

Information submitted  
to the Scientific and Technical Committee

by the United States Party

for the 8<sup>th</sup> Annual Conference of the Parties  
to the Convention on the Conservation and  
Management of Pollock Resources  
in the Central Bering Sea

Portland, 15-18 September 2003

Alaska Fisheries Science Center  
National Marine Fisheries Service  
7600 Sand Point Way NE  
Seattle, Wa 98115-0070

Contact email: [Loh-Lee.Low@noaa.gov](mailto:Loh-Lee.Low@noaa.gov)  
(206) 526-4190

# Contents

	<b>Page</b>
<b>Section I</b> (for S&T Agenda 5.1 – Update Catch and Effort Statistics)	
Table 1 -- United States pollock catches, 1993-2002	I-3
Table 2 – Historical catch of pollock from the Bering Sea, 1977-2002	I-4
Figure – Management Areas - Bering Sea-Aleutians	I. 5
Three Tables – North Pacific Fishery Management Council Recommendations for Year 2003 for	
(a) Bering Sea-Aleutians groundfish	I-6
(b) Gulf of Alaska groundfish, and	I-8
(c) Allocations of pollock TAC for the Bering Sea-Aleutians region	I-9
 <b>Section II</b> (for Agenda Item 5.3 – Review of Research Results)	
Report – Results of the March 2003 echo integration-trawl survey of walleye pollock conducted on the southeastern Aleutian Basin near Bogoslof Island, Cruise MF2003-04 (by Denise McKelvey and Neal Williamson)	II-1
Update of results from 2002 acoustic-trawl surveys	II-29
 <b>Section III</b> (for Agenda Item 5.4 – Review the status of Aleutian Basin pollock stocks)	
Report – Eastern Bering Sea walleye pollock stock assessment	III-1
 <b>Section IV</b> (for Agenda Item 5.7– Methodologies to determine AHL)	
Report – Formulation and determination of ABC/AHL Procedure	IV-1
Preliminary computation of 2003 ABC for Bogoslof ABC	IV-3
 <b>Section V</b> (for Agenda Item 7 – Other matters and recommendations)	
Web Site information of Convention reports	V-1

# Section I

<b>Section I</b> (for S&T Agenda 5.1 – Update Catch and Effort Statistics)	
Table 1 -- United States pollock catches, 1993-2002	I-3
Table 2 – Historical catch of pollock from the Bering Sea, 1977-2002	I-4
Figure – Management Areas - Bering Sea-Aleutians	I. 5
Three Tables – North Pacific Fishery Management Council Recommendations for Year 2003 for	
(a) Bering Sea-Aleutians groundfish	I-6
(b) Gulf of Alaska groundfish, and	I-8
(c) Allocations of pollock TAC for the Bering Sea-Aleutians region	I-9

Table 1. United States Pollock Catches in metric tons, 1993-2003

Year	E. Bering Sea	Aleutians	Bogoslof	Gulf of Alaska
1993	1,198,790	54,074	885	108,066
1994	1,197,224	53,224	556	110,890
1995	1,169,614	60,184	264	73,248
1996	1,102,579	26,597	389	37,106
1997	1,036,789	24,721	163	89,893
1998	1,058,288	22,053	8	123,805
1999	889,561	965	1	93,422
2000	1,019,067	1,174	29	23,643
2001	1,247,305	788	61	70,485
2002	1,331,416	1,134	22	50,712
(Through Aug 2, 2003)	887,828	1,514	24	26,787

Note: (Data from <http://www.fakr.noaa.gov/sustainablefisheries/catchstats.htm>)

**Table 2. Historical catch of pollock from the Bering Sea, in metric tons, 1977-2003**

Year	Western Bering Sea	Donut Hole	Navarin Region	Bogoslof	Aleutian Region	Eastern Bering Sea	Total Bering Sea
1977	265000				7625	978370	1,250,995
1978	417000				6282	979431	1,402,713
1979	546,000				9,504	935,714	1,491,218
1980	825,000				58,156	958,280	1,841,436
1981	1,133,000				55,516	973,502	2,162,018
1982	976,000				57,978	955,964	1,989,942
1983	1,006,000				59,026	981,450	2,046,476
1984	755,000	181,200	503,000		81,834	1,092,055	2,613,089
1985	662,000	363,400	488,000		58,730	1,139,676	2,711,806
1986	867,000	1,039,800	570,000		46,641	1,141,993	3,665,434
1987	812,000	1,326,300	463,000	377,436	28,720	859,416	3,866,872
1988	1,327,000	1,395,900	852,000	87,813	30,000	1,228,721	4,921,434
1989	1,029,000	1,447,600	684,000	36,073	15,531	1,229,600	4,441,804
1990	814,000	917,400	232,000	151,672	79,025	1,455,193	3,649,290
1991	504,000	293,400	178,000	264,760	78,649	1,217,301	2,536,110
1992	597,000	10,000	315,000	160	48,745	1,164,440	2,135,345
1993	677,000	1,957	389,000	885	54,074	1,198,790	2,321,706
1994	492,900	NA	288,900	556	53,224	1,197,224	2,032,804
1995	506,300	Trace	427,300	264	60,184	1,169,614	2,163,662
1996	787,000	Trace	753,000	389	26,597	1,102,579	2,669,565
1997	765,000	Trace	735,000	163	24,721	1,036,789	2,561,673
1998	744,000	Trace	719,000	8	22,053	1,058,288	2,543,349
1999	685,000	Trace	639,000	1	965	889,561	2,214,527
2000	522,000	Trace	507,000	29	1,174	1,019,067	2,049,270
2001	551,000	Trace	526,000	61	788	1,247,305	2,325,154
2002	378,000	Trace	370,000	22	1,134	1,331,416	2,080,572
2003*	265,000			24	1,514	887,828	1,154,366

