



Oregon's Sardine Fishery  
2009 Summary

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April 2, 2012

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## **Fishery Management**

Pacific Sardine (*Sardinops sagax*) management has been transformed over the recent decade as a result of biological and industry changes in the directed sardine industry coast-wide. Below is a brief overview of the federal and state management plans.

### **Federal Fishery Management Plan**

In the past, sardines were only managed by the individual states of California, Oregon, and Washington. In 1999, the Pacific Fishery Management Council's Amendment 8 [Coastal Pelagic Species Fishery Management Plan](#) (formerly the Northern Anchovy Fishery Management Plan) placed Pacific Sardine (*Sardinops sagax*), Pacific mackerel (*Scomber japonicus*), Jack mackerel (*Trachurus symmetricus*), and market squid (*Loligo opalescens*) in a management unit with Northern anchovy (*Engraulis mordax*). Under the plan, an annual coast-wide harvest guideline (HG) for sardines was established beginning in 2000 (Table 1). The HG is based on annual sardine biomass assessments and a harvest control rule defined in the Fishery Management Plan.

From 2000 to 2001, the coast-wide HG was allocated 2/3 to southern California and 1/3 to northern California (north of Morro Bay), Oregon, and Washington. In 2002, the Council adopted an interim allocation system for the 2003-2005 seasons that changed the definition of the sub areas and other rules by the following:

- Moved the geographical boundary between sub area A and B from 35 degrees 40 minutes to 39 degrees latitude (Point Arena California).
- Moved the date for un-harvested allocation from October 1 to September 1.
- Changed the percent reallocated from 50% for both areas to 20% for sub area A and 80% for sub area B.
- Reallocated all un-harvested sardines that remained on December 1, coast-wide.

Discussions to design a new long-term allocation system began in 2004 and in June 2005, the Council approved the new allocation formula for Pacific sardines which released allocations of fish coast wide at three set calendar dates rather than to northern and southern areas. The new allocation framework was implemented for the directed Pacific Sardine fishery under Amendment 11 of the Coastal Pelagic Species Fishery Management Plan in 2006:

1. January 1: 35% of the HG to be allocated coast-wide;
2. July 1: 40% of the HG, plus any portion not harvested from the initial allocation, to be reallocated coastwide;
3. September 15: the remaining 25% of the HG, plus any portion not harvested from earlier allocations, to be reallocated coastwide.

Based on a biomass estimate of 662,886 mt the coast wide maximum HG for Pacific sardine was set at 66,932 mt for 2009 in accordance with the Coastal Pelagic Species Fisheries Management Plan (CPS FMP) and procedures for the annual management cycle of Coastal Pelagic Species Fisheries. This was a 25% decrease from the 89,093 mt HG set in 2008. A set aside of 1,200 mt from the HG was established

for an exempted fishing permit (EFP) to allow for an industry sponsored research project to take place during the 2<sup>nd</sup> allocation period. An incidental catch set-aside of 6,500 mt was established to prevent premature closure of other fisheries by allowing for restricted incidental landings of Pacific sardines in fisheries targeting other species. Thus, the directed sardine fishery opened under an initial overall HG of 59,232 mt. In accordance with the recommendation of the Pacific Fishery Management Council (PFMC), in June the set aside for the EFP was increased from 1,200 to 2,400 mt by taking 750 and 450 mt from the directed fishery second and third allocation periods, respectively. The application for an [EFP to conduct a West Coast Sardine Survey](#) was approved and the EFP was issued in July. Table 2 summarizes the 2009 allocation of the coast wide sardine HG. Note that any of the incidental set-aside that is not taken during an allocation period was added to the next allocation period.

## **State Management**

Like Oregon, California and Washington manage their directed sardine fishery programs. All three states are required to be consistent with the Federal Fishery Management Plan. From 1999 to 2005, the Oregon sardine fishery was managed through Oregon Department of Fish and Wildlife (ODFW) Developmental Fisheries Program which limited the number of harvest permits sold. In December 2005, the ODFW Commission moved the Pacific sardine fishery from a developmental fishery into a state run limited entry fishery system. Since 2005, a number of revisions have been made to the limited entry permit system involving number of permits and renewal requirements. Details of changes can be found in ODFW sardine fishery reports for previous years.

## **Changes in Sate Management of the Sardine Fishery in 2009**

All sardines allocated to the directed fishery were harvested before the end of September 2009. Sardine industry participants expressed a number of concerns after the 2008 fishing year ended. ODFW held three public meetings in late 2008 and early 2009 to discuss with stakeholders the potential changes to the management of the Oregon sardine fishery. Several changes to the management of the Oregon sardine fishery were put into place for 2009. The changes adopted by the Commission in April 2009 include:

- 1) The minimum landing requirements for permit renewal was eliminated for years that the federal coast wide harvest guideline was set at  $\leq 100,000$  mt.
- 2) Catch sharing was restricted to permitted catching vessels that had previously landed sardines in the current year, had functional seine gear on the vessel, and was limited to 20% of landings.
- 3) Requirements that the owner/operator be aboard a permitted vessel were eliminated.
- 4) A provision for a lottery system to issue available permits not in use was instituted.

## **ODFW Fishery Goals and Objectives**

The goals for this year's work were to continue to gather information on sardines off Oregon and to continue to improve the coast-wide stock assessment of sardines and document the extent of by-catch in the fishery. The goal was also to monitor and observe the EFP fishing operations and catch landed in Oregon.

Objectives include:

- Collect size, age, and distribution data of adult sardines from harvest areas off Oregon and to support stock assessments and fishery resource monitoring.
- Document by-catch, in terms of species, amount, and condition. Recommend management measures to reduce by-catch if necessary.
- Document harvest methods and distribution of harvest.
- Continue efforts to observe vessel fishing activity at sea.
- Observe EFP operations and monitor catch.

