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Aleutian Islands Cooperative Acoustic Survey Study, 2007

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ABSTRACT

This report documents the second year of the Aleutian Islands Cooperative acoustic study (AICASS). The AICASS was developed to investigate the possibility of conducting scientific acoustic surveys in cooperation with commercial fishermen aboard commercial fishing vessels and use these data to manage the Aleutian Islands walleye pollock (Gadus chalcogrammus) fishery at spatial and temporal scales important to predators such as the Steller sea lion (Eumetopias jubatus). In 2007 the study successfully completed two acoustic surveys and collected biological and oceanographic data important to calculating pollock biomass estimates. The 2007 AICASS demonstrated that it is possible to conduct scientific quality acoustic surveys in the Aleutian Islands aboard properly calibrated and verified commercial fishing vessels equipped with commercially available echosounders.

CONTENTS

INTRODUCTION

The 2007 Aleutian Islands Cooperative Acoustic Survey Study (AICASS) was the second year of a collaborative study between the National Marine Fisheries Service, the Aleut Corporation, the FV *Muir Milach*, B & N Fisheries, and Adak Fisheries LLC using small commercial vessels to survey Alaskan walleye pollock (*Gadus chalcogrammus*; hereafter pollock) in the central Aleutian Islands. The primary objective of the AICASS project was to investigate whether cooperative acoustic surveys could be an effective way to manage the Aleutian Islands pollock fishery at spatial and temporal scales important to predators such as Steller sea lions. For the 2007 AICASS the area north of Amukta Pass to Amchitka Pass were acoustically surveyed. To make this project feasible, 3,000 metric tons (t) of pollock were allocated from the total allowable catch allowing for harvest within Steller sea lion (*Eumetopias jubatus*; hereafter SSL) critical habitat. Two acoustic surveys were conducted by Alaska Fisheries Science Center scientists and contracted biologists on board the FV *Muir Milach*. The 23-m FV *Muir Milach* was equipped with a hull-mounted 38kHz Simrad ES60 echosounder which was calibrated during the study. In addition to the systematic acoustic surveys, biological data were collected from both mid-water verification trawl tows conducted during the surveys by the FV *Intrepid Explorer* (Survey 1) and FV *Muir Milach* (Survey 2) at the direction of the chief scientist, and from commercial trawl tows conducted by several vessels including the two survey vessels between surveys. This report documents the acoustic and biological data collected and summarizes the observed abundance, distribution, size of pollock in the area. Because of their high abundance in the survey area, biological data collected on Pacific ocean perch (*Sebastes alutus*; hereafter POP) and Myctophidae species were also collected during the 2007 study and documented in this report.

Itinerary

3-13-2007	Chief Scientist (CS) and 2 contracted biologists (CB) embark vessels in Adak, AK.
3-14-2007	Calibration: Scabbard Bay, Adak Island, AK Survey 1 commences with CS aboard FV *Muir Milach* and one CB aboard following vessel FV *Intrepid Explorer*.
3-17-2007	Delivery # 1
3-21-2007	Survey 1 completed, Delivery # 2
3-23-2007	Delivery # 3
3-25-2007	Delivery # 4
3-27-2007	Delivery # 5
3-28-2007	Delivery # 6
4-9-2007	Delivery # 7
4-15-2007	Survey 2 commences with CS and one CB aboard FV *Muir Milach*
4-20-2007	Survey 2 completed, transit to Dutch Harbor, AK
4-21-2007	Calibration: Captains Bay Dutch Harbor AK

METHODS

Survey Design

The 2007 study area was located in the central Aleutian Islands area between Gareloi Island and Seguam Island on the north side of the Aleutian chain and included state waters. The study area included two SSL rookeries and eight SSL haulouts. Two acoustic surveys were conducted with 2.5 nautical miles (nmi) spaced parallel transects. In the first survey conducted between 14 March 2007 through 21 March 2007 acoustic transects were surveyed from 173° W to 179 ° W longitude by the FV *Muir Milach* while the FV *Intrepid Explorer* was directed by the CS to conduct trawl tows in locations where the composition of acoustic sign needed to be verified. Vessels were allowed to conduct commercial fishing operations once an area was surveyed and all verification tows completed. The second survey was conducted 13 April 2007 through 20 April 2007 between 173°W and 178°W by the FV *Muir Milach*. All acoustic transects and verification tows were conducted by the FV *Muir Milach*. Acoustic data were also collected opportunistically while steaming to and from the survey area and during trawls. Initial survey design had transects running from 1 nmi inshore of the continental shelf break (>180 m) to 5 nmi offshore after the final continental shelf break. To reduce survey time in light of deteriorating weather conditions, an adaptive strategy was employed and transects were ended when it was determined that pollock acoustic sign was no longer encountered offshore on the transect for at least 1 nmi. Acoustic data (RAW and OUT files) were recorded onto a 250 GB external hard drive. Daily backups of the acoustic data were made onto DVDs.

Acoustic Equipment

A Simrad ES-38B 38kHz split beam transducer with a Simrad ES 60 echosounder was used to collect acoustics data. The transducer was attached to the hull of the 32 m FV *Muir Milach* in a fabricated steel pod. Two ES60 system calibrations were conducted; one prior to the first parallel transect acoustic survey and one following the final acoustic survey (Table 1). The vessel was calibrated in accordance with standard sphere acoustic system calibration methods (Foote et al. 1987). A tungsten carbide sphere (38.1 mm diameter) was suspended below the hull-mounted transducer. The sphere was centered on axis for 10 minutes and then systematically moved throughout a grid of angular coordinates to assess transducer beam characteristics.

Sonar-Self Noise

The signal-to-noise ratios and speed for the optimum survey operations in 2007 were determined from the sonar-self noise test conducted as part of the 2006 AICASS (Barbeaux and Fraser 2009). Acoustic data were recorded from the ES60 echosounder in "passive" mode while the vessel systematically increased speed every 3 minutes from 0 knots to the maximum vessel speed in 2 knot increments. Throughout both surveys in 2007, passive noise data were collected between transects at or near vessel survey speed, the time varied gain (TVG) was added to these data in Echoview (Version 4.3; Myriax), and the data examined visually to confirm that vessel noise levels remained below -80 dB threshold levels at a 500 m range as described in Barbeaux and Fraser (2009).

Oceanographic Equipment

Temperature and salinity profiles were collected throughout the survey using a Seabird 19 conductivity, temperature and depth sensor (CTD) deployed with the third wire on the FV *Muir Milach*. The CTD was held at 1 m below the surface for one minute to acclimate, then was lowered to the target depth or a maximum depth of 260 m and retrieved. Data were processed in the SEASOFT software program, and then utilized to calculate sound speed and correct acoustic data to local environmental conditions.

Trawl Gear and Sampling

At the direction of the chief scientist monitoring acoustic sign on the FV *Muir Milach*, small (less than 10 t) tows were collected to identify observed acoustic backscatter and obtain biological samples. For the first survey biological data on echo sign was sampled by the FV *Intrepid Explorer* using an Aleutian wing trawl (Barbeaux and Fraser 2009) with a 3/8" mesh codend liner. On the second survey the FV *Muir Milach* collected trawl samples using an Aleutian wing trawl net with a 3/8" mesh codend liner. Commercial trawls were conducted by FV *Bristol Explorer*, FV *Northwest Explorer*, and FV *Muir Milach* at the discretion of the vessel captain after areas after the initial acoustic survey was completed and prior to the second survey.

Time, date, and location of each trawl were recorded using standard observer program trawl haul forms (AFSC 2007). All catch was weighed on a calibrated 15 kg motion-compensated Marel scale. All trawls were randomly sampled for species composition with length, weight, fin clip, and otolith samples collected for pollock. Pollock sample targets for each tow were 100 fork length measurements, 50 individual length, weight, maturity, and otolith samples. Pollock maturity was assessed visually and categorized as immature (1), developing (2), pre-spawning (3), spawning (4), and post-spawning (5). Pollock fin clips were collected for genetic samples and stored in micro-ampoules containing 95% alcohol for later processing. Length data were collected for predominant bycatch, which included POP and Myctophidae species. A random sample of 30 to 50 POP lengths and, as time permitted; up to 50 weight-at-length samples were collected. Fork lengths on predominant species of Myctophidae including *Stenobrachius leucopsaurus*, *Diaphus theta,* and *Protomyctophum thomsoni* were collected as time permitted.

