

## **2009 BOTTOM TRAWL SURVEY OF GROUND FISH RESOURCES IN THE GULF OF ALASKA**

Prepared by Mark Wilkins and Michael Martin

Cruise ID: <b>2009-01</b>	Vessels: <b><i>Sea Storm</i></b>
Cruise Dates: <b>May 18 – July 31, 2009</b>	<b><i>Vesteraalen</i></b>
	<b><i>Pacific Explorer</i></b>

**Alaska Fisheries Science Center**  
7600 Sand Point Way NE  
Seattle, WA 98115-6349

October 29, 2009

---



## Overview

The eleventh in a series of comprehensive bottom trawl surveys of groundfish resources in the Gulf of Alaska (GOA) region was conducted from May 18 through July 31, 2009, by the Resource Assessment and Conservation Engineering (RACE) Division of the Alaska Fisheries Science Center (AFSC), Seattle, Washington. Since 1999 this survey has been conducted biennially; earlier surveys were conducted triennially between 1984 and 1999. This report summarizes the sampling operations and preliminary results of the 2009 survey.

The standard biennial GOA survey area, established in 1999, stretches from the U.S.-Canada border at Dixon Entrance (54° 30' N latitude) to the Islands of the Four Mountains at the base of the Aleutian Islands (170° W longitude) including depths from approximately 15 to 1,000 m. The entire standard area was surveyed in 2009, as it was in 1999, 2005, and 2007. Subsets of the standard area were sampled in 2001 (only the area west of 147° W longitude and depths to 500 m were surveyed) and 2003 (only stations shallower than 700 m were surveyed). Each of the earlier triennial surveys (1984-1996) covered the entire continental shelf to 500 m depths, but only the 1984 and 1987 triennial surveys included stations between 500 and 1,000 m.

Commercially valuable species of flatfish, roundfish, rockfish, and invertebrates inhabit the area. In many areas rocky bottom conditions provide abundant substrate for many species of bryozoans, hydroids, sponges and corals. These invertebrate communities, in turn, provide essential habitat for juveniles and adults of many groundfish species.

## Objectives

The major survey objective is to continue the time series begun in 1984 to monitor trends in distribution, abundance, and population biology of important groundfish species and to describe and measure various biological and environmental parameters. Specific objectives of the 2009 survey include:

1. collect catch and effort data which can be used to describe the distribution and estimate the abundance of principal groundfish and invertebrate species that inhabit the Gulf of Alaska;
2. collect data to define population biology parameters, *i.e.*, size, sex, age, growth, length-weight relationships, feeding habits, and spawning condition for selected species;
3. monitor and collect trawl performance information; and
4. collect samples and data requested by other researchers or research groups.



## Vessels and Gear

The *Pacific Explorer*, *Vesteraalen*, and *Sea Storm* are all house-forward trawlers with stern ramps, multiple net storage reels (mounted forward of the working deck and/or aft over the stern ramp), telescoping deck cranes, propeller nozzles, and paired, controlled-tension hydraulic trawl winches with 1,280 m (*Pacific Explorer*), 1,460 m (*Sea Storm*) or 2,200 m (*Vesteraalen*) of 2.54 cm diameter steel cable. The *Vesteraalen* and *Sea Storm* both measure 38 m in length (LOA) and are powered by single main engines (1,710 continuous HP for *Sea Storm* and 1,725 HP for *Vesteraalen*). The *Pacific Explorer* measures 47 m LOA and is powered by a single main engine (1,800 hp). Each vessel is equipped with a full suite of state-of-the-art navigational and fishing electronics including Global Positioning Systems (GPS) with video position plotters, radars, color video fish-finders, and recording depth sounders. Each vessel's crew consisted of the captain, lead fisherman, engineer-fisherman, fisherman, and cook or cook-fisherman. The *Pacific Explorer* was operated by Captain Rick Loan for the first leg and by Captain Lorin Perry for the remaining legs. Captain Tim Cosgrove and Captain Steve Branstiter skippered the *Vesteraalen* and *Sea Storm*, respectively, for the entire survey period.

Stations were sampled with the RACE Division's standardized Poly Nor'Eastern high opening bottom trawls rigged with roller gear, as described in Stauffer (2004)<sup>1</sup>, Appendix 1. This trawl has a 27.2 m headrope with twenty-one 30 cm diameter floats and a 24.3 m long, 1/2-inch long-link alloy chain fishing line attached to a 24.9 m, 0.95 cm diameter 6×19 galvanized steel wire footrope. The roller gear is 24.2 m long and constructed of 1.9 cm diameter 6×19 galvanized steel wire rope and 36 cm rubber bobbins separated by a solid string of 10 cm rubber disks. In addition, 5.9 m wire rope extensions with 10- and 20 cm rubber disks were used to span each lower flying wing section. The trawls are constructed with 12.7 cm stretched-mesh polyethylene web with a 3.2 cm stretched-mesh nylon liner in the codend. Bridles consist of triple 54.9 m long, 1.6 cm diameter galvanized wire rope. Chain setback extensions to the headrope and side panel attachments are 46 and 23 cm, respectively. Steel 1.83 × 2.74 m V-doors weighing approximately 800 kg each are used to spread the net. Fishing dimensions of the trawls were measured using Scanmar<sup>2</sup> acoustic net mensuration equipment and fishing performance was monitored with electronic bottom contact sensors and Seabird SBE-19 micro-bathythermographs. Among all acceptable performance tows with direct measurements, net width averaged 16.06 m (range 12.54 – 19.31 m) and net height averaged 6.36 m

---

<sup>1</sup>Stauffer, Gary (compiler). 2004. NOAA Protocols for Groundfish Bottom Trawl Surveys of the Nation's Fishery Resources. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-F/SPO-65, 205 p.

<sup>2</sup>Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.



(range 3.87 – 9.05 m). Net dimension statistics (with number of hauls actually measured) by vessel were:

Vessel (# measured)	Average Net Width (m)	Net Width Range (m)	Average Net Height (m)	Net Height Range (m)	Average Tow Depth (m)
<i>Pacific Explorer</i> (253 hauls)	15.85	13.92 – 18.31	6.35	3.87 – 9.05	152.99
<i>Sea Storm</i> (270 hauls)	15.86	13.67 – 17.84	6.57	5.16 – 8.10	120.96
<i>Vesteraalen</i> (280 hauls)	16.44	12.54 – 19.31	6.15	4.92 – 8.81	197.51

The minor differences in average net spread and height among the three vessels is at least partly explained by the average tow depth among the vessel, since net spread has been shown to increase with tow depth. Tow depth differences resulted from our station assignment scheme in the central part of the survey area that, for logistic purposes, assigned tows to vessels based primarily on minimizing travel time between stations. As a result, the *Sea Storm* sampled most of the nearshore stations, the *Vesteraalen* sampled most of the deeper stations, and the *Pacific Explorer* sampled mostly in middle depths during the second and third legs of the survey.

