



Black Cod Almanac

MESA Program, Auke Bay Laboratories, NMFS, Juneau, AK

January 2022

Greetings!

We hope this New Year finds you in good health and thinking about the upcoming 2022 season! This is the 9th installment of the Black Cod Almanac, which was created to improve communication and increase dialogue between scientists and members of the industry. The intent is to provide updates on relevant research, summarize highlights of both the Groundfish Plan Team and the North Pacific Fishery Management Council meetings, and share news that may be of interest to those involved with the federal sablefish fishery. Please feel free to pass this on, or to send us email addresses of others who may appreciate receiving this newsletter.



Special thanks to the F/V Alaskan Leader, Chief Scientist Jason Wright, and biologists Greg Jay and Sara Bird for once again pulling off a successful longline survey during the pandemic!

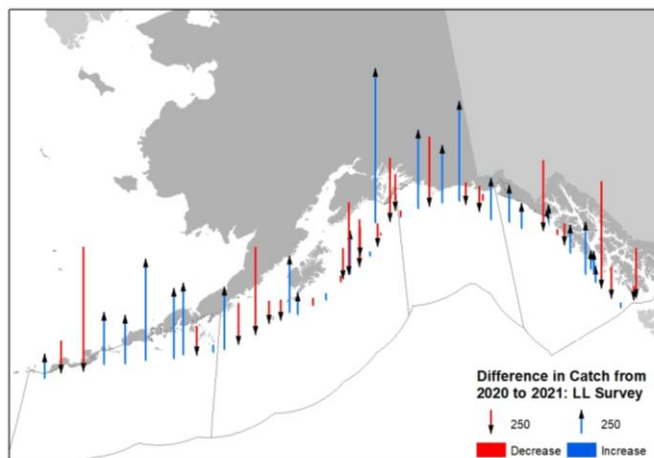
INSIDE THIS ISSUE

- 2021 NMFS LONGLINE SURVEY UPDATE
- NOVEMBER 2021 GROUND FISH PLAN TEAM MEETING SUMMARY
- DECEMBER 2021 NPFMC MEETING SUMMARY
- NEW RESEARCH AND HOT TOPICS
- ANOTHER FAREWELL

2021 NMFS Longline Survey

The 2021 NMFS longline survey sampled waters throughout the Gulf of Alaska (GOA) and in the Bering Sea (BS), from June 2021 – August 2021. During the survey, catch is recorded, sablefish otoliths are collected for age reading, sablefish lengths are taken, and a subset of sablefish are tagged and released for research on movement. Longline survey observations are a highly influential data source used for the sablefish assessment model, which estimates spawning biomass and is used to set harvest limits.

- **Sablefish continue to increase, though mainly in the west:** LL Survey Relative Population Numbers (RPNs; area-weighted measures of catch rates) were up 20% in the BSAI, and down 3% in the GOA from 2020



The difference in catch (CPUE) of fish at each slope station of the longline survey in the GOA from 2020 to 2021. Red bars indicate a decrease in CPUE from 2020 to 2021, and blue bars indicate an increase in CPUE from 2020 to 2021.

- Orca whale depredation was average in the EBS and low in the WGOA. Sperm whale depredation increased slightly in the CGOA but decreased in both WYAK and EYAK/SE.
- Total tagged fish: 6,156 sablefish, 315 shortspine thornyhead, and 27 Greenland turbot

2021 November Groundfish Plan Team Meeting Highlights

<http://www.npfmc.org/fishery-management-plan-team/goa-bsai-groundfish-plan-team/>

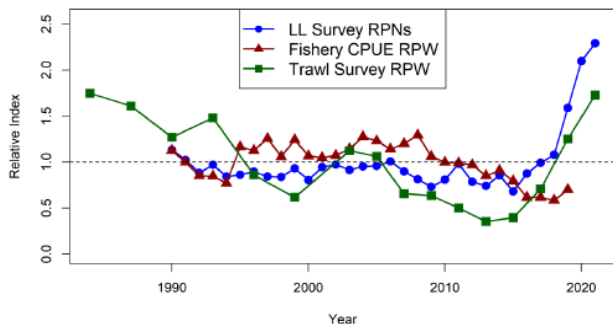
Daniel Goethel presented the sablefish assessment during the November 2021 NPFMC Groundfish Plan Team meeting that was held virtually November 15 – 19, 2021.