Data Analysis

A PC-based post-processing software, Echoview (Version 4.3; Myriax), was used to analyze acoustic data. Data were analyzed between 15 m from the surface down to 500 m. The ES60 triangle wave dither (Ryan and Kloser 2003) was removed using the ES60Adjust Version 1.6 software package (Kieth et al. 2005). Bottom lines and the near-bottom shadow zone (Kloser 1996), also referred to as the acoustic deadzone (Ona and Mitson 1996) were edited and defined. Echosign was categorized by species into pollock and non-pollock regions including POP, Myctophidae, Pacific cod, and unknown pelagic species regions. For bottom depths shallower than 500 m the sounder-detected bottom determined by the Simrad ES60 bottom detection algorithm was initially used. This initial bottom depth was visually assessed and manually edited based on relative S_V to prevent inclusion of bottom backscatter in biomass estimation. The bottom depth was set and visually inspected to insure that the bottom was not integrated during processing. Because of the complex bathymetry of the region surveyed there were large areas near the bottom where acoustic measures were inaccurate or unavailable. This area was referred to in this study as an acoustic deadzone (DZ, Kloser 1996; Rose 2003). In Echoview, two bottom depths were defined for analysis: the top of the DZ and a “true” bottom (TB) depth. Two estimates of pollock backscatter density were estimated for each survey, the first for the area between 15 m from surface to the DZ and the second from the DZ to the TB. Pollock backscatter in the DZ was estimated using the deadzone estimation algorithm provided in Echoview. The algorithm calculates the average volume backscatter for each ping from the DZ to 3 m above the DZ and then applies this average to the deadzone region for each ping.

Biological data from the 45 verification and commercial tows were used to scale pollock backscatter to biomass in metric tons. All length and weight data collected during the study were aggregated and fork lengths were binned to the nearest centimeter. Weight W (kg) at length l for both surveys was then calculated using a linear regression of the log transformed weight at length data [$\log(\hat{W}_l) = \alpha + \beta \log(FL)$ and therefore:

$$\hat{W}_l = e^{\alpha} \times FL^{\beta} \ . \quad [1]$$

The target strength TS_l at fork length l (cm) was estimated by using the pollock target strength to length relationship equation:

$$TS_l = 20 \log_{10} \mathrm{FL} - 66 \text{ dB} \quad \text{(Traynor 1996).} \quad [2]$$

The proportion p_l of backscatter attributable to pollock at fork length l was then estimated as:

$$p_l = \frac{f_l\left(10^{TS_l/10}\right)}{\sum f_l\left(10^{TS_l/10}\right)}, \quad [3]$$

where f_l was the number of pollock at fork length l in the length frequency sample.

The estimated backscatter s_{Ai} (nautical area scattering coefficient, m^2nmi^{-2} (MacLennan et al. 2002) of pollock in each elementary distance sampling unit (EDSU) *i* was then used to calculate the density of pollock (N; number/nmi^{-2}) at fork length *l* for each EDSU *i* :

$$N_{il} = \frac{p_l \times s_{Ai}}{4\pi \times 10^{TS_l/10}}. \qquad [4]$$

Biomass (*B*) in metric tons (t) for each EDSU *i* was then estimated as:

$$B_i = \sum_{l=0}^{i} N_{il} \times \frac{\hat{W}_l}{1000} \times 1.25 \text{ nmi}^2, \qquad [5]$$

where W_l was the average weight at fork length *l* in kilograms. Each were multiplied by 1.25 nmi^2 (0.5 nmi long EDSU spaced at 2.5 nmi). Total survey biomass was estimated by summing the biomass from all EDSUs. A one-dimensional geostatistical procedure was used to estimate the relative error (Williamson and Traynor 1996). The relative error is defined as the ratio of the square root of the estimation variance to the estimate of biomass (Honkalehto et al. 2009).

Five regions were differentiated to describe changes in pollock distribution and abundance in the survey area (Fig.1). The Delarof region included transects north and west of Tanaga Island to just of west of Garaloi Island including waters between 179° W and 178°W and north of Skagul Island. The Tanaga region included waters north of Kanaga and Tanaga Islands from 178°W to 177°W. The Adak region is between 177° W and 175° 30’ W and includes transect north of Adak Island to Kasatochi Island. The Knoll region spans from Kastochi Island to west of North Cape on Atka Island between 175°30’ W and 174°30’W. The Atka Flats region is located east of Atka Island between 174°30’W to 173° W.

RESULTS

Oceanographic Conditions

Five CTD casts were made during the second survey throughout the area corresponding to regions defined for analysis of pollock distribution (Figs. 2 and 3). The sixth cast was made in Captains Bay, Dutch Harbor during the calibration at the end of the survey. The mean water column temperature in the 2007 AICASS area was 3.61 °C with a standard deviation of 0.18 °C. The mean water column salinity for the study area was 33.2 ppt with a standard deviation of 0.006 ppt.

The weather in the central Aleutians can be a particularly limiting factor for acoustic survey work from small vessels, and this year's AICASS lost survey time due to weather on both surveys. Data from the Adak NOAA station (NOAA 2008) show the range of conditions typical to this area (Fig. 4).

Distribution and Abundance

Acoustic data from 88 transects were collected over approximately 6,949 nmi^2 between 173°W and 179°W providing a biomass index for both survey periods (Table 2 and Fig. 5). The spatial distribution varied between surveys (Figs. 6 and 7). The pollock biomass estimate for Survey 1 was 15,646 t without the deadzone estimation (DZE) and was 19,609 t with it. In Survey 2 the total biomass was 12,906 t without the DZE and 16,586 t with it. A commercial harvest of 1,317.82 t of groundfish (89% pollock) was collected by the FV *Muir Milach*, FV *Bristol Explorer*, and FV *Northwest Explorer* and processed by Adak Fisheries processing plant on Adak Island. Seventy-two percent of the pollock collected during the survey came from the Knoll area (Fig. 8).

During the first survey, 9,601 t of the biomass was in Tanaga, 4,536 t in the Knoll, 2,452 t in Atka Flats, 1,974 t in between Adak and Great Sitkin Island, and 1,046 t in the Delarofs. On the second survey, 6,403 t of pollock were in the Atka flats area, 3,068 t in Adak, 2,606 t in the Knoll, 1,494 t in the Delarofs, with only 3,016 t remaining in Tanaga (Table 2, Fig. 9).

Biological Sampling

Biological data was collected from 23 commercial trawls, and 22 verification trawls conducted throughout the survey area (Table 2 and Fig. 10). A total of 2,677 length samples, 1,264 weight at length, maturity and otolith samples, and 500 fin clips for genetic analysis were collected from pollock. The mean length for all pollock was 57 cm, with females having a larger mean length at 59 cm than males at 56 cm (Fig. 11). The average weight calculated for pollock from weight at length data were 1.55 kg (Fig. 12). A total of 928 POP length samples were also collected (Fig. 13). Pollock maturity stages varied between sexes with more males spawning than females (Table 3 and Fig. 4). Maturity varied between surveys with more spawning fish in Survey 2 (Table 3 and Fig. 4).

DISCUSSION

The 2007 AICASS resulted in two pollock biomass estimates for the area between 173° W and 179° W longitude. The area surveyed in 2007 was nine times larger than the largest area surveyed in 2006 (Barbeaux and Fraser 2009). In 2007 the change in pollock abundance between Survey 1 and Survey 2 was quite low (~1,413 t), well within the margin of error for this survey (Table 2). Unlike 2006 a large decline in abundance was not as apparent in 2007. This may suggest that the pollock surveyed in the larger 2007 area were distinct from other populations at least for the time period assessed. There was, however, a shift in distribution of pollock within the survey area between the two 2007 surveys. In Survey 1 between 49% and 51% of the pollock were observed in the Tanaga region. In Survey 2 pollock were more evenly distributed and the largest proportion of pollock were observed in the Atka Flats region (39%). The shift in pollock distribution was accompanied with a change in pollock maturity. Survey 1 had less than 4% of the pollock at a spawning (4) or spent (5) maturity condition, while for Survey 2 over 42% of the pollock were in spawning (4) or spent (5) maturity condition. This suggests that pollock in the Aleutian Islands are most highly aggregated in the pre-spawning maturity condition consistent with findings from winter surveys for Shelikof Strait in the Gulf of Alaska (Wilson 1994).

The 2007 AICASS adequately demonstrated the suitability of using commercial fishing vessels for conducting acoustic surveys in the winter on pelagic fish resources in the Aleutian Islands region. The acoustic system and hull configuration of the FV *Muir Milach* is no different than most fixed propeller stern trawl fishing vessels used in the region. For the purposes of this study and potential use of these survey data to set catch limits by area for a local fishery, data quality was adequate. The calibration procedure and vessel self-noise testing employed in this study should be standard practice for conducting quantitative acoustic survey work from commercial fishing vessels.

The 2006 and 2007AICASS surveys have been the only research conducted on winter pollock distribution and temporal stability in the Aleutian Islands west of 170° W longitude. The 2006 effort resulted in multiple acoustic surveys of the area of high pollock abundance near Atka Island. The abundance of pollock in this area remained stable in the beginning of the 2006 survey period then decreased rapidly over subsequent passes as both fishing occurred and the proportion of spawning and spent pollock in the region increased (Barbeaux and Fraser 2009). The abundance and distribution of pollock near Atka Island in 2006 was consistent with the 2007 surveys. Both 2007 surveys consistently observed high densities of pollock in the same areas as seen in 2006. The pollock maturity and length data collected during the two studies suggest that these were pre-spawning aggregations. Areas where pollock abundance were high were also areas with high pollock catches in the 1990s winter fisheries (Barbeaux et al. 2015). The consistent cooperative survey results and a 20-year history of high catches suggest that bathymetry and perhaps oceanographic conditions make these areas preferred habitat for forming pre-spawning aggregations of pollock.

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Table 1. -- Acoustic system settings and calibration results for the FV *Muir Milach*.