\* U.S. data for 2003 is through August 2, 2003; Russian data through Aug 31, 2003

**Sources of Data**

U.S. Data, 1979-1992 from Pollock stock assessment document at 7th Annual Conference

1993-2003 data from web site: [www.fakr.noaa.gov](http://www.fakr.noaa.gov)

Navarin Data, 1994-2001 (from Russian pollock stock assessment document presented by the Russian Party at the 6th annual conference in Poland)

Navarin Data, 1984-1993 (from The Aleutian Basin Pollock Stock in 2001 written by TINRO and presented at 6th annual conference)

Western Bering Sea data from Balykin (1996)

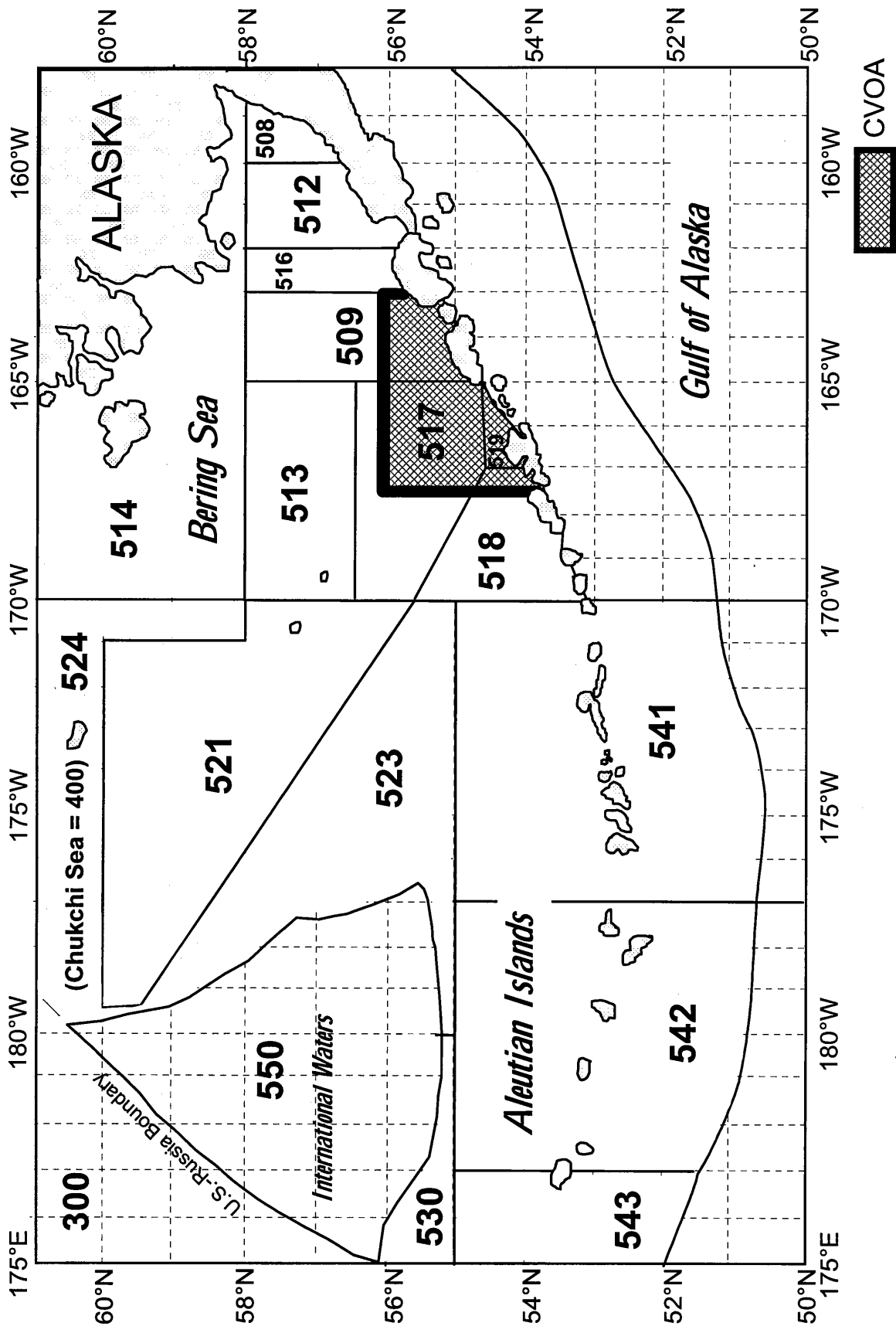


Figure 2 to Part 679. BSAI Catcher Vessel Operational Area (CVOA) (South of 56°00' N lat between 163°00' W and 167°30' W long)

**NORTH PACIFIC FISHERY MANAGEMENT COUNCIL RECOMMENDATIONS**

**DRAFT**

**Bering Sea and Aleutian Islands**

**2002 Specifications and Recommendations for Final 2003 Specifications (mt)**

Species	Area	2002 Biomass	2002 OFL	2002 ABC	2002 TAC	2002 Catch*	2003 Biomass	2003 OFL	2003 ABC	2003 TAC
Pollock	EBS	9,800,000	3,530,000	2,110,000	1,485,000	1,484,927	11,100,000	3,530,000	2,330,000	1,491,760
	AI	106,000	31,700	23,800	1,000	1,041	175,000	52,600	39,400	1,000
	Bogoslof	232,000	46,400	4,310	100	38	227,000	45,300	4,070	50
Pacific cod	BSAI	1,540,000	294,000	223,000	200,000	184,937	1,680,000	324,000	223,000	207,500
Yellowfin sole	BSAI	1,597,000	136,000	115,000	86,000	74,861	1,550,000	136,000	114,000	83,750
Greenland turbot	BSAI	208,000	36,500	8,100	8,000	2,753	112,000	17,800	5,880	4,000
	BS			5,427	5,360	2,287				2,680
	AI			2,673	2,640	466				1,320
Arrowtooth flounder	BSAI	671,000	137,000	113,000	16,000	11,443	597,000	139,000	112,000	12,000
Rock sole	BSAI	1,850,000	268,000	225,000	54,000	41,621	877,000	132,000	110,000	44,000