The 2021 assessment included the following new data:

- **Catch:** updated catch for 2020, new projected 2021 – 2023 catches
- **Relative abundance:** 2021 longline survey, 2021 trawl survey
- **Ages:** 2020 longline survey, 2020 fixed gear fishery
- **Lengths:** 2020 fixed gear fishery, 2020 trawl fishery, 2021 longline survey, 2021 trawl survey
- **Depredation:** estimates of killer and sperm whale depredation in the fishery were updated and projected for 2021 – 2023

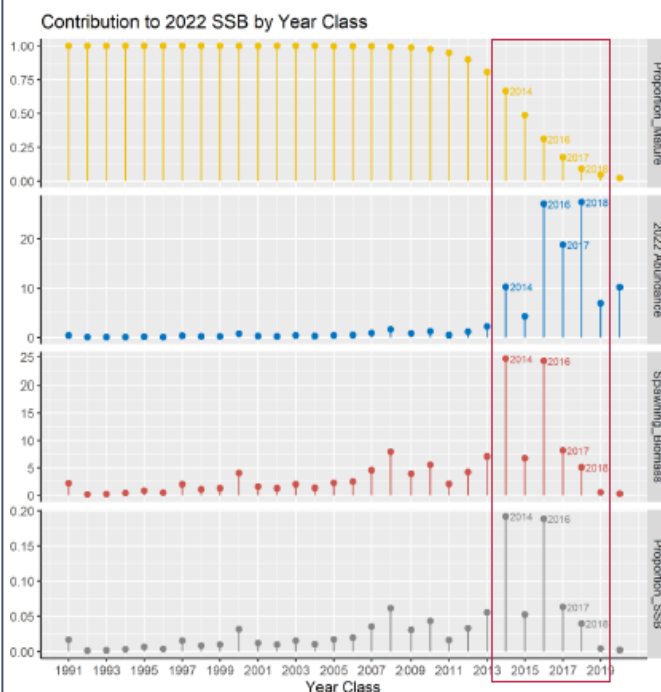
Summarized results:

- **Abundance indices:** The 2021 longline survey relative abundance index was up 10% from 2020 (LL Survey Relative Population Number (RPN), blue line in figure). The 2021 GOA trawl survey was up 40% from 2019 (Trawl survey RPW, green line in figure). **The fishery catch-rate/abundance index (Fishery CPUE Relative Population Weight (RPW), red line in figure)**

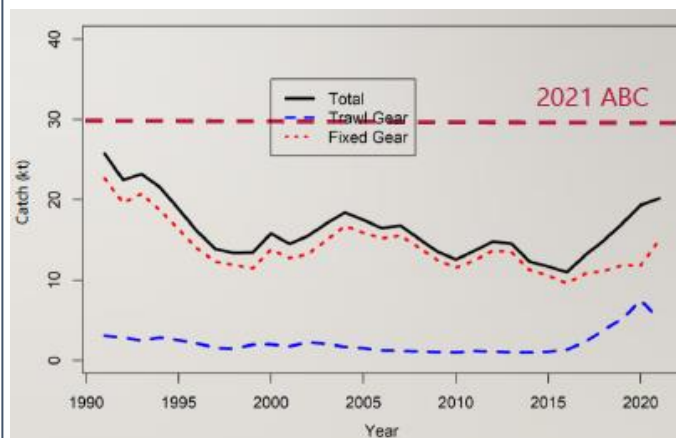


2021 Groundfish Plan Team cont.

- **Recruitment:** The large estimated 2014 and time series high 2016 year class are each expected to compromise 20% of the 2022 spawning biomass, while being 60% and 30% mature, respectively. The 2017 and 2018 year classes, both of which are estimated to be of similar size to the 2014 year class, are expected to each contribute ~5% of the projected SSB, despite being less than 20% mature.



- **Catch:** Total catch continues to increase: fixed gear catch increased while catch in trawl gear decreased.



Time series of total sablefish catch (kilotons; kt), and catch (kt) in both trawl and fixed gear.

2021 Groundfish Plan Team cont.

- **Assessment Model Changes:** The following are the assessment model changes implemented by the sablefish authors.

1. Biological Parameter Updates:

Weight & Length – Updated growth estimates using data through 2019 results in slower growth but larger maximum sizes being attained.



Estimated length and weight at age for sablefish currently used (1996-2004) and updated for 2021 assessment (1996-2019).

Maturity – The utilization of more accurate histological data shows that recent maturity has increased slightly for younger ages, while decreasing at intermediate ages. More detailed results are discussed in the Research section below.

