Cruise Report:
USCGC Healy 13-01, July 29-August 15, 2013
Chukchi Sea

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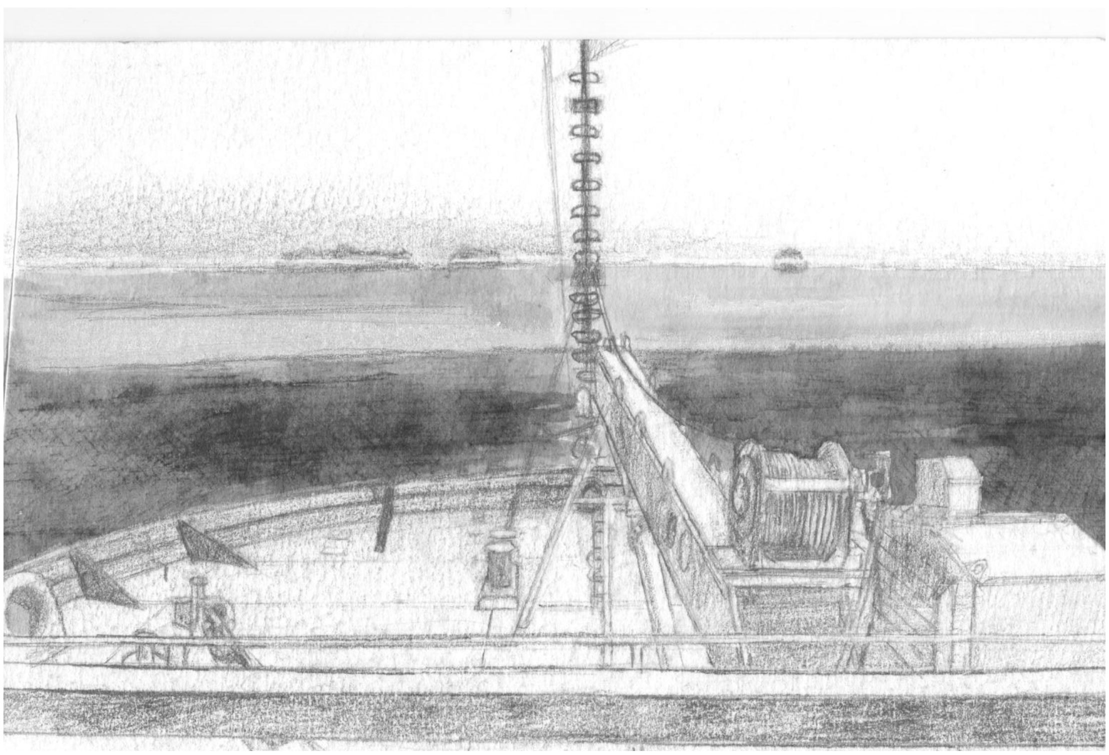

BOEM
Bureau of Ocean Energy Management

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USCGC Healy Cruise HLY1301

July 29 - August 15, 2013

Summary:

Healy Cruise 13-01 departed the port of Dutch Harbor in Unalaska, Alaska on July 29 2013. The cruise terminated in Barrow on August 15. With funding provided by US Bureau of Ocean Energy Management, our goals were to undertake basic scientific research in the Hanna Shoal region that has been identified as a key ecological area in the Chukchi Sea. The northern Chukchi Shelf receives large inputs of organic matter advected from the highly productive shelf regions of the North Pacific and from in situ sources of primary production, including epontic ice algae, sediment microalgae and phytoplankton. These contributions of highly labile organic carbon, together with potential benthic sources of regenerated inorganic nitrogen, probably contribute to the high secondary production in various portions of this region. In particular, the relatively shallow depths (40-55 m) and appreciable bottom flow facilitate high standing stocks of biota, particularly in the benthos. These "hotspots" have been noted in the vicinity of Hanna Shoal, particularly along its southeastern and eastern margins. In recognition of the importance of the biological significance of this region and its importance for oil and gas exploration and development, this research undertook a multidisciplinary investigation to examine the biological, chemical and physical properties that define this ecosystem. Our study focuses on water column and benthic trophic structure, sediment parameters, inventories of anthropogenic chemicals (trace metals and organics), and inventories of plankton, benthic and epibenthic fauna. Coincidently, the physical oceanographic study addresses water mass movements through direct measurement of circulation, density fields, ice conditions and modeling. This cruise also facilitated the collection of important marine mammal and seabird surveys conducted from the bridge whenever viewing conditions permitted.

Acknowledgements: We thank the US Coast Guard crew, officers and commanding officer onboard Healy for their hard work implementing the cruise objectives, particularly those who helped deploy gear on the deck during the cruise. Robert Thombley and Toby Martin of the Ship-based Science Technical Support in the Arctic (STARC) project provided logistical and ship system support before and during the cruise. Donny Graham and Jeff Hardwick of the Coast Guard's civilian computer network unit were also key assets. We thank Bureau of Ocean Energy Management program manager Heather Crowley for joining us during the cruise. Support for our teacher at sea, Andrea Skloss, was provided by the National Science Foundation through the PolarTREC program. Financial support for the research was provided by the US Bureau of Ocean Energy Management. We thank Karl Newyear and his staff at Umiaq, Inc. for their ground support in Barrow and Reneé Crain of the National Science Foundation (NSF) for facilitating assistance by NSF's contracted logistical support enterprise in Barrow. The Bowhead Transportation Company provided logistical support for the transfer from ship to shore and we are grateful for their willingness to efficiently transfer the science party to shore.

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Hanna Shoal Data Management

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The University of Texas at Austin's Center for Research in Water Resources (CRWR) is responsible for coordination of data management for the Hanna Shoal project. The data management program seeks to provide persistent and sustainable information which is readily accessible to the target audience and features a standardized project database as a back-end and a public outreach website as a front-end to achieve this goal.

While on board the ship, the CRWR representative has two primary responsibilities. The first is to keep a record of the time, location, and bottom depth of each sampling cast event. This geospatial information is critical for analysis of all data collected, and having it managed by a single entity prevents errors inherent in the keeping of multiple records. The second responsibility is to aid in enhancing the situational awareness of the scientists and crew. This is accomplished through coordinating with the Chief Scientist and the PIs to prepare maps of the planned order of stations combined with current ice conditions, and by operating from a central location to conveniently gather and disseminate information on the current status of sampling operations. For the 2013 cruise, the ship's map server was out of commission, and the CRWR representative worked with STARC personnel to develop a GIS-based local and regional map view updated every five minutes, accessible anywhere on the ship's wireless network (Figure 1). This served as both a general resource and a tool to quickly evaluate the need to reposition based on the ship's current relation to the station coordinates.

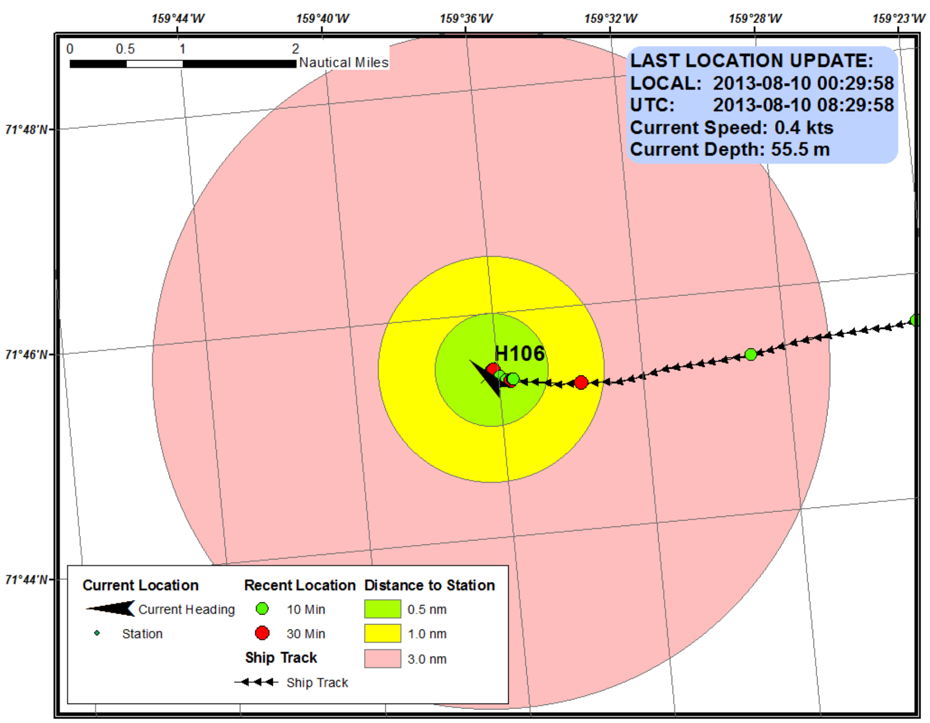

Figure 1: Sample Local Map. This file was automatically generated at five mintue intervals and posted to the ship's local network web page.

After the cruise is complete and the PIs have organized their data, it is sent to CRWR for processing and archival (Figure 2). The data is first transformed from the PI-submitted files into a format compatible with the Observation Data Model (ODM) database. ODM is a relational database model developed by the Consortium of Universities for the Advancement of Hydrologic Science Information (CUAHSI) to enable the streamlined organization of observed data. It is based on various controlled vocabularies, also developed by CUAHSI, which ensure that all researchers use the same terminology. When this is complete, the data is loaded into the ODM database, exported to spreadsheets, and these files are sent to the PIs for review. If errors are found, these are corrected and the process is repeated. Once the data files are finalized, they are submitted to the National Oceanographic Data Center (NODC) for permanent archival.

Throughout the project, CRWR works with the individual Hanna Shoal PIs to combine their research findings with the collected geospatial information to produce informative maps. Figure 3 shows a map of stations occupied, and coordinates and activities are tabulated in the following table.

Figure 2: Diagram of the data management process.

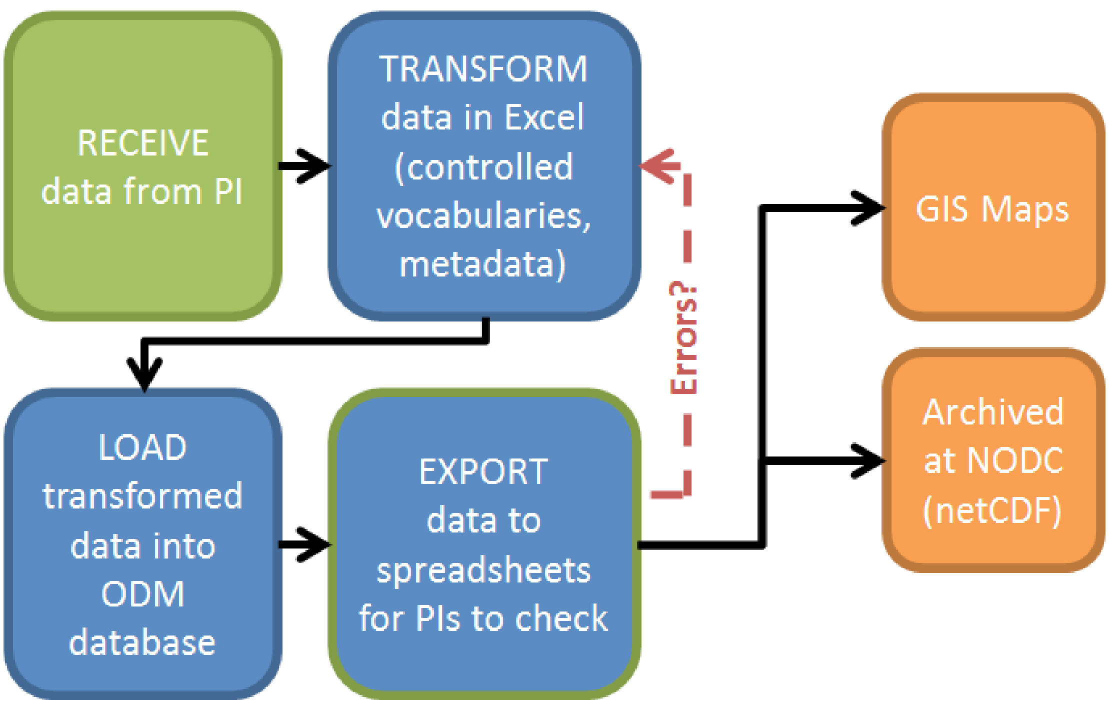

Table 1. Event Log

Station Number	Station Name	Events	Station Start (local time)	Station Finish (local time)	Latitude	Longitude
001	BRS5	CTD, BC, PPK1, BONGO, DRIFT	07/31/2013 23:10	08/01/2013 01:25	65° 43.44” N	168° 57.42” W
002	CBL11	CTD, BC, PPK1, PPK2, BONGO, RING, GRAB, DGRAB, XHAPS, LAND, BEAM, DRIFT	08/02/2013 07:04	08/02/2013 15:04	72° 6.198” N	165° 27.336” W
003	H112	CTD, BC, PPK1, PPK2, BONGO, RING, GRAB, DGRAB, XHAPS, BOX, BEAM	08/02/2013 20:36	08/03/2013 04:36	72° 47.624” N	164° 53.89” W
004	H114	CTD, PPK2, BONGO	08/03/2013 08:08	08/03/2013 09:34	72° 57.269” N	164° 9.173” W
005	HSNW56	CTD, BONGO	08/03/2013 12:45	08/03/2013 13:20	72° 41.745” N	164° 31.935” W
006	NW1	CTD	08/03/2013 14:38	08/03/2013 14:53	72° 38.295” N	164° 23.461” W
007	NW2	CTD	08/03/2013 15:59	08/03/2013 16:19	72° 34.951” N	164° 14.265” W
008	HSNW50	CTD, BONGO	08/03/2013 17:11	08/03/2013 18:04	72° 31.517” N	164° 5.944” W
009	NW3	CTD	08/03/2013 19:15	08/03/2013 19:30	72° 26.682” N	163° 54.392” W
010	NW4	CTD	08/03/2013 20:28	08/03/2013 20:38	72° 21.888” N	163° 43.131” W
011	HSNW40	CTD, BONGO	08/03/2013 21:41	08/03/2013 22:15	72° 16.85” N	163° 32.034” W
012	UTX1	CTD, BONGO, RING, GRAB, BEAM	08/04/2013 00:16	08/04/2013 04:20	72° 3.72” N	164° 7.86” W
013	H6	CTD, BEAM	08/04/2013 06:07	08/04/2013 06:54	72° 9.616” N	163° 34.566” W
014	H7	CTD, BC, PPK1, PPK2, BONGO, RING, GRAB, DGRAB, XHAPS, BOX, BEAM	08/04/2013 08:57	08/04/2013 14:15	72° 6.892” N	162° 43.446” W
015	H17	CTD, BC, PPK1, PPK2, BONGO, RING, GRAB, DGRAB, XHAPS, LAND, BEAM	08/04/2013 15:47	08/04/2013 21:35	71° 59.478” N	163° 23.003” W
016	CC1	CTD, BONGO	08/05/2013 00:37	08/05/2013 01:02	71° 59.317” N	164° 43.973” W
017	HS3	CTD, BC, PPK1, PPK2, BONGO, RING, GRAB, DGRAB, XHAPS, BOX, BEAM	08/05/2013 06:26	08/05/2013 10:48	71° 55.998” N	162° 40.08” W
018	UTX8	CTD, BC, PPK1, PPK2, BONGO, RING, GRAB, DGRAB, XHAPS, BEAM	08/05/2013 14:24	08/05/2013 17:43	71° 43.53” N	163° 27.372” W
019	UTX11	CTD, BC, PPK1, PPK2, BONGO, RING, GRAB, DGRAB, XHAPS, BEAM	08/05/2013 20:20	08/05/2013 23:53	71° 27.18” N	162° 36.642” W
020	H3	CTD, BONGO	08/06/2013 03:52	08/06/2013 04:21	71° 52.191” N	162° 2.854” W
021	TW1	CTD	08/06/2013 05:30	08/06/2013 05:44	71° 45.06” N	161° 59.357” W

