Cruise Report for the 2008 Beaufort Sea Survey

July 27 – August 30, 2008

F/V *Ocean Explorer*

Photo credit: All vessel and scientific crew

NOAA – U.S. Department of Commerce
National Marine Fisheries Service
Alaska Fisheries Science Center (AFSC)

MMS – U.S. Department of the Interior
Minerals Management Service
Alaska OCS Region

TABLE OF CONTENTS

Tables (page number)

Figures (page number)

Overview

The Alaska Fisheries Science Center's Status of Stocks and Multispecies Assessment (SSMA) Program's Fishery Interaction Team (FIT) conducted a fish survey in the marine offshore waters of the Beaufort Sea (155°W to 152°W) during the month of August, 2008. The Mineral Management Service (MMS) provided funding for the survey. The results of the survey will provide estimates of abundance, species composition and biological information of marine fish and invertebrates, oceanographic properties and information on the macro- and micro-zooplankton communities.

The F/V *Ocean Explorer* (Darin Vanderpol, captain) was charted to conduct the survey; operations began and ended in Dutch Harbor, Alaska.

Objectives

1. To quantify the distribution, abundance, and biological condition of important offshore marine fish species.

2. To assess the biology, behavior, and dynamics of key ecosystem components for ongoing scientific research.

3. Based on results of the survey, recommend methods for future monitoring that could provide time-series and data trend information necessary to support offshore development decisions and serve as a proto-type fisheries component of future MMS or other ocean observing systems.

General Sampling Methods

Bottom trawl survey
The distribution and abundance of adult and juvenile demersal fish and their dominant benthic invertebrate prey in offshore habitats (20 m to the shelf break) was assessed with 83-112 eastern otter trawls, the standard for AFSC bottom trawl surveys of the Bering Sea shelf. AFSC standard survey methods were followed including maintaining a constant vessel speed and monitoring of vertical and horizontal net openings with net sounders. A stratified sampling plan was employed with survey effort distributed among three strata defined by water depth: 20 – 50 m, 50 – 100 m, and 100 m – 500 m, which correspond to documented changes in water masses in the Beaufort Sea that are likely to affect the distribution of fish and their prey.

Acoustic survey
The distribution and abundance of pelagic fish were assessed using acoustic methods (limited to times and areas that did not conflict with subsistence whaling operations). Adult and juvenile fish were surveyed with echo integration trawl (EIT) survey methods similar to those used during other routine AFSC acoustic surveys. 7 parallel transects oriented inshore to offshore from the 20m to the 500m isobath were surveyed. The transects were approx 30 nmi long and spaced 10 nmi apart. Mid-water trawl hauls were conducted with a Marinovich net when and where significant amounts of fish were detected by the acoustic system to determine the species

composition and to collect other biological information from the sound reflecting layers (a.k.a. "backscattering").

Oceanography
Physical and biological oceanographic data were collected to assess water column properties and the food fields upon which the fish depend. The water column properties measured were the distribution of water mass types defined by temperature, salinity and density profiles, and the flow fields setting the boundaries and distribution of the water masses. The physical information was provided by CTD (conductivity – temperature – depth) measurements. Plankton tows using bongo nets were completed in conjunction with the CTD measurements. These tows collected the samples needed to quantify the species composition, abundance and biomass of the zooplankton available to the fish. The shipboard physical oceanographic sampling and zooplankton sampling took place along the transects described above, often at the same locations as the bottom trawl sampling.

Scientific Personnel and Affiliations

Elizabeth Logerwell (Field Party Chief; FPC)	Alaska Fisheries Science Center (AFSC)
Kimberly Rand	Alaska Fisheries Science Center (AFSC)
Sandra Parker-Stetter	University of Washington (UW)
Erika Acuna	Alaska Fisheries Science Center (AFSC)
Jennifer Nomura	Alaska Fisheries Science Center (AFSC)
Heloise Chenelot	University of Alaska Fairbanks (UAF)

Detailed Cruise Schedule

Charter start date	7/27/2008
Unpack and set-up	7/27/2008
Acoustic calibration	7/28-29/2008
Leave Dutch Harbor	7/30/2008
Mark wires	8/1/2008
Arrive survey grounds	8/6/2008
Finish survey	8/22/2008
Return Dutch Harbor	8/27/2008
Acoustic calibration	8/28/2008
Pack-up and load gear	8/29/2008
Charter end date	8/30/2008

Bottom Trawl Survey

Methods

Figure 1 and Table 1 show the location of the bottom trawl stations sampled during the cruise. The original survey plan called for stations to be distributed among depth strata (20-50 m, 50-100 m, 100-500 m) on every other transect (4 of the total 7 transects). Stations were to be occupied along each transect in its entirety starting at the westernmost transect and proceeding to the east. However, the presence of sea ice in the study area required a modification of the original plan. Dense sea ice covered the inner- and mid-shelf strata (20-100 m) when the vessel arrived on the grounds on August 6 and persisted for six days. On August 12 it was possible to trawl at mid-shelf stations (less than 100 m water depth), although it required navigating through ice to reach open water, and fishing operations were conducted within 0.5 to 3 nmi of the ice. However, the next day (August 13), the mid-shelf region was mostly clear of ice, and ice was not encountered in densities requiring a change in survey plans for the remainder of the cruise.