## **Oregon Sardine Fishery for 2009**

The 2009 season proved challenging for Oregon's sardine directed fishing industry due to another significant decrease of the HG from prior years. The 2008 HG was the first to fall below 110,000 mt since an annual coast-wide HG was set beginning in 2000 (Table 1). The HG in 2008 was 42% less than in 2007. The HG for 2009 was 25% less than in 2008 and the set asides for industry sponsored research and incidental catch in other CPS fisheries further reduced the allocation to the directed fishery (Table 2). The directed sardine fishery closed early in all three allocation periods for the second year in a row because the harvest allocation was projected to be reached before the end of each period. The directed fishery was open for 75 of 365 days or 20.5% of the fishing year. The first allocation period closed February 20, 2009. The industry's ability to efficiently catch and process sardines combined with the reduced HG, good market conditions, and good weather in California (where all the sardines were caught during this period) all contributed to the early closure. Thus, the first of the three allocation periods was unavailable for Oregon fishermen who had typically started landing sardines in mid-June in previous years. The Oregon sardine fishery was open for a total of 25 fishing days during the second and third allocation periods in 2009. The second coast-wide allocation period commenced on July 1 and was open for 17 days. The third allocation period was open for 8 days, from September 15 through September 22. The harvest of sardines in Oregon was 20,298 mt in 2009.

Off Oregon weather events such as: storms, heavy fog, and or high seas are major factors in the success rate for catching sardines. These types of events make it difficult to predict how many pounds of sardines will be delivered during any given day (Figure 1). Other variables that can affect Oregon based fishermen is the quality of the sardines. Belly thickness, quantity of food in the stomach tissues, average size of the fish, and oil content can all influence the quality of the fish. All of these factors can affect the ex-vessel price paid to the fishermen. Sardines caught in the summer months in the areas of Oregon and Washington are feeding in the productive nutrient rich waters. During this time, the fish are increasing their oil content or "fat". High oil content is important in the palatability for human consumption. The peak in oil content for sardines off Oregon and Washington generally occurs in August and September, which coincides with the peak months of sardine landings in Oregon from 2005 - 2007 (Figure 2).

Sardine fishing in Oregon and Washington waters is a day time operation. When possible, spotter planes are used to assist fishing vessel captains in locating schools of fish. The spotter plane pilots and the fishing boat captains work as a team in increasing the efficiency in catching sardines. When fishermen are successful at rounding up their catch, distances to processors can be a factor. Processing facilities in Oregon are located in the Astoria area. Tides, currents, and contending with the Columbia River all produce challenges in the cost of fuel and predictably of the sardine fishery. Most offloads begin in the

mid to late afternoon and/or at night. It is rare for a fisherman to make more than one landing in a twenty four hour period.

## **Landings & Effort**

The first directed landing of sardines into Oregon since 1948 occurred in 1999 for a total of 1.7 million pounds (776 mt) by three vessels. The highest landings took place in 2007, with over 152 million pounds (69 mt) landed (Table 1).

August and September have generally been the months with the highest rate of landings. However, because of decline in the HG and the early closure of allocation periods described above, much of this peak fishing period of prior years was not available to Oregon fishermen in 2009 (Figures 1 and 2). These changes led to a derby style fishery. Fishermen fished earlier and harder in July and also fished hard while the fishery was open in September. The HG for the second and third periods was exhausted quickly. The third coast-wide allocation period was open for eight days. Oregon's total landings for the third and final allocation period were 15,716,055 lbs, (7,129 mt) of sardines. The port average daily landings for the second allocation and third allocation periods were 1,707,806 lbs, (775 mt) and 1,964,507 lbs. (891 mt) respectively. Individual vessel landings ranged from 18,727 lbs (8.76 mt) to over 439376 lbs. (113.8 mt) (Figure 3).

All Oregon landings occurred in allocation periods 2 and 3 when Oregon harvested approximately 31.3% of the coast wide total landings in 25 days of fishing (Table 3). California landed in all three periods harvesting 56.4% and Washington landed 12.3% of the total during periods 2 and 3.

A total of 371 landings were made to eight different processors throughout Warrenton and Astoria.

Occasionally, vessels set on fish that exceed the capacity of the vessel and will often share the fish with another vessel. Rather than releasing the fish, the vessel will hold the fish in the net and allow another vessel to pump from the first fishing vessels net. According to logbook information approximately 1,080,000 lbs (490 mt) were shared between vessels.

Although twenty-five permits were issued, only twenty permits were actively utilized in the 2009 fishery (Table 1). The top three vessels targeting sardines and landing into Oregon accounted for 27.9% of the harvest.

## **Fishery Value**

The 20,298 mt of sardines landed in Oregon continues to have a strong market for both human consumption and bait. Sardine value varied from zero to \$0.12 per pound. Approximately 97% of the sardine landed was sold for at least \$0.06 per pound, with approximately 54% selling for \$0.12 per pound or more. The ex-vessel value of the 2009 sardine fishery in Oregon was approximately \$5.0 million, the third highest on record (Table 1). It is noteworthy that even with the major decline in HG the value of the fishery is still very high.

## **Non Target Species**

Oregon's sardine permit rule stipulates that an at sea observer is required to be allowed on the vessel when requested by ODFW. Currently ODFW does not have personnel dedicated to observe on sardine vessels and document by-catch of non-target species. Available staff made attempts to observe trips, however, only one of the 371 trips (0.2%) had an observer on board.

Oregon's limited entry sardine permit rules require fishermen to report in the logbook incidental catch including salmonids and other species. Logbook data indicate approximately 611 sets were made of which 81% of sets were successful for catching sardines. The estimated total catch of salmon for the fishery, based on log data, was 241 salmon (Table 4). The incidental catch rate was 0.012 salmon per mt of sardines landed. An estimated 52.3% of all the salmon netted were released alive. Other non-target species caught in the 2009 season included Pacific and jack mackerel, Pacific herring, Northern anchovy, and dog sharks (Table 5).

## **Area of Catch**

Log books provide information on time of day, fishing location, depth and water temperature. Of the 611 sets made, 351 (57%) were made before twelve noon. The southernmost set was made off Tillamook Head and the most northern set was made off of Grays Harbor Washington (Figure 4). Depths recorded in log books ranged from 5 to 100 fathoms with the average being 33 fathoms and the median depth being 34 fathoms. Water temperatures recorded ranged from 49 to 63 degrees Fahrenheit, with the average and median being 56.8 and 56 degrees, respectively. Approximately 37 % of the sardines were caught off the Oregon coastline, with the remainder caught off Washington.