022	TW2	CTD	08/06/2013 06:47	08/06/2013 07:04	71° 38.342" N	161° 54.953" W
023	TW3	CTD, BONGO	08/06/2013 08:05	08/06/2013 08:31	71° 31.633" N	161° 48.889" W
024	TW4	CTD	08/06/2013 09:44	08/06/2013 10:00	71° 24.164" N	161° 44.065" W
025	CBL13	CTD, BC, PPK1, PPK2, BONGO, RING, GRAB, DGRAB, XHAPS, BOX, LAND, BEAM	08/06/2013 10:53	08/06/2013 17:06	71° 17.892" N	161° 41.322" W
026	TW6	CTD	08/06/2013 18:48	08/06/2013 18:57	71° 19.493" N	160° 58.783" W
027	TW7	CTD	08/06/2013 21:05	08/06/2013 21:31	71° 21.1" N	160° 13.408" W
028	CBL14	CTD, BONGO, GRAB, BEAM	08/06/2013 23:47	08/07/2013 23:58	71° 22.608" N	159° 28.068" W
029	TW8	CTD	08/07/2013 01:21	08/07/2013 01:31	71° 21.289" N	159° 22.71" W
030	TW9	CTD	08/07/2013 02:03	08/07/2013 02:16	71° 19.999" N	159° 17.17" W
031	TW10	CTD	08/07/2013 02:46	08/07/2013 03:00	71° 18.6" N	159° 11.399" W
032	TW11	CTD	08/07/2013 03:25	08/07/2013 03:44	71° 17.318" N	159° 5.925" W
033	TW12	CTD	08/07/2013 04:11	08/07/2013 04:25	71° 15.923" N	159° 0.031" W
034	TW14	CTD, BONGO, RING	08/07/2013 05:23	08/07/2013 06:15	71° 11.04" N	158° 39.072" W
035	TW13	CTD	08/07/2013 06:41	08/07/2013 06:57	71° 12.363" N	158° 46.352" W
036	H111	CTD, BC, PPK1, PPK2, BONGO, RING, GRAB, DGRAB, BOX	08/07/2013 07:30	08/07/2013 11:43	71° 14.536" N	158° 53.436" W
037	H109	CTD, BC, PPK1, PPK2, BONGO, RING, GRAB, DGRAB, XHAPS	08/07/2013 14:15	08/07/2013 17:59	71° 30" N	159° 30.72" W
038	H108	CTD, BC, PPK2, BONGO, RING, GRAB, DGRAB, BEAM	08/07/2013 19:35	08/07/2013 22:52	71° 36.66" N	159° 22.68" W
039	BarC1	CTD, PPK1, BONGO, GRAB, DGR-AB	08/08/2013 06:07	08/08/2013 08:15	71° 15.024" N	157° 10.158" W
040	BarC2	CTD, GRAB, DGRAB	08/08/2013 08:47	08/08/2013 09:38	71° 17.424" N	157° 14.856" W
041	BarC3	CTD, PPK1, PPK2, BONGO, RING, GRAB	08/08/2013 10:02	08/08/2013 11:34	71° 19.818" N	157° 19.728" W
042	BarC4	CTD, GRAB	08/08/2013 12:10	08/08/2013 12:56	71° 22.194" N	157° 25.14" W
043	BarC5	CTD, PPK1, PPK2, BONGO, RING, GRAB, XHAPS, BOX	08/08/2013 13:27	08/08/2013 17:28	71° 24.798" N	157° 29.898" W
044	BarC6	CTD, GRAB	08/08/2013 18:07	08/08/2013 18:43	71° 27.57" N	157° 34.962" W
045	BarC7	CTD, PPK1, PPK2, BONGO, GRAB	08/08/2013 19:10	08/08/2013 20:28	71° 30.024" N	157° 39.624" W
046	BarC8	CTD, GRAB	08/08/2013 20:55	08/08/2013 21:24	71° 32.4" N	157° 44.934" W

047	BarC9	CTD, PPK1, PPK2, BONGO, RING, GRAB, DGRAB	08/08/2013 21:50	08/08/2013 23:54	71° 34.812" N	157° 50.43" W
048	BarC10	CTD, GRAB, BEAM	08/09/2013 00:23	08/09/2013 01:40	71° 37.2" N	157° 55.83" W
049	CA1	CTD	08/09/2013 03:07	08/09/2013 03:21	71° 46.307" N	158° 7.853" W
050	CA2	CTD, BONGO	08/09/2013 05:39	08/09/2013 06:11	71° 53.75" N	157° 17.463" W
051	CA3	CTD, BONGO	08/09/2013 07:23	08/09/2013 07:47	71° 54.621" N	157° 48.394" W
052	H29	CTD, BC, PPK1, PPK2, BONGO, RING, GRAB, DGRAB, XHAPS, BOX, LAND, BEAM	08/09/2013 09:30	08/09/2013 16:05	71° 55.715" N	158° 19.676" W
053	H32	CTD, BC, PPK2, BONGO, GRAB, BEAM	08/09/2013 18:49	08/09/2013 21:45	71° 46.62" N	159° 0.42" W
054	H106	CTD, BC, PPK2, BONGO, GRAB	08/09/2013 23:09	08/10/2013 00:50	71° 45.516" N	159° 36.182" W
055	CA4	CTD, BONGO	08/10/2013 02:30	08/10/2013 03:00	71° 44.305" N	160° 9.653" W
056	CBL15	CTD, BONGO, GRAB, BEAM	08/10/2013 04:27	08/10/2013 06:26	71° 43.644" N	160° 43.098" W
057	H107	CTD, BC, PPK1, PPK2, BONGO, RING, GRAB, DGRAB, XHAPS, BOX, GC, BEAM	08/10/2013 08:50	08/10/2013 13:20	71° 41.466" N	159° 52.324" W
058	H33	CTD, BC, PPK1, PPK2, BONGO, RING, GRAB, DGRAB, XHAPS, LAND, BEAM, BOAT	08/10/2013 14:38	08/10/2013 21:15	71° 49.367" N	159° 46.329" W
059	YF1	CTD	08/10/2013 23:03	08/10/2013 23:11	72° 0.443" N	159° 36.583" W
060	YF2	CTD, BONGO	08/11/2013 00:51	08/11/2013 01:16	72° 8.082" N	159° 31.633" W
061	YF3	CTD	08/11/2013 02:53	08/11/2013 03:03	72° 15.911" N	159° 26.441" W
062	YF4	CTD, BONGO	08/11/2013 04:46	08/11/2013 05:14	72° 27.438" N	159° 17.985" W
063	H28	CTD, BC, BONGO, RING, GRAB, DGRAB, XHAPS, BOX, GC, BEAM	08/11/2013 06:12	08/11/2013 10:35	72° 24.038" N	159° 20.774" W
064	H15	CTD, BC, PPK1, PPK2, BONGO, RING, GRAB, DGRAB, XHAPS, GC, BEAM	08/11/2013 12:36	08/11/2013 16:05	72° 26.764" N	160° 22.717" W
065	H27	CTD, BC, PPK1, PPK2, BONGO, RING, GRAB, DGRAB, XHAPS, BOX, BEAM	08/11/2013 19:27	08/11/2013 23:10	72° 51.307" N	161° 13.024" W
066	CP1	CTD	08/11/2013 23:53	08/12/2013 00:02	72° 44.054" N	161° 9.625" W
067	CP2	CTD, BONGO	08/12/2013 00:50	08/12/2013 01:26	72° 37.865" N	161° 5.969" W
068	CP3	CTD	08/12/2013 02:13	08/12/2013 02:20	72° 31.733" N	161° 2.381" W
069	CP4	CTD, BONGO	08/12/2013 03:10	08/12/2013 03:39	72° 25.692" N	160° 58.968" W
070	CP5	CTD	08/12/2013 05:00	08/12/2013 05:16	72° 19.843" N	160° 56.988" W

071	CP6	CTD	08/12/2013 06:01	08/12/2013 06:09	72° 19.711" N	161° 14.598" W
072	H9	CTD, BC, PPK1, BONGO, RING, GRAB, DGRAB, XHAPS, BEAM	08/12/2013 07:51	08/12/2013 11:08	72° 13.135" N	160° 52.38" W
073	H34	CTD, BC, PPK1, PPK2, BONGO, RING, GRAB, DGRAB, XHAPS, BEAM	08/12/2013 13:54	08/13/2013 14:07	71° 59.244" N	160° 24.233" W
074	HSNE40	CTD, BONGO	08/12/2013 18:40	08/12/2013 19:04	72° 7.267" N	160° 29.735" W
075	HSNE45	CTD	08/12/2013 20:18	08/12/2013 20:27	72° 8.245" N	160° 13.243" W
076	H20	CTD, BONGO, GRAB, BEAM	08/12/2013 21:19	08/12/2013 22:08	72° 9.147" N	159° 55.704" W
077	HSNE48	CTD	08/12/2013 23:24	08/12/2013 23:30	72° 9.48" N	159° 31.623" W
078	HSNE50	CTD, BONGO	08/13/2013 00:43	08/13/2013 01:07	72° 9.749" N	159° 7.346" W
079	HSNE53	CTD	08/13/2013 02:11	08/13/2013 02:32	72° 10.319" N	158° 52.045" W
080	HSNE56	CTD	08/13/2013 04:32	08/13/2013 04:41	72° 10.88" N	158° 33.092" W
081	H102	CTD, BC, PPK1, PPK2, BONGO, RING, GRAB, DGRAB, XHAPS, BOX, BEAM	08/13/2013 06:00	08/13/2013 10:04	72° 12.173" N	158° 24.547" W
082	RP1	CTD	08/13/2013 11:02	08/13/2013 11:12	72° 13.37" N	158° 6.09" W
083	RP2	CTD	08/13/2013 11:54	08/13/2013 12:05	72° 14.4" N	158° 8.03" W
084	RP3	CTD, BONGO	08/13/2013 13:05	08/13/2013 13:32	72° 16.01" N	157° 58.43" W
085	RP4	CTD	08/13/2013 14:20	08/13/2013 14:30	72° 17.3" N	157° 49.36" W
086	RP5	CTD, BONGO	08/13/2013 15:08	08/13/2013 15:38	72° 18.48" N	157° 39.62" W
087	RP6	CTD, BONGO	08/13/2013 16:12	08/13/2013 16:44	72° 19.68" N	157° 31.53" W
088	RP7	CTD, BONGO	08/13/2013 17:26	08/13/2013 18:03	72° 21.31" N	157° 23.26" W
089	RP8	CTD, BONGO	08/13/2013 18:39	08/13/2013 19:18	72° 22.53" N	157° 13.45" W
090	RP9	CTD	08/13/2013 19:54	08/13/2013 20:09	72° 23.73" N	157° 5.466" W
091	RP10	CTD, BONGO	08/13/2013 20:46	08/13/2013 21:28	72° 25.189" N	156° 56.023" W
092	RP11	CTD	08/13/2013 22:02	08/13/2013 22:21	72° 26.344" N	156° 46.757" W
093	RP12	CTD, BONGO	08/13/2013 23:02	08/13/2013 23:48	72° 27.66" N	156° 37.849" W
094	RP13	CTD	08/14/2013 00:34	08/14/2013 12:27	72° 29.344" N	156° 28.556" W
095	H103	CTD, BONGO, RING	08/14/2013 01:44	08/14/2013 03:56	72° 30.017" N	156° 21.083" W

096	BarC10	CTD	08/14/2013 11:20	08/14/2013 11:27	71° 37.2” N	157° 55.83” W
097	BarC9	CTD	08/14/2013 11:53	08/14/2013 12:04	71° 34.812” N	157° 50.43” W
098	BarC8	CTD	08/14/2013 12:38	08/14/2013 12:45	71° 32.4” N	157° 44.934” W
099	BarC7	CTD	08/14/2013 13:21	08/14/2013 13:32	71° 30.024” N	157° 39.624” W
100	BarC6	CTD	08/14/2013 14:02	08/14/2013 14:11	71° 27.57” N	157° 34.962” W
101	BarC5	CTD	08/14/2013 14:38	08/14/2013 14:50	71° 24.798” N	157° 29.898” W
102	BarC4	CTD	08/14/2013 15:18	08/14/2013 15:31	71° 22.194” N	157° 25.14” W
103	BarC3	CTD	08/14/2013 16:02	08/14/2013 16:12	71° 19.818” N	157° 19.728” W
104	BarC2	CTD	08/14/2013 16:45	08/14/2013 16:51	71° 17.424” N	157° 14.856” W
105	BarC1	CTD	08/14/2013 17:19	08/14/2013 17:24	71° 15.024” N	157° 10.158” W

Table 2. Codes for over the side events

Code	Full Event Name	Location Deployed
CTD	CTD/Rosette	Starboard, CTD winch
BC	Benthic Camera	Starboard, hand-deployed
PPK1	Net, Phytoplankton - Stable Isotopes	Starboard, hand-deployed
PPK2	Net, Phytoplankton - Trace Metal	Starboard, hand-deployed
BONGO	Net, Bongo	Stern Winch
RING	Net, Ring	Stern Winch
GRAB	Grab, van Veen	Stern Winch
DGRAB	Grab, Double van Veen	Stern Winch
XHAPS	Corer, Haps-Multi	Stern Winch
BOX	Corer, Box	Stern Winch
GC	Corer, Gravity	Stern Winch
BEAM	Trawl, Beam	Stern Winch

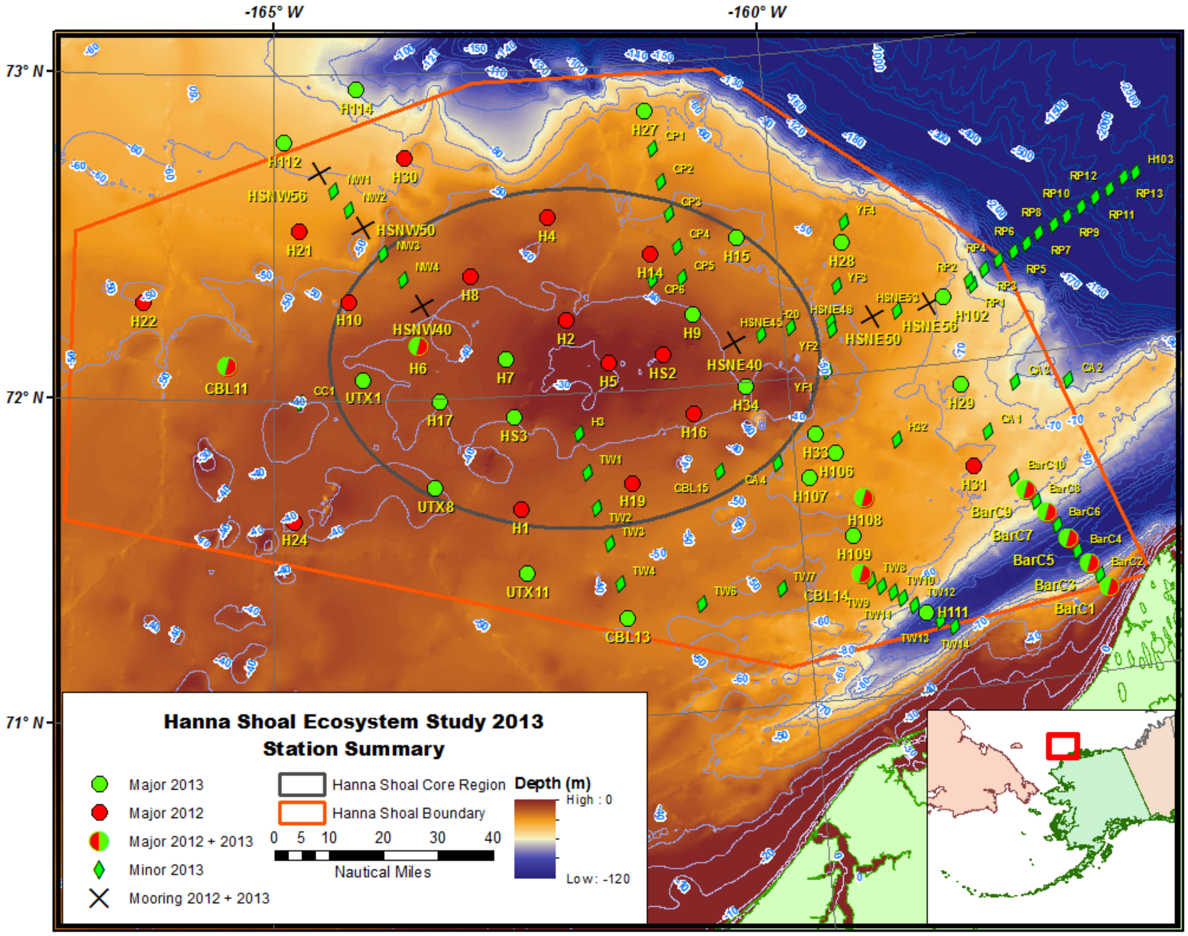

Figure 3: Station Sampling Map. Base-map is derived from Jakobsson, M., L. A. Mayer, B. Coakley, J. A. Dowdeswell, S. Forbes, B. Fridman, H. Hodnesdal, R. Noormets, R. Pedersen, M. Rebesco, H.-W. Schenke, Y. Zarayskaya A, D. Accettella, A. Armstrong, R. M. Anderson, P. Bienhoff, A. Camerlenghi, I. Church, M. Edwards, J. V. Gardner, J. K. Hall, B. Hell, O. B. Hestvik, Y. Kristoffersen, C. Marcussen, R. Mohammad, D. Mosher, S. V. Nghiem, M. T. Pedrosa, P. G. Travaglini, and P. Weatherall, The International Bathymetric Chart of the Arctic Ocean (IBCAO) Version 3.0, Geophysical Research Letters, doi: 10.1029/2012GL052219.

STARC Post Cruise Report for Healy 1301

Robert Thombley, SIO (0700-1900 watch on HLY1301)
Toby Martin, OSU (1900-0700 watch on HLY1301)

The following systems provided data during this cruise:

ADCP: 75kHz and 150kHz phased array current profiles
CTD profiles
EM122 multibeam bathymetry
High resolution GPS and ship motion
Knudsen 3.5kHz echo sounder bathymetry
MET: Meteorological and sea surface underway data
pCO2: Surface dissolved CO2

This report summarizes each of these systems, and includes notes regarding data quality and any processing steps performed on the data.

General

This was the first scientific cruise on Healy after major restructuring of all the shipboard scientific data collection systems. Most systems were nominal for the duration of the cruise. On 10 August 2013 at approximately 0025 GMT, the Healy experienced a shipwide power outage. All of our systems were powered down at this time. This resulted in a data gap of a few hours while the STARC team scrambled to get all systems powered back on and functional. All systems returned to nominal status, excepting a few power supplies, after the unscheduled power cycling. The majority of this cruise was in shallow water (<200m) and favorable, if cold, sea conditions. Ice was present, but patchy, for more than 60% of the cruise.

ADCP

ADCP data was collected over the cruise from an RD Instruments brand 75kHz and 150kHz, phased array sonar. The following information comes from the UHDAS ADCP webpage on board the Healy.

