ESA-listed Rockfishes in Puget Sound: Catch Reconstruction

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Contents

Description

This R markdown file goes through the catch reconstruction of yelloweye rockfish and bocaccio in Puget Sound. This document will generate different plausible catch scenarios and address the sources of uncertainty at each step of the analysis. This document is organized in reverse chronological order, beginning with the commercial catch and then going through the recreational catch.

Additionally, in accordance with the 2017 Rockfish Recovery Plan, catch histories for three different geographic areas are constructed:

1. The entire DPS (Canada and United States), minus the Hood Canal population
2. The Hood Canal population
3. The United States side of the DPS, excluding Hood Canal

Commercial data

First step: Load species composition data from Cyreis Schmitt

The first step in our analysis is to load the species composition tables from Cyreis Schmitt, as this data will be used for multiple time periods in the commercial catch.

```
## Load species composition tables
comp_table_path <- here("catch_reconstruction_data", "commercial", "schmitt_1991_table2_spp_comp_region_
trawl_comps <- read_excel(comp_table_path, sheet = "trawl")
set_net_comps <- read_excel(comp_table_path, sheet = "set_net")
set_line_comps <- read_excel(comp_table_path, sheet = "set_line")
troll_comps <- read_excel(comp_table_path, sheet = "troll")
jig_comps <- read_excel(comp_table_path, sheet = "jig")

# Convert all to long format, and format for joining

# trawl_comps
trawl_comps %>%
  pivot_longer(cols = colnames(trawl_comps)[c(2:length(colnames(trawl_comps)))], names_to = "region") %
  # Change percentages to proportions
  mutate(., value = value/100) %>%
  # Keep only yelloweye and bocaccio
  subset(., species %in% c("Yelloweye", "Bocaccio")) %>%
  mutate(., bocaccio_prop = ifelse(species == "Bocaccio", value, NA)) %>%
  mutate(., yelloweye_prop = ifelse(species == "Yelloweye", value, NA)) %>%
  # Drop species column now that it's in column name; also drop "value" (since these are now separated
  dplyr::select(-c(species, value)) %>%
  # Merge rows together, replacing NAs
  group_by(region) %>%
  summarise_each(funs(sum(., na.rm = TRUE))) -> trawl_comps_YE_boc
  # Add region numbers
  trawl_comps_YE_boc$REGION = c(5,1,4,3,2,6,7)
  # Add gear type column
  trawl_comps_YE_boc$gear <- "Bottom trawl"

# set_net_comps
set_net_comps %>%
  pivot_longer(cols = colnames(set_net_comps)[c(2:length(colnames(set_net_comps)))], names_to = "region
  # Change percentages to proportions
  mutate(., value = value/100) %>%
  # Keep only yelloweye and bocaccio
  subset(., species %in% c("Yelloweye", "Bocaccio")) %>%
  mutate(., bocaccio_prop = ifelse(species == "Bocaccio", value, NA)) %>%
  mutate(., yelloweye_prop = ifelse(species == "Yelloweye", value, NA)) %>%
  # Drop species column now that it's in column name; also drop "value" (since these are now separated
  dplyr::select(-c(species, value)) %>%
  # Merge rows together, replacing NAs
  group_by(region) %>%
  summarise_each(funs(sum(., na.rm = TRUE))) -> set_net_comps_YE_boc
  # Add region numbers
  set_net_comps_YE_boc$REGION = c(5,1,4,3,2,6,7)
  # Add gear type column
  set_net_comps_YE_boc$gear <- "Set net"
```

```
# set_line_comps
set_line_comps %>%
  pivot_longer(cols = colnames(set_line_comps)[c(2:length(colnames(set_line_comps)))], names_to = "regi
  # Change percentages to proportions
  mutate(., value = value/100) %>%
  # Keep only yelloweye and bocaccio
  subset(., species %in% c("Yelloweye", "Bocaccio")) %>%
  mutate(., bocaccio_prop = ifelse(species == "Bocaccio", value, NA)) %>%
  mutate(., yelloweye_prop = ifelse(species == "Yelloweye", value, NA)) %>%
  # Drop species column now that it's in column name; also drop "value" (since these are now separated
  dplyr::select(-c(species, value)) %>%
  # Merge rows together, replacing NAs
  group_by(region) %>%
  summarise_each(funs(sum(., na.rm = TRUE))) -> set_line_comps_YE_boc
  # Add region numbers
  set_line_comps_YE_boc$REGION = c(5,1,4,3,2,6,7)
  # Add gear type column
  set_line_comps_YE_boc$gear <- "Set line"

# troll_comps
troll_comps %>%
  pivot_longer(cols = colnames(troll_comps)[c(2:length(colnames(troll_comps)))], names_to = "region") %
  # Change percentages to proportions
  mutate(., value = value/100) %>%
  # Keep only yelloweye and bocaccio
  subset(., species %in% c("Yelloweye", "Bocaccio")) %>%
  mutate(., bocaccio_prop = ifelse(species == "Bocaccio", value, NA)) %>%
  mutate(., yelloweye_prop = ifelse(species == "Yelloweye", value, NA)) %>%
  # Drop species column now that it's in column name; also drop "value" (since these are now separated
  dplyr::select(-c(species, value)) %>%
  # Merge rows together, replacing NAs
  group_by(region) %>%
  summarise_each(funs(sum(., na.rm = TRUE))) -> troll_comps_YE_boc
  # Add region numbers
  troll_comps_YE_boc$REGION = c(5,1,4,3,2,6,7)
  # Add gear type column
  troll_comps_YE_boc$gear <- "All troll"

# jig_comps
jig_comps %>%
  pivot_longer(cols = colnames(jig_comps)[c(2:length(colnames(jig_comps)))], names_to = "region") %>%
  # Change percentages to proportions
  mutate(., value = value/100) %>%
  # Keep only yelloweye and bocaccio
  subset(., species %in% c("Yelloweye", "Bocaccio")) %>%
  mutate(., bocaccio_prop = ifelse(species == "Bocaccio", value, NA)) %>%
  mutate(., yelloweye_prop = ifelse(species == "Yelloweye", value, NA)) %>%
  # Drop species column now that it's in column name; also drop "value" (since these are now separated
  dplyr::select(-c(species, value)) %>%
  # Merge rows together, replacing NAs
  group_by(region) %>%
  summarise_each(funs(sum(., na.rm = TRUE))) -> jig_comps_YE_boc
  # Add region numbers
```

```
  jig_comps_YE_boc$REGION = c(5,1,4,3,2,6,7)
  # Add gear type column
  # jig_comps_YE_boc$gear <- NA
  jig_comps_YE_boc$gear <- "Handline jig"

# Join all comp data together
trawl_comps_YE_boc %>%
  bind_rows(., set_net_comps_YE_boc) %>%
  bind_rows(., set_line_comps_YE_boc) %>%
  bind_rows(., troll_comps_YE_boc) %>%
  bind_rows(., jig_comps_YE_boc) -> comp_tables
```

2004-2020

Notes:

This data period is characterized by 1) low catches of bocaccio and yelloweye following regulatory changes and 2) relatively high confidence in the data.

Catch areas:

This data is split by region into the marine fish-shellfish marine catch reporting areas (WDFW). Areas in relation to DPSs: 1. Hood Canal: Regions 27A, 27B, and 27C. Note that Rickey's management region of "Hood Canal" includes area 25C in addition to these, but according to the rockfish recovery plan 25C is not part of the DPS. 27A appears to mostly be within the Hood Canal DPS, but a small section is outside. 2. U.S. DPS except Hood Canal: Everything else except areas 29 and 23C (these are West Juan de Fuca and outside of the DPS).

We are currently lacking regional resolution for this time period which should hopefully be fixed soon.

Yelloweye catch scenarios

Yelloweye rockfish are a reporting category for this time period and as such will only have one catch estimate.

Bocaccio catch scenarios

Bocaccio rockfish are lumped into the "shelf rockfish" category and will have different catch scenarios (these could be amended if any species composition data comes available):

1. High catch: All "shelf rockfish" are bocaccio.
2. Medium catch: 50% of "shelf rockfish" are bocaccio.
3. Low catch: No "shelf rockfish" are bocaccio.

```
PS_CL_1970_2020_path <- here("catch_reconstruction_data", "commercial", "Puget Sound commercial landings
PS_CL_1970_2020 <- read_excel(PS_CL_1970_2020_path, skip = 1, sheet = "By catch area")

# Create new categories and rename
PS_CL_1970_2020 %>%
  dplyr::rename(catch_lbs = SumOfRoundPoundQuantity, year = Year, species = MarketSpeciesCategoryName) %
  mutate(DPS = ifelse(CatchAreaCode %in% c("27A", "27B", "27C"), "Hood Canal",
                      ifelse(CatchAreaCode %in% c("29.0", "23C"), "Outside DPS","U.S. DPS except Hood Ca
```

```
  dplyr::select(-c(CatchAreaCode, CatchAreaDescription, MarketSpeciesCategoryCode)) %>%
  group_by(year, DPS, species) %>%
  summarise(catch_lbs = sum(catch_lbs)) -> PS_CL_1970_2020
```

```
## `summarise()` has grouped output by 'year', 'DPS'. You can override using the `.groups` argument.
```

```
# Yelloweye are a market category; subset yelloweye
PS_CL_1970_2020 %>%
  # Ungroup to prevent duplicated rows
  ungroup() %>%
  subset(year >= 2004) %>%
  subset(., species == "ROCKFISH (YELLOWEYE)") %>%
  # Add zeros for years where there was no catch using tidyverse::complete
  complete(., DPS = c("U.S. DPS except Hood Canal", "Outside DPS", "Hood Canal"), year = seq(2004, 2020
  subset(., DPS %in% c("U.S. DPS except Hood Canal", "Hood Canal")) %>%
  # Drop species field
  dplyr::select(-species) -> YE_comm_2004_2020

# Generate three catch scenarios (all the same)
YE_comm_2004_2020 %>%
  mutate(., high_catch = catch_lbs) %>%
  mutate(., low_catch = catch_lbs) %>%
  mutate(., medium_catch = catch_lbs) -> YE_comm_2004_2020

# Bocaccio are not a market category, but are in the "shelf rockfish" group
PS_CL_1970_2020 %>%
  # Ungroup to prevent duplicated rows
  ungroup() %>%
  subset(year >= 2004) %>%
  subset(., species == "SHELF ROCKFISH") %>%
  # Add zeros for years where there was no catch using tidyverse::complete
  complete(., DPS = c("U.S. DPS except Hood Canal", "Outside DPS", "Hood Canal"), year = seq(2004, 2020
  # Combine US side of DPS and Hood Canal for Bocaccio
  mutate(DPS = ifelse(DPS %in% c("Hood Canal", "U.S. DPS except Hood Canal"), "U.S. DPS", DPS)) %>%
  group_by(year, DPS) %>%
  summarise(catch_lbs = sum(catch_lbs))  %>%
  subset(., DPS == "U.S. DPS") -> shelf_RF_comm_2004_2020
```

```
## `summarise()` has grouped output by 'year'. You can override using the `.groups` argument.
```

```
# Generate three catch scenarios
shelf_RF_comm_2004_2020 %>%
  mutate(., high_catch = catch_lbs) %>%
  mutate(., low_catch = 0) %>%
  mutate(., medium_catch = 0.5*catch_lbs) -> shelf_RF_comm_2004_2020
```

1970-2003

Notes:

This data was provided by Wayne Palsson. For the time period 1970-2003, catch has already been prorated to species level based on catch composition data.

Yelloweye catch scenarios

Yelloweye rockfish was estimated by prorating total rockfish catch based on reliable catch composition data for this time period. However, region 3 (Strait of Juan de Fuca) is about half in and half out of the DPS, as such, the different catch scenarios concern whether or not this data is included:

1. High catch: All catch from the Strait of Juan de Fuca is included.
2. Medium catch: 50% of the catch from the Strait of Juan de Fuca is included.
3. Low catch: No catch from the Strait of Juan de Fuca is included.

Bocaccio catch scenarios

Bocaccio was estimated by prorating total rockfish catch based on reliable catch composition data for this time period and as such will only have one catch estimate. However, region 3 (Strait of Juan de Fuca) is about half in and half out of the DPS, as such, the different catch scenarios concern whether or not this data is included:

1. High catch: All catch from the Strait of Juan de Fuca is included.
2. Medium catch: 50% of the catch from the Strait of Juan de Fuca is included.
3. Low catch: No catch from the Strait of Juan de Fuca is included.

Prepare data

Here we load the HISCOM data and make edits to it, converting species, gear, and region codes to what they actually signify.

```
HISCOM_path <- here("catch_reconstruction_data", "commercial", "HISCOM.xlsx")

HISCOM <- read_excel(HISCOM_path)

# Change types of certain columns
HISCOM %>%
  mutate(., YEAR = as.numeric(YEAR)) %>%
  mutate(., REGION = as.numeric(REGION)) %>%
  mutate(EFFORT = as.numeric(EFFORT)) %>%
  mutate(SPECIES = as.numeric(SPECIES)) %>%
  dplyr::rename(species_code = SPECIES) -> HISCOM

# Change species column to species names rather than codes; use conversion table Wayne provided
recreational_weight_conversion_path <- here("catch_reconstruction_data", "recreational", "Recreationalc
recreational_weight_conversion <- read_excel(recreational_weight_conversion_path, sheet = "Sheet1", ski
```

```
## New names:
## * `` -> ...1
## * `` -> ...2
```

```
recreational_weight_conversion %>%
  dplyr::rename(species = "...2") %>%
  dplyr::rename(species_code = "...1") %>%
  # Drop weight conversions
  dplyr::select(-c(kg, lbs)) -> species_code_key
```

```
# Make some edits to make it consistent with the Rickey doc

# Add the missing codes
missing_codes <- data.frame(species_code = c(35, 36, 37), species = c("MONTHLY or ANNYAL TOTAL CATCH", "
species_code_key <- dplyr::bind_rows(species_code_key, missing_codes)

species_code_key <- species_code_key[!is.na(species_code_key$species_code),]

# Merge on species_code; drop species_code
HISCOM %>%
  dplyr::left_join(., species_code_key, by = "species_code") %>%
  dplyr::select(-c(species_code)) -> HISCOM

# Change effort to text
effort_codes <- data.frame(EFFORT = c(1,2,3,4,5,6,7,8,9,10,11,12), gear = c("Handline jig", "Bottomfish
# Merge on EFFORT; drop EFFORT
HISCOM %>%
  dplyr::left_join(., effort_codes, by = "EFFORT") %>%
  dplyr::select(-c(EFFORT)) -> HISCOM

# Create a region code to region name key (from Rickey)
HISCOM_regions <- data.frame(REGION = c(1,2,3,4,5,6,7,8,9), region = c("Gulf - Bellingham", "San Juan Is
# Change region numbers to region names
HISCOM %>%
  left_join(., HISCOM_regions, by = "REGION") -> HISCOM
```

```
# Subset yelloweye
HISCOM %>%
  subset(., gear == "Total commercial effort") %>%
  subset(., species == "Yelloweye rockfish") %>%
  dplyr::select(c(YEAR, region, gear, TOTAL)) %>%
  dplyr::rename(year = YEAR) %>%
  # Add zeros for years where there was no catch using tidyverse::complete
  ungroup() %>%
  complete(., region = c("Gulf - Bellingham", "San Juan Islands", "Strait of Juan de Fuca", "Hood Canal

# Subset Hood Canal population - only one estimate
YE_HISCOM %>%
  subset(., region == "Hood Canal") %>%
  mutate(., DPS = "Hood Canal")  %>%
  # add columns for joining
  mutate(., high_catch = TOTAL) %>%
  mutate(., low_catch = TOTAL) %>%
  mutate(., medium_catch = TOTAL) %>%
  dplyr::rename(., catch_lbs = TOTAL) %>%
  dplyr::select(-c(region, gear)) -> YE_HISCOM_hood_canal

# High catch scenario - including all catch from Strait of Juan de Fuca
YE_HISCOM %>%
  subset(., region == "All PS") %>%
  mutate(., DPS = "U.S. DPS except Hood Canal") %>%
  dplyr::rename(high_catch = TOTAL) -> YE_HISCOM_USDPS_high
```

```
# Medium catch scenario - including 50% of catch from Strait of Juan de Fuca
YE_HISCOM %>%
  subset(., region %in% c("All PS", "Strait of Juan de Fuca")) %>%
  group_by(year) %>%
  mutate(medium_catch = TOTAL - 0.5*TOTAL[region == "Strait of Juan de Fuca"]) %>%
  mutate(., DPS = "U.S. DPS except Hood Canal") %>%
  subset(., region == "All PS") -> YE_HISCOM_USDPS_medium

# Low catch scenario - including no catch from Strait of Juan de Fuca
YE_HISCOM %>%
  subset(., region %in% c("All PS", "Strait of Juan de Fuca")) %>%
  group_by(year) %>%
  mutate(low_catch = TOTAL - TOTAL[region == "Strait of Juan de Fuca"]) %>%
  mutate(., DPS = "U.S. DPS except Hood Canal") %>%
  subset(., region == "All PS") -> YE_HISCOM_USDPS_low

# Subset bocaccio
HISCOM %>%
  subset(., gear == "Total commercial effort") %>%
  subset(., species == "Bocaccio") %>%
  dplyr::select(c(YEAR, region, gear, TOTAL)) %>%
  dplyr::rename(year = YEAR) %>%
  # Add zeros for years where there was no catch using tidyverse::complete
  ungroup() %>%
  complete(., region = c("Gulf - Bellingham", "San Juan Islands", "Strait of Juan de Fuca", "Hood Canal

# High catch scenario - including all catch from Strait of Juan de Fuca
BOC_HISCOM %>%
  subset(., region == "All PS") %>%
  mutate(., DPS = "U.S. DPS") %>%
  dplyr::rename(high_catch = TOTAL) -> BOC_HISCOM_USDPS_high

# Medium catch scenario - including 50% of catch from Strait of Juan de Fuca
BOC_HISCOM %>%
  subset(., region %in% c("All PS", "Strait of Juan de Fuca")) %>%
  group_by(year) %>%
  mutate(medium_catch = TOTAL - 0.5*TOTAL[region == "Strait of Juan de Fuca"]) %>%
  mutate(., DPS = "U.S. DPS") %>%
  subset(., region == "All PS") -> BOC_HISCOM_USDPS_medium

# Medium catch scenario - including no catch from Strait of Juan de Fuca
BOC_HISCOM %>%
  subset(., region %in% c("All PS", "Strait of Juan de Fuca")) %>%
  group_by(year) %>%
  mutate(low_catch = TOTAL - TOTAL[region == "Strait of Juan de Fuca"]) %>%
  mutate(., DPS = "U.S. DPS") %>%
  subset(., region == "All PS") -> BOC_HISCOM_USDPS_low
```

```
# Plot catch of yelloweye and bocaccio by region, to get a visual on how sensitive estimates will be to
YE_HISCOM_plot_region <- ggplot(subset(YE_HISCOM, !(region %in% c("All PS", "PS + West Juan de Fuca", "
  geom_bar(stat = "identity") +
  ggtitle("Yelloweye catch by region, 1955-2003") +
  scale_fill_tableau(palette = "Tableau 10")
```

```
ggsave(paste0(fig_dir, "/YE_HISCOM_plot_region.png"), YE_HISCOM_plot_region, height = 8, width = 10)

BOC_HISCOM_plot_region <- ggplot(subset(BOC_HISCOM, !(region %in% c("All PS", "PS + West Juan de Fuca",
  geom_bar(stat = "identity") +
  ggtitle("Bocaccio catch by region, 1955-2003") +
  scale_fill_tableau(palette = "Tableau 10")

ggsave(paste0(fig_dir, "/BOC_HISCOM_plot_region.png"), BOC_HISCOM_plot_region, height = 8, width = 10)
```

```
YE_HISCOM_USDPS_low %>%
  left_join(., YE_HISCOM_USDPS_medium, by = c("year", "region", "gear", "TOTAL", "DPS")) %>%
  left_join(., YE_HISCOM_USDPS_high, by = c("year", "region", "gear", "DPS")) %>%
  dplyr::rename(catch_lbs = TOTAL) %>%
  dplyr::select(-c(region, gear)) %>%
  # Add hood canal data
  bind_rows(., YE_HISCOM_hood_canal) %>%
  # Subset years
  subset(., year >= 1970) -> YE_comm_1970_2003

BOC_HISCOM_USDPS_low %>%
  left_join(., BOC_HISCOM_USDPS_medium, by = c("year", "region", "gear", "TOTAL", "DPS")) %>%
  left_join(., BOC_HISCOM_USDPS_high, by = c("year", "region", "gear", "DPS")) %>%
  dplyr::rename(catch_lbs = TOTAL) %>%
  dplyr::select(-c(region, gear)) %>%
  # Subset years
  subset(., year >= 1970) -> BOC_comm_1970_2003
```

1955-1969

Notes:

This data was provided by Wayne Palsson. For this time period, we have three categories for rockfish: "general rockfish", "red snapper", and "black rockfish". We do not have any catch composition data for this time period.

There are two main decisions to make regarding this time period:

1. Are yelloweye catches for this time period limited to "red snapper", or is it possible that in addition to "red snapper" there are actually yelloweye in the "general rockfish" category?
2. Should catches from the Strait of Juan de Fuca be included?

For now, we will assume that yelloweye catch is only the "red snapper" catch. Bocaccio catch will be prorated based on the 1970-1987 catch composition data from Schmitt 1991.

We also have "red snapper" already from the HISCOM data, so we just need to re-subset that dataframe for the appropriate timeframe. Another interesting note: West Juan de Fuca (region 7) was not used until 1970. Does this mean that there was no catch from this region until 1970 when it abruptly started, or was this due to a change in regional reporting requirements? i.e. were Strait of Juan de Fuca and West Juan de Fuca one region prior to 1970?

Yelloweye catch scenarios

Region 3 (Strait of Juan de Fuca) is about half in and half out of the DPS, as such, the different catch scenarios concern whether or not this data is included:

1. High catch: All "red snapper" catch from the Strait of Juan de Fuca is included.
2. Medium catch: 50% of the "red snapper" catch from the Strait of Juan de Fuca is included.
3. Low catch: No "red snapper" catch from the Strait of Juan de Fuca is included.

Bocaccio catch scenarios

For the time period 1955-1969, for the Strait of Juan de Fuca (region 3), there are only the following gear types: All troll, Drag seine, Bottom trawl, Set net and Salmon net. According to the species composition table from Cyreis Schmitt, none of these gear types ever caught Bocaccio in the Strait of Juan de Fuca. Thus the catch of Bocaccio will not be affected by how much of the Strait of Juan de Fuca catch is included in the catch estimates.

Therefore, there is only one estimate of Bocaccio from this time period.

```
# Yelloweye
YE_HISCOM_USDPS_low %>%
  left_join(., YE_HISCOM_USDPS_medium, by = c("year", "region", "gear", "TOTAL", "DPS")) %>%
  left_join(., YE_HISCOM_USDPS_high, by = c("year", "region", "gear", "DPS")) %>%
  dplyr::rename(catch_lbs = TOTAL) %>%
  dplyr::select(-c(region, gear)) %>%
  # Add hood canal data
  bind_rows(., YE_HISCOM_hood_canal) %>%
  # Subset years
  subset(., year >= 1955 & year <= 1969) -> YE_comm_1955_1969

# Bocaccio
# Prorate Bocaccio catch based on species composition tables from Cyreis Schmitt
comp_tables
```

```
## # A tibble: 35 x 5
##    region            bocaccio_prop yelloweye_prop REGION gear
##    <chr>                     <dbl>          <dbl>  <dbl> <chr>
##  1 central_sound               0              0         5 Bottom trawl
##  2 gulf_bellingham             0              0.04      1 Bottom trawl
##  3 hood_canal                  0              0         4 Bottom trawl
##  4 juan_de_fuca                0              0         3 Bottom trawl
##  5 san_juan_islands            0              0         2 Bottom trawl
##  6 south_sound                 0              0         6 Bottom trawl
##  7 west_juan_de_fuca           0              0         7 Bottom trawl
##  8 central_sound               0.7            0         5 Set net
##  9 gulf_bellingham             0              0         1 Set net
## 10 hood_canal                  0.2            0.05      4 Set net
## # ... with 25 more rows
```

```
HISCOM %>%
  # Subset years for which we need to prorate catch
  subset(., YEAR >= 1955 & YEAR <= 1969) %>%
  # Subset only unidentified rockfishes (for this time period, it is all rockfish that aren't "red snap
```

```
  subset(., species %in% c("Misc. rockfish")) %>%
  dplyr::select(c(YEAR, REGION, region, gear, TOTAL, species)) %>%
  # Drop the total commercial effort category
  subset(., gear != "Total commercial effort") %>%
  # combine the troll categories
    mutate(gear = ifelse(gear %in% c("All (combined) troll (1970-1979)", "Bottomfish troll (1980-)", "O
  # Remove the summary regions
  subset(., !(region == "All PS")) %>%
  # Add the comp table data
  left_join(., dplyr::select(comp_tables, -region), by = c("REGION", "gear")) %>%
  # Multiple TOTAL by prop to get catch
  mutate(., bocaccio_catch_estimate = bocaccio_prop*TOTAL) -> boc_55_69_prorated

# summarise across years, rename columns
boc_55_69_prorated %>%
  dplyr::rename(year = YEAR) %>%
  group_by(year) %>%
  summarise(catch_lbs = sum(bocaccio_catch_estimate, na.rm = TRUE)) %>%
  mutate(DPS = "U.S. DPS") %>%
  mutate(., high_catch = catch_lbs) %>%
  mutate(., medium_catch = catch_lbs) %>%
  mutate(., low_catch = catch_lbs) -> BOC_comm_55_69
```

1943-1954

Notes:

This data comes from the yellow book. We do not have any region-specific information for this time period, but we do have catches by gear.

