Washington Department of Fish and Wildlife Contribution to the 2021 Meeting of the Technical Sub-Committee (TSC) of the Canada-U.S. Groundfish Committee: Reporting for the period from May 2020-April 2021

April 20th-21st, 2021

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Contents

I. Agency Overview

The Washington Department of Fish and Wildlife is divided into three major resource management Programs (Fish, Habitat, and Wildlife) and three major administrative support programs (Enforcement, Technology & Financial Management, and Capital & Asset Management). Within the Fish Program, research and management of marine fishes is housed within the Fish Management Division, which also oversees research and management of shellfish, warmwater species, and aquatic invasive species. Two primary work units deal with marine fish research within the Fish Management Division. The Toxics-focused Biological Observation System for the Salish Sea (TBiOS) (formerly Puget Sound Ecosystem Monitoring Program or PSEMP) conducts considerable marine forage fish and groundfish research in Puget Sound, but focuses on the accumulation of toxic contaminants in these species. The unit is led by Jim West and also consists of Sandy O'Neill, Dr. Louisa Harding, Mariko Langness, and Rob Fisk. A second and larger work unit within the Fish Management Division is the Marine Fish Science (MFS) Unit, which itself is broadly separated into three groups that deal with distinct geographic regions and/or species assemblages (Puget Sound Groundfish, Marine Forage Fish, and Coastal Marine Fish), though there is some overlap of senior staff. The entire MFS Unit is overseen by Dr. Theresa Tsou, while Lisa Hillier oversees the Unit budget, manages the Washington Conservation Corps (WCC) survey group, and assists with stock assessments both on the coast and in Puget Sound. Dr. Dayv Lowry was the lead of the Puget Sound Groundfish Unit until September 2020, but the position is currently vacant; Phill Dionne leads statewide marine forage fish research and management; and Lorna Wargo leads the Coastal Unit for groundfish, coastal pelagic species, and shrimp management, fishery monitoring, and research.

Puget Sound Marine Fish Science (PSMFS) Unit ~ Groundfish

PSMFS Unit tasks are primarily supported by supplemental funds from the Washington State Legislature for the recovery of Puget Sound bottomfish populations, and secondarily by a suite of collaborative external grants. The main activities of the unit include the assessment of marine fish populations in Puget Sound, study of marine fish ecology and demography, evaluation of bottomfish in marine reserves and other fishery-restricted areas, and development of conservation plans for particular species (and species groups) of interest. Groundfish in Puget Sound are managed under the auspices of the Puget Sound Groundfish Management Plan (Palsson, et al. 1998) and management has become increasingly sensitive to the ESA-listing of Canary Rockfish, Yelloweye Rockfish, and Bocaccio, in Puget Sound since 2010 (National marine Fisheries Service 2010). In 2017 Canary Rockfish were delisted, but Yelloweye Rockfish and Bocaccio still very much drive management of all groundfish species.

In addition to Dr. Dayv Lowry (lead, until Sept. 2020), staff of the PSMFS Unit during the reporting period included Robert Pacunski, Larry LeClair, Jennifer Blaine, Andrea Hennings, Mark Millard, Ian Craick, and Katie Kennedy. Since December of 2016 and until his departure from WDFW, Dr. Lowry also served as the Washington State representative on the Scientific and Statistical

Committee (SSC) of the North Pacific Fishery Management Council (NPFMC), and members of the PSMFS Unit are occasionally called upon to assist with evaluation of documents pertinent to fisheries in federal waters off Alaska. In 2018 Lisa Hillier was added to the NPFMC Groundfish Plan Teams for both the Bering Sea and Gulf of Alaska.

Marine Forage Fish (MFF) Unit

Forage fish in Washington are managed under the auspices of the Forage Fish Management Plan (Bargmann 1998) and managed by members of the statewide Marine Forage Fish (MFF) Unit, which works primarily in Puget Sound. Together with Phill Dionne, the MFF Unit is composed of Dr. Todd Sandell, Adam Lindquist, Patrick Biondo, Kate Olson, Eric Bruestle, Aidan Coyle (until Sept. 2020), and Stephanie Lewis. During herring spawning season, the unit receives staff support from members of the Intertidal Shellfish Unit as needed (i.e., the "loan" of four staff at approximately half time for four months).

Primary Contacts – Puget Sound, Forage Fish, and TBiOS:
Groundfish Monitoring, Research, and Assessment – *Contact: Robert (Bob) Pacunski 425-379-2314, robert.pacunski@dfw.wa.gov; Dr. Theresa Tsou 360-902-2855, tien-shui.tsou@dfw.wa.gov.*
Forage Fish Stock Assessment and Research – *Contact: Phill Dionne 360-902-2641, phillip.dionne@dfw.wa.gov; Dr. Todd Sandell 425- 379-2310, todd.sandell@dfw.wa.gov.*
Toxics-focused Biological Observation System for the Salish Sea (TBiOS) (formerly Puget Sound Ecosystem Monitoring Program or PSEMP) – *Contact: Dr. Jim West 360-902-2842, james.west@dfw.wa.gov).*
For complete staff contact information see section VIII of this report.

Coastal Marine Fish Science (CMFS) Unit

In addition to Lorna Wargo, staff of the Coastal Marine Fish Science (CMFS) Unit during the reporting period included Rob Davis, Donna Downs, Kristen Hinton, Jamie Fuller, Michael Sinclair, and Tim Zepplin. Unit tasks are supported through a combination of state general and federal funds. Long-standing activities of the unit include the assessment of groundfish populations off the Washington coast, the monitoring of groundfish commercial and recreational landings, coastal rockfish research projects, and the monitoring and management of ocean pink shrimp. In the last two years, the coastal unit has expanded to also include the monitoring and management of coastal pelagic species (CPS), including finfish and squid species, through collaborative research projects with federal and industry partners.

Groundfish and CPS on the Washington coast are subject to state regulatory and policy authority as well as to federal management under the Magnuson-Stevens Fishery Conservation and Management Act and the PFMC's fishery management plans for groundfish and CPS. The Department's Forage Fish Management Plan also guides management of coastal fishery resources in state waters. The

MFS Unit contributes fishery policy and scientific support for federal West Coast groundfish and CPS management via participation on the Coastal Pelagic Species Management Team (CPSMT, Lorna Wargo) and the Scientific and Statistical Committee (SSC, Dr. Theresa Tsou), of the Pacific Fishery Management Council (PFMC). Landings and fishery management descriptions for PFMC are summarized annually in the Stock Assessment and Fishery Evaluation (SAFE) documents.

Additional West Coast fishery management support is provided by the Intergovernmental Ocean Policy Unit, which consists of a currently vacant lead (previously Michele Culver), Corey Niles, Heather Hall, Whitney Roberts, and Victoria Knorr. Whitney also serves on the PFMC's Groundfish Management Team (GMT), as does Erica Crust of the Fish Program's Ocean Sampling Program. Further support is provided to the PFMC by Randi Thurston, who serves on the Habitat Committee.

Primary Contacts – Coastal MFS Unit:
Groundfish Management, Monitoring, Research, and Assessment – *Contact: Dr. Theresa Tsou 360-902-2855, tien-shui.tsou@dfw.wa.gov; Lorna Wargo 360- 249-1221 lorna.wargo@dfw.wa.gov; Corey Niles, 360-902-2733, corey.niles@dfw.wa.gov (Coastal Marine Policy Lead).*
Coastal Pelagic Species /Forage Fish Management, Monitoring, Research, and Assessment – *Contact: Lorna Wargo 360- 249-1221 lorna.wargo@dfw.wa.gov; Phill Dionne 360-902-2641, phillip.dionne@dfw.wa.gov.*
For complete staff contact information see section VIII of this report.

II. Surveys

A. Puget Sound Bottom Trawl

Since 1987, the Washington Department of Fish and Wildlife (WDFW) has conducted bottom trawl surveys in Puget Sound – defined as all marine waters of the State of Washington east of the mouth of the Sekiu River in the Strait of Juan de Fuca – that have provided invaluable long-term, fisheries-independent indicators of population abundance for benthic organisms living on low-relief, unconsolidated habitats. These surveys have been conducted at irregular intervals and at different geographic scales since their initiation (Quinnell et al. 1991; Quinnell et al. 1993; Palsson et al. 1998; Palsson et al. 2002; Palsson et al. 2003; Blaine et al. 2020). Surveys in 1987, 1989, and 1991 were semi-stratified random surveys of the majority of Puget Sound. From 1994-97 and 2000-07, surveys were annual, stratified-random surveys focusing on individual sub-basins (WDFW unpublished data; Palsson et al. 1998; Blaine et al. 2020). Starting in 2008, surveys became synoptic again, sampling annually at fixed index sites throughout Puget Sound (Blaine et al., in prep).

The specific objectives of the annual index trawl survey are to estimate the relative abundance, species composition, and biological characteristics of bottomfish species at pre-selected, permanent index stations. Key species of interest include Pacific Cod, Walleye Pollock, Pacific Hake, English

Sole, North Pacific Spiny Dogfish, and all species of skates; however, all species of fishes and invertebrates are identified to the lowest taxonomic level practicable, weighed, and recorded. For key species, size distribution data and various biological samples are collected from a subset of individuals from each sampling location. For the index survey, the study area is subdivided into eight regions (eastern Strait of Juan de Fuca, western Strait of Juan de Fuca, San Juan Islands, Georgia Basin, Whidbey Island sub-basin, Central Puget Sound, Hood Canal, and South Puget Sound) and four depth strata ("S"= 5-20 fa, "T"= 21-40 fa, "U"= 41-60 fa, "V"= >60 fa). A total of 51 fixed index stations throughout the study area are sampled each spring (late April-early June) (Figure 1).