"Healy has two Doppler sonars for measuring ocean currents, both manufactured by Teledyne R.D.Instruments. The two instruments are both phased array sonars, one operating at 75kHz and one at 150kHz. These instruments are capable of pinging in two modes: broadband (higher resolution, reduced range) or narrowband (lower resolution, deeper range)

Electrical interference has been a problem with ADCPs on the Healy in the past, reducing range and increasing bias. In an effort to reduce noise and biases and increase range, the deck units of both instruments (electronics chassis) were temporarily moved to a different location during the 2011 field season. The new location greatly improved noise levels, depth penetration, and reduced the biases in both instruments. A permenant spot has been found for the deck units (starting in 2012) that attempts to replicate the success of the the 2011 season.

During the 2012 shakedown cruise, the 75 kHz Ocean Surveyor ADCP (OS75) was capable of reaching similar depths to 2011, but final performance remains to be seen. Much will depend on the power supplied to the deck units. The OS75 broadband mode is apparently biased again, but the broadband mode seems better. Both OS150 modes seemed reasonable. The instruments should probably both run with NB mode only (except for diagnostics). Because the ship often works in shallow water, defaults are set to run with NB mode only, and bin sizes smaller than the recommended default (4m for OS150, 8m for OS75)

Data acquisition and processing are performed by “UHDAS”, a software package written at the University of Hawaii. “UHDAS”, was installed on the Healy in 2010 and updated in April, 2011. Data acquisition, automated processing, web serving and diskserving are done by the ADCP Linux pc, “currents”. Currents belongs to the ship; Currents is NOT available for general use. Please respect this restriction and help us to maintain the integrity of this computer for acquisition and processing. Access to raw data, preliminary processed data, and plots is through SAMBA share and this website.

Although a final processing of the ADCP data set will be needed after the cruise, we hope that the differences between the final version and the automated processed version will be small. The biggest differences will likely be found under adverse conditions. In bad weather, low scattering conditions, ice, or some speed/heading/sea state conditions (eg. entrainment of bubbles under the transducer), there may be only a few bins, and those could suffer from along-track bias.“

ADCP data collection during HLY1301 was exceptional. There were two down periods in the Ashtech heading data which may (very) slightly impact data quality. These down periods happened on 31 July 2013 (approximately 2 hours) and 13 Aug 2013 (approximately 25 minutes). No other issues to report.

CTD

We performed a total of 105 CTD stations during this cruise. There were no sensor replacements performed on this cruise, save the removal of Dr. Roger Harvey’s phycoerythrin fluorometer prior to cast 09601.

Sensors used on HLY1301

- Seabird Electronics (SBE) SBE9+ CTD (s/n 090638)
- SBE 3+ temperature sensors
  - Primary s/n: 032945 (Calibration Date: 06 Apr 2013)
  - Secondary s/n: 032855 (Calibration Date: 25 Apr 2013)
- SBE 4 conductivity sensors
  - Primary s/n: 042545 (Calibration Date: 05 Apr 2013)
  - Secondary s/n: 042568 (Calibration Date: 02 May 2013)
- Digiquartz pressure sensor (permanently installed within SBE9+)
  - S/N: 090638 (Calibration Date: 06 Apr 2013)
- SBE43 oxygen sensor (plumbed inline with primary temperature and conductivity sensors)
  - S/N: 430456 (Calibration Date: 03 Apr 2013)
- Benthos altimeter

- S/N: Benthos 872 (No calibration needed)
- Wetlabs Cstar transmissometer
- S/N: CST-390DR (Factory Calibration Date: Apr 2013; field calibration before 1st station and after last station)
- Wetlabs ECO-FLRTD Chla fluorometer
- S/N: FLRTD-074 (Calibration Date: Jan 2013)
- Wetlabs ECO-FLRTD CDOM fluorometer
- S/N: FLCDRTD-2226 (Calibration Date: Jan 2012)
- Turner Cyclops-7 Phycoerythrin fluorometer
- S/N: 2180324 (Calibration Date: unknown)
- Biospherical QSP-2300 PAR sensor
- S/N: 70115 (Calibration Date: June 2011)

Prior to the first station, the transmissometer was field calibrated through SeaBird Electronics' Seasave program (to display voltages). Results are as follows:

Beginning of HLY1301 (30 July 2013)
$V_{openPath}$ = 4.839 Volts
$V_{blockedPath}$ = 0.057 Volts

End of HLY1301 (14 Aug, 2013)
$V_{openPath}$ = 4.837 Volts
$V_{blockedPath}$ = 0.058 Volts

On all casts, CTD had a 1-2 minute soak at 10m (15m for Go-Flo casts), returned to the surface (5-8m for Go-Flo casts) and went to between 2 and 5 meters above the bottom.

Casts were performed using a 24 place rosette frame holding twenty four 10L General Oceanics Niskin X external spring niskin bottles. Once per day, 7-8 GoFlo bottles were installed in place of the Niskin X bottles for trace metals sampling.

CTD data was processed using a Seabird Electronics' SBEDataProcessing suite of data processing scripts. Each cast was processed using the following workflow:

1. DataConversion.psa: Used to convert from the hexadecimal file format to a human readable format (.cnv file).
2. WildEdit.psa: Used to remove any outliers in the data.
3. BottleSummary.psa: Used to create a snapshot of the CTD data during each bottle trip.
4. BinAverage.psa: Used to average the downcast CTD data into 0.5 meter depth bins.
5. SeaPlot.psa: Used to create plots of the processed data.

CTD performed as expected on the cruise with only one mechanical re-termination, move grip above kink, coil spare on top) necessary prior to station 052 (09 Aug 2013 @ 10:30am Local Time).

EM122 Bathymetry

A Kongsberg EM122 collected data throughout the cruise. The EM122 is a deep water multibeam sonar system that performs best in deep water (>1000m) with no ice. This cruise had both slushy ice and very shallow water for most of it. Despite that, data was generally good. At the beginning of the cruise, in very shallow water (~30m depth) there were problems with the EM122 tracking the bottom consistently. This has became less of an issue and we had generally good bottom tracking throughout the cruise.

The EM122 uses sound velocity measurements both at the level of the transducer and throughout the water column to effect more precise beam forming and return processing. Sound velocity profiles of the water column, calculated from CTD casts, were input into the system at least once per day. Surface sound velocity was calculated using the thermosalinograph (SBE45 s/n:450215, Calibration Date: 03-Apr-2013) in the Bio Chem Lab located at the effluent end of the uncontaminated surface sea water pipe. The input to this system from the ocean is at approximately 5m below MWL. Estimated transit times from ocean to SBE45 are on the order of 21 minutes.

High Resolution GPS and Motion Reference

The Healy has several high accuracy GPS systems and motion reference units. There are two posMV units giving highly accurate heading, attitude, position, velocity and heave measurements, as well as a Trimble AG132 dGPS system and an Ashtech ADU5 attitude system. These units experienced nearly 100% uptime on this cruise with very few problems, save for the ship's power outage and the two Ashtech drop outs previously mentioned.

Knudsen 3.5kHz Echo Sounder Bathymetry

The ship has a Knudsen 3260 echo sounder with 3.5kHZ phased array transducers mounted in the transducer well on the hull of the Healy. We had relatively strong bottom tracking for almost all of the cruise, but due to the noisy platform there tends to be strong false returns in the top 10-20m (the ship's draft is approximately 11m below MWL).12kHz pinging was not used nor collected.

There was a short break in data collection on 13 August 0130 GMT when the data recording location was moved. Sound speed was changed from 1500 to 1458 at approximately 1945 GMT on 2 August 2013 to match the EM122 sound speed reading. It was changed back to 1500 at 0300 GMT 3 August 2013 when, after discussion, it was determined that the Knudsen sound speed value should not deviate from 1500.

Meteorological and Underway Sea Surface Data Collection: MET System

There is a network of dozens of sensors mounted throughout the ship that collect environmental data in real time for archival and display. Individual data streams exist for monitoring sea surface temperatures, salinity, fluorescence, and oxygen levels as well as wind speed and direction, ship movement and location and atmospheric conditions. The system responsible for aggregating all of these individual data streams is the called the MET system. Data streams are monitored and recorded/displayed once every 15 seconds. The MET system also produces a number of data files for use after the cruise. For more information about the MET and the files it produces see the MET manual metACQ.pdf within the manuals section of the MET data.

There were a number of a small issues with the MET system throughout HLY1301.

- Erroneous underway flow through system data resulting from communication errors between the port passage & bio chem lab sensors and the main met computer.
- Erroneous air temperature values caused by sensor flooding in the air temperature sensors.
- Moderate to frequent troubleshooting of the MET system requiring STARC to stop data collection in order to correct any issues (Approximately 1 time/day for roughly 5-10 minutes).
- Flow meter recalibration on 07 Aug 2013 to account for large differences between recorded flow rate and observed flow rate. Observed flow rates prior to the recalibration were approximately 5 L/min in the port passage (flow meter read 1.8 L/min) and 2.8 L/min in the Bio Chem lab (flow meter read 2.1 L/min).
- Relative humidity sensor reading appeared high for most of the cruise despite an apparently functional sensor.
- Large differences in magnitude of the readings between the C3 chlorophyll *a* fluorometer in the port ssw station and the SeaPoint fluorometer in the Bio Chem lab. Since fluorescence response varies with fluorescing species distribution in the water column, the fluorometers are not calibrated, so only qualitative or relative measurements have any meaning. The temporal trends of both fluorometers were consistent.

PCO2 Underway CO2 System

The PCO2 underway seawater pCO2 sampling system had a difficult cruise. Hardware malfunctions in the sampling system as well as software bugs left us without much usable data on HLY1301. The PCO2 system seems to be operating well as of 13 August 2013. Data prior to that on HLY1301 are considered to be suspect due to a dying flow controller.

University of Maryland Center for Environmental Science (Chesapeake Biological Laboratory) HLY1301 Cruise Report

Lee W. Cooper, PI, Chief Scientist, Jacqueline M. Grebmeier, PI/co-Chief Scientist
Onboard sampling team: Lee Cooper, Jacqueline Grebmeier, Christian Johnson, Mengjie Zhang, Laura Gemery, Dubrava Kirievskaya, Holly Kelly, Christina Goethel, Piper Lewis

The Chesapeake Biological Laboratory (CBL) research group undertook both water column and sediment sample collections during the HLY1301 cruise (Table 1). Water column collections included water sampling for chlorophyll from the rosette (Table 2) and inorganic nutrients. The water column chlorophyll was analyzed shipboard using a Turner Designs AU-20 fluorometer (non-acidification or Welschmeyer method) following a 24-hour in the dark incubation with 90% acetone at 4 °C.

Table 1. CBL sample collection. KEY: Stn=Station, WC=water column, Chl=chlorophyll, Sed=sediment, TOC=total organic carbon, Ben Cam=benthic camera, vV=van Veen grab (5, unless noted), XHAPS for SCOC=Multi-HAPS corer collections for SCOC=sediment community oxygen consumption, Sed for Metals=sediments for metals, Infauna AA-isotopes=Infauna for amino acid isotopic analyses, cod=fish type. Preliminary data have been analyzed and integrated concentrations over the whole water column are shown in Table below and are also plotted on Figures 1 and 2 (this section)

Stn #	Stn Name	Date (local AK time)	WC-Chl a	WC	Sed Chl a & TOC	Ben Cam	vV grab	XHAPS SCOC (JG)	Sed for	Infauna AA-	Cod
1	BRS5		X	X		X					
2	CBL11		X	X	X		X	X	X	X	X
3	H112		X	X	X	X (2)	X	X	X	X	
4	H114		X	X							
12	UTX1		X	X	X		X		X	X	
14	H7		X	X	X	X	X	X	X	X	X
15	H17		X	X	X		X	X	X	X	X
17	HS3		X	X	X	X	X	X	X	X	
18	UTX8		X	X	X		X	X	X	X	
19	UTX11		X	X	X	X	X	X	X	X	
25	CBL13		X	X	X	X	X	X	X	X	
28	CBL14				X		X				
36	H111		X	X	X	X	X		X	X	
37	H109		X	X	X	X	X	X	X	X	X
38	H108		X	X	X	X	X		X	X	

39	BarC1		X	X	X	X	X (1)		X		
40	BarC2		X	X	X		X (1)		X		
41	BarC3		X	X	X		X (1)				
42	BarC4		X	X	X		X (1)				
43	BarC5		X	X	X		X	X	X	X	
44	BarC6		X	X	X		X (1)		X		
45	BarC7		X	X	X	X	X (1)		X		
46	BarC8		X	X	X		X (1)		X		
47	BarC9		X	X	X	X	X (1)		X		
48			X	X	X		X (1)		X		
52	H29		X	X	X	X	X	X		X	X
53	H32		X	X	X	X	X				X
54	H106		X	X	X	X	X			X	
56	CBL15				X						
57	H107		X	X	X	X	X	X		X	
58	H33		X	X	X		X	X		X	X
63	H28		X	X	X		X	X	X		
64	H15		X	X	X		X	X	X	X	
65	H27		X	X	X	X	X	X	X		X
72	H9		X	X	X	X	X	X	X		
73	H34		X	X	X			X	X	X	X
81	H102		X	X	X			X			

Preliminary data have been analyzed and integrated concentrations over the whole water column are shown in the table below and are also plotted on Figure 1 (this section).

Inorganic nutrients were also collected from the CTD rosette and filtered shipboard. These samples were returned to CBL, and nutrient analysis is now underway. Water samples for $^{18}O/^{16}O$ ratios were also collected on a stations on the Distributed Biological Observatory transect line across Barrow Canyon, as well aa other stations on the cruise, and will be analyzed at CBL using a stable isotope mass spectrometer.

Surface sediments were collected throughout the cruise from the top of the van Veen grab before it was opened to minimize disturbance of surface sediments. These collections included determinations of inventories of chlorophyll a in surface sediments (Figure 2) shipboard, using a 12 hour incubation in the dark at 4°C and similar measurement as with water column measurement described above. Other sediments were collected to determine C/N ratios and grain size. A separate sediment sample was collected to assay surface sediments for ostracod abundance (see Laura Gemery sub-report).

Station	Station Name	Date	Latitude Dec. Deg.	Longitude Dec. Deg.	Integrated Chl *a* (mg/ m2)	Sediment Chl *a* (mg/ m^2)
1	BRS5	7/31/2013	65.724	-168.957	226.88	no sample
2	CBL11	8/2/2013	72.103	-165.456	9.70	12.99
3	H112	8/2/2013	72.794	-164.898	2.64	0.39
12	UTX1	8/4/2013	72.062	-164.131	25.15	14.32
14	H7	8/4/2013	72.115	-162.724	137.58	13.02
15	H17	8/4/2013	71.991	-163.383	44.94	20.75
17	HS3	8/5/2013	71.933	-162.668	255.52	12.11
18	UTX8	8/5/2013	71.726	-163.456	28.17	17.92
19	UTX11	8/5/2013	71.453	-162.611	200.26	15.81
25	CBL13	8/6/2013	71.298	-161.689	69.75	17.27
28	CBL14	8/7/2013	72.377	-159.468	no sample	7.38
36	H111	8/7/2013	71.242	-158.891	168.18	14.38
37	H109	8/7/2013	71.500	-159.512	51.17	6.85
38	H108	8/7/2013	71.611	-159.378	236.69	8.49
39	BarC1	8/8/2013	71.250	-157.169	34.29	6.56
40	BarC2	8/8/2013	71.290	-157.248	32.24	16.98
41	BarC3	8/8/2013	71.330	-157.329	60.41	18.99
42	BarC4	8/8/2013	71.370	-157.419	158.55	21.59
43	BarC5	8/8/2013	71.413	-157.498	113.08	38.64
44	BarC6	8/8/2013	71.460	-157.583	86.83	20.78
45	BarC7	8/8/2013	71.500	-157.660	108.26	11.46
46	BarC8	8/8/2013	71.540	-157.749	130.17	11.23
47	BarC9	8/8/2013	71.580	-157.841	54.31	16.43
48	BarC10	8/9/2013	71.620	-157.931	59.74	5.46
52	H29	8/9/2013	71.929	-158.328	241.50	3.30
53	H32	8/9/2013	71.777	-159.007	207.08	6.63
54	H106	8/9/2013	71.759	-158.603	90.97	8.90
56	CBL15	8/9/2013	71.727	-160.718	no sample	10.29
57	H107	8/10/2013	71.691	-159.872	50.03	5.70
58	H33	8/10/2013	71.823	-159.772	88.45	5.37
63	H28	8/11/2013	72.401	-159.346	23.85	7.37
64	H15	8/11/2013	72.446	-160.379	49.31	no sample
65	H27	8/11/2013	72.855	-161.217	7.12	3.32
72	H9	8/11/2013	72.219	-160.873	35.73	0.20
81	H102	8/13/2013	72.203	-158.409	80.26	6.57

Organisms in each grab from which surface sediments were collected were also returned to CBL for a Ph.D. thesis (Mengjie Zhang) project that involves food web analysis using amino acids extracted from various food web components. Additionally four quantitative grabs were collected and sieved for determinations of species composition and biomass. These infaunal organisms were preserved in formalin and will be returned to CBL for taxonomic and biomass analysis after the Healy returns to Seattle.

Sediment was collected by Dubrava Kirievskaya for trace metal analysis. Replicate sediment cores were collected by the multiple HAPS coring systems and used for shipboard incubations in the dark and at in-situ bottom water temperatures using one of the temperature controlled chamber rooms on Healy. Oxygen utilization, as well as inorganic nutrient and inorganic carbon exchange, were all measured during these incubations.

