Oregon's Sardine Fishery
2004 Summary

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INTRODUCTION

Background

Pacific sardines (*Sardinops sagax*) are managed under the Pacific Fishery Management Council's Coastal Pelagic Species Fishery Management Plan (FMP). Under the FMP, the biomass of sardines is estimated each year and a coast-wide harvest guideline is established. In 2002, the Council adopted an interim allocation system for the 2003-2004 seasons. Discussions to design a new allocation system began in 2004. Under the interim allocation system, the harvest guideline is allocated 2/3 to the southern area (south of Point Arena, California) and 1/3 to the northern area (north of Point Arena, mainly Oregon and Washington). Any portion of the harvest guideline that is unused by September 1 may be re-allocated 80/20 between the southern and northern areas. For 2004, the coast-wide harvest guideline was 122,747 mt (up from 110,908 mt for 2003) and the initial northern allocation was 40,917 mt.

Except for the coast-wide harvest guideline, management of sardines north of 39° N (approximately Point Arena) continues under state management as long as the management measures are consistent with the FMP. In Oregon, sardines are managed under the Developmental Fishery Program which limits the number of harvest permits. Prior to 2001, 15 permits were allowed and all were issued in 1999 and 2000. In 2001, five additional permits were added (for a total of 20) to encourage an increase in processing capabilities.

Goals and Objectives

The goals for this year's work were to continue to gather information on sardines off Oregon to improve the coast-wide stock assessment of sardines and document the extent of by-catch in the fishery.
Objectives include:

- Collect size, age, and distribution data of adult sardines off Oregon, from both the harvest areas and outside harvest areas.
- Document bycatch, in terms of species, amount, and condition. Recommend management measures to reduce by-catch if necessary.
- Document harvest methods, distribution of harvest, and catch per unit of effort.
- Test for oil content using an Islandic scale.

FISHERY DESCRIPTION

Landings / Effort

The first directed landings of sardines into Oregon since 1948 occurred in 1999 for a total of 1.7 million pounds (775.7 mt) by three vessels. Landings and effort have increased each year since (Table 1).

In 2004, almost 80 million pounds (36,111 mt) were landed into Oregon, mostly into Astoria (99%). Nineteen vessels targeted sardines using seine gear, two vessels landed small amounts as

incidental catch in the whiting fishery with trawl gear. A small amount was also harvested from Winchester Bay for a local bait fishery. The seine vessels made 939 landings averaging 84,761 lb (38.4 mt) per landing. Individual landings ranged from 4,032 lb (1.8 mt) to over 203,826 lb (92 mt) (Figure 1). Table 1 compares details for the 1999 through 2004 fisheries.

This year, more vessels participated in the fishery for longer periods of time than in past years. Of the 19 vessels targeting sardines, 14 made 98 % of the landings by weight. These 14 vessels made 40 or more landings (Figure 2) and worked 13 - 21 weeks of the fishery. Five vessels worked during 6 weeks or less of the fishery, making less than 10 landings per vessel. Two vessels made only enough landings to qualify their permit for renewal.

As in past years, the first landings were made in early June (Table 1). July and August continue to be the peak months of harvest with 30% and 37% of this year's total harvest in each month, respectively (Table 2, Figure 3). This year, with favorable ocean conditions, 27% of the landings came after September 1st and final landings were made in mid-December. Combined Oregon and Washington landings through August (32,193 mt) were short of the initial allocation of 40,917 mt for the northern area fisheries (Table 3). Landings for the second period (September through November) (12,505 mt) were only slightly short of the allocation for the northern area fisheries (13,612 mt).

Eight processors bought sardines in 2004. Average ex-vessel price was $0.05 per pound ($107 per mt). The average ex-vessel price has remained stable since the beginning of the fishery (Table 1). However, the price structure has varied somewhat, with a decrease in 2004 of the percentage of sardines selling for less than $0.05/pound (Figure 4). A few individuals have expressed concern with the amount of sardines that are considered "waste", not marketable due to size or condition. The percentage of zero-value fish has increased somewhat since 2000 (Figure 4). Most of the zero-value fish is given to a local company to process into fish meal. The price composition over the season shows the highest percent of zero-value fish in September and October (Figure 5), possibly due to an increase in the amount of smaller fish, unsuitable for the tuna bait market, in the area later in the season. There is also a considerable difference in the percent of zero-value fish between processors, ranging from 0% to 12.7% (Figure 6). We do not know for certain if this represents an actual difference in the amount of "waste" fish or a difference in recording methods.