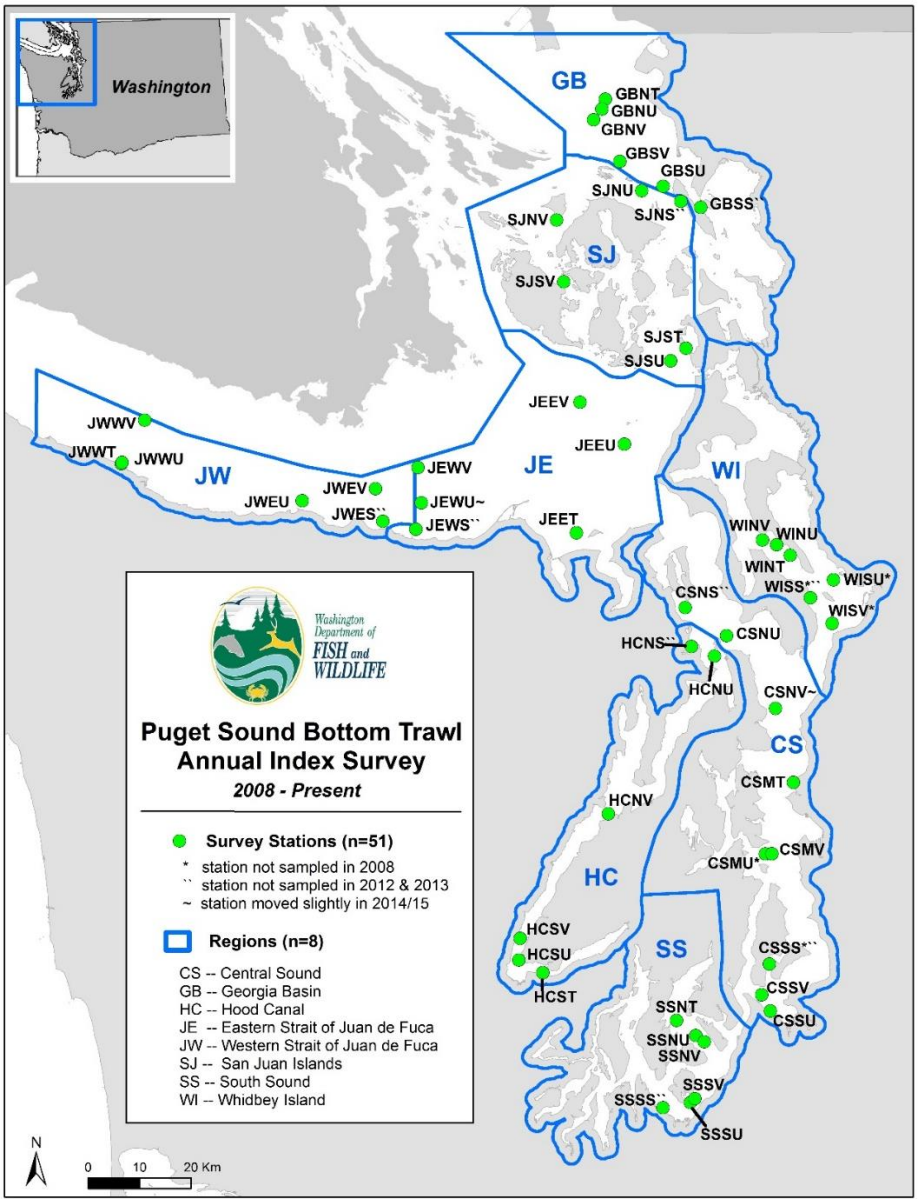

Figure 1. Trawl site locations for the index survey, sampled 2008-19.

Index stations were originally selected from trawl stations sampled during previous survey efforts at randomized locations throughout Puget Sound. Station selection was based on known trawlability and other logistical concerns and was informed by previously obtained biological data. Stations are named using a four-letter system with the first two letters designating the region, the third letter indicating the sub-region or position within the region (north, south, middle, east, west), and the final letter designating the depth stratum. The index stations have remained relatively consistent since 2008, with a few exceptions: starting in 2009, 5 stations were added to make the current 51-station design; in 2012 and 2013, stations in the shallowest stratum (S) were not surveyed because of concerns from NOAA about impacts to juvenile salmonids; and in 2014 and 2015, stations JEWU and CSNV were moved slightly to accommodate concerns raised by fiber-optic cable companies.

The trawling procedure of the survey has remained largely consistent throughout the historical survey period and complete details can be found in Blaine et al. (2016). The 57-foot F/V CHASINA is the chartered sampling vessel, and it is equipped with an agency-owned 400-mesh Eastern bottom trawl fitted with a 1.25-inch codend liner. The net is towed at each station for a distance of ~0.40 nautical miles at a speed of 1-3 knots, and the tows last approximately 11 minutes. The resulting catch is identified to the lowest taxonomic level possible, weighed, counted, and most of the catch is returned to the sea. The density of fish at each station is determined by dividing the catch numbers or weight by the area sampled with the net, which is based on a mensuration study conducted in 1994 (WDFW unpublished data). A small portion of the catch is retained for biological sampling, either when fresh on deck or after being preserved (freezing, ethyl alcohol, or formalin) for processing in the laboratory. Samples collected may include: fin clips (genetics); scales, spines, and otoliths (ageing); stomachs and intestines (gut contents); and muscle tissue (stable isotopes). When necessary, whole specimens may also be retained for positive identification or special projects being conducted by the WDFW or its collaborators.

From 2008 to 2013, two trawl samples were collected at each station and were spaced several hundred meters apart to be close to each other but not directly overlapping. However, based on the similarity of catches in these paired tows at most stations, and in the interest of minimizing bottomfish mortality associated with the trawl survey, the protocol was altered in 2014. After the first tow is completed, the processed catch is compared to the average catch at that station since 2008. If the species comprising the majority (>75% by weight) of the catch fall within the previous years' average (+/- standard deviation), no second tow is conducted at that station. If it is determined that the species composition was substantially different than expected, a second tow is conducted. This greatly improves the efficiency of the survey, as an average of only 4 stations have required a second tow each year. This newly gained efficiency has allowed institution of a new sampling program, conducting vertical plankton tows, to assess primary prey availability. In 2014 bottom-contact sensors were also added to the footrope to improve understanding of net performance and increase the accuracy of density estimates from the trawl, and a mini-CTD was deployed on the headrope to collect water quality data at each station and provide more accurate

depth readings. In 2017, a Marport unit was also attached to the headrope to provide a live data feed regarding the net's depth, proximity to the bottom, and opening height.

The WDFW bottom trawl survey is the largest, and longest-running, fishery-independent survey of benthic organisms in Puget Sound. As such, this dataset provides an invaluable monitoring opportunity for populations of bottomfish and select benthic invertebrates, particularly given the inter-annual variation of many fish species. Continued collection of these data is important, as they can serve as a baseline for evaluating future population shifts due to fishery management actions, disease outbreaks, catastrophic events, and/or environmental shifts. Additionally, the data, samples, and estimates from the trawl survey are not only important for the WDFW's marine fish monitoring efforts but are also used by other entities both within and outside the agency. Data from the bottom trawl survey will also become a cornerstone of the Puget Sound Partnership's new vital sign indicator "groundfish and benthic invertebrates."

The 2020 Index bottom trawl survey was unfortunately cancelled due to the COVID-19 pandemic, but the 2021 survey is scheduled to occur April 19-May 14, 2021. *For more information about the bottom trawl survey, please contact: Jen Blaine (Jennifer.blaine@dfw.wa.gov).*

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B. Annual Pacific Herring Assessment in Puget Sound

Consistent with previous years, Pacific herring stocks in Puget Sound (southern Salish Sea) were assessed by WDFW staff through spawn deposition field surveys from January through June using the established methods of Stick et al. (2014) and Sandell et al. (2019). WDFW staff based in the Olympia, Mill Creek, and Port Townsend offices attempted to conduct spawn deposition surveys of all herring populations in Washington annually (acoustic-trawl surveys were discontinued in 2009 due to budget cuts; as a result, we are no longer able to estimate the age structure, fecundity, etc. of the herring stocks). Stock biomass assessment activities for the 2021 spawning season are in progress.

WDFW recognizes 21 different herring stocks in Puget Sound and two coastal stocks (Willapa Bay and Grays Harbor), based primarily on the timing and location of spawning activity. Historically there were three distinct genetic groupings (Cherry Point, Squaxin Pass, and the "all other stocks" complex). However, recent research focusing on SNP sequencing has determined that, at present, only the Cherry Point and Elliott Bay stocks are unique; the remaining stocks now comprise the "Other Stocks" grouping (Petrou et al., 2021). Within this "Other Stocks" grouping, research has identified differences in stock timings that include an "Early Winter" (Jan-Feb), "Late Winter" (Feb-March), and "Spring" (April and later) stock groupings. Only five of the stocks have been sequenced to date, and we await further genetic analysis results from our collaborators at the University of Washington (Drs. Lorenz Hauser and Eleni Petrou).

In 2020, spawn deposition field surveys began on January 2nd but were suspended on March 16th due to the COVID-19 pandemic; boat-based work resumed on May 18th, and a total of 134 surveys were completed (as opposed to 225 in 2019). Surveys included the primary spawning areas of 12 of the 21 Puget Sound herring stocks (nine stocks had inadequate or no coverage). In spite of this, 2020 was a dramatic year for herring in Washington state, with an overall increase in estimated spawning biomass (ESB) to 18,559 metric tons, the highest since the 1980s and clearly an underestimate given the limited sampling effort (in 2019, the total ESB was 7,891 mt). The biggest increases occurred at Purdy (884 mt; South Sound), Quilcene Bay (7,118 mt; Hood Canal) and Port Orchard-Port Madison (7,077 mt; Central Basin); these were the largest spawning events ever recorded at these sites. However, the genetically distinct, late-spawning Cherry Point stock ESB was 274 mt in 2020, down from 290 mt in 2019, though surveys there were incomplete.

Coastal surveys were heavily impacted by the pandemic with very limited coverage of Willapa Bay and Grays Harbor. Only one survey was conducted in Grays Harbor on 2/5/20, with no spawn detected, and no surveys were carried out in Willapa Bay. In general, herring spawning biomass for these areas is relatively small compared that of Puget Sound.

Given the fluidity of our genetic stock groupings, we now consider the basin of spawning activity (Figure 2) as the preferred method of biomass reporting; Figure 3 shows the marked shift from a

broadly based spawn deposition (heaviest in the North) towards the dominance of the few stocks mentioned above. Overall this is excellent news for the southern Salish Sea and bodes well for the higher trophic levels, including ESA-listed fish, seabirds, and marine mammals, that depend on herring for food, but the declines in certain regions, particularly South Puget Sound, remain a cause for concern.

For more information about the Pacific Herring assessment, please contact: Todd Sandell (todd.sandell@dfw.wa.gov).

