excluding 2013) with consistent data collection are presented to show the trend extending past when the most recent outside Yelloweye Rockfish stock assessment was completed.

The IPHC survey targets Halibut and the survey timing is aligned with when Halibut are growing, which may increase hook competition and could produce potential biases. It should also be noted that when the set line is longer (made up of more skates) it may fall outside of the targeted bottom type and therefore may have a different catch composition than directly on the targeted station.

There is a new abundance index for outside Yelloweye Rockfish from the IPHC survey from 1995-2014 that was developed as part of the 2014 stock assessment for outside Yelloweye Rockfish. This index was initially developed for a recent Redbanded Rockfish stock assessment (Edwards et al. 2017) and was extended to outside Yelloweye Rockfish. This index was not incorporated in the model for the recent outside Yelloweye Rockfish assessment, but is included in Appendix B of the assessment (Yamanka et al. 2018). The new approach uses the ‘effective skate number’ calculated by the IPHC to calculate a catch rate per set, which “standardizes survey data when the number of hooks, hook spacing, or hook type varied” (Yamanaka et al. 2008). A mean catch rate per year is calculated from the mean catch rate for all sets, and a survey index is created which is shown to be applicable coastwide despite changes to spatial coverage or technical details of the survey among years. Four time series are constructed which have either the first 20 or all hooks from each skate enumerated, and are from either only north of the west coast of Vancouver Island (WCVI) or the full coast. The two series that cover only north of WCVI are standardized and combined to create the longest time series possible (Table 20, Figure 42). The survey series that cover the full coast are then compared against those from north of WCVI to show that they follow the same trend and the northern indices can therefore be used to represent the entire coast. See Appendix B in the 2014 outside Yelloweye Rockfish stock assessment for complete details on this new index.

Locations of all usable sets are shown in Figure 43 (left panel); relative densities of Yelloweye Rockfish are shown in the right panel. Yelloweye Rockfish was generally caught throughout the survey area, with the highest densities of Yelloweye Rockfish encountered at the southern tip of Haida Gwaii. Yelloweye was distributed primarily between 70 and 170 m with no apparent trends (Figure 44). High proportions (between 34 and 45%) of sets caught Yelloweye Rockfish (Figure 45).

The relative abundance index from the IPHC survey series shows a slight decreasing trend fluctuating between higher index values in years 2004, 2008 and 2016, and lower in 2007 and 2014 (Table 21, Figure 49).

*Table 20. (from Yamanaka et al. (2018) Appendix B) IPHC catch rates by year for Series AB, constructed by combining 1995 and 1996 data from Series B with the full data for Series A. The 1995 and 1996 values were rescaled by multiplying them by the ratio of the geometric means of the bootstrapped means for the two series for the overlapping years, GA/GB. Values are GA = 1.12 and GB= 1.06 such that GA/GB = 1.05. 'No YE' is the proportion of sets that did not catch Yelloweye Rockfish that year. Lower and Upper are the lower and upper bounds of the 95% bias-corrected and adjusted (BCa) confidence intervals.*

| Year | # Sets | No YE | Sample Mean | Bootstrapped Mean | Lower | Upper | CV |
|---|---|---|---|---|---|---|---|
| 1995 | 115 | 0.7 | 2.28 | 2.28 | 1.44 | 3.71 | 0.24 |
| 1996 | 120 | 0.61 | 1.96 | 1.97 | 1.32 | 2.93 | 0.2 |
| 1997 | 121 | 0.66 | 2.31 | 2.31 | 1.58 | 3.37 | 0.19 |
| 1998 | 128 | 0.66 | 1.85 | 1.85 | 1.21 | 3.08 | 0.23 |
| 1999 | 134 | 0.62 | 1.73 | 1.72 | 1.18 | 2.56 | 0.2 |
| 2000 | 129 | 0.64 | 1.75 | 1.75 | 1.21 | 2.51 | 0.18 |
| 2001 | 135 | 0.7 | 1.77 | 1.77 | 1.2 | 2.6 | 0.19 |
| 2002 | 135 | 0.75 | 0.92 | 0.92 | 0.61 | 1.53 | 0.23 |
| 2003 | 135 | 0.67 | 1.07 | 1.06 | 0.72 | 1.69 | 0.22 |
| 2004 | 135 | 0.69 | 1.28 | 1.28 | 0.87 | 1.92 | 0.2 |
| 2005 | 135 | 0.69 | 1.17 | 1.16 | 0.79 | 1.75 | 0.2 |
| 2006 | 135 | 0.76 | 1.16 | 1.16 | 0.74 | 1.8 | 0.22 |
| 2007 | 135 | 0.76 | 1.05 | 1.05 | 0.66 | 1.65 | 0.23 |
| 2008 | 134 | 0.77 | 1.16 | 1.16 | 0.72 | 1.98 | 0.26 |
| 2009 | 135 | 0.71 | 1.45 | 1.45 | 0.95 | 2.24 | 0.22 |
| 2010 | 135 | 0.68 | 1.67 | 1.67 | 1.1 | 2.68 | 0.23 |
| 2011 | 135 | 0.71 | 1.06 | 1.06 | 0.71 | 1.57 | 0.2 |
| 2012 | 135 | 0.77 | 0.88 | 0.88 | 0.57 | 1.45 | 0.24 |
| 2014 | 135 | 0.76 | 0.68 | 0.68 | 0.43 | 1.15 | 0.25 |

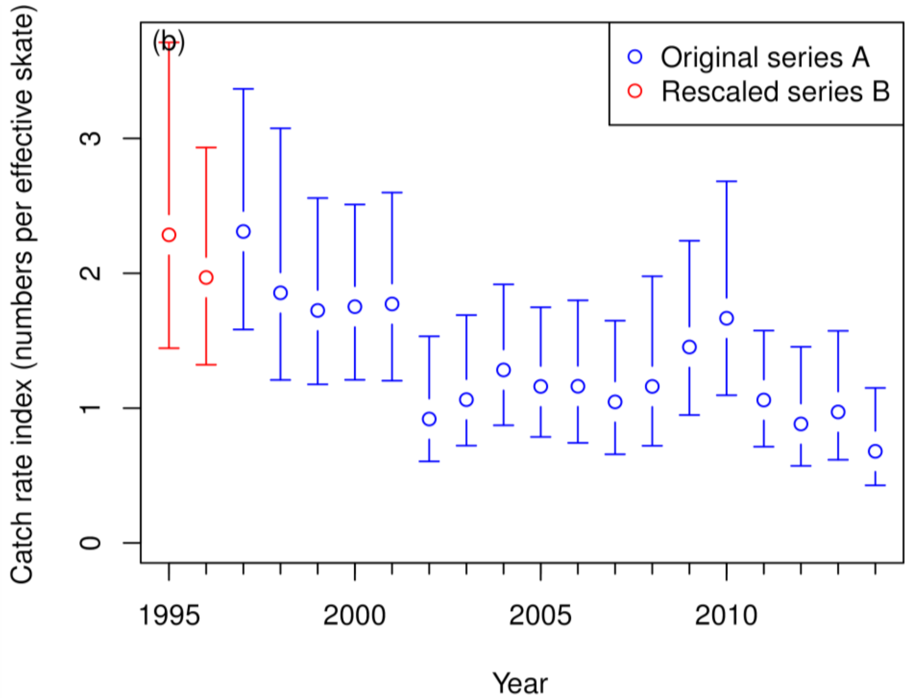



*Figure 42. IPHC survey relative abundance index using the first 20 hooks of each skate at stations north of WCVI for survey years from 1997-2014, and scaling all hooks from 1995-1996 to extend the index to obtain the longest time series possible. Comparison with survey series from the full coast shows that the indices follow the same trends and the survey index from stations north of WCVI can be used to represent coastwide outside Yelloweye Rockfish abundance trends.*

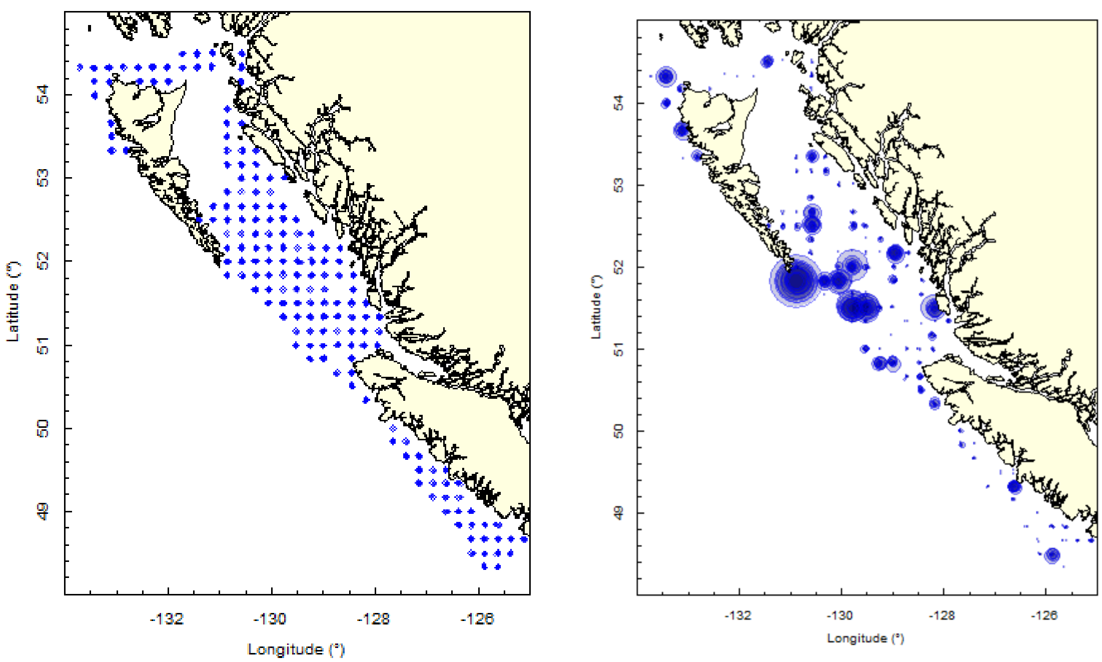



*Figure 43. IPHC survey – Left panel showing the locations of all sets in all years, right panel showing survey sets where Yelloweye Rockfish was captured. The size of the circles are proportional to the catch density (largest circle = 5,959 pieces/km² on the southern tip of Haida Gwaii in 2010).*

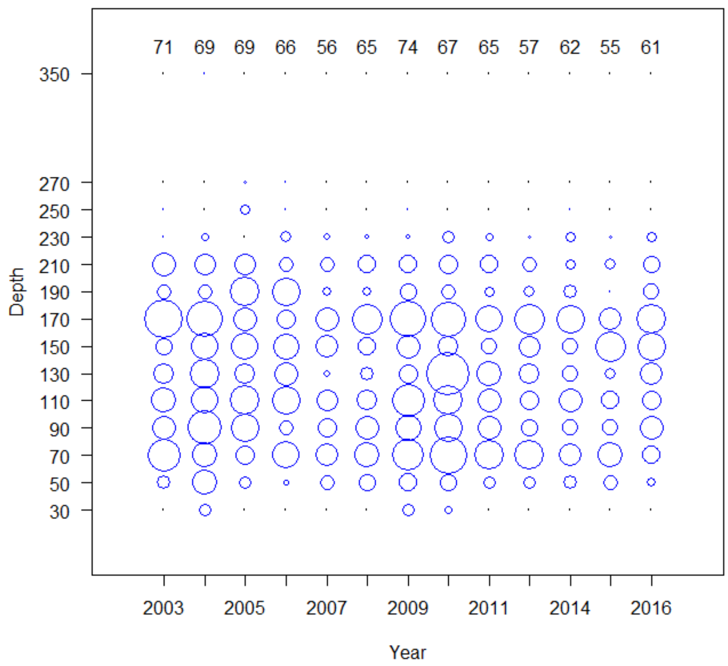



*Figure 44. Distribution of Yelloweye Rockfish catch weights in the IPHC survey by 20 m depth interval and year. Depth interval is shown as the center of the interval and is based on the modal bottom depth of the set.*

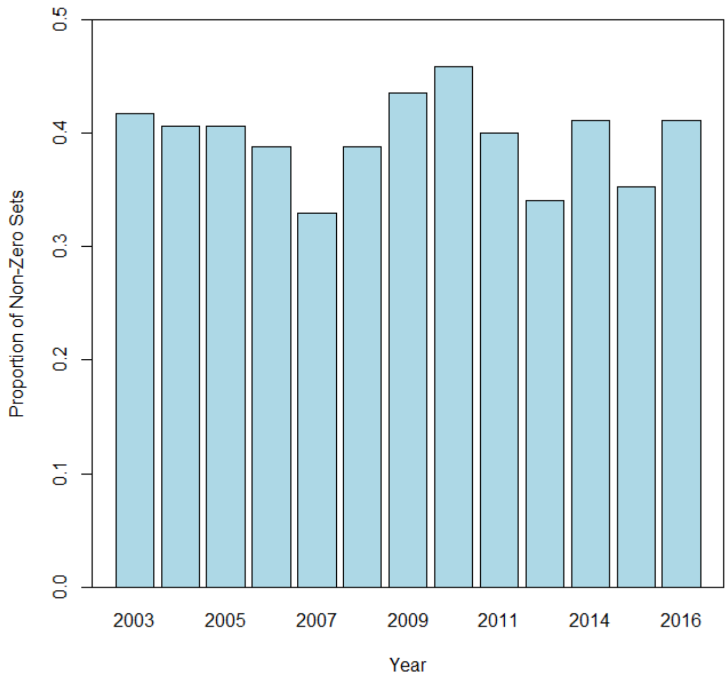



*Figure 45. Proportion of sets by year in the IPHC survey where Yelloweye Rockfish was captured.*

*Table 21. Relative abundance index for Yelloweye Rockfish in the IPHC survey by year. Units are kg, however, note that these are indices only, not absolute values. Bootstrap bias corrected confidence intervals and CVs are based on 1000 random draws with replacement. The analytic CV s based on the assumption of random tow selection within a stratum.*

| | | Bootstrap Results | | | |
|---|---|---|---|---|---|
| **Year** | **Index** | **Mean** | **Lower CI** | **Upper CI** | **CV** |
| 2003 | 12,266,383 | 12,267,970 | 7,760,529 | 17,825,203 | 0.21 |
| 2004 | 15,282,224 | 15,304,561 | 10,243,657 | 20,710,032 | 0.18 |
| 2005 | 13,240,161 | 13,228,693 | 9,063,073 | 18,083,363 | 0.17 |
| 2006 | 13,291,453 | 13,276,936 | 8,595,957 | 18,438,522 | 0.19 |
| 2007 | 11,102,317 | 11,156,276 | 7,416,208 | 15,365,277 | 0.18 |
| 2008 | 13,437,158 | 13,437,703 | 8,641,945 | 19,247,360 | 0.20 |
| 2009 | 15,787,522 | 15,902,158 | 10,820,099 | 21,487,959 | 0.17 |
| 2010 | 17,237,991 | 17,205,885 | 11,233,838 | 24,794,967 | 0.20 |
| 2011 | 12,758,038 | 12,719,641 | 8,322,705 | 17,453,058 | 0.19 |
| 2012 | 11,737,600 | 11,749,365 | 7,869,100 | 16,203,521 | 0.18 |
| 2014 | 8,029,327 | 8,069,952 | 5,270,780 | 11,483,199 | 0.19 |
| 2015 | 7,961,333 | 8,001,822 | 4,609,779 | 12,640,747 | 0.25 |
| 2016 | 12,403,010 | 12,510,429 | 7,531,837 | 18,247,598 | 0.22 |

#### 5.4.2.4. PHMA Rockfish Longline Survey

The PHMA, in consultation with Fisheries and Oceans Canada (DFO), initiated a depth stratified, random design research longline survey conducted with chartered commercial fishing vessels in 2006. The survey employs standardized longline snap gear and fishing methods and alternates annually between the northern and southern portions of BC (Figure 46). The survey is designed to provide catch rates of all species and biological samples of rockfish from the outside coastal waters of BC for stock assessment, alternating between northern and southern areas. The data series used in this review spans the northern area in 2006, 2008, 2010, 2012, and 2015, and the southern area in 2007, 2009, 2011, 2014, and 2016.