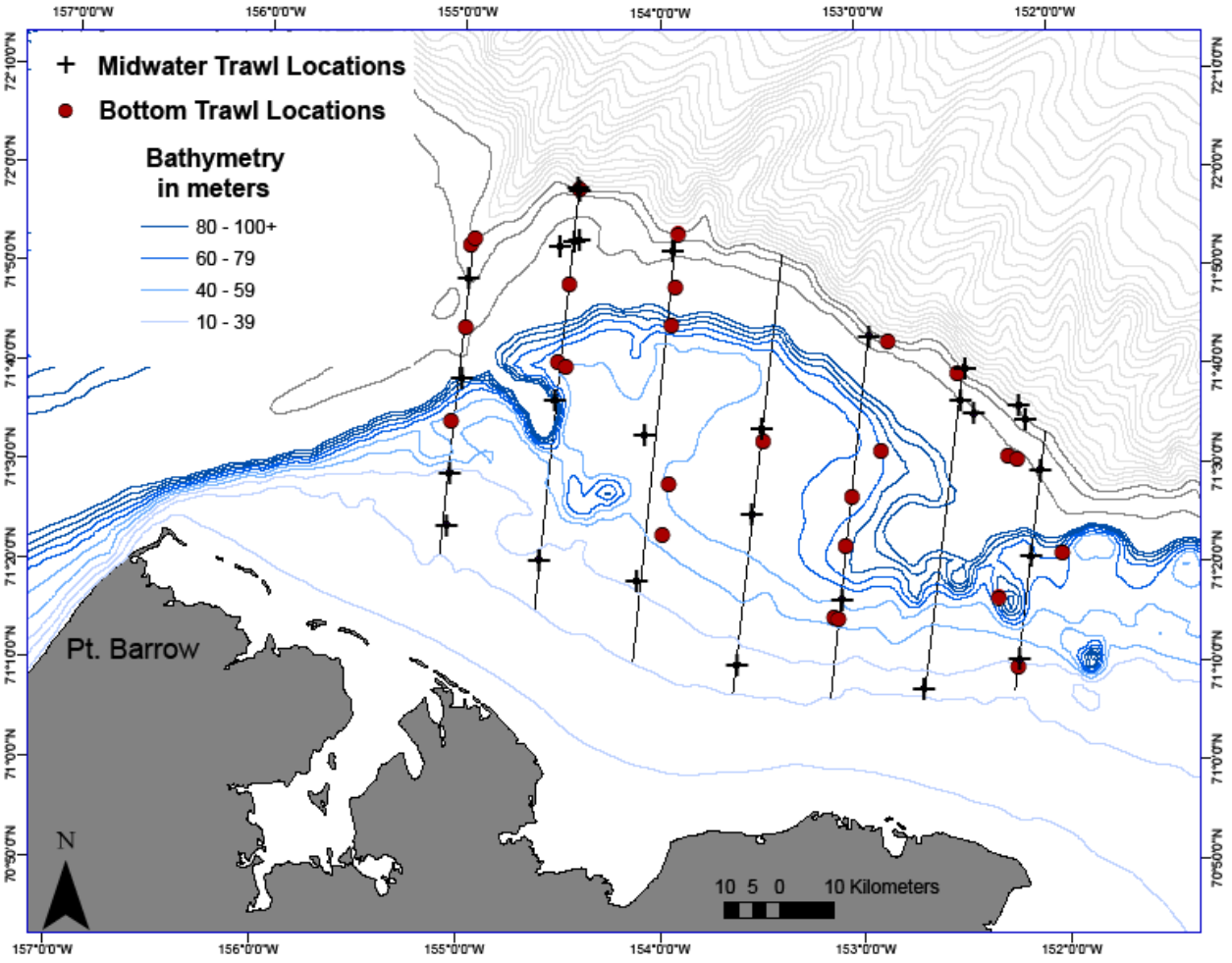

Figure 1. Bottom (solid red circles) and midwater (black crosses) trawl locations, Beaufort sea.

Table 1. Position, bottom depth, qualitative bottom type and total catch weight for all bottom trawls conducted.

Bottom Haul no.	Latitude	Longitude	Bottom Depth	Bottom Type	Total Catch Weight (kg)
1	71.88	-154.97	407	mud	no catch
2	71.89	-154.95	478	mud	694.93
3	71.74	-154.99	200	rocks	751.34
4	71.90	-153.91	356		1881.89
5	71.81	-153.92	144	rocks	1846.51
6	71.81	-154.46	159	mud	9502.65
7	71.98	-154.41	334		2028.50
8	71.72	-152.84	320	mud	1382.47
9	71.66	-152.49	306	mud	1984.08
10	71.52	-152.25	182	mud	2359.84
11	71.75	-153.94	66	rocks	419.10
12	71.69	-154.52	51	rocks	251.08
13	71.48	-153.96	50	mud	339.30
14	71.39	-153.99	44	mud	no catch
15	71.25	-153.13	41	rocks	no catch
16	71.25	-153.11	41	rocks	19.45
17	71.37	-153.07	75	rocks	256.35
18	71.46	-153.04	64	hard	87.81
19	71.16	-152.23	30	mud	no catch
20	71.28	-152.31	51	rocks	38.74
21	71.35	-151.99	84	rocks	27.45
22	71.51	-152.20	182		77.74
23	71.58	-155.05	45	rocks	43.05
24	71.68	-154.48	49	rocks	52.78
25	71.53	-152.89	60	hard	35.52
26	71.55	-153.48	53	hard	10.59

The RACE Division of AFSC provided standardized trawls, bridles, and trawl doors for the survey. Trawling procedures followed the protocols established by Stauffer (2004, NOAA protocols for groundfish bottom trawl surveys of the nation's fishery resources. NOAA Tech. Memo. NMFS-SPO-65, 205p). The trawls were conducted at a speed of 3.0 kt at each station. Stations were initially sampled using a modified 83-112 eastern bottom trawl, with an 83' headrope and a 112' footrope; the net modification includes was as follows:

Excerpted from the RACE ADP CODE BOOK, March 2008 *In* Supplementary Tables – Gear Accessories codes, code 122):

> *A tickler chain, hula, and 1.5" liner covering the entire bottom body, both bottom wings and complete coverage top and bottom of the intermediate and cod end (with 30 mesh*

overlap with standard 1.25" liner extending 65 meshes up from the terminus of the cod end.

The trawls were towed behind 1.83 x 2.75 m (6x9 ft) - 816 kg steel V-doors and paired 180.1' dandylines. Acoustic net mensuration equipment (Netmind) was deployed on the net at all stations for *in situ* net configuration monitoring and area-swept determinations. A bathythermograph was deployed on the headrope of the trawl to collect depth and temperature data for the duration of the tow. Additionally, a bottom contact sensor (inclinometer) was deployed on the footrope to determine the interval the trawl was actually on-bottom in a fishing configuration.