## **Biological Collections**

Collection of biological data from the directed sardine fishery started in 2000. Data collected from each fish includes: weight in grams (g), standard length in millimeters (mm), sex, and maturity stage. Sex and maturity are determined by using the maturity codes system developed at the aging and maturity workshop as an extension of the Annual Trilateral Sardine Forum in April, 2003 (Table 6). Under the direction of the Pacific Fishery Management Council's Coastal Pelagic Species Management Team, biological sampling was based on a formula proportional to the number of metric tons landed in the ports in Oregon. The goal of four fish samples (25 fish per sample) for every 1,000 mt landed is the current guideline. In 2009, the ODFW staff collected 83 biological samples; 34 samples were collected in the second allocation period and 49 in the third period. All of the otoliths collected were sent to the Washington Department of Fish and Wildlife for age reading.

## **Weight, Length, Maturity and Age**

The Oregon sardine fishery typically catches fish between two and five years old with some variation from year to year. Fish selectivity (catch of fish targeted by sizes) varies from year to year and the presence of dominant year classes may be seen. Age data for 2009 fishery samples showed fish ages between two and nine years with a dominant year class of five year old fish (Figure 5 & 6). The age composition reflects the age of fish caught and not necessarily all ages of fish in the population. Fish sampled in 2009 ranged from 48 g to 211 g, with an overall average of 124 g. Standard length ranged

from 145 mm to 243 mm, with an overall average of 197 mm (Table 7 & Figure 7). Age information is shown for years 2004-2009 (Figure 9).

Maturity of sampled fish is determined by visual inspection according to standards agreed upon at the Trilateral Sardine Forum in 2004:

#### Gross Anatomical Maturity Classification System

##### FEMALE - OVARY

- 1 - Clearly Immature: oocytes not visible, ovary is very small, translucent/clear and thin but with rounded edges (torpedo shape).
- 2 - Intermediate: Individual oocytes are not visible to unaided eye (no visible yolk or hydrate oocytes in the ovaries) and ovary is not clearly immature. This includes possible maturing and regressed ovaries.
- 3 - Active: Yolke oocytes visible, any size or amount as long as you can see them by the unaided eye in ovaries. This includes the smaller opaque oocytes (around 0.4-0.5 mm) to the large yellowish oocytes (about 0.6-0.8mm). If hydrated oocytes are also present, then classify ovary as "stage 4".
- 4 - Hydrated oocytes present, yolke oocytes may or may not, also be seen; any amount of hydrated oocytes (large and transparent) qualifies for this class from few to many or even if loose or "oozing/running" from ovary.

##### MALE – TESTIS

- 1 - Clearly Immature: testis is very small, knife-shaped, translucent/clear, and thin with a flat ventral edge.
- 2 - Intermediate: no milt evident and is not clearly immature; includes maturing or regressed testes
- 3 - Milt is present: either oozing from pore, in the duct, or when testis is cut with a knife.

Most of the fish (98 %), both male and female, for 2009 were a maturity code 2, intermediate (Figure 8). Only a handful (2%) of fish showed signs of maturity stage 3. Females within the maturity code guideline have an additional 4<sup>th</sup> stage. There was only one female sampled that was category stage 4.

## Acknowledgments

Many thanks to Washington Department of Fish and Wildlife for aging otoliths, Carol Henry of WDFW, California Department of Fish and Game, and all the skippers, crew members, and processors for their assistance, Robert C. Ireland from ODFW for the GIS work.



Table 1. Comparison of Oregon Sardine Fisheries 2000-2009

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Coast-wide harvest guideline (mt)	186,791	134,737	118,442	110,908	122,747	136,179	118,936	152,654	89,093	66,932
Initial northern allocation (mt)	62,264	44,912	39,481	36,969	40,917	45,393	--	--	--	--
Permits issued	15	20	20	20	20	20	26	26	25	25
Vessels targeting sardine	14	18	17	17	19	20	16	22	22	20
Landings by targeting vessels	349	453	657	712	939	1,090	766	877	471	371
Average landing (mt)	60,183	62,260	76,208	78,207	84,761	91,216	102,599	105,960	104,171	114,754
Total OR directed fishery landings (mt)	9,528	12,798	22,771	25,258	36,111	45,110	35,648	42,151	22,949	20,298
Start date	14-Jun	04-Jun	10-Jun	22-Jun	08-Jun	26-Apr	29-Jun	07-Jun	01-Jul	01-Jul
End date	12-Oct	05-Oct	14-Oct*	02-Oct	17-Dec	18-Oct	18-Oct	13-Oct	22-Sep	23-Sep
# of buyers	3	5	7	7	8	10	7	8	8	8
Average ex-vessel price/lb	\$0.05	\$0.06	\$0.05	\$0.05	\$0.05	\$0.05	\$0.05	\$0.05	\$0.11	\$0.11
Total value of Sardine Fishery	\$1,108,126	\$1,547,878	\$2,633,988	\$2,718,336	\$4,596,848	\$5,550,238	\$3,714,520	\$4,539,791	\$5,659,963	\$4,980,577
Percent of Sardines Harvested Off Oregon (Log Data)	75%	73%	90%	65%	59%	39%	43%	53%	67%	37%

**Table 2.** Coast wide allocation for directed sardine fishery, 2009.

	Jan 1 - June 30	July 1- Sept 14	Sept 15 - Dec 31	Total
Coastwide Maximum HG (mt)				66,932
EFP Set Aside				1,200
Seasonal Allocation (mt)	23,006	26,293	16,433	65,732
Incidental Set-Aside	1,000	1,000	4,500	6,500
Initial Directed Fishery Allocation	22,006	25,293	11,933	59,232

**Table 3.** Directed sardine landings (mt) into Oregon, Washington, and California, 2009.

Allocation Periods	Oregon	Washington	California	Total
*Period 1 <i>Jan 1- Jun 30</i>	0	0	20,560	20,560
**Period 2 <i>July 1 - Sept 14</i>	13,169	4,580	11,290	29,039
***Period 3 <i>Sept 15 - Dec 31</i>	7,129	3,429	4,695	15,253
Total	20,298	8,009	36,545	<b>64,852</b>
Percent by State	31.3%	12.3%	56.4%	

\* Period 1 closed, February 20, 2009

\*\*Period 2 closed, July 18, 2009.

\*\*\*Period 3 closed, Sept 23, 2009.