## Itinerary

18 – 22 May	Charter begins. Load gear and supplies in Dutch Harbor and set up for sampling
21 – 24 May	Vessels depart Dutch Harbor, conduct standardization exercises, and begin sampling for Leg 1
7 June	End of Leg I, crew change at Sand Point, begin Leg 2
25 June	End of Leg II, crew change at Kodiak, begin Leg 3
13 July	End of Leg III, crew change at Seward, begin Leg 4
30 – 31 July	End of charter, off-load gear in Ketchikan



## Survey Area

The survey is designed to assess the groundfish and invertebrate resources of the Gulf of Alaska continental shelf and upper continental slope in the area between the Islands of Four Mountains (170° W longitude) and Dixon Entrance (132°30' W longitude) between nearshore (minimum practical fishing depth is about 15 m) and the 1,000 m isobath, as shown in Figure 1. The total area covered by the standard survey is 320,006 km<sup>2</sup>.

## Survey Design and Methods

Methods employed during all AFSC RACE Division surveys follow the standards described in Stauffer (2004)<sup>1</sup>, Appendix 1. These protocols serve to standardize the warp measurement and monitoring, use of auto-trawl instrumentation, operations procedures, and gear construction and maintenance.

Similar to previous surveys of the same area, the 2009 GOA survey employed a stratified-random design utilizing 59 strata based on the 100, 200, 300, 500, 700, and 1,000 m isobaths, major geographic features such as banks and gullies, and statistical areas of the North Pacific Fishery Management Council (NPFMC) and the International North Pacific Fisheries Commission. A modified Neyman optimum allocation strategy using data from previous GOA surveys was used to allocate effort among strata. Optimum allocation calculations were made for each of the principal groundfish species in each prior survey year based on that year's survey data and the estimated time to perform a tow in a given stratum as the cost variable (deeper tows take longer to execute and are more likely to require repeated tows to obtain a satisfactory sample; therefore they cost more). The mean of the resulting proportions was then calculated, resulting in an estimate of optimal allocation for each of the principal groundfish species. A weighted mean of these values was then calculated using the product of each species' current ex-vessel value and its biomass as the weighting variable. This determined the proportion of total survey effort allocated to each stratum which, when multiplied by the estimated available effort (total number of tows), determined the number of tows assigned to each stratum. Where practical, tows were allocated randomly among the three vessels. To optimize use of survey time and fuel consumption, assignment of tows to vessels was non-random in the Central GOA where the shelf is nearly 200 km wide in places. In general, the *Vesterdaalen* was assigned to sample the outer shelf and slope stations, the *Pacific Explorer* the middle shelf stations, and the *Sea Storm* the nearshore stations. However, tows in all strata except those between Kodiak Island and Cook Inlet were assigned randomly between at least two vessels.

The target on-bottom duration for a standard trawl haul is 15 minutes. Trawling time on bottom was estimated during the tow using real-time net configuration data (wingspread and headrope height) acoustically transmitted to the vessel. Position data (from GPS) were collected every two



seconds throughout the tow. Temperature and depth were recorded every three seconds with a micro-bathymograph attached to the trawl headrope. The bottom contact sensor, a recording accelerometer sensor attached to the fishing line to detect contact with the bottom, also collected data every second. Final tow durations, start and end times, and geographic positions were estimated from all available information collected from each tow.

The operational guidelines for successfully completing a standard survey tow are:

- 15 minutes towing time at a speed of 3 knots, resulting in a distance fished of approximately 1.4 km (0.75 nmi). Some tows were cut short due to hang-ups or to avoid obstacles that would cause gear damage. Tows as short as 10 minutes, if meeting all other success criteria, were judged acceptable.
- Appropriate length of trawl warp was deployed, as specified in the standard survey scope table. The goal of each tow was to not exceed 10 m of depth change over the 15-minute towing period.
- Net mensuration indicates that fishing gear was operating within normal limits, taking into account that the net width tends to increase and net height decreases as more trawl warp is deployed.
- Survey gear remained in continuous contact with the bottom.
- No significant hang-ups, gear damage or gear conflicts (e.g., crab pots).
- All sampling was done during daylight hours (all start and end times fell between 30 minutes after sunrise and 30 minutes before sunset).

Catches were sorted to species, weighed, and counted according to standard protocol. Extensive size composition data were collected with barcode-based recording devices and downloaded to a database after each tow. A variety of biological data including age structures (otoliths), lengths, and weights of individual specimens were collected and entered in the database.

Ancillary data and specimens were collected for researchers within the AFSC Groundfish Program, other AFSC research units, and other affiliated and non-affiliated agencies and educational institutions, including whole specimens, ovaries, a variety of tissues, and acoustic data. Scientists aboard the vessels also collected information on sightings of short-tailed albatross, marine mammals, and collected continuous echosounder data streams.

## Results

Sampling generally proceeded from west to east. Some of the pre-assigned stations were not sampled due to untrawlable bottom conditions. In these cases, alternate station grid cells were sampled. Of the 883 standard survey tows attempted, 823 were successfully completed, ranging in depth from 21 m to 984 m (Fig. 1). Table 1 presents, in descending order, the cumulative catch of



the most commonly caught species during survey tows in each of the NPFMC regulatory areas. A summary of the number of fish measured, by species and regulatory area, appears in Table 2 and Tables 3 and 4 summarize the biological data (length-weight observations and age structures, respectively) collected by species and regulatory area. Size composition estimates for the entire GOA are presented in Figure 2 for six of the most abundant groundfish species.

Over the entire survey area, the most abundant species in 2009 were, in order, arrowtooth flounder, Pacific ocean perch (POP), walleye pollock, Pacific cod, giant grenadier, and Pacific halibut (Table 1). POP and arrowtooth flounder were the two most abundant species in the Eastern GOA; the same two species, order reversed, were the two most abundant species in the Central GOA; and arrowtooth flounder and pollock were the two most abundant species in the Western GOA. Pacific cod ranked third most abundant in the Western and Central GOA. Pacific halibut was also abundant in all areas of the GOA. Estimates of abundance, distribution, and size composition from the survey results have been provided to stock assessment analysts for updates to the annual SAFE Report of the NPFMC's GOA Plan Team.