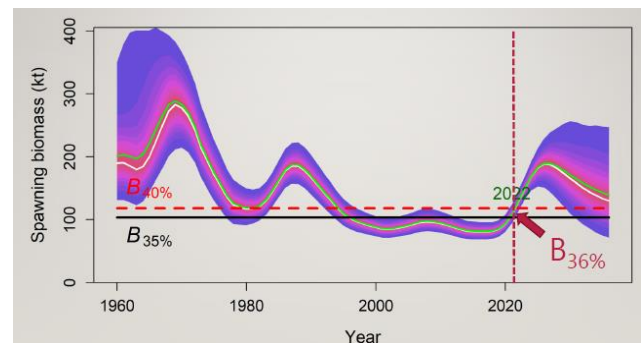
2. Remove Catchability Priors: Removing catchability priors enables unconstrained estimation of parameters.
3. Apply Data Reweighting: A formal data weighting approach (the Francis method) was implemented, consistent with best practices.



2021 Groundfish Plan Team cont.

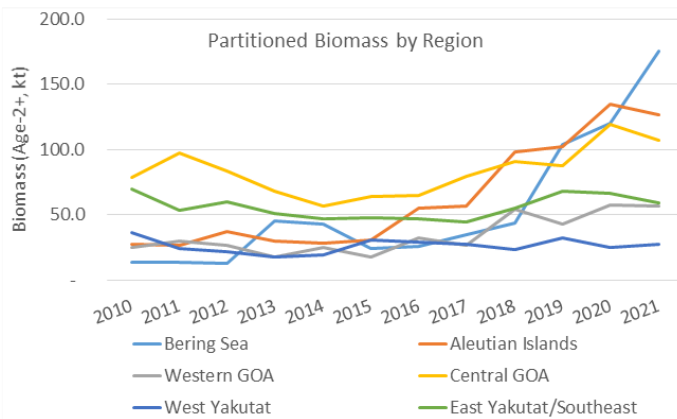
4. Add Recent (2016) Time Block for Fishery Selectivity and Catchability, and Survey Selectivity: This addresses issues with recruitment estimation and associated degradation in model diagnostics in recent years. By adding a recent time block, new parameter estimates were incorporated into the model starting in 2016 for the fixed gear fishery catchability and selectivity and the longline survey selectivity. The recent time block for fixed gear fishery catchability and selectivity was warranted given the rapid alteration in gear composition since pot gear was legalized in the GOA in 2017 along with potential changes in length-specific targeting due to the influx of small sablefish. There have also been recent increases in abundance of younger fish in deep water strata in the longline survey, where they have not historically been caught. These changes in availability to the longline survey appear to have occurred only for certain age and size classes, which was adequately modeled with the addition of a recent survey selectivity time block.

- **Model results:** Spawning biomass is increasing rapidly; **author recommended 2022 ABC (quota) = maxABC = 34,521 t. This is an 18% increase from the 2021 ABC.**



2021 Groundfish Plan Team cont.

- **Apportionment:** Based on 5 yr average survey biomass and year 2 (50%) of SSC 4-yr stair step (from 2019 fixed apportionment towards full survey proportions).
 - Addresses biological concerns (avoid localized depletion)
 - This is NOT a static apportionment, the proportions will change yearly based on changing distributions and updated survey biomass
 - High BS longline survey catch in 2021 (~32% of LL survey biomass) resulted in increased apportionment to the BS region



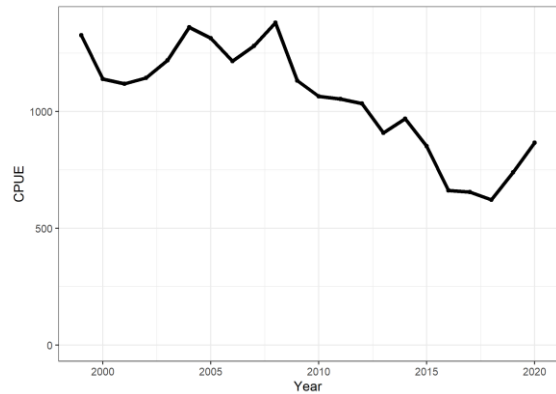
Time series of biomass (kt) partitioned by management area: Bering Sea, Aleutian Islands, Western Gulf of Alaska (GOA), Central GOA, West Yakutat, and East Yakutat/Southeast.