Yelloweye Rockfish was captured in a high proportion of the PHMA sets. Greatest relative densities of Yelloweye Rockfish were encountered surrounding southern Haida Gwaii and off the northwest coast of Vancouver Island (Figure 46, right panel). Depth of capture was mostly between 100 and 190 m in the north, and 70 and 190 m in the south, with no clear trends over time (Figure 47).

The proportion of sets capturing Yelloweye has increased in the northern area since the beginning of the survey series from around 70% to 80%, and has varied from just above to just below 60% in the southern area (Figure 48). Similarly, the relative abundance index has increased slightly in the northern area (Table 22, Figure 49). The index indicates a potential decrease in the southern area over the time series (Table 22, Figure 49).

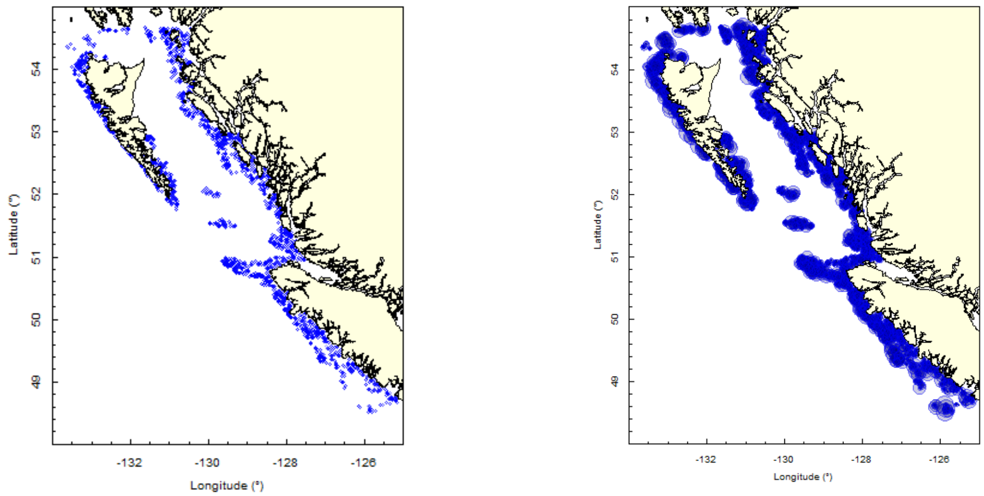



*Figure 46. PHMA Longline survey – Left panel showing the locations of all sets in all years, right panel showing survey sets where Yelloweye Rockfish was captured. The size of the circles are proportional to the catch density (largest circle = 31,395 pieces/km$^2$ off WCVI in 2011).*

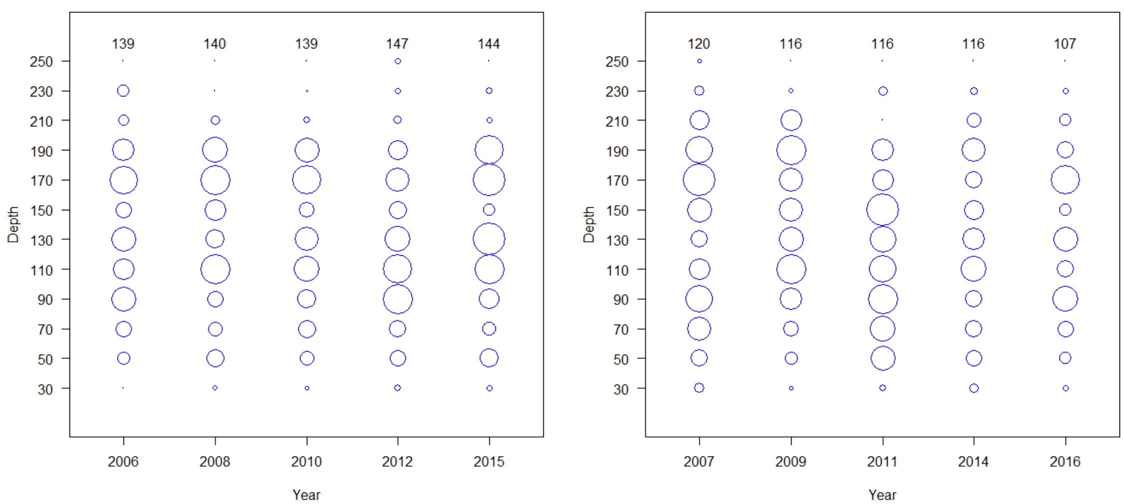



*Figure 47. Distribution of Yelloweye Rockfish catch weights in the PHMA survey by 20 m depth interval and year (left panel = north, right panel = south). Depth interval is shown as the center of the interval and is based on the modal bottom depth of the set. The size of the circle is proportional to the catch weight.*

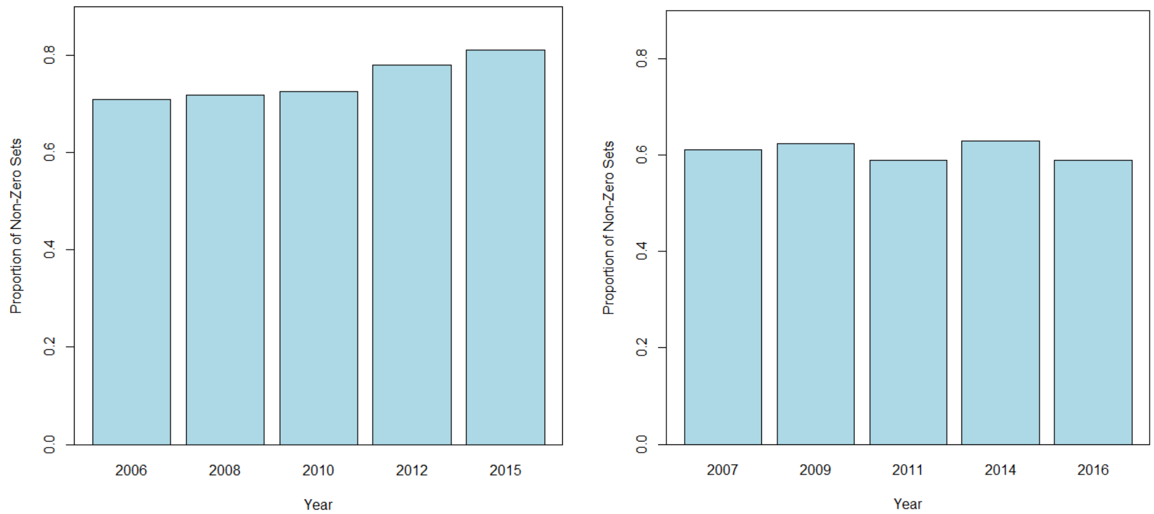



*Figure 48. Proportion of sets by year in the PHMA survey where Yelloweye Rockfish was captured (left panel = north, right = south).*

*Table 22. Relative abundance index for Yelloweye Rockfish in the PHMA survey by year. Units are in pieces; however, note that these are indices only, not absolute values. Bootstrap bias corrected confidence intervals and CVs are based on 1000 random draws with replacement. The analytic CV is based on the assumption of random tow selection within a stratum.*

| | | | | Bootstrap Results | | |
|---|---|---|---|---|---|---|
| **Area** | **Year** | **Biomass** | **Mean** | **Lower CI** | **Upper CI** | **CV** |
| **North** | 2006 | 21,269,132 | 21,310,042 | 16,929,313 | 26,398,561 | 0.11 |
| | 2008 | 25,901,162 | 25,829,441 | 19,302,441 | 32,347,162 | 0.12 |
| | 2010 | 23,962,596 | 23,984,963 | 17,932,633 | 30,876,466 | 0.14 |
| | 2012 | 27,123,508 | 27,138,255 | 20,755,587 | 34,226,760 | 0.13 |
| | 2015 | 30,888,454 | 31,074,704 | 23,579,024 | 39,456,197 | 0.13 |
| **South** | 2007 | 20,109,293 | 20,053,380 | 15,610,634 | 24,999,152 | 0.12 |
| | 2009 | 19,834,488 | 19,883,367 | 15,607,992 | 24,821,590 | 0.12 |
| | 2011 | 24,105,706 | 24,141,205 | 18,854,319 | 29,485,404 | 0.11 |
| | 2014 | 14,649,526 | 14,740,274 | 11,007,263 | 18,893,328 | 0.14 |
| | 2016 | 14,208,655 | 14,140,084 | 10,762,588 | 17,872,107 | 0.13 |

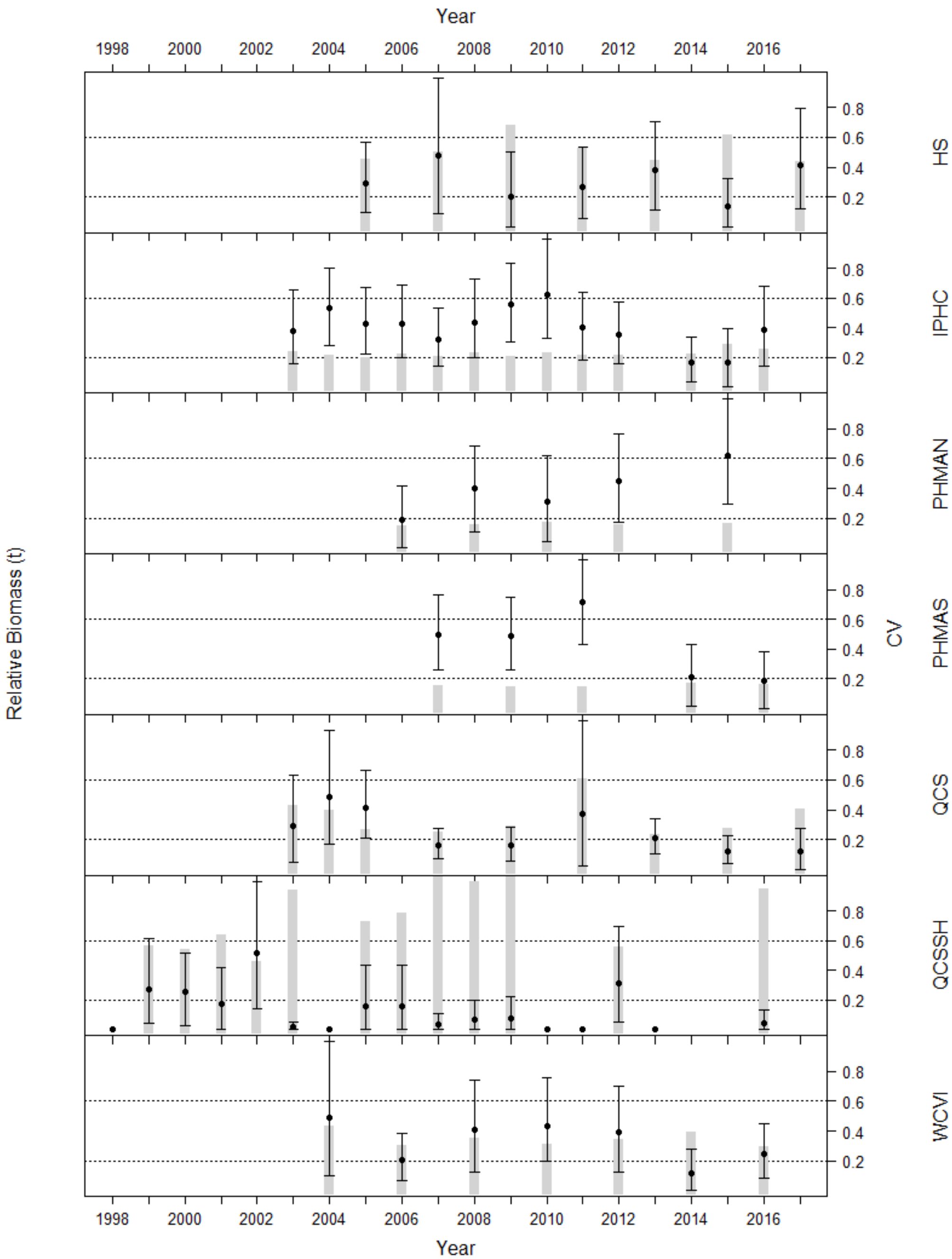



*Figure 49. Relative population index values for seven fishery-independent survey series for outside Yelloweye Rockfish. The index values are shown as circles with the vertical lines representing the bootstrap 95% bias-corrected confidence intervals obtained for a sample of size 1,000 drawn with replacement. Grey vertical bars indicate the annual survey coefficient of variation (CV). Reference lines (dotted horizontal lines) are provided at CV=0.2 and CV=0.6 to assist comparing relative observation errors between surveys and years. HS = Hecate Strait synoptic bottom trawl survey, IPHC = International Pacific Halibut Commission standardized stock assessment survey, PHMAN = Pacific Halibut Management Association survey (north), PHMAS = Pacific Halibut Management Association survey (south), QCS = Queen Charlotte Sound synoptic bottom trawl survey, QCSSH = Queen Charlotte Sound shrimp trawl survey, WCVI = West Coast Vancouver Island synoptic bottom trawl survey.*

## 5.5. REMOTELY OPERATED VEHICLE (ROV) VIDEO SURVEYS – INSIDE AND OUTSIDE

In addition to research fishing surveys, visual surveys have been conducted using a ROV in 2009-2011 to study fish communities within and outside of established RCAs. The ROV video data have been analyzed by Haggarty et al. (2016) examining fish densities and assessing stock status and habitat of inshore rockfish. Although the ROV surveys do not provide a time series to analyze trends, they are intended to be repeated in future years to examine the effects of RCA's on rockfish populations and are therefore summarized in this report. These visual surveys occurred in both the inside and outside DUs.