Water temperatures patterns observed during the 2009 survey resembled those seen during the 2007 survey. The patterns seen in both of these recent years were much different than those from prior GOA surveys. West of about 140° W longitude, water temperature cooled rapidly between the surface and about 50 m, below which warmer water was usually observed. Water temperatures from GOA surveys, adjusted to remove the effect of date of collection on water temperature through the use of a general linear model, are shown in Figure 3, binned by half-degree longitude and depth (depth increments were finer at shallower depths to capture the rapid changes in water temperatures often seen in these depths). The prevalence of cooler water around 100 m with warmer water below is more clearly shown in Figure 4. The very warm near-surface temperatures that were observed in 2003 and 2005 were largely absent in 2007 and 2009, although surface waters in the western portion of the survey area were generally warmer in 2009 than in 2007. In all years prior to 2007, water temperatures at depths greater than 400 m have generally been cooler than 4 °C. Since 2007, water warmer than 4 °C has extended to almost 600 m throughout most of the survey area.

---

For further information, contact Mr. Russ Nelson, Director, Resource Assessment and Conservation Engineering Division, Alaska Fisheries Science Center, National Marine Fisheries Service, 7600 Sand Point Way NE, Seattle, WA 98115-6349. Telephone (206) 526-4103.

---



## Scientific Personnel

<b><i>Vesteraalen</i></b>			
<b>Leg 1</b>	<b>Leg 2</b>	<b>Leg 3</b>	<b>Leg 4</b>
Chris Rooper <sup>a</sup>	Mark Zimmermann <sup>a</sup>	Michael Martin <sup>a</sup>	Michael Martin <sup>a</sup>
Christina Conrath	Lyle Britt	Jim Stark	Nancy Roberson
Jason Conner	Lisa DeForest	Amie Olson	Pam Goddard
Lyle Britt	Jameson Gregg <sup>b</sup>	Kim Sawyer <sup>c</sup>	Barney Baker
Alison Deary	Alison Deary	Roger Clark	Ernestine Ahgeak <sup>c</sup>
Andy Whitehouse	Todd TenBrink	Rick Hibpshman	Erika Acuna
<b><i>Sea Storm</i></b>			
<b>Leg 1</b>	<b>Leg 2</b>	<b>Leg 3</b>	<b>Leg 4</b>
Paul von Szalay <sup>a</sup>	Brian Knoth <sup>a</sup>	Mark Wilkins <sup>a</sup>	Mark Zimmermann <sup>a</sup>
Jim Stark	Jon Short	Chris Rooper	Bill Flerx
Robin Harrison	Teresa Jewell	Heather Kenney	Eric Brown
Ron Payne	Zachary Cress	Clint Leach <sup>c</sup>	Paul McCluskey
Lorin Anderson	Kevin Spanik <sup>b</sup>	Brita Mjos <sup>c</sup>	Elizabeth Wackenhut <sup>c</sup>
Rick Hibpshman	Mei-Sun Yang	Kevin Thompson <sup>d</sup>	Mei-Sun Yang
		Andy Whitehouse	
<b><i>Pacific Explorer</i></b>			
<b>Leg 1</b>	<b>Leg 2</b>	<b>Leg 3</b>	<b>Leg 4</b>
Nate Raring <sup>a</sup>	Ned Laman <sup>a</sup>	Paul von Szalay <sup>a</sup>	Ned Laman <sup>a</sup>
Bill Flerx	Nate Raring	Jay Orr	Frank Shaw
Frank Shaw	Roger Clark	Charles Hutchinson	Roger Clark
Jay Orr	Evan McOmber <sup>b</sup>	Audrey Djunaedi <sup>e</sup>	Calvin Blood
Beth Matta	Michael Moon	Thaddaeus Buser <sup>f</sup>	Oisin Gunning <sup>c</sup>
Paul Logan <sup>g</sup>	Paul Logan <sup>g</sup>	Paul Logan <sup>g</sup>	Paul Logan <sup>g</sup>
<sup>a</sup> Field Party Chief Personnel are AFSC staff from Seattle, Kodiak, or Auke Bay (ABL, Juneau) unless noted as follows:			
<sup>b</sup> Collaborating scientist, VIMS NEAMAP Surveys		<sup>e</sup> Hollings intern, AFSC, Auke Bay Lab	
<sup>c</sup> Intern – AFSC		<sup>f</sup> Collaborating scientist, University of Washington SAFS Fish Collection	
<sup>d</sup> Volunteer – Oregon State University		<sup>g</sup> International Pacific Halibut Commission, Seattle, WA	



**Table 1: Total cumulative catch estimates for the most commonly captured fish and invertebrate species, by North Pacific Fisheries Management Council regulatory area and the entire Gulf of Alaska, ranked in order of relative abundance.**

<i>Western Gulf of Alaska</i>			<i>Central Gulf of Alaska</i>		
<u>Name</u>	<u>Weight (kg)</u>	<u>Count</u>	<u>Name</u>	<u>Weight (kg)</u>	<u>Count</u>
Arrowtooth flounder	19,899	42,088	Arrowtooth flounder	78,153.7	94,459
Walleye pollock	18,950	13,712	Pacific ocean perch	50,023.9	80,020
Pacific cod	15,807	13,560	Pacific cod	38,669.7	31,530
Atka mackerel	10,021	7,883	Walleye pollock	36,850.3	52,809
Pacific halibut	7,950	4,988	Giant grenadier	29,180.7	9,720
Giant grenadier	7,713	2,694	Pacific halibut	23,185.3	9,277
Flathead sole	6,396	23,711	Flathead sole	9,503.3	27,506
Southern rock sole	6,121	9,822	Sablefish	9,317.6	3,340
Northern rock sole	4,679	15,399	Southern rock sole	7,496.1	12,298
Northern rockfish	3,806	3,901	Rex sole	6,400.5	17,624
Pacific ocean perch	3,411	7,831	Dusky rockfish	4,444.3	2,966
Shortspine thornyhead	1,873	8,538	Eulachon	3,814.0	117,562
Sablefish	1,712	1,040	Northern rockfish	3,424.1	3,580
Rex sole	1,659	4,280	Northern rock sole	3,240.1	5,334
Yellow Irish lord	1,578	2,462	Dover sole	2,861.2	3,442
Gigantic anemone	1,260	4,114	Shortspine thornyhead	2,764.1	10,915
Tanner crab	1,203	2,462	Shortraker rockfish	2,378.2	715
Yellowfin sole	1,061	2,268	Rougheye rockfish	2,294.0	1,980
Starry flounder	874	486	Pacific sleeper shark	1,906.8	8
Pacific sleeper shark	856	6	Big skate	1,659.5	109
Shortraker rockfish	629	261	Yellowfin sole	1,618.5	5,074
Big skate	547	29	Longnose skate	1,605.4	177
Unidentified sponge	509	1	Blackspotted rockfish	1,506.5	1,240
Alaska plaice	491	411	Gigantic anemone	1,375.9	3,872
Great sculpin	295	126	Butter sole	1,104.6	2,761
Blackspotted rockfish	249	313	Starry flounder	944.1	447
Dark rockfish	234	213	Aleutian skate	848.2	106
Dover sole	226	297	Pacific herring	760.2	4,546
Aleutian skate	217	28	Lingcod	675.6	128
Popeye grenadier	207	1,369	English sole	662.1	1,205
Magistrate armhook squid	163	824	Spiny dogfish	639.5	327
Alaska skate	148	29	Tanner crab	619.2	1,786
Giant octopus	139	35	Popeye grenadier	537.9	3,978
Tree sponge	137	--	Clay pipe sponge	466.6	--