Table 1. Comparison of 1999 through 2004 Oregon sardine fisheries.

	1999	2000	2001	2002	2003	2004
initial northern allocation (mt)		62,264	44,912	39,481	36,969	40,917
pounds landed (metric tons)	1,709,686 (776)	21,005,311 (9,528)	28,214,988 (12,798)	50,068,717 (22,711)	55,683,476 (25,258)	79,610,370 (36,111)
permits issued	15	15	20	20	20	20
vessels targeting sardines	3	14	18	17	17	19
landings by target vessels	23	349	453	657	712	939
average landing (lb)	74,306	60,183	62,260	76,208	78,207	84,761
start date	6/21	6/14	6/4	6/10	6/22	6/8
end date	9/15	10/12	10/5	10/14*	10/2	12/17
buyers	1	3	5	7	7	8
average ex-vessel price/lb	$0.05	$0.05	$0.06	$0.05	$0.05	$0.05

*closure from 9/14-9/20

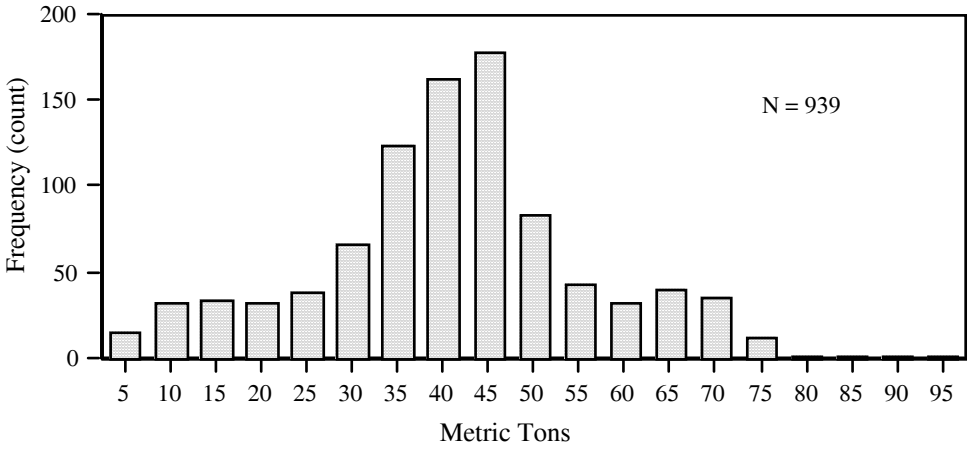

Figure 1. Frequency of sardines (mt) per landing, 2004.

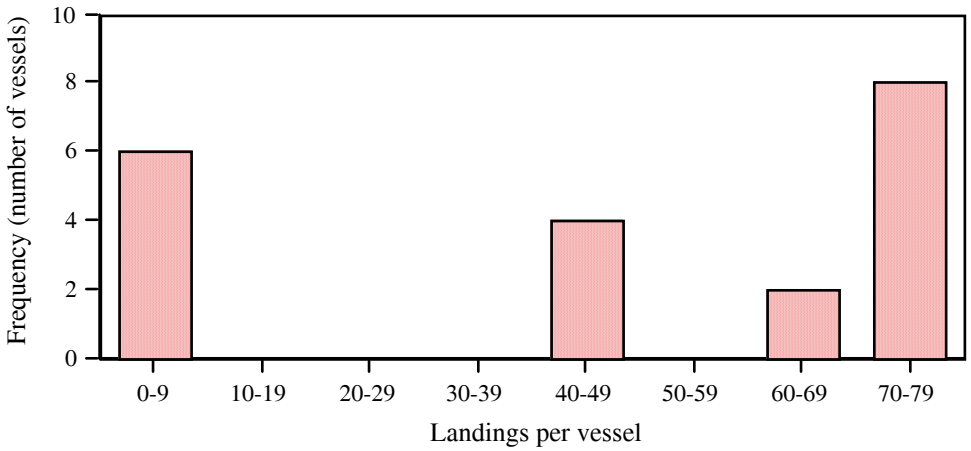

Figure 2. Frequency of landings per vessel, 2004.