The main decision for this time period is how to estimate the catch by region. While the yellow book does not have regional information, the bound volume data does. The bound volume catch estimates are very similar to those of the yellow book, especially for the later period (1955 onwards). At that point, should we just use the bound volume data, instead of using the yellow book for total catch and gear type and bound volume data to estimate regional proportions?

We will first compare yellow book and bound volume data for this time period. - Based on a visual comparison of yellow book and bound volume data for 1955-1960, all regions look fairly comparable except for the "Gulf - Bellingham" region, which has higher values in the yellow book.

Main decisions for this time period:

1. Do we use the catch composition data for 1970-1987 (20-40 years after this time period)? I don't see what other data we could use.
2. What gear and region information do we use?

- Yellow book gear information, multiplied by the regional proportions from the bound volume data
- All data from bound volumes (total catch, gear, and region)
- Yellow book catch totals, prorated by gear and region from the bound volumes (this feels really inaccurate).
- Bound volume data multiplied by a conversion factor that is equal to mean yellow book divided by mean bound volume catch?

```
yellowbook_path <- here("catch_reconstruction_data", "commercial", "yellowbook_1921_1954.csv")

yellowbook <- read.csv(yellowbook_path)

# convert to long format; drop non-gear type names
yellowbook %>%
  dplyr::select(-c(total, species)) %>%
  pivot_longer(., cols = colnames(yellowbook)[!colnames(yellowbook) %in% c("year", "species", "total")]

# Add source column
yb_long %>%
  mutate(source = "Yellow Book") -> yb_long

# Fill NAs with zeros
yb_long[is.na(yb_long$value),]$value <- 0

# Rename gear types to match with bound volumes
unique(yb_long$gear)
```

```
## [1] "pound_net"      "drag_seine"     "set_net"        "otter_trawl"
## [5] "handline_troll" "set_line"       "beam_trawl"     "other_gear"
## [9] "unknown"
```

```
yb_long %>%
  mutate(gear = ifelse(gear == "pound_net", "Pound Net",gear)) %>%
  mutate(gear = ifelse(gear == "drag_seine", "Drag Seine",gear)) %>%
  mutate(gear = ifelse(gear == "set_net", "Set Net",gear)) %>%
  mutate(gear = ifelse(gear == "otter_trawl", "Trawl",gear)) %>%
  mutate(gear = ifelse(gear == "handline_troll", "Troll",gear)) %>%
  mutate(gear = ifelse(gear == "set_line", "Set line",gear)) %>%
  mutate(gear = ifelse(gear == "beam_trawl", "Trawl",gear)) %>%
  mutate(gear = ifelse(gear == "other_gear", "Other",gear))  -> yb_long
```

```
BV_path <- here("catch_reconstruction_data", "commercial", "boundvolumes_OLDMFLnData36_60_ROCKFISH.xlsx

BV_1936_60 <- read_excel(BV_path)

BV_35_42_path <- here("catch_reconstruction_data", "commercial", "boundvolumes_OLDMFLnData35_42_12570_I

BV_1935_42 <- read_excel(BV_35_42_path)
# Subset rockfish
BV_1935_42 %>%
  subset(., Species_Orig == "ROCK COD")  -> BV_1935_42

# Combine two dfs
setdiff(colnames(BV_1935_42), colnames(BV_1936_60))
```

```
## [1] "XRefSpeciesID_Fkey"       "Utilization"
## [3] "XRef_GearCodeID _Fkey"    "XRefAreaID_Fkey"
## [5] "Amount_Landed_Normalized"
```

```
setdiff(colnames(BV_1936_60), colnames(BV_1935_42))
```

```
## [1] "Norm_Species"     "Norm_Disposition" "Norm_Gear"        "Norm_CatchArea"
## [5] "Norm_AmtLanded"   "Select4Edit"
```

```
# Drop the columns that aren't in both (these aren't informative)
# Rename certain columns

BV_1935_42 %>%
  dplyr::select(-c("XRefSpeciesID_Fkey", "Utilization",  "XRef_GearCodeID _Fkey", "XRefAreaID_Fkey")) %>%
  dplyr::rename(Norm_AmtLanded = Amount_Landed_Normalized) -> BV_1935_42

BV_1936_60 %>%
  dplyr::select(-c(Select4Edit)) -> BV_1936_60

BV_1935_42 %>%
  bind_rows(., BV_1936_60) -> BV_1935_60

# Load the catch area to region key
BC_catcharea_key_path <- here("catch_reconstruction_data", "commercial", "boundvolume_catcharea_key.xlsx")
BC_catcharea_key <- read_excel(BC_catcharea_key_path)

# Combine the two catch area columns, join with key
BV_1935_60 %>%
  mutate(., catch_area = ifelse(is.na(Norm_CatchArea), CatchArea_Orig, Norm_CatchArea)) %>%
  left_join(., BC_catcharea_key, by = "catch_area") -> BV_1935_60

# Drop the data from outside PS
BV_1935_60 %>%
  subset(., !(region %in% c("OUTSIDE", "COAST", "COLUMBIA RIVER", "UNKNOWN"))) -> BV_PS

# Edit gears
BV_PS %>%
  mutate(., gear = ifelse(is.na(Norm_Gear), Gear_Orig, Norm_Gear)) %>%
  mutate(gear = ifelse(gear %in% c("BT", "Trawl - Otter", "Trawl - Beam"), "Trawl", gear)) %>%
  mutate(gear = ifelse(gear %in% c("DS", "Drag Seine"), "Drag Seine", gear)) %>%
  mutate(gear = ifelse(gear %in% c("H&L", "HL", "Hook and Line"), "Hook and Line", gear)) %>%
  mutate(gear = ifelse(gear %in% c("SL", "Longline/Set Line"), "Set line", gear)) %>%
  mutate(gear = ifelse(gear %in% c("PS", "Purse Seine", "Purse Seine  - (salmon)"), "Purse seine", gear)
  mutate(gear = ifelse(gear %in% c("Troll - Unknown", "Troll - (salmon)", "Troll - Bottomfish"), "Troll"
  mutate(gear = ifelse(gear %in% c("Handline/Jigger"), "Handline jig", gear)) %>%
  mutate(gear = ifelse(gear %in% c("Set Net/Gillnet - Tribal", "Drag Seine - Tribal"), "Tribal Fisheries
  mutate(gear = ifelse(gear %in% c("Not reported", "Trap - Shellfish Pot (Dungeness)", "Beach Seine", "(

unique(BV_PS$gear)
```

```
##  [1] "Trawl"            "Drag Seine"       "Hook and Line"    "Set line"
##  [5] "Purse seine"      "Troll"            "Other"            "Set Net"
##  [9] "Handline jig"     "Tribal Fisheries"
```

```
subset(BV_PS, YearLanded_Orig == 1941)
```

```
## # A tibble: 460 x 40
##    YearLanded_Orig Species_Code_Or~ Species_Orig CurrDispCode_Fk~ Gear_Code_Orig
##              <dbl> <chr>            <chr>        <lgl>            <chr>
##  1            1941 -999             ROCK COD     NA               -999
##  2            1941 -999             ROCK COD     NA               -999
##  3            1941 -999             ROCK COD     NA               -999
##  4            1941 -999             ROCK COD     NA               -999
##  5            1941 -999             ROCK COD     NA               -999
##  6            1941 -999             ROCK COD     NA               -999
##  7            1941 -999             ROCK COD     NA               -999
##  8            1941 -999             ROCK COD     NA               -999
##  9            1941 -999             ROCK COD     NA               -999
## 10            1941 -999             ROCK COD     NA               -999
## # ... with 450 more rows, and 35 more variables: Gear_Orig <chr>,
## #   Area_Code_Orig <chr>, CatchArea_Orig <chr>, Month_Orig <dbl>,
## #   Day_Orig <dbl>, Amount_CUn_Orig <dbl>, Amount_CRd_Orig <dbl>,
## #   Amount_CDressed_Orig <lgl>, Source <chr>, Units_Orig <dbl>,
## #   Comment_Orig <lgl>, LandingDistrict_Orig <chr>, BndVolPageNo_Orig <dbl>,
## #   Fishery_Orig <lgl>, Vessel_PlateNum_Orig <lgl>, Quality_Orig <lgl>,
## #   RecType_Orig <chr>, OLDMFLnData_ID <dbl>, RecTypeID_Fkey <chr>,
## #   InputDataQualityID_Fkey <chr>, Norm_AmtLanded <dbl>, DateAdded <dttm>,
## #   DateEdited <dttm>, EditorsComment <lgl>, `Edited2-99` <lgl>,
## #   Link2OrigMaster <dbl>, Norm_Species <chr>, Norm_Disposition <chr>,
## #   Norm_Gear <chr>, Norm_CatchArea <chr>, catch_area <chr>, region <chr>,
## #   state <chr>, confidence <dbl>, gear <chr>
```

```
# Summarize by year to compare with yellow book data
BV_PS %>%
  dplyr::select(YearLanded_Orig, Norm_AmtLanded) %>%
  group_by(YearLanded_Orig) %>%
  summarise(annual_catch = sum(Norm_AmtLanded, na.rm = TRUE)) %>%
  mutate(data_source = "Bound Volumes")-> BV_PS_annual_sums

# Reformat to join with yellow book data
BV_PS %>%
  dplyr::rename(year = YearLanded_Orig, value = Norm_AmtLanded) %>%
  dplyr::select(year, value, gear, region) %>%
  # Sum by region, gear, and year
  group_by(year, gear, region) %>%
  summarise(value = sum(value)) %>%
  # Use complete to fill in zeros for missing year-gear-region combinations
  ungroup() %>%
  complete(., region = c("Gulf - Bellingham", "San Juan Islands", "Strait of Juan de Fuca", "Hood Canal
  mutate(., source = "Bound Volumes") -> BV_PS_sums
```

```
## `summarise()` has grouped output by 'year', 'gear'. You can override using the `.groups` argument.
```

```
BV_PS_sums %>%
  bind_rows(., yb_long) -> BV_YB

# Plot BV catch by region
BV_catch_by_region <- ggplot(BV_PS_sums, aes(x = year, y = value, fill = region)) +
  geom_bar(stat = "identity")+
```

```
  scale_fill_tableau(palette = "Tableau 10")+
  ggtitle("Bound volume catch by region")+
  ylab("Proportion of catch") +
  xlab("Year")

ggsave(paste0(fig_dir, "/BV_catch_by_region.png"), BV_catch_by_region, height = 8, width = 10)

# Bound Volumes - Plot total catch by gear type
BV_gear <- ggplot(subset(BV_YB, source == "Bound Volumes" & year >= 1943 & year <= 1954), aes(x = year,
  geom_bar(stat = "identity")+
  scale_fill_tableau(palette = "Tableau 10")+
  ggtitle("Bound volume catch by gear")+
  ylab("Proportion of catch") +
  xlab("Year")

ggsave(paste0(fig_dir, "/BV_gear.png"), BV_gear, height = 8, width = 10)

# Yellow Book - Plot total catch by gear type
YB_gear <- ggplot(subset(BV_YB, source == "Yellow Book" & year >= 1943 & year <= 1954), aes(x = year, y
  geom_bar(stat = "identity")+
  scale_fill_tableau(palette = "Tableau 10")+
  ggtitle("Yellow Book catch by gear")+
  ylab("Proportion of catch") +
  xlab("Year")

ggsave(paste0(fig_dir, "/YB_gear.png"), YB_gear, height = 8, width = 10)
```

Approach 1: Using the bound volume data as is

Gear categories in bound volume data that are missing from the species composition data: "Drag Seine", "Hook and Line", "Other", "Purse seine", "Tribal Fisheries". The biggest category of these is the "drag seine" category.

Note: With this approach, we are just calculating all of the bound volume data at the same time (including the period 1935-1942).

Yelloweye catch scenarios Region 3 (Strait of Juan de Fuca) is about half in and half out of the DPS, as such, the different catch scenarios concern whether or not this data is included:

1. High catch: All prorated catch from the Strait of Juan de Fuca is included.
2. Medium catch: 50% of the prorated catch from the Strait of Juan de Fuca is included.
3. Low catch: No prorated catch from the Strait of Juan de Fuca is included.

Bocaccio catch scenarios Region 3 (Strait of Juan de Fuca) is about half in and half out of the DPS, as such, the different catch scenarios concern whether or not this data is included:

1. High catch: All prorated catch from the Strait of Juan de Fuca is included.
2. Medium catch: 50% of the prorated catch from the Strait of Juan de Fuca is included.
3. Low catch: No prorated catch from the Strait of Juan de Fuca is included.

```
# Rename comp_tables regions/gears for joining with BV
comp_tables %>%
  # Regions
  mutate(region = ifelse(region == "central_sound", "Central Puget Sound", region)) %>%
  mutate(region = ifelse(region == "gulf_bellingham", "Gulf - Bellingham", region)) %>%
  mutate(region = ifelse(region == "hood_canal", "Hood Canal", region)) %>%
  mutate(region = ifelse(region == "juan_de_fuca", "Strait of Juan de Fuca", region)) %>%
  mutate(region = ifelse(region == "san_juan_islands",  "San Juan Islands", region)) %>%
  mutate(region = ifelse(region == "south_sound", "Southern Puget Sound", region)) %>%
  mutate(region = ifelse(region == "west_juan_de_fuca", "West Juan de Fuca", region)) %>%
  # Gears
  mutate(gear = ifelse(gear == "Bottom trawl", "Trawl", gear)) %>%
  mutate(gear = ifelse(gear == "Set net", "Set Net", gear)) %>%
  mutate(gear = ifelse(gear == "All troll", "Troll", gear)) -> comp_tables_BV

# unique(comp_tables_BV$gear)
# unique(BV_PS_sums$gear)
setdiff(unique(BV_PS_sums$gear), unique(comp_tables_BV$gear))
```

```
## [1] "Drag Seine"       "Hook and Line"    "Other"            "Purse seine"
## [5] "Tribal Fisheries"
```

```
BV_PS_sums %>%
  left_join(., comp_tables_BV, by = c("region", "gear")) %>%
  mutate(., YE_catch_estimate = value * yelloweye_prop) %>%
  mutate(., BOC_catch_estimate = value * bocaccio_prop) -> BV_PS_sums_prorate

# sum across each year and region

# Yelloweye
BV_PS_sums_prorate %>%
  group_by(year, region) %>%
  summarise(catch_lbs = sum(YE_catch_estimate, na.rm = TRUE)) -> BV_PS_ye_prorated
```

```
## `summarise()` has grouped output by 'year'. You can override using the `.groups` argument.
```

```
# Subset Hood Canal
BV_PS_ye_prorated %>%
  subset(., region == "Hood Canal") %>%
  dplyr::rename(DPS = region) -> BV_hood_canal_ye_prorated

# Calculate U.S. DPS minus Hood Canal
BV_PS_ye_prorated %>%
  mutate(., area = ifelse(region != "Hood Canal", "All PS", region)) %>%
  group_by(year, area) %>%
  summarise(catch_lbs = sum(catch_lbs))  %>%
  subset(., area == "All PS") -> BV_PS_ye_sums
```

```
## `summarise()` has grouped output by 'year'. You can override using the `.groups` argument.
```

```
# Subset Strait of Juan de Fuca
BV_PS_ye_prorated %>%
  subset(., region == "Strait of Juan de Fuca") %>%
  mutate(., area = "Strait of Juan de Fuca") -> BV_jdf_ye_prorated

# Join US DPS and Strait of JDF
BV_PS_JDF_ye_sums <- bind_rows(BV_PS_ye_sums, BV_jdf_ye_prorated)

# Low catch scenario - including no catch from Strait of Juan de Fuca
BV_PS_JDF_ye_sums  %>%
  group_by(year) %>%
  mutate(low_catch = catch_lbs - catch_lbs[area == "Strait of Juan de Fuca"]) %>%
  mutate(., DPS = "U.S. DPS except Hood Canal") %>%
  subset(., area == "All PS") -> YE_BV_USDPS_low

# Medium catch scenario - including no catch from Strait of Juan de Fuca
BV_PS_JDF_ye_sums  %>%
  group_by(year) %>%
  mutate(medium_catch = catch_lbs - 0.5*catch_lbs[area == "Strait of Juan de Fuca"]) %>%
  mutate(., DPS = "U.S. DPS except Hood Canal") %>%
  subset(., area == "All PS") -> YE_BV_USDPS_medium

# High catch scenario - including no catch from Strait of Juan de Fuca
BV_PS_JDF_ye_sums  %>%
  group_by(year) %>%
  mutate(high_catch = catch_lbs - 0*catch_lbs[area == "Strait of Juan de Fuca"]) %>%
  mutate(., DPS = "U.S. DPS except Hood Canal") %>%
  subset(., area == "All PS") -> YE_BV_USDPS_high

# Combine all catch scenarios
YE_BV_USDPS_low %>%
  left_join(., YE_BV_USDPS_medium, by = c("year", "area", "DPS", "region", "catch_lbs")) %>%
  left_join(., YE_BV_USDPS_high, by = c("year", "area", "DPS", "region", "catch_lbs")) %>%
  dplyr::select(-c(region, area)) %>%
  # add hood canal data
  bind_rows(., BV_hood_canal_ye_prorated) %>%
  # Subset years
  subset(., year <= 1954) -> YE_BV_comm_1935_1954

###### Bocaccio
BV_PS_sums_prorate %>%
  group_by(year, region) %>%
  summarise(catch_lbs = sum(BOC_catch_estimate, na.rm = TRUE)) -> BV_PS_BOC_prorated
```

```
## `summarise()` has grouped output by 'year'. You can override using the `.groups` argument.
```

```
# Calculate U.S. DPS minus Hood Canal
BV_PS_BOC_prorated %>%
  mutate(., area = "All PS") %>%
  group_by(year, area) %>%
  summarise(catch_lbs = sum(catch_lbs))  -> BV_PS_BOC_sums
```

```
## `summarise()` has grouped output by 'year'. You can override using the `.groups` argument.
```

```
# Subset Strait of Juan de Fuca
BV_PS_BOC_prorated %>%
  subset(., region == "Strait of Juan de Fuca") %>%
  mutate(., area = "Strait of Juan de Fuca") -> BV_jdf_BOC_prorated

# Join US DPS and Strait of JDF
BV_PS_JDF_BOC_sums <- bind_rows(BV_PS_BOC_sums, BV_jdf_BOC_prorated)

# Low catch scenario - including no catch from Strait of Juan de Fuca
BV_PS_JDF_BOC_sums  %>%
  group_by(year) %>%
  mutate(low_catch = catch_lbs - catch_lbs[area == "Strait of Juan de Fuca"]) %>%
  mutate(., DPS = "U.S. DPS") %>%
  subset(., area == "All PS") -> BOC_BV_USDPS_low

# Medium catch scenario - including no catch from Strait of Juan de Fuca
BV_PS_JDF_BOC_sums  %>%
  group_by(year) %>%
  mutate(medium_catch = catch_lbs - 0.5*catch_lbs[area == "Strait of Juan de Fuca"]) %>%
  mutate(., DPS = "U.S. DPS") %>%
  subset(., area == "All PS") -> BOC_BV_USDPS_medium

# High catch scenario - including no catch from Strait of Juan de Fuca
BV_PS_JDF_BOC_sums  %>%
  group_by(year) %>%
  mutate(high_catch = catch_lbs - 0*catch_lbs[area == "Strait of Juan de Fuca"]) %>%
  mutate(., DPS = "U.S. DPS") %>%
  subset(., area == "All PS") -> BOC_BV_USDPS_high

# Combine all catch scenarios
BOC_BV_USDPS_low %>%
  left_join(., BOC_BV_USDPS_medium, by = c("year", "area", "DPS", "region", "catch_lbs")) %>%
  left_join(., BOC_BV_USDPS_high, by = c("year", "area", "DPS", "region", "catch_lbs")) %>%
  dplyr::select(-c(region, area)) %>%
  # Subset years
  subset(., year <= 1954) -> BOC_BV_comm_1935_1954
```

1921-1933

Notes:

This data comes from the yellow book. We do not have any region-specific information for this time period, but we do have catches by gear. Catches from this time period are also very low compared to later stages of the time series.

The main decision for this time period is how to estimate the catch by region. I am additionally unaware of any information that would give us an indication of region-specific effort.

Main decisions for this time period:

1. How do we prorate the catches by region?

- From the data, we know that as a proportion of total catch, certain regions increased over time and others decreased. For example, the Strait of Juan de Fuca becomes increasingly important over time.

In the absence of regional information, we will use different plausible scenarios for catch by region:

Effort by region These estimates are based on a subjective estimate of proportion of effort in the late 30s/early 40s (the time period closest to this one that has regional information).

Region	Percentage of Effort
Central Puget Sound	35%
Gulf - Bellingham	15%
Hood Canal	5%
San Juan Islands	10%
Southern Puget Sound	30%
Strait of Juan de Fuca	5%

I will use this table to prorate catch, based on a gear + region (from the Schmitt et al. 1991 table, which is admittedly from half a century later).

Yelloweye catch scenarios This time period has a huge amount of uncertainty, but also has minimal data and thus the different catch scenarios are unlikely to make much of a difference to stock status.

1. High catch: Double the prorated catch (2x estimates).
2. Medium catch: The prorated catch (1x estimates).
3. Low catch: Half of the prorated catch (0.5x estimates).

Bocaccio catch scenarios This time period has a huge amount of uncertainty, but also has minimal data and thus the different catch scenarios are unlikely to make much of a difference to stock status.