The first three bottom trawls were deployed for 30 minutes of bottom contact time. However, the nets were damaged by large catches of invertebrates and/or rocks and the tow time was reduced to 15 minutes. Continued difficulty with large catches of rocks and mud and subsequent net loss or damage resulted in further limitation of tow time to 5 minutes. On the 15th trawl, the third and final modified (lined) 83-112 net on board was irreparably damaged so the remaining 11 stations were sampled with a standard (un-lined) 83-112. Two stations were re-sampled with the un-lined net so that a qualitative comparison between the catch of the lined and un-lined nets could be made.

11 stations were sampled in the offshore stratum (100-500 m) and 9 stations were sampled in the mid-shelf stratum (50-100 m), see Figure 1. Especially rocky and muddy bottom in the shallowest survey depths made it difficult to fully sample the nearshore stratum (20-50 m). Only 6 stations were sampled at depths less than 50 m, and no bottom trawls were conducted at depths less than 30 m.

Results – Fish

Fish comprised 6% of the total weight captured in the bottom tows of which 38 species of fish were identified. Several species could only be identified to the genus or family level in the field. Of the total weight of fish captured in the bottom tows, 80% was Arctic cod and several species of eelpouts made up 13% of the total weight. The total number and weight of each species is summarized in Table 2. Arctic cod occurred at all bottom trawl stations; percent Arctic cod per haul is summarized in Figure 2. Note: the species listed are preliminary field identifications. All species were vouchered and will be confirmed and/or identified in the laboratory at the Alaska Fisheries Science Center in Seattle. In Table 2, the total numbers and weights for each haul have been combined by species; this includes the extrapolated numbers and weights from hauls that were subsampled and the actual numbers and weights from hauls that were entirely processed; hauls 1 – 15 were subsampled due to the large number and diversity of invertebrates and hauls 16 – 26 were relatively small catches, therefore were not subsampled.

Arctic cod were also the dominate catch in the mid-water hauls by weight and numbers. A total of 798.49 kg of catch were processed and 764.11 kg was Arctic cod. The second most prevalent species in the mid-water hauls were jellyfish (*Chrysaora* sp., *Cyanea* sp., and jellyfish unid.) at 22.73 kg total for all mid-water hauls combined.

Table 2. List of fish species (common name in parenthesis) captured in the bottom trawls, their total numbers and total weight (kg). Species in BOLD may be range extension from the Bering and Chuckchi seas.

Species	Total numbers	Total weight (kg)
Boreogadus saida (Arctic cod)	64,144	1241.95
Lycodes raridens (marbled eelpout)	1,348	119.51
Lycodes sp. (6 species)	513	53.46
Hippoglossoides robustus (Bering flounder)	231	34.62
Theragra chalcogramma (walleye pollock)	1,082	34
Lycodes polaris (polar eelpout)	658	20.58
Reinhardtius hippoglossoides (Greenland halibut)	221	11.55
Liparis gibbus (variegated snailfish)	151	10.47
Lycodes seminudus (longear eelpout)	44	6.4
Liparis fabricii (gelatinous seasnail)	162	4.87
Lycodes rossi? (threespot eelpout)	19	4.33
Triglops pingeli (ribbed sculpin)	219	1.29
Myoxocephalus verrucosus	36	1.25
Gadus macrocephalus (Pacific cod)	5	1.02
Lumpenus maculatus (prickleback)	208	0.95
Artediellus scaber (hamecon)	154	0.94
Mallotus villosus (capelin)	9	0.86
Gymnocanthus tricuspis (Arctic staghorn sculpin)	77	0.84
Family Liparidae (snailfish unid.)	69	0.62
Myoxocephalus sp. (sculpin unid.)	106	0.44
Careproctus sp. (snailfish unid.)	4	0.33
Careproctus rastrinus (salmon snailfish)	9	0.33
Triglops nybelini (bigeye sculpin)	71	0.21
Lumpenus fabricii (slender eelblenny)	30	0.19
Leptagonus sp. (poacher)	3	0.1
Icelus spatula (spatulate sculpin)	9	0.08
Icelus sp. (sculpin unid.)	12	0.06
Eleginus gracilis (saffron cod)	4	0.06
Gymnelus sp. (eelpout unid.)	1	0.05
Icelinus borealis (northern sculpin)	3	0.02
Eumicrotremus derjugini (leatherfin lumpsucker)	6	0.01
Liparis sp. (snailfish unid.)	3	0.01
Nautichthys pribilovius (eyeshade sculpin)	1	0.01