Flathead sole	BSAI	695,000	101,000	82,600	25,000	15,419	550,000	81,000	66,000	20,000
Alaska plaice	BSAI	1,110,000	172,000	143,000	12,000	12,291	1,080,000	165,000	137,000	10,000
Other flatfish	BSAI	78,300	21,800	18,100	3,000	2,628	107,000	21,400	16,000	3,000
Sablefish	EBS	28,000	2,900	1,930	1,930	893	31,000	4,290	2,900	2,900
	AI	39,000	3,850	2,550	2,550	994	39,000	4,590	3,100	3,100
Pacific Ocean Perch	BSAI	377,000	17,500	14,800	14,800	11,221	375,000	18,000	15,100	14,100
	Bering Sea			2,620	2,620	642			2,410	1,410
	Eastern			3,460	3,460	2,758			3,500	3,500
	Central			3,060	3,060	2,971			3,340	3,340
	Western			5,660	5,660	4,850			5,850	5,850
Northern rockfish	BSAI	150,000	9,020	6,760			156,000			
	BS				19	109		161	121	121
	AI				6,741	3,951		9,332	6,980	5,879
Shortraker/rougheye	BSAI	48,000	1,369	1,028			32,000	1,290	967	
	BS				116	99				137
	AI				912	474				830
Other rockfish (incl. sharpchin)	EBS	6,880	482	361	361	399	18,000	1,280	960	960
	AI	12,900	901	676	676	547	15,000	846	634	634
Atka mackerel	AI	439,700	82,300	49,000	49,000	43,993	358,300	99,700	63,000	60,000
	Eastern			5,500	5,500	5,002			10,650	10,650
	Central			23,800	23,800	20,947			29,360	29,360
	Western			19,700	19,700	18,044			22,990	19,990
Squid	BSAI	n/a	2,620	1,970	1,970	784	n/a	2,620	1,970	1,970
Other Species	BSAI	667,000	78,900	39,100	30,825	26,467	695,000	81,100	43,300	32,309
<b>BS/AI TOTAL</b>		<b>19,655,780</b>	<b>4,974,242</b>	<b>3,184,085</b>	<b>2,000,000</b>	<b>1,922,532</b>	<b>19,774,300</b>	<b>4,867,309</b>	<b>3,298,792</b>	<b>2,000,000</b>

EBS = eastern Bering Sea

BSAI = Bering Sea & Aleutians

BS = Bering Sea

AI = Aleutian Islands

OFL = overfishing level

ABC = acceptable biological catch

TAC = total allowable catch

\*through 11/02/02 including CDQ harvest

Gulf of Alaska  
2002 Specifications and Council's Final 2003 Specifications (mt)