HAPS core and gravity core collections were used to support measurements of sedimentation rates. Cores were sectioned and canned in calibrated geometric containers and were returned to CBL. Radiogenic isotopes such as ^{137}Cs and ^{210}Pb

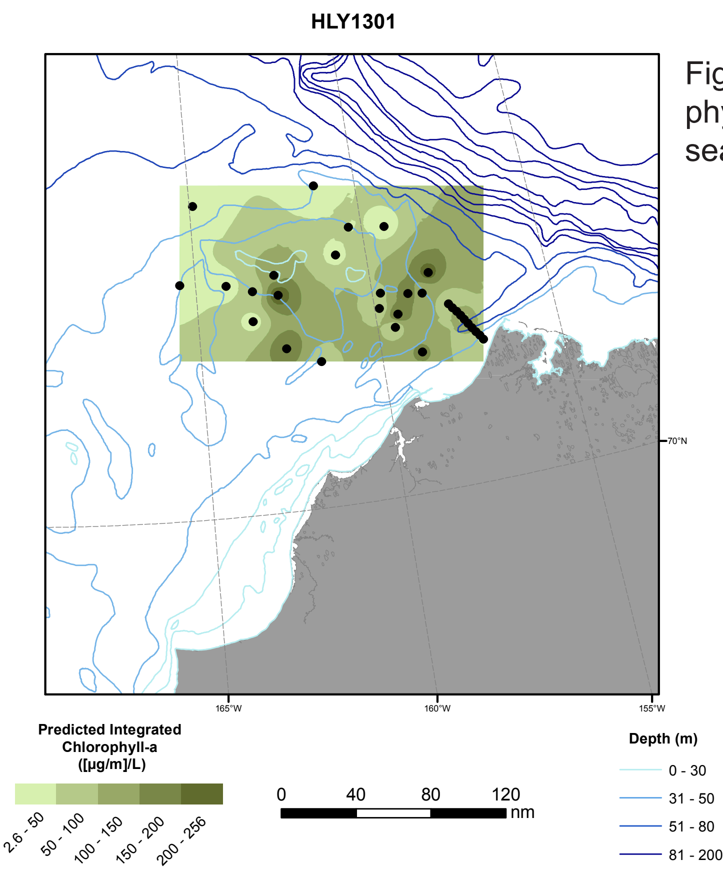

Figure 1. Water column chlorophyll integrated from surface to sea floor.

will be counted at CBL using two low background gamma spectrometers in order to determine sedimentation rates.

At each station where it was practical, and dependent upon sea state and ice conditions, a submersible video camera system was lowered to the seafloor to document the epibenthic communities at each station. These video clips were used by the University of Alaska Fairbanks research trawling team, and will also be analyzed on a semi-quantitative basis to estimate organisms per square meter and/or to characterize the epibenthic communities at each location sampled. In a related cooperative effort with the trawling team, Arctic Cod (Boreogadus saida) were collected by Christian Johnson when captured during trawling. Fish were measured and otoliths were removed for age-length analysis and strontium and barium measurements as an indicator of inhabited salinity.

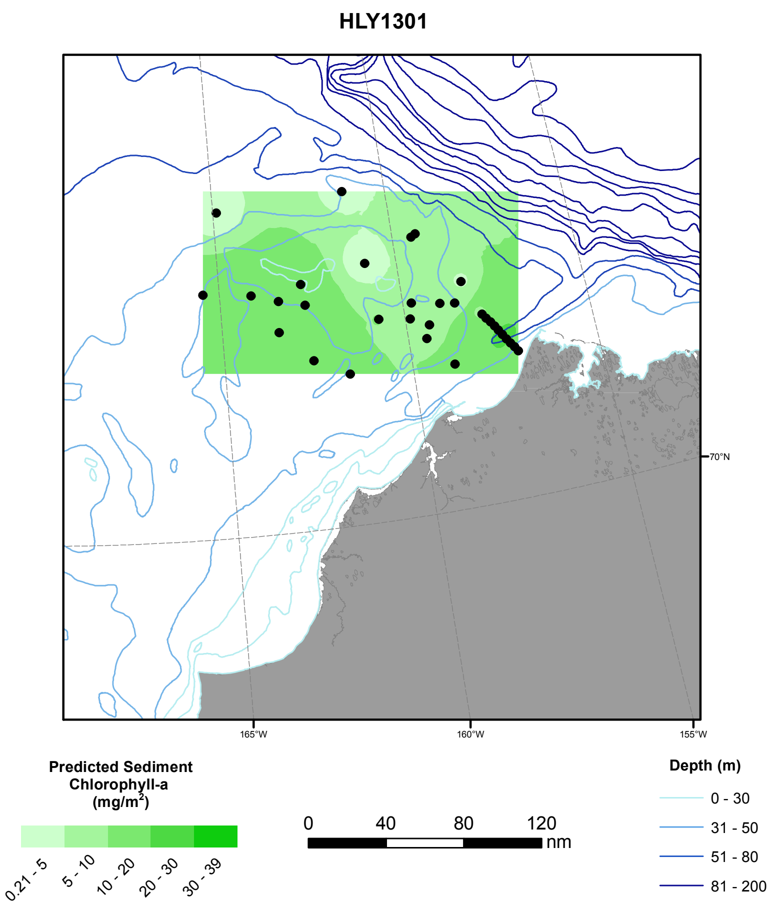

Figure 2. Sediment chlorophyll inventories in surface sediments. These data are means of duplicate sediment samples (1 cm^3) collected from the top of the van Veen grab before it was opened. Samples were incubated for 12 hours in the dark at 4°C before flurometry measurements were made using a Turner Designs AU-20 instrument (non-acidification method).

Cruise Summary, HLY1301
Laura Gemery, U.S. Geological Survey at Reston, Virginia, U.S.A.

This USGS project, in collaboration with several institutions (University of Maryland, Ohio State University), are using ostracodes and other microfauna found in surface sediment samples and Arctic sediment core records to assess 1.) shelf ecosystem response to changing oceanographic conditions the last century and 2.) climatic impacts on Arctic Ocean circulation, sea level, temperature and sea ice.

During HLY1301, 35 Van Veen grabs and 8 HAPS core tops (top few centimeters) were collected from sites on the Chukchi continental shelf (see table of sample locations below). Samples were immediately frozen for future processing and analysis at the USGS lab. Ostracodes present in these grabs and coretops will be quantitatively analyzed using multivariate quantitative and clustering techniques.

Seven samples were analyzed on board, yielding 538 specimens. Paracyprideis pseudopunctillata was the most abundant species. The percent abundance of the dominant species is as follows:

H. fascis	N. leioderma	P.	P. janae	S. bradii	S. complanata
2.78	4.27	30.48	7.99	3.53	5.0

Sample list for ostracode anaylsis:

002	CBL11
003	H112
012	UTX1
014	H7
015	H17
017	HS3
018	UTX8
19	UTX11
025	CBL13
028	CBL14
036	H111
037	H109
038	H108
039	BarC1
040	BarC2
041	BarC3
042	BarC4
043	BarC5
044	BarC6

045	BarC7
046	BarC8
047	BarC9
048	BarC10
052	H29
053	H32
054	H106
056	CBL15
057	H107
058	H33
063	H28
064	H15
065	H27
072	H9
073	H34
81	H102

Dissolved Organic Matter (DOM) Molecular Characterization and Chromophoric DOM (CDOM) Distribution in the Chukchi Sea

Michael Gonsior (PhD), University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory

The molecular composition of dissolved organic matter (DOM) remains largely unknown and only recently modern analytical techniques became available to describe the molecular composition of extremely complex mixtures based on the exact measurements of molecular ion masses using ultrahigh resolution mass spectrometry. This technique known as electrospray ionization Fourier transform ion cyclotron resonance mass spectrometry (FT-MS) will be applied on samples collected at stations and depths given in Table 1. This is the first attempt to evaluate the differences in DOM on the molecular level in relatively fine resolution throughout the entire water column within the Hanna Shoal region. Results will yield a description of all ionizable organic molecules present in the area and can also be used as a reference for future studies.

The second major objective during the research cruise Healy 13-01 was to establish a distribution profile of the light-absorbing or chromophoric DOM (CDOM) in the region. This CDOM is important due to its ability to absorb harmful ultraviolet radiation and its active participation in the global carbon cycle including its photochemical activity that leads to its degradation and the production of CO and CO2. The surface distribution will be continuously (every 10 min) measured using UV-Vis spectra between 260-700 nm and a custom-designed Ocean Optics miniature (Jaz) UV-Vis system combined with a 50 cm pathlength waveguide (World Precision Instruments). The water column CDOM (UV-Vis) and fluorescent CDOM (FDOM) will be measured using the HORIBA Aqualog fluorometer. This fluorometer is capable of simultaneously measure the UV-Vis spectrum and the excitation emission matrix fluorescence (EEM) of any given water sample. Furthermore, the large sample set, collected during this expedition, will allow to develop a statistical model referred to as Parallel Factor Analysis (PARAFAC) model and to assign PARAFAC components including their relative distribution within the region.

Table 1: List of samples collected during the Healy 1301 cruise and analysis that will be undertaken.

Sample number	Sample_ID	water depth (m)	system	EEM fluorescence	FT-MS
1	Station01/Bering Strait-5	5	CTD	x	x
2	Station01/Bering Strait-15	15	CTD	x	x
3	Station01/Bering Strait-25	25	CTD	x	x
4	Station01/Bering Strait-35	35	CTD	x	x
5	Station01/Bering Strait-46	45	CTD	x	x
6	Station02/CBL11-5	5	CTD	x	x
7	Station02/CBL11-15	15	CTD	x	x
8	Station02/CBL11-25	25	CTD	x	x
9	Station02/CBL11-35	35	CTD	x	x
10	Station03/H112-5	5	CTD	x	x
11	Station03/H112-15	15	CTD	x	x
12	Station03/H112-25	25	CTD	x	x
13	Station03/H112-35	35	CTD	x	x
14	Station03/H112-50	50	CTD	x	x
15	Station03/H112-57	57	CTD	x	x
16	Station04/H114-5	5	CTD	x	x
17	Station04/H114-15	15	CTD	x	x
18	Station04/H114-25	25	CTD	x	x
19	Station04/H114-35	35	CTD	x	x
20	Station04/H114-50	50	CTD	x	x
21	Station04/H114-67	67	CTD	x	x
22	Station11/UTX1-5	5	CTD	x	x
23	Station11/UTX1-15	15	CTD	x	x
24	Station11/UTX1-25	25	CTD	x	x
25	Station11/UTX1-35	35	CTD	x	x
26	Station15/H7-5	5	CTD	x	x
27	Station15/H7-15	15	CTD	x	x
28	Station15/H7-25	25	CTD	x	x
29	Station15/H7-34	34	CTD	x	x
30	Station16/H17-5	5	CTD	x	x
31	Station16/H17-15	15	CTD	x	x
32	Station16/H17-25	25	CTD	x	x
33	Station16/H17-32	32	CTD	x	x
34	Station17/HS3-5	5	CTD	x	x
35	Station17/HS3-15	15	CTD	x	x
36	Station17/HS3-23	23	CTD	x	x
37	Station17/HS3-35	35	CTD	x	x
38	Station18/UTX8-5	5	CTD	x	x
39	Station18/UTX8-15	15	CTD	x	x
40	Station18/UTX8-25	25	CTD	x	x
41	Station18/UTX8-33	33	CTD	x	x
42	Station19/UTX11-5	5	CTD	x	x
43	Station19/UTX11-15	15	CTD	x	x

44	Station19/UTX11-25	25	CTD	x	x
45	Station19/UTX11-35	35	CTD	x	x
46	Station25/CBL13-5	5	CTD	x	x
47	Station25/CBL13-15	15	CTD	x	x
48	Station25/CBL13-25	25	CTD	x	x
49	Station25/CBL13-45	45	CTD	x	x
50	Station36/H111-5	5	CTD	x	x
51	Station36/H111-15	15	CTD	x	x
52	Station36/H111-25	25	CTD	x	x
53	Station36/H111-35	35	CTD	x	x
54	Station36/H111-50	50	CTD	x	x
55	Station36/H111-75	75	CTD	x	x
56	Station36/H111-107	107	CTD	x	x
57	Station37/H109-5	5	CTD	x	x
58	Station37/H109-15	15	CTD	x	x
59	Station37/H109-25	25	CTD	x	x
60	Station37/H109-53	53	CTD	x	x
61	Station39/Barc01-5	5	CTD	x	x
62	Station39/Barc01-15	15	CTD	x	x
63	Station39/Barc01-25	25	CTD	x	x
64	Station39/Barc01-35	35	CTD	x	x
65	Station39/Barc01-46	46	CTD	x	
66	Station40/Barc02-5	5	CTD	x	
67	Station40/Barc02-15	15	CTD	x	
68	Station40/Barc02-25	25	CTD	x	
69	Station40/Barc02-35	35	CTD	x	
70	Station40/Barc02-57	57	CTD	x	
71	Station41/Barc03-5	5	CTD	x	
72	Station41/Barc03-15	15	CTD	x	
73	Station41/Barc03-25	25	CTD	x	
74	Station41/Barc03-35	35	CTD	x	
75	Station41/Barc03-50	50	CTD	x	
76	Station41/Barc03-75	75	CTD	x	
77	Station41/Barc03-89	89	CTD	x	
78	Station42/Barc04-5	5	CTD	x	
79	Station42/Barc04-15	15	CTD	x	
80	Station42/Barc04-25	25	CTD	x	
81	Station42/Barc04-35	35	CTD	x	
82	Station42/Barc04-50	50	CTD	x	
83	Station42/Barc04-75	75	CTD	x	
84	Station42/Barc04-109	109	CTD	x	
85	Station43/Barc05-5	5	CTD	x	x
86	Station43/Barc05-15	15	CTD	x	x
87	Station43/Barc05-25	25	CTD	x	x
88	Station43/Barc05-35	35	CTD	x	x
89	Station43/Barc05-50	50	CTD	x	x

90	Station43/Barc05-75	75	CTD	x	x
91	Station43/Barc05-90	90	CTD	x	x
92	Station43/Barc05-123	123	CTD	x	x
93	Station44/Barc06-5	5	CTD	x	
94	Station44/Barc06-15	15	CTD	x	
95	Station44/Barc06-25	25	CTD	x	
96	Station44/Barc06-35	35	CTD	x	
97	Station44/Barc06-50	50	CTD	x	
98	Station44/Barc06-75	75	CTD	x	
99	Station44/Barc06-103	103	CTD	x	
100	Station45/Barc07-5	5	CTD	x	
101	Station45/Barc07-15	15	CTD	x	
102	Station45/Barc07-25	25	CTD	x	
103	Station45/Barc07-35	35	CTD	x	
104	Station45/Barc07-50	50	CTD	x	
105	Station45/Barc07-80	80	CTD	x	
106	Station46/Barc08-5	5	CTD	x	
107	Station46/Barc08-15	15	CTD	x	
108	Station46/Barc08-25	25	CTD	x	
109	Station46/Barc08-35	35	CTD	x	
110	Station46/Barc08-50	50	CTD	x	
111	Station46/Barc08-67	67	CTD	x	
112	Station47/Barc09-5	5	CTD	x	
113	Station47/Barc09-15	15	CTD	x	
114	Station47/Barc09-25	25	CTD	x	
115	Station47/Barc09-35	35	CTD	x	
116	Station47/Barc09-50	50	CTD	x	
117	Station47/Barc09-61	61	CTD	x	
118	Station48/Barc10-5	5	CTD	x	x
119	Station48/Barc10-15	15	CTD	x	x
120	Station48/Barc10-25	25	CTD	x	x
121	Station48/Barc10-35	35	CTD	x	x
122	Station48/Barc10-50	50	CTD	x	x
123	Station48/Barc010-57	57	CTD	x	x
124	Station52/H29-5	5	CTD	x	x
125	Station52/H29-15	15	CTD	x	x
126	Station52/H29-25	25	CTD	x	x
127	Station52/H29-35	35	CTD	x	x
128	Station52/H29-56	56	CTD	x	x
129	Station 57/H107-5	5	CTD	x	x
130	Station 57/H107-15	15	CTD	x	x
131	Station 57/H107-25	25	CTD	x	x
132	Station 57/H107-35	35	CTD	x	x
133	Station 57/H107-46	46	CTD	x	x
134	Station 58/H33-5	5	CTD	x	x
135	Station 58/H33-15	15	CTD	x	x
136	Station 58/H33-25	25	CTD	x	x
137	Station 58/H33-35	35	CTD	x	x

138	Station 58/H33-46	46	CTD	x	x
139	Station 63/H28-5	5	CTD	x	x
140	Station 63/H28-15	15	CTD	x	x
141	Station 63/H28-25	25	CTD	x	x
142	Station 63/H28-35	35	CTD	x	x
143	Station 63/H28-46	46	CTD	x	x
144	Station 64/H15-5	5	CTD	x	x
145	Station 64/H15-15	15	CTD	x	x
146	Station 64/H15-25	25	CTD	x	x
147	Station 64/H15-35	35	CTD	x	x
148	Station 64/H15-45	45	CTD	x	x
149	Station 65/H27-5	5	CTD	x	x
150	Station 65/H27-15	15	CTD	x	x
151	Station 65/H27-25	25	CTD	x	x
152	Station 65/H27-35	35	CTD	x	x
153	Station 65/H27-46	46	CTD	x	x
154	Station 72/H9-5	5	CTD	x	x
155	Station 72/H9-15	15	CTD	x	x
156	Station 72/H9-25	25	CTD	x	x
157	Station 72/H9-33	33	CTD	x	x
158	Station /H102-5	5	CTD	x	x
159	Station /H102-15	15	CTD	x	x
160	Station /H102-25	25	CTD	x	x
161	Station /H102-35	35	CTD	x	x
162	Station /H102-60	60	CTD	x	x
163	Healy_T1	5	Ship seawater	x	x
164	Healy_T2	5	Ship seawater	x	x
165	Healy_T3	5	Ship seawater	x	x
166	Healy_T4	5	Ship seawater	x	x
167	Healy_T5	5	Ship seawater	x	x
168	Healy_T6	5	Ship seawater	x	x
169	Healy_T7	5	Ship seawater	x	x
170	Healy_T8	5	Ship seawater	x	x
171	Healy_T9/station01	5	Ship seawater	x	x
172	Healy_T10	5	Ship seawater	x	x
173	Healy_T11	5	Ship seawater	x	x
174	Healy_T12	5	Ship seawater	x	x
175	Healy_T13/station 02/CBL11	5	Ship seawater	x	x
176	Healy_T14/station 03/H112	5	Ship seawater	x	x
177	Healy_T15/station 04/H114	5	Ship seawater	x	x
178	Healy_T16/ Station11/UTX1	5	Ship seawater	x	x
179	Healy_T17/ Station15/H7	5	Ship seawater	x	x
180	Healy_T18/ Station16/H17	5	Ship seawater	x	x
181	Healy_T19/ Station17/HS3	5	Ship seawater	x	x
182	Healy_T20/ Station18/UTX8	5	Ship seawater	x	x
183	Healy_T21/ Station19/UTX11	5	Ship seawater	x	x
184	Healy_T22/ Station25/CBL13	5	Ship seawater	x	x
185	Healy_T23/ station36/H111	5	Ship seawater	x	x

186	Healy_T24/ station37/H109	5	Ship seawater	x	x
187	Healy_T25/ station39/Barc01	5	Ship seawater	x	x
188	Healy_T26/ station43/Barc05	5	Ship seawater	x	x

Note: T-stations were collected along a transect from the Bering Strait towards Barrow Canyon.

