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Washington Review of Commercial Fisheries 2014-2015 Sardine and Mackerel and 2014 Anchovy

by Lorna Wargo and Kristen Hinton

Washington Department of Fish and Wildlife
Fish Program
Fish Management

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Review of Commercial Fisheries

2014-2015 Sardine and Mackerel
and
2014 Anchovy

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Introduction

Pacific sardine, Pacific mackerel, and Northern anchovy belong to a group of fish commonly referred to as forage fish or coastal pelagic species (CPS). Neither term – forage or CPS – denote a distinct list of species in ordinary or scientific usage. Washington uses the term "forage fish" and defines these as anchovy, herring, sand lance, sardine, and smelt for regulatory and management purposes. The federal fishery management plan to which sardine, mackerel, and anchovy are subject, the Coastal Pelagic Species Fishery Management Plan (CPS FMP), also includes squid, herring, and jack mackerel and jack smelt. Elsewhere, or in other contexts, forage fish or CPS may include as many as two dozen other species.

Fish in this group includes species that are distributed in the neritic zone, or coastal nearshore waters, and that live in the water column as opposed to living near or at the seafloor. Populations of these fish are typically highly variable with ranges that can expand and contract dramatically, with abundance and distribution tightly linked to ocean conditions, such as water temperature. These fishes serve as vital sources of food for other fish species, birds, and marine mammals.

Generally harvested with a variety of "round haul" gears elsewhere, only purse seines, lampara nets, and dip nets are authorized for targeted commercial harvest of sardine, mackerel, and anchovy in Washington. Incidental catch does occur with other gears, e.g., trawl nets. Recreational gears include jig, dip net, and cast net but the latter gear is only legal for sardine and anchovy in Washington.

Sardines were first harvested in Washington in 1936 and through the heyday of the "cannery row" era, up to 1950 (PFMC 1948). Then, due to a combination of less favorable environmental conditions (sardine prefer warmer water temperatures) and over-exploitation, the population began to collapse and contracted to its range in southern California. The California fishery closed in 1968. A population rebound was evident by the 1990s and sardine were again observed as far north as British Columbia (McFarlane 2005). The latter part of the 1990s saw continued expansion of sardine into waters off Oregon and Washington in sufficient enough numbers to spur interest in commercial fishing once again. In contrast, mackerel did not garner similar attention and have been harvested only incidentally by fishers targeting sardine.

Northern anchovy have long supported a small-scale, but important fishery on the Washington coast. Aside from some experimental attempts at canning and preservation in the 1940's, this fishery has and continues to primarily provide bait for other high-value fisheries such as commercial albacore tuna and recreational fisheries (PMFC 1948).

Recreational fisheries for sardine, herring, and anchovy exist in Washington, and although harvest data are not collected, catches are presumed to be very small. Sport interest in these fish, similar to the anchovy commercial fishery, is as bait to use in targeting other fish.

Report Scope and Outline

Given the nominal recreational fishery for CPS, this report serves as an informational review of the Washington commercial sardine, mackerel, and anchovy fisheries occurring in the ocean from 0 – 200 miles, Grays Harbor, Willapa Bay, and the Lower Columbia River, i.e., the region comprising "coastal" waters. This report does not include fishery information from the Strait of Juan de Fuca or Puget Sound (or Salish Sea). As coastal fisheries are also subject to federal jurisdiction, we follow the fishery seasons as established through the Pacific Fishery Management Council (PFMC) and National Marine Fisheries Service for the reporting periods: July 1 – June 30 for Pacific sardine and Pacific mackerel, and January 1 – December 31 for Northern anchovy. The following sections provide species specific management and fishery descriptions, including annual harvest specifications and catches. Washington Department of Fish and Wildlife (WDFW) activities and associated data are presented in the fishery monitoring and biological sampling sections.

Fishery Management and Description

Washington state policy and direction for fishery management are established by the Washington Fish and Wildlife Commission (FWC or Commission). The Commission, comprised of nine citizen members, has legislated authority to establish the basic rules and regulations governing the time, place, manner, and methods used to harvest fish in Washington state waters (0-3 miles). In addition, Washington coastal fisheries management is coordinated with the National Marine Fisheries Service (NMFS) through the Pacific Fishery Management Council (PFMC or Council).

The PFMC, one of eight regional fishery councils in the United States established by the Magnuson Fishery and Conservation Act of 1976, is responsible for setting fishery management policy and developing management measures for groundfish, salmon, highly migratory species (e.g., tuna), and a suite of CPS in the Exclusive Economic Zone (3-200 miles) off the coasts of Washington, Oregon, and California. This authority is implemented through the Council's fishery management plans (FMPs) and federal rules. NMFS and the Council govern the commercial and recreational fisheries in federal waters (3-200 miles) off Washington, Oregon, and California. Washington coastal tribes co-manage fisheries in federal waters with NMFS, and in state waters with WDFW.

In 1999, the US Secretary of Commerce approved the Coastal Pelagic Species Fishery Management Plan (CPS FMP) for pelagic species. Managed by the PFMC, stocks in the CPS FMP include Pacific sardine (*Sardinops sagax*), Pacific mackerel (*Scomber japonicas*), Northern anchovy (*Engraulis mordax*), market squid (*Lologo opalescens*), jack mackerel (*Trachurus symmetricus*), Pacific herring (*Clupea pallasii pallasii*), jack smelt (*Atherinopsis californiensis*) and krill (*euphausiids*).

Pacific sardine, mackerel, jack mackerel, and northern anchovy are "management unit species" and thus are required to have over-fishing limits described as well as measures to avoid over-fishing in place. These measures reduce the amount of catch allowed (i.e., annual catch limit) from the over-fishing limit and account for scientific and management uncertainty. Supporting the largest CPS fishery since the species rebounded in the 1990's, Pacific sardine undergo annual quantitative stock assessments and regulation updates. Similarly, Pacific mackerel are subject to regular assessments and regulation changes. Lacking routine assessments, precautionary harvest control rules are in place for Northern anchovy and jack mackerel.

Pacific herring and jack smelt are managed as ecosystem component (EC) species. EC species are not generally targeted or retained for sale, but are encountered infrequently in CPS fisheries. Over-fishing limits do not need to be determined for EC species. Instead, EC species are

prohibited from becoming a directed federal commercial fishery unless, or until, the Council has had an adequate opportunity to assess the scientific information and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem. Specific to Pacific herring, Washington state regulations include an additional requirement. Along the coast, directed harvest of herring is authorized in state or federal waters only by a WDFW director-issued permit.

Krill are managed as a prohibited species; the CPS FMP incorporated a ban on commercial fishing in March 2006. This action was undertaken by the PFMC to prevent the development of a fishery for krill which is a vital food for a diverse array of other marine species.

Pacific Sardine Fishery

Pacific sardine are the primary coastal pelagic species harvested in Washington waters. From 2000 through 2009, participation in the sardine fishery was managed under Washington's Emerging Commercial Fishery Act (ECFA), which provides for the harvest of a newly classified species, or harvest of a classified species in a new area or by new means. The ECFA offers two choices for fishery-permit designations: trial, which does not limit the number of participants, and experimental, which does limit participation and prohibits the transfer or sale of the permit. From 2000 through 2002, the WDFW managed the purse seine fishery for sardine under the trial designation. Absent limited participation, the Washington fishery was managed to a state harvest guideline (HG) of 15,000 metric tons (mt).