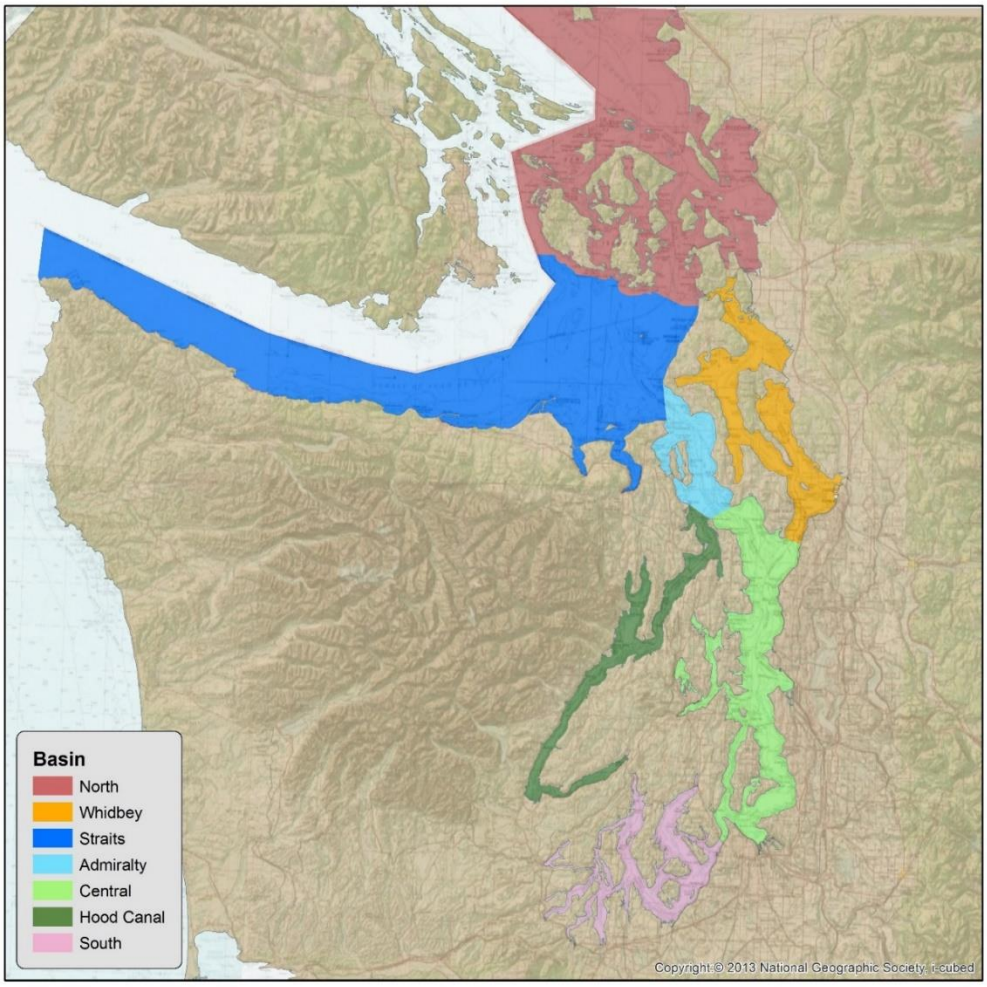

Figure 2: Basin map for herring regions in the southern Salish Sea

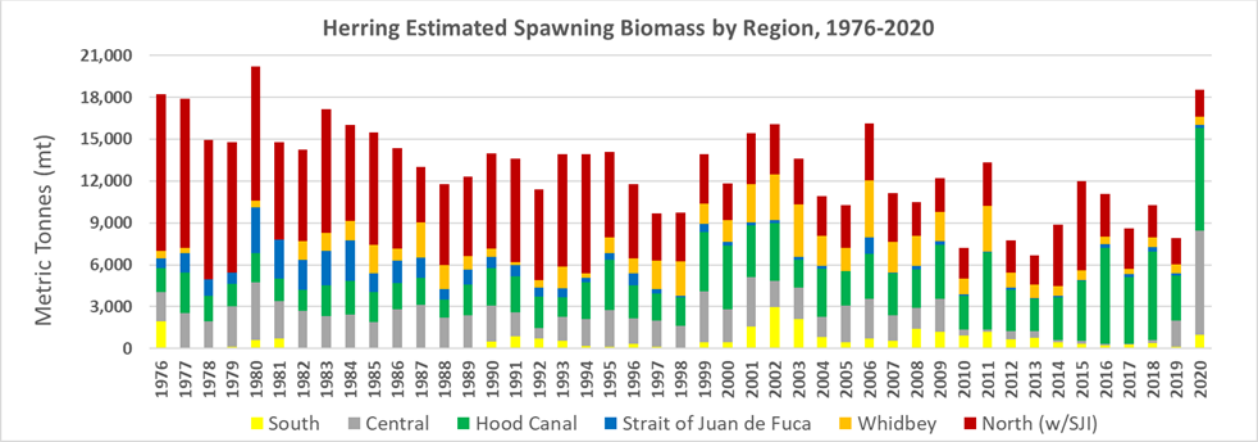

Figure 3. Pacific Herring spawning biomass estimates by Basin in the southern Salish Sea

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C. Coastal Black Rockfish Rod-and-Reel Survey

The WDFW has conducted fishery-independent rockfish surveys on the Washington coast since the 1980s. Historically, these surveys have primarily focused on Black Rockfish due to the predominance of this species in recreational fishery landings. Concerns over population sizes of other less dominant, but highly sought after, nearshore groundfish species has recently motivated survey design changes to address this data need. From 2014 through 2017, the WDFW conducted a series of experimental rod-and-reel surveys devoted to the development of a multispecies, nearshore rockfish survey by evaluating nearshore rockfish distribution, life history, and fishing gear selectivity. This effort indicated that due to variable behaviors and terminal tackle selectivity among species, Washington's nearshore groundfish species would be best described with two separate coastal surveys: one targeting rockfish that typically school above rock piles and another targeting demersal groundfish species.

A standardized rod-and-reel survey designed to describe relative changes in population abundances of nearshore rockfish species and other associated groundfish species along the entire Washington Coast over time was implemented in 2018. Specifically, a "Black Rockfish Survey" was conducted in the spring to describe nearshore schooling species, and a "Demersal Groundfish Survey"

focusing on nearshore demersal rockfish and other associated groundfish species, including Kelp Greenling and Cabezon, was implemented in the fall. This effort was continued in 2019 with adjustments to survey methods addressing some standardization concerns.

In the spring of 2019, 125 specific GPS coordinates located at rocky reefs along the Washington coast were chosen as unique survey index stations for the Black Rockfish Survey. Stations were chosen roughly relative to the amount of known rockfish habitat by Marine Area and depth, and to include both marginal and superior habitat locations based on catch rates from previous WDFW rod-and-reel surveys. The coordinates of seven of these stations were adjusted in the fall of 2019 to avoid hazards and to align spring and fall stations in close proximity. Fishing locations span the entire Washington Coast, from the mouth of the Columbia River to the confluence of the Sekiu River with the Strait of Juan de Fuca, and include all coastal Marine Areas. Location depths are limited to under 40 fathoms, which includes the extent of the typical depth range for Black Rockfish and all locations where the WDFW rod-and-reel surveys have previously encountered Black Rockfish. All 125 of these fixed stations were scheduled to be surveyed in the spring of 2020 at the GPS locations defined in 2019.

The Black Rockfish spring survey is scheduled annually in March, April, and May. The start date for this survey is typically chosen as the day after the Washington recreational groundfish season opens to avoid any possible differences in catch rates due to varying fishing pressure before and after the season. To alleviate vessel availability constraints in the spring of 2020, however, one charter day was fulfilled on March 9th, before the season opened, at remote locations that are unlikely to be fished recreationally at any time during the survey season. Due to restrictions put in place to mitigate the COVID-19 pandemic, 2020 survey operations were terminated on March 23. Two stations in Marine Area 1 and 44 stations in Marine Area 2 were surveyed before the cessation of operations (**Error! Reference source not found.**4). The remaining 22 stations in Marine Area 2 and all 57 stations located on the northern Washington coast (Marine Areas 3 and 4) were not surveyed.

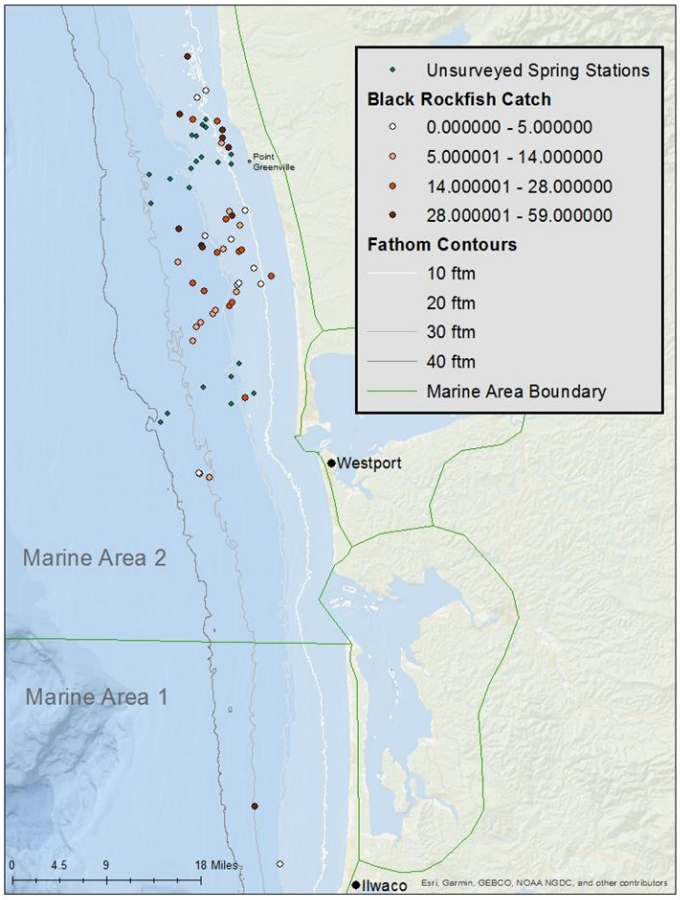

Figure 4. Spring index stations in Marine Areas 1 and 2 with the associated total catch of Black Rockfish in the spring of 2020 by number of individuals. "Unsurveyed Spring Stations" were scheduled but not surveyed in 2020.

Survey operations are conducted on recreational charter vessels staffed with five hired anglers and three to four WDFW scientific staff. All contracted skippers have at least eight years of professional captain experience fishing for rockfish on the Washington Coast, and each angler deployed has over 10 years of experience fishing for rockfish on the Washington Coast. Fishing rods, reels, and terminal tackle are kept consistent across all stations surveyed. Terminal tackle consists of two shrimp flies tied on a leader above a dropper weight, and leaders were pre-tied at specified lengths before the charter day to ensure consistency. The weight of sinkers used for each drift is chosen by the vessel's captain after taking into consideration depth and weather conditions but are kept consistent among anglers for each drift.

All fishing effort is conducted during daylight hours and charter days typically range from 8-11 hours. Cells to be visited on any given charter day are chosen before leaving port by the lead biologist after consultation with the vessel's captain and considering ocean conditions. Fishing effort at each station consists of four eight-minute fishing drifts that began within 50 yards of the station's GPS position. At each station, captains take time to scout for fish aggregations and hard

bottom/high relief areas near the station coordinates before setting up each drift. A fishing "drift" is defined as any consecutive time span that is spent fishing, beginning when the first angler's hook enters the water and ending when the last angler's hook leaves the water for any reason. Depending on weather conditions, the vessel either drifts or anchors over the target area, but vessel disposition is kept constant for each individual station. For recordkeeping purposes, each anchored fishing event is recorded as a drift.