		Survey system settings	Calibrations 10 March	Calibrations 4 April
Echosounder:		Simrad ES60	-	-
Transducer:		ES38B	-	-
Frequency (kHz)		38.00	-	-
Absorption coefficient (dB/km):		10.00	9.70	9.70
Pulse length (ms):		1.024	-	-
Band width (kHz):		2.43 (wide)	-	-
Transmitted power (W):		2000	-	-
Angle sensitivity:		21.90	-	-
2-way beam angle (dB re 1 steradian):		-20.60	-	-
Transducer gain (dB):		26.50	24.76	24.91
Sa correction (dB):		-	-0.57	-0.54
3 dB beam width (deg.)				
	Along:	7.10	7.58	7.16
	Athwart:	7.10	7.35	7.08
Angle offset (deg.)				
	Along:	-	0.04	0.10
	Athwart:	-	-0.02	0.00
Range (m):		500	-	-
post-processing Sv threshold (dB re 1 m^{-1}):		-70.00	-	-
Standard sphere TS (dB re 1 m^2):		-	-42.16	-42.17
Sphere range from transducer (m):		-	19.25	21.50
Water temp. (°C)				
	at transducer:	-	3.55	3.89
	at sphere:	-	3.60	3.78
Water salinity (PSU)				
	at transducer:	-	32.33	33.15
	at sphere:	-	33.13	33.21

Table 2. -- Pollock biomass estimates in metric tons (t) with relative error and compensation fishery removals for 2007 AICASS. Estimates without and with deadzone estimates (DZE) are provided.

	Survey1		Survey2		
Region	W/O DZE	W DZE	W/O DZE	W DZE	Removals
Knoll	3,004	4,536	2,246	2,606	950.4
Delarof	860	1,046	1,127	1,494	0.1
Tanaga	7,844	9,601	2,069	3,016	12.2
Adak	1,639	1,974	2,449	3,068	33.0
Atka Flats	2,298	2,452	5,014	6,403	331.4
Total	15,646	19,609	12,906	16,586	1,327.1
Relative error	10.6%	9.7%	11.9%	13.0%	

Table 3. -- Species composition data from 2007 AICASS, weight, number, and proportion by weight.

Common name	Scientific name	Weight (kg)	Number	Proportion
walleye pollock	*Gadus chalcogrammus*	10,549.26	6,059	69.53%
Pacific ocean perch	*Sebastes alutus*	4,301.49	6,442	28.35%
northern lanternfish	*Stenobrachius leucopsaurus*	153.69	16,718	1.01%
squid	*Teuthoidea*	36.47	294	0.24%
California headlightfish	*Diaphus theta*	26.34	2,794	0.17%
rougheye rockfish	*Sebastes borealis*	17.39	3	0.11%
Pacific halibut	*Hippoglossus stenolepis*	14.80	1	0.10%
Pacific cod	*Gadus macrocephalus*	10.44	1	0.07%
lanternfish undidentified	*Myctophidae*	10.43	21	0.07%
chinook salmon	*Oncorhynchus tshawytscha*	9.37	5	0.06%
brokenline lanternfish	*Lampanyctus jordani*	7.74	167	0.05%
bigeye lanternfish	*Protomyctophum thompsoni*	7.36	2,768	0.05%
magistrate armhook squid	*Berryteuthis magister*	4.23	16	0.03%
arrowtooth flounder	*Atheresthes stomias*	3.75	4	0.02%
boreopacific armhook squid	*Gonatopsis borealis*	3.37	32	0.02%
shrimp	*Arthropoda*	3.34	1,723	0.02%
jellyfish	*Cnidaria*	3.27	9	0.02%
smooth lumpsucker	*Aptocuclus ventricosus*	3.11	2	0.02%
northern smoothtongue	*Leuroglossus schmidti*	2.49	232	0.02%
rex sole	*Glyptocephalus zachirus*	1.99	2	0.01%
Atka mackerel	*Pleurogrammus monopterygius*	1.01	1	0.01%
Pacific viperfish	*Chauliodus macouni*	0.97	40	0.01%
slender barracudina	*Lestidops ringens*	0.22	2	<0.01%
calyx squid	*Chiroteuthis calyx*	0.22	1	<0.01%
slender fangjaw	*Sigmos gracilis*	0.02	2	<0.01%
pigmy snailfish	*Lipariscus nanus*	0.01	7	<0.01%
blue lanternfish	*Tarletonbeania crenularus*	0.01	2	<0.01%
smalldisk snailfish	*Careproctus gilberti*	0.001	1	<0.01%
ebony snailfish	*Paraliparis holomelas*	0.001	1	<0.01%
whitetail sculpin	*Malacocottus aleuticus*	0.01	1	<0.01%
	Total	15,172.80	37,351	

Table 4. -- Pollock maturity stage by date for 2007 AICASS.

	Immature (1)	Developing (2)	Pre-spawning (3)	Spawning (4)	Spent (5)	Total
14-21 March	18	24	273	11	2	328
22 March – 12 April	0	13	182	9	9	213
13-20 April	3	14	76	39	29	161
Total	21	51	531	59	40	702

Table 5. -- Commercial and verification trawl haul statistics for 2007 AICASS. Trawl type are acoustic verification tows (V) and commercial fishing tows (C) including the estimated official total catch (OTC) in metric tons (t).

Date (GMT)	Trawl Type	Time (GMT)	Start position				Depth (M)		OTC (t)
			Latitude (N)		Longitude (W)		Bottom	Footrope	
14 March	V	4:30 PM	52°	7.64	176°	02.98	180	178	0.51
15 March	V	3:03 PM	52°	15.38	175°	07.20	188	183	0.00
15 March	V	6:54 PM	52°	14.50	174°	53.19	150	130	0.77
15 March	V	9:23 PM	52°	18.73	174°	44.35	185	175	0.40
16 March	V	1:39 PM	52°	26.80	173°	47.49	192	190	0.85
16 March	V	5:49 PM	52°	25.09	173°	43.12	205	200	0.29
16 March	V	9:27 PM	52°	17.63	173°	32.59	186	170	0.33
17 March	V	9:15 AM	52°	18.25	174°	49.69	420	260	0.02
17 March	V	8:16 PM	52°	4.87	176°	15.34	380	190	0.18
18 March	V	8:33 AM	51°	58.08	177°	03.11	380	196	0.35
18 March	V	12:24 PM	51°	51.48	177°	16.67	330	265	0.21
19 March	V	1:24 AM	51°	49.87	177°	24.24	250	173	0.38
19 March	V	9:29 AM	51°	48.66	177°	32.25	180	173	0.17
19 March	V	10:21 PM	51°	55.01	177°	36.71	185	174	0.40
20 March	V	1:06 AM	51°	54.93	177°	48.59	650	240	0.01
20 March	V	2:07 PM	51°	39.20	178°	26.02	200	190	0.04
20 March	V	6:44 PM	51°	39.99	178°	32.31	245	180	0.05
27 March	C	6:00 AM	52°	15.10	174°	51.80	160	140	28.53
27 March	C	8:00 AM	52°	18.60	174°	56.30	145	120	33.28
27 March	C	11:30 AM	52°	18.00	174°	46.80	140	120	47.55
15 April	V	12:12 PM	51°	53.14	177°	28.80	210	181	0.34
15 April	V	6:44 PM	51°	51.35	177°	17.18	250	210	0.36
16 April	V	11:00 AM	52°	2.66	176°	19.77	210	191	1.06
17 April	V	3:45 AM	52°	18.22	174°	46.44	135	133	0.75
17 April	V	12:15 AM	52°	26.82	173°	47.57	186	181	1.81
16 March	C	12:01 AM	52°	19.00	174°	46.50	185	163	72.96
16 March	C	3:15 AM	52°	16.30	174°	49.30	200	188	102.15
18 March	C	12:43 AM	52°	13.00	174°	57.60	190	175	66.33
18 March	C	4:58 PM	52°	18.90	174°	45.70	210	190	61.22
19 March	C	12:12 AM	52°	19.20	174°	45.40	200	185	112.24
19 March	C	4:32 AM	52°	19.00	174°	45.70	165	150	107.14
22 March	C	12:01 AM	52°	17.00	174°	48.20	170	158	102.58

Table 5. -- Cont.

Date (GMT)	Trawl Type	Time (GMT)	Start position				Depth (M)		OTC (t)
			Latitude (N)		Longitude (W)		Bottom	Footrope	
22 March	C	3:03 AM	52°	19.00	174°	45.00	175	163	97.92
22 March	C	7:00 AM	52°	15.50	174°	50.80	155	143	116.57
25 March	C	1:31 AM	51°	53.70	177°	32.90	240	100	9.44
25 March	C	5:43 AM	51°	54.10	177°	34.00	220	160	0.94
5 April	C	8:25 AM	51°	58.90	176°	20.50	100	78	30.87
6 April	C	3:02 AM	52°	16.20	173°	43.60	110	96	0.77
6 April	C	10:55 AM	52°	16.80	173°	02.60	139	123	38.59
6 April	C	1:05 PM	52°	16.20	173°	11.30	136	122	84.89
6 April	C	3:55 PM	52°	16.40	173°	03.00	149	127	84.89
6 April	C	7:45 PM	52°	16.80	173°	17.80	143	123	69.46
24 March	C	2:00 AM	52°	27.00	173°	47.00	210	180	2.25
24 March	C	7:00 AM	52°	17.50	173°	25.50	160	140	22.49
25 March	C	8:00 PM	52°	17.80	173°	33.50	180	160	24.74

Table 6. -- Oceanographic CTD location, date, average salinity in parts per million, and average temperature in degrees Celsius.