The Pacific Northwest sardine fishery saw a rapid expansion of catch between the years 1999 to 2002; during that period, landings into Washington increased from 771 mt to 15,820 mt. In response, the WDFW engaged in an extensive public process to address management needs in the fishery. In 2003, following this public process, a formal Sardine Advisory Board (Board) was created, and the WDFW Director, in collaboration with the Board, advanced the sardine fishery designation from trial to experimental as provided for under the ECFA. The number of experimental fishery permits was capped at 25. The experimental fishery program continued through June 2009. Besides limiting participation, the WDFW also restricted the amount of sardines sold for reduction (i.e., converted to fish meal, fertilizer, or similar product) to a 15 percent season cumulative total by weight by individual vessel.

Effective July 2009, legislation to establish a commercial license limitation program specifically for the harvest and delivery of Pacific sardines into Washington was passed into law. The new law established 16 permanent licenses which can be transferred or sold. In addition, the law provided criteria for the issuance of temporary annual licenses at the discretion of the WDFW

Director. The total combined number of permanent and temporary annual licenses cannot exceed 25.

Since 2012, the Quinault Indian Nation has conducted a sardine purse-seine fishery. The process for tribal participation is coordinated by the Quinault through the National Marine Fisheries Service as described in the Council's CPS FMP (CPS FMP Amendment 9) and NMFS regulations (50 CFR 660.518). The Quinault fishery operates under tribal regulation and within their usual and accustomed fishing grounds and stations (U & A), directly off Westport/Grays Harbor, Washington, or the portion of the Marine Fish/Shellfish Fishery Management Area between 47°40.10' N. lat. (Destruction Island) and 46°53.30' N. lat. (Point Chehalis). Catches from the Quinault sardine fishery are not reported here, but are included in the CPS SAFE report (SAFE 2014).

Through the Council process, scientists conduct an annual coastwide sardine stock assessment that incorporates survey and fishery data. The Council's Scientific and Statistical Committee reviews the assessment and recommends an annual coastwide overfishing limit (OFL) to the Council. Each year, after considering the information presented through its advisory bodies and public comment, the Council adopts the OFL, an acceptable biological catch (ABC), harvest guideline (HG), and research set aside (EFP). The Pacific sardine HG is allocated by seasonal periods, with releases on July 1, September 15, and January 1; if a period allocation (i.e., catch quota) is not attained, it, and any remaining incidental fishery set aside, is rolled to the next period, but not to the next year.

By state regulation, Washington license holders can commence landing sardines beginning April 1. However, in some years, the period allocation is harvested by the California fishery before April 1 and active fishing in Washington cannot begin until July 1. Weather and sardine presence/accessibility are also factors affecting when active fishing begins. There were no landings into Washington between January 1 and June 30 in three of the 15 years since 2000.

Monthly distribution of landings varies depending on period allocation availability, sardine presence, and ocean/weather conditions. Typically, the majority of Washington catch is landed during the second management period. Prior to 2008, sardine landings were distributed throughout June, July, August, September, and occasionally October and November. Since then, due to decreasing HGs and the more rapid attainment of period allocations, landings have been largely limited to July and September.

Sardine Fishery Year Change

For several decades, the sardine fishery was managed following the calendar year: January 1 to December 31. Over the years, the annual cycle for surveys, assessments, and management

actions naturally aligned to this schedule. In recent years, new and expanded surveys created conflicts for field researchers and stock assessment scientists as both surveys and assessments had to be rushed to accommodate the January 1 fishery season start date. To ease this burden, in 2013, the Council approved changing the start date from January 1 to July 1; an "interim" six-month period was used to achieve the transition. Fishery management specifications were adopted separately for the period January 1 – June 30, 2014 (Table 1) and the full fishing year, July 1, 2014 – June 30, 2015 (Table 2).

Table 1. Interim annual specifications and harvest guideline (mt), January 1, 2014 – June 30, 2014.

OFL	59,214
ABC	32,753
HG	29,770
ACT	19,846
EFP Set Aside	0
	January 1, 2014 – June, 30, 2014
Seasonal Allocation	6,946 (35% of ACT)
Tribal Request	1,000
Incidental Fishery Set Aside	500
Directed Fishery HG	5,446

Table 2. Annual specifications and harvest guideline by allocation period (mt), July 1, 2014 – June 30, 2015 as originally adopted April 2013.

OFL	39,210			
ABC	35,792			
ACL	23,293			
EFP Set Aside	0			
Tribal Request	4,000			
	Total	Period 1 JUL 1 – SEP 14	Period 2 SEP 15 – DEC 30	Period 3 JAN 1 – JUN 30
Adjusted HG	19,293	7,718	4,823	6,752
Incidental Fishery Set Aside	1,500	500	500	500
Directed Fishery HG	17,793	7,218	4,323	6,252

Early Closure of the 2014-2015 Directed Sardine Fishery

At its April 2015 meeting, the Council recommended immediate closure of the directed fishery for the remainder of the fishing year (July 1, 2014 – June 30, 2015) to reduce fishery impacts on sardine. This action was taken in response to a mistake discovered in the 2014 Pacific sardine stock assessment. The fishery closed effective April 29, 2015.

The original 2014 assessment estimated sardine biomass at 369,506 mt and this was used to set the 2014-2015 HG of 23,293 mt (Table 2). Once corrected, the assessment reduced the biomass estimate to 275,700 mt and the corresponding HG decreased to 13,300 mt. Total commercial (non-treaty directed and tribal) landings tallied 17,148 mt, well in excess of what would have been set for the annual quota. This action also considered the most recent 2015 assessment conducted in March that indicates a multi-year recruitment failure, meaning the Pacific sardine population is not sustaining itself. Figure 1 shows year class abundance from 1993 through 2014.

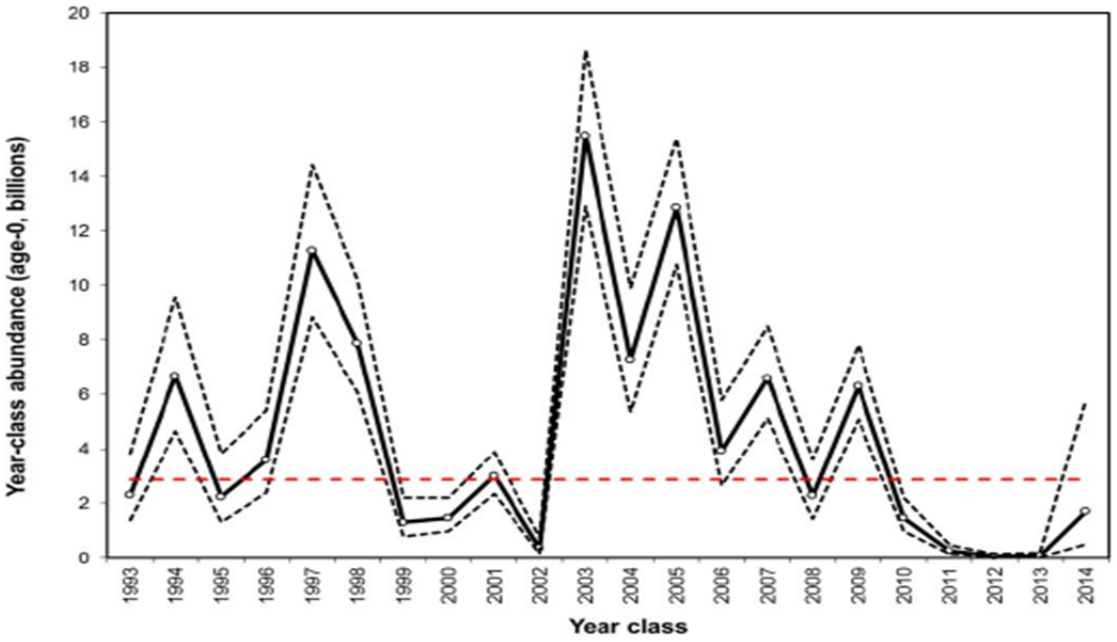


Figure 1. Pacific sardine recruitment trends from 1993 through 2014, from Assessment of the Pacific Sardine Resource in 2015 for USA Management in 2015-2016, Hill et.al. 2015. The red line represents R-zero.