A total of 7 surveys were completed in and outside of 47 RCAs with a total of 424 transects completed in a paired sampling design over similar rockfish habitat inside and adjacent to the RCAs (Haggarty et al. 2016, 2017). Full survey methods are detailed in Haggarty et al. (2017).

The ROV surveys were conducted in both the inside and outside management areas. All usable transects are shown in Figure 50 (left panel). The highest densities (based on count of Yelloweye Rockfish that was seen in a transect divided by the area swept by the transect) occurred off the northwest coast of Vancouver Island (Figure 50, right panel). Depths at which Yelloweye Rockfish was visually recorded were concentrated between 50 and 90 m (Figure 51).

Data from this survey were previously analyzed in Haggarty et al. (2016). Densities of Yelloweye from their analysis are reported in Table 23 by survey area. There are no population trends from this survey data as the survey sites are not repeated over time.

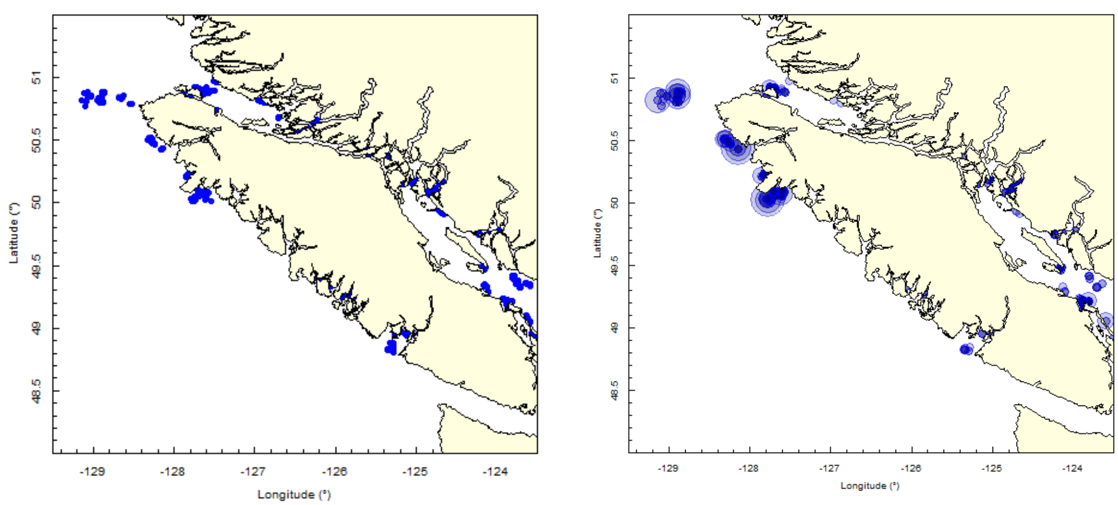



*Figure 50. Yelloweye RCA ROV survey – Left panel showing the locations of all sets in all years, right panel showing survey sets where Yelloweye Rockfish was seen. The size of the circles is proportional to the observed density (largest circle = 4 pieces/event (number seen on the screen in one frame) off the northwest coast of Vancouver Island in 2011).*

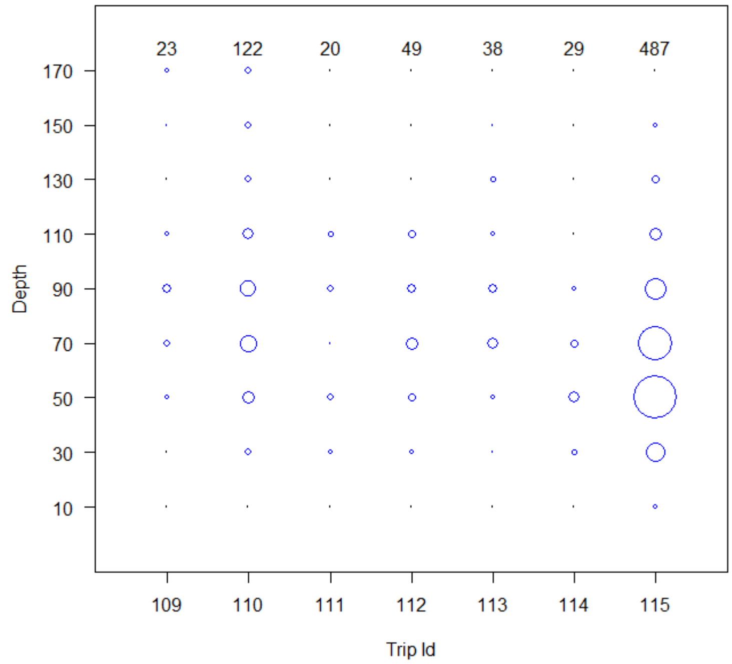



*Figure 51. Distribution of Yelloweye Rockfish observed in the ROV video survey by 20 m depth interval and trip. Depth interval is shown as the center of the interval and is based on the modal bottom depth of the set. The size of the circle is proportional to the catch weight.*

*Table 23. From Haggarty et al. (2016). The number of transects, mean and Standard Deviation (SD) of fish Densities (#/100 m²) for Yelloweye Rockfish inside and outside of RCAs observed on ROV video surveys by region (YE = Yelloweye Rockfish, JS = Johnstone Strait, QCS = Queen Charlotte Sound and SOG = Strait of Georgia; JS & QCS = inside DU, WCVI = outside DU).*

| Region | RCA | N | $\bar{x}$ | SD |
|---|---|---|---|---|
| Strait of Georgia | In | 122 | 0.1 | 0.18 |
| (13) | Out | 81 | 0.12 | 0.21 |
| Hohnstone Strait | In | 13 | 0.05 | 0.1 |
| (5) | Out | 15 | 0.13 | 0.16 |
| Queen Charlotte Strait | In | 18 | 0.26 | 0.36 |
| (5) | Out | 16 | 0.12 | 0.13 |
| West Coast of Vancouver Island | In | 46 | 0.2 | 0.25 |
| (7) | Out | 54 | 0.2 | 0.26 |

## 5.6. US ASSESSMENTS

Yelloweye Rockfish occur in American waters both to the north and south of BC. The U.S. west coast (Washington, Oregon and California) Yelloweye Rockfish stock declined sharply in the 1980’s and early 1990’s and the spawning biomass was recently reported as approximately 70% of the initial spawning biomass (National Marine Fisheries Service 2017). Yelloweye Rockfish was declared "overfished" in 2002 and was managed under a rebuilding plan (Methot and Piner 2002) and is now currently managed under the rockfish recovery plan (National

Marine Fisheries Service 2017). In a status review for a suite of rockfish species, the National Marine Fisheries Service determined that Yelloweye Rockfish in Puget Sound/Georgia Basin is a distinct population segment (Drake et al. 2010) and was listed as threatened under the Endangered Species Act (National Marine Fisheries Service 2017). The recommended catch for Yelloweye Rockfish for the U.S. west coast is 26 t. The current spawning biomass is at 70% of unfished (Taylor and Wetzel 2011), up from 23.3% estimated in the 2002 stock assessment (Methot and Piner 2002).

In Alaska, Yelloweye Rockfish are included within an aggregate of demersal shelf rockfish (DSR) that are managed jointly by the state of Alaska and the National Marine Fisheries Service in the Southeast outside subdistrict (SEO) and managed solely by the State in the internal state water subdistricts. The 2016 stock assessment for Yelloweye Rockfish estimated an exploitable biomass of 10,347 t for the SEO in 2017 and the ABC for Yelloweye Rockfish for the SEO was set at 227 t for all demersal shelf rockfish, 207 t of which were allocated to Yelloweye Rockfish (Olson et al. 2016). However, it was decided that due to drastic reductions in estimated biomass, three of the sections within the SEO would not be open for 2017, and the ABC for the remaining section, East Yakutat (EYKT), was set at 28 t for all demersal shelf rockfish (Alaska Department of Fish and Game 2017a). Yelloweye Rockfish within State waters is managed to 50 t catch quotas for the NSEI and SSEI areas combined (Alaska Department of Fish and Game 2017b).

# 6. THREATS AND LIMITING FACTORS

## 6.1. FISHERY REMOVALS

The principal threat to Yelloweye Rockfish is fishery removal which is managed by harvest quotas by PFMA areas (see Fisheries Management description in Section 4.4). Commercial catch in the inside DU reached a peak of around 170 t in the mid-80s, and has decreased to less than 10 t annually in recent years. In the outside area, commercial catch reached a peak of nearly 2000 t in 1990, and in recent years has decreased to less than 300 t. Catch monitoring and control has improved substantially with 100% monitoring and reporting in the commercial fishery since 2006. RCAs protect 28% of inside rockfish habitat and 15% of outside rockfish habitat.

The scope of direct removal by fisheries includes the areas of Yelloweye Rockfish habitat fished. Inside Yelloweye Rockfish extent of occurrence covers 14,267 $km^2$. Recent captures in fisheries and surveys occur over approximately 3,956 $km^2$ of this range. Outside Yelloweye Rockfish extent of occurrence is 108,035 $km^2$. Captures in fisheries and surveys occur over approximately 49,924 $km^2$ of this range.

## 6.2. THREATS TO HABITAT

### 6.2.1. Habitat Damage

There is no evidence of imminent or changing threat to Yelloweye Rockfish habitat. Bottom trawl (DFO 2006), longline and trap (DFO 2010) fishing gear are known to have an impact on benthic habitat. The freezing of the trawl fishery boundaries restricts bottom trawl fishing activity to areas that have already been trawled therefore leaving other areas relatively undisturbed. RCAs, MPAs and sponge reef fishery closures provide protection of a portion of Yelloweye Rockfish habitat.

### 6.2.2. Climate Change and Ocean Acidification

There is no evidence of a threat to Yelloweye Rockfish or their habitat due to climate change. Water temperatures are predicted to increase at a rate of approximately 0.11 degrees per decade with the greatest increases predicted within in the upper few meters down to 75 m (Rhein et al. 2013). Upwelling along the BC coast may moderate increases in warming ocean waters. Changing ocean chemistry accompanying climate change and resulting in a decreased pH (ocean acidification) of surface waters may affect some rockfish species. Reduced pH has been shown to affect behaviour, swimming speed, aerobic scope and gene expression in some juvenile rockfish in California (Hamilton et al. 2014, 2017).

## 6.3. PREDATION

Pinnipeds are known to consume rockfish including Yelloweye Rockfish. There has been an increase in pinniped (harbour seal and Steller sea lion) abundance since the 1970's (Olesiuk 2009, 2010), but it is unknown how much Yelloweye Rockfish pinnipeds currently consume. In the most recent Yelloweye Rockfish stock assessment, their annual consumption by pinnipeds was estimated from pinniped abundance, pinniped bioenergetic requirements, proportions of rockfish in pinniped diets and proportion of Yelloweye Rockfish compared with all rockfish in the inside DU. Estimated annual consumption by species was: 72 tonnes Yelloweye Rockfish consumed per year by Harbour Seals (*Phoca vitulina*), 10 tonnes by Steller Sea Lions (*Eumetopias jubatus*), and 23 tonnes by California Sea Lions (*Zalophus californianus*). As pinniped abundance has increased since the 1970's, consumption rates of rockfish by pinnipeds may also increase in both DUs. A new stock assessment methodology that accounts for trends in pinniped predation as a separate 'fishing fleet' was discussed in the most recent assessment of inside Yelloweye Rockfish for illustrative purposes only to evaluate the sensitivity of the stock assessment results to possible variation in predation by pinnipeds (Yamanaka et al. 2012).

# 7. PROTECTION AND STATUS

Yelloweye Rockfish are currently listed as a species of "Special Concern" by COSEWIC. In British Columbia, Yelloweye Rockfish are protected by various catch quota restrictions in both the commercial and recreational fishery (Table 9, Table 10, Table 11). Catch quotas for Yelloweye Rockfish in commercial fisheries declined dramatically between 2001 and 2002 in an effort to reduce directed and non-directed Yelloweye Rockfish captures; by 50% in the outside area and 75% in the inside area. The coastwide overall commercial sector TAC has been further reduced in steps outlined in the outside Yelloweye Rockfish rebuilding plan, which for the current 2017/2018 fishing year is 110 t. RCAs restrict fishing activity in 15% of rockfish habitats outside and 28% of rockfish habitats on the inside, and are intended to protect Yelloweye Rockfish and other inshore rockfish and their habitat. Yelloweye Rockfish are also protected by other conservation measures on the BC coast including sponge reef closures, the Gwaii Haanas National Marine Park Reserve MPA and the limits of the bottom trawl fishery boundary.

This species does not have any international status designations. In U.S. waters south of British Columbia, Yelloweye Rockfish have been declared "overfished" and the Puget Sound/Georgia Basin distinct population segment was listed as Threatened under the Endangered Species Act in 2010.

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## APPENDIX A

*Table A1. Coastwide estimates of Yelloweye Rockfish and all rockfish (pieces) from the iRec survey.*

| Year | Yelloweye Rockfish | All rockfish |
|---|---|---|
| 2012[1] | 34,698 | 292,250 |
| 2013 | 36,770 | 313,343 |
| 2014 | 47,078 | 371,490 |
| 2015 | 49,517 | 302,490 |
| 2016 | 40,118 | 319,785 |

[1] 2012 iRec covers July-December. All other years for iRec are full calendar year.