Five anglers fish for the total fishing time at each station surveyed, and the same five anglers fish all stations each charter day. Before fishing begins at each survey station, anglers are randomly assigned to a standard fishing position on the vessel for all drifts at that station. These standard angler fishing positions are established on either the port or starboard side of the vessel, depending on the captain's preference, and are evenly spread out along the vessel from bow to stern.

For each drift, anglers start and end fishing at the same time but are allowed to retrieve their gear as many times as necessary during the drift to land catch or maintain gear. Individual angler times per drift are recorded as the total time hooks are in the water, which excludes any time that fishing gear is out of the water either to land a fish or work on the gear. Anglers are allowed to fish anywhere in the water column that they expected to catch the most fish, and captains are encouraged to describe the depths of fish aggregations to them.

Effort information collection includes station number, GPS location of the start and end of each drift, depth, disposition of vessel (anchored or drifting), drift speed and direction, number of anglers, total fishing time per station, and terminal tackle gear type. The intensity and direction of weather conditions including tide, wind, and swell are also recorded. Fishing time, catch by species, gear loss, and fishing depth (benthic or pelagic) are recorded by angler. Catch is identified to species, measured (fork length), and scanned for previously implanted tags. Fish that are not chosen for age structure sampling are released at capture location, with a descending device when necessary. Released Yelloweye Rockfish are tagged with both an internal PIT tag and an external Floy tag. Released China, Copper, Deacon, Quillback, Tiger, and Vermilion Rockfish, as well as Cabezon and Kelp Greenling, are tagged with a Floy tag and released.

Over 8 charter days in the spring of 2020, 46 stations were successfully surveyed in Marine Areas 1 and 2 before survey operations were canceled due to state and agency safety restrictions. Recreational fishing effort in the survey area, which is typically significant over the survey season, was abnormally low from self-imposed precautionary measures including the cancelation of all Westport charter trips after March 16th and many private anglers opting to stay home. Five to seven stations were surveyed each charter day dependent on the distance of target locations from port. Average drift speeds at each station ranged from 0 to .9 knots and all stations were fished while drifting. Total angler rod hours at surveyed stations ranged from 2.5 to 2.9.

Most stations that typically produce highly diverse catch are found in Marine Areas 3 and 4, which were not surveyed in 2020. Because of this, and the overall limited total fishing effort, the diversity of catch in the 2020 Black Rockfish survey was abnormally low. Seven different species were still encountered (**Error! Reference source not found.**), with Black Rockfish the most predominant species captured across both Marine Areas (**Error! Reference source not found.**). Other high-catch species included Lingcod and Canary Rockfish.

Table 1. Catch by number of all species per Marine Area and depth bin in the 2020 spring survey.

Species	Marine Area 1	Maring Area 2				Grand Total
	21-30 Fathoms	0-10 Fathoms	11-20 Fathoms	21-30 Fathoms	31-40 Fathoms	
Black Rockfish	38	195	288	257	1	779
Brown Irish Lord					1	1
Canary Rockfish			1	8	27	36
Deacon Rockfish				2		2
Kelp Greenling		1				1
Lingcod		3	11	18	4	36
Yellowtail Rockfish				8	2	10
Grand Total	38	199	300	293	35	865

Favorable ocean conditions and the early spring timing of the Black Rockfish Survey allowed the completion of 36.8% of the scheduled index sites in 2020 before COVID-19 restrictions were put in place that effectively ended the survey. The limited data collected are a viable portion of this survey's time series and will be available to groundfish stock assessors. However, some of the particular constraints of the survey year should be considered when interpreting this year's data, including the restricted geographic coverage and the historic species compositions and catch rates of unsurveyed stations relative to stations completed in 2020. The 2021 Black Rockfish Survey is scheduled to begin on March 10th with no significant changes to survey methods or station locations.

For more information about the Black Rockfish survey, please contact: Rob Davis (Robert.davis@dfw.wa.gov).

D. Coastal Nearshore Demersal Groundfish Rod and Reel Survey

The Demersal Groundfish Survey component of WDFW's multispecies nearshore rod-and-reel survey efforts is conducted annually in the fall. This survey describes relative changes in population abundances of Washington's nearshore demersal groundfish species that are typically found individually or in small groups directly on or near rocky substrate. The target demersal species include China, Copper, Quillback, Tiger, Vermilion, and Yelloweye Rockfish, as well as Kelp Greenling and Cabezon.

The locations of the Demersal Groundfish Survey span the Washington Coastal Marine Areas 2, 3 and 4, in depths from subtidal to 40 fathoms. Marine Area 1 has little known habitat containing demersal species and is not included in this survey. Similar to the Black Rockfish Survey, "stations" consist of a single GPS position at the center of rocky substrate. Sixty-four fixed stations were selected for the Demersal Groundfish Survey in the fall of 2019. Based on catch rates from previous WDFW rod-and-reel surveys, stations were selected to include both marginal and prime habitat locations for each target demersal species. All of these fixed stations were scheduled to be surveyed in the fall of 2020 at the locations defined in 2019.

Methods of the fall survey are identical to those described in the spring Black Rockfish Survey with a few key methodology changes to better represent demersal species. These adjustments include not targeting schools of fish in the water column; restricting all angler fishing effort to on or near the bottom; and changing the terminal tackle to salmon mooching rigs baited with white worms. All other data collection and fishing effort methods are kept consistent with the spring survey described above.

The Demersal Groundfish Survey was cancelled in 2020 as a result of the COVID-19 pandemic. This survey provides the only source of fishery-independent data on many of Washington's coastal nearshore groundfish species. For many of the demersal groundfish species that are the focus of this survey, sufficient life history or biological data is lacking, and little data exists to develop relative indices of abundance, making this research particularly critical. The data collected by this survey inform state and federal scientists in stock assessments, which in turn inform the status and management of multiple groundfish species. The absence of the 2020 data will likely increase scientific uncertainty in these groundfish assessments, although the effect of this loss will be somewhat mitigated with the continuation of this survey going forward. The 2021 Demersal Groundfish Survey is scheduled to occur in September and October with no significant changes to survey methods or design.

For more information about the Demersal Groundfish Survey, please contact: Rob Davis (Robert.davis@dfw.wa.gov).

E. Nearshore Coastal Pelagic Species Acoustic Trawl Methodology Survey of the California Current off Washington and Oregon

In 2019, the WDFW Marine Fish Science unit placed biologists onboard the F/V LISA MARIE in a collaborative survey conducted by the NOAA/Southwest Fishery Science Center (SWFSC), the West Coast Pelagic Conservation Group (WCPCG) – a commercial fishery industry coalition, and the WDFW. The work accomplished in 2019 was a continuation of a "proof of concept" study initiated by industry in 2017 to extend acoustic surveying and sampling of the coastal pelagic species (CPS) assemblage to the nearshore, complementing the offshore NOAA/SWFSC California

Current Ecosystem survey (CCES). The CCES acoustic trawl methodology survey conducted annually by the NOAA Southwest Fisheries Science Center (SWFSC) is a critical tool for understanding the abundance and distribution of Coastal Pelagic Species (CPS) such as Pacific Sardine, Northern Anchovy, Pacific Herring, Pacific Mackerel, Jack Mackerel, and mesopelagic fishes. The WCPCG had applied for a federal Saltonstall-Kennedy grant to continue and expand the effort in 2020; however, this survey was cancelled due to the COVID-19 pandemic. *For more information about the CPS survey, please contact: Lorna Wargo (Lorna.wargo@dfw.wa.gov).*

III. Fishery Monitoring

A. Puget Sound Port Sampling/Creel Surveys of Recreational Fisheries

Estimates are made for the recreational harvest of bottomfish, Pacific Halibut, salmonids, and other fishes caught in Puget Sound on an annual basis in Washington waters. Catch composition is estimated in two-month "waves" throughout the year via angler intercept surveys (i.e., creel sampling) and phone surveys. Staffing for angler intercept surveys, contracting of the phone surveys, and all estimation procedures are the responsibility of the Fish Program. *For more details, please contact Anne Stephenson (Puget Sound; Ann.stephenson@dfw.wa.gov) or Eric Kraig (estimation; Eric.kraig@dfw.wa.gov).*

B. Ocean/Coastal Port Sampling/Creel Surveys of Recreational and Commercial Fisheries

WDFW supports groundfish stock assessments and management of fisheries through multiple interrelated groups that collect and process biological and catch data: the Fish Program's Ocean Sampling Program, and the Coastal Marine Fish Science (CMFS) Unit's commercial fishery sampling group and recreational fishery sampling group.

Ocean Sampling Program for Recreational Fisheries – The Ocean Sampling Program (OSP) is responsible for catch estimation of ocean salmon and groundfish recreational fisheries. OSP uses port exit counts, primarily, and dockside angler interviews of recreational landings at Ilwaco-Chinook, Westport, La Push, and Neah Bay to track quota attainment for Chinook and Coho Salmon, and to estimate catch of groundfish species. In addition, dockside samplers collect biological and tag data from salmon, and length data from groundfish. *For more details, please contact Wendy Beeghley (Wendy.beeghley@dfw.wa.gov).*

CMFS Unit Commercial Fishery Sampling – Data on commercial groundfish, CPS, and Hagfish fisheries are collected by CMFS group technicians at all primary coastal ports: Westport, Ilwaco, Chinook, Bellingham, Blaine, Neah Bay, and La Push. The commercial sampling team has two major objectives: (1) to collect biological data – such as sizes, otoliths, and gonads – from commercially landed groundfish to support research and stock assessments; and (2) to collect

groundfish catch data via commercial fisheries logbooks, fish receiving tickets, and species composition sampling of mixed-species market categories, which support fisheries monitoring and in-season management decision making.

The CMFS Unit produces periodic reports intended to inform fishery managers and fishery assessment authors by describing the biological and catch data collection methods and an inventory of data collected. Descriptions of port and fishery dynamics offer context for the changes to data collection methods. Collectively the series of reports serve to document changes in fishery monitoring and sampling goals, and approaches and procedures in response to evolving fishery management science and management needs. The most recent report, published June 2020, summarizes activities and accomplishments from 2015 through 2018 (Downs et al. 2020).

References cited

Downs, D., K. Hinton, J. Fuller, T. Zepplin, K. Lawson, L. Wargo, T.S. Tsou. 2020. Washington Coastal Commercial Groundfish Fisheries Monitoring Program: Progress Report 2015-2018. Washington Department of Fish and Wildlife. Fish Program Report Number FPA 20-07.