Fishery Summary of the 2014 Interim Sardine Fishing Season

During the interim period, three vessels participated in the Washington sardine fishery. Landings from January 1 through June 30, 2014 totaled 910 mt, or 13 percent of the 6,946 mt initially allocated coastwide (California, Oregon, Washington, and Quinault Tribe) for harvest (Table 3). The ex-vessel value of sardine landed into Washington from the directed fishery during this period averaged $307/mt and totaled $279,317. Individual landings ranged from approximately 30 mt to a little over 100 mt, and averaged 64 mt. The fishery also landed 14 mt of Pacific mackerel and 13.5 mt of jack mackerel. Note, interim period data are combined with the 2014-2015 fishing season for Figures 2, 3, 4, 8, 9, and 10, as well as Tables 4, 5, and 7.

Fishery Summary of the 2014 – 2015 Sardine Fishing Season

Washington sardine licenses are issued on the calendar year, thus all 16 licenses renewed during the interim management period remained valid through the end of 2014. Eight vessels, or half of the licensed fleet, participated in the fishery. Sardine landings for Washington totaled 6,276 mt, representing 22 percent of the initial coastwide HG (Table 3). All of the sardine catch for the 2014-2015 fishing year was landed in July and September 2014. Per landing tonnage averaged about 57 mt, and ranged from just under 10 mt to about 110 mt. Total direct value of landings was $2.8 million. Incidentally landed species included 489 mt of Pacific mackerel and 158 mt of jack mackerel. These landings represent the second highest total for Pacific mackerel and the highest total for jack mackerel since the directed sardine fishery began in Washington in 2000.

The total direct value[1] of the Washington sardine fishery has varied as a function of price, effort, and HG availability. Total direct value has averaged $2.2 million, peaking at $7.7 million in 2012 (Figure 4). Vessels based in Ilwaco and Westport sometimes use spotter planes to locate sardines. In general, pilots receive about 10% of the landing revenue.

Since the reintroduction of the Washington fishery in 2000 to 2015, the price per pound for sardine more than tripled. Direct value price to the fisher ranged from $0.04 to $0.06 per pound from 2000 to 2007, and between $0.09 and $0.12 per pound from 2008 to 2013. During 2014-2015, the direct price per pound averaged approximately $0.20 per pound for sardines processed either for bait or for human consumption markets, with rendered sardines averaging approximately $0.05 per pound.

The number of vessels participating in the Washington fishery during each phase: trial, experimental, and limited entry averaged 17, 7, and 10 respectively (Figure 5). During the trial phase, direct value per vessel averaged $66,300. After transitioning to an experimental fishery (i.e., limited entry), the direct value per vessel averaged $123,700 from 2003 through 2009. With the permanent limited-entry licensed fishery, average per vessel value rose to $398,200. Per vessel direct value peaked in 2012 at $701,600 and declined to $511,400 in 2013; per vessel direct value averaged $385,830 in 2014.

[1] Direct value, also known as ex-vessel value, is the price or total value paid to the fisherman.

Table 3. Biomass, harvest guidelines, and landings (mt) of sardine from 2000 through 2014-2015.

Year	Biomass (1+)[2]	Coastwide Harvest Guideline[3]	Total Coastwide Landings[3]	Washington Non-Tribal Landings	Washington Non-tribal Landings as Percent of Coastwide Landings
2000	1,581,346	186,791	72,496	4,842	7%
2001	1,182,465	134,737	78,520	11,121	14%
2002	1,057,599	118,442	101,367	15,820	16%
2003	999,871	110,908	74,599	11,920	16%
2004	1,090,587	122,747	92,613	8,907	10%
2005	1,193,515	136,179	90,130	6,714	7%
2006	1,061,391	118,937	90,776	4,363	5%
2007	1,319,072	151,654	127,695	4,663	4%
2008	832,706	89,093	87,175	6,432	7%
2009	662,886	66,932	67,083	8,008	12%
2010	702,024	72,039	66,891	12,389	19%
2011	537,173	50,526	46,745	8,009	17%
2012	988,385	109,409	101,103	34,611	34%
2013	659,539	66,495	61,646	29,900	48%
2014 Interim	378,120	6,946	6,550	909	13%
2014-2015	369,506	23,293	17,148	6,276	22%

[2] The biomass values presented here are those used to calculate and set annual harvest specifications for annual management. These cannot be used for retrospective fishery management performance evaluation.
[3] For 2014-2015 management was based on an annual catch limit (ACL) and not the harvest guideline calculation to accommodate the updated scientific information relating to temperature (PFMC 2014a).
[3] Coastwide landings are acquired from the Council (PFMC 2014).

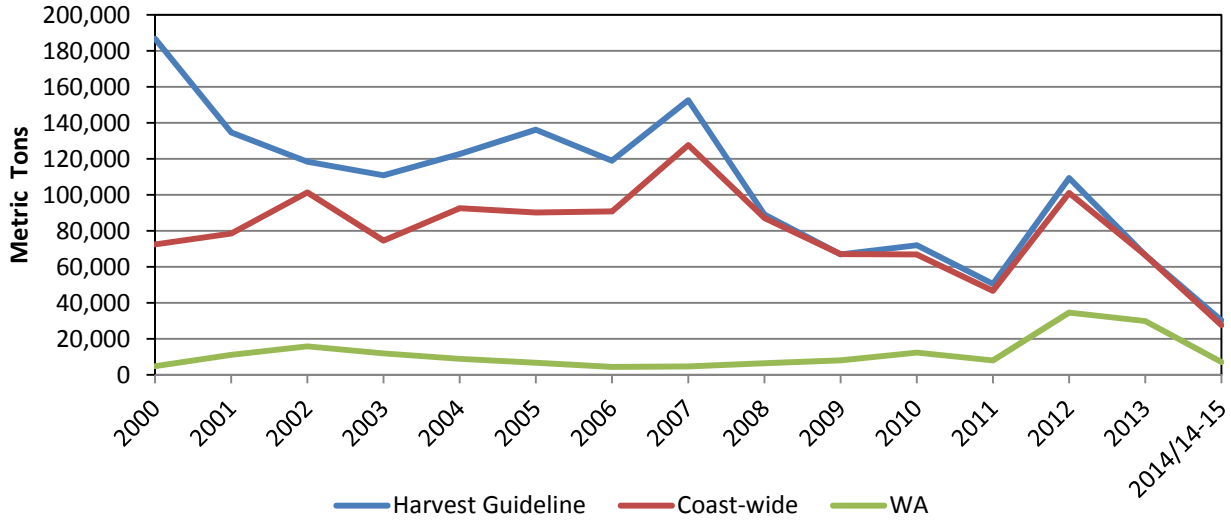


Figure 2. Harvest guideline and annual landings (mt) of sardine both coastwide and Washington only.