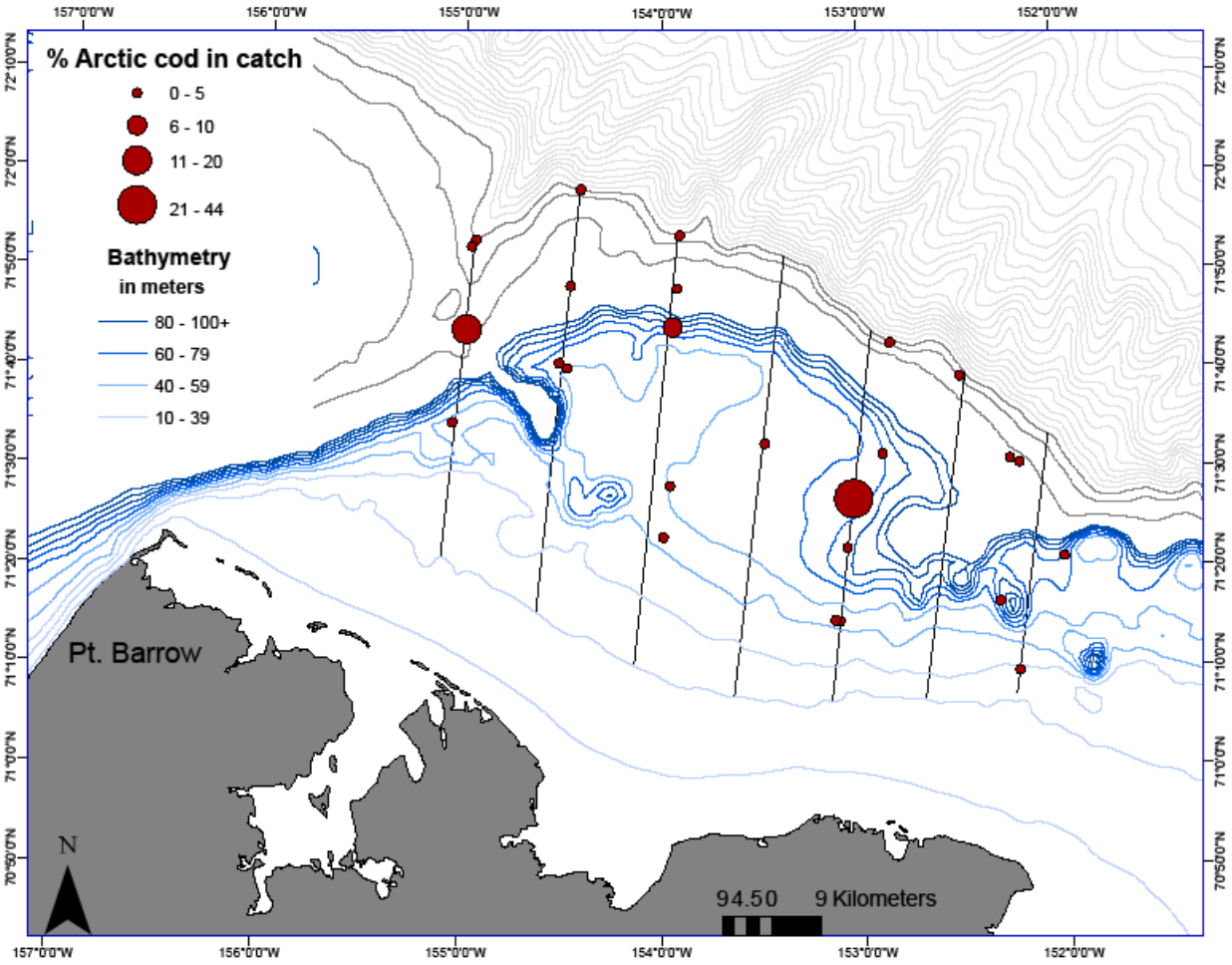

Figure 2. Percent Arctic cod present in bottom trawl locations, Beaufort sea.

Results – Vouchered specimens for species ID

Preliminary results suggest that six species (see BOLD in Table 2) have extended their range into the Beaufort sea from the Chukchi and/or Bering sea. Approximately 38 species of fish were identified from which 400+ specimens were collected for laboratory identification and future distribution to taxonomic collections.

Results – Invertebrates

Invertebrates made up 94% of the total weight captured in the bottom tows of which approximately 174 species were identified. Similar to fish, all invertebrates were identified to the lowest taxonomic level possible in the field (family, genus or species). Of the invertebrates, *Ophiura sarsi* (brittlestar) made up 41% and *Chionoecetes opilio* made up 10% of the total weight. Approximately 95% of the total invertebrate weight is summarized by species in Table 3. In Table 3, the total weight from each haul has been combined by species; the weight per species

includes the extrapolated weights from hauls that were subsampled and the actual weights from hauls that were entirely processed; hauls 1 – 15 were subsampled due to the large number and diversity of invertebrates and hauls 16 – 26 were relatively small catches, therefore were not subsampled.

Table 3. List of invertebrate species (common name in parenthesis) captured in the bottom trawls, their total numbers and total weight (kg).

Species	Total weight (kg)
Ophiura sarsi (brittle star)	9775.94
Empty shells (bivalve/gastropod)	3916.97
Chionoecetes opilio (crab)	2362.39
Musculus niger (mollusk)	1424.95
Ctenodiscus crispatus (starfish)	940.07
Urticina lofotensis (sea anemone)	488.22
Strongylocentrotus sp. (sea urchin)	418.61
Psolus squamatus (sea cucumber)	352.89
Buccinum polare (snail)	213.27
Snail eggs unid.	208.49
Pyrulofusus sp. (snail)	176.72
Neptunea sp. (snail)	154.28
Phascolosomatidae (worms)	149.47
Gorgonocephalus eucnemis (basketstar)	142.96
Gersemia sp. (soft coral)	125.35
Psolus phantapus (sea cucumber)	123.21

Results – Biologicals

Arctic cod from every bottom and mid-water haul were sexed and lengthed. Greenland halibut, Bering flounder, Pacific cod and walleye pollock were also sexed and lengthed when encountered. We sexed and lengthed 2,938 Arctic cod, 99 walleye pollock, 27 Bering flounder, 10 Greenland halibut and 2 Pacific cod. All Bering flounder and Greenland halibut were collected for identification vouchers or food habits analysis. All walleye pollock (and the two specimens of Pacific cod) were lengthed and frozen for otoliths, food habits and genetic analysis. Of the 2,938 Arctic cod (Figure 3), the mode for both females and males was 100 cm; the average length for females was 118 cm and the average length for males was 109 cm.

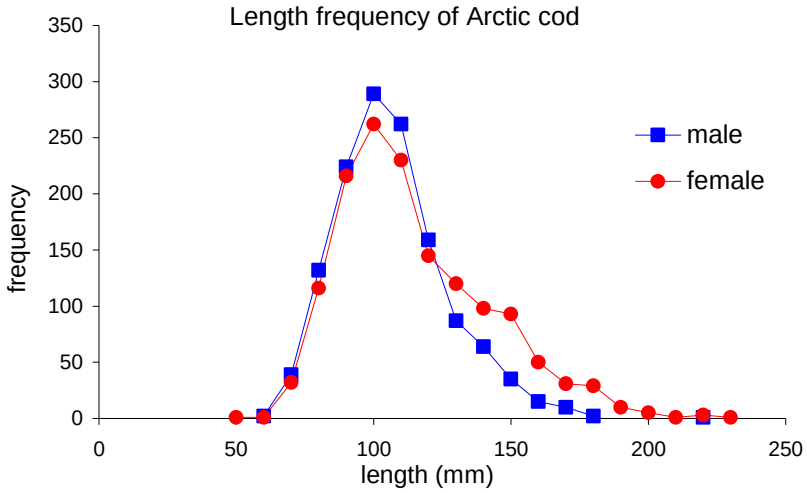

Figure 3. Length frequency of Arctic cod captured in the bottom trawls by sex.