**Table 4.** Estimated number of salmon caught in directed sardine fishery based on log book data and at sea observers, 2000-2009.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total Salmon recorded	206	472	274	460	823	541	257	519	198	241
Salmon/trip	0.6	1.1	0.4	0.7	0.9	0.5	0.03	0.6	0.4	0.7
Salmon/mt	0.02	0.04	0.013	0.02	0.023	0.013	0.007	0.012	0.008	0.012
% of logs turned in to ODFW	94%	93%	95%	88%	95%	92%	97%	99.9%	100%	100%

**Table 5.** Recorded incidental catch in metric tons from fish tickets, 2001-2009.

	2001	2002	2003	2004	2005	2006	2007	2008	2009
Pacific mackerel	52.8	126.3	158.3	161.5	316.1	665	699.7	58.1	49.5
Jack mackerel	1.2	0.3	3.2	24.1	3.6	1.4	8	1.6	2
Pacific herring	-	3.3	-	10.3	0.1	1.2	-	55.8	-
Northern anchovy	-	0.2	-	1	68.4	8.6	-	2.4	-
American shad	-	0.3	-	1.2	-	0.44	-	0.3	-
Pacific hake	-	-	0.1	-	-	-	-	-	-
Sharks	-	-	0.3	0.3	0.4	0.16	0.14	0.01	1.1
Squid	-	-	-	13.9	-	-	-	-	-
Jellyfish	-	-	-	5.5	-	-	-	-	-

**Table 6.** Maturity stages of Pacific sardine (abbreviated) for males and females.

Code	Females - Description	Males - Description
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	

**Table 7.** Weight and length data for directed sardine fishery, 2000-2009.

Year		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Weight (gm)	average	153.4	153.8	183.1	174.6	154.4	87.2	117.9	109.6	121.8	123.7
	range	79.9 - 273.3	46.4 - 241.0	83.2 - 301.6	29.0 - 279.0	31.3 - 293.6	29.4 - 222.0	77.2 - 241.1	67.3 - 270.2	53.9 - 232.2	48.2 - 211.0
Length (mm)	average	209	212	222	217	206	174	194	196	199	197
	range	118 - 257	145 - 256	116 - 260	70 - 300	76 - 259	120 - 287	174 - 254	170 - 271	118 - 257	145 - 243
Number of fish sampled		940	1,000	1,549	968	1,024	399	300	2,075	2,000	2,075

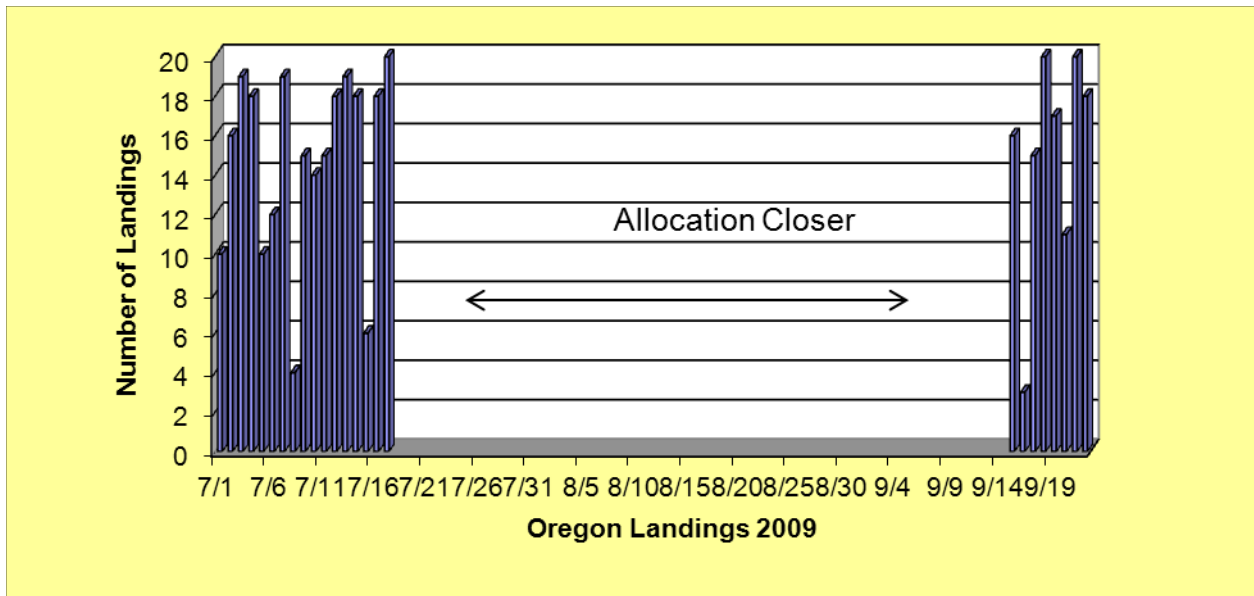


Figure 1. Daily landings by vessel during the second and third allocation period for Oregon 2009 season.