Table 1: Continued.

<i>Eastern Gulf of Alaska</i>			<i>Total Survey Area</i>		
<u>Name</u>	<u>Weight (kg)</u>	<u>Count</u>	<u>Name</u>	<u>Weight (kg)</u>	<u>Count</u>
Pacific ocean perch	15,562.7	29,515	Arrowtooth flounder	111,622.7	156,773
Arrowtooth flounder	13,569.9	20,226	Pacific ocean perch	68,997.5	117,366
Shortraker rockfish	5,295.3	929	Walleye pollock	58,663.7	75,630
Pacific halibut	3,916.8	1,168	Pacific cod	55,011.0	45,349
Sablefish	3,299.8	1,449	Giant grenadier	37,759.7	12,794
Walleye pollock	2,862.9	9,109	Pacific halibut	35,052.6	15,433
Shortspine thornyhead	2,701.1	12,781	Flathead sole	16,473.0	54,101
Pacific hake	2,364.2	1,689	Sablefish	14,329.1	5,829
Dover sole	2,152.8	3,074	Southern rock sole	13,777.5	22,411
Silvergray rockfish	1,844.8	1,123	Atka mackerel	10,080.9	7,937
Spotted ratfish	1,593.7	3,208	Rex sole	9,309.8	27,952
Rex sole	1,250.2	6,048	Shortraker rockfish	8,302.8	1,905
Rougheye rockfish	1,105.9	1,226	Northern rock sole	7,920.2	20,736
Lingcod	1,060.5	195	Shortspine thornyhead	7,338.2	32,234
Sharpchin rockfish	920.4	3,412	Northern rockfish	7,233.4	7,486
Giant grenadier	866.4	380	Dusky rockfish	5,354.1	3,534
Blackspotted rockfish	856.4	702	Dover sole	5,240.1	6,813
Dusky rockfish	792.3	471	Eulachon	4,276.5	133,959
Spiny dogfish	600.9	361	Rougheye rockfish	3,489.6	3,274
Flathead sole	573.7	2,884	Pacific sleeper shark	2,762.8	14
Pacific cod	534.0	259	Gigantic anemone	2,704.1	8,073
Longnose skate	461.2	73	Yellowfin sole	2,682.7	7,364
Eulachon	435.8	14,055	Blackspotted rockfish	2,612.2	2,255
Chrysaora melanaster jelly	404.9	824	Big skate	2,533.7	189
Redbanded rockfish	385.3	480	Pacific hake	2,365.3	1,690
Primnoa coral	360.8	--	Longnose skate	2,132.2	258
Big skate	327.6	51	Yellow Irish lord	2,027.8	3,290
English sole	316.0	878	Starry flounder	1,910.4	978
Canary rockfish	312.1	154	Silvergray rockfish	1,852.4	1,134
Pacific herring	305.6	3,321	Tanner crab	1,825.1	4,271
Dark blotched rockfish	246.2	190	Lingcod	1,736.1	323
Lion's mane jelly	245.6	498	Spotted ratfish	1,593.7	3,208
Southern rock sole	160.5	291	Spiny dogfish	1,264.1	704
Redstripe rockfish	158.8	299	Butter sole	1,229.3	3,210



**Table 2: Summary of length collections during the 2007 biennial trawl survey of the Gulf of Alaska, by species and North Pacific Fisheries Management Council regulatory area.**

<i><b>Length Frequencies</b></i>				
<u><b>Name</b></u>	<u><b>Western</b></u>	<u><b>Central</b></u>	<u><b>Eastern</b></u>	<u><b>Total / Species</b></u>
Spiny dogfish	15	306	355	676
Pacific sleeper shark	6	7	--	13
deep-sea skate	1	--	--	1
Big skate	29	104	51	184
Bering skate	11	111	23	145
Longnose skate	8	174	72	254
Mud skate	1	--	--	1
Roughtail skate	--	4	--	4
Alaska skate	28	8	--	36
Aleutian skate	28	100	4	132
Commander skate	--	1	--	1
Whiteblotched skate	4	--	--	4
Spotted ratfish	--	--	1,377	1,377
Pacific sanddab	--	--	60	60
Arrowtooth flounder	14,978	37,703	10,237	62,918
Kamchatka flounder	1	--	--	1
Pacific halibut	4,948	9,229	1,166	15,343
Flathead sole	7,356	12,520	1,223	21,099
Slender sole	2	33	482	517
Petrale sole	--	1	119	120
English sole	133	684	693	1,510
Dover sole	252	3,210	2,894	6,356
Deepsea sole	--	12	4	16
Rex sole	3,285	11,968	4,683	19,936
Yellowfin sole	1,100	1,808	22	2,930
Starry flounder	483	405	45	933
Sand sole	4	128	--	132
Northern rock sole	6,145	3,734	3	9,882
Southern rock sole	6,485	6,216	291	12,992
Butter sole	179	1,730	269	2,178
Curlfin sole	--	--	1	1
Alaska plaice	390	107	--	497
Blackfin poacher	--	3	--	3
Sturgeon poacher	8	21	--	29
Sablefish	647	3,040	1,406	5,093
Searcher	110	80	6	196
Pacific herring	2	348	228	578