Approximately 1,213 Arctic cod were sexed, lengthed, weighed and their otoliths (age structures) were collected. Within this same collection, approximately 10 females per bottom or mid-water tow had their ovaries removed and preserved in 10% formalin. Within each bottom tow, between 10 and 15 fish were collected for food habits analysis. In conjunction, several specimens of Arctic cod were frozen for future stable isotope analysis. Collections from the micro- and macro- zooplankton Bongo tows (~20 samples) were also frozen for stable isotope analysis.

Acoustics and Mid-water Trawl Survey

Methods

Acoustic transect locations are shown in Figure 1 (black line). Mid-water trawl locations are also shown in Figure 1 (symbol) and are listed in Table 4. Acoustic data began when the vessel departed the dock in Dutch Harbor and continued until the vessel returned to Dutch Harbor at the end of the survey. In the study region, data were collected along the acoustic transects, beginning on the easternmost transect, on August 16 after most bottom trawl operations had been completed. Over 250 nautical mile (nmi) of data were collected along transects.

Acoustic data were collected with the vessel's hull-mounted Simrad ES60 38 kHz (model 380) transducer. Prior to the scientific party's arrival in Dutch Harbor, the Captain collected some specified data to determine whether electrical or mechanical noise was present in the acoustic data. As a result, the acoustic transceiver and data cables were moved prior to the survey. This modification greatly reduced the presence of noise in the data. The echosounder was tested in a partial calibration (on-axis only with some swing data to verify that all quadrants were active) prior to the survey and a full calibration, including data to measure beam angles, was collected upon return to Dutch Harbor.

A Marinovich mid-water net was provided to the survey by the RACE Division of AFSC. The same V-doors and dandylines that were used for the bottom trawl were also used for the Marinovich net. A vessel speed of 2-4 kt was maintained during the tow and tows lasted between 10-60 minutes depending on acoustic target density. The vessel's third wire system (Simrad Mesotech FS903) was used to monitor the net headrope position during the deployment and an autonomous bathythermograph was attached to the headrope to collect temperature and depth data.

The Marinovich mid-water net, with average fishing dimensions during the survey of 3 m vertical by 6 m horizontal, was used to identify targets observed on the acoustics. Of the twenty-eight mid-water trawls that were completed (Figure 1, Table 4), 6 were completed along the ice edge prior to the start of the acoustic transects. When the acoustic signal suggested that large zooplankton were present, a 20 cm and 60 cm bongo net were also deployed to identify targets.

Table 4. Midwater haul number, its latitude and longitude.

Midwater Haul no.	Latitude	Longitude
1	71.97	-154.41
2	71.98	-154.42
3	71.89	-154.44
4	71.88	-154.51
5	71.89	-154.41
6	71.59	-152.42
7	71.56	-154.08
8	71.32	-154.12
9	71.50	-155.06
10	71.62	-154.53
11	71.87	-153.94
12	71.17	-153.62
13	71.43	-153.54
14	71.57	-153.49
15	71.73	-152.94
16	71.28	-153.09
17	71.13	-152.69
18	71.67	-152.46
19	71.61	-152.48
20	71.18	-152.22
21	71.35	-152.15
22	71.49	-152.09
23	71.60	-152.19
24	71.58	-152.16
25	71.35	-154.61
26	71.41	-155.07
27	71.66	-155.00
28	71.82	-154.98

Oceanographic Sampling

Figure 4 and Table 5 show the location of CTD casts and zooplankton (bongo net) tows. CTDs and bongo nets were deployed at nearly every bottom trawl station and at some mid-water stations (depending on the distribution and characteristics of the acoustic scattering). Additional CTD and bongo sampling was conducted at close spacing (approx. 4-5 km) along two transects in order to quantify fine-scale changes in water mass properties across the shelf. A total of 56 CTDs and 38 bongo tows were successfully completed.