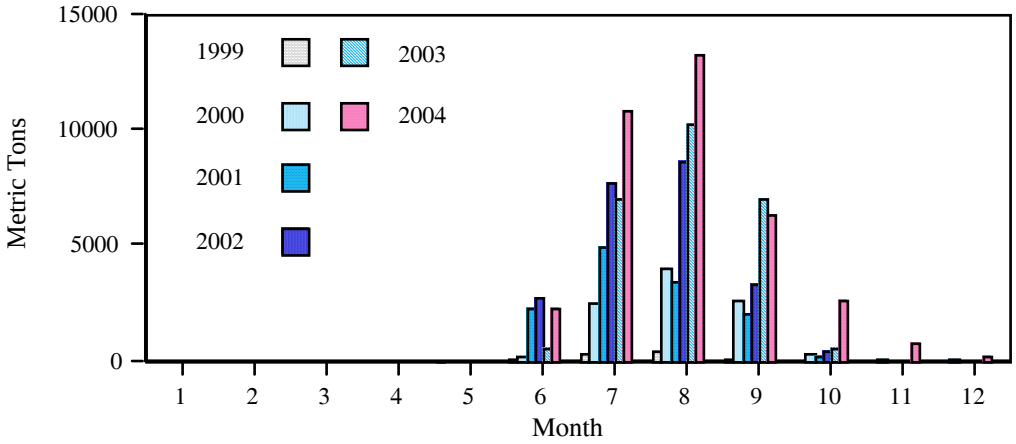

Figure 3. Monthly landings (mt) of sardines into Oregon, 1999-2004.

Table 2. Landings (mt) of sardines into Oregon, by month, 1999-2004.

	1999	2000	2001	2002	2003	2004
May	0.1					
June	50	205	2,288	2,724	503	2,203
July	238	2,457	4,898	7,677	6,991	10,825
August	383	3,960	3,393	8,650	10,263	13,214
September	104	2,599	1,993	3,258	7,006	6,291
October		303	208	402	495	2,603
November		3				762
December		2				213

Table 3. Landings (mt) of sardines into Oregon and Washington, by month and allocation period, 2004.

					initial allocation (Jan-Aug): 40,917 mt second allocation (Sept-Nov): 13,612 mt
Month	OR	WA*	Total	Cumulative Total	Total for allocation period
Jan					
Feb					
Mar					
Apr					
May					
Jun	2,203.5	235.3	2,438.8	2,438.8	
Jul	10,824.9	2093.1	12,918.0	15,356.8	
Aug	13,214.3	3621.9	16,836.2	32,193.0	32,193.0
Sep	6,291.2	2116.4	8,407.6	40,600.6	
Oct	2,602.9	732.7	3,335.6	43,936.2	
Nov	761.6		761.6	44,697.8	12,504.8
Dec	212.7		212.7	44,910.5	212.7
Total	36,111.1	8,799.4	44,910.5		

* WA landing data from M. Culver, WDFW

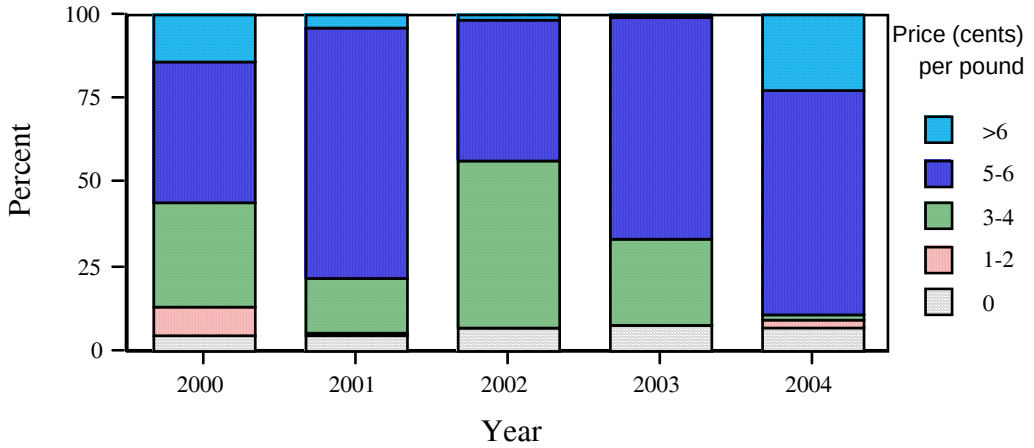

Figure 4. Annual ex-vessel price (cents/lb) composition (%) of Oregon sardines, 2000-2004.