FISHERY AND SURVEY CPUE

cara.rodgveller@noaa.gov

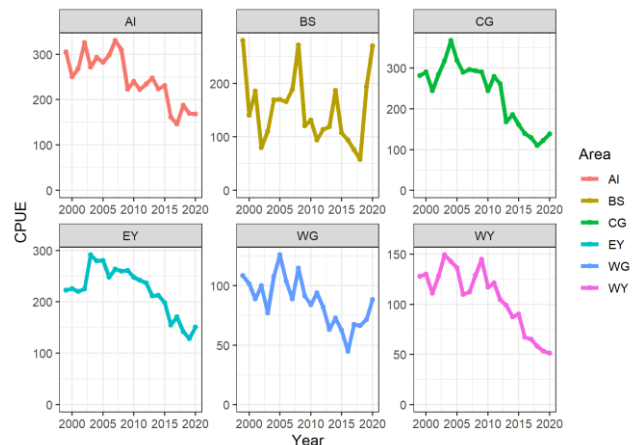
The observer and logbook data from the hook and line gear are used to create a fishery index. The 2020 logbook data were not available in time for use in the 2021 assessment, as a result there was no 2020 data point included in the CPUE index. Here we present the 2020 fishery CPUE data that was unavailable for the 2021 assessment that will be used in the next SAFE. Data used in these figures can be found in the SAFE report, except for logbook data for 2020. Total fishery CPUE increased by 17% in 2020 from 2019. This follows an increase of 19% from 2018 to 2019.

FISHERY AND SURVEY CPUE CONT.



Time series of total fishery catch per unit of effort (CPUE).

Fishery CPUE continued to increase in the Bering Sea (BS, 39%), Western Gulf (WG, 24%), Central Gulf (CG, 13%), and East Yakutat (EY, 17%) management areas in 2020 from 2019. There were continued decreases in the Aleutian Islands (AI, -1%) and West Yakutat (WY, -4%) areas from 2019 to 2020. Note that there was no AI data for 2020, and the value presented here is based on a recent 3 year average.



This past year MESA member Kari Fenske returned home to Wisconsin to work for the Wisconsin DNR. Not only will Kari's contributions to the sablefish assessment be missed, but also her smile and upbeat attitude. Best of luck Kari! You leave a big hole at the AFSC!



THIS YEAR'S RESEARCH

- MATURITY & GROWTH
- HEALTH & REFLEXES AFTER CAPTURE
- GEAR COMPARISON STUDIES ON THE LONGLINE SURVEY

ONGOING RESEARCH

- ASSESSMENT UPDATES TO ADDRESS CHANGING AVAILABILITY TO GEARS AND SURVEYS, IMPROVED FORMULATION OF NATURAL MORTALITY, UPDATED DEMOGRAPHICS, DATA WEIGHTING, INCORPORATION OF TAGGING DATA, AND MODELING POT GEAR
- IMPROVING THE CPUE INDEX TO ADDRESS THE SHIFT TO POT GEAR
- ONGOING GENETICS TO EXPLORE STOCK STRUCTURE
- COASTWIDE SABLEFISH ASSESSMENT WORK
- SPATIAL ASSESSMENT (TAG INTEGRATED) EXPLORATION
- SIMULATION STUDY EXPLORING ROBUSTNESS OF NPFMC HARVEST STRATEGIES TO SPASMODIC SABLEFISH RECRUITMENT EVENTS

THE AFSC IS INTERESTED IN EXPLORING COOPERATIVE RESEARCH IDEAS

We always encourage open communication and welcome research ideas. If you have a topic that you think is worth exploring, please email Chris Lunsford at chris.lunsford@noaa.gov.

NE PACIFIC SABLEFISH GROWTH

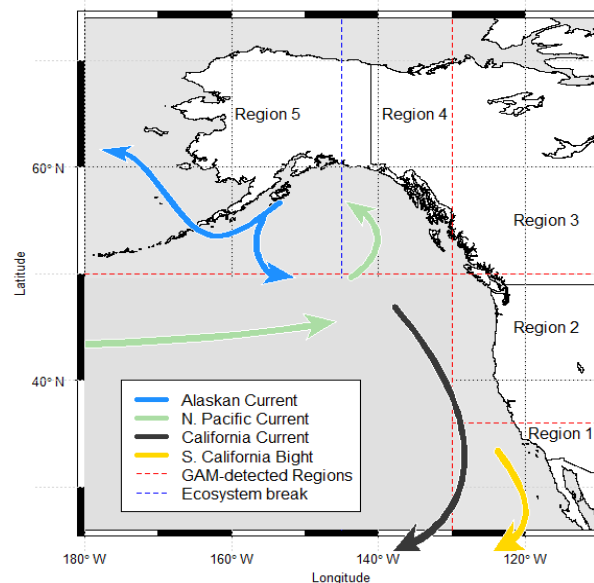
NEW STUDY FINDS ZONES OF DISTINCT SABLEFISH GROWTH, CORRESPONDING TO OCEANOGRAPHY

maia.kapur@noaa.gov

Researchers at UW, NOAA and DFO collaborated on a study using survey data since the 1980s to determine whether there are specific blocks of time, and areas of the coastal NE Pacific, between which sablefish growth varies significantly. The study used a "data driven" method which detected breakpoints in space and time and resulted in five distinct areas and two time periods. The detected areas coincided with major oceanographic features, like the bifurcation of the California Current off the coast of British Columbia, and the convergence of the

NE PACIFIC SABLEFISH GROWTH CONT.