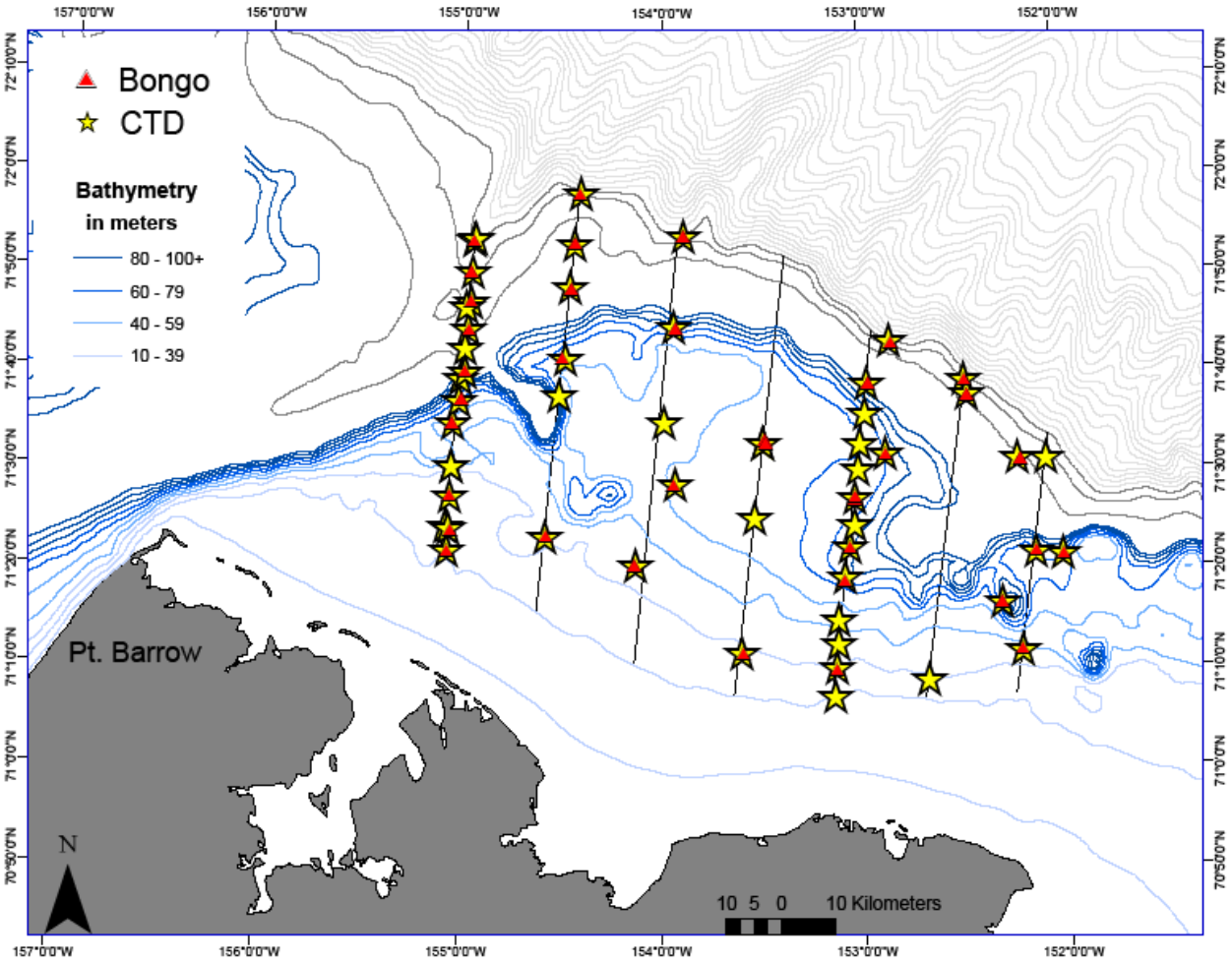

Figure 4. Bongo (red triangle) and CTD (yellow star) stations, Beaufort sea.

Table 5. Date, time, bottom depth, and position of all CTD and zooplankton (bongo) tows during cruise

Station	CTD #	Bongo #	Date (GMT)	Time (GMT)	Bottom Depth (m)	Latitude	Longitude
1	CTD001	BON001	8/6/2008	23:49	445	71.89	-154.95
2	CTD002	BON002	8/7/2008	4:20	300	71.84	-154.96
3	CTD003	BON003	8/7/2008	5:19	300	71.79	-154.97
4	CTD004	BON004	8/7/2008	18:21	200	71.74	-154.98
5	CTD005	BON005	8/8/2008	1:44	357	71.90	-153.89
7	CTD006	BON006	8/9/2008	2:24	158	71.81	-154.46
9	CTD008	BON007	8/10/2008	1:00	275	71.97	-154.41
13	CTD009	BON009	8/10/2008	18:53	190	71.88	-154.45
15	CTD010	BON010	8/11/2008	3:38	333	71.72	-152.85
16	CTD011	BON011	8/11/2008	18:41	333	71.66	-152.48
18	CTD012	BON012	8/12/2008	1:41	187	71.52	-152.21
19	CTD013	BON013	8/12/2008	21:45	66	71.75	-153.94
20	CTD014	BON014	8/13/2008	2:10	50	71.69	-154.49
21	CTD015		8/13/2008	17:50	47	71.59	-153.99
22	CTD016	BON015	8/13/2008	20:56	47	71.48	-153.94
24	CTD017	BON016	8/14/2008	3:48	31	71.35	-154.13
25	CTD018		8/14/2008	17:53	40	71.25	-153.12
26	CTD019	BON017	8/14/2008	22:50	75	71.37	-153.06
27	CTD020	BON018	8/15/2008	0:16	72	71.32	-153.09
28		BON019	8/15/2008	2:22	64	71.45	-153.03
29	CTD022		8/15/2008	2:54	72	71.41	-153.04
30	CTD023		8/15/2008	3:44	60	71.50	-153.01
31	CTD024		8/15/2008	4:11	58	71.55	-153.00
32	CTD025		8/15/2008	4:42	63	71.60	-152.98
34	CTD026	BON020	8/15/2008	19:03	49	71.28	-152.30
35	CTD027	BON021	8/15/2008	22:09	85	71.36	-151.99
37	CTD028	BON022	8/16/2008	16:22	44	71.58	-155.06
38	CTD029	BON023	8/16/2008	18:36	20	71.37	-155.08
39	CTD030		8/16/2008	19:16	21	71.41	-155.08
40	CTD031	BON024	8/16/2008	19:45	24	71.46	-155.06
41	CTD032		8/16/2008	20:30	27	71.51	-155.06
42	CTD033	BON025	8/16/2008	21:33	56	71.62	-155.03
43	CTD034		8/16/2008	22:07	90	71.66	-156.00
44	CTD035		8/16/2008	22:42	150	71.71	-154.99
46	CTD036		8/17/2008	3:14	457	71.89	-154.95
47	CTD037		8/17/2008	16:40	26	71.51	-155.06
48	CTD038		8/17/2008	22:21	42	71.63	-154.52
49	CTD039	BON026	8/18/2008	19:01	25	71.20	-153.60
51	CTD040		8/18/2008	22:07	57	71.42	-153.53
52	CTD041	BON027	8/19/2008	0:07	52	71.55	-153.49
53	CTD042	BON028	8/19/2008	4:05	112	71.65	-152.97
55	CTD043	BON029	8/19/2008	16:28	63	71.46	-153.04
57	CTD044		8/19/2008	20:33	32	71.21	-153.12
58	CTD045	BON030	8/19/2008	21:00	26	71.17	-153.13
59	CTD046		8/19/2008	21:36	22	71.12	-153.14
60	CTD047		8/19/2008	23:19	25	71.15	-152.68
61	CTD048	BON031	8/20/2008	5:14	225	71.63	-152.46

Station	CTD #	Bongo #	Date (GMT)	Time (GMT)	Bottom Depth (m)	Latitude	Longitude
62	CTD049	BON032	8/20/2008	16:35	36	71.20	-152.21
63	CTD050	BON033	8/20/2008	18:37	63	71.36	-152.13
64	CTD051		8/20/2008	21:42	267	71.52	-152.07
66	CTD052	BON034	8/21/2008	3:28	59	71.53	-152.87
67	CTD053	BON035	8/21/2008	15:33	52	71.55	-153.49
68	CTD054	BON036	8/21/2008	19:37	26	71.39	-154.58
69	CTD055	BON037	8/21/2008	21:40	21	71.41	-155.07
70	CTD056	BON038	8/22/2008	0:39	102	71.67	-154.99
71	CTD057		8/22/2008	4:30	297	71.78	-154.99

CTD casts were made using an SBE 19*plus* and the NMFS – FOCI winch, which was installed on the "helo" deck on the stern of the vessel. The CTD was deployed to a depth of 1 to 2 m off bottom (depending on sea state), at a rate of no more than 30 m/min.