*Table A2. Recreational creel estimates of number of boat trips and captures (retained + released) of Yelloweye Rockfish and all rockfish (pieces) from West Coast of Vancouver Island (WCVI, Outside DU) and East Coast Vancouver Island (ECVI, Inside DU) with Area 11 reported separately (area 11 is split between the inside and outside DU's). For comparison, estimates of Yelloweye Rockfish and all rockfish (pieces) from the iRec survey are included.*

| Area | Year | Boat trips | Yelloweye Rockfish | All Rockfish | iRec Yelloweye Rockfish | iRec All Rockfish |
|---|---|---|---|---|---|---|
| WCVI | 2000 | 57,332 | 1,744 | 8,920 | - | - |
| | 2001 | 60,815 | 4,482 | 18,967 | - | - |
| | 2002 | 75,138 | 1,623 | 24,801 | - | - |
| | 2003 | 84,126 | 1,793 | 17,078 | - | - |
| | 2004 | 81,825 | 1,333 | 14,210 | - | - |
| | 2005 | 79,190 | 2,682 | 22,126 | - | - |
| | 2006 | 79,401 | 3,524 | 20,027 | - | - |
| | 2007 | 63,396 | 6,496 | 22,295 | - | - |
| | 2008 | 65,527 | 9,392 | 28,108 | - | - |
| | 2009 | 70,574 | 6,877 | 21,575 | - | - |
| | 2010 | 65,169 | 7,243 | 21,071 | - | - |
| | 2011 | 71,162 | 12,252 | 28,918 | - | - |
| | 2012 | 63,288 | 10,068 | 25,951 | 11,209 | 74,730 |
| | 2013 | 51,940 | 6,509 | 18,088 | 16,047 | 101,260 |
| | 2014 | 58,762 | 5,555 | 22,646 | 19,356 | 122,154 |
| | 2015 | 58,390 | 7,916 | 27,084 | 19,337 | 103,824 |
| | 2016 | 63,982 | 7,266 | 29,389 | 11,963 | 91,099 |
| ECVI | 2000 | 201,870 | 6,424 | 74,918 | - | - |
| | 2001 | 214,568 | 8,833 | 86,771 | - | - |
| | 2002 | 228,035 | 3,364 | 48,900 | - | - |
| | 2003 | 197,227 | 3,796 | 31,583 | - | - |
| | 2004 | 153,998 | 3,086 | 25,789 | - | - |
| | 2005 | 128,916 | 1,555 | 17,287 | - | - |
| | 2006 | 131,295 | 2,472 | 27,951 | - | - |
| | 2007 | 134,161 | 952 | 19,783 | - | - |
| | 2008 | 113,111 | 1,788 | 19,556 | - | - |
| | 2009 | 139,431 | 1,659 | 29,042 | - | - |
| | 2010 | 116,268 | 1,849 | 24,640 | - | - |
| | 2011 | 140,486 | 1,922 | 26,309 | - | - |
| | 2012 | 137,024 | 2,038 | 24,834 | 12,766 | 155,010 |
| | 2013 | 134,305 | 1,475 | 20,200 | 9,018 | 136,516 |
| | 2014 | 171,348 | 763 | 19,444 | 9,366 | 131,557 |
| | 2015 | 174,789 | 2,751 | 28,620 | 8,017 | 99,363 |
| | 2016 | 166,624 | 3,584 | 31,033 | 11,098 | 124,506 |
| Area 11 | 2005 | 10 | 1 | 1 | - | - |
| | 2007 | 1,236 | 720 | 1,243 | - | - |
| | 2008 | 1,380 | 852 | 2,435 | - | - |
| | 2009 | 1,199 | 802 | 3,150 | - | - |
| | 2010 | 1,038 | 846 | 1,788 | - | - |
| | 2011 | 1,572 | 837 | 2,278 | - | - |
| | 2012 | 2,024 | 1,439 | 3,668 | 2,122 | 9,156 |
| | 2013 | 1,777 | 671 | 2,795 | 803 | 5,163 |
| | 2014 | 1,408 | 888 | 3,020 | 1,390 | 5,431 |
| | 2015 | 1,222 | 1,091 | 4,440 | 741 | 4,178 |
| | 2016 | 1,728 | 966 | 5,047 | 772 | 4,294 |

[1] 2012 iRec covers July-December. All other years for iRec are full calendar year.

*Table A3. Recreational lodge logbook estimates of number of anglers and captures (kept + released) of Yelloweye Rockfish and all rockfish (pieces), including an indication of the percent of rockfish not identified to species, from Areas 7, 8, and 9 on the central coast. For comparison, estimates of Yelloweye Rockfish and all rockfish (pieces) from the iRec survey are included.*

| **Area** | **Year** | **Anglers** | **Yelloweye Rockfish** | **All rockfish** | **% unk/unik.** | **iRec Yelloweye Rockfish** | **iRec All rockfish** |
|---|---|---|---|---|---|---|---|
| | 2002 | 6740 | 456 | 1762 | 10 | - | - |
| | 2003 | 8363 | 521 | 1591 | 1 | - | - |
| | 2004 | 10930 | 597 | 1716 | 2 | - | - |
| | 2005 | 10432 | 634 | 1608 | <1 | - | - |
| | 2006 | 10883 | 522 | 2064 | 0 | - | - |
| | 2007 | 10911 | 1332 | 3105 | 16 | - | - |
| | 2008 | 8255 | 906 | 1694 | 4 | - | - |
| Area 7 | 2009 | 4656 | 874 | 1576 | 10 | - | - |
| | 2010 | 4651 | 688 | 1254 | 13 | - | - |
| | 2011 | 4788 | 764 | 1412 | 5 | - | - |
| | 2012 | 4901 | 758 | 1427 | 12 | 711 | 4204 |
| | 2013 | 4481 | 742 | 1433 | 14 | 1274 | 16211 |
| | 2014 | 7321 | 660 | 1977 | 8 | 2462 | 15425 |
| | 2015 | 10866 | 1063 | 2723 | 5 | 1683 | 9187 |
| | 2016 | 8457 | 902 | 2829 | 7 | 1725 | 11960 |
| | 2002 | 5930 | 457 | 1174 | 0 | - | |
| | 2003 | 5963 | 328 | 933 | 1 | - | - |
| | 2004 | 5686 | 385 | 1062 | 3 | - | - |
| | 2005 | 6285 | 414 | 1016 | 6 | - | - |
| | 2006 | 6488 | 636 | 2367 | <1 | - | - |
| | 2007 | 6660 | 799 | 2239 | <1 | - | - |
| | 2008 | 5493 | 588 | 2381 | <1 | - | - |
| Area 8 | 2009 | 4628 | 207 | 1172 | 0 | - | - |
| | 2010 | 4347 | 108 | 1124 | 11 | - | - |
| | 2011 | 4443 | 108 | 1438 | 1 | - | - |
| | 2012 | 4477 | 258 | 1571 | 1 | 1108 | 5914 |
| | 2013 | 4120 | 231 | 1166 | 23 | 893 | 4388 |
| | 2014 | 4217 | 325 | 1486 | 6 | 1552 | 12685 |
| | 2015 | 5469 | 235 | 1868 | 3 | 179 | 1746 |
| | 2016 | 6095 | 440 | 2111 | 1 | 942 | 6362 |
| | 2002 | 14579 | 166 | 1667 | 8 | - | - |
| | 2003 | 14934 | 219 | 1746 | 1 | - | - |
| | 2004 | 17077 | 374 | 2178 | 7 | - | - |
| | 2005 | 16397 | 331 | 2097 | 4 | - | - |
| | 2006 | 18119 | 561 | 3399 | 3 | - | - |
| | 2007 | 15640 | 417 | 3080 | 4 | - | - |
| | 2008 | 13028 | 456 | 2296 | 20 | - | - |
| Area 9 | 2009 | 10618 | 53 | 1291 | 52 | - | - |
| | 2010 | 10174 | 93 | 2412 | 17 | - | - |
| | 2011 | 9476 | 69 | 1635 | 49 | - | - |
| | 2012 | 7511 | 256 | 1778 | 13 | - | 2033 |
| | 2013 | 9081 | 371 | 2700 | 11 | 49 | 628 |
| | 2014 | 8013 | 270 | 2942 | 8 | 639 | 8187 |
| | 2015 | 8544 | 261 | 3337 | 3 | 337 | 6821 |
| | 2016 | 9248 | 135 | 3298 | 10 | 1022 | 7343 |

[1] 2012 iRec covers July-December. All other years for iRec are full calendar year.

*Table A4. Recreational lodge logbook estimates of number of boat trips and captures (kept + released) of Yelloweye Rockfish and other Rockfish (pieces) from Areas 3 and 4 on the north coast.*

| Area | Year | Boat Trips | Yelloweye Rockfish | Other Rockfish |
|---|---|---|---|---|
| 3 | 2011 | 1350 | 343 | 259 |
| | 2013 | 3298 | 451 | 1135 |
| | 2014 | 4036 | 1117 | 317 |
| | 2015 | not available | 309 | not available |
| | 2016 | not available | 273 | not available |
| | 2017 | not available | 948 | not available |
| 4 | 2011 | 1810 | 386 | 430 |
| | 2013 | 6662 | 338 | 2157 |
| | 2014 | 6974 | 547 | 942 |
| | 2015 | not available | 605 | not available |
| | 2016 | not available | 391 | not available |
| | 2017 | not available | 1,176 | not available |

*Table A5. Recreational catches for all Rockfish (1999-2015) and Yelloweye and other Rockfish (2016-2017) in pieces from Areas 1 and 2 on the north coast. Data include both lodge logbook records and creel surveys. Note that creel surveys have only partial coverage in Area 2W (10-15%).*

| | Area 1 | | Area 2E | | Area 2W | | All areas | |
|---|---|---|---|---|---|---|---|---|
| Year | Yelloweye Rockfish | Rockfish | Yelloweye Rockfish | Rockfish | Yelloweye Rockfish | Rockfish | Yelloweye Rockfish | Rockfish |
| 1999 | - | 8500 | - | 200 | - | 1400 | - | 10,100 |
| 2000 | - | 8,000 | - | 200 | - | 2500 | - | 10,700 |
| 2001 | - | 5,000 | - | 200 | - | 2,300 | - | 7,500 |
| 2002 | - | 5,600 | - | 200 | - | 2,800 | - | 8,600 |
| 2003 | - | 6000 | - | 250 | - | 4500 | - | 10,750 |
| 2004 | - | 6900 | - | 250 | - | 5900 | - | 13,050 |
| 2005 | - | 7,500 | - | 250 | - | 7,500 | - | 15,250 |
| 2006 | - | 7,500 | - | 250 | - | 8,000 | - | 15,750 |
| 2007 | - | 9,000 | - | 250 | - | 12,000 | - | 21,250 |
| 2008 | - | 9,500 | - | 250 | - | 10,500 | - | 20,250 |
| 2009 | - | 6,700 | - | 400 | - | 9,400 | - | 16,500 |
| 2010 | - | 6,150 | - | 350 | - | 9,670 | - | 16,170 |
| 2011 | - | 6,600 | - | 350 | - | 9,450 | - | 16,400 |
| 2012 | - | 7,620 | - | 350 | - | 9,730 | - | 17,700 |
| 2013 | - | 7,750 | - | 350 | - | 10,000 | - | 18,100 |
| 2014 | - | 6,450 | - | 350 | - | 9090 | - | 15,890 |
| 2015 | - | 6,550 | - | 350 | - | 12,200 | - | 19,100 |
| 2016 | 1430 | 4650 | 100 | 350 | 5070 | 5500 | 6600 | 10,500 |
| 2017 | 1650 | 6200 | 200 | 350 | 2700 | 6450 | 4550 | 13,000 |

## APPENDIX B

*Table B1. Research and commercial data sources – Inside DU.*

| Data Type / Analysis | Surveys | Period | # Records | Commercial (by Gear) | Period | # Records |
|---|---|---|---|---|---|---|
| Spatial and Depth Distributions | IRF Longline Survey (North) | 2003 to 2016 | 286 | Bottom Trawl | 1994 to 2008 | 18 |
| | IRF Longline Survey (South) | 2005 to 2015 | 151 | Hook And Line | 1995 to 2018 | 8,248 |
| | Strait of Georgia Dogfish Longline Survey | 1986 to 2014 | 87 | - | - | - |
| | ROV Survey | 2009 to 2011 | 265 | - | - | - |
| | * Other | 1944 to 2015 | 465 | - | - | - |
| Age Length at Age | IRF Longline Survey (North) | 2003 to 2014 | 1,126 | Handline | 2000 to 2000 | 2 |
| | IRF Longline Survey (South) | 2005 to 2015 | 915 | Longline | 1988 to 1994 | 349 |
| | * Other | 1979 to 2010 | 414 | Unknown | 1980 to 1985 | 42 |
| Length-Weight Relationship | IRF Longline Survey (North) | 2003 to 2016 | 1,363 | Handline | 1986 to 2000 | 53 |
| | IRF Longline Survey (South) | 2005 to 2015 | 897 | Longline | 1988 to 2008 | 1,000 |
| | Strait of Georgia Dogfish Longline Survey | 2014 to 2014 | 29 | Troll | 1993 to 1993 | 5 |
| | * Other | 1984 to 2017 | 672 | - | - | - |
| Maturity at Age | IRF Longline Survey (North) | 2003 to 2014 | 1,129 | Handline | 2000 to 2000 | 2 |
| | IRF Longline Survey (South) | 2005 to 2015 | 890 | Longline | 1988 to 1994 | 349 |
| | * Other | 1980 to 2006 | 420 | - | - | - |

* Other refers to individual research trips or surveys that are not part of a recognized time series.