1. High catch: Double the prorated catch (2x estimates).
2. Medium catch: The prorated catch (1x estimates).
3. Low catch: Half of the prorated catch (0.5x estimates).

```
### Central Puget Sound

# Yelloweye
yb_long %>%
  subset(year <= 1933) %>%
  mutate(., region = "Central Puget Sound") %>%
  mutate(., est_catch = 0.35*value) %>%
  left_join(., comp_tables_BV, by = c("region", "gear")) %>%
  mutate(., catch_lbs = est_catch*yelloweye_prop) %>%
  dplyr::select(-c(bocaccio_prop, REGION)) -> ye_CPS_21_33

# Bocaccio
yb_long %>%
  subset(year <= 1933) %>%
  mutate(., region = "Central Puget Sound") %>%
  mutate(., est_catch = 0.35*value) %>%
  left_join(., comp_tables_BV, by = c("region", "gear")) %>%
  mutate(., catch_lbs = est_catch*bocaccio_prop) %>%
  dplyr::select(-c(yelloweye_prop, REGION)) -> boc_CPS_21_33
```

```
### Gulf - Bellingham

# Yelloweye
yb_long %>%
  subset(year <= 1933) %>%
  mutate(., region = "Gulf - Bellingham") %>%
  mutate(., est_catch = 0.15*value) %>%
  left_join(., comp_tables_BV, by = c("region", "gear")) %>%
  mutate(., catch_lbs = est_catch*yelloweye_prop) %>%
  dplyr::select(-c(bocaccio_prop, REGION)) -> ye_GB_21_33

# Bocaccio
yb_long %>%
  subset(year <= 1933) %>%
  mutate(., region = "Gulf - Bellingham") %>%
  mutate(., est_catch = 0.15*value) %>%
  left_join(., comp_tables_BV, by = c("region", "gear")) %>%
  mutate(., catch_lbs = est_catch*bocaccio_prop) %>%
  dplyr::select(-c(yelloweye_prop, REGION)) -> boc_GB_21_33

### Hood Canal

# Yelloweye
yb_long %>%
  subset(year <= 1933) %>%
  mutate(., region = "Hood Canal") %>%
  mutate(., est_catch = 0.05*value) %>%
  left_join(., comp_tables_BV, by = c("region", "gear")) %>%
  mutate(., catch_lbs = est_catch*yelloweye_prop) %>%
  dplyr::select(-c(bocaccio_prop, REGION)) -> ye_HC_21_33

# Bocaccio
yb_long %>%
  subset(year <= 1933) %>%
  mutate(., region = "Hood Canal") %>%
  mutate(., est_catch = 0.05*value) %>%
  left_join(., comp_tables_BV, by = c("region", "gear")) %>%
  mutate(., catch_lbs = est_catch*bocaccio_prop) %>%
  dplyr::select(-c(yelloweye_prop, REGION)) -> boc_HC_21_33

### San Juan Islands

# Yelloweye
yb_long %>%
  subset(year <= 1933) %>%
  mutate(., region = "San Juan Islands") %>%
  mutate(., est_catch = 0.10*value) %>%
  left_join(., comp_tables_BV, by = c("region", "gear")) %>%
  mutate(., catch_lbs = est_catch*yelloweye_prop) %>%
  dplyr::select(-c(bocaccio_prop, REGION)) -> ye_SJI_21_33

# Bocaccio
yb_long %>%
```

```
  subset(year <= 1933) %>%
  mutate(., region = "San Juan Islands") %>%
  mutate(., est_catch = 0.10*value) %>%
  left_join(., comp_tables_BV, by = c("region", "gear")) %>%
  mutate(., catch_lbs = est_catch*bocaccio_prop) %>%
  dplyr::select(-c(yelloweye_prop, REGION)) -> boc_SJI_21_33

# Southern Puget Sound

# Yelloweye
yb_long %>%
  subset(year <= 1933) %>%
  mutate(., region = "Southern Puget Sound") %>%
  mutate(., est_catch = 0.30*value) %>%
  left_join(., comp_tables_BV, by = c("region", "gear")) %>%
  mutate(., catch_lbs = est_catch*yelloweye_prop) %>%
  dplyr::select(-c(bocaccio_prop, REGION)) -> ye_SPS_21_33

# Bocaccio
yb_long %>%
  subset(year <= 1933) %>%
  mutate(., region = "Southern Puget Sound") %>%
  mutate(., est_catch = 0.30*value) %>%
  left_join(., comp_tables_BV, by = c("region", "gear")) %>%
  mutate(., catch_lbs = est_catch*bocaccio_prop) %>%
  dplyr::select(-c(yelloweye_prop, REGION)) -> boc_SPS_21_33

# Strait of Juan de Fuca

# Yelloweye
yb_long %>%
  subset(year <= 1933) %>%
  mutate(., region = "Strait of Juan de Fuca") %>%
  mutate(., est_catch = 0.05*value) %>%
  left_join(., comp_tables_BV, by = c("region", "gear")) %>%
  mutate(., catch_lbs = est_catch*yelloweye_prop) %>%
  dplyr::select(-c(bocaccio_prop, REGION)) -> ye_JDF_21_33

# Bocaccio
yb_long %>%
  subset(year <= 1933) %>%
  mutate(., region = "Strait of Juan de Fuca") %>%
  mutate(., est_catch = 0.05*value) %>%
  left_join(., comp_tables_BV, by = c("region", "gear")) %>%
  mutate(., catch_lbs = est_catch*bocaccio_prop) %>%
  dplyr::select(-c(yelloweye_prop, REGION)) -> boc_JDF_21_33

# Join all yelloweye data together
ye_CPS_21_33 %>%
  bind_rows(., ye_GB_21_33) %>%
  # bind_rows(., ye_HC_21_33) %>%
  bind_rows(., ye_JDF_21_33) %>%
  bind_rows(., ye_SJI_21_33) %>%
```

```
  bind_rows(., ye_SPS_21_33) %>%
  mutate(., DPS = "U.S. DPS except Hood Canal") -> ye_21_33_estimates

ye_HC_21_33 %>%
  mutate(., DPS = "Hood Canal") %>%
  bind_rows(., ye_21_33_estimates) -> ye_21_33_estimates


boc_CPS_21_33 %>%
  bind_rows(., boc_GB_21_33) %>%
  bind_rows(., boc_HC_21_33) %>%
  bind_rows(., boc_JDF_21_33) %>%
  bind_rows(., boc_SJI_21_33) %>%
  bind_rows(., boc_SPS_21_33) %>%
  mutate(., DPS = "U.S. DPS") -> boc_21_33_estimates

# Sum across years, generate catch scenarios
ye_21_33_estimates %>%
  group_by(year, DPS) %>%
  summarise(catch_lbs = sum(catch_lbs, na.rm = TRUE)) %>%
  mutate(., high_catch = catch_lbs * 2) %>%
  mutate(., medium_catch = catch_lbs) %>%
  mutate(., low_catch = catch_lbs * 0.5) -> ye_comm_21_33
```

```
## `summarise()` has grouped output by 'year'. You can override using the `.groups` argument.
```

```
boc_21_33_estimates %>%
  group_by(year, DPS) %>%
  summarise(catch_lbs = sum(catch_lbs, na.rm = TRUE)) %>%
  mutate(., high_catch = catch_lbs * 2) %>%
  mutate(., medium_catch = catch_lbs) %>%
  mutate(., low_catch = catch_lbs * 0.5) -> boc_comm_21_33
```

```
## `summarise()` has grouped output by 'year'. You can override using the `.groups` argument.
```

Commercial catch: All years combined

```
ye_comm_21_33 %>%
  bind_rows(., YE_BV_comm_1935_1954) %>%
  bind_rows(., YE_comm_1955_1969) %>%
  bind_rows(., YE_comm_1970_2003) %>%
  bind_rows(., YE_comm_2004_2020) -> YE_comm_complete


boc_comm_21_33 %>%
  bind_rows(., BOC_BV_comm_1935_1954) %>%
  bind_rows(., BOC_comm_55_69) %>%
  bind_rows(., BOC_comm_1970_2003) %>%
  bind_rows(., shelf_RF_comm_2004_2020) -> BOC_comm_complete
```

DFO Data for Canadian portion of Yelloweye Rockfish DPS

```
DFO_recons_path <- here("catch_reconstruction_data", "canada", "catch-reconstructed.csv")
DFO_recons <- read.csv(DFO_recons_path)

# Create new field to add all catch sources
DFO_recons %>%
  mutate(total_catch = Rec + FSC + Comm) -> DFO_recons

DFO_raw_path <- here("catch_reconstruction_data", "canada", "catch.csv")
DFO_raw <- read.csv(DFO_raw_path)

# Create new field to add all catch sources
DFO_raw %>%
  mutate(total_catch = Rec + FSC + Comm) -> DFO_raw

# Reformat DFO data to join with PS data
DFO_recons %>%
  dplyr::rename(year = Year) %>%
  # convert metric tons to pounds
  mutate(., total_catch_lbs = total_catch * 2204.62) %>%
  mutate(., rec_catch_lbs = Rec * 2204.62) %>%
  mutate(., comm_catch_lbs = Comm * 2204.62) %>%
  mutate(., FSC_catch_lbs = FSC * 2204.62) %>%
  mutate(., country = "Canada") %>%
  dplyr::select(c(year, total_catch_lbs, rec_catch_lbs, comm_catch_lbs, FSC_catch_lbs, country)) -> cana
```

Recreational data

Notes

- The recreational catch has been greater in magnitude than the commercial catch for both species for a large portion of the time series.

First step: load recreational conversion tables

Necessary for converting number of individuals to weight (kg or lbs)

```
recreational_weight_conversion_path <- here("catch_reconstruction_data", "recreational", "Recreationalc
recreational_weight_conversion <- read_excel(recreational_weight_conversion_path, sheet = "Sheet1", ski
```

```
## New names:
## * `` -> ...1
## * `` -> ...2
```

```
recreational_weight_conversion %>%
  dplyr::rename(species = "...2") %>%
  dplyr::select(-"...1") -> recreational_weight_conversion
```

```
# Extract values for yelloweye, bocaccio, all RF
YE_lbs_per_individual <- recreational_weight_conversion[recreational_weight_conversion$species == "Yell
BOC_lbs_per_individual <- recreational_weight_conversion[recreational_weight_conversion$species == "Boc
RF_lbs_per_individual <- recreational_weight_conversion[recreational_weight_conversion$species == "Misc
```

2003-2019

Notes

This data was based on a creel survey of anglers. Catches are overall very low, but there are also high variances in the estimates. Yelloweye and Bocaccio catch scenarios are the same. Of additional note: there is a general rockfish category. Is it possible that some yelloweye or bocaccio are part of this category, despite them also having their own unique categories?

Main decisions for this time period:

1. Do we assume all released catch survived, or do we think that a portion of this value should be considered catch since many are likely to have had barotrauma and died? The main question is what proportion of discarded yelloweye or bocaccio were actually released at depth; Hochhalter and Reed (2011) estimated almost 99% survival of yelloweye rockfish released at depth, but only about 22% of yelloweye rockfish released at the surface.
2. Do we try to prorate the "general rockfish" category at all?
3. How do we combine estimates/variance from the four different "target type" categories ("other", "salmon", "bottom", "halibut").

Yelloweye/Bocaccio catch scenarios

Calculate catch/release/standard deviation for each target type and area individually; sum these for each year.

1. High catch: Creel estimate + one SD; 50% of estimated released rockfishes considered to be catch (died from barotrauma)
2. Medium catch: Creel estimate; 20% of estimated released rockfishes considered to be catch (died from barotrauma)
3. Low catch: Creel estimate - one SD; 5% of estimated released rockfishes considered to be catch (all released at depth, 95% survived - from Hannah et al. 2014, work done on yelloweye)

```
# Read in sport landing data
PSP_sport_2003_2019_path <- here("catch_reconstruction_data", "recreational", "PSP Sport Estimates 2003
PSP_sport_2003_2019 <- read_excel(PSP_sport_2003_2019_path, sheet = "All")

# Fix column names
names(PSP_sport_2003_2019) <- gsub(x = names(PSP_sport_2003_2019), pattern = "\r\n", replacement = "_")
names(PSP_sport_2003_2019) <- gsub(x = names(PSP_sport_2003_2019), pattern = "\\.", replacement = "")
names(PSP_sport_2003_2019) <- gsub(x = names(PSP_sport_2003_2019), pattern = " ", replacement = "_")

# Replace zeros with NAs for variance in catch when catch is zero
PSP_sport_2003_2019[PSP_sport_2003_2019$Est_Catch == 0,]$Var_Catch <- NA

# Calculate standard deviation for estimated catch and release
PSP_sport_2003_2019 %>%
```

```
  mutate(., SD_catch = sqrt(Var_Catch)) %>%
  mutate(., SD_release = sqrt(Var_Release)) -> PSP_sport_2003_2019
```

```
## Warning in sqrt(Var_Release): NaNs produced
```

```
# Subset MCAs that are in DPS
# MCAs 4 and 5 are included in this data but are too far west to be in DPS (see Federal Register from 2
PSP_sport_all <- subset(PSP_sport_2003_2019, !(MCA %in% c("4", "5")))

# Keep only the relevant columns
PSP_sport_all %>%
  dplyr::select(c(Year, MCA, Target_Type, Common_Name, Est_Catch, Var_Catch,Est_Release, Var_Release, SI
  dplyr::rename(year = Year) -> PSP_sport_all

YE_comm_complete
```

```
## # A tibble: 198 x 6
## # Groups:   year [99]
##     year DPS                          catch_lbs high_catch medium_catch low_catch
##    <dbl> <chr>                            <dbl>      <dbl>        <dbl>     <dbl>
##  1  1921 Hood Canal                        22.3       44.6         22.3      11.2
##  2  1921 U.S. DPS except Hood Canal       161.       322.         161.       80.4
##  3  1922 Hood Canal                        31.0       61.9         31.0      15.5
##  4  1922 U.S. DPS except Hood Canal        51.7      103.          51.7      25.9
##  5  1923 Hood Canal                         3.84       7.68         3.84      1.92
##  6  1923 U.S. DPS except Hood Canal        52.9      106.          52.9      26.5
##  7  1924 Hood Canal                         0          0            0         0
##  8  1924 U.S. DPS except Hood Canal       121.       242.         121.       60.4
##  9  1925 Hood Canal                         9.59      19.2          9.59      4.79
## 10  1925 U.S. DPS except Hood Canal        69.2      138.          69.2      34.6
## # ... with 188 more rows
```

```
# Subset yelloweye
yelloweye_sport_2003_2019 <- subset(PSP_sport_all, Common_Name == "Yelloweye Rockfish")

unique(yelloweye_sport_2003_2019$MCA)
```

```
## [1] "6"   "8-1" "7"   "9"   "10"  "8-2" "11"  "12"
```

```
# Subset the Hood Canal population (only two data points, one from 2009 and one from 2016)
yelloweye_sport_2003_2019 %>%
  subset(MCA == "12") %>%
  mutate(., DPS = "Hood Canal") %>%
  ungroup() %>%
  rowwise() %>%
  mutate(., high_catch_n = sum(Est_Catch, 1*SD_catch, 0.5*Est_Release, na.rm = TRUE)) %>%
  mutate(., medium_catch_n = sum(Est_Catch, 0*SD_catch, 0.2*Est_Release, na.rm = TRUE)) %>%
  mutate(., low_catch_n = sum(Est_Catch, -1*SD_catch, 0.05*Est_Release, na.rm = TRUE)) %>%
  dplyr::select(year, DPS, high_catch_n, medium_catch_n, low_catch_n) %>%
  complete(., year = seq(2003, 2019, 1), fill = list(high_catch_n = 0, medium_catch_n = 0, low_catch_n =
  # Convert individuals to weights
```

```
  mutate(., high_catch_lbs = high_catch_n * YE_lbs_per_individual) %>%
  mutate(., medium_catch_lbs = medium_catch_n * YE_lbs_per_individual) %>%
  mutate(., low_catch_lbs = low_catch_n * YE_lbs_per_individual) %>%
  dplyr::select(-c(high_catch_n, medium_catch_n, low_catch_n)) -> YE_HC_rec_2003_2019

# U.S. DPS except Hood Canal
yelloweye_sport_2003_2019 %>%
  subset(MCA != "12") %>%
  ungroup() %>%
  rowwise() %>%
  mutate(., high_catch_n = sum(Est_Catch, 1*SD_catch, 0.5*Est_Release, na.rm = TRUE)) %>%
  mutate(., medium_catch_n = sum(Est_Catch, 0*SD_catch, 0.2*Est_Release, na.rm = TRUE)) %>%
  mutate(., low_catch_n = sum(Est_Catch, -1*SD_catch, 0.05*Est_Release, na.rm = TRUE)) %>%
  group_by(year) %>%
  summarise(high_catch_n = sum(high_catch_n), medium_catch_n = sum(medium_catch_n), low_catch_n = sum(lo
  mutate(., DPS = "U.S. DPS except Hood Canal") %>%
  complete(., year = seq(2003, 2019, 1), fill = list(high_catch_n = 0, medium_catch_n = 0, low_catch_n =
  # Convert individuals to weights
  mutate(., high_catch_lbs = high_catch_n * YE_lbs_per_individual) %>%
  mutate(., medium_catch_lbs = medium_catch_n * YE_lbs_per_individual) %>%
  mutate(., low_catch_lbs = low_catch_n * YE_lbs_per_individual) %>%
  dplyr::select(-c(high_catch_n, medium_catch_n, low_catch_n)) -> YE_USDPS_rec_2003_2019
```

```
# Subset bocaccio
bocaccio_sport_2003_2019 <- subset(PSP_sport_all, Common_Name == "Bocaccio")

bocaccio_sport_2003_2019 %>%
  ungroup() %>%
  rowwise() %>%
  mutate(., high_catch_n = sum(Est_Catch, 1*SD_catch, 0.5*Est_Release, na.rm = TRUE)) %>%
  mutate(., medium_catch_n = sum(Est_Catch, 0*SD_catch, 0.2*Est_Release, na.rm = TRUE)) %>%
  mutate(., low_catch_n = sum(Est_Catch, -1*SD_catch, 0.05*Est_Release, na.rm = TRUE)) %>%
  group_by(year) %>%
  summarise(high_catch_n = sum(high_catch_n), medium_catch_n = sum(medium_catch_n), low_catch_n = sum(lo
  mutate(., DPS = "U.S. DPS") %>%
  complete(., year = seq(2003, 2019, 1), fill = list(high_catch_n = 0, medium_catch_n = 0, low_catch_n =
  # Convert individuals to weights
  mutate(., high_catch_lbs = high_catch_n * BOC_lbs_per_individual) %>%
  mutate(., medium_catch_lbs = medium_catch_n * BOC_lbs_per_individual) %>%
  mutate(., low_catch_lbs = low_catch_n * BOC_lbs_per_individual) %>%
  dplyr::select(-c(high_catch_n, medium_catch_n, low_catch_n)) -> BOC_USDPS_rec_2003_2019
```

1994-2002

Notes:

From Palsson et al. 2009:

"The foremost challenge in the last decade has been monitoring the dominant recreational fishery. Until 2004, bottomfish estimates from the WDFW recreational survey have depended upon open salmon fisheries and salmon catch record cards (Palsson 1988). This system necessitated year-round, open salmon fisheries to result in a complete estimate of bottomfish harvest by hook-and-line, boat-based fishers. Severe salmon

fishery closures began in 1994 resulting in incomplete catch estimates for almost all catch areas until 2004 when a new catch estimation system was instituted."

"Beginning in 1994, large–scale closures occurred for the recreational salmon fishery, preventing successful bottomfish catch and effort estimates in many areas of Puget Sound. When an area is closed to recreational salmon fishing, there is no numerator to divide by then effort or bottomfish catch rate, preventing any point estimate of effort or bottomfish catch. Consequently, bottomfish catch and effort estimates have been severely underestimated from 1994 to 2003."

There were also major changes to the regulations regarding recreational rockfish fishing:

1. 1994: Rockfish daily bag limit reduced to five rockfish in North Sound and three in South Sound.
2. 2000: One rockfish bag limit enacted for all of Puget Sound east of Sekiu River. Emergency regulation temporarily increasing rockfish bag limit to 3 in Sekiu area to allow for black rockfish harvest.
3. 2002: May-Sept 30, west of Slip Point daily limit of 3, only 1 of which may be other than a black rockfish, permanent rule. Temporary prohibition of yelloweye and canary harvest.
4. 2003: Yelloweye and canary rockfish cannot be retained.

So how do we estimate the combined impact of under-reporting and these new regulations?

Here's another big problem: The data that I have is currently summed across "North Puget Sound" and "South Puget Sound". Hood Canal is included in "South Puget Sound". I'm sure this was summed at some point from finer resolution data, but can we find that data? We also don't know exactly how much of the Strait of Juan de Fuca is included in "North Puget Sound" - should follow up with Wayne Palsson. I also need to know why the catch is prorated into species for 1970-1985 but not 1986-2002.

- The creel survey data exists from 2003-present - not sure exactly what the one year difference is? Or perhaps the survey started in 2004, but collected data for 2003?
- Clearly the estimates from 1994 to 2002 are an underestimate - but how can we correct for this? We can use the 1994-2002 data as the minimum catch, and multiply catches by a certain factor for the medium and high catch scenarios. But by what factor do we multiply this? Perhaps we can get some information from the amount of salmon fishing effort relative to historical levels?

Yelloweye/Bocaccio catch scenarios

For this time period, we will prorate catches based on composition data and subsequently multiply by a factor to account for under-reporting. Will need to check in with Greg Lippert/Wayne Palsson to get their thoughts on this, since these are arbitrary values...

1. High catch: Prorated estimate x 3.
2. Medium catch: Prorated estimate x 2.
3. Low catch: Prorated estimate x 1.

For yelloweye, we also need to separate Hood Canal from the rest of the data. Looking at Palsson 1987, catch from Hood Canal looks to be about 1-3% of total catches of yelloweye. For now if we need a placeholder, I think we can safely assume that 2% of yelloweye catch is from Hood canal and it would be a fine assumption. If we're talking about South Puget Sound only, it's more like 12%. We'll use that as a placeholder until we get better data.

```
# Load catch numbers
rec_catch_nos_path <- here("catch_reconstruction_data", "recreational", "rec_catch_numbers_1970_2009.xls

rec_NPS <- read_excel(rec_catch_nos_path, sheet = "North Sound")
rec_NPS[is.na(rec_NPS)] <- 0
```

```
rec_SPS <- read_excel(rec_catch_nos_path, sheet = "South Sound")
rec_SPS[is.na(rec_SPS)] <- 0

# Load species composition data
rec_spp_comp_NPS_path <- here("catch_reconstruction_data", "recreational", "north_sound_rec_comps.xlsx")
rec_spp_comp_SPS_path <- here("catch_reconstruction_data", "recreational", "south_sound_rec_comps.xlsx")
# Mean across time periods
rec_mean_spp_comp_path <- here("catch_reconstruction_data", "recreational", "mean_rec_comps.xlsx")

# Load data, replace all NAs with 0s
rec_spp_comp_NPS <- read_excel(rec_spp_comp_NPS_path)
rec_spp_comp_NPS[is.na(rec_spp_comp_NPS)] <- 0
rec_spp_comp_SPS <- read_excel(rec_spp_comp_SPS_path)
rec_spp_comp_SPS[is.na(rec_spp_comp_SPS)] <- 0
rec_mean_spp_comp_NPS <- read_excel(rec_mean_spp_comp_path, sheet = "North Sound")
rec_mean_spp_comp_NPS[is.na(rec_mean_spp_comp_NPS)] <- 0
rec_mean_spp_comp_SPS <- read_excel(rec_mean_spp_comp_path, sheet = "South Sound")
rec_mean_spp_comp_SPS[is.na(rec_mean_spp_comp_SPS)] <- 0

# Generate species composition data for the time period 1996-2002, since this is the overlap with this

### NORTH PUGET SOUND

# Get sample sizes for each year
NPS_rec_sample_sizes <- as.numeric(rec_spp_comp_NPS[rec_spp_comp_NPS$Species == "Sample Size",][2:dim(r

rec_spp_comp_NPS %>%
  t() %>%
  as.data.frame() %>%
  row_to_names(row_number = 1) %>%
  mutate_all(., as.numeric) %>%
  dplyr::select(-`Sample Size`) %>%
  # Multiply by vector of sample sizes
  as.matrix() * 0.01 * NPS_rec_sample_sizes -> rec_spp_comp_NPS_numbers

as.data.frame(rec_spp_comp_NPS_numbers) %>%
  rownames_to_column("year") %>%
  mutate(year = as.numeric(year)) %>%
  subset(year <= 2002 & year >= 1994) %>%
  mutate(sample_size = rowSums(.)-year) %>%
  # Summarise across all years
  colSums() %>%
  as.data.frame() %>%
  dplyr::rename(., total = `.`) %>%
  rownames_to_column(., "Species") %>%
  subset(., Species != "year") %>%
  mutate(., proportion = total/subset(.,Species == "sample_size")$total) %>%
  subset(., Species != "sample_size")-> NPS_rec_spp_comp_props_96_02

### SOUTH PUGET SOUND

# Get sample sizes for each year
SPS_rec_sample_sizes <- as.numeric(rec_spp_comp_SPS[rec_spp_comp_SPS$Species == "Sample size",][2:dim(r
```

```
rec_spp_comp_SPS %>%
  t() %>%
  as.data.frame() %>%
  row_to_names(row_number = 1) %>%
  mutate_all(., as.numeric) %>%
  dplyr::select(-`Sample size`) %>%
  # Multiply by vector of sample sizes
  as.matrix() * 0.01 * SPS_rec_sample_sizes -> rec_spp_comp_SPS_numbers

as.data.frame(rec_spp_comp_SPS_numbers) %>%
  rownames_to_column("year") %>%
  mutate(year = as.numeric(year)) %>%
  subset(year <= 2002 & year >= 1994) %>%
  mutate(sample_size = rowSums(.)-year) %>%
  # Summarise across all years
  colSums() %>%
  as.data.frame() %>%
  dplyr::rename(., total = `.`) %>%
  rownames_to_column(., "Species") %>%
  subset(., Species != "year") %>%
  mutate(., proportion = total/subset(.,Species == "sample_size")$total) %>%
  subset(., Species != "sample_size")-> SPS_rec_spp_comp_props_96_02
```

```
# North Sound
rec_NPS %>%
  subset(., Year >= 1994 & Year <= 2002) %>%
  dplyr::select(Year, `Bocaccio`, `Yelloweye Rockfish`, `Rockfish - General`) -> rec_NPS_94_02

# Add the catch composition data
rec_NPS_94_02$boc_prop <- subset(NPS_rec_spp_comp_props_96_02, Species == "Bocaccio")$proportion
rec_NPS_94_02$ye_prop <- subset(NPS_rec_spp_comp_props_96_02, Species == "Yelloweye")$proportion


# Yelloweye: Prorate, catch scenarios, estimate weight
rec_NPS_94_02 %>%
  dplyr::rename(year = Year, total = `Rockfish - General`) %>%
  mutate(., high_catch_n = (`Yelloweye Rockfish` + total*ye_prop)*3) %>%
  mutate(., medium_catch_n = (`Yelloweye Rockfish` + total*ye_prop)*2) %>%
  mutate(., low_catch_n = (`Yelloweye Rockfish` + total*ye_prop)*1) %>%
  mutate(., high_catch_lbs = high_catch_n*YE_lbs_per_individual) %>%
  mutate(., medium_catch_lbs = medium_catch_n*YE_lbs_per_individual) %>%
  mutate(., low_catch_lbs = low_catch_n*YE_lbs_per_individual) %>%
  dplyr::select(-c(high_catch_n, medium_catch_n, low_catch_n, boc_prop, ye_prop)) -> ye_rec_NPS_94_02

# Bocaccio: Prorate, catch scenarios, estimate weight
rec_NPS_94_02 %>%
  dplyr::rename(year = Year, total = `Rockfish - General`) %>%
  mutate(., high_catch_n = (`Bocaccio` + total*boc_prop)*3) %>%
  mutate(., medium_catch_n = (`Bocaccio` + total*boc_prop)*2) %>%
  mutate(., low_catch_n = (`Bocaccio` + total*boc_prop)*1) %>%
  mutate(., high_catch_lbs = high_catch_n*BOC_lbs_per_individual) %>%
  mutate(., medium_catch_lbs = medium_catch_n*BOC_lbs_per_individual) %>%
  mutate(., low_catch_lbs = low_catch_n*BOC_lbs_per_individual) %>%
```

```
  dplyr::select(-c(high_catch_n, medium_catch_n, low_catch_n, boc_prop, ye_prop)) -> boc_rec_NPS_94_02


# South Sound
rec_SPS %>%
  subset(., Year >= 1994 & Year <= 2002) %>%
  dplyr::select(Year, `Bocaccio`, `Yelloweye Rockfish`, `Rockfish - General`) -> rec_SPS_94_02

# Add the catch composition data
rec_SPS_94_02$boc_prop <- subset(SPS_rec_spp_comp_props_96_02, Species == "Bocaccio")$proportion
rec_SPS_94_02$ye_prop <- subset(SPS_rec_spp_comp_props_96_02, Species == "Yelloweye")$proportion

# Yelloweye: Prorate, catch scenarios, estimate weight
rec_SPS_94_02 %>%
  dplyr::rename(year = Year, total = `Rockfish - General`) %>%
  mutate(., high_catch_n = (`Yelloweye Rockfish` + total)*ye_prop*3) %>%
  mutate(., medium_catch_n = (`Yelloweye Rockfish` + total)*ye_prop*2) %>%
  mutate(., low_catch_n = (`Yelloweye Rockfish` + total)*ye_prop*1) %>%
  mutate(., high_catch_lbs = high_catch_n*YE_lbs_per_individual) %>%
  mutate(., medium_catch_lbs = medium_catch_n*YE_lbs_per_individual) %>%
  mutate(., low_catch_lbs = low_catch_n*YE_lbs_per_individual) %>%
  dplyr::select(-c(high_catch_n, medium_catch_n, low_catch_n, boc_prop, ye_prop)) -> ye_rec_SPS_94_02

# Bocaccio: Prorate, catch scenarios, estimate weight
rec_SPS_94_02 %>%
  dplyr::rename(year = Year, total = `Rockfish - General`) %>%
  mutate(., high_catch_n = (`Bocaccio` + total*boc_prop)*3) %>%
  mutate(., medium_catch_n = (`Bocaccio` + total*boc_prop)*2) %>%
  mutate(., low_catch_n = (`Bocaccio` + total*boc_prop)*1) %>%
  mutate(., high_catch_lbs = high_catch_n*BOC_lbs_per_individual) %>%
  mutate(., medium_catch_lbs = medium_catch_n*BOC_lbs_per_individual) %>%
  mutate(., low_catch_lbs = low_catch_n*BOC_lbs_per_individual) %>%
  dplyr::select(-c(high_catch_n, medium_catch_n, low_catch_n, boc_prop, ye_prop)) -> boc_rec_SPS_94_02
```

```
ye_rec_SPS_94_02 %>%
  dplyr::select(high_catch_lbs, medium_catch_lbs, low_catch_lbs) -> ye_rec_HC_94_02

ye_rec_HC_94_02 <- ye_rec_HC_94_02*0.12
ye_rec_HC_94_02$year <- seq(1994, 2002, 1)

ye_rec_SPS_94_02 %>%
  mutate(high_catch_lbs = 0.88 * high_catch_lbs) %>%
  mutate(medium_catch_lbs = 0.88 * medium_catch_lbs) %>%
  mutate(low_catch_lbs = 0.88 * low_catch_lbs) -> ye_rec_catch_SPS_noHC_94_02

ye_rec_catch_SPS_noHC_94_02 %>%
  bind_rows(ye_rec_NPS_94_02) %>%
  group_by(year) %>%
  summarise_all(sum) -> ye_rec_catch_USDPS_94_02

# Summarise bocaccio
boc_rec_SPS_94_02 %>%
  bind_rows(boc_rec_NPS_94_02) %>%
```

```
  group_by(year) %>%
  summarise_all(sum) -> boc_rec_catch_USDPS_94_02
```