Rosette Bottle Flushing Experiments During Healy Cruise HLY1301

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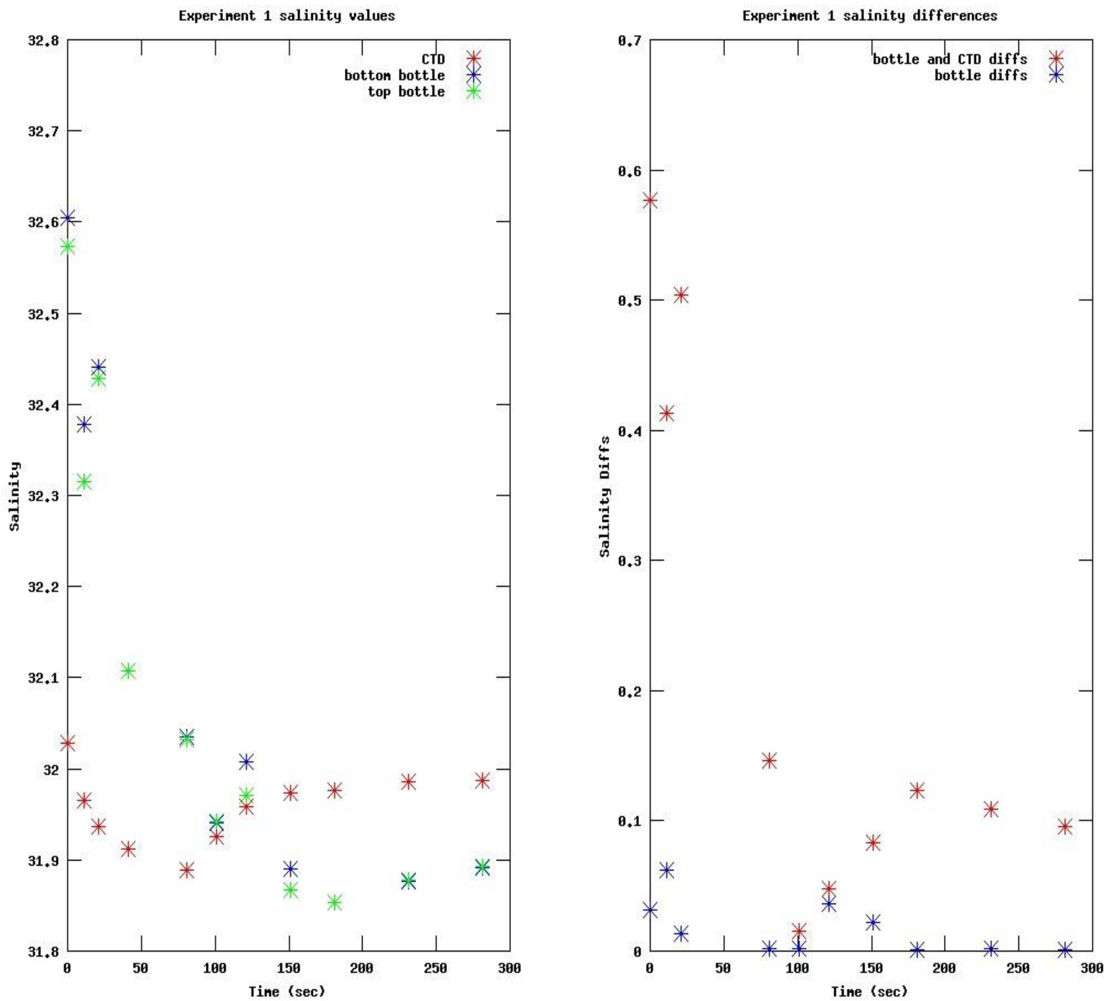
The overall goal of the experiments discussed here was to further understand sampling problems that attend collecting seawater with sampling bottles attached to a rosette. The focus of these experiments is to determine the optimum bottle flushing times required to acquire representative seawater samples. Five experiments were conducted. An underlying rationale for these experiments comes from previous findings that suggest significant issues with bottle flushing in the highly stratified waters of the Chukchi, and Beaufort Seas.

1. The first test was to stop the rosette in the middle of a strong halocline (identified on the downcast) on the upcast and begin tripping the bottles over a defined period of time.
2. The second test was identical to the first with the addition of a yo-yo effect at the prescribed depth to investigate the impact of ship roll on flushing.
3. The third test consisted of sampling at three depth levels: the well mixed bottom, the lower half of the halocline, and the upper half of the halocline; four bottles were tripped at each depth over a range of times.
4. The fourth test was identical to the third with the addition of a yo-yo effect, again to simulate ship role.
5. The fifth test focused on tripping the bottles while the rosette was still in motion. The rosette was deployed four separate times, each time with a decrease in upward velocity.

Table 1: Stations at which experiments were conducted..

Station/Cast #	**Station Name**	**Experiment**	**Station/Cast #**		
00501	HSNW60	1	06101		3
00701	NW2	2	06201		3
00801	HSNW50	5 (full speed)	06701		4
00901	NW3	5 (½ speed)	06901		3
02101	TW1	5 (¼ speed)	07001		3
02201	TW2	5 (□ speed)	07901		3
03802	H108	2			

Figure 1: Preliminary results for station 00501 (experiment 1). Water samples were taken from the bottom and top of each bottle.



HANNA SHOAL ECOSYSTEM STUDY 2013: Cruise Report

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Organic Contaminants and Lipid Biomarkers

As part of the chemical analysis of the COMIDA-Hanna Shoal Ecosystem Study project, a suite of samples have been collected during HLY-1301 cruise operations to expand our baseline analysis of organic contaminants (PAHs, n-alkanes) and lipid biomarkers of carbon flow in the Chukchi Sea. Sediments and particles for contaminant analysis were prioritized for areas which were not sampled during HLY-1201. Several sample types have been obtained over the study area. The first are particulate organic material collected onto combusted GF/F filters at several water column depths from each of the process station. Typically three water column depths in each process station were collected that include near surface (5m), the chlorophyll maximum and near bottom water (<5M off bottom). CTD profiles were used to capture the chlorophyll maximum and allowed the distinction of major water masses to be accurately determined at each site and guide collections. Sample sites are described in summary Table 1.

At all major process stations, bottom sediments were sampled using a box corer. The corer was highly successful (10 of 11 drops fired) with down core sections of sediment ranging from 16-28 cm below the sediment water interface obtained at 10 targeted process stations. All sediment samples were sectioned in 1 cm increments from 0-10 cm and 2 cm increments below to the bottom of each core. All down core sediment samples were split with the Trefry group for parallel measures of trace elements in sediments and biota. Appropriate blanks (air, water) were also collected in parallel to quantify background amounts and ship contamination. At the majority of process stations, the box core was subdivided to allow subcores for determination of oxygen penetration, Eh measures and pH with increasing sediment depth. At minor stations subsamples from double Van Veen grabs (surface 0-1cm) were obtained to intercalibrate with other measures, to link to faunal distributions and allow tighter spatial coverage if needed in the future. A summary of sediment samples collected is included in summary Table 1.

We continued to examine selected benthic fauna first collected as part of the COMIDA study to investigate organic contaminant concentrations and distributions in potential prey items for upper trophic level consumers. We targeted the northern Neptune whelk (*Neptunea heros*), which were collected opportunistically from epibenthic trawls conducted by the Konar team. Analysis of Neptunea foot muscle collected during the COMIDA 2009 and 2010 cruises revealed low concentrations of organic contaminants; yet natural product lipid biomarkers and compound-specific carbon isotope analysis suggested these organisms have a complex trophic status (Taylor and Harvey, in prep). The samples collected during HLY-1301 allow expansion to areas not collected during HLY-1201 with notably several larger animals obtained. Neptunea with shell size greater than 4 cm were previously targeted, but due to differences seen among size classes, organisms 2-4 cm were also collected during HLY1201. Neptunea samples collected during this expedition are summarized in the Table 1.

Protein turnover by native bacterial populations

At two stations during the cruise, incubations were established with bottom waters to examine rates of organic material turnover and the bacterial community associated with the process. Such information will be valuable not only for fundamental information on carbon cycling in the Hanna shoal system, but also should provide insight into the natural communities which are responsible. For these incubations water column phytoplankton >10μm were concentrated from the Chlorophyll maximum water column and used to supplement bottom waters to track protein as a major component of the total organic matter. We will use recent approaches for proteomic analysis developed by our group and others for marine particulate material to characterize the protein distribution of the bacterial fraction present over time. The hypothesis being tested is that the individual protein distribution present in bacterial populations will relate to the substrate being utilized and role in bacterial metabolism. Particulate samples were collected over 2 weeks to track both the changes during degradation of the particulate material present as well as the distribution of proteins present in the native bacterial community. A summary of the samples obtained are shown in Table 2.

Enzymatic hydrolysis of peptides as a function of clay concentration.

The remineralization rate of particulate organic matter can be affected by association with inorganic mineral phases. In most regions biogenic opal and calcium carbonate are the major particulate mineral phases in the water column. However, in specific ocean environments lithogenic mineral phases can be important. Terriginous input and redistribution of suspended sediments by dirty ice floes are two processes relevant to the Hanna Shoal region. A set of incubation experiments were conducted to quantify the degradation rate of natural particulate organic material by a representative bacterial community at in-situ temperature. Several treatments were conducted to test the effect of increasing concentrations of clay mineral phases on POM degradation along the cruise transect.

On August 31, fifty litres of seawater were sampled from the sub-surface chlorophyll maximum at station 001. The particulate material was concentrated via gravity filtration through a 5 um nylon mesh and this material was frozen to create a detrital carbon source. These particulate additions were made together with clay concentrations of 0, 1, 10, 100, 1000 mg L-1. These sampes were incubated with the <1 um bacterial community, sampled at the DCM, station H7. Samples for total POC and amino acids were taken every-day for an 8-day period to follow the change and composition of POM at in-situ temperatures.

The enzymatic hydrolysis of peptides was also determined as a function of increasing clay concentrations 0, 1, 10, 100, 1000 mg / L. Enzyme measurements were made at the following stations and depths :

(020) Station H3 – Deep chlorophyll maximum
(026) Station TW6 – Deep Chlorophyll maximum
(043) BARC5 – Deep Chlorophyll maximum
(063) Surface, DCM, 5 mab, box core water
(064) Surface, DCM, 5 mab
(073) Surface, DCM, 5 mab

Phycoerythrin and Cyanobacteria

Chemical analysis of a subset of water column particles collected from below the chlorophyll maximum as well as the underlying surface sediments obtained during the COMIDA 2009 cruise revealed an abundance of cyanobacteria-specific biomarkers (C2-methylated and saturated bacteriohopanetetrol-pentose; BHPs) in the Chukchi Sea. While contributions of cyanobacteria to the overall primary production in the Chukchi Sea are estimated to be low, their detection below the chlorophyll maximum suggests that they are more important in Arctic waters than previously thought, but it is not clear if they are long term residents previously unrecognized or more temperate species are moving northward as waters warm in summer. In order to further define and target cyanobacteria in the water column of the Chukchi Sea, a fluorometer that is specific for the cyanobacterial pigment, phycoerytherin was installed on the CTD during HLY1201 last year. Again for HLY1301 we tracked CTD profiles of phycoerythrin fluorescence throughout the water column with water samples also collected for analysis by the Ashjian group for estimates of cell counts by flow cytometry. Water from process stations at the depth of phycoerythrin maximum (typically also the chlorophyll maximum) was also collected onto filters for analysis of cyanobacterial specific membrane markers.

Ice algal growth and biomarkers of Ice extent

It's been proposed that specific species of diatoms which reside in ice (ice algae) synthesize a very specific group of lipids as highly branched isoprenoid (HBI) alkanes. These markers are very stable and should be retained in sediment and thus useful for paleo climatological reconstruction of seasonal ice coverage. Previous studies making this suggestion have been limited to the Canadian Arctic and one of our goals on last year's HLY 1201 cruise was collection of sea ice, water column, and sediment samples for further analysis of HBIs to compare previously reported data to the Chukchi Sea signature. These analyses are now being completed, but were limited due to the small samples of ice collected using a homemade basket hung over the side. During HLY-1301, we were fortunate to have Coast guard assistance to employ small boat operations to collect ice away from the ship. Using this operation, the Healy was able to break through an ice field to generate a number of small floes which could be sampled using small boat operations. Ice was collected among small floes, returned to the ship and shared among all interested PI groups for further study. In our case, ice samples were melted under refrigeration, samples concentrated by settling, and concentrated cellular debris either frozen as concentrates or placed on filters for future analysis.

Euphausiid Dynamics in the Chukchi Sea

Euphausiids are a large component of the diet of many marine mammals, including bowhead whales, residing in the Chukchi Sea. Understanding the food resources that they utilize in this region could provide chemical evidence for overwintering strategies in the steadily changing Arctic environment. One series of experiments were designed to determine detrital contribution to euphausiid diet via chemical examination of specific biomarkers. A single experiment number of field samples were conducted at one station (station 38) where adequate numbers of euphausiids were collected by the Ashjian group. This 24 hour experiment placed animals in filtered seawater to purge guts of any previously consumed materials. Animals were then collected individually and residual material filtered onto GF/F filters for lipid characterization.

Age and Diet History of Snow Crab Measurements

Snow crabs from the epibenthic trawls were sampled throughout the cruise for initial samples to determine dietary history and estimates of age. Eyes were removed from all crab samples obtained and flash frozen in liquid nitrogen for lab analysis of lipofuscin, a protein oxidation product that accumulates in neural tissues over time. Over the last decade we have developed biochemical approaches to quantify these products and apply them as proxies to estimate age for several crustaceans (e.g. blue crab and euphausiids). When used in conjunction with measures of known age animals, a calibration can be applied and age of natural populations determined. Although few samples were collected on this cruise (7 snow crabs), they will be a useful addition to animals collected during the HLY 2012 cruise.

In addition to estimates of age from neural tissues, a claw and leg from each crab were removed, flash frozen in LN2 and stored at 80°C for analysis in the laboratory. Extraction, identification, and quantification of lipids (especially fatty acids) present in the muscle tissue can provide insights into the dietary history of these benthic feeders over the range of stations sampled during the summer season.