Date	Location		Time	Region	Salinity (ppm)	Temperature (°C)
14 April	51° 45.80 N	178° 01.00 W	8:00 PM	Delarof	33.2	3.76
15 April	51° 53.50 N	177° 29.00 W	1:08 PM	Tanaga	33.22	3.6
16 April	52° 02.72 N	176° 19.41 W	9:56 AM	Adak	33.19	3.7
17 April	52° 18.06 N	174° 47.14 W	3:03 AM	Knoll	33.16	3.49
17 April	52° 26.79 N	173° 48.29 W	11:20 PM	Atka Flats	33.22	3.27

Table 7. -- Delivery weight in metric tons by species for 2007 AICASS compensation fishery. For pollock, Pacific ocean perch (*Sebastes alutus*; POP), king salmon *Oncorhynchus tshawytscha)*, rock sole *(Lepidopsetta* sp.*)*, and Pacific cod *(Gadus macrocephalus*; P.cod)

Date	Pollock	POP	King salmon	Rock sole	P. cod
17 March	158.41	16.69	0.014		
21 March	330.84	16.09			
24 March	297.63	19.44			
25 March	10.39				
27 March	47.74	1.53		0.22	
27 March	92.27	17.10			
9 April	232.40	76.11		0.12	0.85
Total	1,169.67	146.96	0.014	0.35	0.85

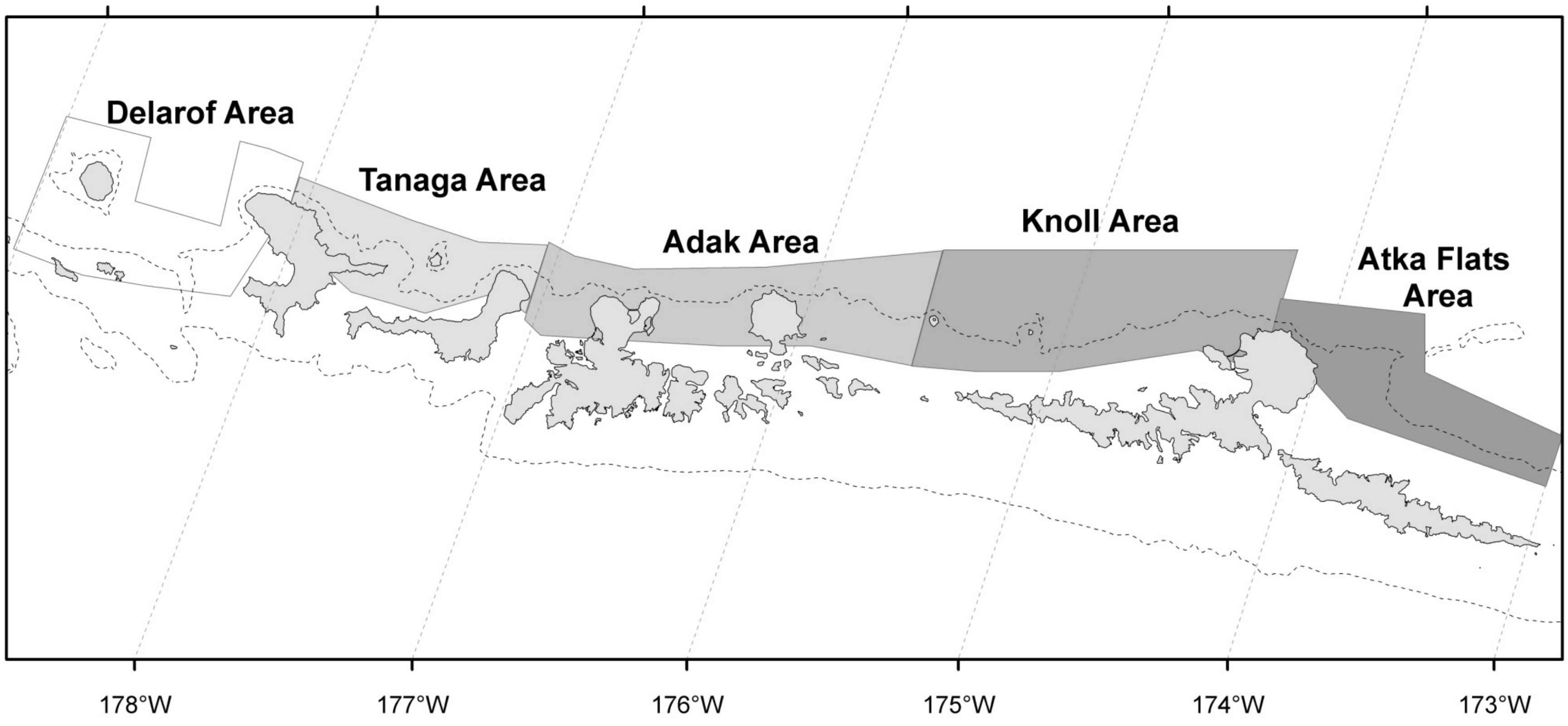

Figure 1. -- 2007 AICASS region descriptions with 300 m bathymetry contour (dashed line).

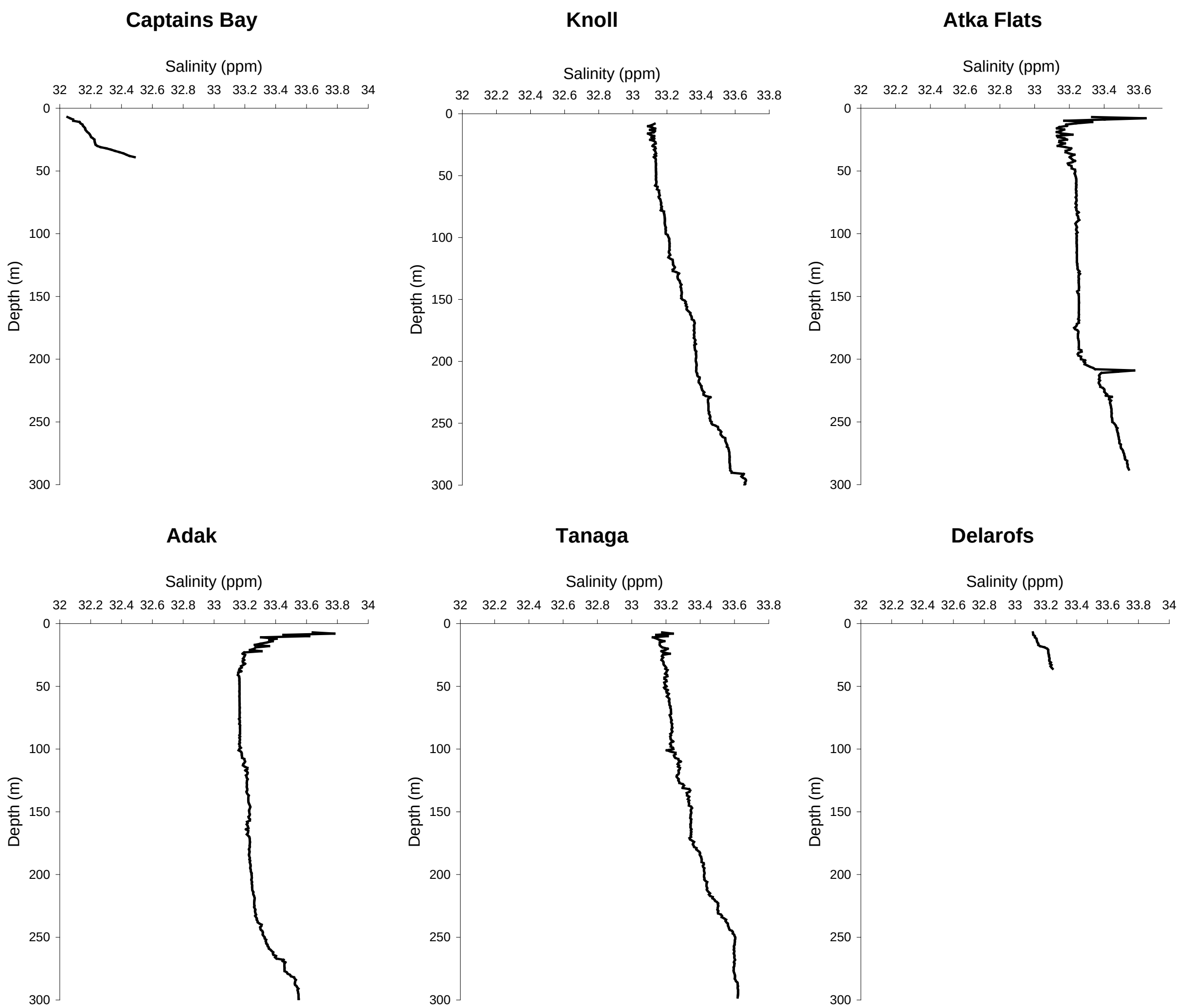

Figure 2. -- Individual salinity profiles by 2007 AICASS region.