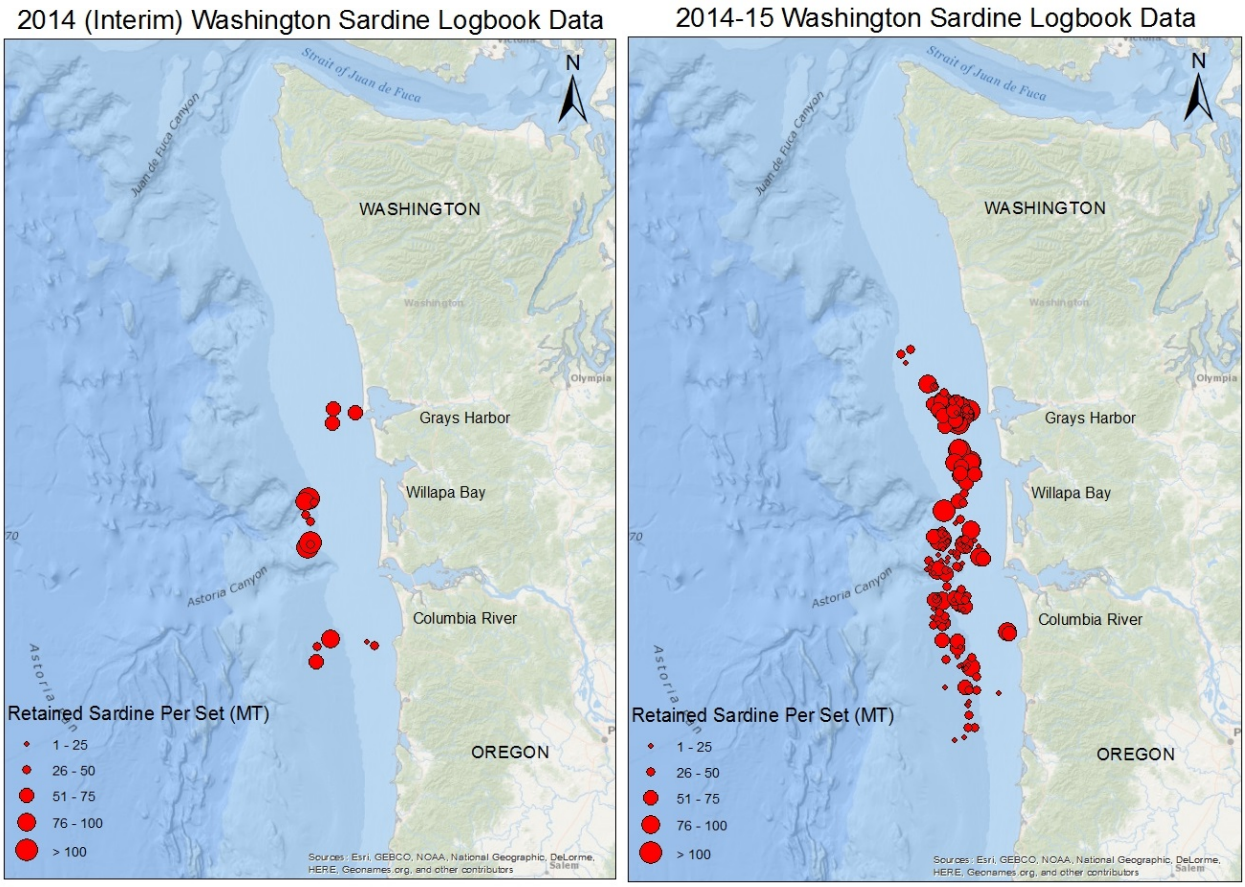


Figure 3. 2014 (Interim) and 2014-2015 sardine fishery set locations as reported in Washington logbooks.

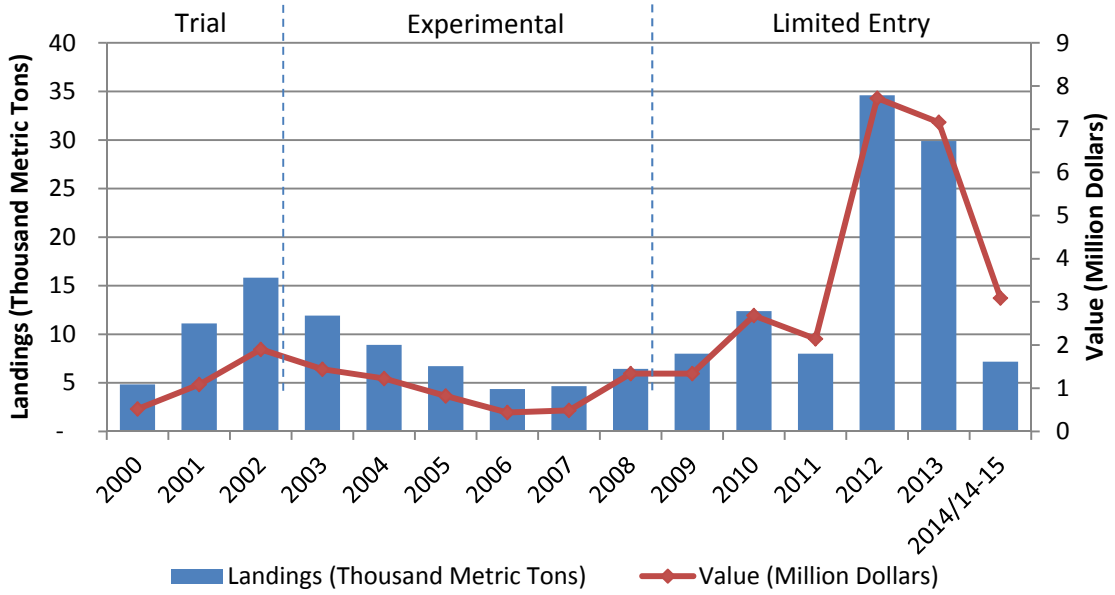


Figure 4. Washington total annual landings (mt) and total fishery direct value, 2000-2014/14-15.

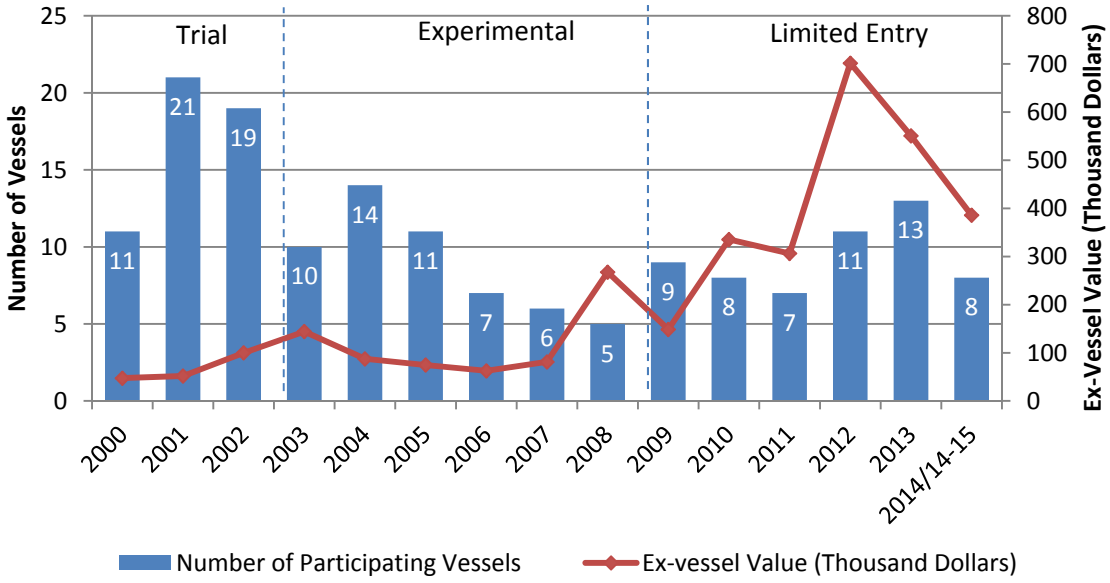


Figure 5. Number of Washington vessels and per vessel direct value, 2000-2014/14-15.