1970-1993

Notes

Wayne Palsson does not seem to have a high degree of confidence for the recreational catch for this time period; however, there is also no indication of how to quantitatively address this uncertainty.

Catch composition data for the recreational fishery exists for 1980-1986 and 1989 for this time period; the next compositional data is from 1996. We will use all compositional data from 1980-1986 and 1989 to prorate catches for this time period. There is also some catch composition data for 1965-1967; see PDF page 108 from Palsson et al. 2009, with the original data from Buckley (1967, 1968); Buckley and Satterthwaite (1970).

Yelloweye and Bocaccio catch scenarios

There is only one catch scenario for yelloweye and bocaccio.

```
# North Sound
as.data.frame(rec_spp_comp_NPS_numbers) %>%
  rownames_to_column("year") %>%
  mutate(year = as.numeric(year)) %>%
  subset(year <= 1989 & year >= 1980) %>%
  mutate(sample_size = rowSums(.)-year) %>%
  # Summarise across all years
  colSums() %>%
  as.data.frame() %>%
  dplyr::rename(., total = `.`) %>%
  rownames_to_column(., "Species") %>%
  subset(., Species != "year") %>%
  mutate(., proportion = total/subset(.,Species == "sample_size")$total) %>%
  subset(., Species != "sample_size")-> NPS_rec_spp_comp_props_80_89

# South Sound
as.data.frame(rec_spp_comp_SPS_numbers) %>%
  rownames_to_column("year") %>%
  mutate(year = as.numeric(year)) %>%
  subset(year <= 1989 & year >= 1980) %>%
  mutate(sample_size = rowSums(.)-year) %>%
  # Summarise across all years
  colSums() %>%
  as.data.frame() %>%
  dplyr::rename(., total = `.`) %>%
  rownames_to_column(., "Species") %>%
  subset(., Species != "year") %>%
  mutate(., proportion = total/subset(.,Species == "sample_size")$total) %>%
  subset(., Species != "sample_size")-> SPS_rec_spp_comp_props_80_89
```

```
# Use the same data files as were previously loaded for the 1994-2002 data

# North Sound
```

```
rec_NPS %>%
  subset(., Year >= 1970 & Year <= 1993) %>%
  dplyr::select(Year, `Bocaccio`, `Yelloweye Rockfish`, `Rockfish - General`) -> rec_NPS_70_93

# Add the catch composition data
rec_NPS_70_93$boc_prop <- subset(NPS_rec_spp_comp_props_80_89, Species == "Bocaccio")$proportion
rec_NPS_70_93$ye_prop <- subset(NPS_rec_spp_comp_props_80_89, Species == "Yelloweye")$proportion


# Yelloweye: Prorate, catch scenarios, estimate weight
rec_NPS_70_93 %>%
  dplyr::rename(year = Year, total = `Rockfish - General`) %>%
  mutate(., high_catch_n = (`Yelloweye Rockfish` + total*ye_prop)*1) %>%
  mutate(., medium_catch_n = (`Yelloweye Rockfish` + total*ye_prop)*1) %>%
  mutate(., low_catch_n = (`Yelloweye Rockfish` + total*ye_prop)*1) %>%
  mutate(., high_catch_lbs = high_catch_n*YE_lbs_per_individual) %>%
  mutate(., medium_catch_lbs = medium_catch_n*YE_lbs_per_individual) %>%
  mutate(., low_catch_lbs = low_catch_n*YE_lbs_per_individual) %>%
  dplyr::select(-c(high_catch_n, medium_catch_n, low_catch_n, boc_prop, ye_prop)) -> ye_rec_NPS_70_93

# Bocaccio: Prorate, catch scenarios, estimate weight
rec_NPS_70_93 %>%
  dplyr::rename(year = Year, total = `Rockfish - General`) %>%
  mutate(., high_catch_n = (`Bocaccio` + total*boc_prop)*1) %>%
  mutate(., medium_catch_n = (`Bocaccio` + total*boc_prop)*1) %>%
  mutate(., low_catch_n = (`Bocaccio` + total*boc_prop)*1) %>%
  mutate(., high_catch_lbs = high_catch_n*BOC_lbs_per_individual) %>%
  mutate(., medium_catch_lbs = medium_catch_n*BOC_lbs_per_individual) %>%
  mutate(., low_catch_lbs = low_catch_n*BOC_lbs_per_individual) %>%
  dplyr::select(-c(high_catch_n, medium_catch_n, low_catch_n, boc_prop, ye_prop)) -> boc_rec_NPS_70_93


# South Sound
rec_SPS %>%
  subset(., Year >= 1970 & Year <= 1993) %>%
  dplyr::select(Year, `Bocaccio`, `Yelloweye Rockfish`, `Rockfish - General`) -> rec_SPS_70_93

# Add the catch composition data
rec_SPS_70_93$boc_prop <- subset(SPS_rec_spp_comp_props_80_89, Species == "Bocaccio")$proportion
rec_SPS_70_93$ye_prop <- subset(SPS_rec_spp_comp_props_80_89, Species == "Yelloweye")$proportion

# Yelloweye: Prorate, catch scenarios, estimate weight
rec_SPS_70_93 %>%
  dplyr::rename(year = Year, total = `Rockfish - General`) %>%
  mutate(., high_catch_n = (`Yelloweye Rockfish` + total*ye_prop)*1) %>%
  mutate(., medium_catch_n = (`Yelloweye Rockfish` + total*ye_prop)*1) %>%
  mutate(., low_catch_n = (`Yelloweye Rockfish` + total*ye_prop)*1) %>%
  mutate(., high_catch_lbs = high_catch_n*YE_lbs_per_individual) %>%
  mutate(., medium_catch_lbs = medium_catch_n*YE_lbs_per_individual) %>%
  mutate(., low_catch_lbs = low_catch_n*YE_lbs_per_individual) %>%
  dplyr::select(-c(high_catch_n, medium_catch_n, low_catch_n, boc_prop, ye_prop)) -> ye_rec_SPS_70_93

# Bocaccio: Prorate, catch scenarios, estimate weight
```

```
rec_SPS_70_93 %>%
  dplyr::rename(year = Year, total = `Rockfish - General`) %>%
  mutate(., high_catch_n = (`Bocaccio` + total*boc_prop)*1) %>%
  mutate(., medium_catch_n = (`Bocaccio` + total*boc_prop)*1) %>%
  mutate(., low_catch_n = (`Bocaccio` + total*boc_prop)*1) %>%
  mutate(., high_catch_lbs = high_catch_n*BOC_lbs_per_individual) %>%
  mutate(., medium_catch_lbs = medium_catch_n*BOC_lbs_per_individual) %>%
  mutate(., low_catch_lbs = low_catch_n*BOC_lbs_per_individual) %>%
  dplyr::select(-c(high_catch_n, medium_catch_n, low_catch_n, boc_prop, ye_prop)) -> boc_rec_SPS_70_93
```

```
ye_rec_SPS_70_93 %>%
  dplyr::select(high_catch_lbs, medium_catch_lbs, low_catch_lbs) -> ye_rec_HC_70_93

ye_rec_HC_70_93 <- ye_rec_HC_70_93*0.12
ye_rec_HC_70_93$year <- seq(1970, 1993, 1)

ye_rec_SPS_70_93 %>%
  mutate(high_catch_lbs = 0.88 * high_catch_lbs) %>%
  mutate(medium_catch_lbs = 0.88 * medium_catch_lbs) %>%
  mutate(low_catch_lbs = 0.88 * low_catch_lbs) -> ye_rec_catch_SPS_noHC_70_93

ye_rec_catch_SPS_noHC_70_93 %>%
  bind_rows(ye_rec_NPS_70_93) %>%
  group_by(year) %>%
  summarise_all(sum) -> ye_rec_catch_USDPS_70_93

# Summarise bocaccio
boc_rec_SPS_70_93 %>%
  bind_rows(boc_rec_NPS_70_93) %>%
  group_by(year) %>%
  summarise_all(sum) -> boc_rec_catch_USDPS_70_93
```

Pre-1970

We know that there was some recreational catch for this time period, but it was not documented.

Notes

In all of the Buckley documents, yelloweye rockfish is called "Rasphead rockfish". Catch statistics by area since 1965.

Wayne Palsson says this about the Buckley papers: "Early species composition observations are available for 1965 to 1967 based on expanded harvest estimates (Buckley 1967, 1968; Buckley and Satterthwaite 1970) and offer a glimpse into earlier species proportions of the rockfish harvest in North and South Puget Sound. Samplers at that time were developing their basis of species identifications and some observations may be questionable."

Yelloweye catch scenarios

?????? Not sure if I should try to multiply by a factor or not for different scenarios... documents do say that these should be treated as minimum estimates, but I'm not sure what a defensible conversion factor is.

Buckley docs (1965-1967) Buckley (1967) - 1965 recreational bottomfish fishery: - Distinction between "incidental" and "specific" harvests: - "Bottomfish caught while actively angling for salmon were incidental harvests." - "Bottomfish caught while actively angling for species other than salmon were specific harvests." - "The Washington sport-angling harvest of marine bottomfish, also referred to as"nonsalmon food fish", has been considered of negligible importance in our management scheme and very little effort was expended in this direction through 1964. In early 1965, however, the recreation potential offered by bottomfish species and their future importance in the rapidly expanding Washington sport fishery prompted the inclusion of their harvest in the regular sampling of the salmon-sport fishery." - "At present, the majority of Washington's sport anglers consider most bottomfish as"scrap fish" and the ratio of the number retained in the harvest to the number actually caught appears extremely low in all areas." - Possible that catch is underestimate of total fishing mortality of rockfishes, given barotrauma - "1965 was the first year State-wide bottomfish harvests were calculated" - "Bottomfish data were usually taken for species, but if this was not possible (perhaps due to insufficient time for positive identification) those fish in question were recorded on the family level." - This explains why sometimes rockfish are identified to the species level and sometimes only as "unclassified rockfish". - If we assume that identification was done randomly (no bias towards not identifying certain species), then we can use the comps for the identified species to identify the unidentified species

Buckley and Sattherwhaite (1970) - 1967 recreational bottomfish fishery: - See marine area codes on page 40. Regions 6-12 are the DPS. Region 13 was not added until 1976, according to Palsson 1987 - prior to 1976, region 12 encompassed regions 12 and 13. - "Any specific bottomfish angling in these areas in previous years was apparently at a level low enough to remain undetected at past sampling intensities. Sampling procedures and manpower levels did not change significantly in these areas in 1967, indicating a substantial increase in specific bottomfish angling." - "The calculated total sport harvest of 276,837 bottomfish in 1967 was a 15% increase over the 1966 catch of 250,483 fish, the only other year for which state-wide figures are available." - "Rockfish were the dominant family, contributing more than 54% of the total incidental harvest." - "Rockfish were the dominant family, accounting for more than 43% of the total specific harvest."

Bargmann tables (1968-1973)

- Use years 1968 and 1969. Data is available in Google Drive here (old fishery records and analysis): https://docs.google.com/spreadsheets/d/0B3NnRv_9_F9sNG1ITG1fQU5ZUFk/edit#gid=1104389180
- "The data used in this report were gathered by technicians collecting data primarily for the sport salmon fishery, and data on marine fish catches were recorded secondarily. As such, there were many gaps and areas of incomplete coverage in the bottomfish harvest estimates. The reader is cautioned that **the estimates presented here should be regarded as minimum harvest estimates**.

WDFW Annual Bulletins These are all available online through the University of Washington library.

1940 report: - "Approximately 60% of the resorts reported regularly on a purely voluntary basis... It should be noted that all individual catches brought in to any given resort cannot be recorded by the manager. For that reason the catch statistics given below can be assumed to constitute only a very conservative record of the number of fish caught by recreational fishermen fishing from the various resorts." - "In estimating the total sports catch of any species for 1940, allowance must be made for (a) 43% of known boathouses not reporting during the eight-months period above, (b) four additional months to complete the year, and (c) catches made by persons not using boathouse facilities. - Tables indicate the in each year, somewhere between 30% and 60% of total known boathouses are reporting. -"While statistics of sports catches kept by the Department of Fisheries on the present basis provide the basis of reasonable estimates, **the data are by no means complete or accurate**."

Note: Annual bulletins started in 1935, but 1935-1937 had no note of sport fishing statistics. Reporting by boathouses dropped dramatically in 1942, and then in 1943 it appears that the Department of Fisheries stopped surveying boathouses altogether.

A quote from page 11 of the 1946 annual bulletin:

"The Puget Sound salmon investigation was extended in 1946 to include a study of the magnitude of the sport fishery. **A similar study had been carried on for several years before the war** and had demonstrated the necessity for determining the number of fish which is taken each year by Puget Sound sportsmen. Daily catch report blanks were distributed to boathouse operators throughout the Puget Sound area and sport-catch statistics were received from more than one half of the boathouses contacted." - So clearly there was a sport fishery, but they seem to have stopped monitoring it during the war and didn't pick it up again. - Nothing from 1943-1945, then they started again in 1946

From page 27 of the 1948 annual bulletin (this is about the recreational salmon fishery):

"The sport fishery, however, has increased in popularity in recent years and the number of fishermen has increased tremendously. New areas have become popular. In 1939 there were 231,000 fishermen days, while in 1947 there were 343,000, or an increase of 100,000 in eight years. These figures, moreover, merely represent just those persons that fished from rented boats, and **no estimate is attempted of trips made in private boats**. At the present the Department of Fisheries has no check or record of private boat fishing, but in 1949 a survey will be made of this fishing for the first time." - Increased recreational effort, and these statistics are an underestimate (these surveys only of boathouses).

Page 43 of the 1949 report: "Surveys of the number fishermen using **Puget Sound** have been made by the department since 1938 but never such scale 1949 when evaluation of private fishing parties was attempted along with the usual boathouse count . It is calculated that a minimum of 684,814 fisherman trips occurred, compared with the previous high of 343,000 in 1947. There are about 150 boathouses renting 4,000 small fishing craft on the Sound . Another 2,000 private boats are moored at the boathouses exclusive of public moorage facilities. A total of 15,000 outboard motorboats is registered with the coast guard . Boat counts in the sports fishing areas showed an average of about 30 private craft for every 100 rented boats during the busiest part of the 1949 season . The average in the winter months, from November through February, was about 7 for every 100. In arriving at the total number of fishermen , boathouse catches were increased in these proportions to allow for fish landed by private boats . During the winter , as many as 100 fishermen a day fished from Seattle docks . Their take of salmon , often as great as that of the boat fishermen , also is included in the sports total." - They stopped monitoring the bottomfish fishery it seems, but there are at least records of fisherman trips/fishermen days. - I think a reasonable estimate would be a ramp up from the original estimates in 1938 through when we have data starting in 1965? Not sure what sort of ramp though. - Constant ramp of +25,000 fishermen days/year would get reasonably close to 1965 values - Annual growth rate of 4-5% also is fairly good

Page 101 of the 1949 report: "Bottom Fish Management It is fallacious to believe that stocks of fish may be saved for future use merely through extended closures . Unless the fish are cropped annually by as many pounds as the stock can produce , wealth in the form of fish food and payroll is irretrievably lost. A given area will produce fish only within the limits of its food supply . Once a protected stock reaches this limit , it becomes stable with mutual mortality offsetting the spawning increment. Amid the population exist many fish whose growth has ceased , either from age or lack of food , and they continue to consume food in direct competition with their own young , even to the point of utilizing them as food. Chinook and silver salmon compete for food supply with dogfish , rockfish , true cod , black cod , pollack , ratfish and some species of sole. The young salmon and bottom fish feed on planktonic crustaceans such as amphipods , mysids, euphasids and other larval crustacean and fish forms. Other salmon and bottom fish forage on such small fishes as herring , sand lances , pilchards and anchovies . To insure a greater productivity of food fish it is first neces sary to eliminate the pressure of undesirable scrap fish whose sport and com mercial value is negligible. This can be achieved through an extensive bottom fishery , since dragging is an effective means controlling worm infes tations and thwarting the tendency of scrap fish to dominate the food supply of a fishable area which has been closed . - R . Walter Williams , Biologist" - That's nuts

Page 66 of the 1962 report (of the recreational salmon fishery): For all of Washington: "The estimated number of angler trips was a new record jumping to 1,130,800, an increase of nearly 100,000 over the previous high set in 1961." "The total catch in Puget Sound of 193,200 salmon, was not large when compared to the corresponding 778,800 angler trips". - This would not represent a big ramp up from 1949 (684,814).

Page 16-D of the 1965 report: "A calculated 34,196 angler trips were expended in noncoastal marine areas

for bottomfish only in 1965, approximately 3.4% of the 1965 food fish angling effort for these waters." - This same information is in the Buckley (1967) report on the 1965 bottomfish sport fishery.

Page 16-A of the 1965 report has angler trips by area - "The 1,278,000 angler trips expended... were only below the 1,432,000 trips recorded for 1963". - 1,278,000 total in Washington - 125,000 in Ilwaco, 170,000 in Westport, 22,000 in LaPush, 46,000 in Neah Bay (I believe these are the coastal marine waters), then 98,000 in Sekiu-Pillar Point.

Effort statistics - 1943: no mention of sport fishery effort - 1944-1947: no mention of sport fishery effort - 1948: "There are over 150 boathouses and resorts operating on Puget Sound with a total of about 4,000 boats . In addition , there are a large number of residents who own their own boats and fish throughout the year . At the boathouses alone , 2,000 private boats for salmon fishing are moored . About 15,000 outboard boats are regis tered with the Coast Guard , many of which are used for salmon fishing. **Each year around 350,000 fishermen try their luck for salmon on Puget Sound . This figure does not actually represent 350,000 persons , but is a total of all fishing trips, or fishermen days.** - 1949: Table 2 (PDF page 55) clearly shows that estimates of fisherman days exists for 1938, 1939, 1940, 1946, 1947, and 1949. - 1950: Decrease in number of fisherman days in the salmon fishery (page 34 of doc) - table 1 - 1951: Increase in number of fisherman days (see table 1) - It appears that the 62nd annual report contains 1951 and 1952, but complete statistics for only 1951? MISSING: 63rd annual report. 64th is published in 1956, but mostly concerns 1954 - 1953:"On Puget Sound a total of 652,000 fisherman trips, an all-time record, were made". - 1954: - 1956:"More fishermen than ever before" but does not list how many... - 1957: "Fishermen's trips were estimated at approximately one million" - but does not differentiate between PS and coastal waters - 1958: trips broken apart by region! Yay! - 1959: change in size limit led to decrease in number of fishermen days - 1960: Effort is not listed. Less salmon caught, but does say that there was good halibut fishing, which would be relevant for catches of other bottomfishes. - 1961: Effort listed. Calls 1960 "dismal". - 1962: effort listed - 1963: effort listed. Notes that in 1964, all salmon anglers are required to submit punch cards with salmon catch, as the previous system of relying on boat houses is being undermined by the increase in private boat ownership. - 1963 effort table lists effort for 1959-1963 - I don't think any effort is listed for 1964

Information on Boathouses https://cwbblog.wordpress.com/2012/12/18/new-exhibit-fish-on-opening-at-the-center-for-wooden-boats-december-29th-explores-the-history-of-boathouses-and-fishing-resorts-of-puget-sound/ https://www.cwb.org/fish-on

Maybe 15% of boathouses in 1957 were in Hood Canal, 15% North of Admiralty Inlet, and the other 70% in "South Puget Sound" (south of Admiralty)

Bargmann (1968-1969)

Sheets are numbered according to the table numbers in the document.