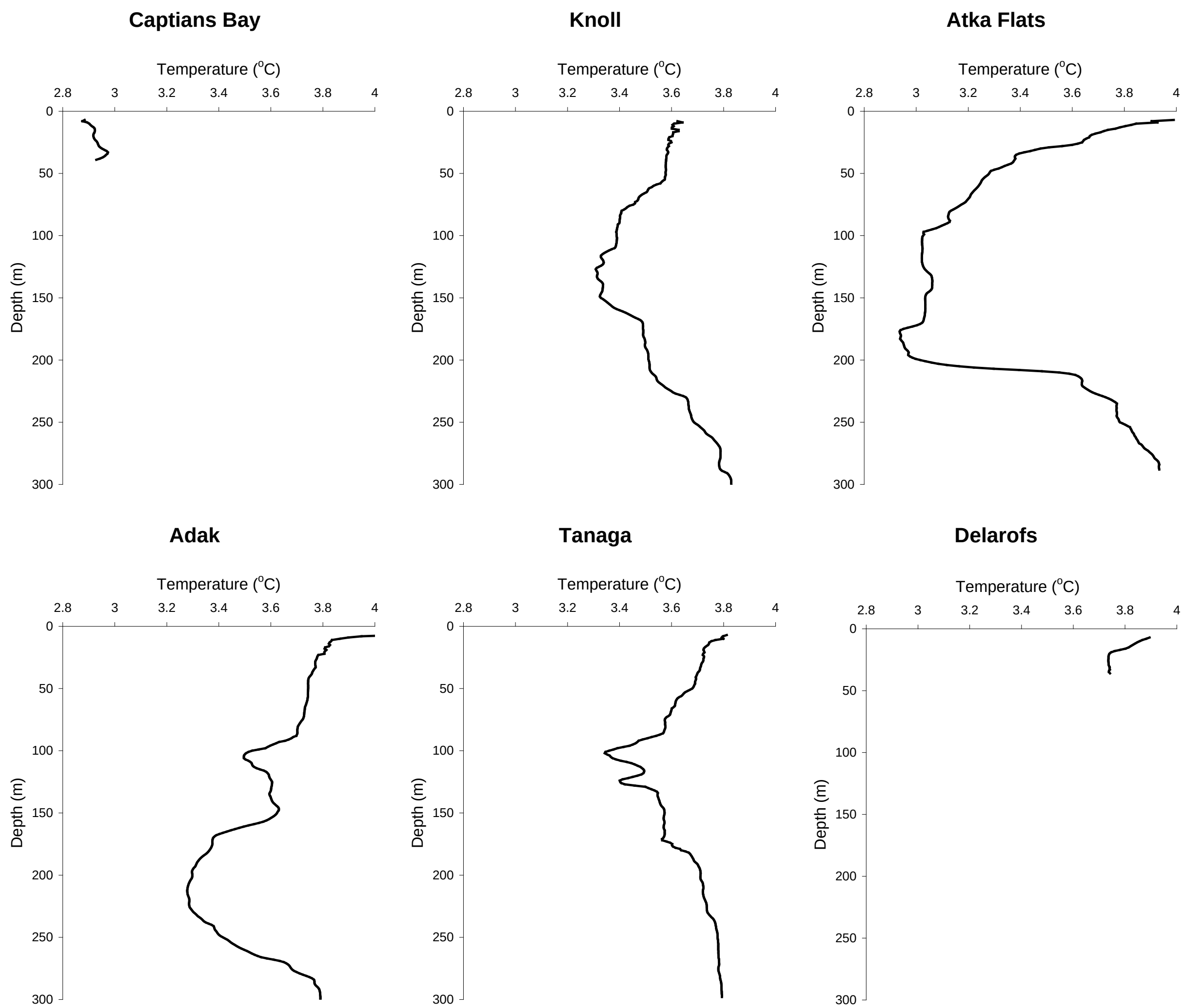

Figure 3. -- Individual temperature profiles by 2007 AICASS region.

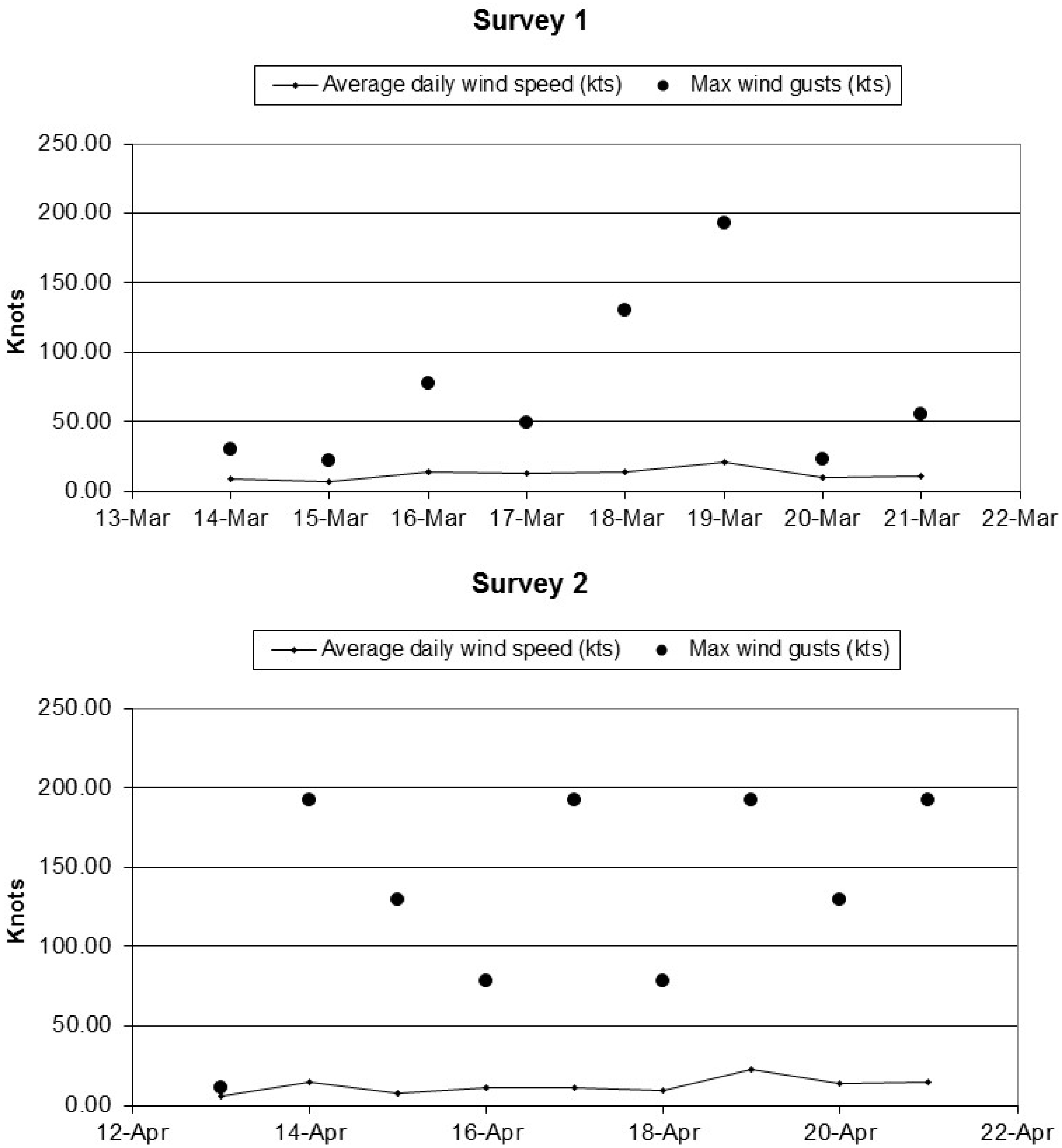

Figure 4. -- Average wind speed and max gust during the 2007 AICASS for Survey 1 (top) and Survey 2 (bottom) in knots from NOAA - National Data Buoy Center, Station ADKA2 - 9461380 - Adak Island, AK.