Pacific Mackerel Fishery

The full range of Pacific mackerel spans from Southeast Alaska to Banderas Bay (Puerta Vallerta) Mexico, with the majority typically located from Monterey Bay, California to Cabo San Lucas, Baja California Sur (Crone 2011).

Since 2000, the Pacific mackerel stock has been managed by the Council under the CPS FMP. Up through 2009, Pacific mackerel typically were fully assessed every three years with harvest specifications set annually based on updates. Following a transition period to address assessment model concerns and to better allocate analytical resources across all CPS, the Council established a four-year cycle for full assessments with interim catch-only projection assessments to determine harvest specifications on a biennial basis beginning in 2013. A catch-only projection assessment utilizes the final model from a fully reviewed or benchmark assessment, only adding catch information to estimate recent stock biomass, and thus requires less scientific review for use. Management for the 2014- 2015 fishing year was based on a catch-only projection estimate of the full assessment conducted in 2011.

Summary of the 2014-2015 Pacific Mackerel Fishery

No Washington fishery license authorizes landing Pacific mackerel from a directed Pacific mackerel purse seine fishery. The Washington law establishing the limited entry program for Pacific sardine did not authorize the directed harvest of Pacific mackerel; hence, this latter species can only be landed incidentally. Lacking such a license and regulations specific to this species and gear, Washington fishers have been precluded from participating in the federal directed mackerel fishery when harvest opportunity exists. As a remedy, and in response to industry request, WDFW approved a trial emerging commercial fishery to open effective April 1, 2016. This action will be fully addressed in the 2015-2016 status report.

Table 4. Biomass, harvest guidelines, and directed commercial landings (mt) of mackerel from 2000 through 2015.

Year[4]	Biomass (1+)[5]	Coastwide Harvest Guideline	Total Coastwide Landings[6]	Washington Landings (Non-tribal only)[7]	Washington Non-tribal Landings as Percent of Coastwide Landings
2000-2001	116,967	20,740	19,510	4	0.02%
2001-2002	84,090	13,837	7,814	198.7	2.5%
2002-2003	77,516	12,535	2,679	248	9.3%
2003-2004	77,892	10,652	4,452	51	1.1%
2004-2005	68,924	13,268	3,938	23	0.6%
2005-2006	101,147	17,419	3,784	18	0.5%
2006-2007	112,700	19,845	6,890	41	0.6%
2007-2008	359,290	40,000	6,286	36	0.6%
2008-2009	264,732	40,000	4,278	6	0.1%
2009-2010	282,049	10,000	3,010	5	0.2%
2010-2011	282,049	11,000	2,086	2	0.1%
2011-2012	211,126	40,514	1,855	83	4.5%
2012-2013	211,126	40,514	4,753	690	14.5%
2013-2014	272,932	52,538	11,998	173	2.0%
2014-2015[8]	304,184	29,170	5,308	489	6.8%

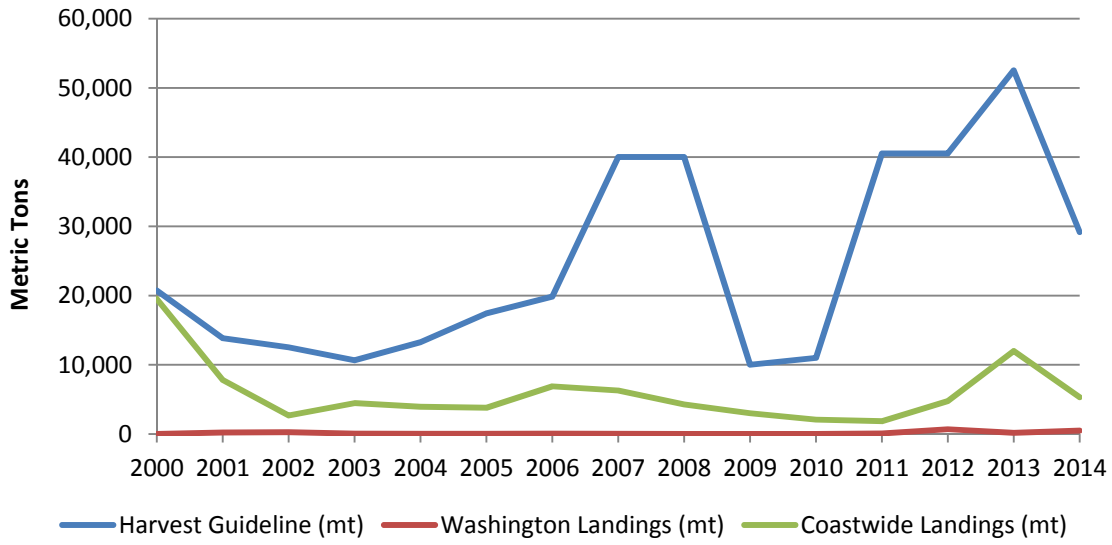


Figure 6. Harvest guideline and annual landings of mackerel both coastwide and Washington only.

[4] Mackerel is managed on a July 1 – June 30 schedule
[5] Biomass used to set HG
[6] Coastwide landings are acquired from the Council (PFMC 2014).
[7] Total landings of non-sorted mackerel and Pacific mackerel combined; about half of all landings from 2000-2014 were unsorted mackerel.
[8] Landings for the 2014-2015 season based on data through May 2015

Northern Anchovy Fishery

Two subpopulations of Northern anchovy are subject to management under the CPS FMP. The Northern subpopulation of Northern anchovy (NSNA) ranges from the Queen Charlotte Islands, British Columbia to approximately Eureka, California. The Central subpopulation (CSNA) ranges from approximately San Francisco, California to Punta Baja, Mexico. Separation of the two subpopulations is based on meristics (McHugh 1951 p. 157) and genetic analysis (electrophoresis of the blood serum transferrin; Vrooman et. al. 1981). The boundary between the two subpopulations overlaps and likely fluctuates seasonally and annually; delineation at San Francisco is done for management purposes (PFMC 1983).

The fishery conducted in Washington harvests fish from the NSNA, a management unit species in the Pacific Fishery Management Council's CPS Fishery Management Plan. The NSNA have never been formally assessed primarily due to the extremely low level of catch; thus, the status of the subpopulation is unknown. Federal management is based on a biomass estimate of 130,000 mt to which a maximum sustained fishing mortality rate (F_{MSY}) of 0.3 is applied. The resulting value, 39,000 mt, represents the overfishing limit (OFL). As a precautionary measure, the OFL is reduced by 75% to establish additional reference points including an acceptable biological catch (ABC) and annual catch level (ACL) of 9,750 mt and an annual catch target (ACT) of 1,500 mt. Attaining the ABC/ACL closes the non-treaty fishery (Washington and Oregon). Attaining or exceeding the ACT triggers consultation by Oregon and Washington as catches reaching that level would indicate a change in the fishery.