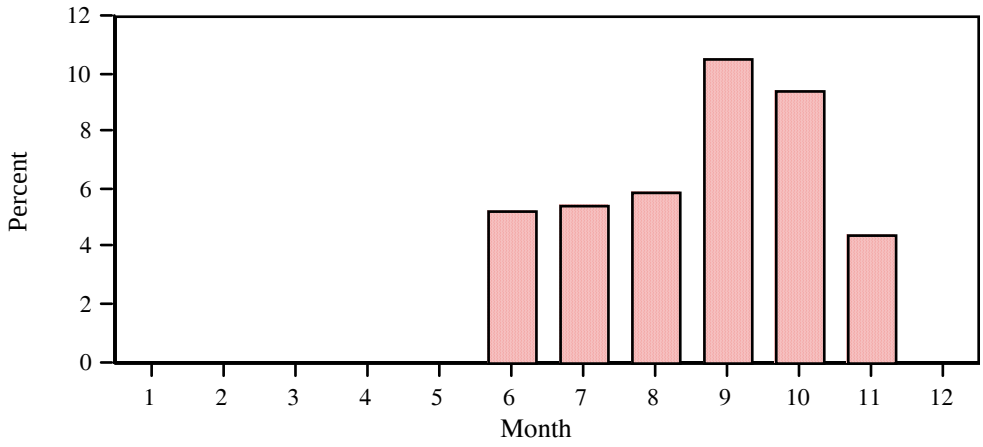

Figure 5. Percent of zero-value sardines, by month, 2004.

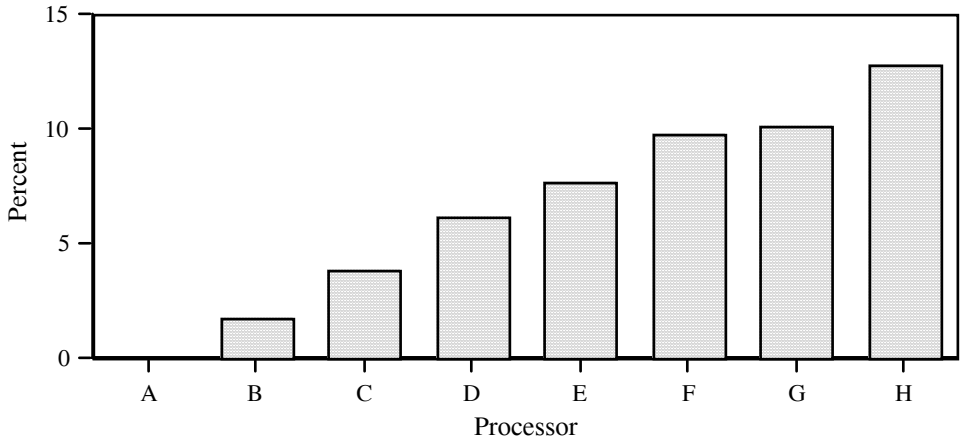

Figure 6. Percent of zero-value sardines, by processor, 2004.

Area of catch

Logbooks are required as a provision of the permit. Logs turned in for 2004 accounted for 97 % of the landings. The area of catch in 2004 was approximately 45 nm north and 35 nm south of the Columbia River and out to approximately 25 nm off shore (Figure 7). This area is similar to the area fished in 2003, but farther to the north than years prior to 2003. Depths in the harvest area ranged from 7 fm to over 300 fm, with an average of 40 fm. Based on log data, 59 % of the pounds landed were taken off Oregon and 41 % off Washington.