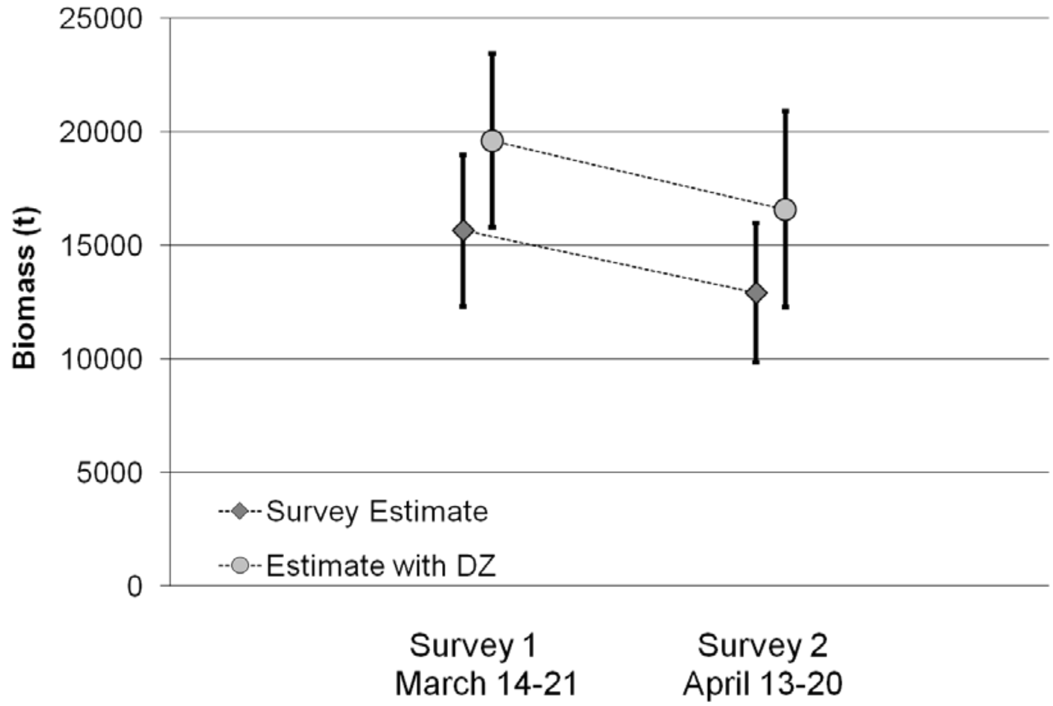

Figure 5. 2007 AICASS biomass estimates in metric tons (t) by survey with confidence intervals of 2× relative error.

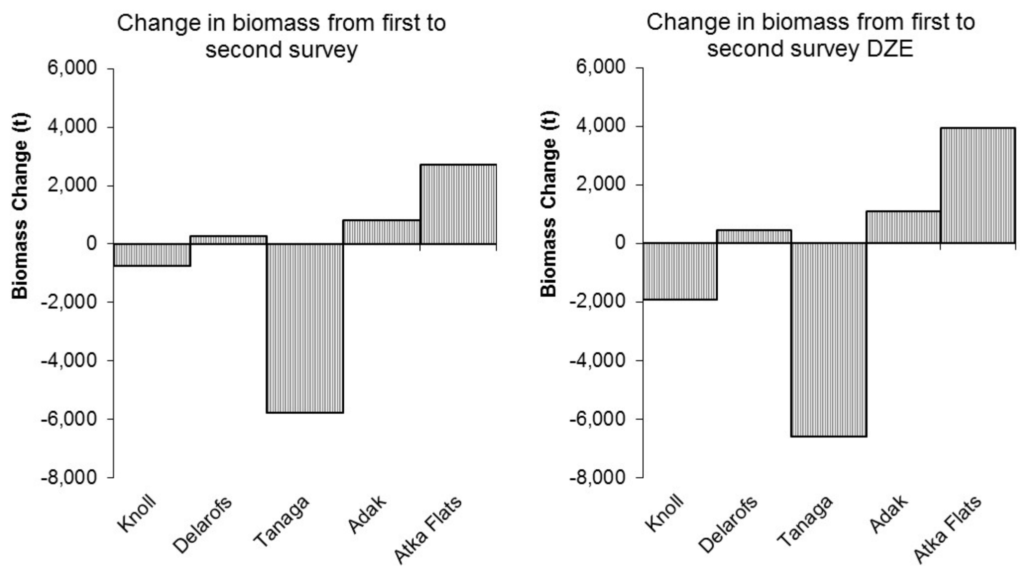

Figure 6. -- Change in biomass from first to second survey for non-deadzone area (left) and including deadzone area (right).

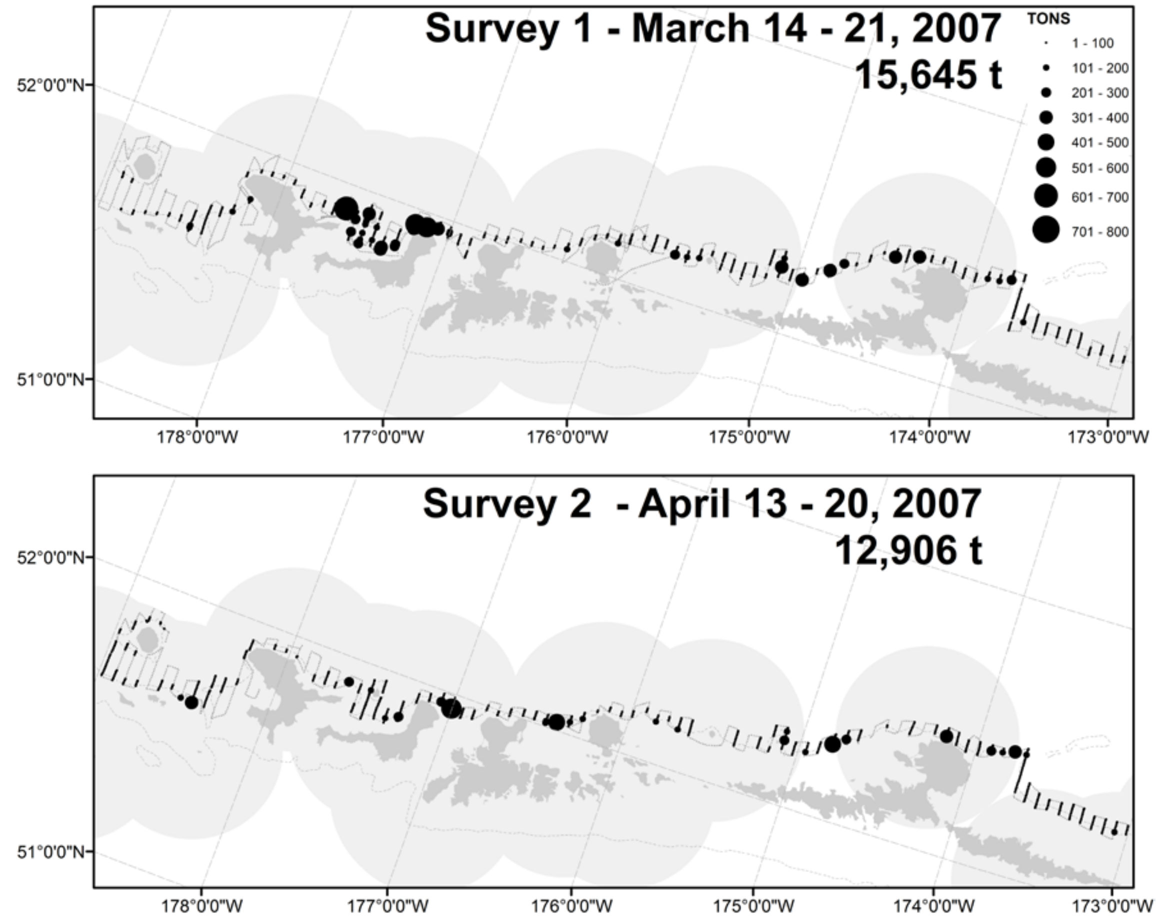

Figure 7. -- Distribution of pollock in 2007 AICASS for the two surveys.

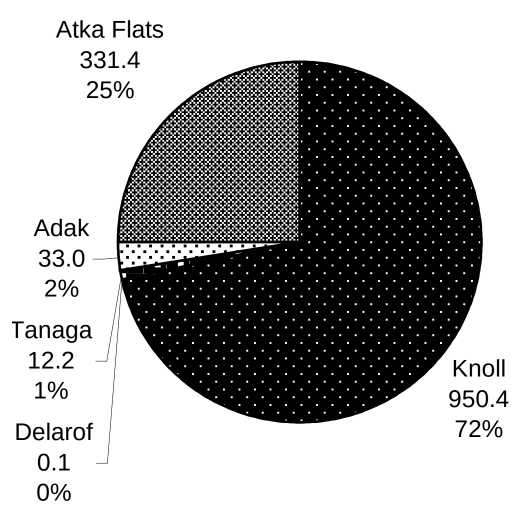

Figure 8. -- Compensation fishery catch by survey region including area, catch in metric tons, and percent of total catch.