Table 1. Summary of samples collected and inventory by Harvey and ODU team

Date		CTD Cast No.	Water	Water Depth (m)	Total Vol	Sediment (Box/Grab)	Sediment depth (cm)	Invertebrates Collected	Size (cm)
8/1/2013	BRS-5	_00102	Chl Max	7	15	-----	-----	-----	-----
8/2/2013	CBL-11	_00201	Chl Max	23	15	Van Veen Grab	0 to 1	*Neptunea*	4.85
								Neptunea	4.45
								Neptunea	5.07
								Neptunea	4.89
								Neptunea	4.83
								Neptunea	4.79
								Snow Crab	4.7
8/2/2013	H112	_00301	Surface	5	20	Box Core	0 to 28	Snow Crab	5.54
			Chl Max	25	20				
			Bottom	57	20				
8/3/2013	H114	_00401	Surface	5	20	-----	-----	-----	-----
			Chl Max	25	20				
			Bottom	67	20				
8/4/2013	H6	-----	-----	-----	-----	-----	-----	*Neptunea*	10.15
8/4/2013	H7	_01401	Surface	5	20	Box Core	0 to 18	-----	-----
			Chl Max	22	21				
			Bottom	32	20				
8/4/2013	H17	-----	-----	-----	-----	Van Veen Grab	0 to 1	*Neptunea*	11.4
								Snow Crab	6.34
8/5/2013	HS3	_01701	Surface	5	20	Box Core	0 to 16	*Neptunea*	4.30
			Chl Max	23	20				
			Bottom	36	20				
8/5/2013	UTX-8	-----	-----	-----	-----	Van Veen Grab	0 to 1	*Neptunea*	10.30
8/5/2013	UTX-11	_01901	Chl Max	24	20	-----	-----	-----	-----
8/6/2013	H3	_02001	Chl Max	23	8	-----	-----	-----	-----
8/6/2013	CBL-13	_02501	Surface	5	21	Box Core	0 to 20	-----	-----

			Chl Max	25	19				
			Bottom	46	20				
8/7/2013	H111	_03601	Surface	5	20	Box Core	0 to 12	-----	-----
			Chl Max	34	20				
			Bottom	106	20				
8/7/2013	H109	-----	-----			Van Veen Grab	0 to 1	-----	-----
8/7/2013	H108	_03801	Chl Max	25	21	Van Veen Grab	0 to 1	-----	-----
8/8/2013		_04301	Surface	5	18	Box Core	0 to 30	-----	-----
			Chl Max	45	19				
			Bottom	122	21				
8/9/2013	H29	_05201	Surface	5	21	Box Core	0 to 22	*Neptunea*	4.14
			Chl Max	24	21			*Neptunea*	4.03
			Bottom	56	21			Snow Crab	4.84
	H107	_05701	Surface	5	21	Box Core	0 to 16	-----	-----
			Chl Max	30	21				
			Bottom	47	20				
	CBL-15	-----	-----			-----	-----	*Neptunea*	8.30
	H33	-----	-----	-----	-----	Van Veen Grab	0 to 1	-----	-----
	H28	_06301	Surface	5	21	Box Core	0 to 24	*Neptunea*	12.60
			Chl Max	28	20				
			Bottom	46	19				
	H27	-----	-----	-----	-----	Box Core	0 to 30	-----	-----
	H9	-----	-----	-----	-----	-----	-----	*Neptunea*	5.38
	H34	-----	-----	-----	-----	Van Veen Grab	0 to 1	-----	-----
	H20	-----	-----	-----	-----	-----	-----	Snow Crab	6.1
	H102	-----	-----	-----	-----	Box Core	0 to 1	Snow Crab	6.7

HLY1301, Hanna Shoal Study

Plankton Abundance and Composition
Carin Ashjian and Robert G. Campbell, PIs
Samuel Laney, Collaborator

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The primary goal of our component is to describe the abundance and community composition of the mesozooplankton on Hanna Shoal and the association of those distributions with physical oceanographic features such as water mass and circulation. Other objectives include differentiation of the congeneric copepod species *Calanus glacialis* and *C. marshallae* using molecular techniques and an assessment of the metabolic condition of *Calanus* spp. in late summer for comparison with previous studies and to expand our understanding of the life history of this species. (*C. marshallae* and *C. glaclialis* cannot be differentiated reliably using morphometrics). We are particularly interested in describing the abundances and distributions of the large bodied *Calanus* spp. and euphausiids (krill) as they are key prey species for the planktivorous bowhead whale. Plankton on Hanna Shoal may comprise species of both Arctic and Bering Sea origin, since the dominant currents in the Chukchi Sea may advect Bering Sea species to the region. This year we also are describing the abundance and distribution of phytoplankton types and of the coccoid cyanobacteria *Synechococcus* using both a benchtop Imaging FlowCytobot adapted for shipboard use by S. Laney and an Accuri portable flow cytometer. A portion of this work is done in collaboration with Sam Laney (WHOI).

Mesozooplankton samples were collected at all regular stations and at selected high-resolution stations in conjunction with CTD sampling during the night. Night sampling was intended to capture krill, since these animals can easily see the nets during daylight and also remain near the sea floor during daytime, ascending into the water column to feed at night (diel vertical migration). Zooplankton were collected with vertical tows of a paired Bongo net frame equipped with 150 and 500 μm black mesh nets, flow meters, and a time-depth recorder. The nets also were equipped with a flashing strobe that was intended to stun or to impair the vision of krill, decreasing their ability to see the net and to escape and thereby increasing the effectiveness of the nets. Casts were conducted from surface to ~2 m off of the seafloor. Samples were preserved in 4% formalin seawater immediately following collection and will be enumerated in the laboratory for the abundance of the different taxa, species, and life stage once the samples are returned from Healy in November. Total biomass for each sample will be estimated using the non-destructive displacement volume method. At most locations, 1-2 additional net tows were conducted using a 1-m^2 ring net equipped with black 250 μm mesh, a time-depth recorder, a strobe, and a large non-filtering cod end. At a subset of locations, *C. glacialis/marshallae* from these tows were selected using microscopy and preserved in alcohol for genetic analysis or photographed (for later size determination) and frozen at -80°C for measurement of the RNA/DNA (a measure of metabolic activity). Plankton from these net tows were used also by the Dunton and Trefry groups.

We conducted Bongo net tows at 46 locations and 47 Ring net tows at 24 locations (Tables 1 & 2). Animals were picked using microscopy for genetic analysis and RNA/DNA, a measure of metabolic activity, at 23 locations (Table 3). Based on qualitative examinations of the samples, *Calanus glacialis/marshallae* were ubiquitous on the Shoal, with elevated abundances seen at the stations on the southern half of the Bank relative to those observed on the northern half of the Bank. The proportion of different life stages varied with location. Higher proportions of late stage copepodids were observed on the deeper portions of the southern and western Shoal. Barnacle nauplii were abundant on the crest of the shoal. Larvaceans and chaetognaths (*Sagitta* sp.) also were particularly abundant this year. At some locations, small medusa or ctenophores were abundant. Krill were collected in Barrow Canyon, where flow was to the NE, and in smaller quantities along the shelf-break to the north of Hanna Shoal at bottom depths greater than 180 m. This confirms our observations of last year that few krill are found on Hanna Shoal itself, but rather are found in surrounding water masses and currents. The Arctic copepod species *C. hyperboreus* was observed on the northern flank of Hanna Shoal and in the NE corner of our study area.

Water was collected for analysis of microplankton composition and abundance both from Niskin bottles during casts of the CTD/rosette system and also from the underway seawater sampling system. During the transit from Dutch Harbor to Hanna Shoal, samples were collected at hourly intervals over much of the transit. During the work on Hanna Shoal, samples were collected from all CTD casts conducted at process stations from the same standard depths (5, 15, 25, 35, 50, 75 m, 5 mab, and at the chlorophyll max) as the water that was collected for nutrients and chlorophyll analysis by the Grebmeier/Cooper team. Samples were kept in the dark at ~2°C until analyzed (time from collection to analysis was on the order of hours and did not exceed 12 hours). Samples were analyzed on board. Preliminary processing of the Cytobot data was conducted but taxonomic identification will not be conducted until return to the laboratory in Woods Hole. Preliminary processing of the flow cytometer data was conducted on board. Altogether 314 samples were collected and analyzed during the cruise.

Differences in abundance in the near-surface (5 m) samples analyzed with the flow cytometer were observed along the transect from Dutch Harbor to Hanna Shoal and the different taxonomic groups varied in the locations of their maximum abundance (Figures 3-5). Small phytoplankton (small photosynthetic eukaryotes) were most abundant in the Chukchi near Point Hope and in Barrow Canyon, while large phytoplankton (large photosynthetic eukaryotes) were most abundant in Bering Strait. *Synechococcus* was only infrequently observed and was most abundant off of Nunavik Island and in Barrow Canyon. Looking at distributions on Hanna Shoal and in Barrow Canyon, both small phytoplankton and *Synechococcus* were abundant only in Barrow Canyon, and *Synechococcus* was absent over much of the Bank, while large phytoplankton were ubiquitous across the shoal with regions of elevated abundance that included Barrow Canyon and the southern shoal (Figures 6-8). Small phytoplankton were most abundant in the warm Bering Sea water while large phytoplankton were most abundant in and above the winter water, likely blooming at the pycnocline (Figures 9-10). *Synechococcus* was present in Winter Water and in Bering Sea water or at the boundary between those two water types (Figure 11). Not surprisingly, large phytoplankton and *Synechococcus* were absent in the deeper warm, salty Atlantic type water seen in the Basin. *Synechococcus* were abundant in melted sea ice (not shown) but were not present in the cold, fresh ice melt seen near the surface at many stations.

Table 1. Stations at which Bongo Net tows were conducted during the cruise.

Station #	Station Name	Date (local)	Time (local) hour	Time (local) min	Latitude (Deg. N)	Longitude (Deg. W)	Bottom Depth (m)	Net Depth (m)
1	BRS5	8/1/2013	0	43	65.725	168.856	52.3	38
2	CBL11	8/2/2013	8	32	72.107	165.489	47.2	33
3	H112	8/2/2013	21	20	72.798	164.888	63.6	63
3	H112	8/2/2013	22	34	72.794	164.931	63.5	50
4	H114	8/3/2013	9	6	72.959	164.165	75.6	74
5	HSNW60	8/3/2013	13	15	72.681	164.551	57	55
8	HSW50	8/3/2013	17	55	72.528	164.153	52.8	49
11	HSW40	8/3/2013	22	0	72.270	163.569	43	41
12	UTX1	8/4/2013	0	53	72.060	164.157	41.5	23.8
14	H7	8/4/2013	9	35	72.113	162.774	40.1	34.7
15	H17	8/4/2013	16	44	71.986	163.405	41.3	36.9
16	CC1	8/5/2013	0	54	71.984	164.750	42	32.5
17	HS3	8/5/2013	7	14	71.943	162.699	42.1	33.6
18	UTX8	8/5/2013	15	2	71.728	163.457	38	36
19	UTX11	8/5/2013	21	0	71.459	162.615	43	41
20	H3	8/6/2013	4	8	71.870	162.057	42	43.4
23	TW3	8/6/2013	8	24	71.527	161.830	47.1	37.9
25	CBL13	8/6/2013	11	44	71.302	161.687	50	47.7
28	CBL14	8/7/2013	0	8	71.380	159.471	54.5	49.9
34	TW14	8/7/2013	5	45	71.187	158.651	96.5	90
36	H111	8/7/2013	8	23	71.248	158.897	113	106.2
37	H109	8/7/2013	14	6	71.501	159.513	53	47.7
38	H108	8/7/2013	20	14	71.611	159.389	54	50
39	BARC1	8/8/2013	6	47	71.250	157.217	51.6	40.11
41	BARC3	8/8/2013	10	37	71.335	157.323	96	91.1
43	BARC5	8/8/2013	14	27	71.424	157.544	128	112

45	BARC7	8/8/2013	21	45	71.507	157.689	85	83
47	BARC9	8/8/2013	22	43	71.578	157.858	67	58
50	CA2	8/9/2013	5	50	71.895	157.312	79	67.2
51	CA3	8/9/2013	7	38	71.912	157.817	70	60.7
52	H29	8/9/2013	10	56	71.930	158.332	66.2	58.5
53	H32	8/9/2013	19	33	71.778	159.018	54	54
54	H106	8/9/2013	23	54	71.758	159.600	53	46.6
55	CA4	8/10/2013	2	50	71.739	160.180	51	45.5
56	CBL15	8/10/2013	5	8	71.731	160.749	48	33.6
57	H107	8/10/2013	9	35	71.676	159.829	54.4	49.9
58	H33	8/10/2013	16	48	71.837	159.737	50	44
60	YF2	8/11/2013	1	8	72.137	159.527	47	43.4
62	YF4	8/11/2013	5	9	72.459	159.308	52	47.7
63	H28	8/11/2013	6	59	72.398	159.337	52.6	49.9
64	H15	8/11/2013	13	3	72.446	160.376	52.3	46
65	H27	8/11/2013	19	58	72.835	161.205	53	47
67	CP2	8/12/2013	1	18	72.629	161.108	51	47.7
69	CP4	8/12/2013	3	35	72.431	160.992	46.7	45.5
72	H9	8/12/2013	8	31	72.218	160.867	38	34.7
73	H34	8/12/2013	14	17	71.983	160.413	40	36

Table 2. Stations at which Ring Net tows were conducted during the cruise. TDR=Time Depth Recorder that was attached to the net to give the depth to which the net fished.

Station #	Station Name	Date (local)	Time (local) hour	min	Latitude (Deg. N)	Longitude (Deg. W)	Bottom Depth (m)	Net Depth (m)
2	CBL11	8/2/2013	8	3	72.108	-165.467	47.1	40
2	CBL11	8/2/2013	8	14	72.107	-165.474	47.1	39
3	H112	8/2/2013	22	54	72.793	-164.942	63.4	56
3	H112	8/2/2013	23	3	72.793	-164.948	63.4	55
12	UTX1	8/4/2013	1	16	72.049	-164.179	42.3	37.9
12	UTX1	8/4/2013	1	24	72.045	-164.184	41.9	37.9
14	H7	8/4/2013	9	36	72.115	-162.793	40.4	36.9
14	H7	8/4/2013	10	5	72.113	-162.797	40.6	32.5
15	H17	8/4/2013	16	44	71.982	-163.414	41.4	39
15	H17	8/4/2013	16	53	71.981	-163.419	41.3	34.7
17	HS3	8/5/2013	7	31	71.942	-162.709	42.1	35.8
17	HS3	8/5/2013	7	37	71.942	-162.713	41.8	35.8
18	UTX8	8/5/2013	15	17	71.727	-163.459	38	37
18	UTX8	8/5/2013	15	37	71.723	-163.460	38	37
19	UTX11	8/5/2013	21	18	71.459	-162.625	44	39
19	UTX11	8/5/2013	21	26	71.459	-162.629	47	38
25	CBL13	8/6/2013	12	1	71.305	-161.687	50	40.1

25	CBL13	8/6/2013	12	8	71.305	-161.686	50	44.4
34	TW14	8/7/2013	6	4	71.192	-158.651	96.6	90
36	H111	8/7/2013	8	38	71.248	-158.898	113.5	108.4
36	H111	8/7/2013	8	51	71.248	-158.899	113.9	106.2
37	H109	8/7/2013	14	21	71.501	-159.522	53	47.7
37	H109	8/7/2013	14	30	71.501	-159.527	53	45.5
38	H108	8/7/2013	20	28	71.609	-159.393	52	48
38	H108	8/7/2013	20	37	71.608	-159.395	53	46
41	BARC3	8/8/2013	10	54	71.335	-157.329	96.3	87.8
41	BARC3	8/8/2013	11	5	71.334	-157.333	96.6	84.5
43	BARC5	8/8/2013	14	52	71.432	-157.519	124	114
43	BARC5	8/8/2013	15	10	71.437	-157.507	126	110
47	BARC9	8/8/2013	23	43	71.582	-157.857	65.6	59.6
52	H29	8/9/2013	11	8	71.931	-158.333	61.6	57.4
52	H29	8/9/2013	11	16	71.930	-158.334	61.3	57.4
57	H107	8/10/2013	9	53	71.680	-159.843	53.1	48
57	H107	8/10/2013	10	1	71.682	-159.843	53.1	47.7
58	H33	8/10/2013	17	1	71.836	-159.741	51	41
58	H33	8/10/2013	17	8	71.835	-159.743	51	51
58	H33	8/10/2013	17	21	71.834	-159.746	51	47
63	H28	8/11/2013	7	13	72.398	-159.342	54.4	49.9
63	H28	8/11/2013	7	22	72.398	-159.344	52.5	45.5
64	H15	8/11/2013	13	18	72.447	-160.377	51.6	42
64	H15	8/11/2013	13	25	72.447	-160.378	51.1	43
65	H27	8/11/2013	20	13	72.837	-161.211	52	49
65	H27	8/11/2013	20	22	72.837	-161.213	52	48
72	H9	8/12/2013	8	44	72.219	-160.869	37.4	32.5
72	H9	8/12/2013	8	50	72.219	-160.871	37.9	33.6
73	H34	8/12/2013	14	36	71.984	-160.411	40	35
73	H34	8/12/2013	14	41	71.986	-160.410	40.1	33

Table 3. Locations at which animals were picked for genetic and RNA/DNA analysis. For genetics, animals were picked either in batches of ~50 of individual stage that were preserved together in EtOH or as individuals that were photographed for later size determination and preserved in vials containing EtOH. Several “bulk” samples also were collected and preserved in EtOH from which animals of particular species and life stages can later be sorted microscopically for analysis

Station	Station Name	EtOH *Calanus*	Scint Krill	EtOH Indiv. *Calanus*	RNA/DNA	Bulk
1	BRS5	x				
2	CBL11	x	x			
3	H112	x				
4	H114	x	x			
12	UTX1		x	x		x
14	H7	x				
15	H17	x				
17	HS3	x	x			
19	UTX11				x	
25	CBL13	x			x	
34	TW14	x	x		x	
36	H111	x	x			
38	H108					x
41	BARC3					x
43	BARC5		x		x	x
52	H29	x			X	
57	H107	x				
58	H33		x			x
63	H28		x	x		
64	H15	x	x			
65	H27	x				
72	H9	x				
95	H103					x

Table 4. Locations on Hanna Shoal at which water samples were collected for analysis using desktop imaging Flow CytoBot and the Accuri flow cytometer.