Tables of interest: - Table 9: Area 6 (Strait of Juan de Fuca) incidental catch - Table 10: Area 6 (Strait of Juan de Fuca) specific catch - Table 11: Area 7 (SJI) incidental catch - Table 12: Area 7 (SJI) specific catch - Table 13: Area 8 (Deception Pass and Hope Island) incidental catch - Table 14: Area 8 (Deception Pass and Hope Island) specific catch - Table 15: Area 9 (Admirality Inlet, Possession Sound, Saratoga Passage, Port Susan/North Puget Sound) incidental catch - Table 16: Area 9 (Admirality Inlet, Possession Sound, Saratoga Passage, Port Susan/North Puget Sound) specific catch - Table 17: Area 10 (Seattle and Bremerton/Central Puget Sound) incidental catch - Table 18: Area 10 (Seattle and Bremerton/Central Puget Sound) specific catch - Table 19: Area 11 (South Puget Sound) incidental catch - Table 20: Area 11 (South Puget Sound) specific catch - Table 21: Area 12 (Hood Canal) incidental catch - Table 22: Area 12 (Hood Canal) specific catch

Need to skip first four rows, and first column.

```
bargmann_path <- here("catch_reconstruction_data", "recreational", "pre_1970", "Bargman tables.xls")
```

```
JDF_inc <- read_excel(bargmann_path, sheet = "9", skip = 4)
JDF_spe <- read_excel(bargmann_path, sheet = "10", skip = 4)
SJI_inc <- read_excel(bargmann_path, sheet = "11", skip = 4)
SJI_spe <- read_excel(bargmann_path, sheet = "12", skip = 4)
DPHI_inc <- read_excel(bargmann_path, sheet = "13", skip = 4)
DPHI_spe <- read_excel(bargmann_path, sheet = "14", skip = 4)
NPS_inc <- read_excel(bargmann_path, sheet = "15", skip = 4)
NPS_spe <- read_excel(bargmann_path, sheet = "16", skip = 4)
CPS_inc <- read_excel(bargmann_path, sheet = "17", skip = 4)
CPS_spe <- read_excel(bargmann_path, sheet = "18", skip = 4)
SPS_inc <- read_excel(bargmann_path, sheet = "19", skip = 4)
SPS_spe <- read_excel(bargmann_path, sheet = "20", skip = 4)
HC_inc <- read_excel(bargmann_path, sheet = "21", skip = 4)
HC_spe <- read_excel(bargmann_path, sheet = "22", skip = 4)

# Make some edits/re-format
JDF_inc %>%
  mutate(take = "incidental", area = 6) %>%
  dplyr::select(-c(`Annual Avg`, `Percent of Total`, `1970`, `1971`, `1972`, `1973`)) -> JDF_inc
JDF_spe %>%
  mutate(take = "specific", area = 6) %>%
  dplyr::select(-c(`Annual Avg`, `Percent of Total`, `1970`, `1971`, `1972`, `1973`)) -> JDF_spe
SJI_inc %>%
  mutate(take = "incidental", area = 7) %>%
  dplyr::select(-c(`Annual Avg`, `Percent of Total`, `1970`, `1971`, `1972`, `1973`)) -> SJI_inc
SJI_spe %>%
  mutate(take = "specific", area = 7) %>%
  dplyr::select(-c(`Annual Avg`, `Percent of Total`, `1970`, `1971`, `1972`, `1973`)) -> SJI_spe
DPHI_inc %>%
  mutate(take = "incidental", area = 8) %>%
  dplyr::select(-c(`Annual Avg`, `Percent of Total`, `1970`, `1971`, `1972`, `1973`)) -> DPHI_inc
DPHI_spe %>%
  mutate(take = "specific", area = 8) %>%
  dplyr::select(-c(`Annual Avg`, `Percent of Total`, `1970`, `1971`, `1972`, `1973`)) -> DPHI_spe
NPS_inc %>%
  mutate(take = "incidental", area = 9) %>%
  dplyr::select(-c(`Annual Avg`, `Percent of Total`, `1970`, `1971`, `1972`, `1973`)) -> NPS_inc
NPS_spe %>%
  mutate(take = "specific", area = 9) %>%
  dplyr::select(-c(`Annual Avg`, `Percent of Total`, `1970`, `1971`, `1972`, `1973`)) -> NPS_spe
CPS_inc %>%
  mutate(take = "incidental", area = 10) %>%
  dplyr::select(-c(`Annual Avg`, `Percent of Total`, `1970`, `1971`, `1972`, `1973`)) -> CPS_inc
CPS_spe %>%
  mutate(take = "specific", area = 10) %>%
  dplyr::select(-c(`Annual Avg`, `Percent of Total`, `1970`, `1971`, `1972`, `1973`)) -> CPS_spe
SPS_inc %>%
  mutate(take = "incidental", area = 11) %>%
  dplyr::select(-c(`Annual Avg`, `Percent of Total`, `1970`, `1971`, `1972`, `1973`)) -> SPS_inc
SPS_spe %>%
  mutate(take = "specific", area = 11) %>%
  dplyr::select(-c(`Annual Avg`, `Percent of Total`, `1970`, `1971`, `1972`, `1973`)) -> SPS_spe
HC_inc %>%
```

```
  mutate(take = "incidental", area = 12) %>%
  dplyr::select(-c(`Annual Avg`, `Percent of Total`, `1970`, `1971`, `1972`, `1973`)) -> HC_inc
HC_spe %>%
  mutate(take = "specific", area = 12) %>%
  dplyr::select(-c(`Annual Avg`, `Percent of Total`, `1970`, `1971`, `1972`, `1973`)) -> HC_spe

# Join together all
JDF_inc  %>%
  bind_rows(., JDF_spe) %>%
  bind_rows(., SJI_inc) %>%
  bind_rows(., SJI_spe) %>%
  bind_rows(., DPHI_inc) %>%
  bind_rows(., DPHI_spe) %>%
  bind_rows(., NPS_inc) %>%
  bind_rows(., NPS_spe) %>%
  bind_rows(., CPS_inc) %>%
  bind_rows(., CPS_spe) %>%
  bind_rows(., SPS_inc) %>%
  bind_rows(., SPS_spe) %>%
  bind_rows(., HC_inc) %>%
  bind_rows(., HC_spe) -> bargmann_data

# combine years into one column
bargmann_data %>%
  pivot_longer(., cols = c(`1968`, `1969`), names_to = "year") %>%
  dplyr::rename(catch_individuals = value) -> bargmann_data

# Remove the irrelevant species
bargmann_data %>%
  subset(Species %in% c("Rockfish- unlcassified", "Rockfish-unclassified", "Rockfish- unclassified", "R
  mutate(Species = ifelse(Species %in% c("Bocaccio", "Boccacio"), "Bocaccio", Species)) %>%
  mutate(Species = ifelse(Species %in% c("Rockfish- unlcassified", "Rockfish-unclassified", "Rockfish- u

# Replace all NAs with zeros
bargmann_data[is.na(bargmann_data$catch_individuals),]$catch_individuals <- 0
unique(bargmann_data$area)
```

```
## [1]  6  7  8  9 10 11 12
```

```
# Add a North Puget Sound vs. South Puget Sound vs. Hood Canal column for prorating catch, dividing DPS
bargmann_data %>%
  mutate(., PS = ifelse(area %in% c(8,9,10,11), "South Puget Sound",
                        ifelse(area == 12, "Hood Canal",  "North Puget Sound"))) -> bargmann_data
```

```
# Summarise across regions
bargmann_data %>%
  group_by(year, Species, PS) %>%
  summarise(total_catch = sum(catch_individuals)) -> bargmann_annual_sums
```

```
## `summarise()` has grouped output by 'year', 'Species'. You can override using the `.groups` argument
```

```
# Prorate catch according to 1965-1967 comp data
# Add the catch composition data
# Note: is it better to use these estimates, or use the same year and use only the species-level identi

# Here we are using the South Puget Sound comps for the Hood Canal catches
bargmann_annual_sums %>%
  mutate(boc_prop = ifelse(PS == "North Puget Sound", subset(rec_mean_spp_comp_NPS, Species == "Bocacci
  mutate(ye_prop = ifelse(PS == "North Puget Sound", subset(rec_mean_spp_comp_NPS, Species == "Yellowey


# Prorate and summarise for yelloweye

# U.S. DPS minus Hood canal
bargmann_annual_sums %>%
  subset(Species %in% c("unclassified rockfish", "Yelloweye rockfish")) %>%
  mutate(., catch = ifelse(Species == "Yelloweye rockfish", total_catch, ye_prop*total_catch)) %>%
  subset(PS != "Hood Canal") %>%
  group_by(year) %>%
  summarise(catch = sum(catch)) %>%
  mutate(catch_lbs = catch*YE_lbs_per_individual) -> ye_catch_bargmann_USDPS

# Hood Canal
bargmann_annual_sums %>%
  subset(Species %in% c("unclassified rockfish", "Yelloweye rockfish")) %>%
  mutate(., catch = ifelse(Species == "Yelloweye rockfish", total_catch, ye_prop*total_catch)) %>%
  subset(PS == "Hood Canal") %>%
  group_by(year) %>%
  summarise(catch = sum(catch)) %>%
  mutate(catch_lbs = catch*YE_lbs_per_individual) -> ye_catch_bargmann_HC

# Prorate and summarise for bocaccio
bargmann_annual_sums %>%
  subset(Species %in% c("unclassified rockfish", "Bocaccio")) %>%
  mutate(., catch = ifelse(Species == "Bocaccio", total_catch, boc_prop*total_catch)) %>%
  group_by(year) %>%
  summarise(catch = sum(catch)) %>%
  mutate(catch_lbs = catch*BOC_lbs_per_individual) -> boc_catch_bargmann
```

Buckley (1965-1967)

The Buckley tables have the exact same numbering as the Bargmann tables

```
buck65_path <- here("catch_reconstruction_data", "recreational", "pre_1970", "Buckley 1965 tables.xls")

JDF_inc <- read_excel(buck65_path, sheet = "9", skip = 3)
JDF_spe <- read_excel(buck65_path, sheet = "10", skip = 3)
SJI_inc <- read_excel(buck65_path, sheet = "11", skip = 4)
SJI_spe <- read_excel(buck65_path, sheet = "12", skip = 3)
DPHI_inc <- read_excel(buck65_path, sheet = "13", skip = 3)
DPHI_spe <- read_excel(buck65_path, sheet = "14", skip = 3)
NPS_inc <- read_excel(buck65_path, sheet = "15", skip = 3)
NPS_spe <- read_excel(buck65_path, sheet = "16", skip = 3)
CPS_inc <- read_excel(buck65_path, sheet = "17", skip = 3)
```

```
CPS_spe <- read_excel(buck65_path, sheet = "18", skip = 3)
SPS_inc <- read_excel(buck65_path, sheet = "19", skip = 3)
SPS_spe <- read_excel(buck65_path, sheet = "20", skip = 3)
HC_inc <- read_excel(buck65_path, sheet = "21", skip = 3)
HC_spe <- read_excel(buck65_path, sheet = "22", skip = 3)

# Make some edits/re-format
JDF_inc %>%
  mutate(take = "incidental", area = 6) %>%
  dplyr::select(Species, Totals, take, area) -> JDF_inc
JDF_spe %>%
  mutate(take = "specific", area = 6) %>%
  dplyr::select(Species, Totals, take, area) -> JDF_spe
SJI_inc %>%
  mutate(take = "incidental", area = 7) %>%
  dplyr::select(Species, Totals, take, area) -> SJI_inc
SJI_spe %>%
  mutate(take = "specific", area = 7) %>%
  dplyr::select(Species, Totals, take, area) -> SJI_spe
DPHI_inc %>%
  mutate(take = "incidental", area = 8) %>%
  dplyr::select(Species, Totals, take, area) -> DPHI_inc
DPHI_spe %>%
  mutate(take = "specific", area = 8) %>%
  dplyr::select(Species, Totals, take, area) -> DPHI_spe
NPS_inc %>%
  mutate(take = "incidental", area = 9) %>%
  dplyr::select(Species, Totals, take, area) -> NPS_inc
NPS_spe %>%
  mutate(take = "specific", area = 9) %>%
  dplyr::select(Species, Totals, take, area) -> NPS_spe
CPS_inc %>%
  mutate(take = "incidental", area = 10) %>%
  dplyr::select(Species, Totals, take, area) -> CPS_inc
CPS_spe %>%
  mutate(take = "specific", area = 10) %>%
  dplyr::select(Species, Totals, take, area) -> CPS_spe
SPS_inc %>%
  mutate(take = "incidental", area = 11) %>%
  dplyr::select(Species, Totals, take, area) -> SPS_inc
SPS_spe %>%
  mutate(take = "specific", area = 11) %>%
  dplyr::select(Species, Totals, take, area) -> SPS_spe
HC_inc %>%
  mutate(take = "incidental", area = 12) %>%
  dplyr::select(Species, Totals, take, area) -> HC_inc
HC_spe %>%
  mutate(take = "specific", area = 12) %>%
  dplyr::select(Species, Totals, take, area) -> HC_spe

# Join together all
JDF_inc  %>%
  bind_rows(., JDF_spe) %>%
```

```
  bind_rows(., SJI_inc) %>%
  bind_rows(., SJI_spe) %>%
  bind_rows(., DPHI_inc) %>%
  bind_rows(., DPHI_spe) %>%
  bind_rows(., NPS_inc) %>%
  bind_rows(., NPS_spe) %>%
  bind_rows(., CPS_inc) %>%
  bind_rows(., CPS_spe) %>%
  bind_rows(., SPS_inc) %>%
  bind_rows(., SPS_spe) %>%
  bind_rows(., HC_inc) %>%
  bind_rows(., HC_spe) -> buck65_data

# combine years into one column
buck65_data %>%
  dplyr::rename(catch_individuals = Totals) -> buck65_data

# Save data for species comps
buck65_data_2 <- buck65_data

unique(buck65_data$Species)
```

```
##  [1] "Black rockfish"         "Copper rockfish"        "Rasphead rockfish"
##  [4] "Rockfishes"             "Total Catch"            "% Total"
##  [7] "Total angler\ntrips"    "Catch per\nangler trip" "Brown rockfish"
## [10] "Quillback rockfish"     "Rosethorn rockfish"     "Yellowtail rockfishes"
## [13] "Canary rockfish"        "Bocaccio"               "Yellowtail rockfish"
## [16] "China rockfish"
```

```
# Remove the irrelevant species
buck65_data %>%
  subset(Species %in% c("Rasphead rockfish", "Rockfishes", "Bocaccio")) %>%
  mutate(Species = ifelse(Species == "Rasphead rockfish", "Yelloweye rockfish", Species)) -> buck65_data

unique(buck65_data$area)
```

```
## [1]  6  7  9 10 11 12
```

```
# Add a North Puget Sound vs. South Puget Sound vs. Hood Canal column for prorating catch, dividing DPS
buck65_data %>%
  mutate(., PS = ifelse(area %in% c(8,9,10,11), "South Puget Sound",
                        ifelse(area == 12, "Hood Canal",  "North Puget Sound"))) -> buck65_data
```

Note: Yelloweye catchces from this time period are crazy high, mostly owing to a super high incidental take in area 11 (South Puget Sound) - 3450 individuals, with 2,429 in the month of June.

```
buck66_path <- here("catch_reconstruction_data", "recreational", "pre_1970", "Buckley 1966 tables.xls")

JDF_inc <- read_excel(buck66_path, sheet = "11", skip = 4)
JDF_spe <- read_excel(buck66_path, sheet = "12", skip = 4)
SJI_inc <- read_excel(buck66_path, sheet = "13", skip = 4)
SJI_spe <- read_excel(buck66_path, sheet = "14", skip = 4)
```

```
DPHI_inc <- read_excel(buck66_path, sheet = "15", skip = 4)
DPHI_spe <- read_excel(buck66_path, sheet = "16", skip = 4)
NPS_inc <- read_excel(buck66_path, sheet = "17", skip = 4)
NPS_spe <- read_excel(buck66_path, sheet = "18", skip = 4)
CPS_inc <- read_excel(buck66_path, sheet = "19", skip = 4)
CPS_spe <- read_excel(buck66_path, sheet = "20", skip = 4)
SPS_inc <- read_excel(buck66_path, sheet = "21", skip = 4)
SPS_spe <- read_excel(buck66_path, sheet = "22", skip = 4)
HC_inc <- read_excel(buck66_path, sheet = "23", skip = 4)
HC_spe <- read_excel(buck66_path, sheet = "24", skip = 4)

# Make some edits/re-format
JDF_inc %>%
  mutate(take = "incidental", area = 6) %>%
  dplyr::select(Species, Totals, take, area) -> JDF_inc
JDF_spe %>%
  mutate(take = "specific", area = 6) %>%
  dplyr::select(Species, Totals, take, area) -> JDF_spe
SJI_inc %>%
  mutate(take = "incidental", area = 7) %>%
  dplyr::select(Species, Totals, take, area) -> SJI_inc
SJI_spe %>%
  mutate(take = "specific", area = 7) %>%
  dplyr::select(Species, Totals, take, area) -> SJI_spe
DPHI_inc %>%
  mutate(take = "incidental", area = 8) %>%
  dplyr::select(Species, Totals, take, area) -> DPHI_inc
DPHI_spe %>%
  mutate(take = "specific", area = 8) %>%
  dplyr::select(Species, Totals, take, area) -> DPHI_spe
NPS_inc %>%
  mutate(take = "incidental", area = 9) %>%
  dplyr::select(Species, Totals, take, area) -> NPS_inc
NPS_spe %>%
  mutate(take = "specific", area = 9) %>%
  dplyr::select(Species, Totals, take, area) -> NPS_spe
CPS_inc %>%
  mutate(take = "incidental", area = 10) %>%
  dplyr::select(Species, Totals, take, area) -> CPS_inc
CPS_spe %>%
  mutate(take = "specific", area = 10) %>%
  dplyr::select(Species, Totals, take, area) -> CPS_spe
SPS_inc %>%
  mutate(take = "incidental", area = 11) %>%
  dplyr::select(Species, Totals, take, area) -> SPS_inc
SPS_spe %>%
  mutate(take = "specific", area = 11) %>%
  dplyr::select(Species, Totals, take, area) -> SPS_spe
HC_inc %>%
  mutate(take = "incidental", area = 12) %>%
  dplyr::select(Species, Totals, take, area) -> HC_inc
HC_spe %>%
  mutate(take = "specific", area = 12) %>%
```

```
  dplyr::select(Species, Totals, take, area) -> HC_spe

# Join together all
JDF_inc  %>%
  bind_rows(., JDF_spe) %>%
  bind_rows(., SJI_inc) %>%
  bind_rows(., SJI_spe) %>%
  bind_rows(., DPHI_inc) %>%
  bind_rows(., DPHI_spe) %>%
  bind_rows(., NPS_inc) %>%
  bind_rows(., NPS_spe) %>%
  bind_rows(., CPS_inc) %>%
  bind_rows(., CPS_spe) %>%
  bind_rows(., SPS_inc) %>%
  bind_rows(., SPS_spe) %>%
  bind_rows(., HC_inc) %>%
  bind_rows(., HC_spe) -> buck66_data

# combine years into one column
buck66_data %>%
  dplyr::rename(catch_individuals = Totals) -> buck66_data

# Save data for species comps
buck66_data_2 <- buck66_data

unique(buck66_data$Species)
```

```
##  [1] "Black rockfish"        "Copper rockfish"       "Total Catch"
##  [4] "Percent of Total"      "Total angler trips"    "Catch per angler trip"
##  [7] "Canary rockfish"       "Yelloweye rockfish"    "Rockfishes"
## [10] "Quillback rockfish"    "Tiger rockfish"        "Yellowtail rockfish"
## [13] "Bocaccio"              "Brown rockfish"        "Vermilion rockfish"
## [16] "Greenstriped rockfish"
```

```
# Remove the irrelevant species
buck66_data %>%
  subset(Species %in% c("Yelloweye rockfish", "Rockfishes", "Bocaccio")) %>%
  mutate(Species = ifelse(Species == "Rasphead rockfish", "Yelloweye rockfish", Species)) -> buck66_data

unique(buck66_data$area)
```

```
## [1]  6  7  8  9 10 11
```

```
# Add a North Puget Sound vs. South Puget Sound vs. Hood Canal column for prorating catch, dividing DPS
buck66_data %>%
  mutate(., PS = ifelse(area %in% c(8,9,10,11), "South Puget Sound",
                        ifelse(area == 12, "Hood Canal",  "North Puget Sound"))) -> buck66_data

buck67_path <- here("catch_reconstruction_data", "recreational", "pre_1970", "buckley 1967 tables.xls")

JDF_inc <- read_excel(buck67_path, sheet = "16", skip = 3)
JDF_spe <- read_excel(buck67_path, sheet = "17", skip = 3)
```

```
SJI_inc <- read_excel(buck67_path, sheet = "18", skip = 3)
SJI_spe <- read_excel(buck67_path, sheet = "19", skip = 3)
DPHI_inc <- read_excel(buck67_path, sheet = "20", skip = 3)
DPHI_spe <- read_excel(buck67_path, sheet = "21", skip = 3)
NPS_inc <- read_excel(buck67_path, sheet = "22", skip = 3)
NPS_spe <- read_excel(buck67_path, sheet = "23", skip = 3)
CPS_inc <- read_excel(buck67_path, sheet = "24", skip = 3)
CPS_spe <- read_excel(buck67_path, sheet = "25", skip = 3)
SPS_inc <- read_excel(buck67_path, sheet = "26", skip = 3)
SPS_spe <- read_excel(buck67_path, sheet = "27", skip = 3)
HC_inc <- read_excel(buck67_path, sheet = "28", skip = 3)
HC_spe <- read_excel(buck67_path, sheet = "Sheet9", skip = 3)

# Make some edits/re-format
JDF_inc %>%
  mutate(take = "incidental", area = 6) %>%
  dplyr::rename(Species = Area) %>%
  dplyr::select(Species, Totals, take, area) -> JDF_inc
JDF_spe %>%
  mutate(take = "specific", area = 6) %>%
  dplyr::rename(Species = Area) %>%
  dplyr::select(Species, Totals, take, area) -> JDF_spe
SJI_inc %>%
  mutate(take = "incidental", area = 7) %>%
  dplyr::rename(Species = Area) %>%
  dplyr::select(Species, Totals, take, area) -> SJI_inc
SJI_spe %>%
  mutate(take = "specific", area = 7) %>%
  dplyr::rename(Species = Area) %>%
  dplyr::select(Species, Totals, take, area) -> SJI_spe
DPHI_inc %>%
  mutate(take = "incidental", area = 8) %>%
  dplyr::rename(Species = Area) %>%
  dplyr::select(Species, Totals, take, area) -> DPHI_inc
DPHI_spe %>%
  mutate(take = "specific", area = 8) %>%
  dplyr::rename(Species = Area) %>%
  dplyr::select(Species, Totals, take, area) -> DPHI_spe
NPS_inc %>%
  mutate(take = "incidental", area = 9) %>%
  dplyr::rename(Species = Area) %>%
  dplyr::select(Species, Totals, take, area) -> NPS_inc
NPS_spe %>%
  mutate(take = "specific", area = 9) %>%
  dplyr::rename(Species = Area) %>%
  dplyr::select(Species, Totals, take, area) -> NPS_spe
CPS_inc %>%
  mutate(take = "incidental", area = 10) %>%
  dplyr::rename(Species = Area) %>%
  dplyr::select(Species, Totals, take, area) -> CPS_inc
CPS_spe %>%
  mutate(take = "specific", area = 10) %>%
  dplyr::rename(Species = Area) %>%
```

```
  dplyr::select(Species, Totals, take, area) -> CPS_spe
SPS_inc %>%
  mutate(take = "incidental", area = 11) %>%
  dplyr::rename(Species = Area) %>%
  dplyr::select(Species, Totals, take, area) -> SPS_inc
SPS_spe %>%
  mutate(take = "specific", area = 11) %>%
  dplyr::rename(Species = Area) %>%
  dplyr::select(Species, Totals, take, area) -> SPS_spe
HC_inc %>%
  mutate(take = "incidental", area = 12) %>%
  dplyr::rename(Species = Area) %>%
  dplyr::select(Species, Totals, take, area) -> HC_inc
HC_spe %>%
  mutate(take = "specific", area = 12) %>%
  dplyr::rename(Species = Area) %>%
  dplyr::select(Species, Totals, take, area) -> HC_spe

# Join together all
JDF_inc  %>%
  bind_rows(., JDF_spe) %>%
  bind_rows(., SJI_inc) %>%
  bind_rows(., SJI_spe) %>%
  bind_rows(., DPHI_inc) %>%
  bind_rows(., DPHI_spe) %>%
  bind_rows(., NPS_inc) %>%
  bind_rows(., NPS_spe) %>%
  bind_rows(., CPS_inc) %>%
  bind_rows(., CPS_spe) %>%
  bind_rows(., SPS_inc) %>%
  bind_rows(., SPS_spe) %>%
  bind_rows(., HC_inc) %>%
  bind_rows(., HC_spe) -> buck67_data

# combine years into one column
buck67_data %>%
  dplyr::rename(catch_individuals = Totals) -> buck67_data

# Save data for species comps
buck67_data_2 <- buck67_data

unique(buck67_data$Species)
```

```
##  [1] "Black rockfish"          "Canary rockfish"
##  [3] "China rockfish"          "Copper rockfish"
##  [5] "Rasphead rockfish"       "Vermilion rockfish"
##  [7] "Rockfishes"              "Total Catch"
##  [9] "% of Total"              "Angler trips"
## [11] "Catch per\n angler trip" "Quillback rockfish"
## [13] "Yellowtail rockfish"     "Brown rockfish"
## [15] "Bocaccio"                "Greenstriped rockfish"
## [17] "Brown Rockfish"          "Blue rockfish"
## [19] "Shortbelly rockfish"
```

```
# Remove the irrelevant species
buck67_data %>%
  subset(Species %in% c("Rasphead rockfish", "Rockfishes", "Bocaccio")) %>%
  mutate(Species = ifelse(Species == "Rasphead rockfish", "Yelloweye rockfish", Species)) -> buck67_data

unique(buck67_data$area)
```

```
## [1]  6  7  8  9 10 11 12
```

```
# Add a North Puget Sound vs. South Puget Sound vs. Hood Canal column for prorating catch, dividing DPS
buck67_data %>%
  mutate(., PS = ifelse(area %in% c(8,9,10,11), "South Puget Sound",
                        ifelse(area == 12, "Hood Canal",  "North Puget Sound"))) -> buck67_data
```

Recalculate Buckley compositions

Here we will recalculate the Buckley species compositions so that we can get comps on a finer scale than "North Puget Sound" and "South Puget Sound".