SPECIES	Area	2002					2003			
		Biomass	OFL	ABC	TAC	Catch*	Biomass	OFL	ABC	TAC
Pollock <sup>1</sup>	W (61)			17,730	17,730	17,381			16,788	16,788
	C (62)			23,045	23,045	20,380			19,685	19,685
	C (63)			9,850	9,850	10,809			10,339	10,339
	WYAK	726,600	75,480	1,165	1,165	1,818	670,410	69,410	1,078	1,078
	EYAK/SE	28,710	8,610	6,460	6,460	2	28,710	8,610	6,460	6,460
	TOTAL	755,310	84,090	58,250	58,250	50,390	699,120	78,020	54,350	54,350
Pacific Cod	W			22,465	16,849	15,327			20,600	15,450
	C			31,680	24,790	25,094			29,000	22,690
	E			3,455	2,591	103			3,200	2,400
	TOTAL	428,000	72,100	57,600	44,230	40,524	452,000	70,100	52,800	40,540
Deep water flatfish <sup>2</sup>	W			180	180	19			180	180
	C			2,220	2,220	530			2,220	2,220
	WYAK			1,330	1,330	2			1,330	1,330
	EYAK/SEO			1,150	1,150	7			1,150	1,150
	TOTAL	68,263	6,430	4,880	4,880	558	68,260	6,430	4,880	4,880
Rex sole	W			1,280	1,280	398			1,280	1,280
	C			5,540	5,540	2,611			5,540	5,540
	WYAK			1,600	1,600	0			1,600	1,600
	EYAK/SEO			1,050	1,050	0			1,050	1,050
	TOTAL	71,326	12,320	9,470	9,470	3,009	71,330	12,320	9,470	9,470
Shallow water flatfish <sup>3</sup>	W			23,550	4,500	241			23,480	4,500
	C			23,080	13,000	6,599			21,740	13,000
	WYAK			1,180	1,180	2			1,160	1,160
	EYAK/SEO			1,740	1,740	0			2,960	2,960
	TOTAL	349,992	61,810	49,550	20,420	6,842	349,990	61,810	49,340	21,620
Flathead sole	W			9,000	2,000	419			16,420	2,000
	C			11,410	5,000	1,689			20,820	5,000
	WYAK			1,590	1,590	0			2,900	2,900
	EYAK/SEO			690	690	0			1,250	1,250
	TOTAL	170,915	29,530	22,690	9,280	2,108	132,260	51,560	41,390	11,150
Arrowtooth flounder	W			16,960	8,000	6,100			17,990	8,000
	C			106,580	25,000	14,674			113,050	25,000
	WYAK			17,150	2,500	56			18,190	2,500
	EYAK/SEO			5,570	2,500	111			5,910	2,500
	TOTAL	1,760,000	171,060	146,260	38,000	20,941	1,302,000	181,390	155,140	38,000
Sablefish	W			2,240	2,240	1,780			2,570	2,570
	C			5,430	5,430	6,120			6,440	6,440
	WYAK			1,940	1,940	1,548			2,320	2,320
	SEO			3,210	3,210	2,798			3,560	3,560
	TOTAL	188,000	19,350	12,820	12,820	12,246	182,000	20,020	14,890	14,890
Other Slope rockfish	W			90	90	222			90	90
	C			550	550	481			550	550
	WYAK			260	150	37			270	150
	EYAK/SEO			4,140	200	31			4,140	200
	TOTAL	107,960	6,610	5,040	990	771	107,960	6,610	5,050	990



SPECIES	Area	2002	2002	2002	2002	2002	2003	2003	2003	2003
		Biomass	OFL	ABC	TAC	Catch	Biomass	OFL	ABC	TAC
Northern rockfish	W			810	810	337			890	890
	C			4,170	4,170	2,998			4,640	4,640
	E			0 <sup>4</sup>	0 <sup>4</sup>	NA			0 <sup>4</sup>	0 <sup>4</sup>
	TOTAL	94,350	5,910	4,980	4,980	3,335	108,830	6,560	5,530	5,530
Pacific ocean perch	W		3,110	2,610	2,610	2,723		3,220	2,700	2,700
	C		9,760	8,220	8,220	8,263		10,120	8,510	8,510
	WYAK			780	780	748			810	810
	SEO		2,800	1,580	1,580	1		2,900	1,640	1,640
	TOTAL	293,240	15,670	13,190	13,190	11,735	298,820	16,240	13,660	13,660
Shortraker/rougheye	W			220	220	260			220	220
	C			840	840	628			840	840
	E			560	560	403			560	560
	TOTAL	70,890	2,340	1,620	1,620	1,291	66,830	2,340	1,620	1,620
Pelagic shelf rockfish	W			510	510	183			510	510
	C			3,480	3,480	2,680			3,480	3,480
	WYAK			640	640	448			640	640
	EYAK/SEO			860	860	7			860	860
	TOTAL	62,489	8,220	5,490	5,490	3,318	62,500	8,220	5,490	5,490
Demersal Shelf Rockfish		15,615	480	350	350	182	17,510	540	390	390
Atka Mackerel	GW	unknown	6,200	600	600	84	unknown	6,200	600	600
Thornyhead rockfish	W			360	360	368			360	360
	C			840	840	504			840	840
	E			790	790	253			800	800
	TOTAL	77,840	2,330	1,990	1,990	1,125	85,760	3,050	2,000	2,000
Other Species	GW		NA	NA	11,330	3,748	NA	NA	NA	11,260
GOA TOTAL		4,514,190	504,450	394,780	237,890	162,207	4,005,170	531,410	416,600	236,440