Alaskan Current with the North Pacific Current around 145°W. As expected, sablefish grow much faster and to a larger size in Alaska than they do down south. The study additionally detected a change in average length-at-age where fish of both sexes in all regions grew smaller (on average) after year 2010, which may correspond to climactic regimes. This research can help inform growth estimates for assessment modeling.



This figure illustrates the five coastal 'growth regions' identified in the study, among which sablefish length-at-age is significantly different (dashed lines). The colored arrows show major oceanographic currents, which might explain the differences among regions as they move nutrients and warm water masses throughout the region.

POT AND HOOK & LINE FISHERY CPUE INDEX

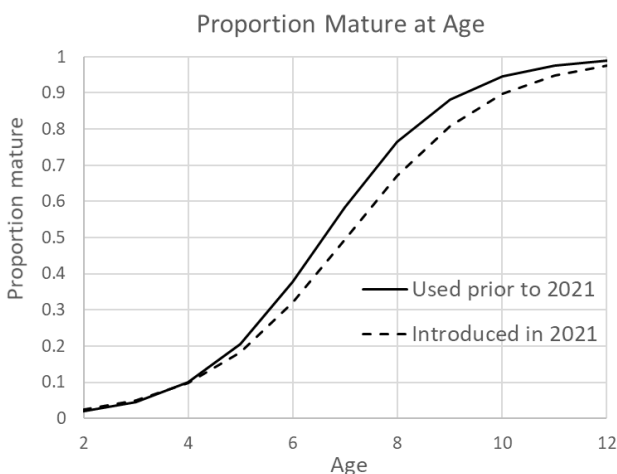
Hook and line and pot data is available from logbooks and observer data. Pot gear has increased rapidly in popularity since it was legalized in the GOA in 2017. Pot data has been reported in the assessment, but has not yet been used as an index of abundance. ABL is partnering with UAF to produce fishery indices that include pot and hook and line gears. We plan to meet with interested stakeholders in early 2022 to discuss and learn more about the sablefish pot fishery to help develop this index.

SABLEFISH MATURITY IN STOCK ASSESSMENT

cara.rodgveller@noaa.gov

In the 2021 assessment the proportion of female sablefish mature at age was changed to reflect the most recent research collections. The new curve presents a lower proportion of fish mature at age (for intermediate ages) than what was used previously. While the majority of the population is young, the differences of switching to the new curve will not have large impacts on the population of female spawning biomass.

Skip spawning fish, those that are abstaining from spawning in the current year, was observed at very different rates during recent data collections (21% in 2011, which was a cold year, and 2-5% in 2015, which was a warm year). Because of this variability, the SSC recommended that skip spawning not be incorporated into the maturity curve until more data can be collected, which would have decreased the overall estimates of spawning biomass. Skip spawning has been shown to be related to body condition. Because fish in the BSAI have a high ratio of weight to length, as determined by measurements on the longline survey, we plan to conduct studies of condition and maturity in multiple management areas in Alaska. From these length, weight, otolith (age), and tissue samples, we can determine whether spawning status is related to condition and if maturity curves and skip spawning vary by area.



LONGLINE SURVEY: SLINKY POT GEAR COMPARISON PILOT STUDY

pat.malecha@noaa.gov

NOAA scientists on the 2021 AFSC longline survey collaborated with the crew of the FV *Alaskan Leader* to conduct a 3-day pilot study comparing standard survey hook-and-line gear with slinky, or codcoil, collapsible pots. Slinky pots are becoming commonplace in the commercial sablefish fishery and are named for their coiled spring steel frames that allow the trap to fully collapse for storage or deployment. Slinky pots are lightweight and have made pot fishing accessible to smaller vessels that are unable to fish larger rigid pots due to limited deck space or hydraulic power. Despite their rising popularity in the fishery, little empirical data exists that provides performance metrics of slinky pots including selectivity and CPUE relative to hook-and-line gear. Interpreting commercial fishery data from slinky pot catches is thus problematic for stock assessment purposes. The objective of the pilot study was to compare catch compositions, catch rates, and size-selectivities of the two gear types. Ultimately, the results of the pilot study will be used to inform designs of more rigorous gear experiments in the future.