**Length Frequencies**

<u>Name</u>	<u>Western</u>	<u>Central</u>	<u>Eastern</u>	<u>Total / Species</u>
Pacific grenadier	12	375	69	456
Giant grenadier	1,035	2,343	368	3,746
Popeye grenadier	398	857	221	1,476
Armorhead sculpin	9	--	--	9
Darkfin sculpin	5	3	67	75
Red Irish lord	--	2	--	2
Yellow Irish lord	1,759	813	--	2,572
Great sculpin	125	168	11	304
Plain sculpin	42	111	--	153
Spinyhead sculpin	14	24	69	107
Bigmouth sculpin	15	46	3	64
Pacific sandfish	3	65	27	95
Pacific tomcod	49	257	241	547
Pacific cod	7,150	10,213	247	17,610
Pacific flatnose	--	1	12	13
Saffron cod	--	2	--	2
Walleye pollock	7,426	18,689	4,761	30,876
Lingcod	--	121	193	314
Atka mackerel	769	49	1	819
Kelp greenling	38	114	1	153
Pacific hake	--	1	904	905
Eulachon	223	3,765	2,733	6,721
Capelin	163	715	171	1,049
Chinook salmon	--	19	7	26
Coho salmon	--	--	6	6
Pink salmon	2	11	2	15
Chum salmon	9	126	2	137
Sockeye salmon	--	--	1	1
Prowfish	22	23	8	53
Twoline eelpout	--	--	1	1
Wattled eelpout	3	16	51	70
Shortfin eelpout	26	106	37	169
Shortspine thornyhead	3,219	6,770	6,416	16,405
Longspine thornyhead	--	377	527	904
Rougheye rockfish	54	1,571	973	2,598
Blackspotted rockfish	247	987	335	1,569
Pacific ocean perch	2,909	13,646	7,540	24,095
Silvergray rockfish	--	11	411	422
Dark rockfish	213	10	4	227



***Length Frequencies***

<u>Name</u>	<u>Western</u>	<u>Central</u>	<u>Eastern</u>	<u>Total / Species</u>
Dusky rockfish	90	1,594	340	2,024
Darkblotched rockfish	--	1	183	184
Splitnose rockfish	--	--	14	14
Greenstriped rockfish	--	--	105	105
Widow rockfish	--	1	4	5
Yellowtail rockfish	--	2	89	91
Rosethorn rockfish	--	1	206	207
Quillback rockfish	4	3	14	21
Black rockfish	1	4	1	6
Canary rockfish	--	--	26	26
Northern rockfish	968	1,876	5	2,849
Redstripe rockfish	1	8	200	209
Yelloweye rockfish	--	17	14	31
Redbanded rockfish	8	151	439	598
Stripetail rockfish	--	26	--	26
Harlequin rockfish	8	136	363	507
Pygmy rockfish	--	159	40	199
Sharpchin rockfish	4	240	1,641	1,885
Shortraker rockfish	214	706	479	1,399
Yellowmouth rockfish	--	--	4	4
Giant octopus	4	4	--	8
Eastern Pacific bobtail	--	2	--	2
Magistrate armhook squid	253	731	378	1,362
<b>Total / Region</b>	74,133	161,864	56,679	292,676



**Table 3: Length-weight data collected during the 2007 biennial trawl survey of the Gulf of Alaska, by species and North Pacific Fisheries Management Council regulatory area.**

<i>Length-Weight Measurements</i>				
<u>Name</u>	<u>Western</u>	<u>Central</u>	<u>Eastern</u>	<u>Total / Species</u>
Spiny dogfish	--	2	--	2
Pacific sleeper shark	4	4	--	8
Deepsea skate	1	--	--	1
Big skate	29	103	51	183
Bering skate	1	36	--	37
Longnose skate	8	173	71	252
Roughtail skate	--	1	--	1
Alaska skate	--	2	--	2
Aleutian skate	2	43	--	45
Pacific sanddab	--	--	47	47
Arrowtooth flounder	342	554	264	1,160
Flathead sole	140	523	41	704
Slender sole	--	--	8	8
Petrale sole	--	1	10	11
English sole	--	--	22	22
Dover sole	37	225	208	470
Deepsea sole	--	5	3	8
Rex sole	64	256	176	496
Starry flounder	--	16	--	16
Sand sole	--	5	--	5
Northern rock sole	297	217	--	514
Southern rock sole	177	333	3	513
Butter sole	--	58	--	58
Curlfin sole	--	--	1	1
Alaska plaice	--	2	--	2
Sawback poacher	--	--	9	9
Sturgeon poacher	30	101	--	131
Sablefish	54	324	264	642
Searcher	84	40	8	132
Pacific herring	--	--	14	14
Giant grenadier	165	120	62	347
Popeye grenadier	--	24	11	35
Armorhead sculpin	27	10	--	37
Darkfin sculpin	14	66	55	135
Red Irish lord	6	2	--	8
Scissortail sculpin	5	18	--	23
Ribbed sculpin	--	1	--	1



**Length-Weight Measurements**

<u>Name</u>	<u>Western</u>	<u>Central</u>	<u>Eastern</u>	<u>Total / Species</u>
Roughspine sculpin	6	--	5	11
Great sculpin	--	2	--	2
Pacific staghorn sculpin	--	--	1	1
Spinyhead sculpin	13	4	6	23
Bigmouth sculpin	--	1	--	1
Pacific sandfish	3	2	1	6
Pacific tomcod	--	68	41	109
Pacific cod	262	227	72	561
Pacific flatnose	--	--	15	15
Walleye pollock	381	830	359	1,570
Lingcod	--	2	62	64
Atka mackerel	288	45	1	334
Kelp greenling	--	3	--	3
Pacific hake	--	1	--	1
Eulachon	20	381	--	401
Capelin	40	96	--	136
Coho salmon	--	--	2	2
Pink salmon	--	1	1	2
Chum salmon	--	2	--	2
Prowfish	--	7	2	9
Wattled eelpout	19	9	6	34
Black eelpout	--	--	2	2
Shortfin eelpout	35	69	16	120
Blackbelly eelpout	--	--	12	12
Shortspine thornyhead	168	231	231	630
Longspine thornyhead	--	--	20	20
Rougheye and blackspotted rockfish unid.	--	19	--	19
Rougheye rockfish	29	295	171	495
Blackspotted rockfish	109	220	91	420
Pacific ocean perch	133	159	129	421
Silvergray rockfish	--	2	95	97
Dusky rockfish	58	643	42	743
Darkblotched rockfish	--	--	42	42
Greenstriped rockfish	--	--	16	16
Rosethorn rockfish	--	--	21	21
Quillback rockfish	3	--	7	10
Northern rockfish	290	368	--	658
Redstripe rockfish	--	--	62	62
Yelloweye rockfish	--	1	2	3
Redbanded rockfish	1	25	67	93