Date (Local)	Time (Local)	Station Number	Station Name	Source	Depth (m)	Latitude	Longitude
7/29/2013	913	N/A	N/A	Science Seawater	5	57.675	167.557
7/29/2013	2127	N/A	N/A	Science Seawater	5	54.980	166.739
7/29/2013	2254	N/A	N/A	Science Seawater	5	55.312	166.836
7/30/2013	435	N/A	N/A	Science Seawater	5	56.638	167.235
7/30/2013	600	N/A	N/A	Science Seawater	5	56.959	167.334
7/30/2013	700	N/A	N/A	Science Seawater	5	57.181	167.403
7/30/2013	811	N/A	N/A	Science Seawater	5	57.444	167.484
7/30/2013	1609	N/A	N/A	Science Seawater	5	59.369	168.102
7/30/2013	1712	N/A	N/A	Science Seawater	5	59.555	168.164
7/30/2013	1810	N/A	N/A	Science Seawater	5	59.775	168.237
7/30/2013	1911	N/A	N/A	Science Seawater	5	59.996	168.311
7/30/2013	2012	N/A	N/A	Science Seawater	5	60.201	168.380
7/30/2013	2113	N/A	N/A	Science Seawater	5	60.366	168.386
7/30/2013	2214	N/A	N/A	Science Seawater	5	60.531	168.389
7/30/2013	2309	N/A	N/A	Science Seawater	5	60.666	168.391
7/31/2013	0	N/A	N/A	Science Seawater	5	60.852	168.395
7/31/2013	358	N/A	N/A	Science Seawater	5	61.661	168.410
7/31/2013	500	N/A	N/A	Science Seawater	5	61.836	168.413
7/31/2013	600	N/A	N/A	Science Seawater	5	62.005	168.416
7/31/2013	700	N/A	N/A	Science Seawater	5	62.173	168.419
7/31/2013	800	N/A	N/A	Science Seawater	5	62.324	168.422
7/31/2013	900	N/A	N/A	Science Seawater	5	62.547	168.426
7/31/2013	1000	N/A	N/A	Science Seawater	5	62.774	168.430
7/31/2013	1100	N/A	N/A	Science Seawater	5	62.996	168.434
7/31/2013	1200	N/A	N/A	Science Seawater	5	63.212	168.440
7/31/2013	1300	N/A	N/A	Science Seawater	5	63.444	168.464
7/31/2013	1401	N/A	N/A	Science Seawater	5	63.687	168.496
7/31/2013	1500	N/A	N/A	Science Seawater	5	63.902	168.525
7/31/2013	1600	N/A	N/A	Science Seawater	5	64.140	168.558
7/31/2013	1700	N/A	N/A	Science Seawater	5	64.380	168.591
7/31/2013	1808	N/A	N/A	Science Seawater	5	64.653	168.630
7/31/2013	1900	N/A	N/A	Science Seawater	5	64.848	168.657
7/31/2013	2000	N/A	N/A	Science Seawater	5	65.079	168.701
7/31/2013	2100	N/A	N/A	Science Seawater	5	65.337	168.778
7/31/2013	2200	N/A	N/A	Science Seawater	5	65.578	168.850
8/1/2013	10	1	BRS5	Niskin	35	65.719	168.873
8/1/2013	10	1	BRS6	Niskin	47	65.719	168.873

8/1/2013	10	1	BRS7	Niskin	25	65.719	168.873
8/1/2013	10	1	BRS8	Niskin	15	65.719	168.873
8/1/2013	10	1	BRS9	Niskin	5	65.719	168.873
8/1/2013	300	N/A	N/A	Science Seawater	5	66.104	168.743
8/1/2013	400	N/A	N/A	Science Seawater	5	66.331	168.784
8/1/2013	510	N/A	N/A	Science Seawater	5	66.592	168.969
8/1/2013	600	N/A	N/A	Science Seawater	5	66.786	168.910
8/1/2013	700	N/A	N/A	Science Seawater	5	67.044	168.833
8/1/2013	800	N/A	N/A	Science Seawater	5	67.285	168.760
8/1/2013	900	N/A	N/A	Science Seawater	5	67.504	168.692
8/1/2013	1000	N/A	N/A	Science Seawater	5	67.738	168.620
8/1/2013	1100	N/A	N/A	Science Seawater	5	67.954	168.552
8/1/2013	1200	N/A	N/A	Science Seawater	5	68.159	168.488
8/1/2013	1300	N/A	N/A	Science Seawater	5	68.335	168.431
8/1/2013	1400	N/A	N/A	Science Seawater	5	68.573	168.355
8/1/2013	1500	N/A	N/A	Science Seawater	5	68.805	168.183
8/1/2013	1400	N/A	N/A	Science Seawater	5	68.573	168.355
8/1/2013	1500	N/A	N/A	Science Seawater	5	68.805	168.183
8/1/2013	1600	N/A	N/A	Science Seawater	5	69.032	168.008
8/1/2013	1700	N/A	N/A	Science Seawater	5	69.264	167.826
8/1/2013	1800	N/A	N/A	Science Seawater	5	69.495	167.644
8/1/2013	1900	N/A	N/A	Science Seawater	5	69.724	167.462
8/1/2013	2000	N/A	N/A	Science Seawater	5	69.956	167.274
8/1/2013	2100	N/A	N/A	Science Seawater	5	70.188	167.085
8/1/2013	2200	N/A	N/A	Science Seawater	5	70.419	166.895
8/1/2013	2300	N/A	N/A	Science Seawater	5	70.631	166.717
8/2/2013	6	N/A	N/A	Science Seawater	5	70.848	166.534
8/2/2013	100	N/A	N/A	Science Seawater	5	71.021	166.387
8/2/2013	206	N/A	N/A	Science Seawater	5	71.248	166.192
8/2/2013	303	N/A	N/A	Science Seawater	5	71.439	166.026
8/2/2013	415	N/A	N/A	Science Seawater	5	71.672	165.822
8/2/2013	500	N/A	N/A	Science Seawater	5	71.810	165.700
8/2/2013	719	2	CBL11	Niskin	35	72.110	165.434
8/2/2013	719	2	CBL11	Niskin	39.2	72.110	165.434
8/2/2013	719	2	CBL11	Niskin	25	72.110	165.434
8/2/2013	719	2	CBL11	Niskin	23	72.110	165.434
8/2/2013	719	2	CBL11	Niskin	15	72.110	165.434
8/2/2013	719	2	CBL11	Niskin	5	72.110	165.434
8/2/2013	1833	N/A	N/A	Science Seawater	5	72.629	165.028
8/2/2013	1938	N/A	N/A	Science Seawater	5	72.722	164.938
8/2/2013	2034	3	H112	Niskin	57.03	72.799	164.877
8/2/2013	2034	3	H112	Niskin	50	72.799	164.877
8/2/2013	2034	3	H112	Niskin	35	72.799	164.877

8/2/2013	2034	3	H112	Niskin	25	72.799	164.877
8/2/2013	2034	3	H112	Niskin	24.9	72.799	164.877
8/2/2013	2034	3	H112	Niskin	15	72.799	164.877
8/2/2013	2034	3	H112	Niskin	5	72.799	164.877
8/3/2013	505	N/A	N/A	Science Seawater	5	72.834	164.718
8/3/2013	612	N/A	N/A	Science Seawater	5	72.859	164.559
8/3/2013	730	4	H114	Niskin	35	72.878	164.139
8/3/2013	730	4	H114	Niskin	65.95	72.878	164.139
8/3/2013	730	4	H114	Niskin	50	72.878	164.139
8/3/2013	730	4	H114	Niskin	25	72.878	164.139
8/3/2013	730	4	H114	Niskin	25	72.878	164.139
8/3/2013	730	4	H114	Niskin	15	72.878	164.139
8/3/2013	730	4	H114	Niskin	5	72.878	164.139
8/3/2013	1102	N/A	N/A	Science Seawater	5	72.836	164.357
8/3/2013	1206	N/A	N/A	Science Seawater	5	72.726	164.488
8/3/2013	1308	N/A	N/A	Science Seawater	5	72.681	164.547
8/3/2013	1412	N/A	N/A	Science Seawater	5	72.653	164.425
8/3/2013	1944	N/A	N/A	Science Seawater	5	72.431	163.888
8/3/2013	2125	N/A	N/A	Science Seawater	5	72.285	163.584
8/3/2013	2242	N/A	N/A	Science Seawater	5	72.233	163.696
8/4/2013	58	12	UTX1	Niskin	5mab	72.065	164.124
8/4/2013	58	12	UTX1	Niskin	35	72.065	164.124
8/4/2013	58	12	UTX1	Niskin	25	72.065	164.124
8/4/2013	58	12	UTX1	Niskin	ChlMax	72.065	164.124
8/4/2013	58	12	UTX1	Niskin	15	72.065	164.124
8/4/2013	58	12	UTX1	Niskin	5	72.065	164.124
8/4/2013	502	N/A	N/A	Science Seawater	5	72.114	163.869
8/4/2013	604	N/A	N/A	Science Seawater	5	72.153	163.613
8/4/2013	907	14	H7	Niskin	25	72.117	162.741
8/4/2013	907	14	H7	Niskin	5mab	72.117	162.741
8/4/2013	907	14	H7	Niskin	ChlMax	72.117	162.741
8/4/2013	907	14	H7	Niskin	15	72.117	162.741
8/4/2013	907	14	H7	Niskin	5	72.117	162.741
8/4/2013	1545	15	H12	Niskin	32.9	71.992	163.385
8/4/2013	1545	15	H12	Niskin	25.5	71.992	163.385
8/4/2013	1545	15	H12	Niskin	25.5	71.992	163.385
8/4/2013	1545	15	H12	Niskin	15	71.992	163.385
8/4/2013	1545	15	H12	Niskin	5	71.992	163.385
8/4/2013	2206	N/A	N/A	Science Seawater	5	72.011	163.461
8/4/2013	2304	N/A	N/A	Science Seawater	5	71.993	163.953
8/5/2013	0	N/A	N/A	Science Seawater	5	71.989	164.484
8/5/2013	112	N/A	N/A	Science Seawater	5	71.982	164.745
8/5/2013	218	N/A	N/A	Science Seawater	5	71.965	164.170
8/5/2013	309	N/A	N/A	Science Seawater	5	71.958	164.700
8/5/2013	402	N/A	N/A	Science Seawater	5	71.951	163.408

8/5/2013	502	N/A	N/A	Science Seawater	5	71.940	163.041
8/5/2013	629	17	HS3	Niskin	25	71.943	162.668
8/5/2013	629	17	HS3	Niskin	35.83	71.943	162.668
8/5/2013	629	17	HS3	Niskin	22.66	71.943	162.668
8/5/2013	629	17	HS3	Niskin	15	71.943	162.668
8/5/2013	629	17	HS3	Niskin	5	71.943	162.668
8/5/2013	1430	18	UTX8	Niskin	33	71.733	163.446
8/5/2013	1430	18	UTX8	Niskin	25	71.733	163.446
8/5/2013	1430	18	UTX8	Niskin	21	71.733	163.446
8/5/2013	1430	18	UTX8	Niskin	15	71.733	163.446
8/5/2013	1430	18	UTX8	Niskin	5	71.733	163.446
8/5/2013	1225	N/A	N/A	Science Seawater	5	71.739	162.436
8/5/2013	1336	N/A	N/A	Science Seawater	5	71.734	162.978
8/5/2013	2037	19	UTX11	Niskin	38.97	71.459	162.599
8/5/2013	2037	19	UTX11	Niskin	35	71.459	162.599
8/5/2013	2037	19	UTX11	Niskin	24.2	71.459	162.599
8/5/2013	2037	19	UTX11	Niskin	15	71.459	162.599
8/5/2013	2037	19	UTX11	Niskin	5	71.459	162.599
8/5/2013	1900	N/A	N/A	Science Seawater	5	71.581	162.990
8/6/2013	123	N/A	N/A	Science Seawater	5	71.602	162.415
8/6/2013	213	N/A	N/A	Science Seawater	5	71.707	162.251
8/6/2013	323	N/A	N/A	Science Seawater	5	71.833	162.087
8/6/2013	400	N/A	N/A	Science Seawater	5	71.870	162.050
8/6/2013	518	21	TW1	Science Seawater	5	71.752	161.978
8/6/2013	550	21	TW1	Niskin	24	71.751	161.989
8/6/2013	550	21	TW1	Niskin	23	71.751	161.989
8/6/2013	550	21	TW1	Niskin	22	71.751	161.989
8/6/2013	600	N/A	N/A	Science Seawater	5	71.722	161.993
8/6/2013	715	N/A	N/A	Niskin	22	71.639	161.915
8/6/2013	715	N/A	N/A	Niskin	21	71.639	161.915
8/6/2013	715	N/A	N/A	Niskin	20	71.639	161.915
8/6/2013	1055	N/A	N/A	Niskin	25	71.298	161.676
8/6/2013	1055	N/A	N/A	Niskin	45	71.298	161.676
8/6/2013	1055	N/A	N/A	Niskin	35	71.298	161.676
8/6/2013	1055	N/A	N/A	Niskin	25.7	71.298	161.676
8/6/2013	1055	N/A	N/A	Niskin	15	71.298	161.676
8/6/2013	1055	N/A	N/A	Niskin	5	71.298	161.676
8/6/2013	813	N/A	N/A	Science Seawater	5	71.456	161.785
8/6/2013	2107	27	TW7	Niskin	21	71.352	160.223
8/6/2013	2107	27	TW7	Niskin	20	71.352	160.223
8/6/2013	2107	27	TW7	Niskin	19	71.352	160.223
8/6/2013	2107	27	TW7	Niskin	10	71.352	160.223
8/6/2013	1730	N/A	N/A	Science Seawater	5	71.310	161.460
8/6/2013	1840	N/A	N/A	Science Seawater	5	71.325	160.973

8/6/2013	1910	N/A	N/A	Science Seawater	5	71.335	160.576
8/6/2013	2014	N/A	N/A	Science Seawater	5	71.354	160.228
8/7/2013	103	N/A	N/A	Science Seawater	5	71.370	159.404
8/7/2013	224	N/A	N/A	Science Seawater	5	71.331	159.283
8/7/2013	300	N/A	N/A	Science Seawater	5	71.312	159.205
8/7/2013	400	N/A	N/A	Science Seawater	5	71.271	159.025
8/7/2013	504	N/A	N/A	Science Seawater	5	71.197	158.711
8/7/2013	1328	N/A	N/A	Science Seawater	5	71.435	159.332
8/7/2013	334	32	TW11	Niskin	28.75	71.289	159.099
8/7/2013	334	32	TW11	Niskin	27.73	71.289	159.099
8/7/2013	334	32	TW11	Niskin	26.74	71.289	159.099
8/7/2013	752	36	H111	Niskin	53	71.240	158.892
8/7/2013	752	36	H111	Niskin	106.1	71.240	158.892
8/7/2013	752	36	H111	Niskin	75	71.240	158.892
8/7/2013	752	36	H111	Niskin	35	71.240	158.892
8/7/2013	752	36	H111	Niskin	34	71.240	158.892
8/7/2013	752	36	H111	Niskin	25	71.240	158.892
8/7/2013	752	36	H111	Niskin	15	71.240	158.892
8/7/2013	752	36	H111	Niskin	5	71.240	158.892
8/7/2013	1430	37	H109	Niskin	45.6	71.503	159.492
8/7/2013	1430	37	H109	Niskin	31.2	71.503	159.492
8/7/2013	1430	37	H109	Niskin	25	71.503	159.492
8/7/2013	1430	37	H109	Niskin	15	71.503	159.492
8/7/2013	1430	37	H109	Niskin	5	71.503	159.492
8/7/2013	2037	38	H108	Niskin	47.1	71.612	159.367
8/7/2013	2037	38	H108	Niskin	26.75	71.612	159.367
8/7/2013	2037	38	H108	Niskin	25	71.612	159.367
8/7/2013	2037	38	H108	Niskin	15	71.612	159.367
8/7/2013	2037	38	H108	Niskin	5	71.612	159.367
8/8/2013	612	39	BARC1	Niskin	45	71.253	157.194
8/8/2013	612	39	BARC1	Niskin	35	71.253	157.194
8/8/2013	612	39	BARC1	Niskin	25	71.253	157.194
8/8/2013	612	39	BARC1	Niskin	15	71.253	157.194
8/8/2013	612	39	BARC1	Niskin	5	71.253	157.194
8/8/2013	1005	41	BARC3	Niskin	88.2	71.334	157.311
8/8/2013	1005	41	BARC3	Niskin	75	71.334	157.311
8/8/2013	1005	41	BARC3	Niskin	50	71.334	157.311
8/8/2013	1005	41	BARC3	Niskin	35	71.334	157.311
8/8/2013	1005	41	BARC3	Niskin	25	71.334	157.311
8/8/2013	1005	41	BARC3	Niskin	15	71.334	157.311
8/8/2013	1005	41	BARC3	Niskin	5	71.334	157.311
8/8/2013	1344	43	BARC5	Niskin	121.7	71.405	157.487
8/8/2013	1344	43	BARC5	Niskin	90	71.405	157.487
8/8/2013	1344	43	BARC5	Niskin	75	71.405	157.487
8/8/2013	1344	43	BARC5	Niskin	44.5	71.405	157.487