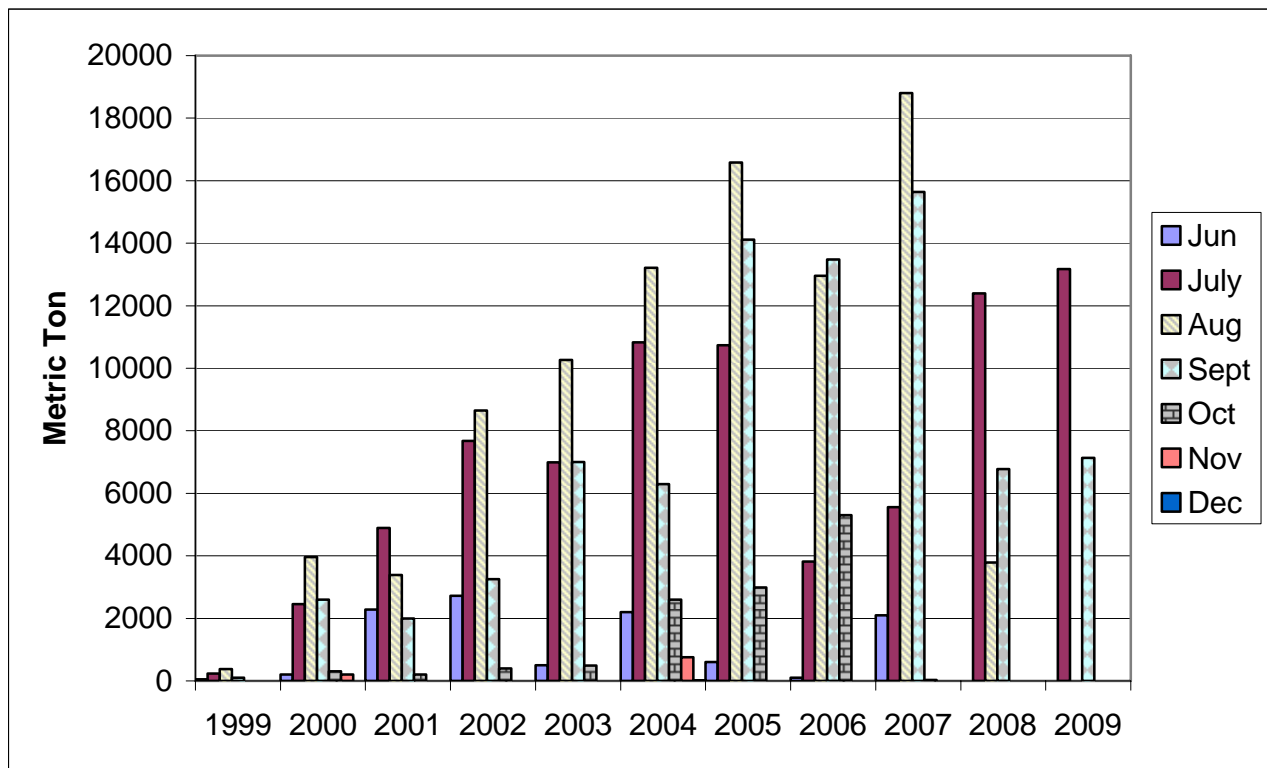
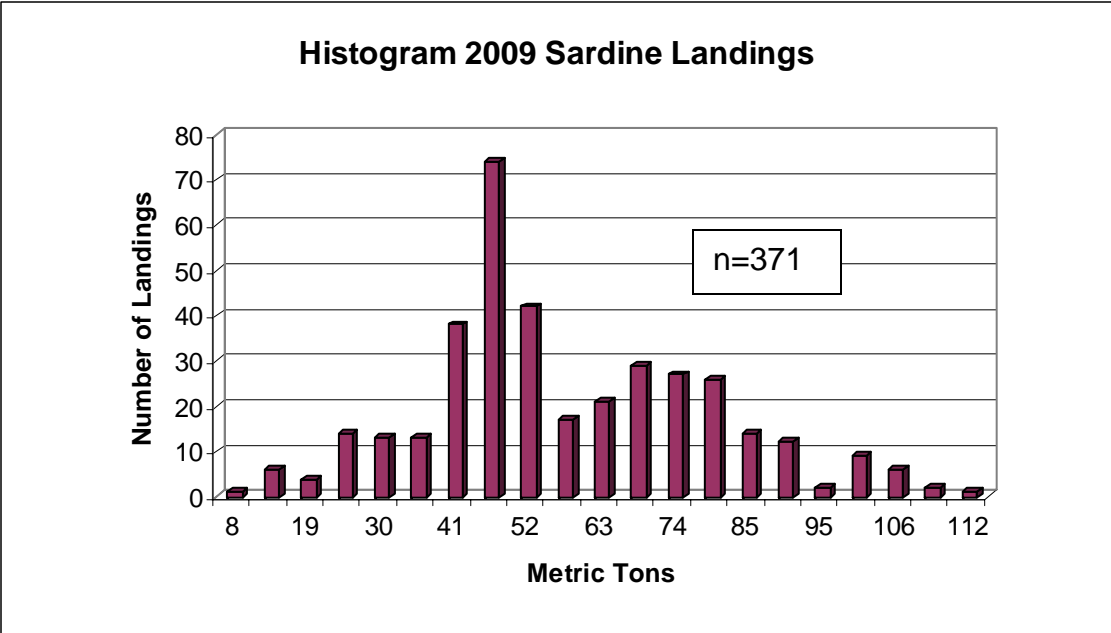
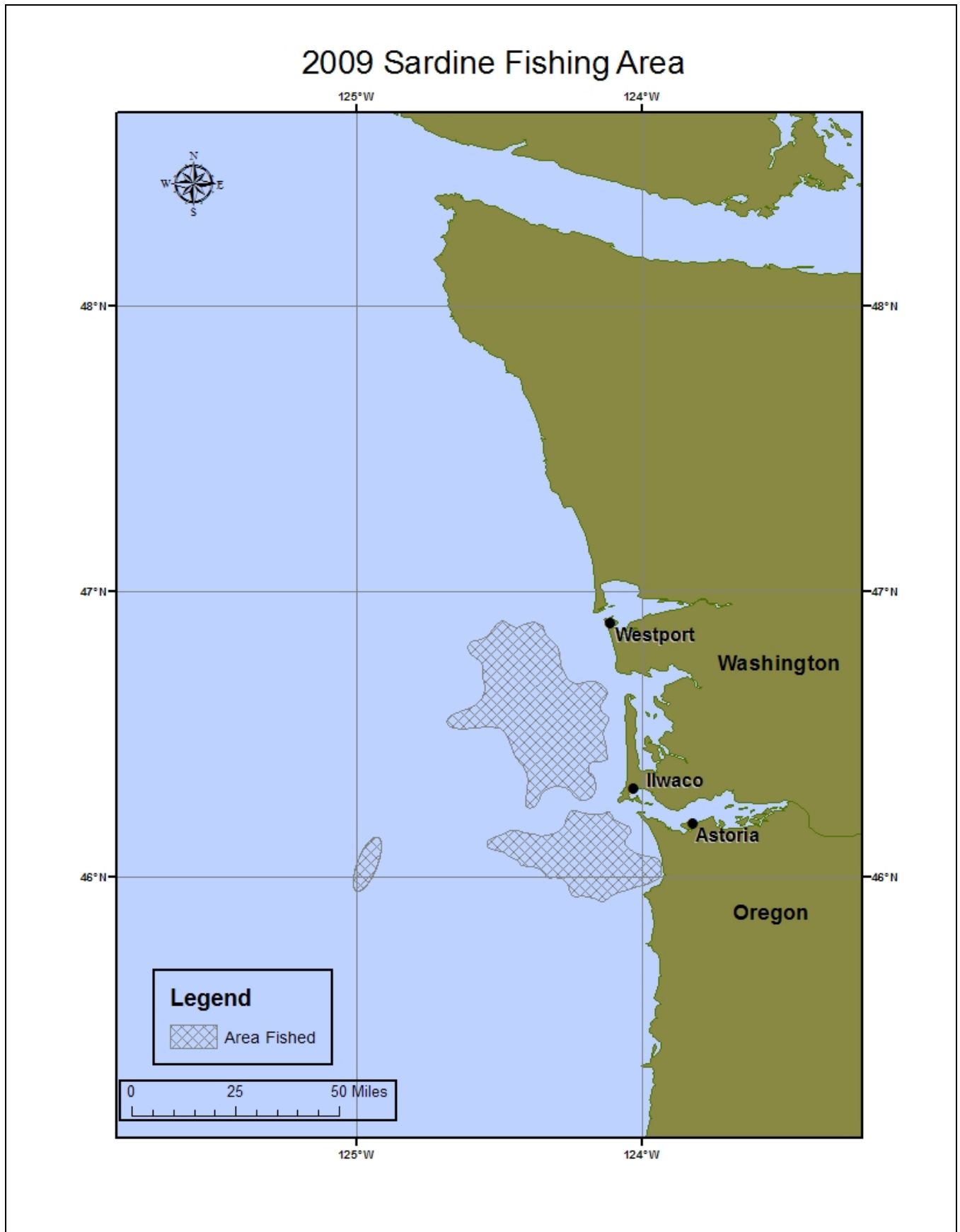