Zooplankton samples were collected with two bongo net frames assembled on one cable and deployed with the NMFS – FOCI winch. The top frame had two 20-cm hoops and 153 µm mesh nets. The bottom frame (one meter away) had two 60-cm hoops with 333-µm mesh nets. Flow meters were mounted in the center of the net mouth openings so that volume sampled could be calculated. During deployment, the vessel speed was maintained such that the wire angle during deployment and retrieval was close to 45°. Wire out rate was 30 m/min and wire in rate was 20 m/min. Samples were rinsed out of the bongo cod-ends and poured into 32 oz jars, preserved by the addition of 50 ml 37% formaldehyde and 20 ml saturated sodium borate.

Temperature-depth data were also collected with a trawl-mounted microbathythermograph (MBT) on all bottom and mid-water trawls. Figure 5 shows bottom temperature at all bottom trawl locations. Bottom temperatures ranged from -1.4 to 1.7 °C. The coldest bottom water appeared to be found depths ranging from around 70 m to 300 m, with warmer water inshore and offshore of those depths.

Continuous sea surface temperature and salinity data were collected with a Seabird SBE45 at one-minute intervals, indexed to location with a GPS. Data were collected 24 hours a day during most of the transit to and from the survey area and during the entire survey (from 4-25 August).

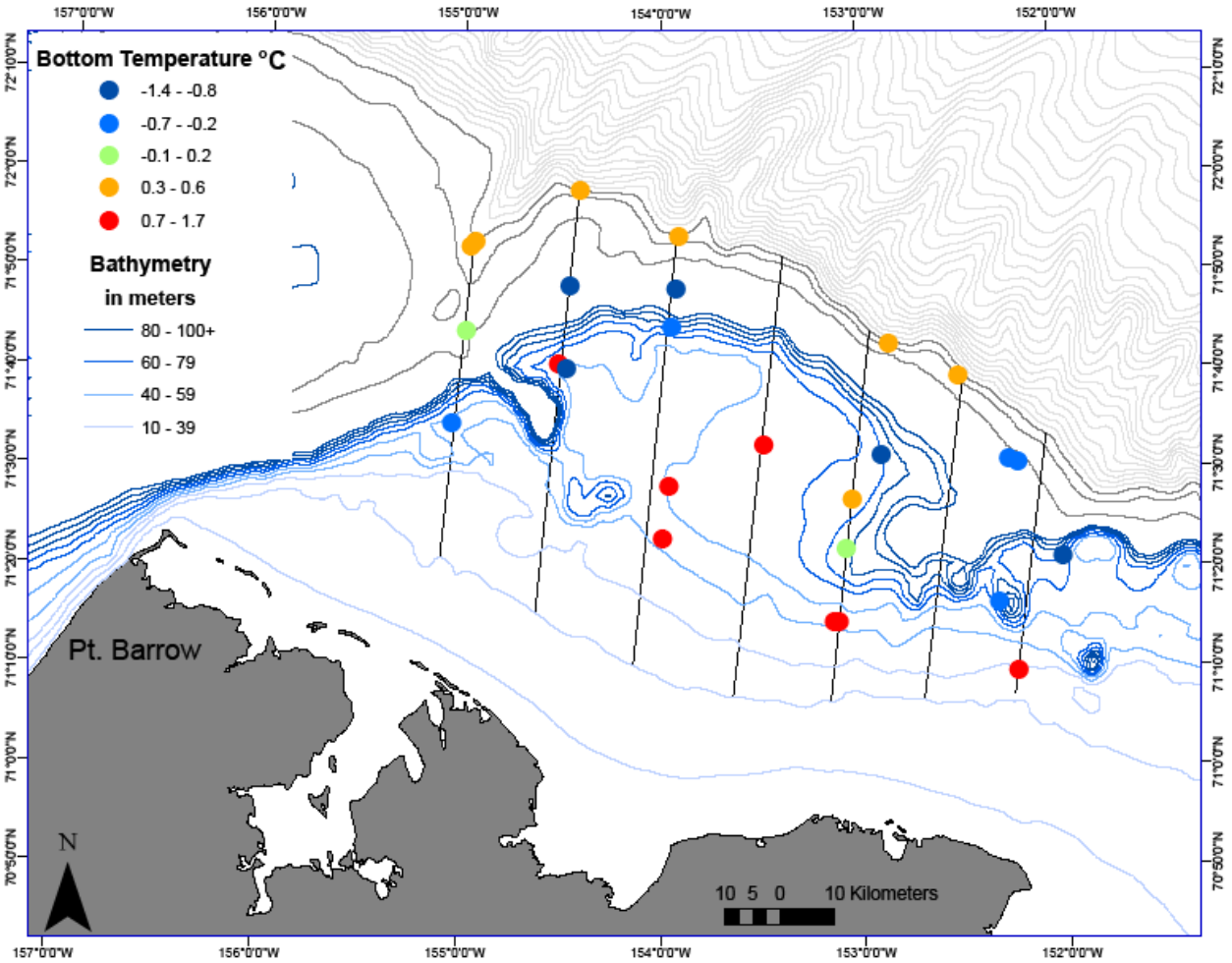

Figure 5. Bottom temperatures as collected from the net mounted microbathythermograph (MBT).

Special Projects

We were able to accommodate 4 special projects. Several of the projects requested entailed collection of species that were not encountered during the survey; therefore they were not completed. The number of individuals per species (other than Arctic cod) was often low, sometimes only 1 or 2 individuals per species were encountered during the entire survey. Approximately 90 *Chionoecetes opilio* and 50 *Hyas coarctatus* were collected for the Alaska Fisheries Science Center; specimens will be examined for the presence of Bitter Crab Syndrome. Arctic cod was collected for the Marine Gene Probe Lab at Dalhousie University as part of a genetic analysis examining transarctic exchange between marine fish species in the Pacific and Atlantic oceans. Approximately 15 species (1-10 individuals per species) were collected for genetic bar coding at the Point Stephens Research Lab in Auke Bay, Alaska. A small collection of juvenile Arctic cod was requested by Minerals Management Service, Anchorage, Alaska.