*Table B1. Research and commercial data sources (cont.) – Outside DU.*

| Data Type / Analysis | Surveys | Period | # Records | Commercial (by Gear) | Period | # Records |
|---|---|---|---|---|---|---|
| Spatial and Depth Distributions | Hecate Strait Synoptic Survey | 2005 to 2017 | 48 | Bottom Trawl | 1994 to 2017 | 18,582 |
| | IPHC Longline Survey | 2003 to 2016 | 875 | Hook And Line | 1995 to 2018 | 91,552 |
| | PHMA Rockfish Longline Survey - Outside North | 2006 to 2015 | 734 | Trap | 2006 to 2017 | 21 |
| | PHMA Rockfish Longline Survey - Outside South | 2007 to 2016 | 590 | - | - | - |
| | Queen Charlotte Sound Shrimp Survey | 1998 to 2016 | 38 | - | - | - |
| | Queen Charlotte Sound Synoptic Survey | 2003 to 2017 | 309 | - | - | - |
| | West Coast Vancouver Island Synoptic Survey | 2004 to 2016 | 140 | - | - | - |
| | ROV Survey | 2009 to 2011 | 100 | - | - | - |
| | * Other | 1944 to 2017 | 928 | - | - | - |
| Age Length at Age | IPHC Longline Survey | 2003 to 2015 | 8,983 | Bottom Trawl | 1990 to 2004 | 339 |
| | PHMA Rockfish Longline Survey - Outside North | 2006 to 2012 | 6,548 | Longline | 1979 to 2010 | 5,657 |
| | PHMA Rockfish Longline Survey - Outside South | 2007 to 2014 | 5,687 | Unknown | 1996 to 1996 | 36 |
| | * Other | 1979 to 2010 | 7,888 | - | - | - |
| Length-Weight Relationship | Hecate Strait Synoptic Survey | 2005 to 2017 | 45 | Bottom Trawl | 2007 to 2007 | 30 |
| | IPHC Longline Survey | 2009 to 2016 | 7,165 | Handline | 1988 to 1997 | 380 |
| | PHMA Rockfish Longline Survey - Outside North | 2010 to 2015 | 4,738 | Longline | 1988 to 2010 | 4,922 |
| | PHMA Rockfish Longline Survey - Outside South | 2009 to 2016 | 6,739 | Recreational Rod & Reel | 2002 to 2002 | 5 |
| | Queen Charlotte Sound Shrimp Survey | 2005 to 2016 | 24 | Troll | 1991 to 1991 | 25 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Queen Charlotte Sound Synoptic Survey | 2003 to 2017 | 564 | - | - | - |
| | West Coast Vancouver Island Synoptic Survey | 2004 to 2016 | 418 | - | - | - |
| | * Other | 1984 to 2017 | 1,034 | - | - | - |
| Maturity at Age | IPHC Longline Survey | 2003 to 2015 | 8,862 | Bottom Trawl | 1990 to 2004 | 148 |
| | PHMA Rockfish Longline Survey - Outside North | 2006 to 2012 | 6,536 | Longline | 1986 to 2005 | 4,744 |
| | PHMA Rockfish Longline Survey - Outside South | 2007 to 2014 | 5,648 | - | - | - |
| | * Other | 1980 to 2006 | 7,800 | - | - | - |

* Other refers to individual research trips or surveys that are not part of a recognized time series.

## APPENDIX C. SQL LISTINGS

*Listing 1- EOO and AOO analyses; Figures 3, 6, and 7.*

```
/*
  This query extracts catch locations for Yelloweye rockfish from all available
  commercial fishery and research data sources.  Spatial functions from the
  "Grids" database are used to construct geometry objects (points) that
  represent the location of each fishing event (using UTM Zone 9N projection)
*/

-- Commercial sources
SELECT DATABASE_NAME,
  FISHERY_SECTOR,
  GEAR,
  TRIP_ID,
  FISHING_EVENT_ID,
  BEST_DATE,
  LATITUDE,
  LONGITUDE,
  Grids.dbo.MakePointUTM(LATITUDE, LONGITUDE) AS GEOM
FROM GFFOS.dbo.GF_MERGED_CATCH
WHERE LATITUDE > 0 AND
  LONGITUDE < 0 AND
  SPECIES_CODE = '442'

-- Unioned with research sources
UNION ALL
SELECT 'GFBio' AS DATABASE_NAME,
  'Research' AS FISHERY_SECTOR,
  G.GEAR_DESC AS GEAR,
  T.TRIP_ID,
  FE.FISHING_EVENT_ID,
  COALESCE(FE_END_DEPLOYMENT_TIME, FE_BEGIN_DEPLOYMENT_TIME,
    FE_BEGIN_RETRIEVAL_TIME, FE_END_RETRIEVAL_TIME) AS BEST_DATE,
  FE_START_LATTITUDE_DEGREE + FE_START_LATTITUDE_MINUTE / 60 AS LATITUDE,
  -(FE_START_LONGITUDE_DEGREE + FE_START_LONGITUDE_MINUTE / 60) AS LONGITUDE,
  Grids.dbo.MakePointUTM(FE_START_LATTITUDE_DEGREE + FE_START_LATTITUDE_MINUTE / 60,
    -(FE_START_LONGITUDE_DEGREE + FE_START_LONGITUDE_MINUTE / 60)) AS GEOM
FROM GFBioSQL.dbo.TRIP T
  INNER JOIN GFBioSQL.dbo.FISHING_EVENT FE ON
  T.TRIP_ID = FE.TRIP_ID
  INNER JOIN GFBioSQL.dbo.FISHING_EVENT_CATCH FEC ON
  FE.FISHING_EVENT_ID = FEC.FISHING_EVENT_ID
  INNER JOIN GFBioSQL.dbo.CATCH C ON
  FEC.CATCH_ID = C.CATCH_ID
  INNER JOIN GFBioSQL.dbo.GEAR G ON
  FE.GEAR_CODE = G.GEAR_CODE
WHERE TRIP_SUB_TYPE_CODE IN (2,3) AND -- Research or charter
  FE_START_LATTITUDE_DEGREE IS NOT NULL AND
  FE_START_LATTITUDE_MINUTE IS NOT NULL AND
  FE_START_LONGITUDE_DEGREE IS NOT NULL AND
  FE_START_LONGITUDE_MINUTE IS NOT NULL AND
  SPECIES_CODE = '442'

-- Unioned with ROV research sources
UNION ALL
SELECT 'PacHLVideo' AS DATABASE_NAME,
```

```sql
  'Research' AS FISHERY_SECTOR,
  'ROV' AS GEAR,
  VE.TRIP_ID,
  TR.EVENT_ID AS FISHING_EVENT_ID,
  TR.TIME_ AS BEST_DATE,
  TR.LATITUDE,
  TR.LONGITUDE,
  Grids.dbo.MakePointUTM(TR.LATITUDE, TR.LONGITUDE) AS GEOM
FROM PacHLVideo.dbo.B3_VIDEO_EVENT VE
  INNER JOIN PacHLVideo.dbo.B4_TRANSECT_RECORDS TR ON
  VE.EVENT_ID = TR.EVENT_ID
  INNER JOIN PacHLVideo.dbo.B5_SPECIES_RECORDS SR ON
  TR.RECORD_ID = SR.RECORD_ID
WHERE TR.LATITUDE IS NOT NULL AND
  TR.LONGITUDE IS NOT NULL AND
  SR.SPECIES_ID = '442'
```

*Listing 2- Depth-of-capture histograms; Figure 4.*

```sql
/*
 This query extracts depth-of-capture records for Yelloweye Rockfish
 from commercial, survey, and ROV records.
*/

-- All commercial fishing events excluding midwater trawl
SELECT FISHING_EVENT_ID AS feid,
  MAX(BEST_DEPTH) AS depth,
  MAX(CASE SPECIES_CODE WHEN '442' THEN 1 ELSE 0 END) AS ye_ind
FROM GFFOS.dbo.GF_MERGED_CATCH C
WHERE BEST_DEPTH > 0 AND
  GEAR <> 'MIDWATER TRAWL'
GROUP BY FISHING_EVENT_ID
UNION ALL
-- Unioned with research survey events excluding midwater trawl
SELECT FE.FISHING_EVENT_ID AS feid,
  MAX(COALESCE(FE_MODAL_BOTTOM_DEPTH, FE_BEGINNING_BOTTOM_DEPTH,
    FE_END_BOTTOM_DEPTH, FE_MIN_BOTTOM_DEPTH, FE_MAX_BOTTOM_DEPTH)) AS depth,
  MAX(CASE SPECIES_CODE WHEN '442' THEN 1 ELSE 0 END) AS ye_ind
FROM GFBioSQL.dbo.TRIP T
  INNER JOIN GFBioSQL.dbo.FISHING_EVENT FE ON
  T.TRIP_ID = FE.TRIP_ID
  INNER JOIN GFBioSQL.dbo.FISHING_EVENT_CATCH FEC ON
  FE.FISHING_EVENT_ID = FEC.FISHING_EVENT_ID
  INNER JOIN GFBioSQL.dbo.CATCH C ON
  FEC.CATCH_ID = C.CATCH_ID
WHERE COALESCE(FE_MODAL_BOTTOM_DEPTH, FE_BEGINNING_BOTTOM_DEPTH,
    FE_END_BOTTOM_DEPTH, FE_MIN_BOTTOM_DEPTH, FE_MAX_BOTTOM_DEPTH) > 0 AND
  TRIP_SUB_TYPE_CODE IN (2,3) AND
  GEAR_CODE <> 6
GROUP BY FE.FISHING_EVENT_ID
UNION ALL
-- Unioned with ROV events
SELECT TR.EVENT_ID AS feid,
  MAX(TR.DEPTH) AS depth,
  MAX(CASE SPECIES_ID WHEN '442' THEN 1 ELSE 0 END) AS ye_ind
FROM PacHLVideo.dbo.B3_VIDEO_EVENT VE
  INNER JOIN PacHLVideo.dbo.B4_TRANSECT_RECORDS TR ON
  VE.EVENT_ID = TR.EVENT_ID
  INNER JOIN PacHLVideo.dbo.B5_SPECIES_RECORDS SR ON
```

```
  TR.RECORD_ID = SR.RECORD_ID
WHERE TR.DEPTH > 0
GROUP BY TR.EVENT_ID
```

*Listing 3- Summary of research biological samples from the Inside DU; Table 2.*

```
-- Summary of Yelloweye biological samples for the inside stock from research
SELECT YEAR(TRIP_START_DATE) AS Year,
  COUNT(DISTINCT(SM.SAMPLE_ID)) AS Samples,
  COUNT(SPECIMEN_ID) AS Specimens,
  SUM(CASE SPECIMEN_SEX_CODE WHEN 1 THEN 1 ELSE 0 END) AS Males,
  SUM(CASE SPECIMEN_SEX_CODE WHEN 2 THEN 1 ELSE 0 END) AS Females,
  SUM(CASE WHEN SPECIMEN_SEX_CODE NOT IN (1,2) THEN 1 ELSE 0 END) AS [Unknown Sex],
  SUM(CASE WHEN Best_Length > 0 THEN 1 ELSE 0 END) AS Lengths,
  SUM(CASE WHEN Round_Weight > 0 THEN 1 ELSE 0 END) AS Weights,
  SUM(CASE WHEN MATURITY_CODE IS NOT NULL THEN 1 ELSE 0 END) AS Maturities,
  SUM(CASE WHEN SPECIMEN_AGE IS NOT NULL THEN 1 ELSE 0 END) AS Aged
FROM B21_Samples SM
  INNER JOIN B22_Specimens SP ON
  SM.SAMPLE_ID = SP.SAMPLE_ID
    -- Yelloweye Rockfish
WHERE SP.SPECIES_CODE = '442' AND
  -- Research or charter
  TRIP_SUB_TYPE_CODE IN (2,3) AND
  -- Inside stock (Area 4B)
  MAJOR_STAT_AREA_CODE = '01'
GROUP BY YEAR(TRIP_START_DATE)
ORDER BY YEAR(TRIP_START_DATE)
```

*Listing 4 – Summary of commercial biological samples from the inside DU; Table 3.*

```
-- Summary of Yelloweye biological samples for the inside stock from commercial fisheries
SELECT YEAR(TRIP_START_DATE) AS Year,
  COUNT(DISTINCT(SM.SAMPLE_ID)) AS Samples,
  COUNT(SPECIMEN_ID) AS Specimens,
  SUM(CASE SPECIMEN_SEX_CODE WHEN 1 THEN 1 ELSE 0 END) AS Males,
  SUM(CASE SPECIMEN_SEX_CODE WHEN 2 THEN 1 ELSE 0 END) AS Females,
  SUM(CASE WHEN SPECIMEN_SEX_CODE NOT IN (1,2) THEN 1 ELSE 0 END) AS [Unknown Sex],
  SUM(CASE WHEN Best_Length > 0 THEN 1 ELSE 0 END) AS Lengths,
  SUM(CASE WHEN Round_Weight > 0 THEN 1 ELSE 0 END) AS Weights,
  SUM(CASE WHEN MATURITY_CODE IS NOT NULL THEN 1 ELSE 0 END) AS Maturities,
  SUM(CASE WHEN SPECIMEN_AGE IS NOT NULL THEN 1 ELSE 0 END) AS Aged
FROM B21_Samples SM
  INNER JOIN B22_Specimens SP ON
  SM.SAMPLE_ID = SP.SAMPLE_ID
    -- Yelloweye Rockfish
WHERE SP.SPECIES_CODE = '442' AND
  -- Not research or charter (therefore commercial)
  TRIP_SUB_TYPE_CODE NOT IN (2,3) AND
  -- Inside stock (Area 4B)
  MAJOR_STAT_AREA_CODE = '01'
GROUP BY YEAR(TRIP_START_DATE)
ORDER BY YEAR(TRIP_START_DATE)
```

*Listing 5- Summary of research biological samples from the outside DU; Table 4.*

```
-- Summary of Yelloweye biological samples for the outside stock from research
```

```
SELECT YEAR(TRIP_START_DATE) AS Year,
  COUNT(DISTINCT(SM.SAMPLE_ID)) AS Samples,
  COUNT(SPECIMEN_ID) AS Specimens,
  SUM(CASE SPECIMEN_SEX_CODE WHEN 1 THEN 1 ELSE 0 END) AS Males,
  SUM(CASE SPECIMEN_SEX_CODE WHEN 2 THEN 1 ELSE 0 END) AS Females,
  SUM(CASE WHEN SPECIMEN_SEX_CODE NOT IN (1,2) THEN 1 ELSE 0 END) AS [Unknown Sex],
  SUM(CASE WHEN Best_Length > 0 THEN 1 ELSE 0 END) AS Lengths,
  SUM(CASE WHEN Round_Weight > 0 THEN 1 ELSE 0 END) AS Weights,
  SUM(CASE WHEN MATURITY_CODE IS NOT NULL THEN 1 ELSE 0 END) AS Maturities,
  SUM(CASE WHEN SPECIMEN_AGE IS NOT NULL THEN 1 ELSE 0 END) AS Aged
FROM B21_Samples SM
  INNER JOIN B22_Specimens SP ON
  SM.SAMPLE_ID = SP.SAMPLE_ID
  -- Yelloweye Rockfish
WHERE SP.SPECIES_CODE = '442' AND
  -- Research or charter
  TRIP_SUB_TYPE_CODE IN (2,3) AND
  -- Outside stock (not Area 4B)
  MAJOR_STAT_AREA_CODE <> '01'
GROUP BY YEAR(TRIP_START_DATE)
ORDER BY YEAR(TRIP_START_DATE)
```

