September 2008

CRUISE RESULTS

ALASKA FISHERIES SCIENCE CENTERS'
BOTTOM TRAWL SURVEY OF THE
EASTERN BERING SEA UPPER CONTINENTAL SLOPE
GROUNDFISH AND INVERTEBRATE RESOURCES

CHARTERED VESSEL F/V *Vesteraalen*
CRUISE 2008-01
May 29 - August 11, 2008

The Resource Assessment and Conservation Engineering (RACE) Division of the Alaska Fisheries Science Center (AFSC) recently completed a bottom trawl survey of the groundfish and invertebrate resources of the Eastern Bering Sea Upper Continental Slope. This report summarizes the preliminary results of the survey.

SURVEY ITINERARY

The 70 day survey was conducted from May 29 to August 11 aboard the chartered commercial fishing vessel *Vesteraalen,* a 38 meter trawler. The survey commenced in Dutch Harbor, Alaska on May 29, 2008. Crew changes occurred at St. Paul Island and Dutch Harbor on June 19-23 and on July 18 in Dutch Harbor. The cruise ended in Dutch Harbor on August 11, 2008. The vessel worked along the continental slope of the eastern Bering Sea from Akutan Island toward the northwest to the international boundary, towing at randomly placed stations at depths between 200 and 1200 meters.

SURVEY OBJECTIVES

The objectives of the 2008 Eastern Bering Sea Upper Continental Slope Survey were to locate and successfully sample randomly placed stations throughout the slope survey area. The survey area was divided into 6 subareas running north to south and 5 depth strata within each subarea distributed between 200-1200 meters. Fishing effort was distributed within each subarea and depth stratum based on the total surface area of the sample area (Table 2). The catch of each successful haul was processed and subsequently recorded via onboard databases. The primary goals of the survey were to:

1) locate and successfully trawl stratified random locations on a variety of slope habitats;

2) describe the composition, spatial and depth distribution, and relative abundance of groundfish and invertebrate resources;

3) collect biological data, including sexed lengths, otoliths, individual weights, stomachs, tissue samples, museum specimens, and digital photographs from a variety of commercially and ecologically important species, and;

4) collect environmental parameters such as bottom depth, water temperatures and sea states to relate changes in fish and invertebrate distribution among years to changes in oceanographic conditions.

Table 1.--Vessel itinerary and scientists participating during the 2008 AFSC Eastern Bering Sea Upper Continental Slope survey of fish and invertebrate resources.

Name	Survey Position	Affiliation
Leg 1: 5/29 - 6/19		
Gerald R. Hoff	Chief Scientist	AFSC, Seattle
Chris Rooper	Fishery Biologist	AFSC, Seattle
Lyle Britt	Fishery Biologist	AFSC, Seattle
Ned Laman	Fishery Biologist	AFSC, Seattle
John Brogan	Fishery Biologist	AFSC, Seattle
Alison Deary	Fishery Biologist	NOAA Intern
Leg 2: 6/19 - 7/18		
Gerald R. Hoff	Chief Scientist	AFSC, Seattle
James W. Orr	Fishery Biologist	AFSC, Seattle
David Somerton	Fishery Biologist	AFSC, Seattle
Elaina Jorgenson	Fishery Biologist	AFSC, Seattle
Richard Hibpshman	Feeding Ecology	AFSC, Seattle
Delsa Anderl	Fishery Biologist	AFSC, Seattle
Leg 3: 7/18 - 8/11		
Stan Kotwicki	Chief Scientist	AFSC, Seattle
Duane Stevenson	Fishery Biologist	AFSC, Seattle
Alison Vijgen	Fishery Biologist	AFSC, Seattle
Beth Matta	Fishery Biologist	AFSC, Seattle
Richard Hibpshman	Feeding Ecology	AFSC, Seattle
Amelia Whitcomb	Fishery Biologist	NOAA Intern

For further information, contact: Russ Nelson, Director, Resource Assessment and Conservation Engineering Division, Alaska Fisheries Science Center, National Marine Fisheries Service, 7600 Sand Point Way NE, Bldg. 4, Seattle, WA, 98115-0070. Telephone (206)526-4170.