The CMFS Unit also monitors commercial coastal pelagic fishery landings in support of stock assessments and fishery management at Ilwaco and Westport. The only active fishery during the reporting period was the baitfish fishery, which harvests Northern Anchovy from the northern subpopulation (NSNA) distributed off Washington, Oregon, and northern California coasts. The NSNA are subject to management under the Pacific Fishery Management Council Coastal Pelagic Species Fishery Management Plan. NSNA have never been formally assessed, primarily due to the extremely low level of catch; thus, the status of the subpopulation is unknown. Biological sampling of landings was started in 2014 to provide time series data for potential assessment in the future as the need arises. Samples of 100 fish are collected weekly during the fishery season (roughly May to September). Fewer samples were collected in 2020 due to reduced fishing activity associated with the COVID-19 pandemic. Table 2 presents an inventory of the number of fish sampled and data collected as annual mean weight and length.

Table 2. An inventory of biological data and annual mean weight and length for Northern Anchovy sampled in the coastal bait fish fishery.

Year	Number sampled Length/Weight/Maturity	Number Aged	Mean Weight (g)	Mean Length (mm)
2015	1150	129	23	129
2016	1126	649	20	118
2017	931	929	14	111
2018	950	792	15	114
2019	1799	1790	16	112

2020	500		13	106

CMFS Unit Recreational Fishery Sampling – The CMFS Unit's recreational groundfish sampling program (RGSP) has two major objectives. The primary objective is to scan recreational groundfish catch at Westport in order to recover tag information and biological data from fish tagged and released during at-sea surveys. The secondary objective of the RGSP is to directly support research and stock assessment by collecting biological data from untagged recreationally caught groundfish species at La Push and Neah Bay. This biological information enhances data collection efforts of the WDFW Ocean Sampling Program previously described.

IV. Reserves

Marine Reserve Monitoring and Evaluation – Due to changes in program priorities and staffing limitations brought on by intensive ROV survey work since 2011, very little directed monitoring of marine protected areas and reserves has occurred in Puget Sound in recent years, with the exception of the synthesis report of LeClair et al (2018). No monitoring activities were conducted in 2020; however, the PSMFS Unit is currently collaborating with the Seattle Aquarium and Point Defiance Zoo and Aquarium to resume dive surveys in 2021/22.

References Cited

LeClair, L., R. Pacunski, L. Hillier, J. Blaine, and D Lowry. 2018. Summary of findings from periodic scuba surveys of bottomfish conducted over a sixteen-year period at six nearshore sites in central Puget Sound. Washington Department of Fish and Wildlife Technical Report. Olympia, WA. FPT 18-04. 189 pp.

V. Review of Agency Groundfish Research, Assessment, and Management

A. Hagfish

The Washington Hagfish Commercial Fishery, which opened in 2005 under developmental regulations, is small in scale, exporting hagfish for both frozen and live-fish food markets in Korea. Hagfish are caught in long-lined barrels constructed from olive oil or pickle barrels modified with an entrance tunnel and dewatering holes (Figure 5). Fishing occurs on soft, muddy habitat along the entire outer coast of Washington and northern Oregon. The fishery operates, by rule, only in offshore waters deeper than 50 fathoms and is open access. Licensed Washington fishers can fish federal waters off of Oregon and land catch into Washington. Live hagfish vessels typically fish grounds closer to their homeports, while at-sea freezing allows some vessels to fish further afield.

The fishery predominantly catches Pacific Hagfish, but Black Hagfish are landed incidentally. A few trips attempting to target Black Hagfish were successful in the recent past, and a small-scale market is developing for the frozen product. Pacific Hagfish predominate from 50-80 fa, while Black Hagfish have been targeted with deeper sets, up to 300 fa; Pacific and Black Hagfish ranges

appear to overlap between 80 and 100 fathoms. Currently, however, fish ticket landing data cannot distinguish between species, as only one species code exists. The median CPUE is about 4.5 pounds, but instances of high CPUE are not uncommon, as evidenced by reports of "plugged" barrels.

Biological sampling data collected from Pacific and Black Hagfish consist of length, weight, maturity, and egg counts for females at maturity stages 4 through 7; however, only Pacific Hagfish data are reported here. Male and female hagfish present similar size distributions (Figure 6). The largest specimen sampled was a 67-cm female, and the smallest a 24-cm specimen, sex unknown. An evaluation of maturity suggests year-round spawning. Fecundity is low, with the number of eggs in females at maturity stages 6 & 7 (Table 3) averaging 25 eggs per female. Few females with developed eggs have been sampled; the 2017-2020 sample contained 13% mature females.

Management of the fishery is challenged by a lack of life history information, partial fishery controls, and high participant turnover. Active fishery monitoring and sampling began in 2009. Due to limited agency resources, only fishery-dependent data programs – including logbooks, fish receiving tickets, and biological sampling of catch – have been developed to inform management. Efforts have been undertaken to refine and improve these programs, including improving systematic sampling, developing species composition protocols, and shifting to use the maturity scale developed by Martini (2013). Interest remains in conducting a study similar to research completed in California to evaluate escapement relative to barrel dewatering-hole size, but funding sources have not yet been identified.

For more information about the Hagfish fishery, please contact: Lorna Wargo (Lorna.wargo@dfw.wa.gov).

Figure 5. Barrels used in the WA commercial hagfish fishery.

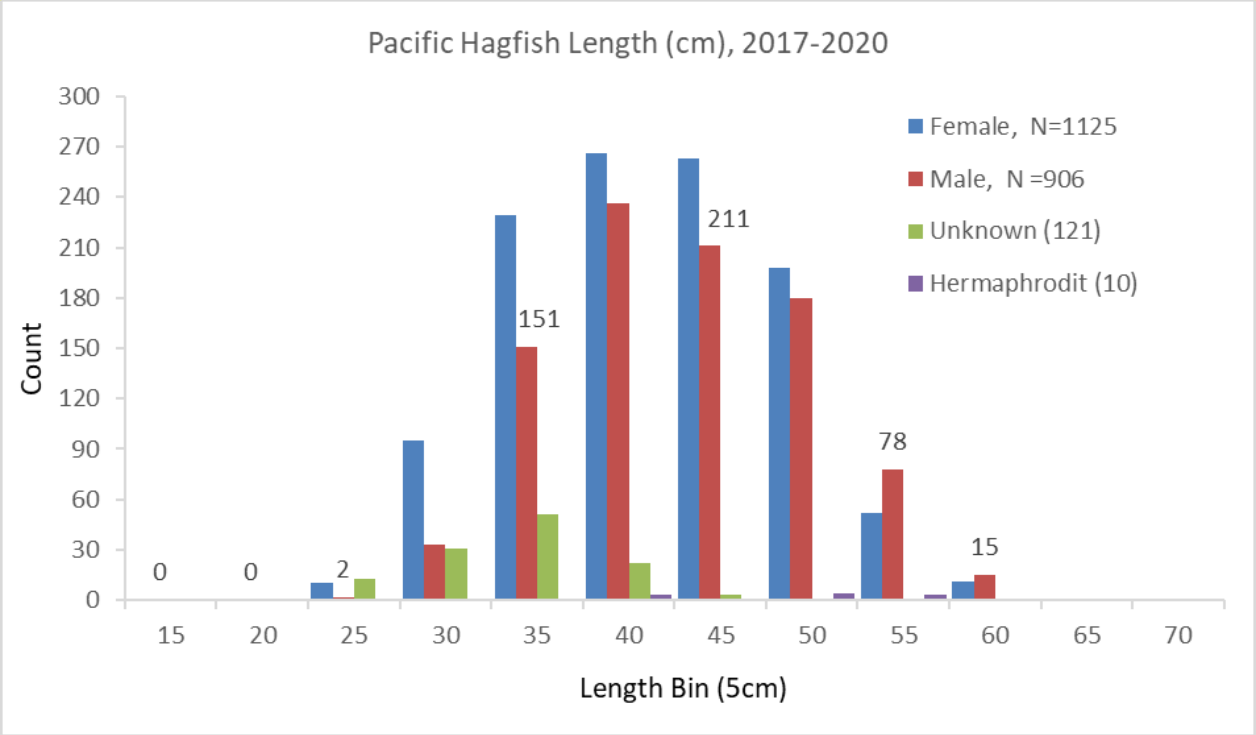

Figure 6. Length (cm) of male and female Pacific hagfish, 2017-2020.

Table 3. Average egg count per mature female Pacific Hagfish collected from Washington landings during 2017-2020.

Pacific Hagfish	Sample Count	Egg count minimum	Egg count maximum	Egg count average
Maturity stage 6	129	9	49	25
Maturity stage 7	16	5	39	19
Total	145			25

B. North Pacific Spiny Dogfish and other sharks

No specific, directed research or management to report. Spiny Dogfish are regularly seen in ROV videos and caught in the Puget Sound Bottom Trawl Survey, where they are counted, weighed, and measured; a tissue plug for genetics is also taken from select individuals. Other shark species occasionally encountered include Brown Catsharks and Sixgill Sharks.

C. Skates

No specific, directed research or management to report. Longnose and Big Skates are regularly seen in ROV videos and caught in the Puget Sound Bottom Trawl Survey, where they are counted, weighed, and measured. Sandpaper skates are also occasionally encountered.

D. Pacific Cod

No specific, directed research or management to report. Pacific Cod are regularly caught (primarily in the Strait of Juan de Fuca) in the Puget Sound Bottom Trawl Survey, where they are counted, weighed, and measured; otoliths for age analysis are also taken from moribund individuals.

E. Walleye Pollock

No specific, directed research or management to report. Walleye Pollock are regularly seen in ROV videos and caught in the Puget Sound Bottom Trawl Survey, where they are counted, weighed, and measured. Rough population estimates are produced as part of the survey analysis.

F. Pacific Whiting (Hake)

No specific, directed research or management to report. Pacific Hake are regularly seen in ROV videos and caught in the Puget Sound Bottom Trawl Survey, where they are counted, weighed, and measured. Rough population estimates are produced as part of the survey analysis.

G. Grenadiers

No specific, directed research or management to report.

H. Rockfishes

Research: ROV Studies of Yelloweye Rockfish in the greater Puget Sound/Georgia Basin DPS – The PSMFS Unit completed a two-year survey of the U.S. portion of the Yelloweye Rockfish and Bocaccio DPSs in January 2017 (see previous TSC reports for preliminary results). Survey stations where Yelloweye Rockfish were observed were prioritized to enable a population estimate for the species to be made as soon as possible. No Bocaccio were encountered at any survey station, though four fish were noted during "exploratory" deployments. Video review of these transects is on-going, with most of the remaining videos containing few or no fish of interest.