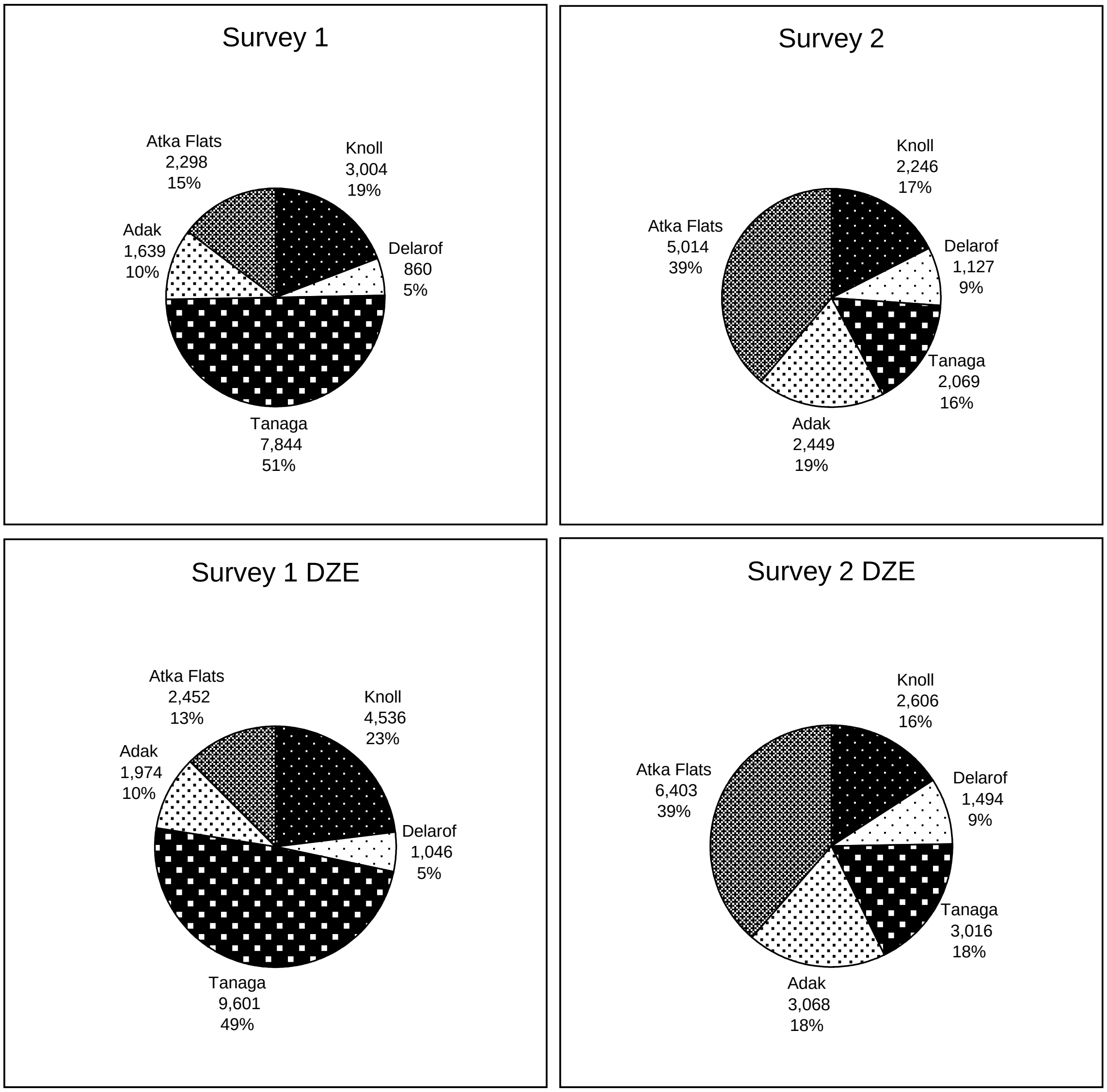

Figure 9. -- Estimated pollock biomass in metric tons (t) by survey area for non-deadzone (top) and including deadzone (bottom) for Survey 1 (left) and Survey 2 (Right) for 2007 AICASS.

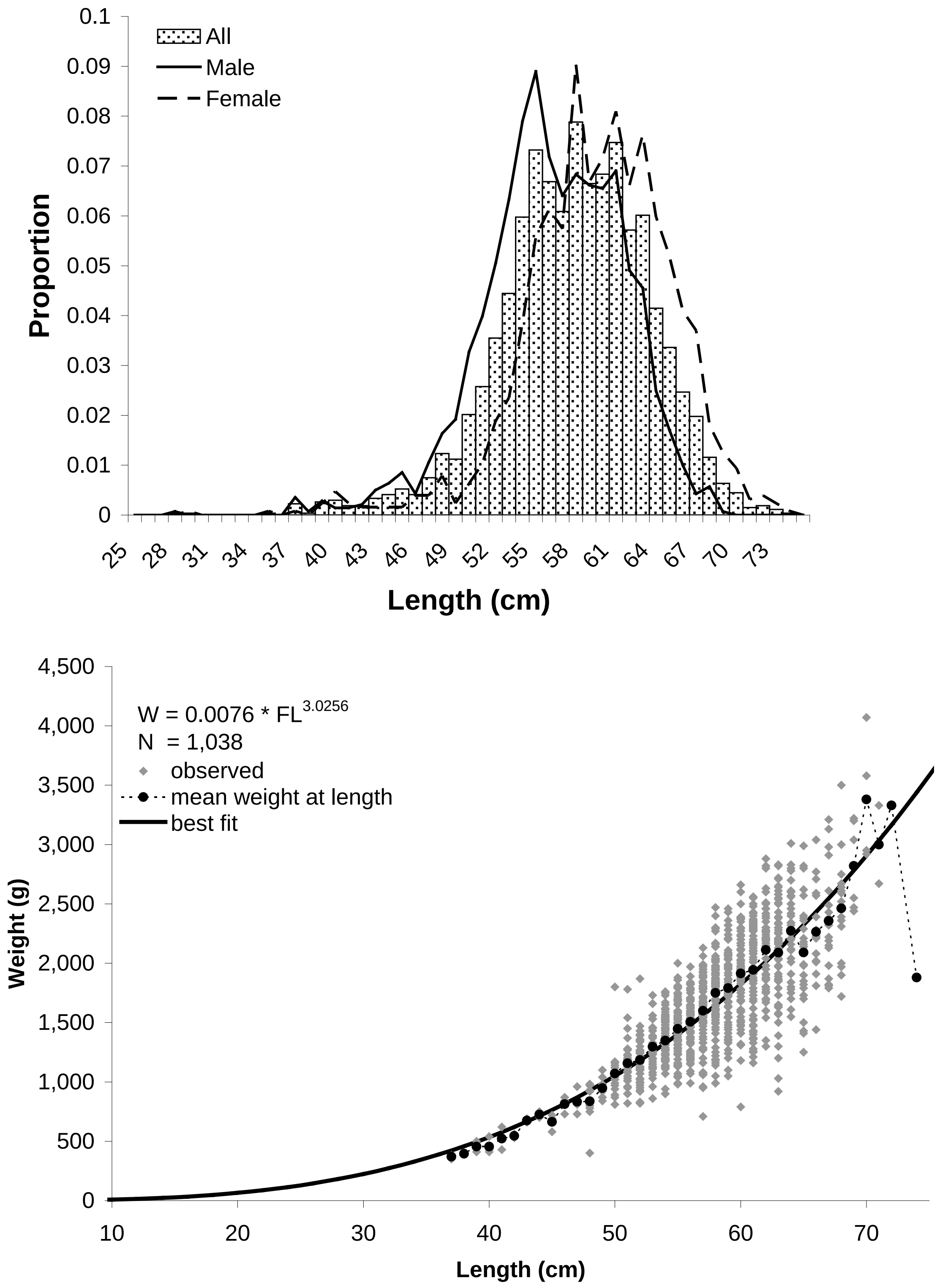

Figure 10. -- Pollock fork length distribution (top) and weight at fork length (bottom) for 2007 AICASS.