SURVEY DESIGN

The 2008 Eastern Bering Sea Upper Continental Slope survey was designed to sample the entire upper slope region from 200-1200 meters using a stratified random design. The goal was to distribute sampling effort in proportion to the survey surface area by depth and subarea. The survey area was divided into 6 physical subareas running south to north (1-6, Figure 1) that may represent distinct biological realms such as canyon areas (2, 4), steep rough slope areas (3,5) and broad gentle sloping areas (1, 6). Each subarea was then divided into five depth strata each covering approximately 200 meters in depth from 200-1200 meters.

Table 2 shows the five depth strata, target depth ranges for each stratum, and the surface area and percentage each depth stratum represented.

SURVEY VESSEL AND METHODS

The *F/V Vesteraalen* is 38 m long and powered by a single main engine developing 1,710 continuous horsepower. The vessel is equipped with a full suite of modern navigation, fish-finding, and communication electronics. An experienced skipper and four-member fishing crew operated the vessel and the fishing gear, while a team of six scientists collected data and specimens from the trawl samples.

The RACE Division provided standardized trawls, bridles, and trawl doors for the survey. A standardized Poly Nor'Eastern high opening bottom trawl equipped with mud-sweep roller gear was used to sample all stations. This sampling trawl has a 27.2 m headrope with twenty-one 30 cm floats and a 24.3 m long-link chain fishing line attached to a 24.9 m footrope. The body of the net was constructed of 127 mm stretched-mesh polyethylene netting, with 89 mm stretched-mesh polyethylene netting in the codend, and a 32 mm stretched-mesh nylon codend liner. The mud-sweep roller gear was constructed of 203 mm solid rubber disks strung over 16 mm high tensile chain. The net was fished with 1.83 H 2.75 m (6 H 9 ft) steel V-doors rigged with four-point bridles to enhance their stability at slow towing speeds and 55-m bridles between the doors and wingtips. This trawl is similar to the standard trawl historically used for the RACE Division, West Coast Upper Continental Slope survey. The fishing dimensions of the trawl were measured using a Scanmar[1] net measurement system.

Sea surface temperatures were collected with a net-mounted SeaBird (SBE-39) data logger which recorded surface-to-bottom temperature-depth profiles. A continuous track of the vessels GPS position during searching and transit operations (observations every 30-40 seconds) was recorded. More detailed position tracks (observations every 6 seconds) were collected during all fishing operations. An attempt was made to perform a 30 minute tow at a constant fishing speed of 2.5 knots with the trawl as close to its equilibrium fishing speed and configuration as possible when the footrope made bottom contact at each station. Electronic bottom contact sensors (BCS) were hung from the footrope of the trawl to detect when the trawl was on bottom and monitor the actual duration that the trawl remained in contact with the seabed. Synchronized data streams from the GPS, BCS, Scanmar net mensuration system, and SeaBird data loggers were synthesized into a data set that described and quantified the sampling effort for each haul. This data set included precise measurements of distance fished, fishing dimensions (width and height) of the net, bottom depth, water temperature, and bottom contact. All electronic data were synthesized after each haul and scrutinized by the lead scientist to determine the quality of the haul before processing the catch and moving to the next station.

The entire contents of every successful tow was processed using standardized RACE catch procedures for groundfish surveys. Catches were sorted by species and each species weighed separately (occasionally invertebrates that were too difficult to identify

[1]Reference to trade names or commercial firms does not constitute U.S. government endorsement.

as distinct were weighed and recorded collectively). A sub-sample (100-250 fish) of most abundant fish species (see Table 3) were randomly selected for further biological data collection including sexed lengths, otoliths, individual weights, and stomachs. Specimens were also collected from many species for more detailed studies of their biology (tissue samples, ovaries, etc) or as whole body specimens of fish and invertebrates that were rare, possibly undescribed, or of systematic interest.