In March and April of 2018, the WDFW conducted a three-week survey in a portion of the Yelloweye Rockfish and Bocaccio DPSs lying in **Canadian waters of the Gulf Islands** within the southern Strait of Georgia. The goals of this survey were to: 1) estimate the population size of Yelloweye Rockfish (and Bocaccio as possible) within the survey area; and 2) utilize a stereo-camera system to collect accurate length information of Yelloweye Rockfish, which is needed for the length-based spawner-per-recruit (SPR) model that will be used as a basis for tracking recovery of the species per the conditions of the federal Recovery Plan. The survey was designed using the same Maximum Entropy (MaxEnt) modelling approach as the 2015-16 Puget Sound survey. The model was developed by Bob Pacunski with data provided by Dana Haggarty (DFO Canada). Funding for the survey was provided by NOAA (Dan Tonnes). A total of 64 transects were completed over 13 sampling days. Yelloweye rockfish were scarce in the southern portion of the survey area, but encounters increased as sampling moved northward. At least 57 Yelloweye

rockfish were identified during video review, but no Bocaccio were observed during the survey. Video review has been completed, and the data are undergoing final QA/QC prior to analysis.

In August 2018, the WDFW conducted a three-week survey of the **San Juan Islands**, which lies within the US portion of the DPSs for Bocaccio and Yelloweye Rockfish, with a total of 60 transects completed over 13 sampling days. This survey had the same goals and sampling design as the survey of the Canadian Gulf Islands and was meant to facilitate cross-border comparisons of rockfish prevalence and size distribution. Consistent with previous ROV surveys of the San Juan Islands in 2008 and 2010, Yelloweye Rockfish were seldom encountered, with only 14 fish observed on 9 transects. Canary rockfish were rarely encountered in the 2008 and 2010 surveys, but 33 fish were seen on eight transects in the most recent survey. No Bocaccio were seen in this survey. Video review has been completed and the data are undergoing final QA/QC prior to analysis.

In October 2018, the WDFW partnered with DFO Canada to conduct a 14-day survey of the **Canadian waters of southern and central Strait of Georgia**. This survey utilized the WDFW-owned ROV deployed from the 40-m long Canadian Coast Guard Ship *Vector*. The primary goals of this survey were to 1) evaluate densities of "inshore rockfish," as defined by DFO, inside and outside established Rockfish Conservation Areas; and 2) use a stereo-camera system to obtain length measurements of Yelloweye Rockfish that will be used in population recovery models. This survey was also designed based on the results of a MaxEnt habitat suitability model. The majority of stations were randomly assigned to High probability polygons inside and outside of selected RCAs, but in some cases it was necessary to hand-place stations due to a lack of matching habitat outside of an RCA. A total of 85 transects were completed in 14 survey days. The habitat in this survey was characterized by high densities of sponges, which provided a highly complex and crevice-rich environment utilized by several rockfish species. In contrast to the previous two surveys, Yelloweye Rockfish were commonly encountered, with over 200 fish of all sizes observed during the survey. No Bocaccio were observed. Reviews of the transect videos were completed in early 2020, and those data have been passed off to DFO along with the associated tracking data for analysis.

In August 2019 the WDFW PSMFS unit initiated an ROV survey focused on benthic rockfishes, Lingcod, and Kelp Greenling within the **interior marine waters of Washington** using a two-stage survey design. Within the Yelloweye Rockfish and Bocaccio DPSs, the survey design was based on the results of a MaxEnt habitat suitability model. Due to a lack of reliable bathymetry coverage for the waters of the Strait of Juan de Fuca west of the western DPS boundary, the MaxEnt approach could not be implemented, and the survey design was based on an evaluation of known and suspected habitats identified during previous drop-camera and ROV surveys. After 450 stations were randomly selected (Figure 8), the survey began on August 6 but was suspended on September 26th due to an equipment failure on the support vessel *R/V Molluscan*. Because the WDFW was already in the process of purchasing a replacement vessel for the *Molluscan*, they opted not to

replace the failed equipment in order to apply those funds to the purchase of the new vessel. The new vessel, the *R/V Salish Rover* (Figure 7), was acquired in December 2019, with retrofitting and needed maintenance completed in June 2020. Due to the COVID-19 pandemic, WDFW protocols prevented the survey from restarting until November 2020, but equipment problems with the ROV system and poor weather conditions only allowed for several days of sampling to be conducted in November and December 2020. Four days of sampling were conducted in February 2021, 10 days were conducted in March, and 4-12 more days of sampling are slated for May-June. Given the delays and setbacks to the survey schedule, the PSMFS Unit has revised and narrowed the scope of the survey to focus on only those stations inside of Admiralty Inlet (Figure 9).

Figure 7: WDFW's new vessel for ROV (and other) operations, the R/V *Salish Rover*. The "*Rover*" is 58 feet long and has a full galley, settee area, head, and 3 staterooms with 2 bunks each.

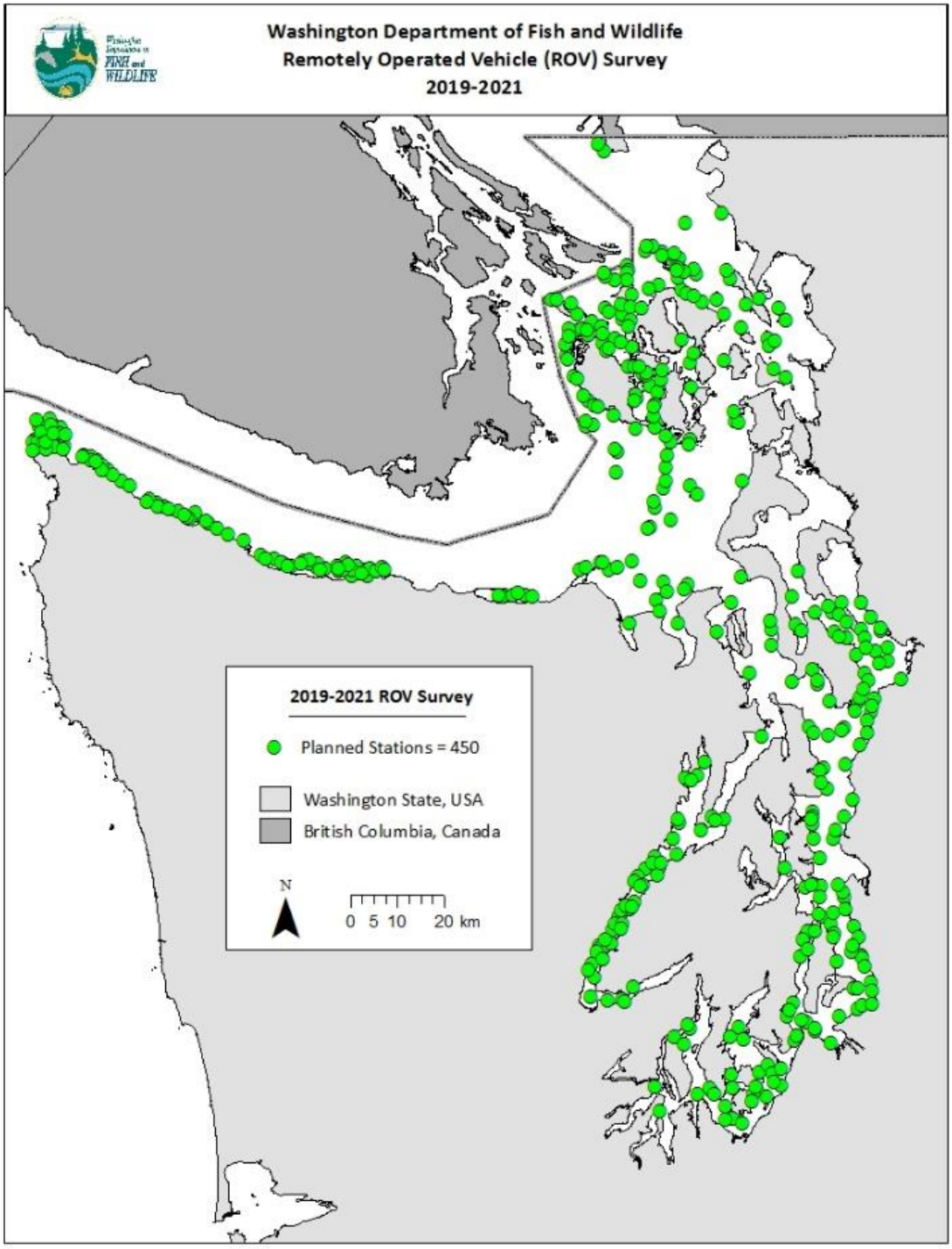

Figure 8. Randomly selected stations (n=450) for the 2019-21 ROV survey. Stations all far within the highly suitable stratum predicted by the MaxEnt model based on prior ROV survey data.