The small scale of the pilot study means that interpretations should be made with caution, but, nevertheless, there were a few interesting results. Most notably was the difference in species catch composition. The most common species caught across both gear types were (in descending order) sablefish, giant grenadier, shortspine thornyhead, shortraker rockfish, and roughey/blackspotted rockfish. Although the two gear types caught a similar number of species overall, the slinky pots caught a lower proportion of non-sablefish species. Across all sets, 95–98% of all fish caught were sablefish for slinky pots, whereas 79–87% of fish caught on hook-and-line sets were sablefish. The biggest species composition discrepancies between the two gear types were for giant grenadier and shortspine thornyhead. Hook-and-line catches of giant grenadier ranged from 8-13% of total catch while pot catches were 1-2%. Similarly, shortspine thornyhead made up 3-7% of the hook-and-line catches and 0-0.2% of pot catches. Complete results of the pilot work will be released in early 2022.

SABLEFISH HEALTH AND REFLEXES AFTER CAPTURE

cara.rodgveller@noaa.gov

Fish exert effort while being brought up from deep depths and can also be injured during capture or exposure to air. Stressors from these processes may lead to behavioral changes, such as changes in reflexes, impaired health, or mortality. To examine the effects of capture and time out of water we caught sablefish using longline gear nearby Juneau, AK. Six reflexes were tested immediately after capture, such as swim response when the tail was grabbed or when an abrupt sound was introduced. Fish were then transported to Juneau in a dark tote with chilled water and held in a dark and cold environment in the laboratory.

After weeks of recuperation time, fish were experimentally held out of water for 3, 6, or 11 minutes (or a control of no time out of water). After the treatment and a week of holding to see if there were mortalities, reflexes were tested again and fish tissues were collected for microscopic examinations of injury or disease.

Sablefish in our study all survived capture and being held out of water, when there were no significant injuries to the gills. On deck there were several reflexes that were not present in all fish; 77% of fish could right themselves after being placed upside down; 69% responded to grabbing the tail; and only 57% responded to sound. A week after the lab experiment the only reflex that did not improve to 100% was a swim response to the sound reflex.



A sablefish being inspected for eye lesions using fluorescent and ultraviolet light.

SABLEFISH HEALTH AND REFLEXES CONT.

The control fish had a 57% response rate, which was the same as the rate on-deck, 3 and 6 minute treatments had a 25% response rate, and none of the 11 minute fish had a sound response. The sound response may be important for locating prey or for evading predators, as sablefish are one of the few deep-sea fish that have been shown to make sound and, therefore, may hear sound. If a response to acoustics helps sablefish evade predators after being returned to the wild, they would be at a risk of predation for at least a week afterward, as we conducted reflex tests 7–10 days after applying the stress of being out of water. The multiple decreased reflexes on-deck, which can be attributed to capture alone, may together affect sablefish swim response and increase their susceptibility to predators if they are released by scientists or during commercial fishing operations. However, there are no data on the mortality of sablefish after returning them to the natural environment.

In the future, we recommend that more potential stressors that occur during longline and pot gear capture and release be tested at-sea and experimentally in the laboratory. Each of these stressors should be tested individually and in combination to identify which factors are the most impactful to behavior, health, and mortality.

<https://www.fisheries.noaa.gov/feature-story/fish-out-water-how-capture-affects-sablefish-health-reflexes-and-survival>

POT GEAR DOCUMENTATION IN 2022

Starting in the 2022 fishing year, pot type (slinky or other) will be recorded in the catch accounting system and during EM video review. Observers will also be taking detailed measurements as part of a special project. The observer-collected data on specific gear configurations will provide information on the prevalence of each pot gear type in the fishery, the dimensions of pots on each vessel, and other configuration measurements, such as the prevalence and size of escape rings.

December 2021 North Pacific Fishery Management Council Meeting Highlights

The December NPFMC meeting was held virtually, December 2 – 15, 2021.

<https://www.npfmc.org/npfmc-newsletters/>

2022/2023 GOA Groundfish Specifications

Sablefish overfishing limit (OFL), acceptable biological catches (ABC), and total allowable catches (TAC) by area for 2022 are below:

Area	OFL (t)	ABC (t)	TAC (t)
AK-Wide	40,432	34,521	34,521
Gulf of Alaska		22,794	22,794
Western		3,727	3,727
Central		9,965	9,965
W. Yakutat		3,437	3,437
E. Yak/S.E. Out		5,665	5,665
Bering Sea		5,264	5,264
Aleutians		6,463	6,463



Biologist Greg Jay recording catch at the rail in the 'doghouse' on the 2021 longline survey. Catch on every hook, including baited or 'ineffective' hooks, is recorded every year on the longline survey. This provides an index of abundance to be used in the sablefish assessment model.