\* Catch through 11/02/02

1/ The pollock ABC has been reduced by 1,700 mt to accommodate the expected Prince William Sound State harvest.

2/ Deep water flatfish includes dover sole, Greenland turbot and deepsea sole.

3/ "Shallow water flatfish" includes rock sole, yellowfin sole, butter sole, starry flounder, English sole, Alaska plaice, and sand sole.

4/ The EGOA ABC for northern rockfish has been included in the WYAK ABC for other slope rockfish.

NOTE:

W = Western Gulf C = Central Gulf E = Eastern Gulf WYAK = West Yakutat EYAK/SEO = East Yakutat/Southeast  
 GW means Gulfwide.

TABLE 3.—2003 ALLOCATIONS OF THE POLLOCK TAC AND DIRECTED FISHING ALLOWANCE (DFA) TO THE INSHORE, CATCHER/PROCESSOR, MOTHERSHIP, AND CDQ COMPONENTS<sup>1</sup>

[Amounts are in mt]

Area and Sector	2003 Allocations	A Season <sup>1</sup>		B Season <sup>1</sup>
		A season DFA (40% of Annual DFA)	SCA harvest limit <sup>2</sup>	B season DFA (60% of Annual DFA)
Bering Sea subarea	1,491,760	-----	-----	-----
CDQ	149,176	59,670	41,769	89,506
ICA <sup>3</sup>	46,990	-----	-----	-----
AFA Inshore	647,797	259,119	181,383	388,678
AFA Catcher/Processors <sup>4</sup>	518,237	207,295	145,106	310,942
Catch by C/Ps <sup>4</sup>	474,187	189,675	-----	284,512
Catch by CVs <sup>4</sup>	44,050	17,620	-----	26,430
Restricted C/P cap <sup>5</sup>	2,591	1,036	-----	1,555
AFA Motherships	129,559	51,824	36,277	77,736
Excessive harvesting share <sup>6</sup>	226,729	-----	-----	-----
Aleutian Islands				
ICA <sup>7</sup>	1,000			
Bogoslof District				
ICA <sup>7</sup>	50			

<sup>1</sup>After subtraction for the CDQ reserve (10 percent) and the ICA (3.5 percent), the pollock TAC is allocated as a DFA: inshore component - 50 percent, catcher/processor component - 40 percent, and mothership component - 10 percent. Under § 679.20(a)(5)(i)(A), the CDQ reserve for pollock is 10 percent. The A season, January 20 - June 10, is allocated 40 percent of the DFA and the B season, June 10 - November 1, is allocated 60 percent of the DFA.

<sup>2</sup>No more than 28 percent of each sector's annual DFA may be taken from the SCA before April 1. The remaining 12 percent of the annual DFA allocated to the A season may be taken outside of SCA before April 1 or inside the SCA after April 1. If 28 percent of the annual DFA is not taken inside the SCA before April 1, the remainder is available to be taken inside the SCA after April 1.

<sup>3</sup>The pollock ICA for the BS subarea is 3.5 percent of the TAC after subtraction of the CDQ reserve.

<sup>4</sup>Under § 679.20(a)(5)(i)(A)(4)(i) and (ii), NMFS will allocate 91.5 percent of the catcher/processor sector allocation to AFA catcher/processers engaged in directed fishing for pollock and 8.5 percent of the catcher/processor sector allocation to AFA catcher vessels delivering to catcher/processers unless changed by the cooperative contracts.

<sup>5</sup>Under § 679.20(a)(5)(i)(A)(4)(iii), unlisted AFA catcher/processers are limited to harvesting not more than 0.5 percent of the catcher/processor sector allocation of pollock.

<sup>6</sup>Under § 679.20(a)(5)(i)(A)(6), NMFS establishes an excessive harvesting share limit equal to 17.5 percent of the sum of the directed fishing allowances established under paragraphs (a)(5)(i) and (a)(5)(ii) of this section.

<sup>7</sup>The Aleutian Islands subarea and the Bogoslof District are closed to directed fishing for pollock. The amounts specified are for incidental catch amounts only, and are not apportioned by season or sector.