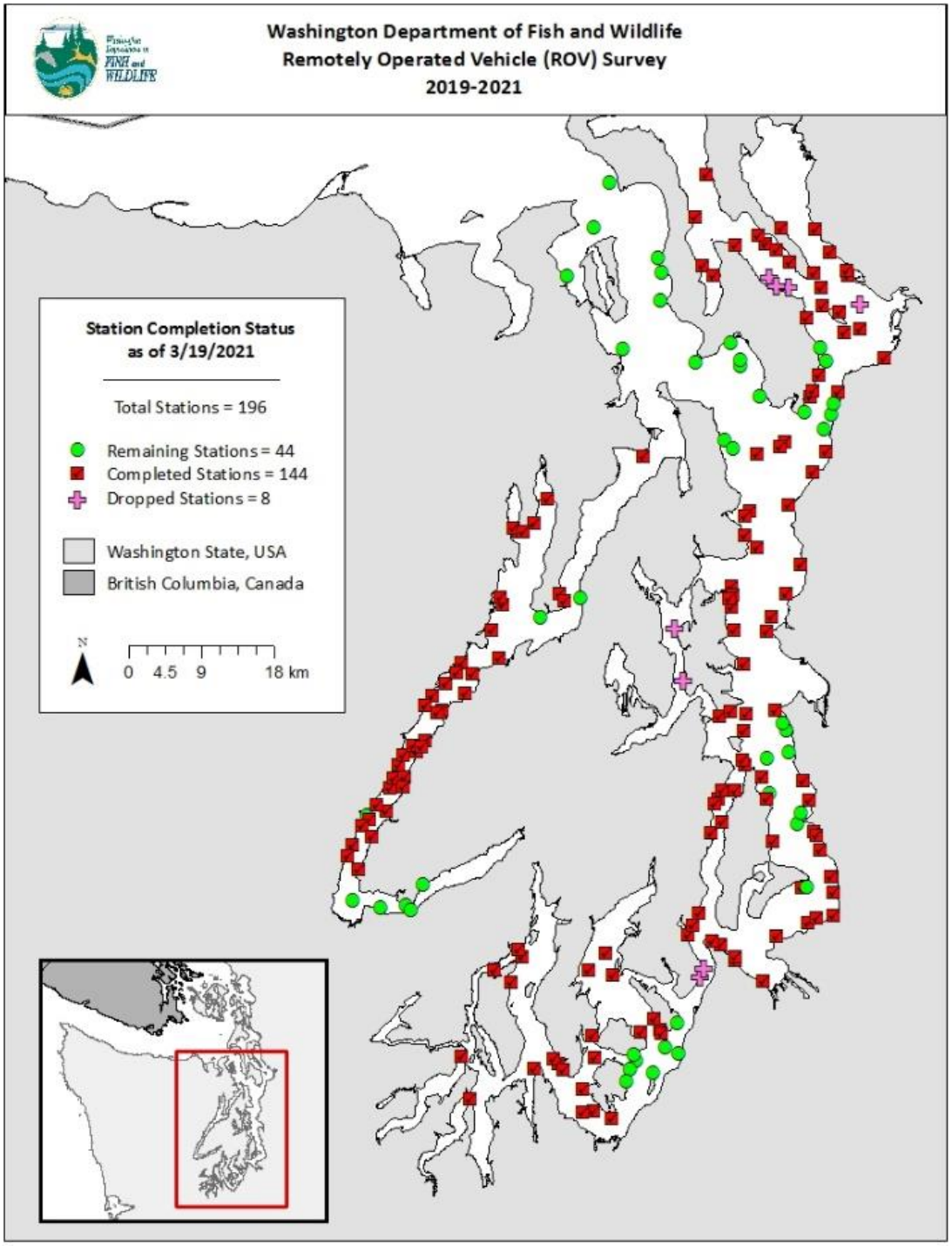

Figure 9. Revised scope of the 2019-2021 ROV survey due to scheduling setbacks from COVID-19 and the new vessel acquisition. Station status is current as of 3/19/2021.

Management – In 2012, NOAA issued a 5-year incidental take permit (ITP) to WDFW that provided for a limited take of ESA-listed rockfish in Puget Sound recreational fisheries and commercial shrimp trawls. Renewal documents were submitted to NOAA in mid-2016, which included an additional request for take coverage in the recreational and commercial shrimp pot fisheries, but due to a disagreement with NOAA resulting from a change in fishery regulations in the Pacific Halibut fishery that allowed for take of lingcod within the DPSs that could potentially impact listed rockfish, the permit review process was halted until the disagreement was resolved in late 2019. However, since the submission of the renewal documents in 2016, a new recreational shrimp fishery has emerged that requires updating the Fishery Conservation Plan that accompanies the ITP application. The FTP is now being updated by the WDFW Shellfish unit and will be resubmitted to NOAA in the near future.

For more details on the ROV program, please contact Bob Pacunski (Robert.pacunski@dfw.wa.gov).

I. Thornyheads

No specific, directed research or management to report.

J. Sablefish

No specific, directed research or management to report. While Sablefish used to be caught regularly – albeit in small numbers – in the Puget Sound bottom trawl survey, they were not encountered from 2011-2016, despite the annual survey efforts. Starting in 2017, however, the survey has begun to encounter them again: 8 were caught in 2017, 2 in 2018, and 8 in 2019.

K. Lingcod

Lingcod Age Structure Processing Lab – The Coastal Marine Fish Science Unit processes lingcod fins collected from Washington (coastal and Puget Sound) commercial and recreational fisheries, and periodically Oregon fisheries by contract. Lingcod fins are processed for ageing using the fin cross-section method. The process includes four steps: drying, gluing, sectioning, and mounting. Each dried and glued fin is secured in a sectioning saw (Beuhler Isomet 1000), and seven to ten cross-sections (2.0 mm) are cut. The sections are mounted onto microscope slides with Cytoseal, dried for at least 24 hours, and sent to age readers. Sectioned fins are aged using the surface-read method. During the reporting period, the lab processed 6,500 fins.

Formal Stock Assessment in Puget Sound – Over the past several years concerns have been raised by the public about Lingcod populations within Puget Sound, especially in the San Juan Archipelago and Central Puget Sound off Edmonds. Specifically, some constituents are concerned that the current management regime is not protective enough, as legal-sized fish (26-36”) are hard to find after only a few weeks into the six-week season (May 1 – June 15). Though declining trends in CPUE are apparent in some regions, the issue seems largely to be a result of increased fishing

pressure/effort, especially near urban centers, since 2010. In addition to the slot limit and short season noted above, the daily bag limit is one fish per angler and fishing is not allowed deeper than 120' to reduce barotrauma impacts on rockfish. The WDFW considers this a highly conservative management regime.

The WDFW has completed an evaluation of Lingcod populations using a Stock Synthesis model, which is a size- and age-structured population assessment tool. This type of model is commonly used for coastal fisheries and is data intensive. The model structure for Puget Sound Lingcod utilizes commercial and recreational landings, length frequency data, age data, and catch-per-unit-effort data to evaluate historic and current trends in the population. When finalized, managers will be able to use the output from the Stock Synthesis model to inform management decisions for Lingcod in Puget Sound. Finalization of the report is expected in fall 2021.

Pre-season Lingcod Rod-and-Reel Test Fishing Survey– In April 2019, the PSMFS Unit conducted a four-day test fishing survey targeting Lingcod in Marine Catch Area 7 (San Juan Islands) prior to the opening of the recreational Lingcod fishing season. This was a pilot study with a primary goal of obtaining basic catch per unit effort (CPUE) and length frequency data for Lingcod under simulated recreational fishery conditions for potential use in a Puget Sound Lingcod stock assessment, and to evaluate the claim made by several recreational anglers that "no more legal sized fish are around." Secondary goals included documenting bycatch and obtaining genetic samples from select fish species to inform demographic models of Puget Sound bottomfish. A second, more comprehensive pre-season survey that included additional sites in Central and Sound Puget Sound was planned for April 2020 but was prevented due to the COVID-19 pandemic. This effort is slated to resume with an April 2021 survey.

L. Atka mackerel

No specific, directed research or management to report.

M. Flatfishes

No specific, directed research or management to report. Several species of flatfish are regularly seen in ROV videos, and eighteen species have been caught in the Puget Sound Bottom Trawl Survey, where they are counted, weighed, and measured. Rough population estimates are produced as part of the survey analysis. The most dominant flatfish species throughout Puget Sound is English Sole, which has been encountered at all depths and in all regions; the 2019 trawl survey estimate for English Sole throughout Puget Sound was 11,500 mt.

N. Pacific halibut & IPHC activities

Sampling Directed Halibut Landings – The 2020 2A Pacific Halibut Non-Tribal Directed Commercial Fishery consisted of 58-hour fishing periods (beginning at 0800 on Monday thru 1800 on Wednesday) starting the 4th week in June and occurring every two weeks until the quota was

attained. There was a total of five openers in 2020, beginning on June 22nd and closing on August 19th. The CMFS Unit was asked by the International Pacific Halibut Commission (IPHC) to assist in collecting dockside Pacific Halibut samples for the 2020 fishery. The IPHC typically provides samplers for each directed halibut opener, but due to strict COVID-19 protocols and staff shortages, they were unable to provide samplers for landings in the southern Washington ports. The CMFS Unit provided sampling coverage for three of the five openers at the ports of Ilwaco and Chinook. Biological data consisting of length, weight, otoliths, and fin clips were collected following the IPHC sampling protocols, and a total of 114 fish were sampled.

O. Other groundfish and forage fish work

Anchovy – Northern Anchovy (northern subpopulation) fisheries in Washington are conducted to provide live bait for recreational and commercial fisheries, and packaged bait for retail to recreational fishermen. Distinguished by gear type, fisheries for anchovy include a lampara-gear fishery and a seine-gear fishery. The lampara-gear fishery is primarily comprised of Albacore Tuna fishers that catch and hold anchovy in onboard live-wells to meet their own bait needs. The purse-seine fishery harvests and holds live bait in dockside net pens for retail sale to recreational and commercial fishers. The fishery occurs in federal waters (3-200 miles), inside three miles (state waters) on the southern Washington coast, as well as within the estuaries of Grays Harbor and Willapa Bay, and in the lower Columbia River. Participation in the fishery is not limited. The northern subpopulation of Northern Anchovy has never been formally assessed through a model-based method, as historically the WDFW did not monitor baitfish landings. To build a time series in support of potential assessment, in 2014 the CMFS Unit began monitoring the commercial baitfish fishery at both Westport and Ilwaco, although the majority of sampling occurs at Westport. An inventory of samples collected and mean length and weight data are presented in Table 4. More complete reporting of these data can be found in an agency technical report in process (contact Lorna Wargo for details).

Table 4. Number of samples, number aged and mean weight and length of Northern Anchovy sampled from the commercial baitfish fishery, 2015 – 2020.

Year	Number sampled Length/Weight/Maturity	Number Aged	Mean Weight (g)	Mean Length (mm)
2015	1150	129	23	129
2016	1126	649	20	118
2017	931	929	14	111
2018	950	792	15	114
2019	1799	1790	16	112
2020	500		13	106

Pacific Sand Lance Genetic Research – Together with partners at the NWFSC, Shoreline Community College, Sea Doc Society, Washington State DNR, North Pacific Research Board, and UW's Friday Harbor Labs, members of the PSMFS Unit and MFF Unit are working to investigate regional variation in population structure of Pacific Sand Lance. Samples have been collected from the San Juan Archipelago, Eagle Harbor (Bainbridge Island), and Nisqually River Delta thus far, and additional collections are planned. Fish have been obtained via beach seining and digging on mud flats during low tide. Thus far, amplification of the DNA has gone well, and is being overseen by the Shoreline Community College molecular genetics lab. Results currently show no population differentiation at any observable geographic scope. Further analysis and processing of additional samples will require additional funding that has not yet been secured.

Smelt – While there are no estimates of biomass or established indices of abundance for smelt in Puget Sound, there are both commercial (purse seine) and recreational (dip net, jigging) fisheries that primarily target surf smelt. Since 2014, the recreational fishery has been limited to the hours between 6am and 10pm, has been open only five days a week, and has a daily bag limit of 10 pounds per person. The commercial fishery has also been limited to the hours between 6am and 10pm, has been open only four days a week, has region specific seasons and closures (Figure 10), and has had an annual quota of 60,000 pounds that is reset on January 1 of each year. Since the commercial quota was established in 2014, it has been reached – and the fishery subsequently closed – by mid-October each year. The only exception to this was in 2020 when the quota was not reached, and the total landings for the year was only 30,876 pounds. This decrease in landings is most likely due to reduced demand due to the COVID-19 pandemic and the departure of one of the primary commercial harvesters.