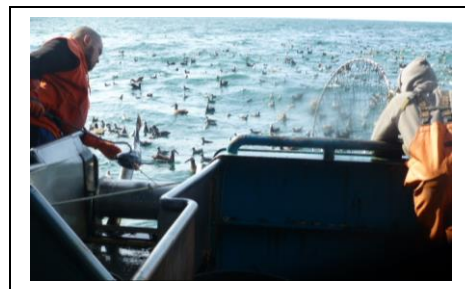
Ecosystem & Socioeconomic Profile

Ecosystem Considerations

- There is **overall cooling in the GOA** while the **EBS remains warm**, although the plankton indicators suggest average feeding conditions.
- Growth of young-of-the-year sablefish in seabird diets was average, while juveniles in the nearshore survey remain very high, and average in the bottom trawl survey.
- Condition of sablefish in the GOA on the longline survey was average to slightly below average.

Socioeconomic Considerations

- Condition of sablefish in the GOA fisheries was very poor (although sample sizes were low).
- Pot catch-per-unit-effort was the highest in the time series and incidental catch in the BS fisheries remain high (although less than last year).
- Ex-vessel value of the fishery and price remain low in 2020 \$\$



Logbooks and Whales

THANK YOU for volunteering to provide whale presence and depredation information in logbooks! This will continue to be an important data source for analyses of the effects of whales in the fishery. **Please continue to include whale data on all sets, even if there are no whales present.** Any questions, please contact Cara Rodgveller, cara.rodgveller@noaa.gov.



AFSC Groundfish Tag Website

NOW Available!

<https://www.fisheries.noaa.gov/resource/map/alaska-groundfish-tagging-map>



The AFSC groundfish tag website is now available! On this site, you are able to view fish movement by species, area, year, or simply type in a specific tag number. There are also a number of tables and figures for viewing these data. All data displayed have been modified to meet confidentiality requirements. Feedback is always welcome!

katy.echave@noaa.gov

Mobile Tag Reporting Application

Coming Soon!



A tag reporting application for mobile devices is currently in development. Our hope is that this application will ease the burden of reporting tag recoveries. Simply enter the requested information in the app, take a photo of the tag, and the tag recovery information will be submitted once within range of cell service or wireless internet. **We hope this will be available for use during the 2022 season! Rewards will still be given.**

katy.echave@noaa.gov

2021 GROUND FISH TAG PROGRAM RECAP

2021 approximate number of tags returned:

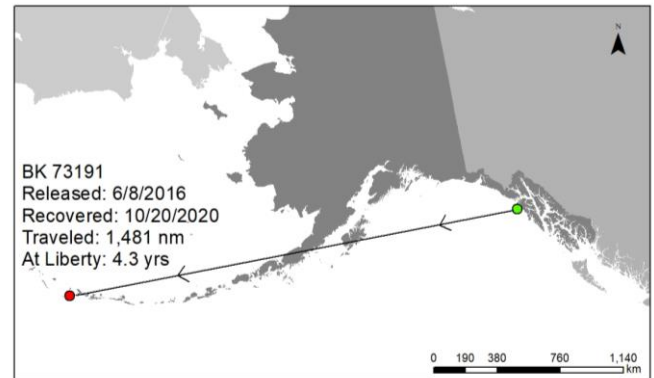
- 400 sablefish (1 electronic archival tag)
- 3 shortspine thornyheads (1 archival tag)
- ~16% of 2021 tags were recovered by trawl gear, 33% by pot gear, 51% by hook and line



Photo of thornyhead being tagged on the longline survey.

Of those SABLEFISH tags:

- Greatest time at liberty: 15,423 days (~42 yrs)
- Shortest time at liberty: 35 days
- Greatest distance traveled: 1,481 nmi



Congrats to the 2020 NMFS Sablefish Tag Recovery Prize Drawing Winners

Seamus Hayden – Kodiak, AK **First Prize: \$1000**
Tag BK 61380 – at liberty for ~4 yrs and traveled 356 nm

Quinn Padgett – Everett, WA **Second Prize: \$500**
Tag BK 82750 – at liberty for 682 days and traveled 7 nm

Frederick Phillips – Sitka, AK **Third Prize: \$250**
Tag SA 12763 – at liberty for ~41 yrs and traveled 786 nm

F/V Banker II – Mill Bay, BC **Fourth Prize: \$250**
Tag BK 82220—at liberty for 263 days and traveled 670 nm

Turn in those tags quick to be included in the 2021 drawing! \$\$\$\$

REMINDER OF LONGLINE SURVEY!