***Length-Weight Measurements***

<u>Name</u>	<u>Western</u>	<u>Central</u>	<u>Eastern</u>	<u>Total / Species</u>
Harlequin rockfish	2	39	118	159
Pygmy rockfish	--	--	25	25
Sharpchin rockfish	4	125	369	498
Shortraker rockfish	46	176	59	281
Smoothskin octopus	--	5	2	7
Flapjack devilfish	5	--	--	5
Giant octopus	26	22	1	49
Benthoctopus sp.	1	--	--	1
Benthoctopus salebrosus	--	1	--	1
Eastern Pacific bobtail	--	5	11	16
Magistrate armhook squid	--	19	30	49
Boreopacific armhook squid	--	4	--	4
Robust clubhook squid	--	1	--	1
Chiroteuthis calyx	--	--	1	1
Taonius pavo	--	1	--	1
<b>Total / Region</b>	<b>3,429</b>	<b>7,376</b>	<b>3,544</b>	<b>14,349</b>



**Table 4: Otolith specimens collected during the 2007 biennial trawl survey of the Gulf of Alaska, by species and North Pacific Fisheries Management Council regulatory area.**

<i>Otolith Specimens</i>				
<u>Name</u>	<u>Western</u>	<u>Central</u>	<u>Eastern</u>	<u>Total / Species</u>