South Puget Sound = areas 8, 9, 10, 11, 12 Hood Canal = area 12 North Puget Sound = areas 5, 6, 7

```
unique(buck65_data_2$Species)
```

```
##  [1] "Black rockfish"         "Copper rockfish"        "Rasphead rockfish"
##  [4] "Rockfishes"             "Total Catch"            "% Total"
##  [7] "Total angler\ntrips"    "Catch per\nangler trip" "Brown rockfish"
## [10] "Quillback rockfish"     "Rosethorn rockfish"     "Yellowtail rockfishes"
## [13] "Canary rockfish"        "Bocaccio"               "Yellowtail rockfish"
## [16] "China rockfish"
```

```
buck65_data_2 %>%
  mutate(year = 1965) %>%
  # Remove the non-informative "Species"
  subset(., !(Species %in% c("Rockfishes", "Total Catch", "% Total",   "Total angler\ntrips",   "Catch p


unique(buck66_data_2$Species)
```

```
##  [1] "Black rockfish"        "Copper rockfish"       "Total Catch"
##  [4] "Percent of Total"      "Total angler trips"    "Catch per angler trip"
##  [7] "Canary rockfish"       "Yelloweye rockfish"    "Rockfishes"
## [10] "Quillback rockfish"    "Tiger rockfish"        "Yellowtail rockfish"
## [13] "Bocaccio"              "Brown rockfish"        "Vermilion rockfish"
## [16] "Greenstriped rockfish"
```

```
buck66_data_2 %>%
  mutate(year = 1966) %>%
  # Remove the non-informative "Species"
  subset(., !(Species %in% c("Rockfishes", "Total Catch", "Percent of Total",   "Total angler trips",

unique(buck67_data_2$Species)
```

```
##  [1] "Black rockfish"          "Canary rockfish"
##  [3] "China rockfish"          "Copper rockfish"
##  [5] "Rasphead rockfish"       "Vermilion rockfish"
##  [7] "Rockfishes"              "Total Catch"
##  [9] "% of Total"              "Angler trips"
## [11] "Catch per\n angler trip" "Quillback rockfish"
## [13] "Yellowtail rockfish"     "Brown rockfish"
## [15] "Bocaccio"                "Greenstriped rockfish"
## [17] "Brown Rockfish"          "Blue rockfish"
## [19] "Shortbelly rockfish"
```

```
buck67_data_2 %>%
  mutate(year = 1967) %>%
  # Remove the non-informative "Species"
  subset(., !(Species %in% c("Rockfishes", "Total Catch", "% of Total",   "Angler trips",   "Catch per\n

# Let's try to reproduce Wayne's comp estimates

# South Puget Sound
buck65_data_2 %>%
  bind_rows(., buck66_data_2) %>%
  bind_rows(., buck67_data_2) %>%
  # Change "Rasphead" to "Yelloweye rockfish"
  mutate(Species = ifelse(Species == "Rasphead rockfish", "Yelloweye rockfish", Species)) %>%
  # Change "Yellowtail rockfishes" to "Yellowtail rockfish"
  mutate(Species = ifelse(Species == "Yellowtail rockfishes", "Yellowtail rockfish", Species)) %>%
  # Change "Brown Rockfish" to "Brown rockfish"
  mutate(Species = ifelse(Species == "Brown Rockfish", "Brown rockfish", Species)) %>%
  subset(area %in% c(8, 9, 10, 11, 12)) %>%
  # Sum across regions and years
  group_by(Species) %>%
  summarise(total = sum(catch_individuals)) %>%
  # Calculate proportions
  ungroup() %>%
  mutate(prop = total/sum(.$total))-> buck65_67_SPS

# Very similar but not identical to Wayne's calculations...


# Calculate proportions for each area separately
buck65_data_2 %>%
  bind_rows(., buck66_data_2) %>%
  bind_rows(., buck67_data_2) %>%
  # Change "Rasphead" to "Yelloweye rockfish"
  mutate(Species = ifelse(Species == "Rasphead rockfish", "Yelloweye rockfish", Species)) %>%
  # Change "Yellowtail rockfishes" to "Yellowtail rockfish"
  mutate(Species = ifelse(Species == "Yellowtail rockfishes", "Yellowtail rockfish", Species)) %>%
  # Change "Brown Rockfish" to "Brown rockfish"
  mutate(Species = ifelse(Species == "Brown Rockfish", "Brown rockfish", Species)) %>%
  group_by(Species,area) %>%
  summarise(total = sum(catch_individuals)) %>%
  group_by(area) %>%
  mutate(prop = total/sum(total)) -> buck65_67_comps_by_area
```

```
## `summarise()` has grouped output by 'Species'. You can override using the `.groups` argument.
```

```
# Sanity check
# buck65_67_comps_by_area %>%
#   group_by(area) %>%
#   summarise(sum(prop))

# Calculate just bocaccio and yelloweye proportions by area
buck65_67_comps_by_area %>%
  subset(Species %in% c("Bocaccio", "Yelloweye rockfish")) %>%
  mutate(ye_prop = ifelse(Species == "Yelloweye rockfish", prop, NA)) %>%
  mutate(boc_prop = ifelse(Species == "Bocaccio", prop, NA)) %>%
  dplyr::select(area, ye_prop, boc_prop) %>%
  group_by(area) %>%
  summarise_all(sum, na.rm = TRUE) %>%
  # Add zeros for years where there was no catch using tidyverse::complete
  complete(., area = seq(6,12,1), fill = list(ye_prop = 0, boc_prop = 0)) -> buck65_67_ESA_comps_by_area

# Calculate bocaccio and yelloweye proportions by area, separately for each year
buck65_data_2 %>%
  bind_rows(., buck66_data_2) %>%
  bind_rows(., buck67_data_2) %>%
  # Change "Rasphead" to "Yelloweye rockfish"
  mutate(Species = ifelse(Species == "Rasphead rockfish", "Yelloweye rockfish", Species)) %>%
  # Change "Yellowtail rockfishes" to "Yellowtail rockfish"
  mutate(Species = ifelse(Species == "Yellowtail rockfishes", "Yellowtail rockfish", Species)) %>%
  # Change "Brown Rockfish" to "Brown rockfish"
  mutate(Species = ifelse(Species == "Brown Rockfish", "Brown rockfish", Species)) %>%
  group_by(year, Species,area) %>%
  summarise(total = sum(catch_individuals)) %>%
  group_by(area, year) %>%
  mutate(prop = total/sum(total)) %>%
  subset(Species %in% c("Bocaccio", "Yelloweye rockfish")) %>%
  mutate(ye_prop = ifelse(Species == "Yelloweye rockfish", prop, NA)) %>%
  mutate(boc_prop = ifelse(Species == "Bocaccio", prop, NA)) %>%
  dplyr::select(year, area, ye_prop, boc_prop) %>%
  group_by(year, area) %>%
  summarise_all(sum, na.rm = TRUE) %>%
  # Add zeros for years where there was no catch using tidyverse::complete
  complete(., area = seq(6,12,1), fill = list(ye_prop = 0, boc_prop = 0)) -> buck65_67_ESA_comps_by_area
```

```
## `summarise()` has grouped output by 'year', 'Species'. You can override using the `.groups` argument
```

```
# Find minimum and maximum proportions for each year and area
buck65_67_ESA_comps_by_area_year %>%
  group_by(area) %>%
  summarise(max_ye_prop = max(ye_prop), min_ye_prop = min(ye_prop)) -> buck_ye_prop_ranges

buck65_67_ESA_comps_by_area_year %>%
  group_by(area) %>%
  summarise(max_boc_prop = max(boc_prop), min_boc_prop = min(boc_prop)) -> buck_boc_prop_ranges
```

Prorate catches, summarise

```
# Summarise across regions
buck65_data %>%
  group_by(Species, area) %>%
  summarise(total_catch = sum(catch_individuals)) -> buck65_annual_sums
```

```
## `summarise()` has grouped output by 'Species'. You can override using the `.groups` argument.
```

```
# Prorate catch according to 1965-1967 comp data
# Add the catch composition data and prorate
buck65_annual_sums %>%
  ungroup() %>%
  left_join(., buck65_67_ESA_comps_by_area, by = "area") %>%
  subset(Species == "Rockfishes") %>%
  mutate(ye_est_catch = ye_prop*total_catch) %>%
  mutate(boc_est_catch = boc_prop*total_catch) %>%
  dplyr::select(area, ye_est_catch, boc_est_catch) -> buck65_prorated_catches

buck65_annual_sums %>%
  ungroup() %>%
  mutate(boc_catch = ifelse(Species == "Bocaccio", total_catch, 0)) %>%
  mutate(ye_catch = ifelse(Species == "Yelloweye rockfish", total_catch, 0)) %>%
  dplyr::select(area, boc_catch, ye_catch) %>%
  group_by(area) %>%
  summarise_all(sum) %>%
  # subset(Species %in% c("Bocaccio", "Yelloweye rockfish")) %>%
  left_join(., buck65_prorated_catches, by = "area") %>%
  group_by(area) %>%
  mutate(ye_catch_total = sum(ye_catch, ye_est_catch)) %>%
  mutate(boc_catch_total = sum(boc_catch, boc_est_catch)) -> buck65_ESA_sums

# Yelloweye: US DPS (no Hood Canal)
buck65_ESA_sums %>%
  subset(area != 12) %>%
  ungroup() %>%
  summarise(catch_n = sum(ye_catch_total)) %>%
  mutate(year = 1965) %>%
  mutate(catch_lbs = catch_n*YE_lbs_per_individual) -> ye_catch_buck65_USDPS

# Yelloweye: Subset Hood Canal
buck65_ESA_sums %>%
  subset(area == 12) %>%
  ungroup() %>%
  summarise(catch_n = sum(ye_catch_total)) %>%
  mutate(year = 1965) %>%
  mutate(catch_lbs = catch_n*YE_lbs_per_individual) -> ye_catch_buck65_HC

# Bocaccio: US DPS (all areas)
buck65_ESA_sums %>%
  ungroup() %>%
  summarise(catch_n = sum(boc_catch_total)) %>%
```

```
  mutate(year = 1965) %>%
  mutate(catch_lbs = catch_n*BOC_lbs_per_individual) -> boc_catch_buck65_USDPS
```

```
# Summarise across regions
buck66_data %>%
  group_by(Species, area) %>%
  summarise(total_catch = sum(catch_individuals)) -> buck66_annual_sums
```

```
## `summarise()` has grouped output by 'Species'. You can override using the `.groups` argument.
```

```
# Prorate catch according to 1966-1967 comp data
# Add the catch composition data and prorate
buck66_annual_sums %>%
  ungroup() %>%
  left_join(., buck65_67_ESA_comps_by_area, by = "area") %>%
  subset(Species == "Rockfishes") %>%
  mutate(ye_est_catch = ye_prop*total_catch) %>%
  mutate(boc_est_catch = boc_prop*total_catch) %>%
  dplyr::select(area, ye_est_catch, boc_est_catch) -> buck66_prorated_catches

buck66_annual_sums %>%
  ungroup() %>%
  mutate(boc_catch = ifelse(Species == "Bocaccio", total_catch, 0)) %>%
  mutate(ye_catch = ifelse(Species == "Yelloweye rockfish", total_catch, 0)) %>%
  dplyr::select(area, boc_catch, ye_catch) %>%
  group_by(area) %>%
  summarise_all(sum) %>%
  # subset(Species %in% c("Bocaccio", "Yelloweye rockfish")) %>%
  left_join(., buck66_prorated_catches, by = "area") %>%
  group_by(area) %>%
  mutate(ye_catch_total = sum(ye_catch, ye_est_catch)) %>%
  mutate(boc_catch_total = sum(boc_catch, boc_est_catch)) -> buck66_ESA_sums

# Yelloweye: US DPS (no Hood Canal)
buck66_ESA_sums %>%
  subset(area != 12) %>%
  ungroup() %>%
  summarise(catch_n = sum(ye_catch_total)) %>%
  mutate(year = 1966) %>%
  mutate(catch_lbs = catch_n*YE_lbs_per_individual) -> ye_catch_buck66_USDPS

# Yelloweye: Subset Hood Canal
buck66_ESA_sums %>%
  subset(area == 12) %>%
  ungroup() %>%
  summarise(catch_n = sum(ye_catch_total)) %>%
  mutate(year = 1966) %>%
  mutate(catch_lbs = catch_n*YE_lbs_per_individual) -> ye_catch_buck66_HC

# Bocaccio: US DPS (all areas)
buck66_ESA_sums %>%
  ungroup() %>%
  summarise(catch_n = sum(boc_catch_total)) %>%
```

```
  mutate(year = 1966) %>%
  mutate(catch_lbs = catch_n*BOC_lbs_per_individual) -> boc_catch_buck66_USDPS
```

```
# Summarise across regions
buck67_data %>%
  group_by(Species, area) %>%
  summarise(total_catch = sum(catch_individuals)) -> buck67_annual_sums
```

```
## `summarise()` has grouped output by 'Species'. You can override using the `.groups` argument.
```

```
# Prorate catch according to 1967-1967 comp data
# Add the catch composition data and prorate
buck67_annual_sums %>%
  ungroup() %>%
  left_join(., buck65_67_ESA_comps_by_area, by = "area") %>%
  subset(Species == "Rockfishes") %>%
  mutate(ye_est_catch = ye_prop*total_catch) %>%
  mutate(boc_est_catch = boc_prop*total_catch) %>%
  dplyr::select(area, ye_est_catch, boc_est_catch) -> buck67_prorated_catches

buck67_annual_sums %>%
  ungroup() %>%
  mutate(boc_catch = ifelse(Species == "Bocaccio", total_catch, 0)) %>%
  mutate(ye_catch = ifelse(Species == "Yelloweye rockfish", total_catch, 0)) %>%
  dplyr::select(area, boc_catch, ye_catch) %>%
  group_by(area) %>%
  summarise_all(sum) %>%
  # subset(Species %in% c("Bocaccio", "Yelloweye rockfish")) %>%
  left_join(., buck67_prorated_catches, by = "area") %>%
  group_by(area) %>%
  mutate(ye_catch_total = sum(ye_catch, ye_est_catch)) %>%
  mutate(boc_catch_total = sum(boc_catch, boc_est_catch)) -> buck67_ESA_sums

# Yelloweye: US DPS (no Hood Canal)
buck67_ESA_sums %>%
  subset(area != 12) %>%
  ungroup() %>%
  summarise(catch_n = sum(ye_catch_total)) %>%
  mutate(year = 1967) %>%
  mutate(catch_lbs = catch_n*YE_lbs_per_individual) -> ye_catch_buck67_USDPS

# Yelloweye: Subset Hood Canal
buck67_ESA_sums %>%
  subset(area == 12) %>%
  ungroup() %>%
  summarise(catch_n = sum(ye_catch_total)) %>%
  mutate(year = 1967) %>%
  mutate(catch_lbs = catch_n*YE_lbs_per_individual) -> ye_catch_buck67_HC

# Bocaccio: US DPS (all areas)
buck67_ESA_sums %>%
  ungroup() %>%
  summarise(catch_n = sum(boc_catch_total)) %>%
```

```
  mutate(year = 1967) %>%
  mutate(catch_lbs = catch_n*BOC_lbs_per_individual) -> boc_catch_buck67_USDPS
```

1965-1969: Combine Buckley and Bargmann

Yelloweye and bocaccio catch scenarios

Single estimate for both species for this time period

```
ye_catch_bargmann_HC %>%
  dplyr::rename(catch_n = catch) %>%
  mutate(year = as.numeric(year)) %>%
  bind_rows(., ye_catch_buck67_HC) %>%
  bind_rows(., ye_catch_buck66_HC) %>%
  bind_rows(., ye_catch_buck65_HC) %>%
  # Single catch scenario
  mutate(high_catch_lbs = catch_lbs, medium_catch_lbs = catch_lbs, low_catch_lbs = catch_lbs) -> ye_rec

ye_catch_bargmann_USDPS %>%
  dplyr::rename(catch_n = catch) %>%
  mutate(year = as.numeric(year)) %>%
  bind_rows(., ye_catch_buck67_USDPS) %>%
  bind_rows(., ye_catch_buck66_USDPS) %>%
  bind_rows(., ye_catch_buck65_USDPS) %>%
  # Single catch scenario
  mutate(high_catch_lbs = catch_lbs, medium_catch_lbs = catch_lbs, low_catch_lbs = catch_lbs)-> ye_rec_

boc_catch_bargmann %>%
  dplyr::rename(catch_n = catch) %>%
  mutate(year = as.numeric(year)) %>%
  bind_rows(., boc_catch_buck67_USDPS) %>%
  bind_rows(., boc_catch_buck66_USDPS) %>%
  bind_rows(., boc_catch_buck65_USDPS) %>%
  # Single catch scenario
  mutate(high_catch_lbs = catch_lbs, medium_catch_lbs = catch_lbs, low_catch_lbs = catch_lbs)-> boc_rec
```

1938-1942 WDFW Annual Bulletins

Yelloweye catch scenarios

Main questions here are 1) how to deal with prorating rockfish category if there is also a "red snapper" category and 2) what species proportions to use 1. High catch scenario: In years where "red snapper" is listed, 2% of the other rockfish catch is red snapper. In years where no red snapper is listed (1938 and 1939), 4% of the rockfish catch is red snapper. 2. Medium catch scenario: In years where "red snapper" is listed, 1% of the other rockfish catch is red snapper. In years where no red snapper is listed (1938 and 1939), 2% of the rockfish catch is red snapper. 3. Low catch scenario: In years where "red snapper" is listed, it is the only yelloweye catch. In years where no red snapper is listed (1938 and 1939), prorate catch based on mean proportion of total rockfishes that are "red snapper" from the years 1940-42.

Bocaccio catch scenarios

Question for bocaccio is how to prorate the general rockfishes category 1. High catch scenario: 2% of the rockfish catch is bocaccio 2. Medium catch scenario: 1% of the rockfish catch is bocaccio 3. Low catch scenario: No bocaccio were caught (0%)

```
WDFW_38_42_path <- here("catch_reconstruction_data", "recreational", "pre_1970", "1938_1942_sportcatch.
```

```
read_excel(WDFW_38_42_path, sheet = "1938") %>%
  mutate(year = 1938) %>%
  mutate(red_snapper = as.numeric(red_snapper)) -> rec_38
```

```
## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion
```

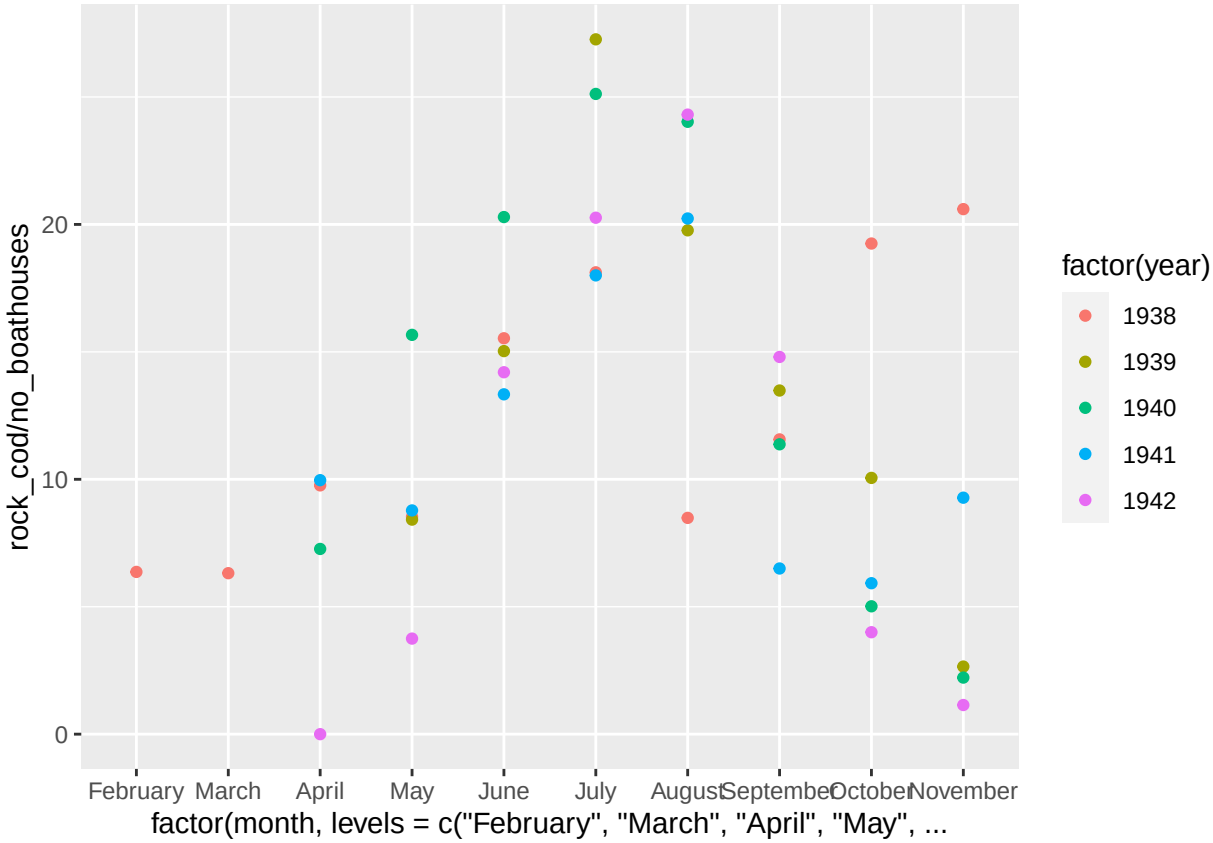
```
read_excel(WDFW_38_42_path, sheet = "1939") %>%
  mutate(year = 1939) %>%
  mutate(red_snapper = as.numeric(red_snapper)) -> rec_39
```

```
## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion
```

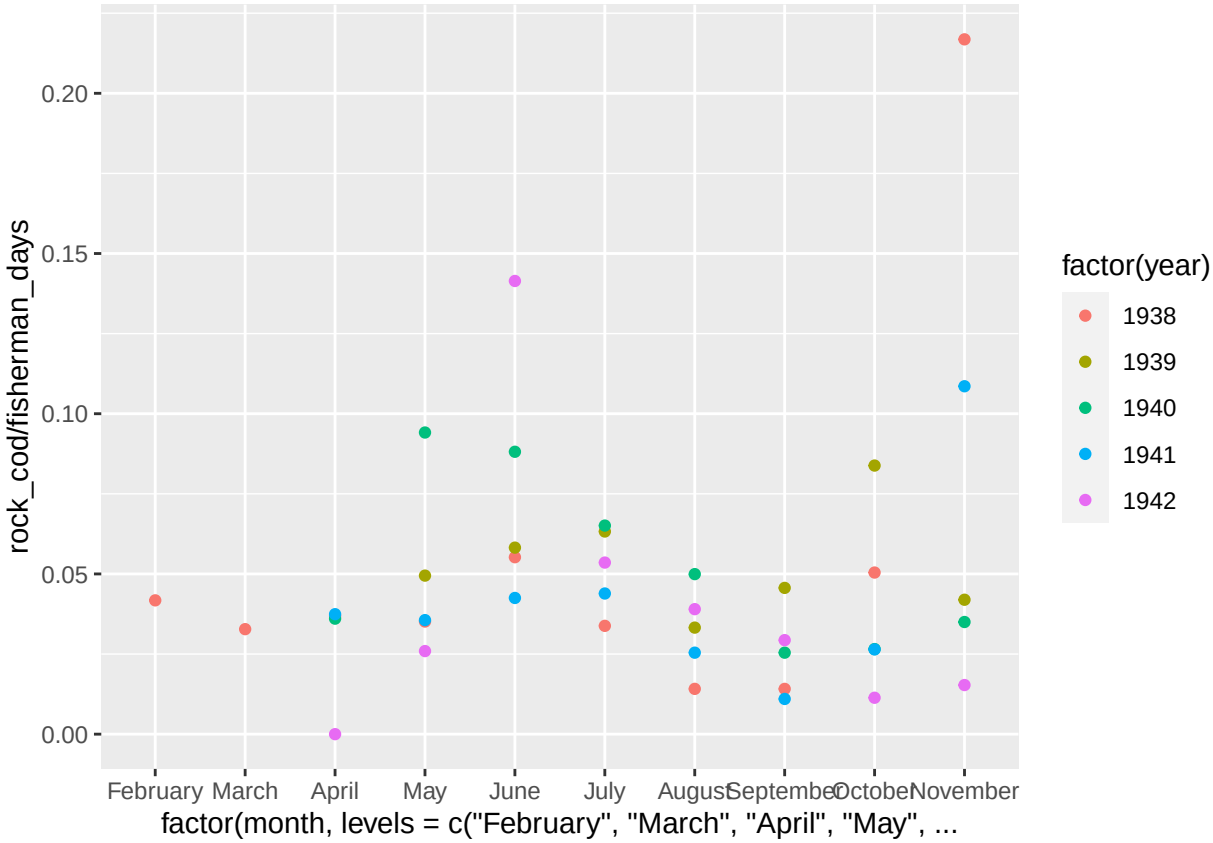
```
read_excel(WDFW_38_42_path, sheet = "1940") %>%
  mutate(year = 1940) -> rec_40
read_excel(WDFW_38_42_path, sheet = "1941") %>%
  mutate(year = 1941) -> rec_41
read_excel(WDFW_38_42_path, sheet = "1942") %>%
  mutate(year = 1942) %>%
  mutate(total_boathouses = as.numeric(total_boathouses))-> rec_42
```

```
## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion
```