# Section II

**Section II** (for Agenda Item 5.3 – Review of Research Results)

Report – Results of the March 2003 echo integration-trawl survey of walleye pollock conducted on the southeastern Aleutian Basin near Bogoslof Island, Cruise MF2003-04 (by Denise McKelvey and Neal Williamson)

II-1

Update of results from 2002 acoustic-trawl surveys

II-29



**Alaska  
Fisheries Science  
Center**

National Marine  
Fisheries Service

U.S. DEPARTMENT OF COMMERCE

## **AFSC PROCESSED REPORT 2003-09**

Results of the March 2003  
Echo Integration-trawl Survey of  
Walleye Pollock (*Theragra chalcogramma*)  
Conducted in the Southeastern  
Aleutian Basin Near Bogoslof Island,  
Cruise MF2003-04

August 2003

This report does not constitute a publication and is for information only.  
All data herein are to be considered provisional.

**Results of the March 2003 Echo Integration-Trawl Survey  
of Walleye Pollock (*Theragra chalcogramma*)  
Conducted in the Southeastern Aleutian Basin  
Near Bogoslof Island, Cruise MF2003-04**

by Denise McKelvey and Neal Williamson

August 2003

## INTRODUCTION

Scientists from the Midwater Assessment and Conservation Engineering Program of the Alaska Fisheries Science Center (AFSC) have conducted echo integration-trawl (EIT) surveys in the southeastern Aleutian Basin near Bogoslof Island to estimate midwater pollock (*Theragra chalcogramma*) distribution and abundance annually since 1988, with the exception of 1990. The biomass estimate for pollock within the Central Bering Sea (CBS) Convention Specific Area<sup>1</sup> obtained during these surveys provide an index of abundance for the Aleutian Basin pollock stock (Honkalehto and Williamson, 1995). The results presented here are from the echo integration-trawl (EIT) survey carried out 8-14 March 2003 aboard the NOAA ship *Miller Freeman*, Cruise MF2003-04.

---

<sup>1</sup> The "specific area" is defined in the Annex to the Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea as "the area south of a straight line between a point at 55° 46' N lat. and 170° W long. and a point at 54° 30' N lat., 167° W long. and between the meridian 167° W long. and the meridian 170° W long. and the north of the Aleutian Islands and straight lines between the islands connecting the following coordinates in the order listed: 52° 49.2 N 169° 40.4 W, 52° 49.8 N 169° 06.3 W, 53° 23.8 N 167° 50.1 W, 53° 18.7 N 167° 51.4 W."



## METHODS

### Itinerary

- 7 Mar Embark scientists in Dutch Harbor, AK.
- 8 Mar Calibration of acoustic system in Captains Bay, AK.
- 9-13 Mar EIT survey of the southeastern Aleutian Basin, near Bogoslof Island.
- 13-14 Mar Survey operations suspended due to bad weather.
- 14-15 Mar Transit to Shelikof Strait, AK.

### Acoustic Equipment

Acoustic data were collected with Simrad EK500<sup>2</sup> and Simrad EK60 quantitative echo-sounding systems (Simrad, 2001; Bodholt et al. 1989, Bodholt and Solli 1992) on the NOAA ship *Miller Freeman*, a 66-m stern trawler equipped for fisheries and oceanographic research. Three split-beam transducers (38 kHz, 120 kHz, and 200 kHz) were mounted on the bottom of the vessel's retractable centerboard extending 9 m below the water surface. System electronics were housed inside the vessel in a permanent laboratory space dedicated to acoustics. Simrad EK 500 data (38 and 120 kHz) and Simrad EK60 data (200 kHz) were logged with SonarData EchoLog 500. The 38 kHz data were analyzed using SonarData Echoview (V 2.25.109) PC-based post-processing software. Echo integration and target-strength (TS) data were collected simultaneously at all frequencies. Results presented here are based on the 38 kHz data.

### Trawl Gear

Midwater and near-bottom echosign was sampled using an Aleutian Wing 30/26 Trawl (AWT). This trawl was constructed with full-mesh nylon wings, and polyethylene mesh in the codend and aft section of the body. The headrope and footrope each measured 81.7 m (268 ft). Mesh sizes tapered from 325.1 cm (128 in) in the forward section of the net to 8.9 cm (3.5 in) in the codend. The net was fitted with a

---

<sup>2</sup> Reference to trade names or commercial firms does not constitute U.S. Government endorsement.



32-mm (1.25-in) codend liner. The AWT was fished with 82.3 m (270 ft) of 1.9-cm (0.75-in) diameter (8 ×19 wire) non-rotational dandyines, 226.8-kg (500-lb) or 340.2-kg (750-lb) tom weights on each side, and 5 m<sup>2</sup> Fishbuster trawl doors [1,247 kg (2,750 lb) each]. Vertical net opening and depth were monitored with a WESMAR third wire netsounder system attached to the trawl headrope; the net opening ranged from 24 to 37 m, and averaged 30 m, while fishing.