*Listing 6- Summary of commercial biological samples from the outside DU; Table 5.*

```
-- Summary of Yelloweye biological samples for the outside stock from commercial
SELECT YEAR(TRIP_START_DATE) AS Year,
  COUNT(DISTINCT(SM.SAMPLE_ID)) AS Samples,
  COUNT(SPECIMEN_ID) AS Specimens,
  SUM(CASE SPECIMEN_SEX_CODE WHEN 1 THEN 1 ELSE 0 END) AS Males,
  SUM(CASE SPECIMEN_SEX_CODE WHEN 2 THEN 1 ELSE 0 END) AS Females,
  SUM(CASE WHEN SPECIMEN_SEX_CODE NOT IN (1,2) THEN 1 ELSE 0 END) AS [Unknown Sex],
  SUM(CASE WHEN Best_Length > 0 THEN 1 ELSE 0 END) AS Lengths,
  SUM(CASE WHEN Round_Weight > 0 THEN 1 ELSE 0 END) AS Weights,
  SUM(CASE WHEN MATURITY_CODE IS NOT NULL THEN 1 ELSE 0 END) AS Maturities,
  SUM(CASE WHEN SPECIMEN_AGE IS NOT NULL THEN 1 ELSE 0 END) AS Aged
FROM B21_Samples SM
  INNER JOIN B22_Specimens SP ON
  SM.SAMPLE_ID = SP.SAMPLE_ID
  -- Yelloweye Rockfish
WHERE SP.SPECIES_CODE = '442' AND
  -- Not research or charter (therefore commercial)
  TRIP_SUB_TYPE_CODE NOT IN (2,3) AND
  -- Outside stock (not Area 4B)
  MAJOR_STAT_AREA_CODE <> '01'
GROUP BY YEAR(TRIP_START_DATE)
ORDER BY YEAR(TRIP_START_DATE)
```

*Listing 7- Length-weight relationship for the inside DU; Figure 8, left panel.*

```
-- Yelloweye Rockfish length-weight data from the inside stock
SELECT SPECIMEN_SEX_CODE AS sex,
  Best_Length AS length,
  Round_Weight AS weight
FROM B21_Samples SM
  INNER JOIN B22_Specimens SP ON
  SM.SAMPLE_ID = SP.SAMPLE_ID
  -- Yelloweye Rockfish
WHERE SM.SPECIES_CODE = '442' AND
  -- Only valid lengths
```

```
  Best_Length > 0 AND
  -- Only valid weights
  Round_Weight > 0 AND
  -- Only confirmed males and females
  SPECIMEN_SEX_CODE IN (1,2) AND
  -- Inside stock (Area 4B)
  MAJOR_STAT_AREA_CODE = '01'
```

*Listing 8- Length-weight relationship for the outside DU; Figure 8, right panel.*

```
-- Yelloweye Rockfish length-weight data from the outside stock
SELECT SPECIMEN_SEX_CODE AS sex,
  Best_Length AS length,
  Round_Weight AS weight
FROM B21_Samples SM
  INNER JOIN B22_Specimens SP ON
  SM.SAMPLE_ID = SP.SAMPLE_ID
  -- Yelloweye Rockfish
WHERE SM.SPECIES_CODE = '442' AND
  -- Only valid lengths
  Best_Length > 0 AND
  -- Only valid weights
  Round_Weight > 0 AND
  -- Only confirmed males and females
  SPECIMEN_SEX_CODE IN (1,2) AND
  -- Outside stock (not Area 4B)
  MAJOR_STAT_AREA_CODE <> '01'
```

*Listing 9- Male and female age distribution histograms for the inside DU; Figure 9.*

```
-- All ages from the inside DU
SELECT SPECIMEN_SEX_CODE AS sex,
  SPECIMEN_AGE AS age
FROM B21_Samples SM
  INNER JOIN B22_Specimens SP ON
  SM.SAMPLE_ID = SP.SAMPLE_ID
  -- Yelloweye Rockfish
WHERE SM.SPECIES_CODE = '442' AND
  -- With valid ages
  SPECIMEN_AGE > 0 AND
  -- From break and burn or break and bake method
  AGEING_METHOD_CODE IN (3, 17) AND
  -- Only males and females
  SPECIMEN_SEX_CODE IN (1,2) AND
  -- From the inside DU (4B)
  MAJOR_STAT_AREA_CODE = '01'
```

*Listing 10- Male and female age distribution histograms for the outside DU; Figure 10.*

```
-- All ages from the outside DU
SELECT SPECIMEN_SEX_CODE AS sex,
  SPECIMEN_AGE AS age
FROM B21_Samples SM
  INNER JOIN B22_Specimens SP ON
  SM.SAMPLE_ID = SP.SAMPLE_ID
  -- Yelloweye Rockfish
WHERE SM.SPECIES_CODE = '442' AND
```

```
  -- With valid ages
  SPECIMEN_AGE > 0 AND
  -- From break and burn or break and bake method
  AGEING_METHOD_CODE IN (3, 17) AND
  -- Only males and females
  SPECIMEN_SEX_CODE IN (1,2) AND
  -- From the outside DU (not 4B)
  MAJOR_STAT_AREA_CODE <> '01'
```

*Listing 11- Male and female ages from research surveys for the inside DU; Figure 11.*

```
-- Inside Yellowye Rockfish ages from research samples
SELECT YEAR(TRIP_START_DATE) AS year,
  SPECIMEN_SEX_CODE AS sex,
  CASE WHEN SPECIMEN_AGE >= 60 THEN 60 ELSE SPECIMEN_AGE END AS age,
  COUNT(SPECIMEN_ID) AS agecount
FROM B21_Samples SM
  INNER JOIN B22_Specimens SP ON
  SM.SAMPLE_ID = SP.SAMPLE_ID
  -- Yelloweye Rockfish
WHERE SM.SPECIES_CODE ='442' AND
  -- Only valid ages
  SPECIMEN_AGE > 0 AND
  -- Only males and females
  SPECIMEN_SEX_CODE IN (1,2) AND
  -- Break and burn or break and bake ageing method
  AGEING_METHOD_CODE IN (3,17) AND
  -- Research or charter
  TRIP_SUB_TYPE_CODE IN (2,3) AND
  -- Unsorted or unknown (assume unsorted)
  ISNULL(SAMPLE_SOURCE_CODE,0) IN (0,1) AND
  -- Inside (Area 4B)
  MAJOR_STAT_AREA_CODE = '01'
GROUP BY YEAR(TRIP_START_DATE),
  SPECIMEN_SEX_CODE,
  -- 60 is the + age group
  CASE WHEN SPECIMEN_AGE >= 60 THEN 60 ELSE SPECIMEN_AGE END
ORDER BY YEAR(TRIP_START_DATE),
  SPECIMEN_SEX_CODE,
  CASE WHEN SPECIMEN_AGE >= 60 THEN 60 ELSE SPECIMEN_AGE END
```

*Listing 12- Male and female ages from research survey for the outside DU; Figure 12.*

```
-- Outside Yellowye Rockfish ages from research samples
SELECT YEAR(TRIP_START_DATE) AS year,
  SPECIMEN_SEX_CODE AS sex,
  -- The + age group
  CASE WHEN SPECIMEN_AGE >= 60 THEN 60 ELSE SPECIMEN_AGE END AS age,
  COUNT(SPECIMEN_ID) AS agecount
FROM B21_Samples SM
  INNER JOIN B22_Specimens SP ON
  SM.SAMPLE_ID = SP.SAMPLE_ID
  -- Yelloweye Rockfish
WHERE SM.SPECIES_CODE ='442' AND
  -- Only valid ages
  SPECIMEN_AGE > 0 AND
  -- Only males and females
  SPECIMEN_SEX_CODE IN (1,2) AND
  -- Break and burn or break and bake ageing method
```

```
  AGEING_METHOD_CODE IN (3,17) AND
  -- Research or charter
  TRIP_SUB_TYPE_CODE IN (2,3) AND
  -- Unsorted or unknown (assume unsorted)
  ISNULL(SAMPLE_SOURCE_CODE,0) IN (0,1) AND
  -- Inside (Area 4B)
  MAJOR_STAT_AREA_CODE <> '01'
GROUP BY YEAR(TRIP_START_DATE),
  SPECIMEN_SEX_CODE,
  CASE WHEN SPECIMEN_AGE >= 60 THEN 60 ELSE SPECIMEN_AGE END
ORDER BY YEAR(TRIP_START_DATE),
  SPECIMEN_SEX_CODE,
  CASE WHEN SPECIMEN_AGE >= 60 THEN 60 ELSE SPECIMEN_AGE END
```

*Listing 13- Male and female ages from dockside monitoring for the inside DU; Figure 13.*

```
-- Inside Yellowye Rockfish ages from DMP
SELECT YEAR(TRIP_START_DATE) AS year,
  SPECIMEN_SEX_CODE AS sex,
  CASE WHEN SPECIMEN_AGE >= 60 THEN 60 ELSE SPECIMEN_AGE END AS age,
  COUNT(SPECIMEN_ID) AS agecount
FROM B21_Samples SM
  INNER JOIN B22_Specimens SP ON
  SM.SAMPLE_ID = SP.SAMPLE_ID
  -- Yelloweye Rockfish
WHERE SM.SPECIES_CODE ='442' AND
  -- Only valid ages
  SPECIMEN_AGE > 0 AND
  -- Only males and females
  SPECIMEN_SEX_CODE IN (1,2) AND
  -- Break and burn or break and bake ageing method
  AGEING_METHOD_CODE IN (3,17) AND
  -- Not research or charter (therefore commercial)
  TRIP_SUB_TYPE_CODE NOT IN (2,3) AND
  -- Set numbers 900+ indicate DMP samples
  FE_MAJOR_LEVEL_ID >= 900 AND
  -- Inside (Area 4B)
  MAJOR_STAT_AREA_CODE = '01'
GROUP BY YEAR(TRIP_START_DATE),
  SPECIMEN_SEX_CODE,
  CASE WHEN SPECIMEN_AGE >= 60 THEN 60 ELSE SPECIMEN_AGE END
ORDER BY YEAR(TRIP_START_DATE),
  SPECIMEN_SEX_CODE,
  CASE WHEN SPECIMEN_AGE >= 60 THEN 60 ELSE SPECIMEN_AGE END
```

*Listing 14- Male and female ages from dockside monitoring for the outside DU; Figure 14.*

```
-- Outside Yellowye Rockfish ages from DMP
SELECT YEAR(TRIP_START_DATE) AS year,
  SPECIMEN_SEX_CODE AS sex,
  CASE WHEN SPECIMEN_AGE >= 60 THEN 60 ELSE SPECIMEN_AGE END AS age,
  COUNT(SPECIMEN_ID) AS agecount
FROM B21_Samples SM
  INNER JOIN B22_Specimens SP ON
  SM.SAMPLE_ID = SP.SAMPLE_ID
  -- Yelloweye Rockfish
WHERE SM.SPECIES_CODE ='442' AND
  -- Only valid ages
  SPECIMEN_AGE > 0 AND
```

```
  -- Only males and females
  SPECIMEN_SEX_CODE IN (1,2) AND
  -- Break and burn or break and bake ageing method
  AGEING_METHOD_CODE IN (3,17) AND
  -- Not research or charter (therefore commercial)
  TRIP_SUB_TYPE_CODE NOT IN (2,3) AND
  -- Set numbers 900+ indicate DMP samples
  FE_MAJOR_LEVEL_ID >= 900 AND
  -- Outside (not Area 4B)
  MAJOR_STAT_AREA_CODE <> '01'
GROUP BY YEAR(TRIP_START_DATE),
  SPECIMEN_SEX_CODE,
  CASE WHEN SPECIMEN_AGE >= 60 THEN 60 ELSE SPECIMEN_AGE END
ORDER BY YEAR(TRIP_START_DATE),
  SPECIMEN_SEX_CODE,
  CASE WHEN SPECIMEN_AGE >= 60 THEN 60 ELSE SPECIMEN_AGE END
```

*Listing 15-Length-age relationship for the inside DU; Figure 15 and 16, left panels.*

```
-- Yelloweye length, age, and sex for the inside stock
SELECT SPECIMEN_SEX_CODE AS sex,
  SPECIMEN_AGE AS age,
  Best_Length AS length
FROM B21_Samples SM
  INNER JOIN B22_Specimens SP ON
  SM.SAMPLE_ID = SP.SAMPLE_ID
  -- Yelloweye Rockfish
WHERE SM.SPECIES_CODE = '442' AND
  -- Valid lengths
  Best_Length > 0 AND
  -- Valid ages
  SPECIMEN_AGE > 0 AND
  -- Ageing method is break and burn or broken and baked
  AGEING_METHOD_CODE IN (3, 17) AND
  -- Only males and females (no unknowns)
  SPECIMEN_SEX_CODE IN (1,2) AND
  -- Inside stock (Area 4B)
  MAJOR_STAT_AREA_CODE = '01'
```

*Listing 16- Length-age relationship for the outside DU; Figure 15 and 16, right panels.*

```
-- Yelloweye length, age, and sex for the outside DU
SELECT SPECIMEN_SEX_CODE AS sex,
  SPECIMEN_AGE AS age,
  Best_Length AS length
FROM B21_Samples SM
  INNER JOIN B22_Specimens SP ON
  SM.SAMPLE_ID = SP.SAMPLE_ID
  -- Yelloweye Rockfish
WHERE SM.SPECIES_CODE = '442' AND
  -- Valid lengths
  Best_Length > 0 AND
  -- Valid ages
  SPECIMEN_AGE > 0 AND
  -- Ageing method is break and burn or broken and baked
  AGEING_METHOD_CODE IN (3, 17) AND
  -- Only males and females (no unknowns)
  SPECIMEN_SEX_CODE IN (1,2) AND
  -- Outside stock (not Area 4B)
```

```
  MAJOR_STAT_AREA_CODE <> '01'
```