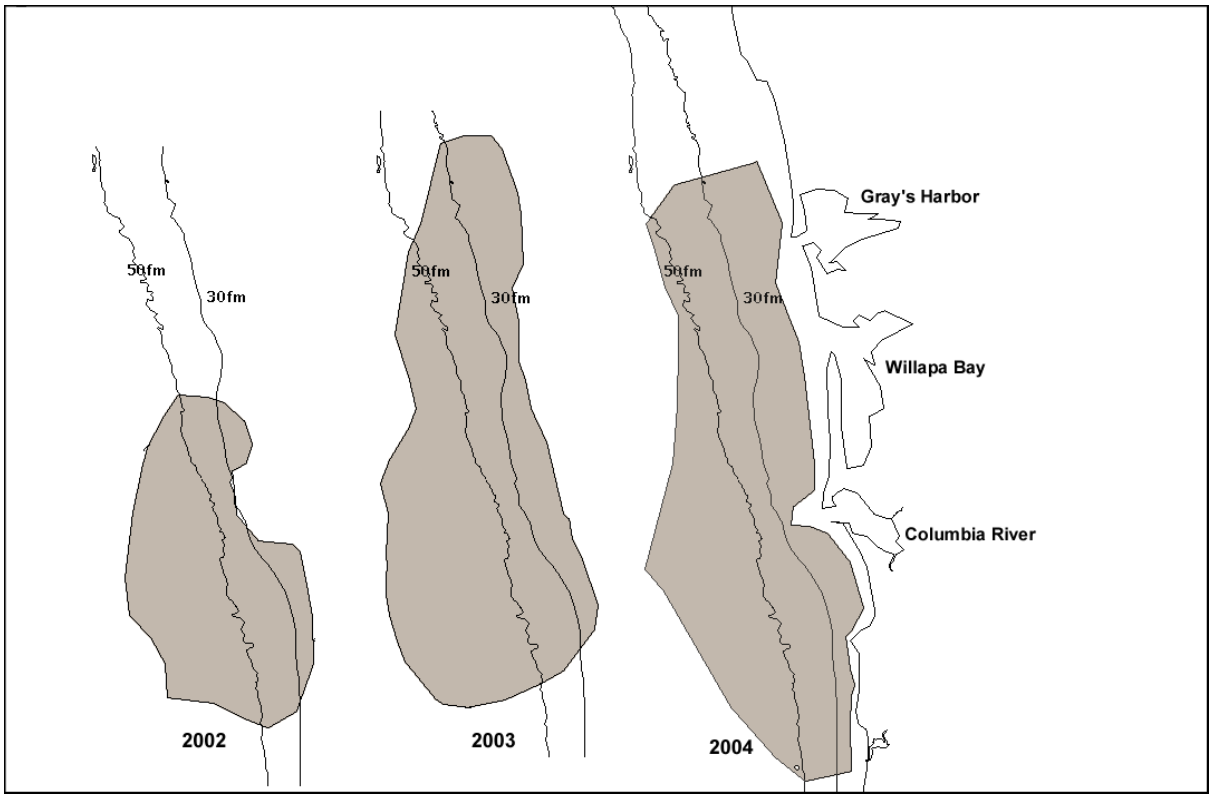

Figure 7. Area of harvest for Oregon's sardine fishery, 2002 - 2004.

NON-TARGET SPECIES

Bycatch

Due to budget restrictions, we did not hire a seasonal employee to ride along on sardine vessels and observe bycatch of non-target species**.** Available staff was able to observe three trips. Vessel skippers also were required to record all species caught in the logbook**.** Logs turned in for 2004 accounted for 97 % of the landings.

Based on both observer and logbook data, bycatch (species caught but not landed) continues to be low. Permit stipulations require a grate must be placed over the intake of the vessel's hold to sort out larger sized fish. Bycatch included salmon, and sharks (Table 4). Numerous jellyfish were also observed in the net and pumped into the hold but not quantified. Salmon was the major species of concern. Based on log records, salmon catch averaged 0.9 per trip, with 68 % released alive. The estimated total catch of salmon for the fishery, based on log data, is 823 salmon (0.024 salmon/mt) (Table 5).

Table 4. Observed and reported catches of non-target species caught in Oregon sardine fishery, 2004.

Species	Logbook data	Observer data
	# Caught	# Caught
Blue shark	1	
Dogfish shark	1	
unknown shark	2	
Salmonids	823 (68% alive; 32% dead)	
Mackerel	118,890 lb	1,000 lb
Anchovy	5,110 lb	
Herring	5,100 lb	
Shad	6,051 lb	
flounder	2	
squid	1,510 lb	1
Jelly fish		present

Table 5. Estimated salmon caught in sardine fishery, 2000-2004. For 2000 and 2001, estimate is based on salmon/trip from observer data. For 2002 - 2004, estimate is based on log data.

Year	Salmon	Salmon / mt
2000	663	0.070
2001	491	0.038
2002	280	0.012
2003	500	0.020
2004	823	0.024

Incidental catch

The amount of incidental catch (landed non-target species) in 2004 was similar to past years, less than 1% of the total landings (Table 6). Mackerel, herring, squid and thresher shark were recorded on fish tickets. The increase in the number of species recorded as incidental catch in 2004 doesn't necessarily mean a higher level of incidental catch; more likely, some processors are being more accurate about recording all landings.