### Oceanographic Equipment

Physical oceanographic data collected during the cruise included temperature/depth profiles obtained with a Sea-Bird Electronics temperature-depth probe (SBE-39) attached to the trawl headrope and conductivity-temperature-depth (CTD) observations collected with a Sea-Bird CTD system at calibration sites. Sea surface temperature, salinity, and other environmental data were collected using the *Miller Freeman's* Scientific Computing System (SCS). Ocean current profile data were obtained using the vessel's centerboard-mounted acoustic Doppler current profiler system operating continuously in water-profiling mode.

### Survey Design

The Bogoslof Island area echo integration-trawl survey began 9 March 2003 north of Unalaska Island at about 167°W longitude, and proceeded west towards the Islands of Four Mountains near 170°W, concluding on 13 March. The 22 north-south parallel transects were spaced 5 nautical miles (nmi) apart and covered a 2,993 nmi<sup>2</sup> area (Fig. 1), within the CBS Specific Area. Average transecting speed was about 11 knots. Echo integration data were collected 24 hours a day between 14 m from the surface (5 m below the centerboard-mounted transducer) and 0.5 m off the bottom, unless the bottom exceeded 1,000 m, the lower limit of data collection. Acoustic system settings used during the collection were based on results from acoustic system calibrations and on experience from prior surveys (Table 1A). Trawl hauls were conducted to identify echosign, and to provide biological samples for the primary goals of the survey and for additional research projects (e.g., fecundity studies, parasite studies). Average trawling speed was approximately 3 knots. Pollock were sampled to determine sex, fork length (FL), body weight, age, maturity, and ovary weight of selected females. Fork lengths were measured to the nearest centimeter (i.e., a fish measuring between 49.5 cm and 50.5 cm was recorded as

50 cm). An electronic motion-compensating scale was used to weigh individual pollock specimens. For age determinations, pollock otoliths were collected and stored in 50% ethanol-water solution. Maturity was determined by visual inspection and categorized as immature, developing, pre-spawning, spawning, or post-spawning. All data were recorded electronically using the Fisheries Scientific Computing System (FSCS) and stored in a relational database. Samples of pollock tissue, ovaries, and gametes were collected for ongoing research by AFSC scientists. Whole fish were retained for training fisheries observers.

Standard sphere acoustic system calibrations were made prior to the Bogoslof Island area survey to measure acoustic system performance for the EK500 at 38 and 120 kHz, and for the EK60 at 200 kHz. During calibrations, the *Miller Freeman* was anchored at bow and stern. Weather, sea state conditions, and acoustic system settings were recorded. Three calibration spheres were suspended below the centerboard-mounted transducers. Two were copper calibration spheres of 23 mm (120-kHz sphere, TS = -40.3 dB) and 60 mm (38-kHz sphere, TS = -33.6 dB) diameter, and the third was a tungsten carbide sphere of 38.1 mm (200-kHz sphere, TS = -39.5 dB) diameter. After each sphere was centered on the acoustic axis, split-beam target-strength and echo integration data were collected to determine acoustic system gain parameters. The average on-axis target strength and on-axis integration values were measured and recorded. Transducer beam characteristics were measured using a Simrad software program (EKLOBES). Each sphere was pulled through its corresponding transducer beam, target-strength data were collected on a grid of angle coordinates, and beam pattern was estimated (Foote et al. 1987).

### Data Analysis

The abundance of pollock was estimated by combining echo integration and trawl data. Echosign identified as pollock was stored in a database. Pollock length data from 5 hauls were aggregated into three analytical strata based on echosign type, geographic proximity of hauls, and similarity in size composition data. Average pollock volume backscattering strength along each 0.5 nmi of transect was multiplied by transect width to estimate area backscattering strength for transect segments. Area backscattering segments were summed to compute total pollock area backscattering for each analytical

stratum. Stratum totals were then summed and scaled using a previously derived relationship between target strength and fish length ( $TS = 20 \text{ Log FL} - 66$ ; Traynor 1996) and the length composition data, resulting in an estimate of numbers of pollock by size. A length-weight relationship observed from trawl data was applied to estimate pollock biomass for each length category. Age data for winter 2003 were not available when this analysis was completed.

In the Bogoslof Island area, pre-spawning pollock aggregations are often densely packed and vertically and/or horizontally stratified by sex. Therefore it is not always possible to obtain an unbiased sample of lengths from these aggregations to estimate population size composition. At ages older than about 5 years, female pollock are longer than male pollock. Thus, biased estimates of sex composition from trawl hauls can result in biased estimates of population size and age composition. As in previous Bogoslof surveys, we assumed that the sex ratio that we sampled was 50:50 and estimated abundance under this assumption.