*Listing 17- Maturity ogives for the inside DU; Figure 17, left panel.*

```
SELECT SPECIMEN_SEX_CODE AS sex,
  SP.MATURITY_CODE AS mat,
  SPECIMEN_AGE AS age,
  SAMPLE_DATE AS date,
  AGEING_METHOD_CODE AS ameth,
  SAMPLE_TYPE_CODE AS stype,
  TRIP_SUB_TYPE_CODE AS ttype,
  YEAR(TRIP_START_DATE) AS year
FROM B21_Samples SM
  INNER JOIN B22_Specimens SP ON
  SM.SAMPLE_ID = SP.SAMPLE_ID
  -- Yelloweye Rockfish
WHERE SM.SPECIES_CODE = '442' AND
  -- Valid maturity codes
  MATURITY_CODE > 0 AND
  -- Valid ages
  SPECIMEN_AGE > 0 AND
  -- Valid sample dates
  SAMPLE_DATE IS NOT NULL AND
  -- Ageing method is break and burn or break and bake
  AGEING_METHOD_CODE IN (3, 17) AND
  -- Only total catch or random samples
  SAMPLE_TYPE_CODE IN (1,2) AND
  -- Only males and females
  SPECIMEN_SEX_CODE IN (1,2) AND
  -- Inside DU
  MAJOR_STAT_AREA_CODE = '01'
```

*Listing 18- Maturity ogives for the outside DU; Figure 17, right panel.*

```
SELECT SPECIMEN_SEX_CODE AS sex,
  SP.MATURITY_CODE AS mat,
  SPECIMEN_AGE AS age,
  SAMPLE_DATE AS date,
  AGEING_METHOD_CODE AS ameth,
  SAMPLE_TYPE_CODE AS stype,
  TRIP_SUB_TYPE_CODE AS ttype,
  YEAR(TRIP_START_DATE) AS year
FROM B21_Samples SM
  INNER JOIN B22_Specimens SP ON
  SM.SAMPLE_ID = SP.SAMPLE_ID
  -- Yelloweye Rockfish
WHERE SM.SPECIES_CODE = '442' AND
  -- Valid maturity codes
  MATURITY_CODE > 0 AND
  -- Valid ages
  SPECIMEN_AGE > 0 AND
  -- Valid sample dates
  SAMPLE_DATE IS NOT NULL AND
  -- Ageing method is break and burn or break and bake
  AGEING_METHOD_CODE IN (3, 17) AND
  -- Only total catch or random samples
  SAMPLE_TYPE_CODE IN (1,2) AND
  -- Only males and females
  SPECIMEN_SEX_CODE IN (1,2) AND
```

```
  -- Inside DU
  MAJOR_STAT_AREA_CODE <> '01'
```

*Listing 19- Groundfish sets pre-RCAs; Figure 22, top panel.*

```
SELECT DATABASE_NAME,
  FISHERY_SECTOR,
  GEAR,
  TRIP_ID,
  FISHING_EVENT_ID,
  BEST_DATE,
  LATITUDE,
  LONGITUDE,
  Grids.dbo.MakePointUTM(LATITUDE, LONGITUDE) AS GEOM
FROM GFFOS.dbo.GF_MERGED_CATCH
WHERE LATITUDE BETWEEN 47 AND 55 AND
  LONGITUDE BETWEEN -135 AND -122 AND
  BEST_DATE BETWEEN '01/01/1997' AND '12/31/2001'
GROUP BY DATABASE_NAME,
  FISHERY_SECTOR,
  GEAR,
  TRIP_ID,
  FISHING_EVENT_ID,
  BEST_DATE,
  LATITUDE,
  LONGITUDE
```

*Listing 20- Groundfish sets post-RCAs; Figure 22, bottom panel.*

```
SELECT DATABASE_NAME,
  FISHERY_SECTOR,
  GEAR,
  TRIP_ID,
  FISHING_EVENT_ID,
  BEST_DATE,
  LATITUDE,
  LONGITUDE,
  Grids.dbo.MakePointUTM(LATITUDE, LONGITUDE) AS GEOM
FROM GFFOS.dbo.GF_MERGED_CATCH
WHERE LATITUDE BETWEEN 47 AND 55 AND
  LONGITUDE BETWEEN -135 AND -122 AND
  BEST_DATE >= '01/01/2012'
GROUP BY DATABASE_NAME,
  FISHERY_SECTOR,
  GEAR,
  TRIP_ID,
  FISHING_EVENT_ID,
  BEST_DATE,
  LATITUDE, LONGITUDE
```

*Listing 21- Bottom trawl sets pre-sponge reefs; Figure 23, top panel.*

```
SELECT DATABASE_NAME,
  FISHERY_SECTOR,
  GEAR,
  TRIP_ID,
  FISHING_EVENT_ID,
  BEST_DATE,
  LATITUDE,
```

```
  LONGITUDE,
  Grids.dbo.MakePointUTM(LATITUDE, LONGITUDE) AS GEOM
FROM GFFOS.dbo.GF_MERGED_CATCH
WHERE LATITUDE BETWEEN 49 AND 55 AND
  LONGITUDE BETWEEN -134 AND -122 AND
  GEAR = 'BOTTOM TRAWL' AND
  BEST_DATE BETWEEN '01/01/1997' AND '12/31/2001' AND
  MAJOR_STAT_AREA_CODE IN ('05','06','07','08')
GROUP BY DATABASE_NAME,
  FISHERY_SECTOR,
  GEAR,
  TRIP_ID,
  FISHING_EVENT_ID,
  BEST_DATE,
  LATITUDE,
  LONGITUDE
```

*Listing 22- Bottom trawl sets post-sponge reefs; Figure 23, bottom panel.*

```
SELECT DATABASE_NAME,
  FISHERY_SECTOR,
  GEAR,
  TRIP_ID,
  FISHING_EVENT_ID,
  BEST_DATE,
  LATITUDE,
  LONGITUDE,
  Grids.dbo.MakePointUTM(LATITUDE, LONGITUDE) AS GEOM
FROM GFFOS.dbo.GF_MERGED_CATCH
WHERE LATITUDE BETWEEN 49 AND 55 AND
  LONGITUDE BETWEEN -134 AND -122 AND
  GEAR = 'BOTTOM TRAWL' AND
  BEST_DATE > '04/02/2012' AND
  MAJOR_STAT_AREA_CODE IN ('05','06','07','08')
GROUP BY DATABASE_NAME,
  FISHERY_SECTOR,
  GEAR,
  TRIP_ID,
  FISHING_EVENT_ID,
  BEST_DATE,
  LATITUDE,
  LONGITUDE
```

*Listing 23- Bottom trawl sets pre-trawl footprint boundary; Figure 24, top panel.*

```
SELECT DATABASE_NAME,
  FISHERY_SECTOR,
  GEAR,
  TRIP_ID,
  FISHING_EVENT_ID,
  BEST_DATE,
  LATITUDE,
  LONGITUDE,
  Grids.dbo.MakePointUTM(LATITUDE, LONGITUDE) AS GEOM
FROM GFFOS.dbo.GF_MERGED_CATCH
WHERE LATITUDE BETWEEN 47 AND 55 AND
  LONGITUDE BETWEEN -135 AND -122 AND
  GEAR = 'BOTTOM TRAWL' AND
  BEST_DATE BETWEEN '01/01/2008' AND '04/02/2012' AND
```

```
  MAJOR_STAT_AREA_CODE <> '01'
GROUP BY DATABASE_NAME,
  FISHERY_SECTOR,
  GEAR,
  TRIP_ID,
  FISHING_EVENT_ID,
  BEST_DATE,
  LATITUDE,
  LONGITUDE
```

*Listing 24- Bottom trawl sets post-trawl footprint boundary; Figure 24, bottom panel.*

```
SELECT DATABASE_NAME,
  FISHERY_SECTOR,
  GEAR,
  TRIP_ID,
  FISHING_EVENT_ID,
  BEST_DATE,
  LATITUDE,
  LONGITUDE,
  Grids.dbo.MakePointUTM(LATITUDE, LONGITUDE) AS GEOM
FROM GFFOS.dbo.GF_MERGED_CATCH
WHERE LATITUDE BETWEEN 47 AND 55 AND
  LONGITUDE BETWEEN -135 AND -122 AND
  GEAR = 'BOTTOM TRAWL' AND
  BEST_DATE > '04/02/2012' AND
  MAJOR_STAT_AREA_CODE <> '01'
GROUP BY DATABASE_NAME,
  FISHERY_SECTOR,
  GEAR,
  TRIP_ID,
  FISHING_EVENT_ID,
  BEST_DATE,
  LATITUDE,
  LONGITUDE
```

*Listing 25- Survey set locations and catch density of Yelloweye Rockfish; Figures 27, 30, 36, 39, 43, 46, and 50*

```
/*
 Query to extract tow locations and CPUE of Yelloweye Rockfish from various
 survey series. CPUE for trawl surveys is calculated as kg per swept area;
 for longline surveys CPUE is pieces per swept area (but the area swept
 is psuedo - we pretend that the catch came from a trawl)
 Survey series ids are:
 Longline:
 39 = Hard bottom longline survey (north)
 40 = Hard bottom longline survey (south)
 14 = IPHC longline survey
 22 = PHMA longline survey (north)
 36 = PHMA longline survey (south)
 76 = Strait of Georgia longline survey
 Trawl:
 1 = Queen Charlotte Sound Synoptic Survey
 3 = Hecate Strait Synoptic Survey
 4 = West Coast Vancouver Island Synoptic Survey
 6 = Queen Charlotte Sound Shrimp Survey
*/
SELECT SURVEY_SERIES_ID AS ssid,
  S.SURVEY_ID AS sid,
```

```
  T.TRIP_ID AS tid,
  FE.FISHING_EVENT_ID AS feid,
  MAX(FE_START_LATTITUDE_DEGREE + FE_START_LATTITUDE_MINUTE / 60) AS lat,
  -MAX(FE_START_LONGITUDE_DEGREE + FE_START_LONGITUDE_MINUTE / 60) AS lon,
  MAX(CASE C.SPECIES_CODE WHEN '442' THEN
    CASE WHEN SURVEY_SERIES_ID IN (39, 40, 14, 22, 36, 76) THEN CATCH_COUNT ELSE
CATCH_WEIGHT END /
      (ISNULL(NULLIF(TRLSP_DOORSPREAD,0) / 1000, 0.07) *
      ISNULL(NULLIF(FE_DISTANCE_TRAVELLED,0),1.8)) ELSE NULL END) AS density
FROM SURVEY S
  INNER JOIN TRIP_SURVEY TS ON
  S.SURVEY_ID = TS.SURVEY_ID
  INNER JOIN TRIP T ON
  TS.TRIP_ID = T.TRIP_ID
  INNER JOIN FISHING_EVENT FE ON
  T.TRIP_ID = FE.TRIP_ID
  INNER JOIN SURVEY_GROUPING SG ON
  S.SURVEY_ID = SG.SURVEY_ID
  INNER JOIN FISHING_EVENT_GROUPING FEG ON
  FEG.FISHING_EVENT_ID = FE.FISHING_EVENT_ID AND
  FEG.GROUPING_CODE = SG.GROUPING_CODE
  LEFT JOIN TRAWL_SPECS TRLSP ON
  FE.FISHING_EVENT_ID = TRLSP.FISHING_EVENT_ID
  INNER JOIN FISHING_EVENT_CATCH FEC ON
  FE.FISHING_EVENT_ID = FEC.FISHING_EVENT_ID
  INNER JOIN CATCH C ON
  FEC.CATCH_ID = C.CATCH_ID
  LEFT JOIN CATCH_SAMPLE CS ON
  C.CATCH_ID = CS.CATCH_ID
WHERE SURVEY_SERIES_ID IN (/* put survey series id(s) here */) AND
  ISNULL(USABILITY_CODE,1) IN (0,1,2,6,12) -- Only usable sets
GROUP BY SURVEY_SERIES_ID, S.SURVEY_ID, T.TRIP_ID, FE.FISHING_EVENT_ID
```

*Listing 26- Catch by depth from surveys; Figures 28, 31, 37, 40, 44, 47, and 51*

```
/*
 Catch weights (for trawl) or pieces (for longline) by depth
 from a survey series.  Survey series are:
 Longline:
 39 = Hard bottom longline survey (north)
 40 = Hard bottom longline survey (south)
 14 = IPHC longline survey
 22 = PHMA longline survey (north)
 36 = PHMA longline survey (south)
 76 = Strait of Georgia longline survey
 Trawl:
 1 = Queen Charlotte Sound Synoptic Survey
 3 = Hecate Strait Synoptic Survey
 4 = West Coast Vancouver Island Synoptic Survey
 6 = Queen Charlotte Sound Shrimp Survey
*/
SELECT SURVEY_SERIES_ID AS ssid,
  S.SURVEY_ID AS sid,
  YEAR(TRIP_START_DATE) AS year,
  -- Best available depth
  FLOOR(COALESCE(FE_MODAL_BOTTOM_DEPTH, FE_BEGINNING_BOTTOM_DEPTH,
    FE_END_BOTTOM_DEPTH, FE_MIN_BOTTOM_DEPTH,
    FE_MAX_BOTTOM_DEPTH) / 20) * 20 + 10 AS depthint,
```

```
  CASE WHEN SURVEY_SERIES_ID IN (14,22,36,39,40,76) THEN SUM(CATCH_COUNT) ELSE
    SUM(CATCH_WEIGHT) END AS catchwt
FROM SURVEY S
  INNER JOIN TRIP_SURVEY TS ON
  S.SURVEY_ID = TS.SURVEY_ID
  INNER JOIN TRIP T ON
  TS.TRIP_ID = T.TRIP_ID
  INNER JOIN FISHING_EVENT FE ON
  T.TRIP_ID = FE.TRIP_ID
  LEFT JOIN TRAWL_SPECS TRL ON
  FE.FISHING_EVENT_ID = TRL.FISHING_EVENT_ID
  INNER JOIN FISHING_EVENT_CATCH FEC ON
  FE.FISHING_EVENT_ID = FEC.FISHING_EVENT_ID
  INNER JOIN CATCH C ON
  FEC.CATCH_ID = C.CATCH_ID
  INNER JOIN SURVEY_GROUPING SG ON
  S.SURVEY_ID = SG.SURVEY_ID
  INNER JOIN FISHING_EVENT_GROUPING FEG ON
  SG.GROUPING_CODE = FEG.GROUPING_CODE AND
  FE.FISHING_EVENT_ID = FEG.FISHING_EVENT_ID
WHERE ISNULL(USABILITY_CODE,1) IN (0,1,2,6,12) AND -- Only usable sets
  COALESCE(FE_MODAL_BOTTOM_DEPTH, FE_BEGINNING_BOTTOM_DEPTH,
FE_END_BOTTOM_DEPTH,
    FE_MIN_BOTTOM_DEPTH, FE_MAX_BOTTOM_DEPTH) < /* insert preferred max depth */ AND
    C.SPECIES_CODE = '442' AND -- Yelloweye
    S.SURVEY_SERIES_ID IN (/* insert survey series id(s) here */)
GROUP BY SURVEY_SERIES_ID, S.SURVEY_ID, YEAR(TRIP_START_DATE),
  FLOOR(COALESCE(FE_MODAL_BOTTOM_DEPTH, FE_BEGINNING_BOTTOM_DEPTH,
FE_END_BOTTOM_DEPTH,
    FE_MIN_BOTTOM_DEPTH, FE_MAX_BOTTOM_DEPTH) / 20) * 20 + 10
ORDER BY YEAR(TRIP_START_DATE), FLOOR(COALESCE(FE_MODAL_BOTTOM_DEPTH,
FE_BEGINNING_BOTTOM_DEPTH,
  FE_END_BOTTOM_DEPTH, FE_MIN_BOTTOM_DEPTH, FE_MAX_BOTTOM_DEPTH) / 20) * 20 + 10
```