RESULTS

Two hundred and seven tows were attempted during the survey and were distributed by area and depth along the slope region (Figure 1). Two hundred tows were completed successfully and were used for biological assessments while seven tows were unsatisfactory or incomplete due to the net coming off bottom during the tow, the net severely damaged during towing, or the net not achieving the proper fishing configuration during the tow due to bottom type or current. Table 2 shows the number of tows completed in each depth strata and the minimum and maximum depths towed within each strata. A comparison of the survey area percentage by depth strata and the number of hauls successfully completed in each depth strata (Table 2) shows that the survey goals were met or exceeded for strata 1-3. In the two deepest stratum (4 and 5) however the amount of effort fell slightly short of the goal due to the difficulty in locating trawlable grounds in deeper slope waters.

Approximately 146 fish species and 251 invertebrate species were identified. However the actual numbers may be slightly higher or lower due to grouping unidentified specimens into a common category or recording a single species as two separate species when identifications were dubious.

Table 3 shows 13 major groups of invertebrates caught in 2008 with the summed catch weight and approximate number of individuals for each group. The summed catch weight of the 13 groups accounted for 98% of the invertebrate total weight caught on the survey with approximately 2% of the weight represented by various invertebrate groups (other invertebrates). The number of species included in each of the 13 major invertebrate groups varies from possibly a single species, such as the sea mouse, to large groups, such as the sea stars, and snails and clams which included more than 40 species in each group. The invertebrate catch weight total for the survey was 11,241.7 kg which is approximately 4.9% of the total survey weight, however invertebrates accounted for 63% of the species diversity.

Table 4 shows 52 fish species in order of highest survey catch weights for which biological data was collected. The 52 species accounted for 99.8% of the total catch weight encountered with the remaining 0.2% representing mostly pelagic fishes such as lantern fishes, anglerfish, unidentified eelpouts, and snailfish species. Biological data collected included 70,554 sexed length fish measurements, >10,000 sexed length crab measurements, 3,036 otoliths, 2,628 stomach samples, approximately 329 fish and invertebrate whole voucher specimens and 1,500 digital photos.

Sexed lengths will be used to develop size composition length frequencies for each species by area or depth strata. Otoliths collected will be used to age many of the commercially important species and those of large biomass species that are of ecological

importance. Stomach scan data will be used for trophic level interactions between species in the slope ecosystem. Individual weights will be used to add to a growing data base of the length-weight relationships used as data checks on a haul by haul basis. Voucher specimens will be used for systematic studies and record verifications and the majority will subsequently be housed at the University of Washington Fish Collection in Seattle, Washington or the California Academy of Sciences in San Francisco, California. The digital photos collected will be catalogued and added to the data base of survey photos that are used for presentations, training, field identification guides, systematic studies and public outreach.