Relative estimation errors for the acoustic data were derived using a one-dimensional (1D) geostatistical method as described by Petitgas (1993), Williamson and Traynor (1996), and Rivoirard et al. (2000). Relative estimation error is defined as the ratio of the square root of the estimation variance to the estimate of acoustic abundance. Geostatistical methods are used for computation of error because they account for the observed spatial structure. These errors quantify only transect sampling variability. Other sources of error (e.g., target strength, trawl sampling) are not included.

## **RESULTS**

### Calibration

Acoustic system calibrations were conducted before, between, and after the winter EIT surveys in the Bering Sea and Gulf of Alaska (Table 1B). The EK500 38-kHz and 120 kHz collection systems showed no significant differences in gain parameters or transducer beam pattern characteristics before and after the Bogoslof Island area survey.

### Oceanographic Conditions

Temperature profiles from the basin region at three sites (Table 2) indicated well-mixed water columns with little variation in temperature between the surface and deeper waters. Temperatures in the upper 500 m of the water column ranged from 3.6° to 5.1°C and averaged 4.4°C.

### Biological Sampling

Biological data and specimens were collected from 5 trawl hauls (Tables 2 and 3; Fig. 1). Poor weather conditions precluded additional trawl sampling. Walleye pollock dominated the trawl catches by weight (97.9%; Table 4). Lanternfish (Myctophidae) and Pacific ocean perch (*Sebastes alutus*) each contributed about 1% of the total catch by weight.

Length measurements were collected from about 1,800 pollock specimens (Table 3, Fig 2) for scaling the acoustic data and computing size-specific population estimates. Pollock sampled in trawl hauls ranged from 33 to 69 cm FL. Length compositions varied over the region surveyed and were grouped into three strata (Fig. 3). Pollock lengths from hauls 1 and 2 were unimodal with the mode at 48-49 cm FL; they were combined to represent the Umnak Pass region, stratum 1. Pollock lengths from haul 3 were more evenly dispersed between 44 and 67 cm FL and were considered to represent the Umnak Island region, stratum 2. Length compositions from hauls 4 and 5 were bimodal with modes at about 48-50 and 59-60 cm. These hauls were combined to represent the Samalga Pass region, stratum 3. Trawl catch sex ratios ranged from 12% to 92% male.

Maturity stage data, length-weight data, and otoliths were collected from 346 pollock specimens. The unweighted maturity composition showed that 81% percent of the female and 25% of the male pollock were in pre-spawning condition (Fig. 4a). Seven percent of the females and about 63% of the males were actively spawning. The average gonado-somatic index (GSI: ovary weight/body weight) for pre-spawning mature female pollock was 0.17 (Fig. 4b), which was similar to the average GSI observed during recent years . This suggests that the survey's timing was similar to previous years in relation to peak spawning. The regression equation of total body weight to length for sexes combined was  $W = 0.003 \times FL^{3.2238}$ , where FL is fork length (cm) and W is weight (g) (Fig. 4c).

### Pollock Distribution and Abundance

The spatial distribution of pollock in the survey area was similar to that observed in recent years. Pollock were primarily concentrated just north of Samalga Pass about 300-400 m below the surface, with lesser concentrations along the shelf break at the northeast end of Umnak Island (Fig. 1).

The abundance estimate for pollock in the Bogoslof area between 14 m below the surface and 1,000 m was estimated at 0.134 billion fish weighing 0.198 million metric tons (Table 5, Fig. 5). The size composition was bimodal; 38% of the pollock by numbers (25% of the biomass) were 54 cm or smaller in length, and of those, the average fork length was 48.9 cm. The remaining 62% of the estimated pollock numbers (75% of the biomass) were larger than 54 cm, and of those, the average fork length was 59.9 cm. Based on the 1D analysis, the relative estimation error of the Bogoslof pollock biomass estimate is 21.5%. The abundance estimates and relative estimation error for pollock inside the CBS Specific Area are the same as for the total area (Table 5).

## **DISCUSSION**

In 2003, as in recent years, pollock were highly concentrated in Samalga Pass (84% of biomass in 2003, 74% in 2002, 76% in 2001), and were otherwise sparsely distributed within the Bogoslof area. Poor weather conditions towards the end of the survey limited trawl sampling to only two hauls in the Samalga Pass region. Length composition data are used to scale acoustic data to total abundance and then, combined with age data, to partition total abundance into year class. If the size composition in the Samalga Pass area was biased due to inadequate sampling, the effect on total abundance would be relatively small because the target strength-to-length relationship changes little over the observed size range of approximately 45-65 cm. However, resultant biases in estimates of size-at-age compositions might be of concern. The bimodal length composition of 48-50 and 59-60 cm observed this year, was consistent with the bimodal length composition observed in this region during the 2002 survey (i.e., 45-47 cm, 56-60 cm) (Fig. 6).