Table 6. Recorded incidental catch (mt) in Oregon sardine fishery, 2000-2004 (from fish ticket data).

Species	2000		2001		2002		2003		2004	
	mt landed	% of catch	mt landed	% of catch	mt landed	% of catch	mt landed	% of catch	mt landed	% of catch
Pacific mackerel	27.3	0.3	52.8	0.4	126.3	0.6	158.3	0.6	161.5	0.5
Jack mackerel	18.2	0.2	1.2	<0.1	0.3	<0.1	3.2	<0.1	24.1	0.1
Pacific herring	-	-	-	-	3.3	<0.1	-	-	10.3	<0.1
anchovy	-	-	-	-	0.2	<0.1	-	-	1.0	<0.1
shad	-	-	-	-	0.3	<0.1	-	-	1.2	<0.1
whiting	-	-	-	-	-	-	0.1	<0.1	-	-
thresher shark	-	-	-	-	-	-	0.3	<0.1	0.3	<0.1
squid	-	-	-	-	-	-	-	-	13.9	<0.1
jellyfish	-	-	-	-	-	-	-	-	5.5	<0.1

BIOLOGICAL SAMPLES

Staff collected 44 biological samples of 25 sardines each. Data collected from each fish included weight (gm), standard length (mm), sex, and maturity. Otoliths were extracted and sent to Washington Department of Fish and Wildlife (WDFW) for age-reading. Other data included on the data sheets were vessel, date, and location and depth of catch. Sex and maturity were determined using the maturity codes developed at the aging and maturing workshop in April, 2003 (Table 7).

Table 7. Sex and maturity stages of Pacific sardine (abbreviated).

Code	Description	
	Females	Males
1	Clearly immature - ovary is very small	Clearly immature - testis is very small
2	Not clearly immature - individual oocytes not visible	No milt evident and is not a clear immature
3	Yolked oocytes visible	Milt is present
4	Hydrated oocytes present	

The weight of individual fish ranged from 31 gm to 294 gm, with an overall average of 154 gm. Standard length ranged from 76 mm to 259 mm, with an overall average of 206 mm (Table 8, Appendix Table A).

The length of sardines harvested in Oregon continues to be large and showed a slight increase over 2003 (Figure 8). However, there was also an increase in the amount of small fish harvested, thus the smaller overall average size for 2004 (Table 8). In 2003, 15% of the fish were smaller than 200 mm in length; in 2004, 35% were smaller than 200 mm. The size composition of the harvested catch probably does not reflect the composition of the population off the Northwest as a whole. Harvesters reported actively avoiding schools of the very small fish, as they would plug the mesh of their nets.

Table 8. Average and range of weight (gm) and length (mm) of sardines sampled from Oregon sardine fishery, 2000-2004.

		2000	2001	2002	2003	2004
Weight (gm)	average	153.4	153.8	183.1	174.6	154.4
	range	79.9 - 273.3	46.4 - 241.0	83.2 - 301.6	29.0 - 279.0	31.3 - 293.6
Length (mm)	average	209	212	222	217	206
	range	118 - 257	145 - 256	116 - 260	70 - 300	76 - 259

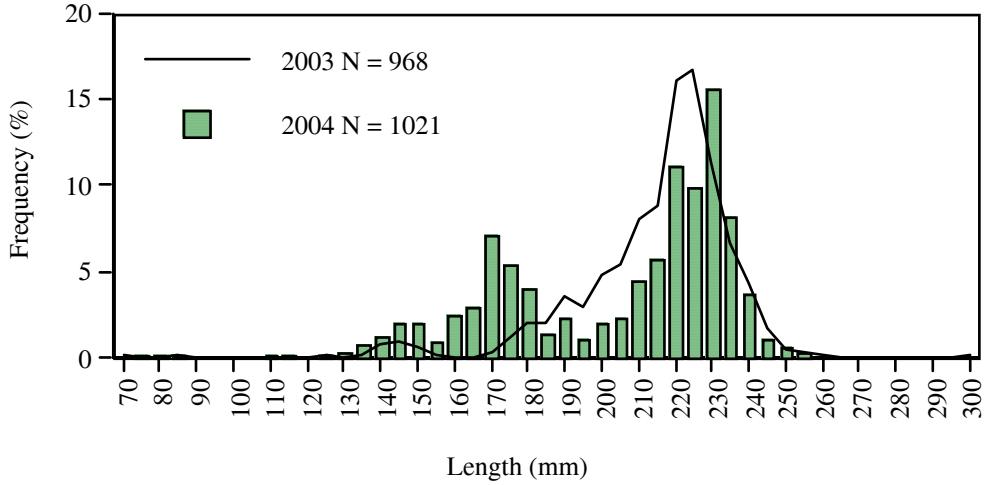

Figure 8. Length frequency (%) of sardines sampled in 2003-2004.