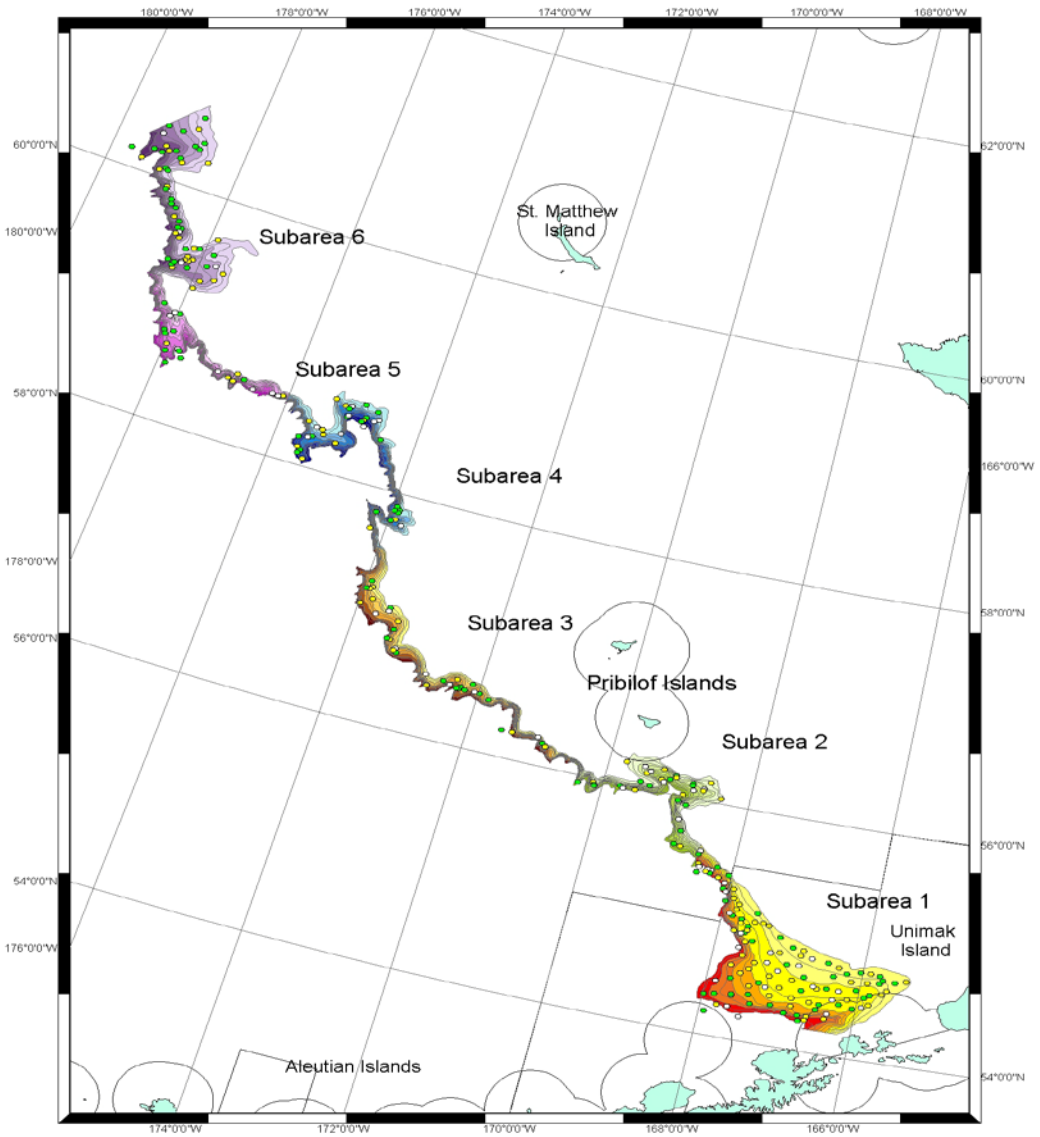

Figure 1. 2008 Eastern Bering Sea Upper Continental Slope Survey. All stations are indicated with colored dots.

Table 2. Results of towing depth distributions from the 2008 Eastern Bering Sea Upper Continental Slope Survey. Depth strata designations (1-5), target depths and the actual depth range of tows; the number of tows completed in each stratum, and the towing effort in comparison to strata areas.

Depth Strata	Target Depth Range (m)	Minimum Bottom Depth (m)	Maximum Bottom Depth (m)	Survey Tows Completed (#)	Strata Survey Area (km2)	Entire Survey Area (%)	Entire Survey Tows (%)
1	200-400	205	394	63	10,329.60	31.32	31.5
2	400-600	402	593	53	8,515.78	25.82	26.5
3	600-800	605	790	32	5,548.59	16.82	16.0
4	800-1,000	804	999	30	4,544.58	13.78	15.0
5	1,000-1,200	1,007	1,178	22	4,047.06	12.27	11.0

Table 3. Invertebrate groups, total weight, and number of individuals caught during the 2008 Eastern Bering Sea Upper Continental Slope Survey.

Common Group Name	Total Catch Weight (kg)	Individuals Caught (#)
tanner, king, lyre crabs	2244.4	11223
sea stars and brittle stars	2227.3	276490
sponges	2160.1	
sea anemone	1594.2	20646
squid and octopus	646.4	1732
snails and clams	325.8	4678
other invertebrates	272.2	1543
shrimps	212.5	33710
corals and sea whips	72.4	499
hermit crabs and shells	63.0	1592
jellyfishes	59.3	296
sea mouse	45.0	2743
empty shells	14.6	
worms	0.1	
Totals	**11241.7**	

Table 4. Fish species (in rank order by weight) caught during the 2008 Eastern Bering Sea Upper Continental Slope Survey. Included are the numbers and types of biological data recorded or collected.