*Listing 27- Proportion of non-zero Yelloweye sets from a survey; Figures 29, 32, 38, 41, 45, and 48.*

```
-- Proportion of non-zero Yelloweye Rockfish sets from a survey
SELECT YEAR(TRIP_START_DATE) AS year,
  SUM(CASE C.SPECIES_CODE WHEN '442' THEN 1.0 ELSE 0.0 END) /
    CAST(COUNT(DISTINCT(FE.FISHING_EVENT_ID)) AS FLOAT) AS propnz
FROM SURVEY S
  INNER JOIN TRIP_SURVEY TS ON
  S.SURVEY_ID = TS.SURVEY_ID
  INNER JOIN TRIP T ON
  TS.TRIP_ID = T.TRIP_ID
  INNER JOIN FISHING_EVENT FE ON
  T.TRIP_ID = FE.TRIP_ID
  INNER JOIN FISHING_EVENT_CATCH FEC ON
  FE.FISHING_EVENT_ID = FEC.FISHING_EVENT_ID
  INNER JOIN CATCH C ON
  FEC.CATCH_ID = C.CATCH_ID
WHERE SURVEY_SERIES_ID IN (/* insert survey series id(s) here */)
GROUP BY YEAR(TRIP_START_DATE)
ORDER BY YEAR(TRIP_START_DATE)
```

*Listing 28- Time series of survey indices; Figures 33 and 49.*

```
-- Returns survey bootstrap indices for selected surveys
SELECT
  -- Use the following case statement to give names to the survey series
  -- Example shown is for inshore rockfish longline north and south, and
  -- SoG dogfish longline
  CASE A.SURVEY_SERIES_ID
    WHEN 39 THEN 'IRFN'
    WHEN 40 THEN 'IRFS'
    WHEN 76 THEN 'SOGDF' ELSE NULL END AS Area,
  A.SURVEY_YEAR AS Year,
  ISNULL(B.BIOMASS,0) AS Biomass,
  ISNULL(B.BOOT_MEAN,0) AS MeanBootstrap,
  ISNULL(B.BOOT_LOWER_CI,0) AS LowerCI,
  ISNULL(B.BOOT_UPPER_CI,0) AS UpperCI,
  ISNULL(B.BOOT_RE,0) AS BootstrapCV
FROM (SELECT *  FROM BOOT_HEADER BH
    WHERE SURVEY_SERIES_ID IN (39, 40, 76) AND
      ACTIVE_IND = 1) A
  LEFT JOIN (SELECT BH.SURVEY_YEAR, BD.*
          FROM BOOT_HEADER BH
            INNER JOIN BOOT_DETAIL BD ON
            BH.BOOT_ID = BD.BOOT_ID
              -- Specify the survey series below
          WHERE BH.SURVEY_SERIES_ID IN (39, 40, 76) AND
            ACTIVE_IND = 1 AND
            SPECIES_CODE = '442') B ON
   A.BOOT_ID = B.BOOT_ID
ORDER BY CASE A.SURVEY_SERIES_ID
    WHEN 39 THEN 'IRFN'
    WHEN 40 THEN 'IRFS'
    WHEN 76 THEN 'SOGDF' ELSE NULL END,
  A.SURVEY_YEAR
```

*Listing 29 – Updates to historic catch; Tables 6 and 7.*

```
-- Returns commercial catch by year and sector which can be appended
-- to reconstructed historic catch records
SELECT
  -- Use the following select statement to give catch (tonnes) by
  -- sector for years 2006 +
  -- Example shown is for the inside DU
          A.YEAR,
          A.ye_du,
          (A.TRAWL_LANDED + A.TRAWL_RELEASED)/1000
                    AS TRAWL_t,
          (A.HAL_LANDED + A.HAL_RELEASED + A.HAL_SBL_LANDED + A.HAL_SBL_RELEASED)/1000
                    AS HALIBUT_t,
          (A.SBL_LANDED + A.SBL_RELEASED)/1000
                    AS SABLEFISH_t,
          (A.DOGFISH_LANDED + A.DOGFISH_RELEASED + LINGCOD_LANDED +
LINGCOD_RELEASED)/1000
                    AS DOGFISH_LINGCOD_t,
          (A.ORF_LANDED + A.ORF_RELEASED)/1000 + (A.IRF_LANDED + A.IRF_RELEASED)/1000
                    AS ROCKFISH_t,
          (A.TRAWL_LANDED + A.HAL_LANDED + A.HAL_SBL_LANDED + A.ORF_LANDED +
A.IRF_LANDED +
```

```
                SBL_LANDED + LINGCOD_LANDED + DOGFISH_LANDED + A.TRAWL_RELEASED +
                A.HAL_RELEASED + A.HAL_SBL_RELEASED + A.ORF_RELEASED + A.IRF_RELEASED
                + SBL_RELEASED + LINGCOD_RELEASED + DOGFISH_RELEASED)/1000
                AS TOTAL_t,
        (A.TRAWL_LANDED + A.HAL_LANDED + A.HAL_SBL_LANDED + A.ORF_LANDED +
A.IRF_LANDED +
                SBL_LANDED + LINGCOD_LANDED + DOGFISH_LANDED)/1000
                AS TOTAL_LANDED_t,
        (A.TRAWL_RELEASED + A.HAL_RELEASED + A.HAL_SBL_RELEASED + A.ORF_RELEASED +
                A.IRF_RELEASED + SBL_RELEASED + LINGCOD_RELEASED +
DOGFISH_RELEASED)/1000
                AS TOTAL_RELEASED_t
FROM (
        SELECT
                CASE WHEN C.MINOR_STAT_AREA_CODE IN
                        ('12', '13', '14', '15', '16', '17', '18', '19', '20', '28', '29')
                        THEN 1 ELSE 2 END AS ye_du,
                YEAR(BEST_DATE) AS YEAR,
                SUM(CASE FISHERY_SECTOR WHEN 'GROUNDFISH TRAWL' THEN
                        ISNULL(LANDED_KG,0) ELSE 0 END) AS TRAWL_LANDED,
                SUM(CASE FISHERY_SECTOR WHEN 'GROUNDFISH TRAWL' THEN
                        ISNULL(DISCARDED_KG,0) ELSE 0 END) AS TRAWL_RELEASED,
                SUM(CASE FISHERY_SECTOR WHEN 'HALIBUT' THEN
                        ISNULL(LANDED_KG,0) ELSE 0 END) AS HAL_LANDED,
                SUM(CASE FISHERY_SECTOR WHEN 'HALIBUT' THEN
                        ISNULL(DISCARDED_KG,0) ELSE 0 END) AS HAL_RELEASED,
                SUM(CASE FISHERY_SECTOR WHEN 'HALIBUT AND SABLEFISH' THEN
                        ISNULL(LANDED_KG,0) ELSE 0 END) AS HAL_SBL_LANDED,
                SUM(CASE FISHERY_SECTOR WHEN 'HALIBUT AND SABLEFISH' THEN
                        ISNULL(DISCARDED_KG,0) ELSE 0 END) AS HAL_SBL_RELEASED,
                SUM(CASE FISHERY_SECTOR WHEN 'ROCKFISH OUTSIDE' THEN

                        ISNULL(LANDED_KG,0) ELSE 0 END) AS ORF_LANDED,
                SUM(CASE FISHERY_SECTOR WHEN 'ROCKFISH OUTSIDE' THEN
                        ISNULL(DISCARDED_KG,0) ELSE 0 END) AS ORF_RELEASED,
                SUM(CASE FISHERY_SECTOR WHEN 'ROCKFISH INSIDE' THEN

                        ISNULL(LANDED_KG,0) ELSE 0 END) AS IRF_LANDED,
                SUM(CASE FISHERY_SECTOR WHEN 'ROCKFISH INSIDE' THEN
                        ISNULL(DISCARDED_KG,0) ELSE 0 END) AS IRF_RELEASED,
                SUM(CASE FISHERY_SECTOR WHEN 'SABLEFISH' THEN
                        ISNULL(LANDED_KG,0) ELSE 0 END) AS SBL_LANDED,
                SUM(CASE FISHERY_SECTOR WHEN 'SABLEFISH' THEN
                        ISNULL(DISCARDED_KG,0) ELSE 0 END) AS SBL_RELEASED,
                SUM(CASE FISHERY_SECTOR WHEN 'LINGCOD' THEN
                        ISNULL(LANDED_KG,0) ELSE 0 END) AS LINGCOD_LANDED,
                SUM(CASE FISHERY_SECTOR WHEN 'LINGCOD' THEN
                        ISNULL(DISCARDED_KG,0) ELSE 0 END) AS LINGCOD_RELEASED,
                SUM(CASE FISHERY_SECTOR WHEN 'SPINY DOGFISH' THEN
                        ISNULL(LANDED_KG,0) ELSE 0 END) AS DOGFISH_LANDED,
                SUM(CASE FISHERY_SECTOR WHEN 'SPINY DOGFISH' THEN
                        ISNULL(DISCARDED_KG,0) ELSE 0 END) AS DOGFISH_RELEASED
        FROM [(local)].GFFOS.dbo.GF_MERGED_CATCH C
        LEFT JOIN [(local)].GFFOS.dbo.LOCALITY L ON
                C.MAJOR_STAT_AREA_CODE = L.MAJOR_STAT_AREA_CODE AND
                C.MINOR_STAT_AREA_CODE = L.MINOR_STAT_AREA_CODE AND
                C.LOCALITY_CODE = L.LOCALITY_CODE
        WHERE SPECIES_CODE = '442'
        GROUP BY YEAR(BEST_DATE), CASE WHEN C.MINOR_STAT_AREA_CODE IN
```

```
        ('12', '13', '14', '15', '16', '17', '18', '19', '20', '28', '29')
        THEN 1 ELSE 2 END) A
        -- Specify A.ye_du = 1 for inside DU or = 2 for outside DU
        -- Specify desired year range
WHERE A.ye_du =1 AND A.YEAR >= 2006
ORDER BY A.YEAR
```

*Listing 30 – Survey summaries; Tables 12 and 13.*

```
SELECT SS.SURVEY_SERIES_DESC AS Survey,
        SS.SURVEY_SERIES_ID,
        MIN(YEAR(TRIP_START_DATE)) AS FirstYear,
        MAX(YEAR(TRIP_START_DATE)) AS LastYear,
        COUNT(DISTINCT(YEAR(TRIP_START_DATE))) AS NumYears,
        COUNT(DISTINCT(CASE C.SPECIES_CODE WHEN '442' THEN
                YEAR(TRIP_START_DATE) ELSE NULL END)) AS SpeciesYears,
        COUNT(DISTINCT(FE.FISHING_EVENT_ID)) AS NumSets,
        COUNT(DISTINCT(CASE C.SPECIES_CODE WHEN '442' THEN
                FE.FISHING_EVENT_ID ELSE NULL END)) AS SpeciesSets,
        AVG(CASE S.TRAWL_IND WHEN 'Y' THEN
                CATCH_WEIGHT ELSE CATCH_COUNT END) AS MnAmtPerSet,
        AVG(CASE C.SPECIES_CODE WHEN '442' THEN
                CASE S.TRAWL_IND WHEN 'Y' THEN CATCH_WEIGHT ELSE CATCH_COUNT END
                        ELSE NULL END) AS MnSppAmtPerSet
FROM [(local)].GFBioSQL.dbo.SURVEY_SERIES SS
        INNER JOIN [(local)].GFBioSQL.dbo.SURVEY S ON
                SS.SURVEY_SERIES_ID = S.SURVEY_SERIES_ID
        INNER JOIN [(local)].GFBioSQL.dbo.TRIP_SURVEY TS ON
                S.SURVEY_ID = TS.SURVEY_ID
        INNER JOIN [(local)].GFBioSQL.dbo.SURVEY_GROUPING SG ON
                S.SURVEY_ID = SG.SURVEY_ID
        INNER JOIN [(local)].GFBioSQL.dbo.TRIP T ON
                TS.TRIP_ID = T.TRIP_ID
        INNER JOIN [(local)].GFBioSQL.dbo.FISHING_EVENT FE ON
                T.TRIP_ID = FE.TRIP_ID
        INNER JOIN [(local)].GFBioSQL.dbo.FISHING_EVENT_GROUPING FEG ON
                FE.FISHING_EVENT_ID = FEG.FISHING_EVENT_ID
                AND     SG.GROUPING_CODE = FEG.GROUPING_CODE
        INNER JOIN [(local)].GFBioSQL.dbo.FISHING_EVENT_CATCH FEC ON
                FE.FISHING_EVENT_ID = FEC.FISHING_EVENT_ID
        INNER JOIN [(local)].GFBioSQL.dbo.CATCH C ON
                FEC.CATCH_ID = C.CATCH_ID
        LEFT JOIN [(local)].GFBioSQL.dbo.TRAWL_SPECS TRLSP ON
                FE.FISHING_EVENT_ID = TRLSP.FISHING_EVENT_ID
        LEFT JOIN [(local)].GFBioSQL.dbo.LONGLINE_SPECS LS ON
                FE.FISHING_EVENT_ID = LS.FISHING_EVENT_ID
WHERE SS.SURVEY_SERIES_ID IN (1,2,3,4,16,6,7,11,14,22,32,36,39,40,35,41,42,43,32,79,45) AND
        ISNULL(COALESCE(TRLSP.USABILITY_CODE, LS.USABILITY_CODE),0) IN (0,1,2,6,12) AND
        C.SPECIES_CODE NOT IN ('M900','M901','003')
GROUP BY SS.SURVEY_SERIES_DESC, SS.SURVEY_SERIES_ID
ORDER BY SS.SURVEY_SERIES_ID
```