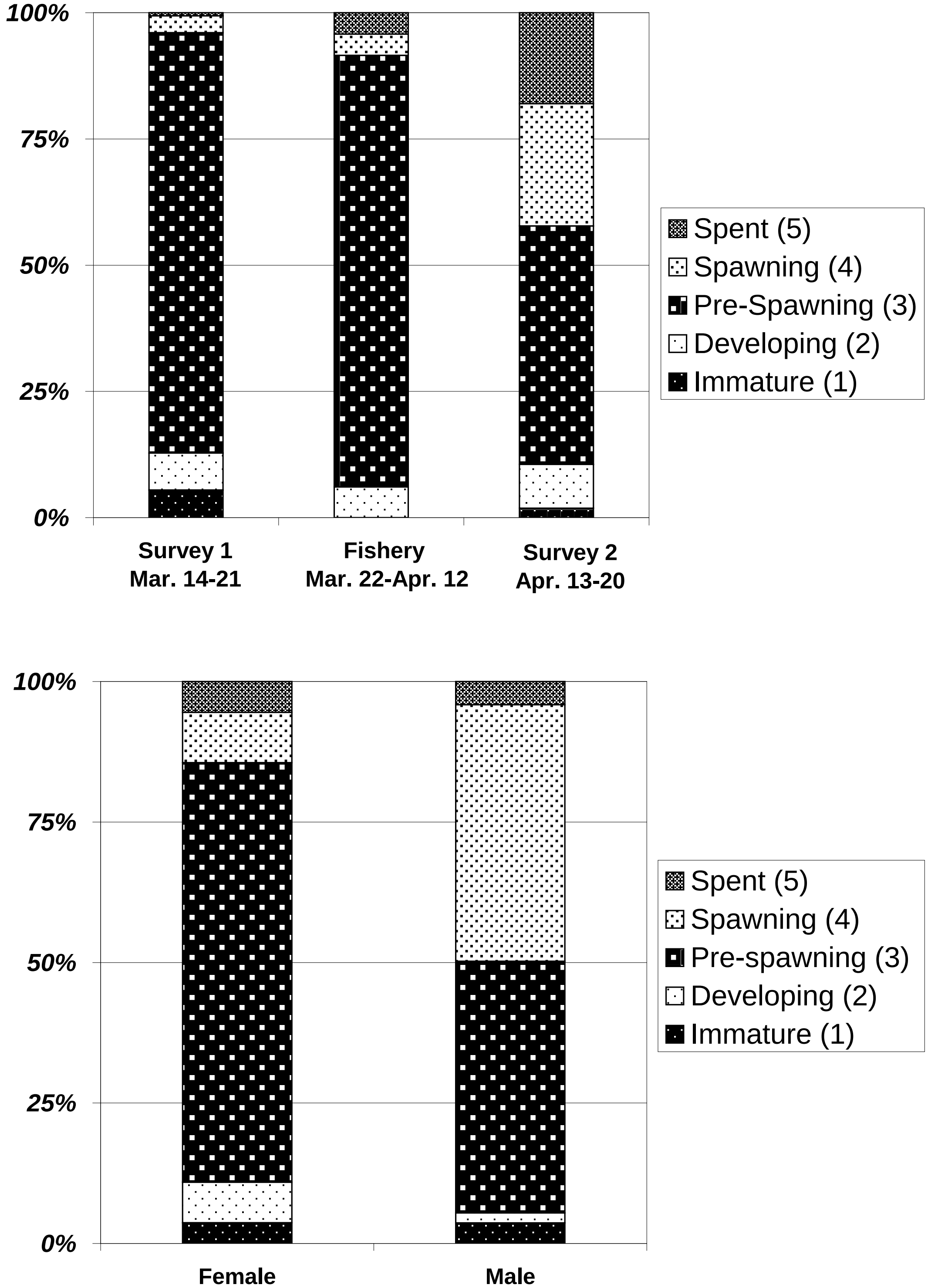

Figure 11. -- Pollock maturity stage for Survey 1, Survey 2, and the between survey compensation fishery by time (top) and by sex (bottom).

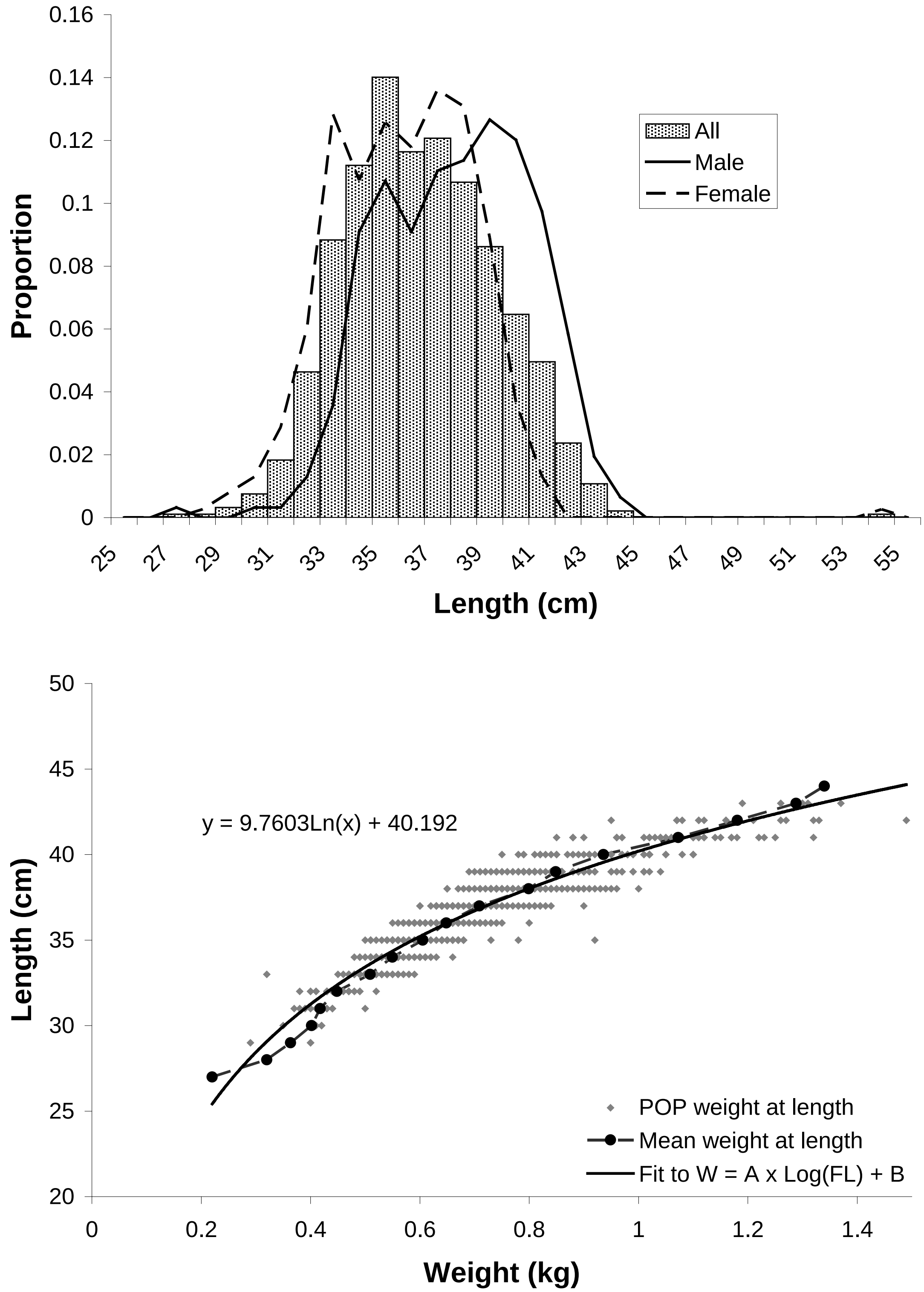

Figure 12. -- Pacific ocean perch length distribution (top) and weight at length (bottom) from the 2007 AICASS.

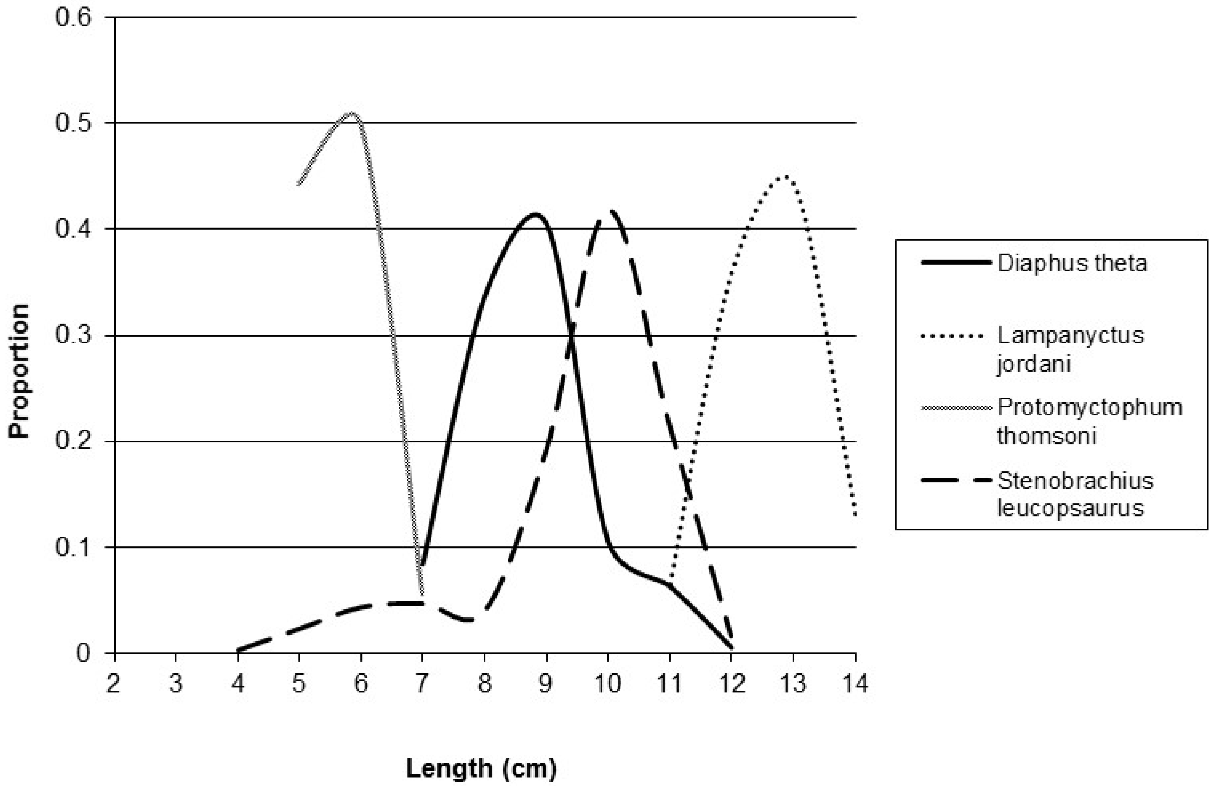

Figure 13. -- Length distribution of predominant Myctophidae species from 2007 AICASS.

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