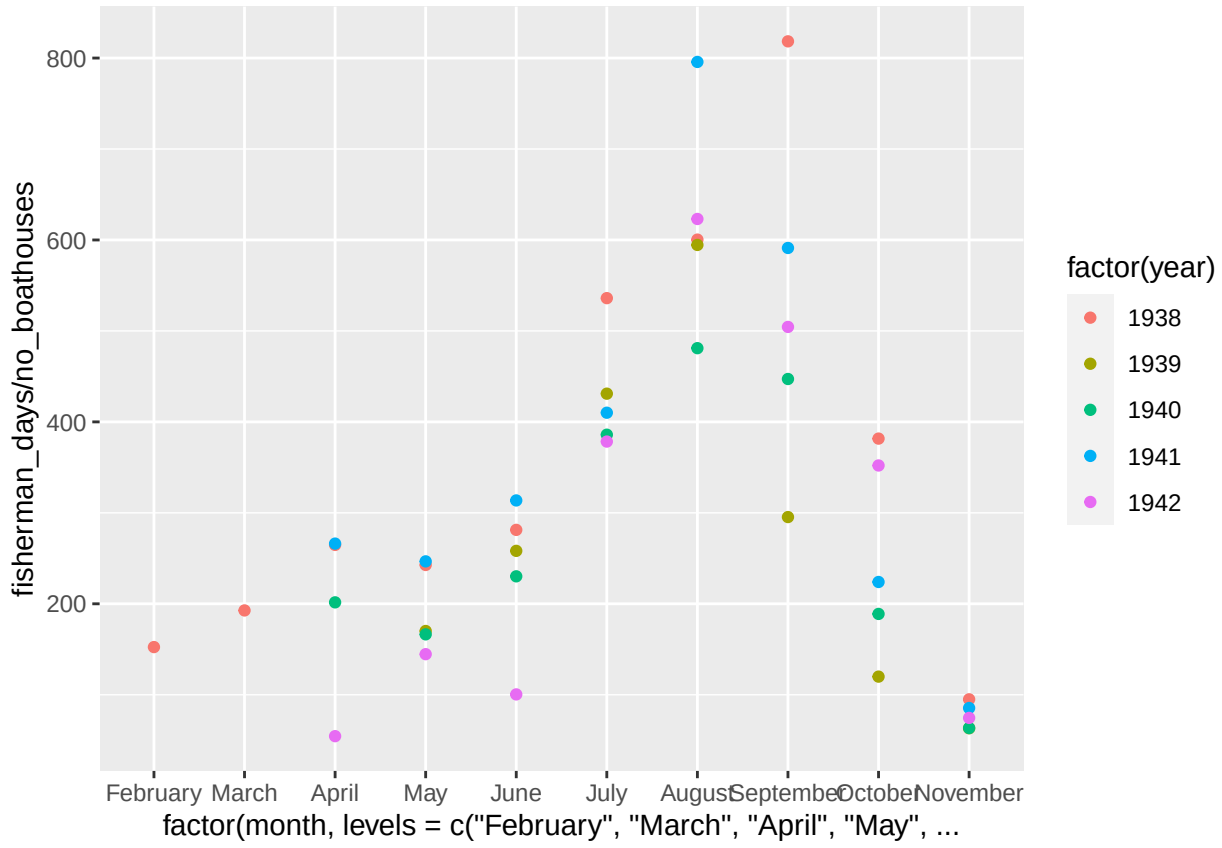
```
rec_38 %>%
  bind_rows(., rec_39) %>%
  bind_rows(., rec_40) %>%
  bind_rows(., rec_41) %>%
  bind_rows(., rec_42) -> rec_38_42



# Plot mean catches by month
ggplot(rec_38_42, aes(x = factor(month, levels = c("February", "March", "April", "May", "June", "July",
  geom_point()
```




```
# Plot CPUE by month
ggplot(rec_38_42, aes(x = factor(month, levels = c("February", "March", "April", "May", "June", "July",
  geom_point()
```




```
# Plot fisherman days per boathouse by month (indication of the busiest seasons)
ggplot(rec_38_42, aes(x = factor(month, levels = c("February", "March", "April", "May", "June", "July",
  geom_point()
```




```
# Peak catches are in the summer, so I don't think that the fact that we're missing December-March is a
```

```
# Add total_boathouses = 130 for 1942; given that total boathouses was 101 in 1939, 130 in 1940, 128 in
rec_38_42 %>%
  mutate(total_boathouses = ifelse(year == 1942, 130, total_boathouses)) -> rec_38_42

# For each month, calculate fisherman_days per boathouse, then use this to estimate total fisherman_day
rec_38_42 %>%
  mutate(days_per_boathouse = fisherman_days/no_boathouses) %>%
  mutate(est_days = days_per_boathouse * total_boathouses) -> rec_38_42
```

How to estimate private boat (non-boathouse) effort? The best indication we have is from the 1949 annual report (which is the first time that they tried to estimate private effort in the recreational (salmon) fishery):

"Boat counts in the sports fishing areas showed an average of about 30 private craft for every 100 rented boats during the busiest part of the 1949 season . The average in the winter months, from November through February, was about 7 for every 100."

Based on a plot of fisherman days per boathouse by month, the peak month is August. So to get from 7 in February to 30 in August, the growth rate is 1.2744. To get from 30 in August to 7 in November, the growth rate is 0.6156.

```
# Calculate multipliers of boathouse fisherman days
private_boats <- data.frame(month = c("February", "March", "April", "May", "June", "July", "August", "S
# Add value February
# private_boats[private_boats$month %in% c("February", "November"),]$multiplier <- 7
```

```
private_boats[private_boats$month == "February",]$multiplier <- 7

for (i in 2:7){
  private_boats$multiplier[i] <- private_boats$multiplier[i-1]*1.2744
}
for (i in 8:10){
  private_boats$multiplier[i] <- private_boats$multiplier[i-1]*0.6156
}

private_boats %>%
  mutate(multiplier = 1+multiplier/100) -> private_boats

# Add private boat effort estimates to estimates of fisherman days
rec_38_42 %>%
  left_join(., private_boats, by = "month") %>%
  mutate(est_days = est_days*multiplier) -> rec_38_42


# Estimate total rock_cod and red_snapper by multiplying catch by est_days/fisherman_days
rec_38_42 %>%
  mutate(., est_RF = rock_cod * est_days/fisherman_days) %>%
  mutate(., est_RS = red_snapper * est_days/fisherman_days) -> rec_38_42

# Calculate rock cod CPUE by fisherman day
rec_38_42 %>%
  group_by(year) %>%
  dplyr::select(fisherman_days, rock_cod, year) %>%
  summarise_all(sum) %>%
  mutate(CPUE = rock_cod/fisherman_days) -> rec_38_42_CPUE

mean_CPUE_38_42 <- mean(rec_38_42_CPUE$CPUE)

# Calculate annual sums
rec_38_42 %>%
  group_by(year) %>%
  dplyr::select(est_RF, est_RS, est_days) %>%
  summarise_all(sum) -> rec_38_42_annual_sums
```

```
## Adding missing grouping variables: `year`
```

```
# Prorate, generate catch scenarios

# Determine red snapper as proportion of total catch comp
subset(rec_38_42_annual_sums, !is.na(est_RS)) %>%
  mutate(total_RF = est_RF + est_RS) -> RF_RS_38_42

RS_prop <- sum(RF_RS_38_42$est_RS)/ sum(RF_RS_38_42$total_RF)

# Prorate yelloweye
rec_38_42_annual_sums %>%
  mutate(low_ye_n = ifelse(is.na(est_RS), est_RF * RS_prop, est_RS)) %>%
  mutate(medium_ye_n = ifelse(is.na(est_RS), est_RF * 0.02, est_RS + est_RF * 0.01)) %>%
  mutate(high_ye_n = ifelse(is.na(est_RS), est_RF * 0.04, est_RS + est_RF * 0.02)) %>%
```

```
  mutate(low_catch_lbs = low_ye_n*YE_lbs_per_individual) %>%
  mutate(medium_catch_lbs = medium_ye_n*YE_lbs_per_individual) %>%
  mutate(high_catch_lbs = high_ye_n*YE_lbs_per_individual) -> YE_rec_38_42

# Subset yelloweye into US DPS and Hood Canal, based on the assumption that 15% of catch was from Hood
YE_rec_38_42 %>%
  dplyr::select(year, low_catch_lbs, medium_catch_lbs, high_catch_lbs, low_ye_n, medium_ye_n, high_ye_n

# Hood Canal
YE_rec_38_42_int*0.15 -> YE_rec_38_42_HC

YE_rec_38_42_HC %>%
  mutate(year = year/0.15) -> YE_rec_38_42_HC

# US DPS
YE_rec_38_42_int*0.85 -> YE_rec_38_42_USDPS

YE_rec_38_42_USDPS %>%
  mutate(year = year/0.85) -> YE_rec_38_42_USDPS

# Prorate bocaccio
rec_38_42_annual_sums %>%
  mutate(low_boc_n = est_RF * 0) %>%
  mutate(medium_boc_n = est_RF * 0.01) %>%
  mutate(high_boc_n = est_RF * 0.02) %>%
  mutate(low_catch_lbs = low_boc_n*BOC_lbs_per_individual) %>%
  mutate(medium_catch_lbs = medium_boc_n*BOC_lbs_per_individual) %>%
  mutate(high_catch_lbs = high_boc_n*BOC_lbs_per_individual) -> BOC_rec_38_42
```

1943-1964: Use information from Buckley and 1938-1942 WDFW annual bulletins

Here we are estimating proportions of the rock_cod catch that we think is yelloweye or bocaccio. 1. Question 1: Do we think that for years where "red snapper" was recorded, there is still some yelloweye in the "rock cod" catch? -I think that the most likely case is that some boathouses did record all yelloweye as "red snapper", while other boathouses didn't make the distinction at all, since these catch records were all voluntarily filled out and submitted. Great! - We can say that 50% of boathouses reported red snapper catch separately and 50% didn't, so we can multiply the proportion by 0.5. 2. Question 2: What catch proportions are reasonable to use? The 1965-1967 Buckley values? - These are the closest recorded catch compositions temporally, but obviously they're not great... 3. Where do we think that the boathouses are? Hopefully we can get some more information from the Center for Wooden Boats... But for now our best guess is: - Maybe 15% of boathouses in 1957 were in Hood Canal, 15% North of Admiralty Inlet, and the other 70% in "South Puget Sound" (south of Admiralty). - At a finer scale: - Based on this map: https://cwbblog.wordpress.com/2012/12/18/new-exhibit-fish-on-opening-at-the-center-for-wooden-boats-december-29th-explores-the-history-of-boathouses-and-fishing-resorts-of-puget-sound/

Okay, let's divide effort by area by # of boathouses (approx - based on map, looks to be about 135 boathouses in Puget Sound) - Area 6: 4% (~5 boathouses) - Area 7: 10% (~13 boathouses) - Area 8: 18% (~25 boathouses) - Area 9: 22% (~30 boathouses) - Area 10: 15% (~20 boathouses) - Area 11: 15% (~20 boathouses) - Area 12: 16% (~22 boathouses)

Yelloweye and Bocaccio catch scenarios

1. High catch scenario: Use max annual Buckley (1965-1967) catch proportions

- The issue with this is that there are some crazy high proportions - e.g. 22% of rockfish catch in Hood canal in 1965 was yelloweye. That leads to some ridiculously high values in the high catch scenario.
- Maybe instead we should use the 1970-1987 proportions? These values look to be more like 1% of total rockfish catch, which would lead to values more in line with the later catches.

2. Medium catch scenario: Use mean Buckley (1965-1967) catch proportions
3. Low catch scenario: Use min annual Buckley (1965-1967) catch proportions

```
rec_43_64_est <- data.frame(year = seq(1943, 1964, 1),est_days = rep(0, 22), est_RF = rep(0,22), est_RS
# Estimate effort (est_days); use 6% annual growth
# Add first year value
rec_43_64_est$est_days[1] <- subset(rec_38_42_annual_sums, year == 1942)$est_days
for (i in 2:dim(rec_43_64_est)[1]){
  rec_43_64_est$est_days[i] <- rec_43_64_est$est_days[i-1]+ rec_43_64_est$est_days[i-1]*0.06
}

# Calculate estimated rockfish catch using mean CPUE from 1938-1942
rec_43_64_est %>%
  mutate(., est_RF = est_days * mean_CPUE_38_42) -> rec_43_64_est

# Compare these values to sums from 1965-1967 from Buckley
RF_sums_buckley <- data.frame(year = c(1965, 1966, 1967), total = c(sum(buck65_data_2$catch_individuals

rec_43_64_est
```

```
##    year  est_days   est_RF est_RS
## 1  1943  349947.8 14184.45      0
## 2  1944  370944.7 15035.51      0
## 3  1945  393201.4 15937.64      0
## 4  1946  416793.4 16893.90      0
## 5  1947  441801.1 17907.54      0
## 6  1948  468309.1 18981.99      0
## 7  1949  496407.7 20120.91      0
## 8  1950  526192.1 21328.16      0
## 9  1951  557763.6 22607.85      0
## 10 1952  591229.5 23964.32      0
## 11 1953  626703.2 25402.18      0
## 12 1954  664305.4 26926.31      0
## 13 1955  704163.8 28541.89      0
## 14 1956  746413.6 30254.41      0
## 15 1957  791198.4 32069.67      0
## 16 1958  838670.3 33993.85      0
## 17 1959  888990.5 36033.48      0
## 18 1960  942329.9 38195.49      0
## 19 1961  998869.7 40487.22      0
## 20 1962 1058801.9 42916.45      0
## 21 1963 1122330.0 45491.44      0
## 22 1964 1189669.8 48220.93      0
```

```
RF_sums_buckley
```

```
##   year total
```

```
## 1 1965 45862
## 2 1966 59459
## 3 1967 58801
```

```
# These values seem totally plausible based on the ramps... there isn't a noticeable discontinuity betw
# Catches in 1970 are around 50k

# Prorate catches
effort_by_area <- data.frame(area = c(6,7,8,9,10,11,12), prop_effort = c(0.04, 0.1, 0.18, 0.22, 0.15, 0

# Yelloweye USDPS
rec_43_64_est %>%
  # Medium catch estimate (best guess)
  mutate(medium_ye_n =
           # Area 6
           subset(buck65_67_ESA_comps_by_area, area == 6)$ye_prop * subset(effort_by_area, area ==6)$pro
           # Area 7
           subset(buck65_67_ESA_comps_by_area, area == 7)$ye_prop * subset(effort_by_area, area ==7)$pro
           # Area 8
           subset(buck65_67_ESA_comps_by_area, area == 8)$ye_prop * subset(effort_by_area, area ==8)$pro
           # Area 9
           subset(buck65_67_ESA_comps_by_area, area == 9)$ye_prop * subset(effort_by_area, area ==9)$pro
           # Area 10
           subset(buck65_67_ESA_comps_by_area, area == 10)$ye_prop * subset(effort_by_area, area ==10)$p
           # Area 11
           subset(buck65_67_ESA_comps_by_area, area == 11)$ye_prop * subset(effort_by_area, area ==11)$p
           ) %>%
  mutate(medium_catch_lbs = medium_ye_n * YE_lbs_per_individual) %>%
  # Low catch estimate
  mutate(low_ye_n =
           # Area 6
           subset(buck_ye_prop_ranges, area == 6)$min_ye_prop * subset(effort_by_area, area ==6)$prop_e
           # Area 7
           subset(buck_ye_prop_ranges, area == 7)$min_ye_prop * subset(effort_by_area, area ==7)$prop_e
           # Area 8
           subset(buck_ye_prop_ranges, area == 8)$min_ye_prop * subset(effort_by_area, area ==8)$prop_e
           # Area 9
           subset(buck_ye_prop_ranges, area == 9)$min_ye_prop * subset(effort_by_area, area ==9)$prop_e
           # Area 10
           subset(buck_ye_prop_ranges, area == 10)$min_ye_prop * subset(effort_by_area, area ==10)$prop
           # Area 11
           subset(buck_ye_prop_ranges, area == 11)$min_ye_prop * subset(effort_by_area, area ==11)$prop
           ) %>%
  mutate(low_catch_lbs = low_ye_n * YE_lbs_per_individual) %>%
  # High catch estimate - v1 with max proportions from Buckley (clearly not an accurate estimate)
  mutate(high_ye_n =
           # Area 6
           subset(buck_ye_prop_ranges, area == 6)$max_ye_prop * subset(effort_by_area, area ==6)$prop_e
           # Area 7
           subset(buck_ye_prop_ranges, area == 7)$max_ye_prop * subset(effort_by_area, area ==7)$prop_e
           # Area 8
           subset(buck_ye_prop_ranges, area == 8)$max_ye_prop * subset(effort_by_area, area ==8)$prop_e
           # Area 9
           subset(buck_ye_prop_ranges, area == 9)$max_ye_prop * subset(effort_by_area, area ==9)$prop_e
```

```
            # Area 10
            subset(buck_ye_prop_ranges, area == 10)$max_ye_prop * subset(effort_by_area, area ==10)$prop
            # Area 11
            subset(buck_ye_prop_ranges, area == 11)$max_ye_prop * subset(effort_by_area, area ==11)$prop
            ) %>%
  mutate(high_catch_lbs = high_ye_n * YE_lbs_per_individual)-> ye_rec_catch_USDPS_43_64

# Yelloweye Hood Canal
rec_43_64_est %>%
  mutate(medium_ye_n =
            # Area 12
            subset(buck65_67_ESA_comps_by_area, area == 12)$ye_prop * subset(effort_by_area, area ==12)$p
            ) %>%
  mutate(medium_catch_lbs = medium_ye_n * YE_lbs_per_individual) %>%
  # High catch estimate - v1 with max proportion (which is 22% and thus not realistic)
  # mutate(high_ye_n =
  #          # Area 6
  #          subset(buck_ye_prop_ranges, area == 12)$max_ye_prop * subset(effort_by_area, area ==12)$pr
  # High catch estiamte - v2 with 1.5x mean proportion
    mutate(high_ye_n =
            # Area 6
            subset(buck65_67_ESA_comps_by_area, area == 12)$ye_prop*1.5 * subset(effort_by_area, area ==
            ) %>%
  mutate(high_catch_lbs = high_ye_n * YE_lbs_per_individual) %>%
  # Low catch estimate
  mutate(low_ye_n =
            # Area 6
            subset(buck_ye_prop_ranges, area == 12)$min_ye_prop * subset(effort_by_area, area ==12)$prop
  mutate(low_catch_lbs = low_ye_n * YE_lbs_per_individual)-> ye_rec_catch_HC_43_64

# Bocaccio, USDPS
rec_43_64_est %>%
  mutate(medium_boc_n =
            # Area 6
            subset(buck65_67_ESA_comps_by_area, area == 6)$boc_prop * subset(effort_by_area, area ==6)$p
            # Area 7
            subset(buck65_67_ESA_comps_by_area, area == 7)$boc_prop * subset(effort_by_area, area ==7)$p
            # Area 8
            subset(buck65_67_ESA_comps_by_area, area == 8)$boc_prop * subset(effort_by_area, area ==8)$p
            # Area 9
            subset(buck65_67_ESA_comps_by_area, area == 9)$boc_prop * subset(effort_by_area, area ==9)$p
            # Area 10
            subset(buck65_67_ESA_comps_by_area, area == 10)$boc_prop * subset(effort_by_area, area ==10)
            # Area 11
            subset(buck65_67_ESA_comps_by_area, area == 11)$boc_prop * subset(effort_by_area, area ==11)
            # Area 12
            subset(buck65_67_ESA_comps_by_area, area == 12)$boc_prop * subset(effort_by_area, area ==12)
            ) %>%
  mutate(medium_catch_lbs = medium_boc_n * BOC_lbs_per_individual) %>%
  # Low catch estimate
  mutate(low_boc_n =
            # Area 6
            subset(buck_boc_prop_ranges, area == 6)$min_boc_prop * subset(effort_by_area, area ==6)$prop
```

```
            # Area 7
            subset(buck_boc_prop_ranges, area == 7)$min_boc_prop * subset(effort_by_area, area ==7)$prop
            # Area 8
            subset(buck_boc_prop_ranges, area == 8)$min_boc_prop * subset(effort_by_area, area ==8)$prop
            # Area 9
            subset(buck_boc_prop_ranges, area == 9)$min_boc_prop * subset(effort_by_area, area ==9)$prop
            # Area 10
            subset(buck_boc_prop_ranges, area == 10)$min_boc_prop * subset(effort_by_area, area ==10)$pro
            # Area 11
            subset(buck_boc_prop_ranges, area == 11)$min_boc_prop * subset(effort_by_area, area ==11)$pro
            # Area 12
            subset(buck_boc_prop_ranges, area == 12)$min_boc_prop * subset(effort_by_area, area ==12)$pro
            ) %>%
  mutate(low_catch_lbs = low_boc_n * BOC_lbs_per_individual) %>%
  # High catch estimate
  mutate(high_boc_n =
            # Area 6
            subset(buck_boc_prop_ranges, area == 6)$max_boc_prop * subset(effort_by_area, area ==6)$prop
            # Area 7
            subset(buck_boc_prop_ranges, area == 7)$max_boc_prop * subset(effort_by_area, area ==7)$prop
            # Area 8
            subset(buck_boc_prop_ranges, area == 8)$max_boc_prop * subset(effort_by_area, area ==8)$prop
            # Area 9
            subset(buck_boc_prop_ranges, area == 9)$max_boc_prop * subset(effort_by_area, area ==9)$prop
            # Area 10
            subset(buck_boc_prop_ranges, area == 10)$max_boc_prop * subset(effort_by_area, area ==10)$pro
            # Area 11
            subset(buck_boc_prop_ranges, area == 11)$max_boc_prop * subset(effort_by_area, area ==11)$pro
            # Area 12
            subset(buck_boc_prop_ranges, area == 12)$max_boc_prop * subset(effort_by_area, area ==12)$pro
            ) %>%
  mutate(high_catch_lbs = high_boc_n * BOC_lbs_per_individual)-> boc_rec_catch_USDPS_43_64
```

Recreational catch: All years combined

```
# Yelloweye, US DPS
YE_rec_38_42_USDPS %>%
  bind_rows(., ye_rec_catch_USDPS_43_64) %>%
  bind_rows(., ye_rec_catch_65_69_USDPS) %>%
  bind_rows(., ye_rec_catch_USDPS_70_93) %>%
  bind_rows(., ye_rec_catch_USDPS_94_02) %>%
  bind_rows(., YE_USDPS_rec_2003_2019) %>%
  dplyr::select(year, low_catch_lbs, medium_catch_lbs, high_catch_lbs) -> YE_USDPS_rec_complete

# Yelloweye, Hood Canal
YE_rec_38_42_HC %>%
  bind_rows(., ye_rec_catch_HC_43_64) %>%
  bind_rows(., ye_rec_catch_65_69_HC) %>%
  bind_rows(., ye_rec_HC_70_93) %>%
  bind_rows(., ye_rec_HC_94_02) %>%
  bind_rows(., YE_HC_rec_2003_2019) %>%
```

```
  dplyr::select(year, low_catch_lbs, medium_catch_lbs, high_catch_lbs) -> YE_HC_rec_complete

# Bocaccio, US DPS
BOC_rec_38_42 %>%
  bind_rows(., boc_rec_catch_USDPS_43_64) %>%
  bind_rows(., boc_rec_catch_65_69) %>%
  bind_rows(., boc_rec_catch_USDPS_70_93) %>%
  bind_rows(., boc_rec_catch_USDPS_94_02) %>%
  bind_rows(., BOC_USDPS_rec_2003_2019) %>%
  dplyr::select(year, low_catch_lbs, medium_catch_lbs, high_catch_lbs) -> BOC_USDPS_rec_complete
```