Big skate	29	45	51	125
Longnose skate	7	121	71	199
Arrowtooth flounder	342	554	264	1,160
Flathead sole	140	523	41	704
Dover sole	37	225	208	470
Rex sole	64	256	176	496
Northern rock sole	297	217	--	514
Southern rock sole	177	333	3	513
Sablefish	54	324	264	642
Giant grenadier	165	120	62	347
Pacific cod	262	227	72	561
Walleye pollock	381	830	359	1,570
Atka mackerel	288	45	1	334
Shortspine thornyhead	168	231	231	630
Rougheye/blackspotted rf (undetermined)	--	19	--	19
Rougheye rockfish	29	295	171	495
Blackspotted rockfish	109	220	91	420
Pacific ocean perch	133	160	129	422
Silvergray rockfish	--	1	95	96
Dusky rockfish	58	643	42	743
Northern rockfish	290	368	--	658
Harlequin rockfish	2	39	118	159
Sharpchin rockfish	4	125	369	498
Shortraker rockfish	46	176	59	281
<b>Total / Region</b>	3,082	6,097	2,877	12,056

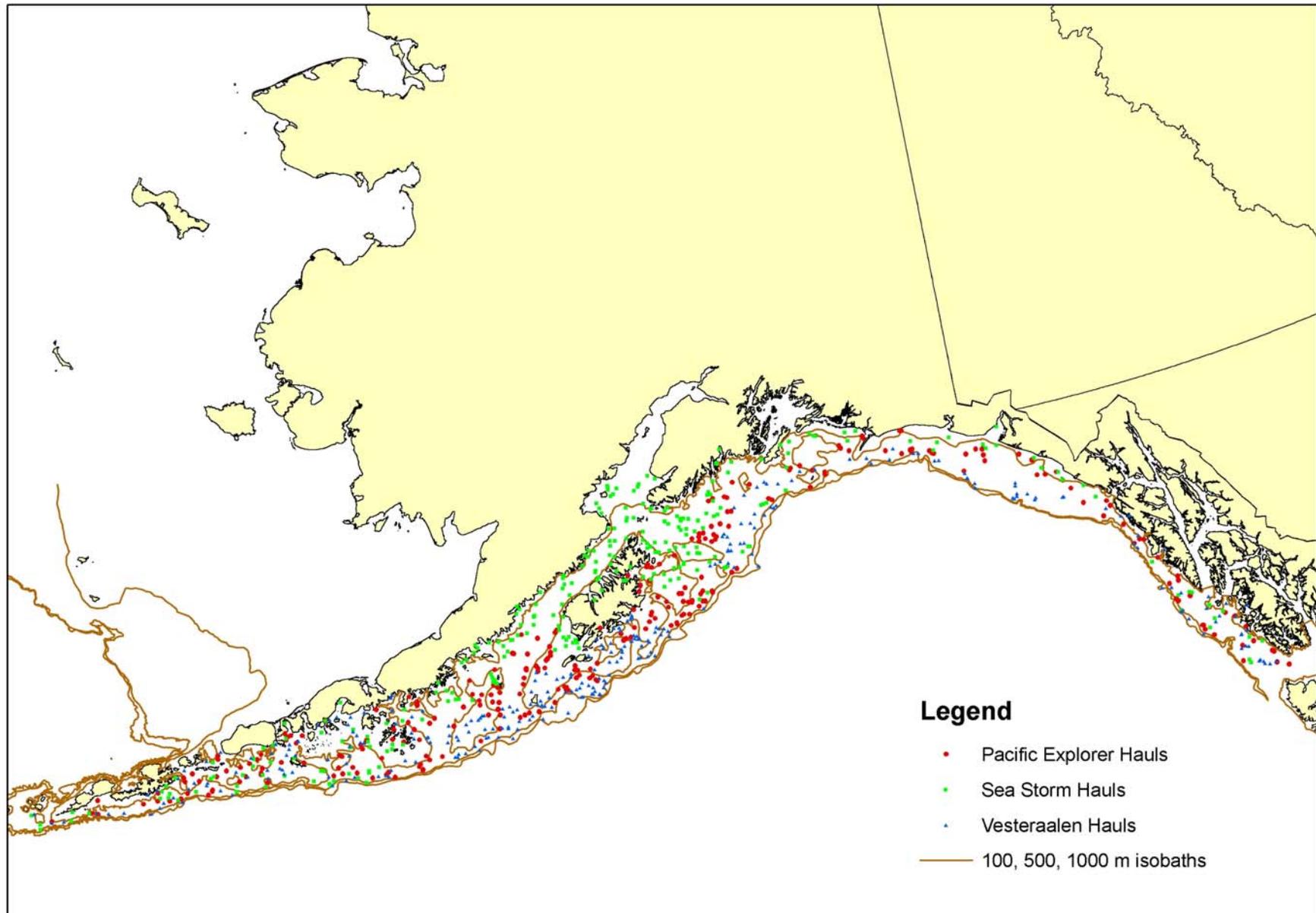
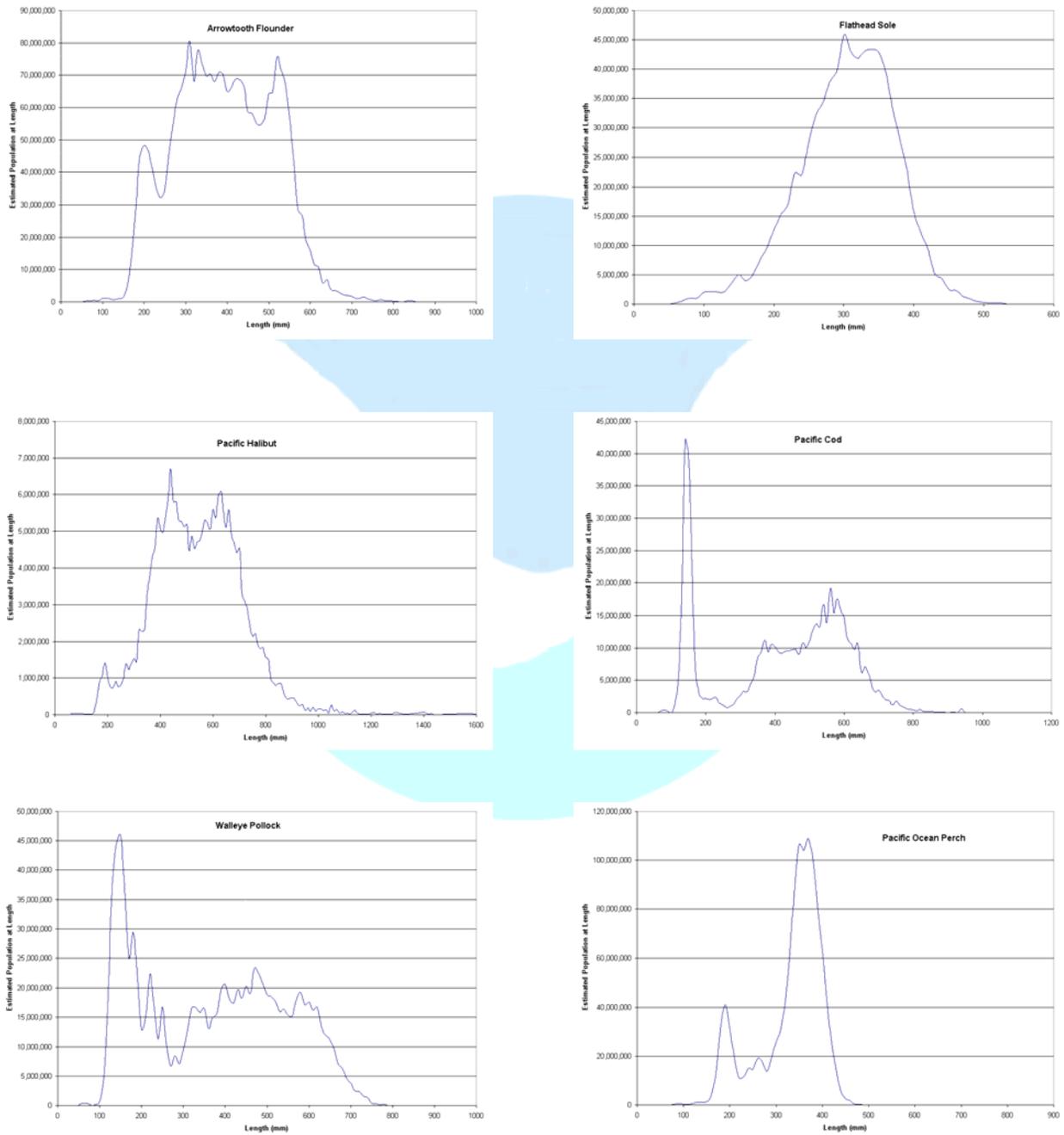