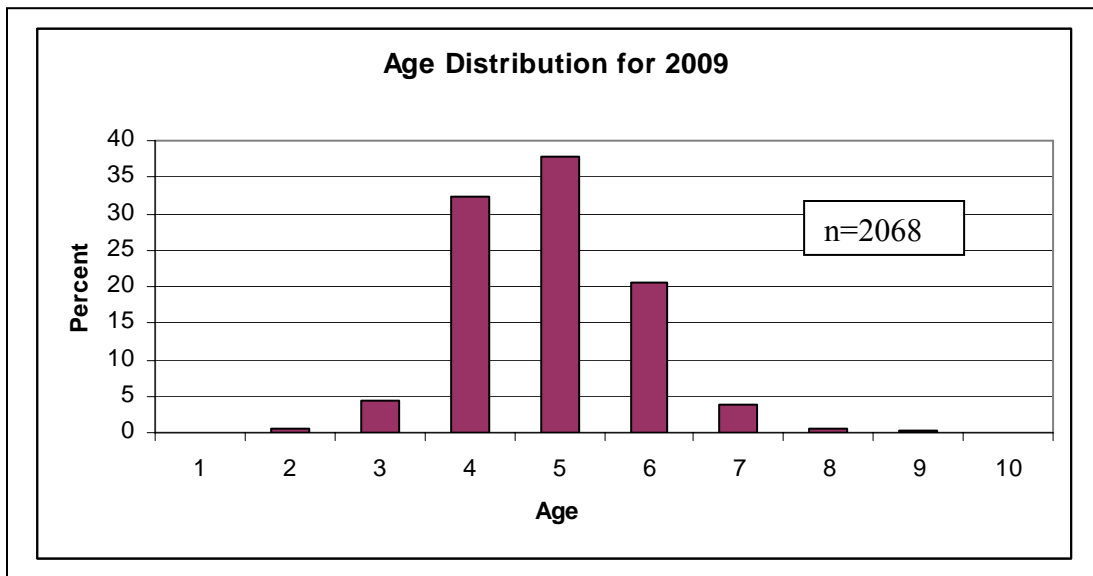
Figure 2. Annual landings (mt) of sardines into Oregon by month, 1999-2009.



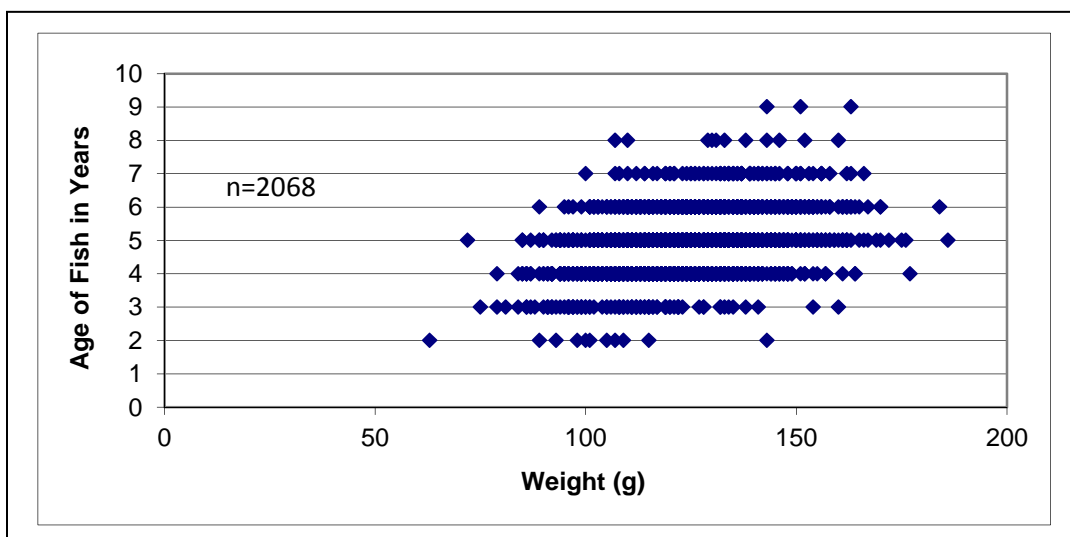
**Figure 3.** Weight of sardines (mt) per landing, 2009.