Anchovy fisheries in Washington are conducted to provide live bait for recreational and commercial fisheries, and packaged bait for retail to recreational fishermen. 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. The non-treaty fishery for anchovy is open year-round, except to protect out-migrating salmon, regulations include late winter-early spring closures of Grays Harbor and Willapa Bay.

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. Participation is not limited; typically about two dozen baitfish-lampara gear licenses and two or three baitfish-purse seine licenses are issued annually.

Fishers are required to document all forage fish used for bait in another fishery on the fish receiving ticket for the target species. Although all Washington anchovy landings are reported

on fish tickets, no distinction is made between anchovy destined for packaged product versus anchovy destined for use as live bait. Landings are typically reported by the scoop and converted to weight for data entry.

Rules limit the catch, possession, or landing of anchovy to 5 mt (11,000 pounds) daily and to 10 mt (22,000 pounds) weekly and the amount of anchovy taken for reduction (or the conversion of fish to products such as fish meal or fertilizer) to 15 percent of a landing by weight. Incidentally caught species include other forage fish species (e.g., sardine, herring) which have species specific landing limits.

Summary of the 2014 Northern Anchovy Fishery

In 2014, six vessels (purse seine and lampara) landed anchovy. This is similar to the previous year's total and below the 10 year average of 166 mt which excludes the atypical 2009 catch (Figure 7). The majority of landings were from the ocean and lower Columbia River; less than 5% of anchovy were caught in either Willapa Bay or Grays Harbor combined. Landings spanned from May through October, with the majority (nearly 80%) landed in June, July, and August.

Total direct value – the amount paid to harvesters – of landed anchovy cannot be reported due to confidentiality standards. At retail, the price of anchovy bait ranged from $1 to $7 per pound, depending on volume purchased and whether bait are live or packaged.

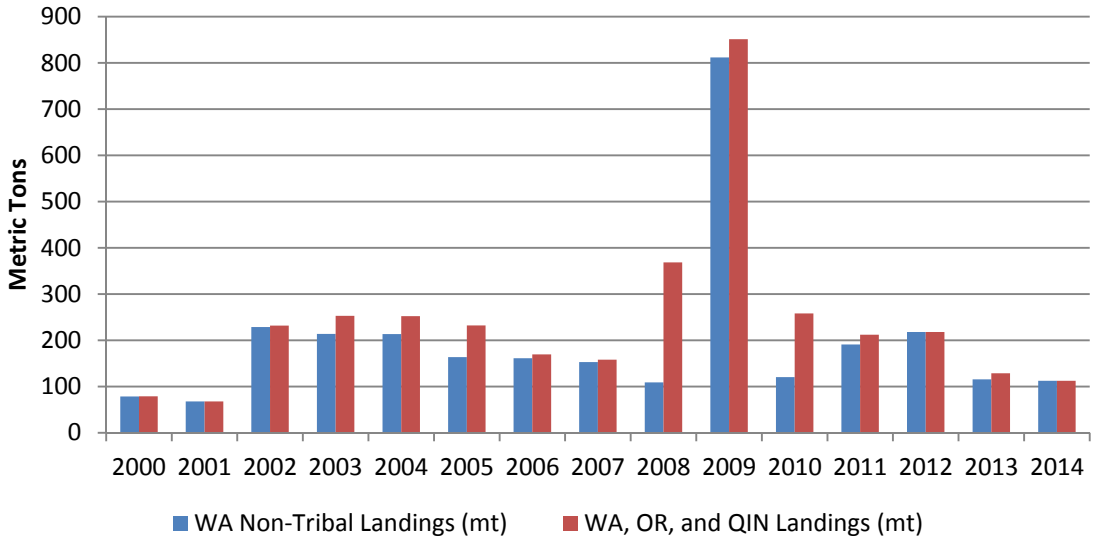


Figure 7. Annual landings of the Northern subpopulation of Northern anchovy (NSNA) in the Washington non-treaty fishery, and Washington, Oregon, and Quinault fisheries combined.

Fishery Monitoring

WDFW biologists and technicians monitor each CPS fishery following fishery-specific goals and objectives. Monitoring activities typically include tracking vessel activity, observing landings dockside, reviewing landing receipts or fish receiving tickets, tallying catch, logbook programs, and at-sea observer coverage. Commercial landings are routinely checked and fish samples are collected for biological data such as length, weight, and otoliths (i.e., ageing).

For fisheries, e.g., sardine, operating under harvest quotas, WDFW biologists produce weekly or even daily catch estimates depending on need, i.e., how close the fishery might be to attaining a harvest guide or quota. These catch estimates are distributed to National Marine Fisheries Service, other state agencies, and industry members to evaluate attainment of the harvest guideline in-season.

Pacific Sardine Fishery

A mandatory Washington state logbook program has been in place since the fishery began in 2000 (Appendix A). Data are maintained in electronic format at the WDFW Region 6 office and are used to plot catch distribution (see Figure 3), reconcile or confirm fish receiving ticket information, calculate catch per unit of effort, and to document bycatch.

Pacific sardines are the targeted catch in the Washington fishery, but anchovy, mackerel, and squid may be retained and landed as incidental catch. In the interim 2014 and 2014-2015 fishing seasons, mackerel, totaling 707 mt, comprised the only incidentally landed coastal pelagic species documented on fish receiving tickets. Otherwise, nominal amounts of two non-target species were reported: chinook and coho salmon (Table 5).

To document bycatch levels in the Pacific sardine fishery, the WDFW conducted a five-year observer program from 2000 through 2004. Overall observer coverage in this program was in excess of 25 percent and results showed bycatch of non-targeted species in the Washington sardine fishery to be relatively low (Culver 2006). Salmon bycatch in the Washington sardine fishery for years subsequent to the observer program is calculated by multiplying total sardine catch by the observed five-year average bycatch rates. Based on the total sardine catch during the interim 2014 season and the 2014/15 fishing year, the total estimated bycatch of salmon was 1,794 fish: 890 chinook and 904 coho salmon (Table 6).

Table 5. Directed sardine fishery incidental catch from fish tickets (mt).

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014-14/15
Arrowtooth Flounder										0.02	
American Shad					<0.01				0.01	0.02	
Chinook									0.03	0.12	<0.01
Chum									<0.01		
Coho									0.29	0.08	<0.01
Mackerel	22.2	23.6	42.0	37.5	9.0	4.5	2.0	0.4	718.9	186.4	546.5
Misc			1.37			2.34				0.01	
Northern Anchovy		1.81					5.44				
Pacific Herring					4.69				<0.01	<0.01	
Pink Salmon									<0.01	<0.01	
General Shark						0.01					
Sole Rex										<0.01	
Spiny Dogfish					<0.01				<0.01	<0.01	

Table 6. Estimated 2014, 2014-2015 salmon bycatch based on 2000-2004 observer catch rates.

Salmon Species	Bycatch Rate	Estimated Catch
Chinook, Live	0.007	207
Chinook, Dead	0.023	683
Coho, Live	0.004	125
Coho, Dead	0.026	779

Pacific Mackerel Fishery

As a directed fishery for mackerel is not authorized in Washington, this species is only landed incidentally to sardine or hake. Due to limited staff resources, mackerel have not been routinely sampled for biological data. Catch of mackerel is tracked via fish receiving tickets and/or logbooks. Previously, WDFW annual reports did not include Pacific mackerel; this update therefore presents data when available from 2013 through June 2015.