Combine recreational and commercial catch and export for modeling

Create separate data frames for each catch scenario. Each data frame should have columns for each separate data source (rec/commercial/FSC, USA or Canada) and a column for total catch.

```
# USDPS only: High catch scenario
YE_comm_complete %>%
  subset(., DPS == "U.S. DPS except Hood Canal") %>%
  dplyr::select(year, high_catch) %>%
  dplyr::rename(US_comm_catch_lbs = high_catch) %>%
  left_join(., YE_USDPS_rec_complete, by = "year") %>%
  dplyr::select(year, US_comm_catch_lbs, high_catch_lbs) %>%
  dplyr::rename(US_rec_catch_lbs = high_catch_lbs) %>%
  mutate(total_catch_lbs = sum(US_comm_catch_lbs, US_rec_catch_lbs, na.rm = TRUE)) -> YE_high_catch_USDP

# USDPS only: medium catch scenario
YE_comm_complete %>%
  subset(., DPS == "U.S. DPS except Hood Canal") %>%
  dplyr::select(year, medium_catch) %>%
  dplyr::rename(US_comm_catch_lbs = medium_catch) %>%
  left_join(., YE_USDPS_rec_complete, by = "year") %>%
  dplyr::select(year, US_comm_catch_lbs, medium_catch_lbs) %>%
  dplyr::rename(US_rec_catch_lbs = medium_catch_lbs) %>%
  mutate(total_catch_lbs = sum(US_comm_catch_lbs, US_rec_catch_lbs, na.rm = TRUE)) -> YE_medium_catch_US

# USDPS only: low catch scenario
YE_comm_complete %>%
  subset(., DPS == "U.S. DPS except Hood Canal") %>%
  dplyr::select(year, low_catch) %>%
  dplyr::rename(US_comm_catch_lbs = low_catch) %>%
  left_join(., YE_USDPS_rec_complete, by = "year") %>%
  dplyr::select(year, US_comm_catch_lbs, low_catch_lbs) %>%
  dplyr::rename(US_rec_catch_lbs = low_catch_lbs) %>%
  mutate(total_catch_lbs = sum(US_comm_catch_lbs, US_rec_catch_lbs, na.rm = TRUE)) -> YE_low_catch_USDPS

# Hood Canal: High catch scenario
YE_comm_complete %>%
  subset(., DPS == "Hood Canal") %>%
  dplyr::select(year, high_catch) %>%
```

```
  dplyr::rename(US_comm_catch_lbs = high_catch) %>%
  left_join(., YE_HC_rec_complete, by = "year") %>%
  dplyr::select(year, US_comm_catch_lbs, high_catch_lbs) %>%
  dplyr::rename(US_rec_catch_lbs = high_catch_lbs) %>%
  mutate(total_catch_lbs = sum(US_comm_catch_lbs, US_rec_catch_lbs, na.rm = TRUE)) -> YE_high_catch_HC

# Hood Canal: Medium catch scenario
YE_comm_complete %>%
  subset(., DPS == "Hood Canal") %>%
  dplyr::select(year, medium_catch) %>%
  dplyr::rename(US_comm_catch_lbs = medium_catch) %>%
  left_join(., YE_HC_rec_complete, by = "year") %>%
  dplyr::select(year, US_comm_catch_lbs, medium_catch_lbs) %>%
  dplyr::rename(US_rec_catch_lbs = medium_catch_lbs) %>%
  mutate(total_catch_lbs = sum(US_comm_catch_lbs, US_rec_catch_lbs, na.rm = TRUE)) -> YE_medium_catch_HC

# Hood Canal: Low catch scenario
YE_comm_complete %>%
  subset(., DPS == "Hood Canal") %>%
  dplyr::select(year, low_catch) %>%
  dplyr::rename(US_comm_catch_lbs = low_catch) %>%
  left_join(., YE_HC_rec_complete, by = "year") %>%
  dplyr::select(year, US_comm_catch_lbs, low_catch_lbs) %>%
  dplyr::rename(US_rec_catch_lbs = low_catch_lbs) %>%
  mutate(total_catch_lbs = sum(US_comm_catch_lbs, US_rec_catch_lbs, na.rm = TRUE)) -> YE_low_catch_HC

# USDPS + Canada - high US catch scenario
canadian_yelloweye_catch %>%
  dplyr::select(-c(total_catch_lbs, country)) %>%
  left_join(., YE_high_catch_USDPS, by = "year") %>%
  dplyr::rename(CAN_rec_catch_lbs = rec_catch_lbs, CAN_comm_catch_lbs = comm_catch_lbs, CAN_FSC_catch_l
  mutate(total_catch_lbs = rowSums(.[2:6], na.rm = TRUE)) -> YE_high_catch_CAN_USA

# USDPS + Canada - medium US catch scenario
canadian_yelloweye_catch %>%
  dplyr::select(-c(total_catch_lbs, country)) %>%
  left_join(., YE_medium_catch_USDPS, by = "year") %>%
  dplyr::rename(CAN_rec_catch_lbs = rec_catch_lbs, CAN_comm_catch_lbs = comm_catch_lbs, CAN_FSC_catch_l
  mutate(total_catch_lbs = rowSums(.[2:6], na.rm = TRUE)) -> YE_medium_catch_CAN_USA

# USDPS + Canada - low US catch scenario
canadian_yelloweye_catch %>%
  dplyr::select(-c(total_catch_lbs, country)) %>%
  left_join(., YE_low_catch_USDPS, by = "year") %>%
  dplyr::rename(CAN_rec_catch_lbs = rec_catch_lbs, CAN_comm_catch_lbs = comm_catch_lbs, CAN_FSC_catch_l
  mutate(total_catch_lbs = rowSums(.[2:6], na.rm = TRUE)) -> YE_low_catch_CAN_USA
```

```
# High catch scenario
BOC_comm_complete %>%
  subset(., DPS == "U.S. DPS") %>%
  dplyr::select(year, high_catch) %>%
  dplyr::rename(US_comm_catch_lbs = high_catch) %>%
  left_join(., BOC_USDPS_rec_complete, by = "year") %>%
```

```
  dplyr::select(year, US_comm_catch_lbs, high_catch_lbs) %>%
  dplyr::rename(US_rec_catch_lbs = high_catch_lbs) %>%
  mutate(total_catch_lbs = sum(US_comm_catch_lbs, US_rec_catch_lbs, na.rm = TRUE)) -> BOC_high_catch_USD


# Medium catch scenario
BOC_comm_complete %>%
  subset(., DPS == "U.S. DPS") %>%
  dplyr::select(year, medium_catch) %>%
  dplyr::rename(US_comm_catch_lbs = medium_catch) %>%
  left_join(., BOC_USDPS_rec_complete, by = "year") %>%
  dplyr::select(year, US_comm_catch_lbs, medium_catch_lbs) %>%
  dplyr::rename(US_rec_catch_lbs = medium_catch_lbs) %>%
  mutate(total_catch_lbs = sum(US_comm_catch_lbs, US_rec_catch_lbs, na.rm = TRUE)) -> BOC_medium_catch_U


# Low catch scenario
BOC_comm_complete %>%
  subset(., DPS == "U.S. DPS") %>%
  dplyr::select(year, low_catch) %>%
  dplyr::rename(US_comm_catch_lbs = low_catch) %>%
  left_join(., BOC_USDPS_rec_complete, by = "year") %>%
  dplyr::select(year, US_comm_catch_lbs, low_catch_lbs) %>%
  dplyr::rename(US_rec_catch_lbs = low_catch_lbs) %>%
  mutate(total_catch_lbs = sum(US_comm_catch_lbs, US_rec_catch_lbs, na.rm = TRUE)) -> BOC_low_catch_USDP
```

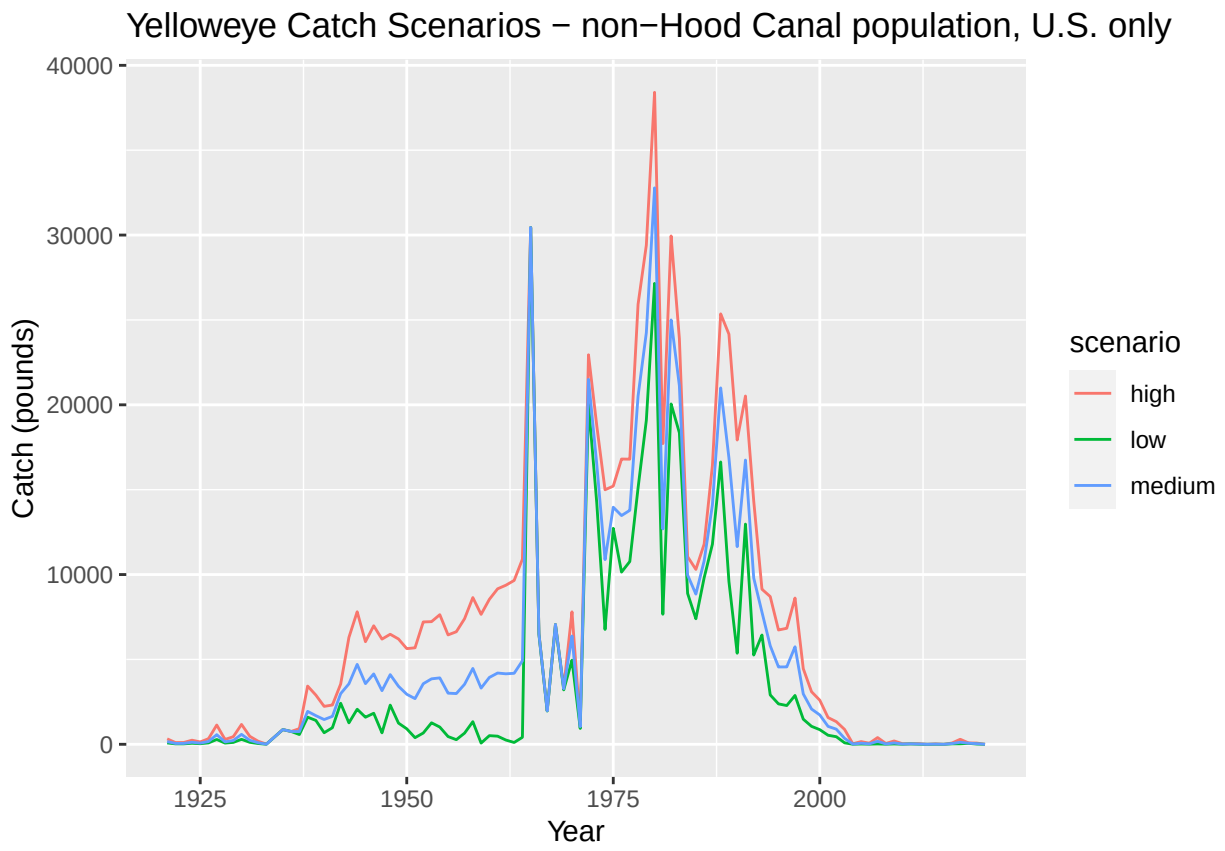
Export all data as CSV for stock status modeling

```
# Yelloweye high catch scenario, US DPS only
write.csv(YE_high_catch_USDPS, here("catch_reconstruction_data", "complete_catch_histories", "yelloweye_

# Yelloweye medium catch scenario, US DPS only
write.csv(YE_medium_catch_USDPS, here("catch_reconstruction_data", "complete_catch_histories", "yellowey

# Yelloweye low catch scenario, US DPS only
write.csv(YE_low_catch_USDPS, here("catch_reconstruction_data", "complete_catch_histories", "yelloweye_U

# Yelloweye high catch scenario, Hood Canal
write.csv(YE_high_catch_HC, here("catch_reconstruction_data", "complete_catch_histories", "yelloweye_HC_

# Yelloweye medium catch scenario, Hood Canal
write.csv(YE_medium_catch_HC, here("catch_reconstruction_data", "complete_catch_histories", "yelloweye_M

# Yelloweye low catch scenario, Hood Canal
write.csv(YE_low_catch_HC, here("catch_reconstruction_data", "complete_catch_histories", "yelloweye_HC_c

# Yelloweye high catch scenario, US DPS + Canada (everything except Hood Canal)
write.csv(YE_high_catch_CAN_USA, here("catch_reconstruction_data", "complete_catch_histories", "yellowey

# Yelloweye medium catch scenario, US DPS + Canada (everything except Hood Canal)
write.csv(YE_medium_catch_CAN_USA, here("catch_reconstruction_data", "complete_catch_histories", "yellow
```

```
# Yelloweye low catch scenario, US DPS + Canada (everything except Hood Canal)
write.csv(YE_low_catch_CAN_USA, here("catch_reconstruction_data", "complete_catch_histories", "yellowey

# Bocaccio high catch scenario, US DPS only
write.csv(BOC_high_catch_USDPS, here("catch_reconstruction_data", "complete_catch_histories", "bocaccio

# Bocaccio medium catch scenario, US DPS only
write.csv(BOC_medium_catch_USDPS, here("catch_reconstruction_data", "complete_catch_histories", "bocacc

# Bocaccio low catch scenario, US DPS only
write.csv(BOC_low_catch_USDPS, here("catch_reconstruction_data", "complete_catch_histories", "bocaccio_
```

Exploratory plots

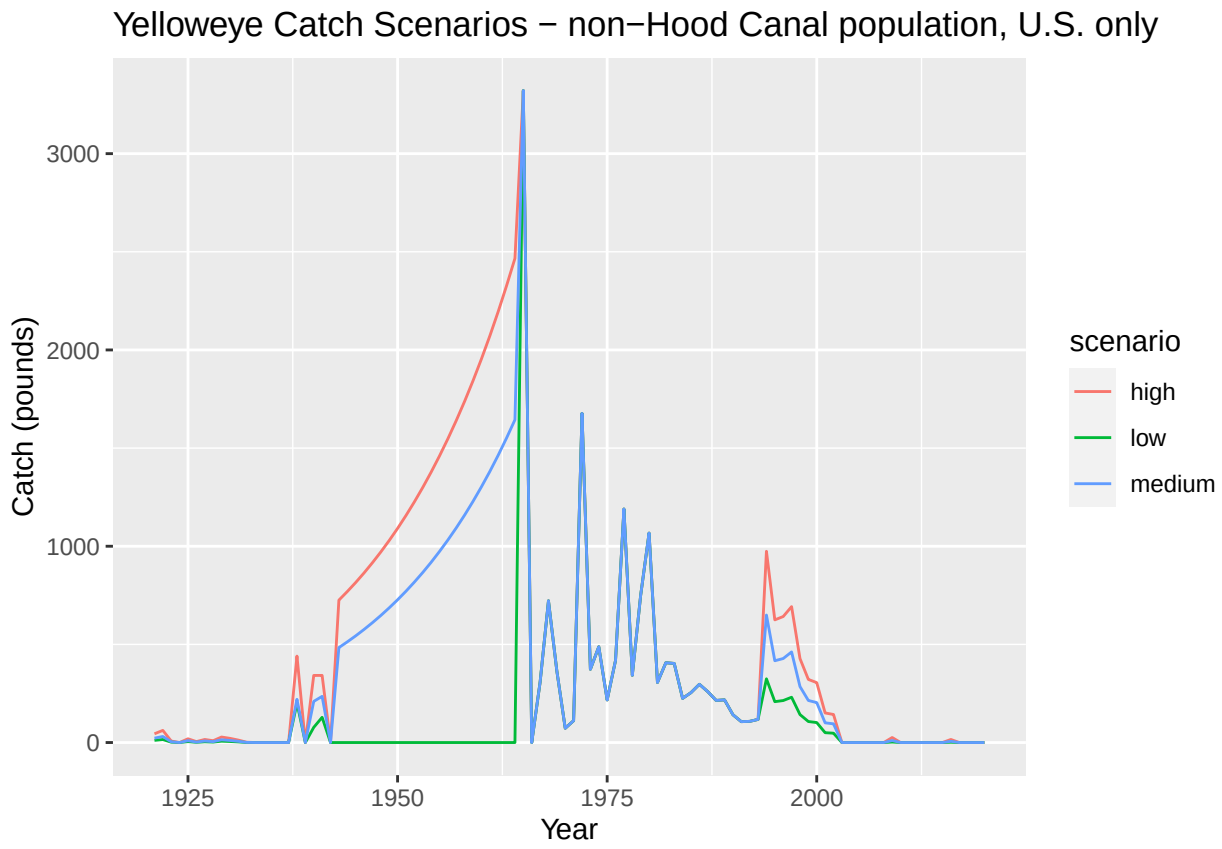
```
fig_dir <- here("figures", "catch_reconstruction", "catch_scenarios")

# Combine data for plotting
YE_high_catch_USDPS %>%
  mutate(., scenario = "high") -> YE_high_USDPS_forplot

YE_medium_catch_USDPS %>%
  mutate(., scenario = "medium") -> YE_medium_USDPS_forplot

YE_low_catch_USDPS %>%
  mutate(., scenario = "low") -> YE_low_USDPS_forplot

# YE_high_USDPS_forplot %>%
#   bind_rows(., YE_medium_USDPS_forplot) %>%
#   bind_rows(., YE_low_USDPS_forplot) %>%
#   dplyr::select(-total_catch_lbs) %>%
#   pivot_longer(., cols = c(US_comm_catch_lbs, US_rec_catch_lbs), names_to = "catch") -> YE_scenarios_

YE_high_USDPS_forplot %>%
  bind_rows(., YE_medium_USDPS_forplot) %>%
  bind_rows(., YE_low_USDPS_forplot) %>%
  dplyr::select(-c(US_comm_catch_lbs, US_rec_catch_lbs)) %>%
  pivot_longer(., cols = c(total_catch_lbs), names_to = "catch") -> YE_scenarios_USDPS

ye_USDPS_scenarios_plot <- ggplot(YE_scenarios_USDPS, aes(x = year, y = value, color = scenario))+
  # geom_bar(stat = "identity", width = 1, position = "dodge") +
  geom_line()+
  scale_fill_tableau(palette = "Tableau 10")+
  ggtitle("Yelloweye Catch Scenarios - non-Hood Canal population, U.S. only")+
  ylab("Catch (pounds)") +
  xlab("Year")

ye_USDPS_scenarios_plot
```




```
ggsave(paste0(fig_dir, "/yelloweye_catch_scenarios_USDPS.png"), ye_USDPS_scenarios_plot, height = 6, wi
```

```
fig_dir <- here("figures", "catch_reconstruction", "catch_scenarios")

# Combine data for plotting
YE_high_catch_HC %>%
  mutate(., scenario = "high") -> YE_high_HC_forplot

YE_medium_catch_HC %>%
  mutate(., scenario = "medium") -> YE_medium_HC_forplot

YE_low_catch_HC %>%
  mutate(., scenario = "low") -> YE_low_HC_forplot

# YE_high_HC_forplot %>%
#   bind_rows(., YE_medium_HC_forplot) %>%
#   bind_rows(., YE_low_HC_forplot) %>%
#   dplyr::select(-total_catch_lbs) %>%
#   pivot_longer(., cols = c(US_comm_catch_lbs, US_rec_catch_lbs), names_to = "catch") -> YE_scenarios_

YE_high_HC_forplot %>%
  bind_rows(., YE_medium_HC_forplot) %>%
  bind_rows(., YE_low_HC_forplot) %>%
  dplyr::select(-c(US_comm_catch_lbs, US_rec_catch_lbs)) %>%
  pivot_longer(., cols = c(total_catch_lbs), names_to = "catch") -> YE_scenarios_HC
```

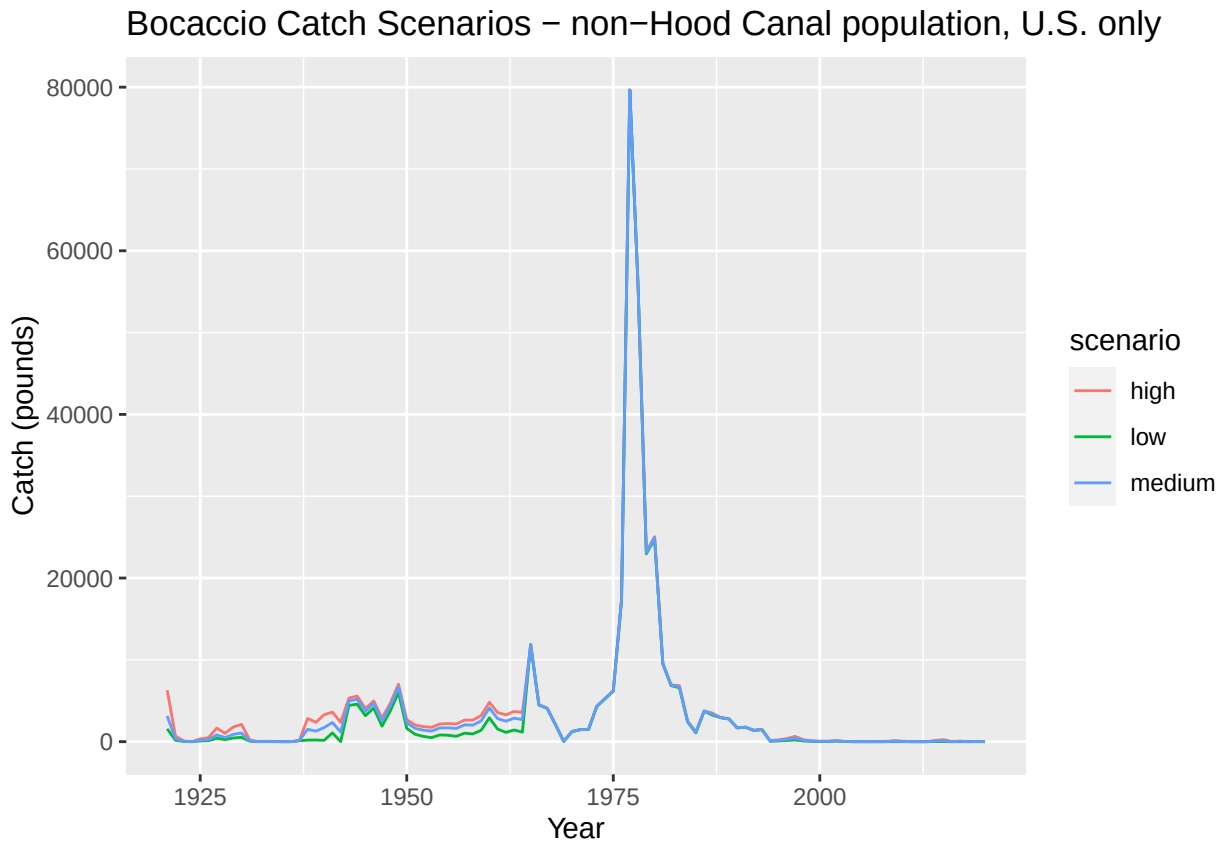
```
ye_HC_scenarios_plot <- ggplot(YE_scenarios_HC, aes(x = year, y = value, color = scenario))+
  # geom_bar(stat = "identity", width = 1, position = "dodge") +
  geom_line()+
  scale_fill_tableau(palette = "Tableau 10")+
  ggtitle("Yelloweye Catch Scenarios - non-Hood Canal population, U.S. only")+
  ylab("Catch (pounds)") +
  xlab("Year")

ye_HC_scenarios_plot
```




```
ggsave(paste0(fig_dir, "/yelloweye_catch_scenarios_HC.png"), ye_HC_scenarios_plot, height = 6, width =
```

```
fig_dir <- here("figures", "catch_reconstruction", "catch_scenarios")

# Combine data for plotting
BOC_high_catch_USDPS %>%
  mutate(., scenario = "high") -> BOC_high_USDPS_forplot

BOC_medium_catch_USDPS %>%
  mutate(., scenario = "medium") -> BOC_medium_USDPS_forplot

BOC_low_catch_USDPS %>%
  mutate(., scenario = "low") -> BOC_low_USDPS_forplot
```

```
# BOC_high_USDPS_forplot %>%
#   bind_rows(., BOC_medium_USDPS_forplot) %>%
#   bind_rows(., BOC_low_USDPS_forplot) %>%
#   dplyr::select(-total_catch_lbs) %>%
#   pivot_longer(., cols = c(US_comm_catch_lbs, US_rec_catch_lbs), names_to = "catch") -> BOC_scenarios_

BOC_high_USDPS_forplot %>%
  bind_rows(., BOC_medium_USDPS_forplot) %>%
  bind_rows(., BOC_low_USDPS_forplot) %>%
  dplyr::select(-c(US_comm_catch_lbs, US_rec_catch_lbs)) %>%
  pivot_longer(., cols = c(total_catch_lbs), names_to = "catch") -> BOC_scenarios_USDPS

BOC_USDPS_scenarios_plot <- ggplot(BOC_scenarios_USDPS, aes(x = year, y = value, color = scenario))+
  # geom_bar(stat = "identity", width = 1, position = "dodge") +
  geom_line()+
  scale_fill_tableau(palette = "Tableau 10")+
  ggtitle("Bocaccio Catch Scenarios - non-Hood Canal population, U.S. only")+
  ylab("Catch (pounds)") +
  xlab("Year")

BOC_USDPS_scenarios_plot
```




```
ggsave(paste0(fig_dir, "/bocaccio_catch_scenarios_USDPS.png"), BOC_USDPS_scenarios_plot, height = 6, wi
```