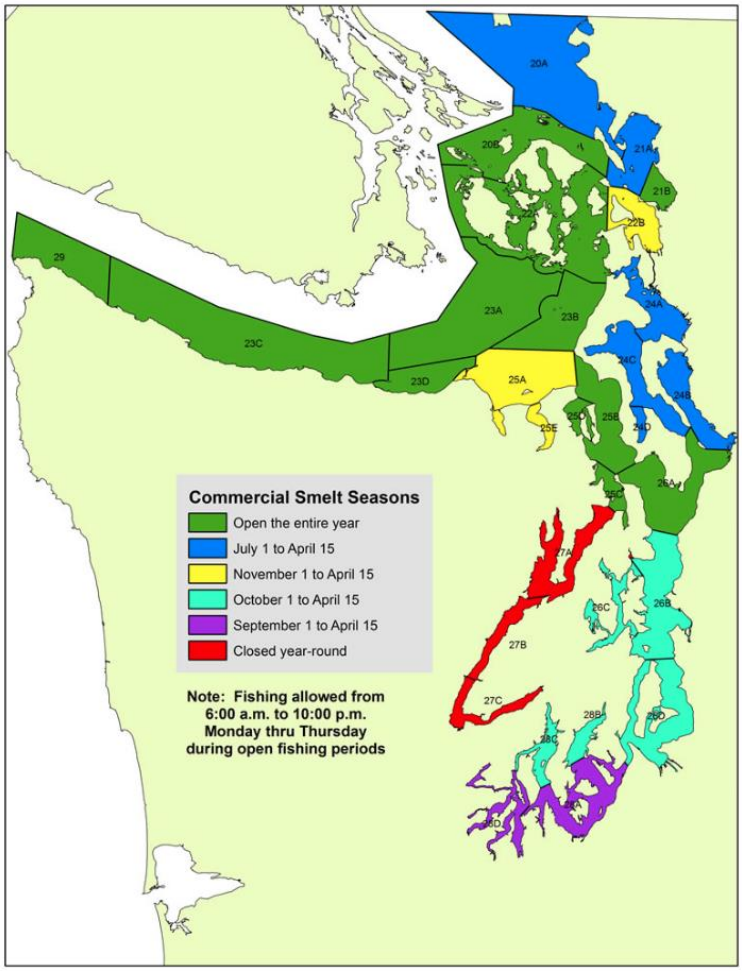

Figure 10: Map of commercial smelt fishery management regions and respective season openings.

Historical Groundfish Fishery Compendium and Catch Reconstructions – Understanding and quantifying the historic fishery removals from a stock is essential to generating a time series of these data, which is, in turn, a crucial input to a variety of stock assessment methods and catch-based management approaches. Estimating population-specific removals is exceptionally hard, though, especially for periods with limited record keeping, aggregation of species into market categories, and aggregation of catch by outdated or poorly described geographic area. Sampling protocols, fishery diversity, catch versus landing location, dead discards, and species identification are significant additional complications that vary across time and space, and for which the level of reporting detail can vary widely.

Given that many groundfish stocks are distributed coast-wide and a complete time series of removals is needed, there is a need to coordinate approaches across the states of Washington, Oregon, and California to confront removal reconstruction challenges and establish common practices. Both California and Oregon have attempted historical removal reconstructions and continue making necessary revisions. Washington's first attempt in reconstructing commercial

landings for Lingcod and rockfish market categories was completed to support 2017 PFMC groundfish stock assessments. Efforts are continuing to reconstruct flatfish catch histories. At least one report detailing data sources and analytical assumptions, and one report providing details on the history of fishery technology and prosecution, are expected to be completed in the next year. Additionally, significant progress has been made on a report documenting the history of the fishery, fishing technology, and harvest patterns for groundfish in Puget Sound. A definitive compendium on the topic is anticipated to be complete by the end of 2022.

VI. Ecosystem Studies

Puget Sound Ecosystem Monitoring Program (PSEMP) update – The Toxics-focused Biological Observation System (TBiOS) team at WDFW has been conducting regular status and trends (S&T) monitoring of toxic contaminants in a wide range of indicator species in Puget Sound, including assessments of health effects on biota, since 1989. TBiOS' most recent regular S&T monitoring includes assessments of English sole (a benthic indicator) in 2015, 2017, and 2019, and Pacific Herring (a pelagic food-web indicator) in 2016, and 2018, and 2020. In addition, TBiOS recently conducted a large-scale assessment of contaminants in winter adult Chinook Salmon (i.e. Blackmouth) from sport fisheries in seven marine areas of Puget Sound (winter 2016/17). Data from the English Sole, Pacific Herring, and Blackmouth studies are summarized online at the Puget Sound Partnership's Toxics in Fish Vital Sign website. The Toxics in Fish Vital Sign is a communication tool that helps distill TBiOS' complex contaminant monitoring information into usable metrics for ecosystem recovery managers.

In addition to benthic and pelagic indicator species, TBiOS has recently adopted two new indicators for assessment of contamination in the nearshore environments of Puget Sound. To ascertain the effects of contaminants on the early life-stages of salmon, TBiOS conducted two assessments (2016 and 2018) of juvenile Chinook Salmon from 12 major rivers and deltas of Puget Sound. In addition, TBiOS recently adopted mussels as a nearshore indicator and has conducted four, Puget Sound-wide assessments of contaminants using transplanted (i.e. caged) mussels over the winters of 2012/13, 2015/16, 2017/18, and 2019/20. TBiOS has secured long-term funding to conduct regular nearshore contaminant surveys with these species into the future.

TBiOS has also conducted a number of special studies, including an account of PBDE (flame retardants) contamination in seaward-migrating juvenile Chinook Salmon in the Snohomish River, linking the contamination with a wastewater effluent source. Publications and reports for a number of these studies are available at the TBiOS list of publications website, as well as at the aforementioned Toxics in Fish Vital Sign website. *For additional details on TBiOS research regarding toxic contaminants in Puget Sound biota, contact Jim West (james.west@dfw.wa.gov).*

United States Navy Drydock Salmon Entrainment Study – Puget Sound Naval Shipyard at Naval Base Kitsap Bremerton (NAVBASE Bremerton) contains six extensive dry docks that are used to clean, inspect, and service ships ranging from small submarines to aircraft carriers (Figure 11). These dry docks are completely man-made and are episodically flooded to move ships in and out of them. Prior sampling for salmonids at NAVBASE Bangor has shown that a variety of groundfish may also entrained during these operations, though no ESA-listed rockfish were encountered. Fish that are entrained may be killed when passing through the inflow/outflow turbines, consumed by birds during dewatering, or left to die after dewatering is complete. While some salvage efforts do occur, they are infrequent and poorly documented.

In January 2020 the PSMFS Unit was contracted to conduct a salmon entrainment study in the drydocks at NAVBASE Bremerton. Although salmon are the primary focus of the study, data will also be collected on other entrained fish species. At the time of this reporting, four sampling events have been conducted in three drydocks; DD5 was sampled on 03 June 2020, DD3 was sampled both on 02 September 2020 and 18 September 2020, and DD6 was sampled on 09 March 2021.

In total, 38 Chinook and 4 Coho have been encountered. The majority of these salmon have been juveniles, with a median length of 165 mm; however, the overall range in lengths is 80-620 mm. Of the Chinook, 13 were hatchery-origin while 25 were wild. Every effort was made to release all salmon quickly and alive. A secondary target species group after salmonids is forage fish, of which 3 primary species have been encountered: Northern Anchovy, Pacific Herring, and Pacific Sand Lance. Of these, Pacific Herring have been the most numerous and frequently encountered species, as they have been present in each of the sampling events thus far, ranging vastly in total counts: 130 fish were caught in DD5 on 6/3/20, 39 in DD3 on 9/2/20, an estimated almost 19,000 in DD3 on 9/18/20, and 125 in DD6 on 5/6/21. Other species regularly encountered include a variety of sculpins and perch, as well as a few flatfish and rockfish (non-ESA) species. At least four more sampling events should occur before the end of the contract period in February 2022.

For more details on the Naval Dry Dock survey, please contact Jen Blaine (Jennifer.blaine@dfw.wa.gov).

Figure 11: Locations of the six service dry docks at Naval Base (NAVBASE) Bremerton on the Kitsap Peninsula in central Puget Sound.

VII. Publications

In 2020-21 staff of the MFS Unit published the documents indicated below.

Blaine, J., D. Lowry, and R. Pacunski. 2020. 2002-2007 WDFW scientific bottom trawl surveys in the southern Salish Sea: species distribution, abundance, and population trends. Fish Program Technical Report No. 20-01. Washington Department of Fish and Wildlife, Olympia, WA. 237 pp.

Burger, M., T. Sandell, C. Fanshier, A. Lindquist, P. Biondo, and D. Lowry. 2020. Findings of the 2016-17 southern Salish Sea acoustic mid-water trawl survey. Fish Program Technical Report No. 20-03. Washington Department of Fish and Wildlife, Olympia, WA. 48 pp.

Davis, R., and L. Wargo. 2020. Enhanced Sampling of the Washington Coast Recreational Groundfish Fishery 2014-2017. Washington Department of Fish and Wildlife. Technical Report No. FPT 20-05.

Downs, D., K. Hinton, J. Fuller, T. Zepplin, K. Lawson, L. Wargo, T.S. Tsou. 2020. Washington Coastal Commercial Groundfish Fisheries Monitoring Program: Progress Report 2015-2018. Washington Department of Fish and Wildlife. Fish Program Report Number FPA 20-07.

Lowry, D, R. Pacunski, E. Kraig, V. Tribble, and T.S. Tsou. 2020. Conservation Plan for reducing the impact of selected fisheries on ESA-listed species in Puget Sound, with an emphasis on

bocaccio and yelloweye rockfish. Washington Department of Fish and Wildlife, Olympia, WA. 100 pp.

Pacunski, R., D. Lowry, J. Selleck, J. Beam, A. Hennings, E. Wright, L. Hillier, W. Palsson, and T.S. Tsou. 2020. Quantification of bottomfish populations, and species-specific habitat associations, in the San Juan Islands, WA employing a remotely operated vehicle and a systematic survey design. Washington Department of Fish and Wildlife. Technical Report No. FPT 20-07.

VIII. Conferences and Workshops

In 2020-21, staff of the MFS Unit presented at, participated in research presented at, and/or arranged symposia at, several regional scientific meetings, and education/outreach events, as indicated below. Most meetings and events were cancelled due to the COVID-19 pandemic.

PFMC ROV Survey and Statistical Methods Review Panel. Santa Cruz, CA, February, 2020. Theresa Tsou (panel member), Bob Pacunski (panel member), and Dayv Lowry (invited observer) attended.

IX. Complete Staff Contact Information

WDFW permanent marine fish management and research staff include (updated 4/2021):

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