Northern Anchovy Fishery

The anchovy fishery is monitored primarily through review of fish receiving tickets to summarize landings and incidentally caught fish; a fishery logbook is not required. However, fishery operations have been observed at-sea as needed to address specific questions, e.g., seabird-purse seine gear interaction. A review of fish tickets indicate small incidental catches in fisheries targeting anchovy (Table 7). Regulations allow retention of herring, candlefish, shad, and sardine in the ocean and lower Columbia (WAC 220-44-020 and WAC 220-33-060) and also herring, candlefish, and sardine in Grays Harbor and Willapa Bay (WAC 220-36-03001 and WAC 220-40-030) as a minor proportion of the total weight of anchovy caught. Anecdotal reports include occasional encounters with sturgeon, but these must be released according to the aforementioned WAC's.

Table 7. Directed anchovy fishery incidental catch from fish tickets (mt).

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Herring										0.5	
Pacific Mackerel						0.1					
Pacific Sardine	26.9	6.4		2.0	3.0	703.6	2.3				
Spiny Dogfish						0.1					

Biological Sampling and Results

Pacific Sardine

The collection of biological samples is coordinated with Oregon Department of Fish and Wildlife (ODFW) staff to ensure sampling coverage is similarly distributed across the Pacific Northwest fishery. Landings are randomly sampled during directed fishery periods. The sampling goal is three samples of 25 individual fish per 1,000 mt sardines landed into Washington ports. Weight, sex, and maturity are recorded and otoliths are extracted for age-reading.

WDFW collected 24 samples of approximately 25 sardines each (628 individual sardines) during the 2014 sardine season. WDFW did not reach the sampling goal of three samples per 1,000 mt landed in June, but did meet this goal in July and September and sampled proportionally to monthly landings in June (Table 8). A total of 628 sardines were sampled for length (standard in millimeters [mm]), weight (grams [g]), sex, maturity, and age. Sardine standard length ranged from 206 mm to 247 mm and weight ranged between 133 g and 289 g. Average sardine length in 2014 was 221 mm while the fourteen year average is 212 mm (Figure 8). The average weight in 2014 was 182 g and the thirteen-year[9] average was 157 g.

Of the 628 sardines sampled, 598 sardines were successfully aged. All samples were sent to the WDFW laboratory in Olympia, Washington for age reading. In 2014, 63 percent of sampled sardine were four year olds (Figure 9). In 2013, the majority (56 percent) of sardine sampled were three year olds. In contrast, from 2009 through 2011 sardine ages of four to six years were the predominate age classes. A complete table of sardine age distribution can be found in Appendix B.

Table 8. Washington Interim 2014, 2014-2015 sardine goals and samples collected by month.

Month	Sardine Landed (mt)	Sampling Goal	Samples Collected	Number of Individual Sardine sampled
June	909	3	1	30
July	3,063	9	14	361
September	3,214	9	9	237

[9] Individual weights of sardine were not collected during the 2000 season.

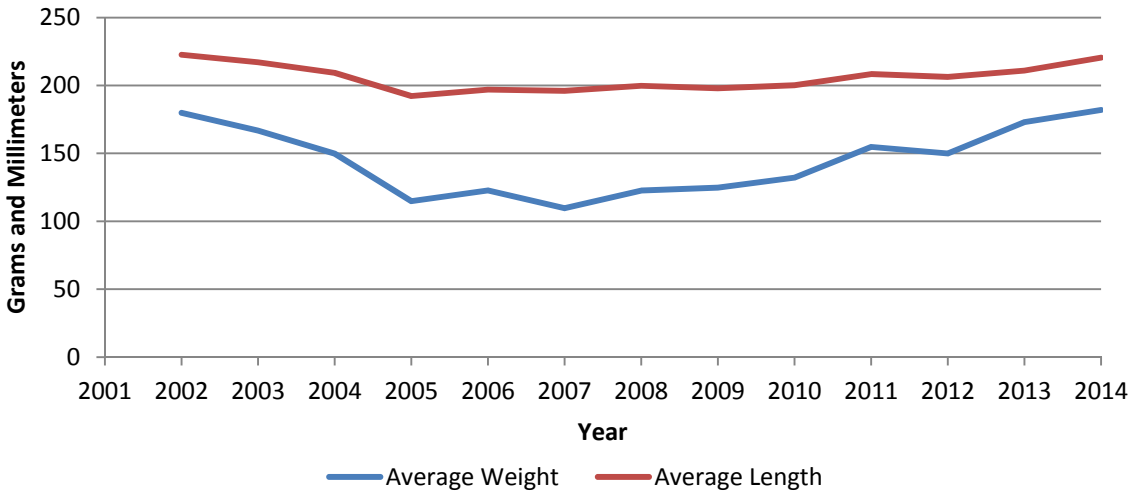


Figure 8. Average lengths and weights of sardine samples by year.

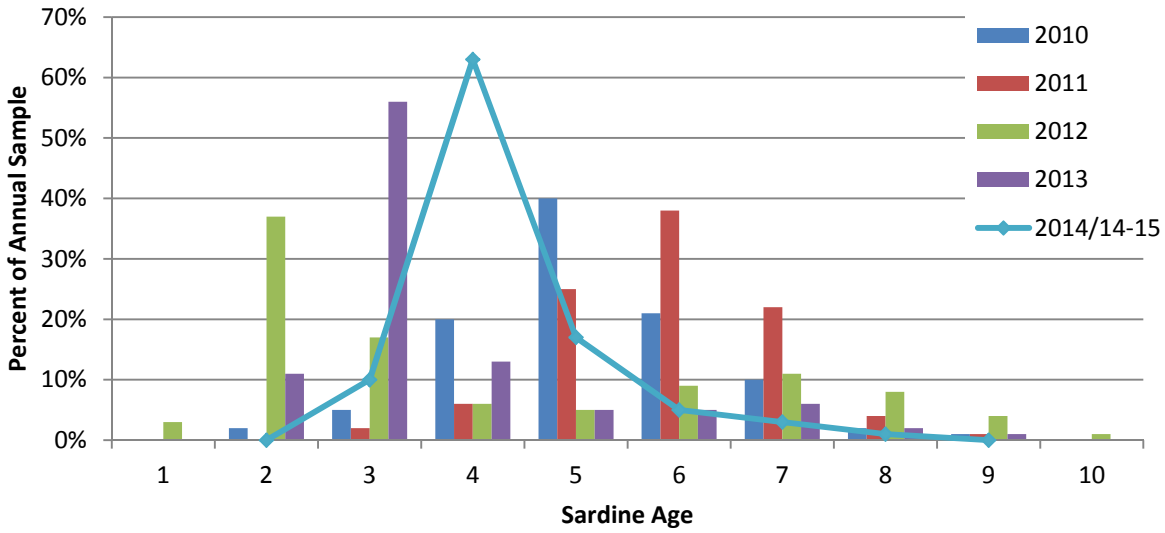
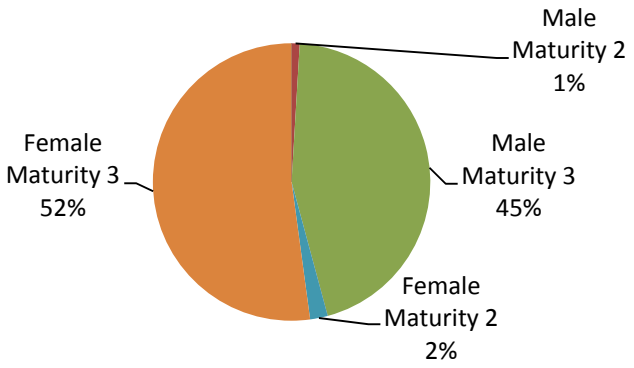


Figure 9. Age distribution of sardine samples, 2010-Interim 2014/14-15. The current year, 2014/14-15, is depicted by the line; previous years are depicted as bars.