Oil Content

In addition to the regular biological samples, sardines were collected for testing of oil content. Oil content can be a factor in determining quality of fish for some markets and will vary over the season. Different processors test for oil content in different ways. Some prefer to test whole fish (in the round) and some prefer to dress the fish (head off and viscera removed). We tested our samples using both methods to possibly create a conversion factor between dressed and whole fish. Icelandic scales were used to determine fish oil content. The Icelandic scale method uses water displacement and oil density to measure oil content; the higher the oil content in the fish, the more the fish will float in fresh water. Two to four sub-samples were taken from nine different landings over the season. Three fish of similar size were measured as a group in each sub-sample.

Although, the oil content showed a general increase over the season (Figure 9), conclusion from these data can not be made at this time because of several sampling issues. Sample sizes were small and showed a wide variation within a sample (Appendix Table B). The reason for the larger variation between dressed and round samples toward the end of the season is unknown (Figure 9). One possible explanation is, later in the season, samples were generally not tested until a few days after they were collected, whereas samples taken earlier in the season were processed more quickly.

We are not sure how this might affect oil content. Also, we noticed that the fresh samples sometimes would have a significant amount of air in their swim bladder which might alter the results for the round fish.

Future samples would need to be larger, more frequent, and throughout the season to produce more data points. The testing would still be conducted using both round and dressed fish. The procedures may need to be modified to remove any air from the swim bladder.

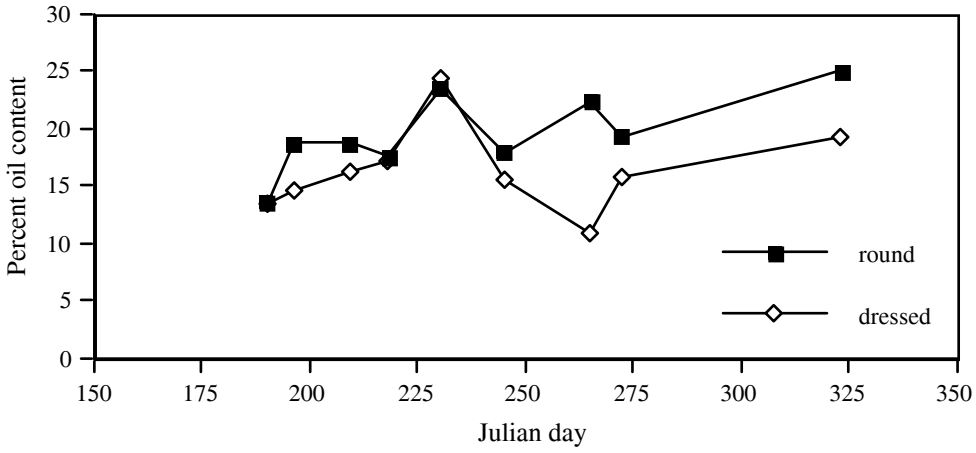

Figure 9. Average percent oil content for round and dressed samples of sardines, 2004.

ACKNOWLEDGMENTS

Many big thanks go to: Zach Forester and Cathy Nist for their at-sea observations, and collecting and working up biological samples and logs; Scott Groth, Christina Durham, and Sheryl Manley for help with data analysis; Washington Department of Fish and Wildlife for aging otoliths; and all the vessel skippers, crew members, and processors for their cooperation.

Appendix Table A. Data summary for 2004 Oregon sardine biological samples.