**Figure 4.** Locations of sets and samples of sardines from log book data 2009.

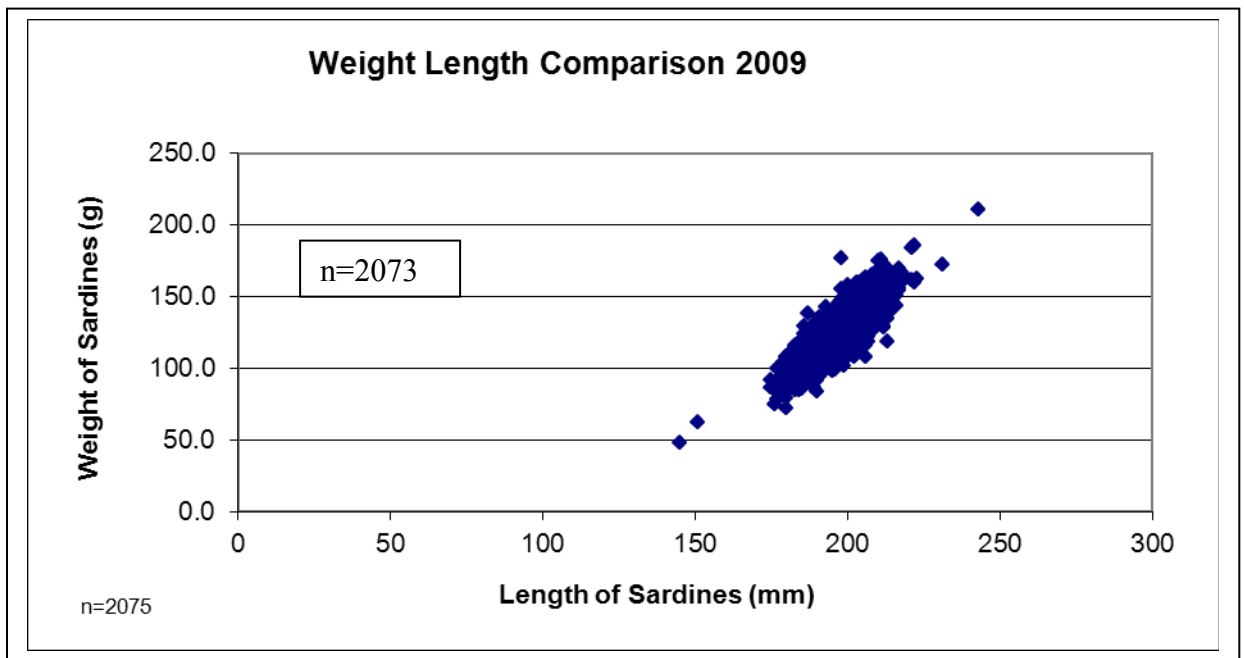


**Figure 5.** Age frequency (%) of sardines sampled, 2009.

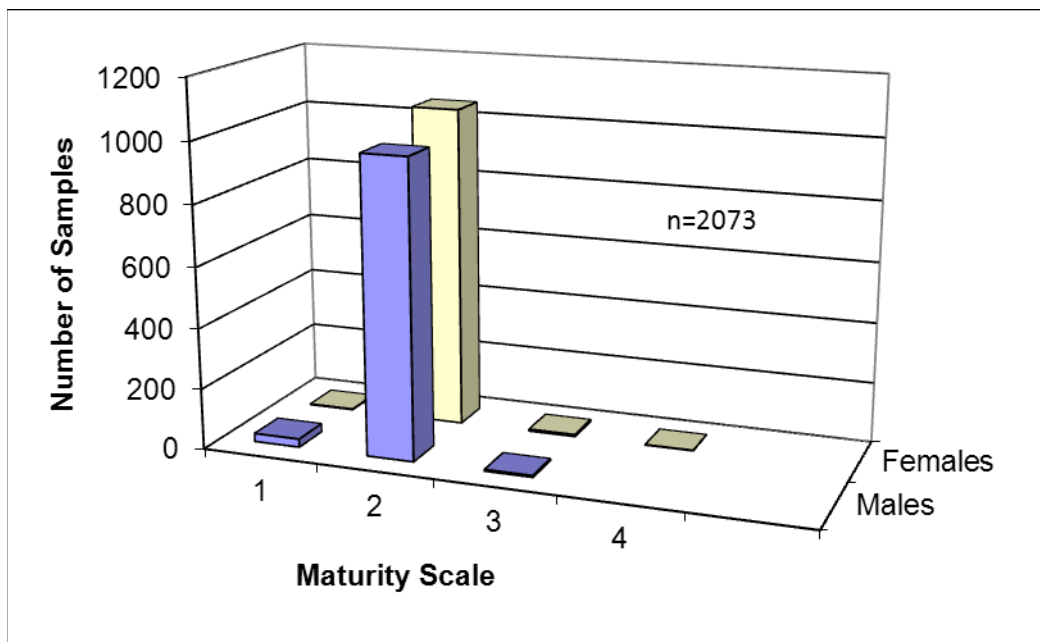


**Figure 6.** Comparison of age and weight of sardines sampled, 2009





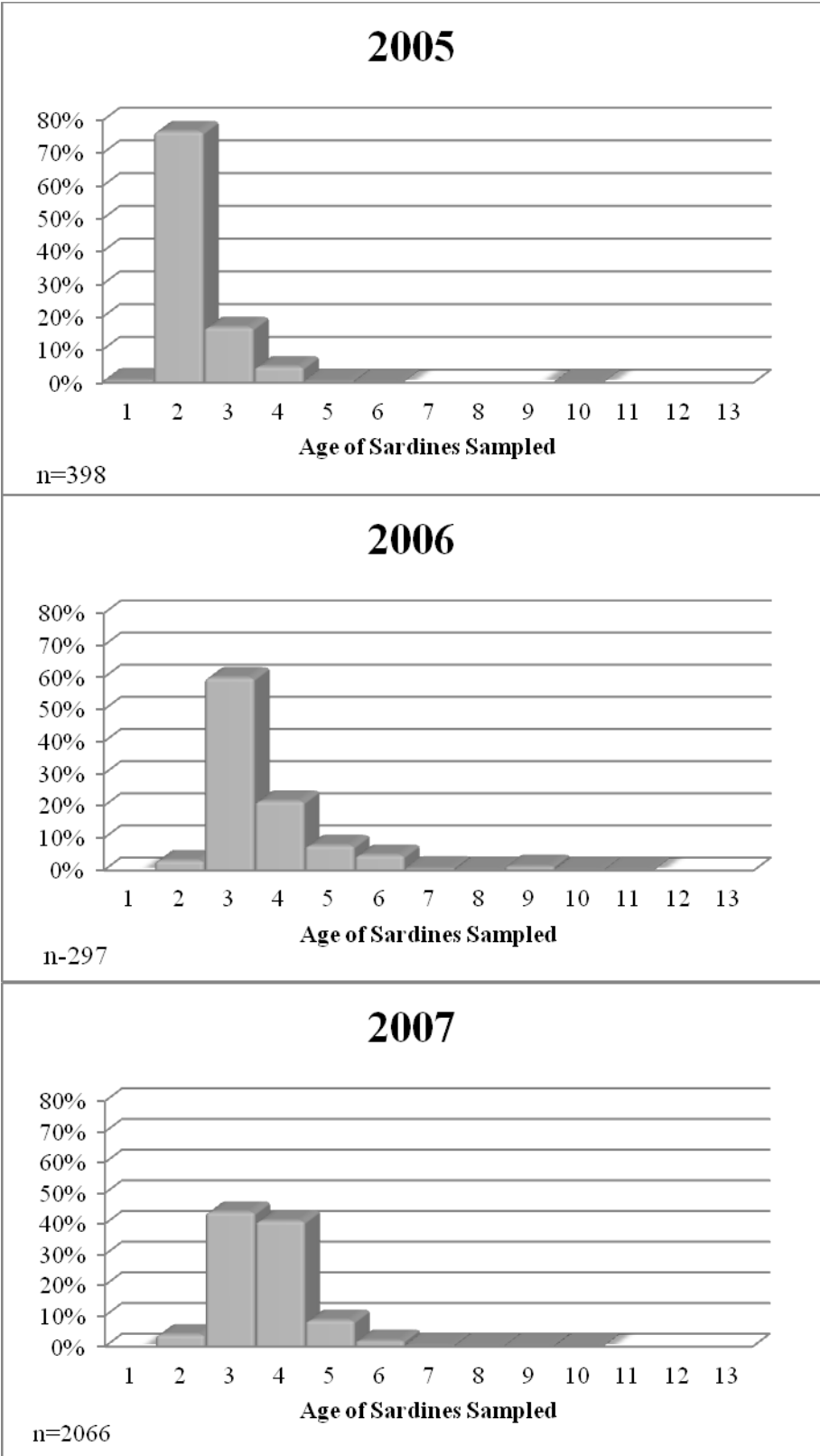
**Figure 7.** Comparison of weight and length of sardines sampled, 2009



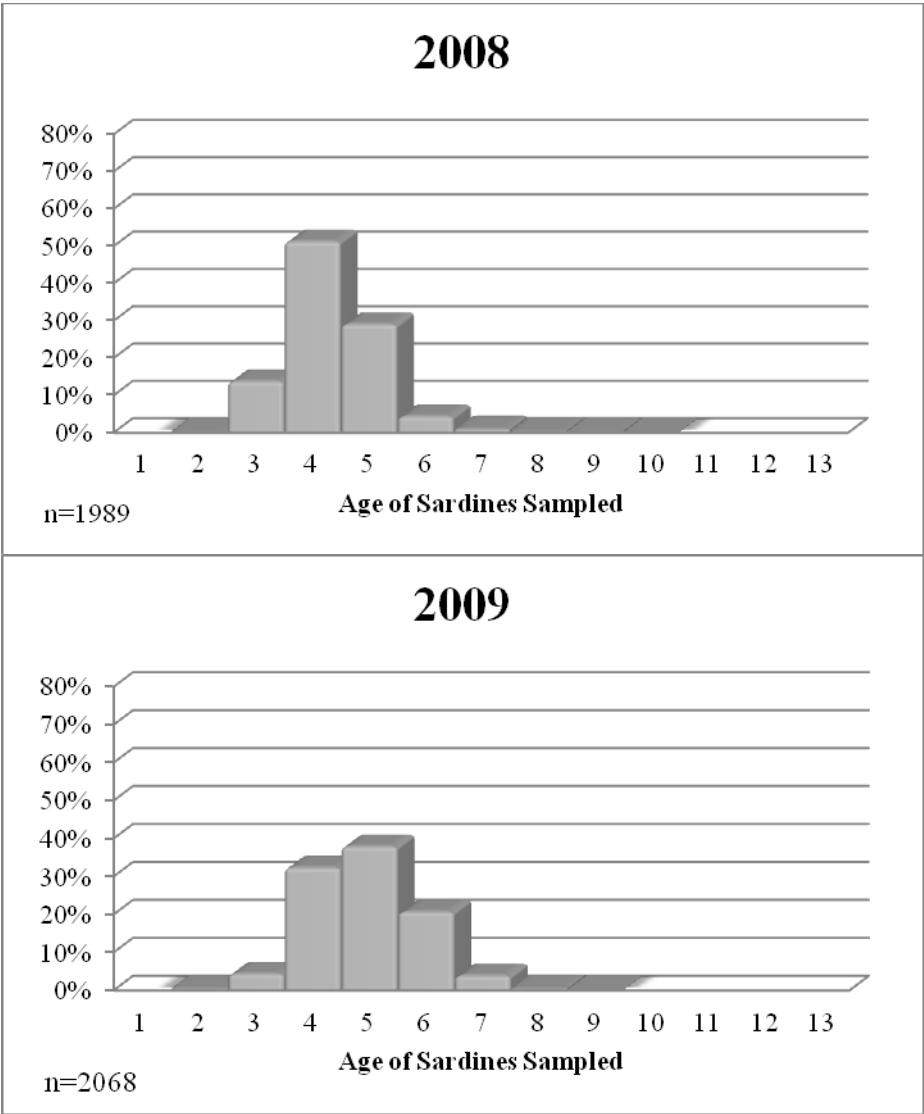
**Figure 8.** Maturity levels for both male and females of sardines sampled, 2009  
 \* Maturity level 1 is least mature and no level 4 for Males, see table 6 for clarification.



**Figure 9.** Age composition of sardines sampled 2004-2009 (continued next pages).



**Figure 9 (continued).** Age composition of sardines sampled 2004-2009.



**Figure 9 (continued).** Age composition of sardines sampled 2004-2009.