Seabird Survey

Data on the distribution and abundance of seabirds were collected during the transit to and from Dutch Harbor and during the acoustic transects, when conditions allowed. This project was a collaboration with US Fish and Wildlife Service. Continuous "strip transects" up to 300 meters wide (depending on visibility) were conducted by a single observer, looking on one side of the vessel (the starboard side). Birds were identified to species, when possible, and counted. Observations were entered into a laptop computer using a program (Dlog2) that assigned time and position to each observation (using a GPS receiver). Table 6 shows the species observed in the study area only (during the acoustic transects) in descending order of abundance (although note that these are raw counts, not densities and therefore do not account for changes in transect width due to changes in visibility). Arctic terns, black-legged kittiwakes and phalaropes were the top three seabirds in terms of abundance. Figure 6 shows the distribution of these three species. Terns appeared to be distributed primarily in the offshore stratum (approx. 100-500 m), whereas kittiwakes were most abundant in the mid- and inner-shelf strata (20-100 m). Phalaropes were very patchy, being observed in high abundances at just two locations in the mid-shelf area.

Table 6. Summary of seabird species observed in study area

Species	Total number
Arctic Tern	261
Black-legged Kittiwake	181
Unidentified Phalarope	113
Unidentified Shorebird	35
Glaucous Gull	35
Unidentified Tern	24
Unidentified Murre	16
Unidentified Gull	7
Parasitic Jaeger	6
Unidentified Jaeger	4
Sabine's Gull	4
Thick-billed Murre	2
Surf Scoter	2
Unidentified Loon	2
Total Birds	**692**

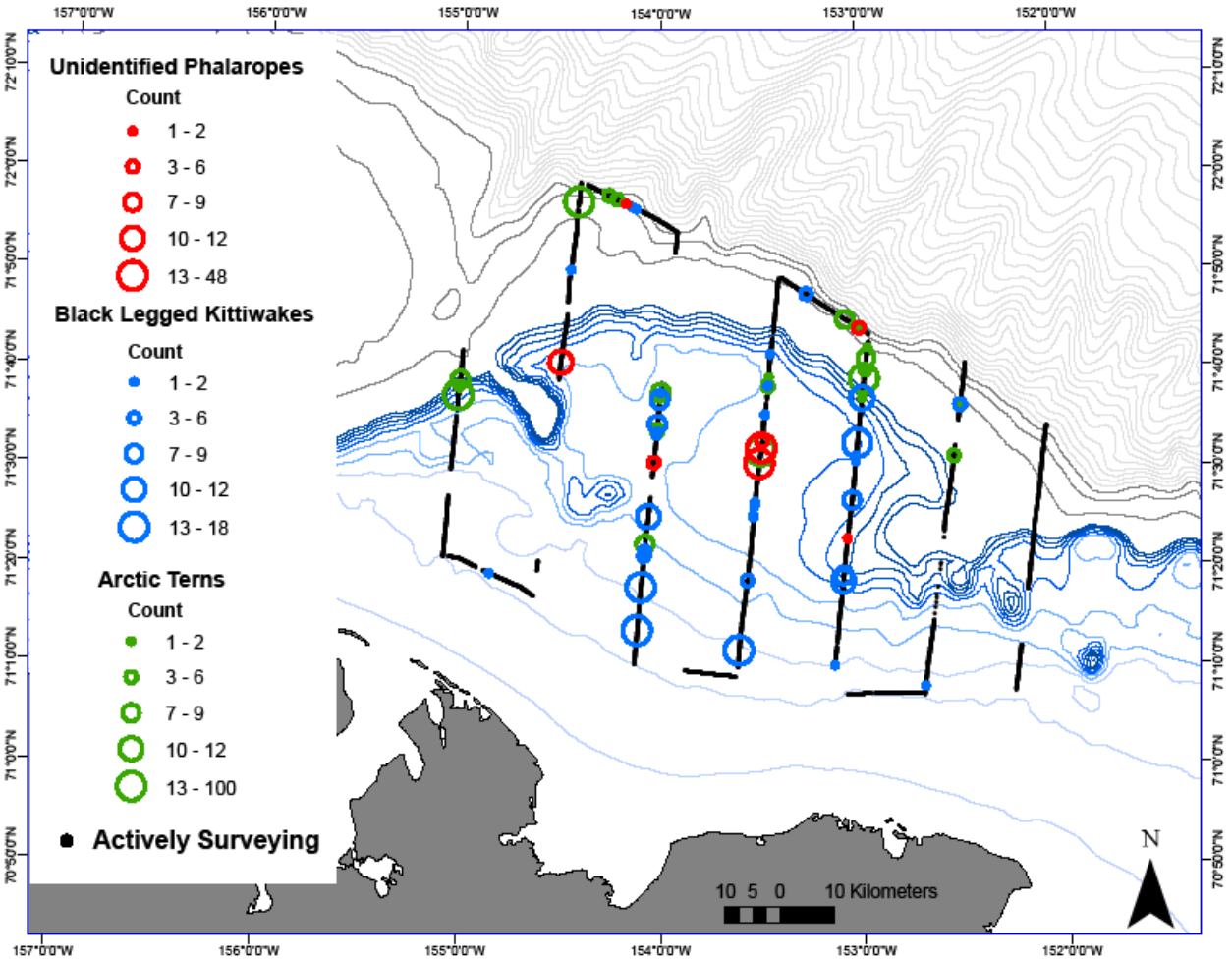

Figure 6. The top 3 most abundant seabirds observed while on seabird observing transects.

Marine Mammal Observations

Opportunistic marine mammal sightings were recorded in collaboration with the Platforms of Opportunity program at the National Marine Mammal Laboratory. The date, time, location, species and number of animals observed was recorded whenever possible. Highlights included an adult polar bear (presumably female) and two cubs on the ice near Pt. Barrow. A swimming polar bear was also observed in the same area. Large numbers of gray whales were observed during the transit to and from the study area, in the Chukchi Sea/Bering Strait area. They appeared to be feeding. No confirmed bowhead whale sightings were made during the transit or in the study area.