Sex and maturity were determined by using the California Department of Fish and Game (CDFG) Standard Maturity Guide for Wetfish, which is based on Hjort, J. (1914) State of Sexual Organs. The majority of sardine analyzed in 2014 were females (54%) and the majority of both sexes had a sexual maturity of level 3 (52%; Figure 10). It is interesting to note that no male or female maturity level 1 fish were identified in 2014. To date, no maturity level 4 fish have been identified from Washington landings.



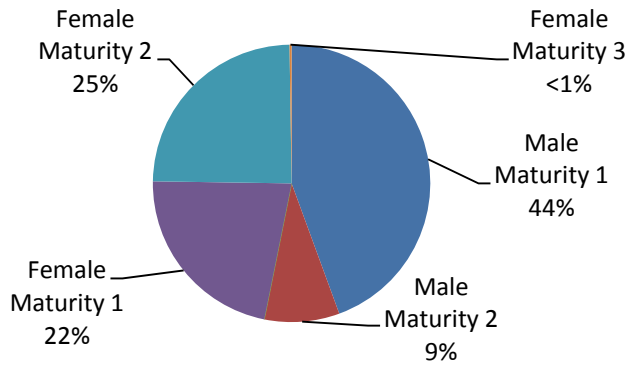
Sexual maturity code description:
(1) Virgin individuals.
(2) Maturing virgins or recovering spent. Males intermediate; no milt present.
(3) Yoked oocytes visible. Milt is present and oozing in males.
(4) Hydrated oocytes present.

Figure 10. Sex and maturity of sardine collected in samples.

Pacific Mackerel

Collection of Pacific mackerel biological data comes from incidental catch in the Pacific sardine fishery and from incidental catch in the North Pacific hake (*Merluccuis productus*) fishery; there is also some minor sampling of sport caught fish. In 2013, average Pacific mackerel length was 209 mm and the average weight was 348 grams. Otoliths were collected and provided to the NMFS Southwest Fishery Science Center. Biological data were not collected in 2014-2015.

Figure 11 shows the distribution of sex and maturities in Pacific mackerel in 2013. Of the 412 maturities (m) collected, 219 were male and 193 were female. Figure 11 shows that 44% of all males were a maturity of 1, while the females were a near even split of 1 and 2 at 22% and 25% respectively.



Sexual maturity code description:
(1) Virgin individuals.
(2) Maturing virgins or recovering spent. Males intermediate; no milt present.
(3) Yoked oocytes visible. Milt is present and oozing in males.
(4) Hydrated oocytes present.

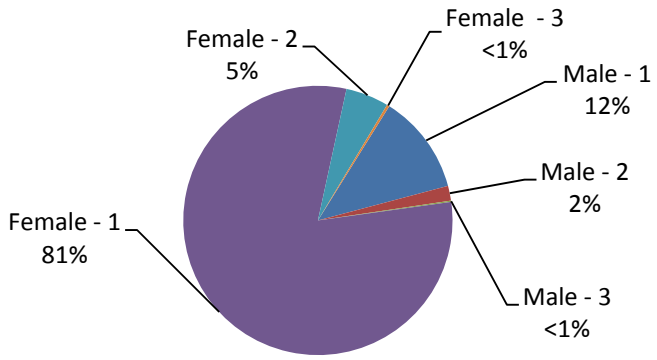
Figure 11. Sex and maturity of mackerel collected in samples.

Northern Anchovy

WDFW sampling of the Northern anchovy fishery began in 2014. The initial goal was to collect 100 fish per sample per landing for length, weight, sex, and maturity. Otoliths were extracted from 10 of the 100 fish sample for age reading. Sampling frequency was opportunistic and aligned to fishery activity. In the future, more otoliths will be extracted for a larger age sample; and fishery and sample data will also be evaluated, particularly to determine if sampling goals should be stratified by port.

Anchovy biological data presented here are collected from commercial landings at two coastal ports in Washington: Ilwaco and Westport. During the 2014 season, a total of 10 samples were taken resulting in 990 anchovies sampled. Average length in 2014 was 106 mm with an average weight of 11g. Of these samples, 108 were aged: 80 were 1 year olds, 5 were 2 year olds, 21 were 3 year olds, and 2 were 5 year olds.

Figure 12 shows the distribution of sex and maturities in Northern anchovy in 2014. Of the 676 maturities taken in 2014, 582 were female and 94 were male, with a large majority of both being maturity 1.



Sexual maturity code description:
(1) Virgin individuals.
(2) Maturing virgins or recovering spent. Males intermediate; no milt present.
(3) Yoked oocytes visible. Milt is present and oozing in males.
(4) Hydrated oocytes present.

Figure 12. Sex and maturity of anchovy collected in samples.

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Appendix A

Washington Department of FISH and WILDLIFE

COASTAL SARDINE FISHERY LOGBOOK

(Complete a log sheet for each fishing trip; more than 1 sheet per day may be used)

Vessel Name_____ Skipper Name_____

Gear Length_____ Gear Depth_____ Mesh Size_____ Grate Used? Yes____ No____ Mesh size_____

Departure Date_____ Return Date_____ Date on which fishing occurred _____

Fish Ticket No._____

			Retained Catch (weight)							OTHER SPECIES	
Time Set	Latitude	Longitude	Sardines	Mackerel	Anchovy	Squid		Chinook	Coho		
							Live				
							Dead				
							Live				
							Dead				
							Live				
							Dead				
							Live				
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							Dead				
							Live				
							Dead				

Contact: Lorna Wargo, WDFW, at (360) 249-1221

Send Logbooks To: WDFW Sardine Program
48 Devonshire Road
Montesano, WA 98563

Logbooks are due by the 15th day of the following month.

Skipper's Signature_____

Notes:

Appendix B

Sardine Age Distribution from Washington Sardine Samples: 2000-2014 (%)															
Age	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
1	1	1	1	2	24	3							3	<1	
2	16	8	5	19	15	49	1	<1		2	2	<1	37	11	<1
3	37	44	15	16	16	10	70	33	6	6	5	2	17	56	10
4	23	29	34	13	10	7	19	52	34	24	20	6	6	13	63
5	13	10	21	19	12	6	6	12	44	34	40	25	5	5	17
6	7	5	12	13	11	5	1	2	14	26	21	38	9	5	5
7	2	2	7	7	5	5	2	<1	2	7	10	22	11	6	3
8	1	<1	4	5	3	5	1		<1	1	2	4	8	2	1
9	<1	<1	1	3	2	4	<1		1		1	1	4	1	<1
10			<1	1	1	1						<1	1	<1	
11			<1	1	<1	2									<1
12			<1	<1	<1	2									
13			<1	<1		1									
14			<1	<1		<1									
15						<1									

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