Sample date	Julian day	No. of males	No. of females	No. of unknown	Ave. wt (gm)	Ave.len (mm)	% Maturity code				
							1	2	3	4	5
6/17/04	169	10	15		184.1	233	0	12	36	28	24
6/17/04	169	13	12		176.3	227	20	64	16	0	0
6/22/04	174	9	16		180.4	226	16	64	20	0	0
6/24/04	176	11	13		194.3	228	46	46	8	0	0
6/24/04	176	9	16		193.5	228	32	68	0	0	0
7/2/04	184	10	15		186.8	231	8	48	40	4	0
7/5/04	187	12	13		200.8	227	0	88	12	0	0
7/8/04	190	10	13	2	166.5	215	8	92	0	0	0
7/14/04	194	9	16		200.4	225	56	32	12	0	0
7/14/04	196	7	18		211.8	229	64	36	0	0	0
7/18/04	200	12	13		210.3	233	44	28	28	0	0
7/20/04	202	8	17		207.8	226	24	72	4	0	0
7/20/04	202	12	13		195.2	222	44	56	0	0	0
7/25/04	207	11	14		209.4	231	60	40	0	0	0
7/25/04	207	9	16		202.3	230	8	76	16	0	0
8/5/04	218	11	14		198.0	223	32	56	12	0	0
8/7/04	220	10	14		184.7	199	13	54	29	4	0
8/8/04	221	12	13		181.5	216	48	44	8	0	0
8/10/04	223	12	13		188.1	214	64	36	0	0	0
8/10/04	223	9	16		161.8	208	20	80	0	0	0
8/16/04	229	13	12		214.9	229	32	68	0	0	0
8/16/04	229	11	14		164.6	206	80	20	0	0	0
8/16/04	229	10	15		181.9	213	80	20	0	0	0
8/16/04	229	10	15		198.3	215	84	16	0	0	0
8/23/04	236	10	14	1	72.6	169	100	0	0	0	0
8/30/04	243	12	13		140.3	198	72	24	4	0	0
8/30/04	243	8	17		205.1	230	40	60	0	0	0
9/6/04	245	9	16		179.2	218	68	32	0	0	0
9/1/04	250	9	16		87.0	175	80	20	0	0	0
9/21/04	265	12	13		79.5	175	100	0	0	0	0
9/21/04	265	9	16		76.5	172	100	0	0	0	0
9/22/04	266	10	15		82.8	176	100	0	0	0	0
9/28/04	272	5	20		82.3	175	100	0	0	0	0
10/5/04	279	1	10	14	41.9	142	100	0	0	0	0
10/12/04	286	7	18		87.8	181	28	68	4	0	0
10/14/04	288	8	15	2	79.7	175	92	8	0	0	0
10/15/04	289	2	16	7	64.3	159	84	16	0	0	0
11/18/04	323	12	12		173.8	224	29	71	0	0	0
12/2/04	337	8	17		170.4	226	0	92	8	0	0
12/15/04	350	10	13	2	69.0	168	100	0	0	0	0
12/18/04	353	8	15	2	49.7	156	100	0	0	0	0
total		390	602	30	154.4	206	53	39	6	1	1

Appendix Table B. Data for Oregon sardine fat content samples, 2004.

Date	Weight (gm) of individual fish	Percent fat	
		round	dressed
7/8	40.1 36.0 49.8	14	15
	173.2 190.8 159	13	12
	sample average	13.5	13.5
7/14	195.3 195.5 192.2	18	11.5
	249.7 209.2 228.7	19.5	17.5
	sample average	18.8	14.5
7/27	211.7 241.3 246.2	21	18
	220.8 213.5 223.6	16	13
	233.4 254.9 210.5	19	18
	sample average	18.7	16.3
8/5	168 162.2 166.3	17.5	17
	222.1 236.4 223.6	17.5	17.5
	sample average	17.5	17.3
8/17	179.4 176.2 176.5	25	25
	181.1 189.9 199.6	22	23
	198.2 193.4 194.7	24	24.5
	218.6 228.5 214.4	23	24.5
	sample average	23.5	24.3

Date	Weight (gm) of individual fish	Percent fat	
		round	dressed
9/1	70.3 61.5 63.0	19	16
	103 101.1 115.8	16.5	15
	123.5 145.7 130.3	17	13.50
	174.9 169.7 191.4	19	17.50
	sample average	17.9	15.5
9/21	61.3 62.3 64.1	25	10.50
	76.6 73.9 65.0	19.50	11.50
	sample average	22.3	11
9/28	74.0 73.1 75.6	22	15
	69.6 66.4 66.3	15	14
	83.2 90.7 82.5	21	18
	sample average	19.3	15.7
11/18	196.0 186.7 194.2	25	25
	200.8 203.3 204.9	25	20
	213.9 200.6 203.6	25	13
	sample average	25	19.3