Figure 1.-- Locations of the 823 stations successfully sampled during the 2009 Biennial Gulf of Alaska Bottom Trawl Survey. Depths of successful tows ranged from 21 to 986 m. The 100, 500, and 1,000 m isobaths are shown.



**Figure 2: Estimated size composition (population number at length) for six major groundfish species assessed during the 2009 bottom trawl survey of Gulf of Alaska groundfish and invertebrate resources.**

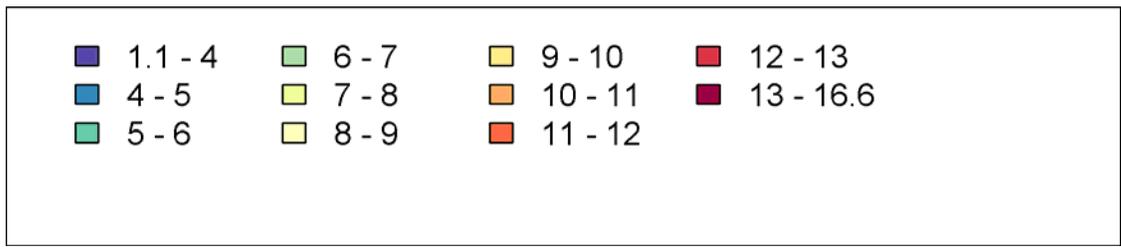
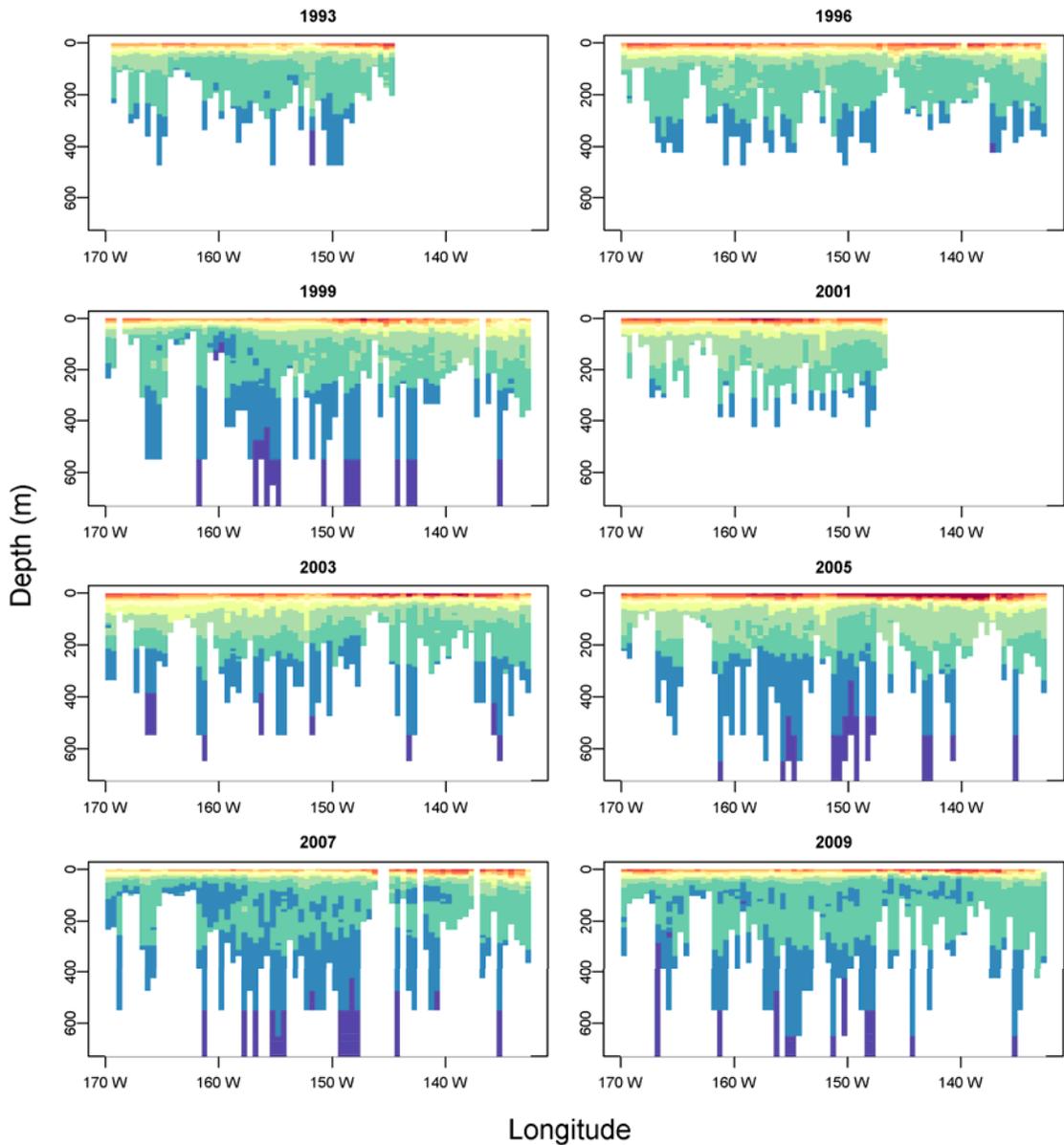


Figure 3. Date adjusted temperature profiles by 1/2 degree longitude intervals for years 1993-2009.

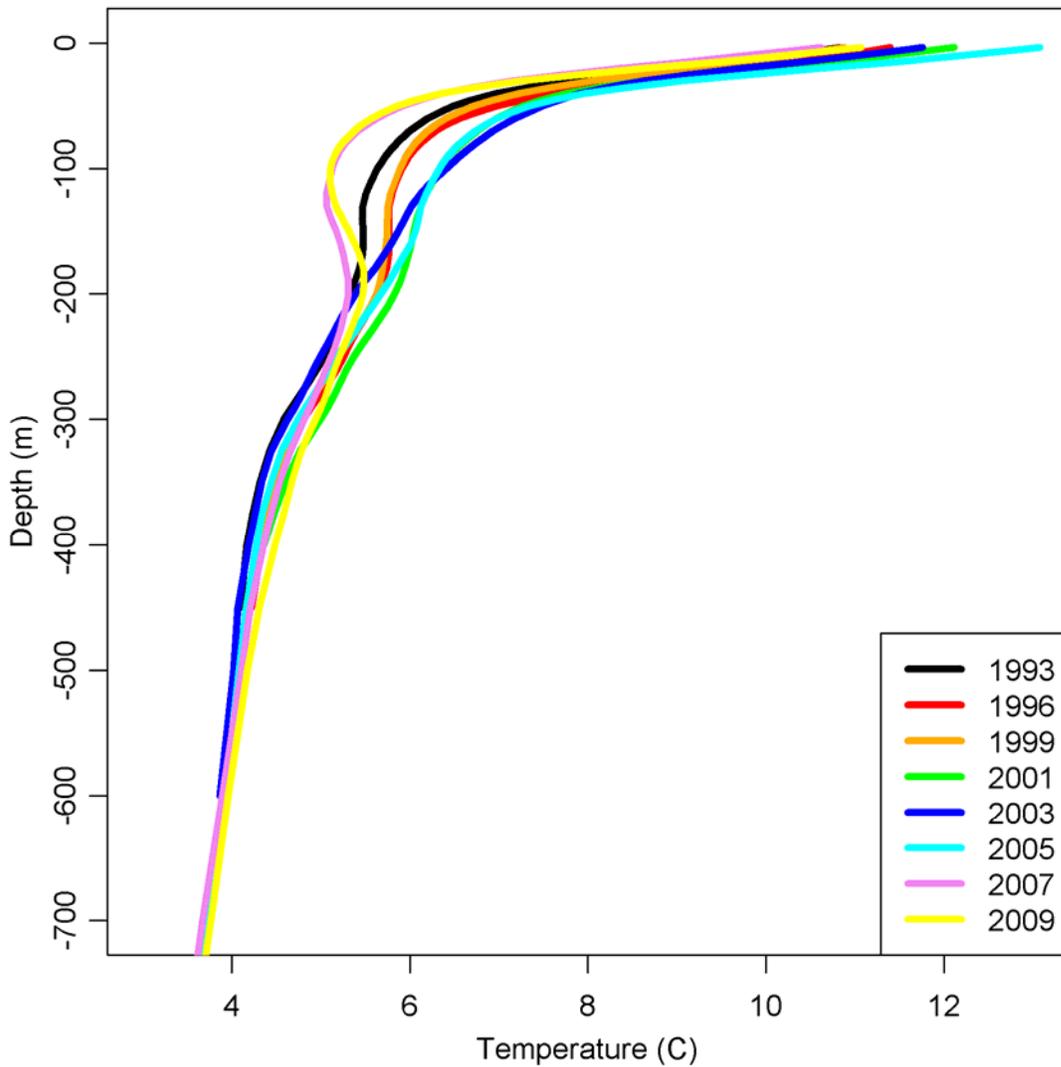


Figure 4. Date adjusted temperature smoothed mean profiles for depths to 800 m for years 1993-2009.