In 2022, the AFSC Longline Survey is scheduled to sample the AI and GOA from late May through August aboard the FV *Alaskan Leader*. The data from the survey is the primary index of abundance used in the sablefish stock assessment. To increase the accuracy of survey results, the survey coordinators and stock assessment authors respectfully request that the fishing fleet avoid stations by staying at least 5 nautical miles from each station for 7 days before and 3 days after the planned sampling dates (3 days after allows for potential survey delays). This will allow the survey vessel to sample the historic stations unencumbered and will hopefully avoid negative effects on catch rates. Please call the Alaska Leader on channel 16 for survey updates if on the fishing grounds. The survey schedule and station locations are available here:

<https://www.fisheries.noaa.gov/resource/document/ala-ska-sablefish-longline-survey-station-schedule>

CONTACTS

Chris Lunsford; Marine Ecology and Stock Assessment (MESA) program manager
chris.lunsford@noaa.gov

Dan Goethel; Lead sablefish assessment author

Pat Malecha; Coordinator of the longline survey
pat.malecha@noaa.gov

Kevin Siwicke; Coordinator of the longline survey
kevin.siwicke@noaa.gov

Katy Echave; Sablefish Tag Program
katy.echave@noaa.gov

Cara Rodgveller; Logbooks & fishery data
cara.rodgveller@noaa.gov

CALENDAR OF EVENTS

ALASKA MARINE SCIENCE SYMPOSIUM

[HTTPS://WWW.ALASKAMARINESCIENCE.ORG/HOME](https://www.alaskamarinescience.org/home)

VIRTUAL EVENT – FREE TO ATTEND!
JANUARY 24 – 27, 2022

SABLEFISH TAG REWARD DRAWING

TED STEVENS MARINE RESEARCH INST. -
JUNEAU, AK - MARCH 2022

Drawing held from all of the 2021 sablefish tag returns for cash rewards.

NORTH PACIFIC FISHERY MANAGEMENT COUNCIL MEETINGS

<https://www.npfmc.org/at-a-glance/>

VIRTUAL VIA ADOBE CONNECT
JANUARY 31 - FEBRUARY 11, 2022

HILTON HOTEL - ANCHORAGE, AK
APRIL 4 – APRIL 12, 2022

HARRIGAN HALL – SITKA, AK
JUNE 6 – 14, 2022

HILTON HOTEL – ANCHORAGE, AK
OCTOBER 3 – 11, 2022

HILTON HOTEL – ANCHORAGE, AK
DECEMBER 5 – 13, 2022

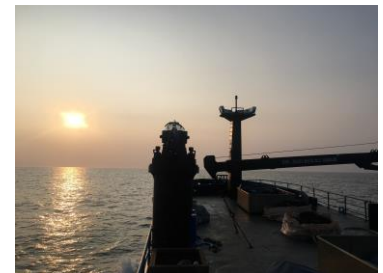
NPFMC GROUND FISH PLAN TEAM MEETINGS

<https://www.npfmc.org/FISHERY-MANAGEMENT-PLAN/GOA-BSAI-GROUNDFISH-PLAN-TEAM/>

ALASKA FISHERIES SCIENCE CENTER –
SEATTLE, WA

SEPTEMBER 21 - 24, 2022

NOVEMBER 14 - 18, 2022



REWARD FOR TAGGED SABLEFISH



The U.S. National Marine Fisheries Service Auke Bay Laboratory in Juneau, AK tags sablefish (blackcod) in the Gulf of Alaska, Bering Sea and Aleutian Islands in order to study distribution and migration.

Tags may be yellow, red, or orange and are usually located below the first dorsal fin on the left side of the fish. In addition, sablefish are being tagged with $\frac{3}{4}$ inch diameter x $2\frac{1}{4}$ inch long electronic tags placed inside the fish with a 3 inch long fluorescent green and pink tag located near the dorsal fin of the fish. The external tag reads – "Reward for Depth Sensor Inside Fish." These electronic tags are worth monetary rewards of up to \$500 if returned.

Postage-paid envelopes are available in most areas. For a reward and information on the tagged fish, please send tags with as much of the following information as possible:

Name of vessel

Location of recovery

Fork length (from tip of snout to fork in tail)

Depth fished

Date of recovery

Sex of the fish

Round weight

Type of gear

Sablefish Tag Program

NOAA/NMFS Auke Bay Laboratories

17109 Pt. Lena Loop Rd.

Juneau, AK 99801