Scientific Name	Common Name	Total Catch Weight (kg)	Catch Numbers	Lengths Taken	Otoliths Collected	Stomachs Collected
Albatrossia pectoralis	giant grenadier	109306.3	30985	11035	595	
Sebastes alutus	Pacific ocean perch	20957.0	24214	2818	413	202
Atheresthes stomias	arrowtooth flounder	17048.2	17056	7528		537
Coryphaenoides cinereus	popeye grenadier	11986.8	72607	8890		
Theragra chalcogramma	walleye pollock	6446.5	6122	2805		337
Sebastolobus alascanus	shortspine thornyhead	6373.3	8669	5482		342
Atheresthes evermanni	Kamchatka flounder	6105.3	5259	3926		
Reinhardtius hippoglossoides	Greenland turbot	5460.2	1671	1307	504	158
Hippoglossoides elassodon	flathead sole	4636.7	11182	6907		
Bathyraja aleutica	Aleutian skate	4101.9	1459	1455		21
Anoplopoma fimbria	sablefish	3076.8	1018	1017		
Bothrocara zestum	western eelpout	2865.5	4625	2731	203	238
Glyptocephalus zachirus	rex sole	2828.4	4505	3419		
Sebastes borealis	shortraker rockfish	2321.4	566	566	540	56
Hippoglossus stenolepis	Pacific halibut	1975.9	264	269		66
Bathyraja maculata	whiteblotched skate	1085.9	375	373		
Bathyraja parmifera	Alaska skate	1071.7	183	183		28
Coryphaenoides acrolepis	Pacific grenadier	1006.9	3651	2811		
Bathyraja lindbergi	commander skate	833.5	447	446		26
Gadus macrocephalus	Pacific cod	810.8	267	264		125
Hemitripterus bolini	bigmouth sculpin	771.6	193	180	140	
Bathyraja interrupta	Bering skate	625.3	548	543		
Lycodes concolor	ebony eelpout	580.8	622	547		147
Bathyraja trachura	roughtail skate	514.9	283	281		18
Somniosus pacificus	Pacific sleeper shark	472.0	31	31		
Bathyraja minispinosa	whitebrow skate	463.7	357	353		13
Psychrolutes phrictus	blob sculpin	292.9	99	95		
Bothrocara brunneum	twoline eelpout	254.6	216	213	132	123
Malacocottus zonurus	darkfin sculpin	243.8	1773	1239	191	
Bathyraja taranetzi	mud skate	229.4	266	266		
Sebastes melanostictus	black-spotted rockfish	122.1	143	137	132	15
Embassichthys bathybius	deepsea sole	117.0	99	99		
Dasycottus setiger	spinyhead sculpin	97.0	772	764		
Zaprora silenus	prowfish	80.8	21	18		
Sebastes aleutianus	rougheye rockfish	80.4	77	76	74	29
Microstomus pacificus	Dover sole	78.5	83	82		
Aptocyclus ventricosus	smooth lumpsucker	70.4	86	81		
Antimora microlepis	Pacific flatnose	62.8	253	253		
Careproctus melanurus	blacktail snailfish	52.4	127	127	112	
Lycodes beringi	Bering eelpout	50.5	939	839		145
Bathyraja abyssicola	deepsea skate	44.3	3	3		2
Lepidopsetta polyxystra	northern rock sole	41.8	75	75		
Pleurogrammus monopterygius	Atka mackerel	8.9	6	6		
Oncorhynchus keta	chum salmon	3.4	3	2		
Raja rhina	longnose skate	3.0	1	1		
Sebastolobus macrochir	broadfin thornyhead	2.4	4	2		
Sebastes variabilis	dusky rockfish	2.3	2	2		
Squalus acanthias	spiny dogfish	2.2	1	1		
Sebastes babcocki	redbanded rockfish	1.5	2	2		
Oncorhynchus gorbuscha	pink salmon	1.0	1	1		
Sebastes polyspinis	northern rockfish	0.8	1	1		
Lycenchelys crotalinus	snakehead eelpout	0.3	5	2		
	Totals	**215671.9**	**202217**	**70554**	**3036**	**2628**