8/8/2013	1344	43	BARC5	Niskin	35	71.405	157.487
8/8/2013	1344	43	BARC5	Niskin	25	71.405	157.487
8/8/2013	1344	43	BARC5	Niskin	15	71.405	157.487
8/8/2013	1344	43	BARC5	Niskin	5	71.405	157.487
8/8/2013	1911	45	BARC7	Niskin	80	71.504	157.639
8/8/2013	1911	45	BARC7	Niskin	75	71.504	157.639
8/8/2013	1911	45	BARC7	Niskin	50	71.504	157.639
8/8/2013	1911	45	BARC7	Niskin	35	71.504	157.639
8/8/2013	1911	45	BARC7	Niskin	21.21	71.504	157.639
8/8/2013	1911	45	BARC7	Niskin	15	71.504	157.639
8/8/2013	1911	45	BARC7	Niskin	5	71.504	157.639
8/8/2013	2153	47	BARC9	Niskin	61.13	71.582	157.824
8/8/2013	2153	47	BARC9	Niskin	50	71.582	157.824
8/8/2013	2153	47	BARC9	Niskin	35	71.582	157.824
8/8/2013	2153	47	BARC9	Niskin	25	71.582	157.824
8/8/2013	2153	47	BARC9	Niskin	23.85	71.582	157.824
8/8/2013	2153	47	BARC9	Niskin	15	71.582	157.824
8/8/2013	2153	47	BARC9	Niskin	5	71.582	157.824
8/9/2013	1030	52	H29	Niskin	25	71.930	158.331
8/9/2013	1030	52	H29	Niskin	55.8	71.930	158.331
8/9/2013	1030	52	H29	Niskin	50	71.930	158.331
8/9/2013	1030	52	H29	Niskin	35	71.930	158.331
8/9/2013	1030	52	H29	Niskin	24.9	71.930	158.331
8/9/2013	1030	52	H29	Niskin	15	71.930	158.331
8/9/2013	1030	52	H29	Niskin	5	71.930	158.331
8/9/2013	2319	54	H106	Niskin	47.5	71.757	159.592
8/9/2013	2319	54	H106	Niskin	35	71.757	159.592
8/9/2013	2319	54	H106	Niskin	29.8	71.757	159.592
8/9/2013	2319	54	H106	Niskin	25	71.757	159.592
8/9/2013	2319	54	H106	Niskin	15	71.757	159.592
8/9/2013	2319	54	H106	Niskin	5	71.757	159.592
8/10/2013	900	57	H107	Niskin	25	71.668	159.806
8/10/2013	900	57	H107	Niskin	46.9	71.668	159.806
8/10/2013	900	57	H107	Niskin	35	71.668	159.806
8/10/2013	900	57	H107	Niskin	29.5	71.668	159.806
8/10/2013	900	57	H107	Niskin	15	71.668	159.806
8/10/2013	900	57	H107	Niskin	5	71.668	159.806
8/10/2013	1445	58	H33	Niskin	45.5	71.882	159.697
8/10/2013	1445	58	H33	Niskin	35	71.882	159.697
8/10/2013	1445	58	H33	Niskin	25	71.882	159.697
8/10/2013	1445	58	H33	Niskin	17.4	71.882	159.697
8/10/2013	1445	58	H33	Niskin	15	71.882	159.697
8/10/2013	1445	58	H33	Niskin	5	71.882	159.697
8/10/2013	1630	58	H33	Sea Ice	NA	71.882	159.697

8/10/2013	1630	58	H33	Sea Ice	NA	71.882	159.697
8/11/2013	617	63	H28	Niskin	25	72.393	159.325
8/11/2013	617	63	H28	Niskin	46.4	72.393	159.325
8/11/2013	617	63	H28	Niskin	35	72.393	159.325
8/11/2013	617	63	H28	Niskin	27.8	72.393	159.325
8/11/2013	617	63	H28	Niskin	15	72.393	159.325
8/11/2013	617	63	H28	Niskin	5	72.393	159.325
8/11/2013	1233	64	H15	Niskin	44.3	72.444	160.376
8/11/2013	1233	64	H15	Niskin	35	72.444	160.376
8/11/2013	1233	64	H15	Niskin	23.2	72.444	160.376
8/11/2013	1233	64	H15	Niskin	15	72.444	160.376
8/11/2013	1233	64	H15	Niskin	5	72.444	160.376
8/11/2013	1925	65	H27	Niskin	46.8	72.831	161.192
8/11/2013	1925	65	H27	Niskin	35	72.831	161.192
8/11/2013	1925	65	H27	Niskin	27.8	72.831	161.192
8/11/2013	1925	65	H27	Niskin	25	72.831	161.192
8/11/2013	1925	65	H27	Niskin	15	72.831	161.192
8/11/2013	1925	65	H27	Niskin	5	72.831	161.192
8/12/2013	753	72	H9	Niskin	25	72.213	160.861
8/12/2013	753	72	H9	Niskin	32.5	72.213	160.861
8/12/2013	753	72	H9	Niskin	23.8	72.213	160.861
8/12/2013	753	72	H9	Niskin	15	72.213	160.861
8/12/2013	753	72	H9	Niskin	5	72.213	160.861
8/12/2013	1402	73	H34	Niskin	35.4	71.981	160.414
8/12/2013	1402	73	H34	Niskin	25	71.981	160.414
8/12/2013	1402	73	H34	Niskin	21.9	71.981	160.414
8/12/2013	1402	73	H34	Niskin	15	71.981	160.414
8/12/2013	1402	73	H34	Niskin	5	71.981	160.414
8/13/2013	610	81	H102	Niskin	50	72.202	158.431
8/13/2013	610	81	H102	Niskin	54.1	72.202	158.431
8/13/2013	610	81	H102	Niskin	35	72.202	158.431
8/13/2013	610	81	H102	Niskin	25	72.202	158.431
8/13/2013	610	81	H102	Niskin	25.6	72.202	158.431
8/13/2013	610	81	H102	Niskin	15	72.202	158.431
8/13/2013	610	81	H102	Niskin	5	72.202	158.431
8/13/2013	1450	86	RP5	Science Seawater	5	72.305	157.699
8/13/2013	1608	87	RP6	Science Seawater	5	72.328	157.526
8/13/2013	1720	88	RP7	Science Seawater	5	72.355	157.388
8/13/2013	1840	89	RP8	Science Seawater	5	72.376	157.225
8/13/2013	2040	91	RP10	Science Seawater	5	72.419	156.933
8/13/2013	2304	93	RP12	Science Seawater	5	72.461	156.630
8/14/2013	37	94	RP13	Science Seawater	5	72.489	156.476
8/14/2013	145	95	H103	Niskin	1614	72.505	156.354
8/14/2013	145	95	H103	Niskin	1400	72.505	156.354

8/14/2013	145	95	H103	Niskin 1200	72.505	156.354
8/14/2013	145	95	H103	Niskin 1100	72.505	156.354
8/14/2013	145	95	H103	Niskin 800	72.505	156.354
8/14/2013	145	95	H103	Niskin 600	72.505	156.354
8/14/2013	145	95	H103	Niskin 400	72.505	156.354
8/14/2013	145	95	H103	Niskin 200	72.505	156.354
8/14/2013	145	95	H103	Niskin 150	72.505	156.354
8/14/2013	145	95	H103	Niskin 100	72.505	156.354
8/14/2013	145	95	H103	Niskin 75	72.505	156.354
8/14/2013	145	95	H103	Niskin 50	72.505	156.354
8/14/2013	145	95	H103	Niskin 25	72.505	156.354
8/14/2013	145	95	H103	Niskin 5	72.505	156.354

Figure 1. Locations of stations at which net tows were collected. Bongo nets were used at all stations; Ring nets were used at a subset of the locations (See Table 2). Ship track from the 150 kHz nb ADCP data.

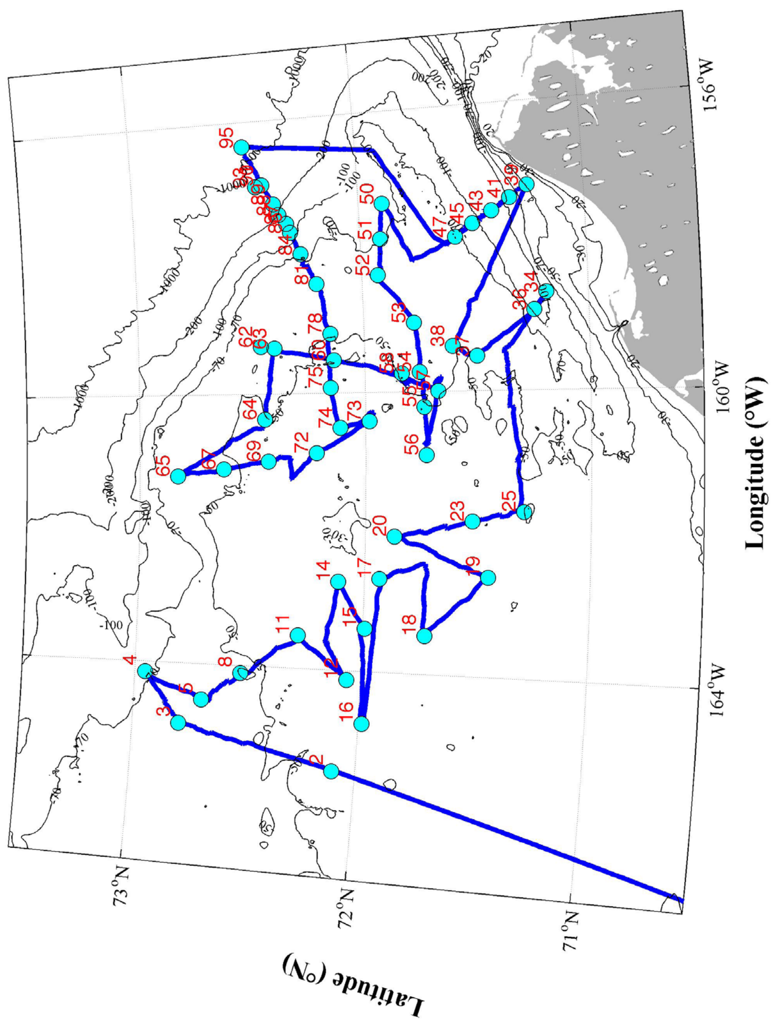


Figure 2. Locations where water samples were collected using either the CTD or the underway science seawater system for analysis in the desktop imaging Flow Cytobot and the flow cytometer.

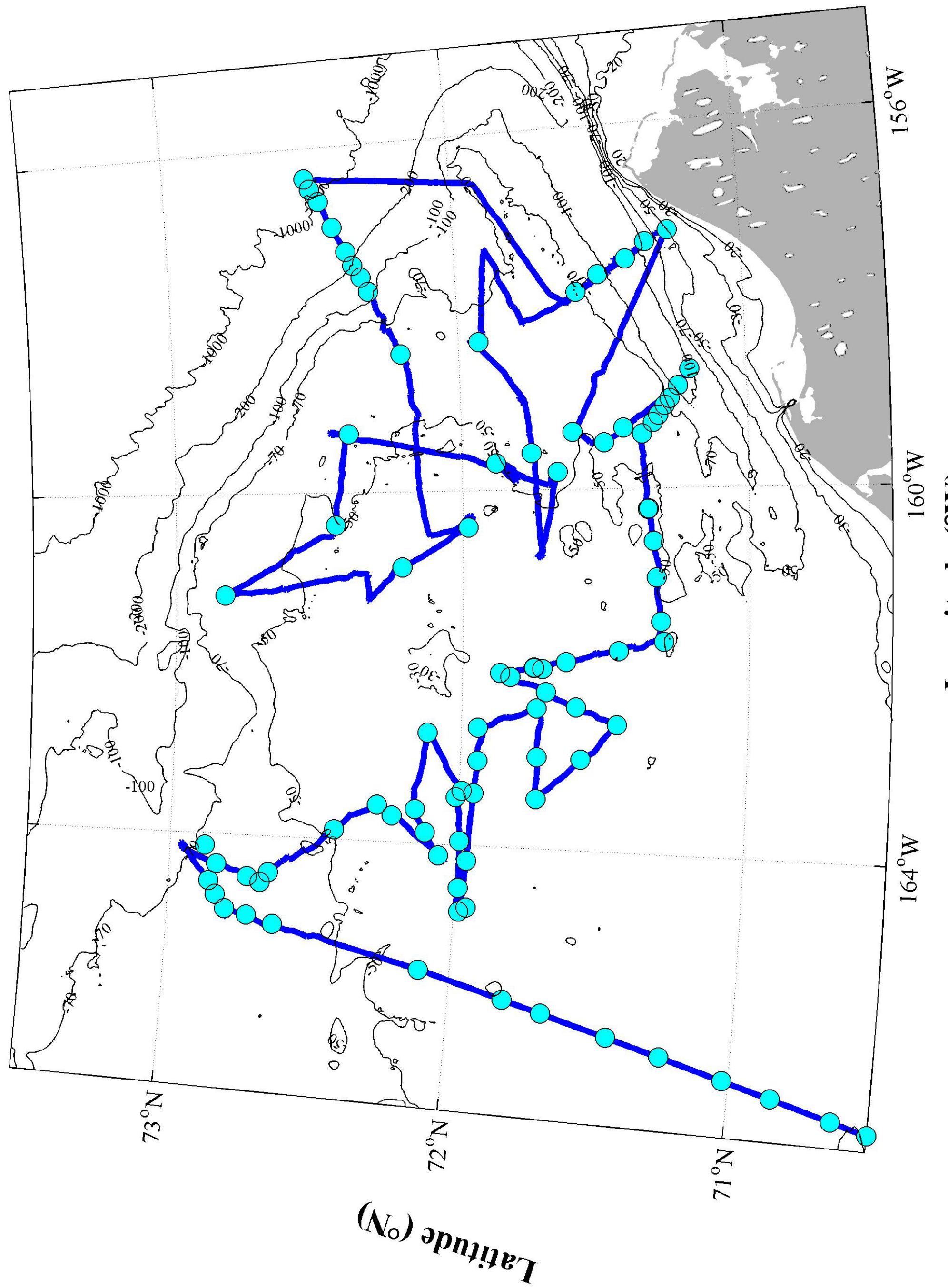


Figure 3. Abundances of small photosynthetic eukaryotes at 5 m during the transit from Dutch Harbor to Hanna Shoal from water collected from the underway science seawater system. (Data are preliminary)

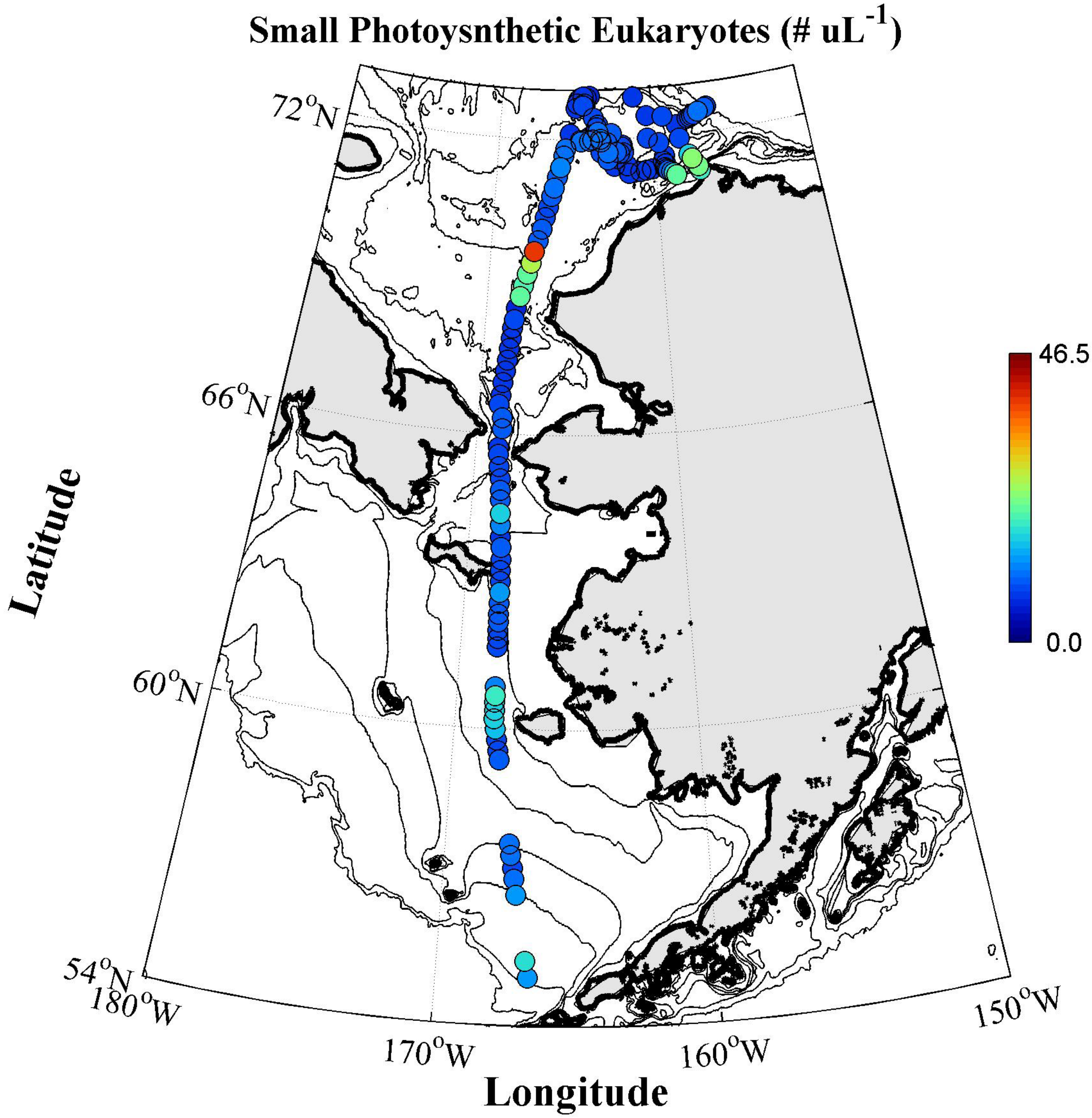


Figure 4. Abundances of large photosynthetic eukaryotes at 5 m from water collected using Niskin bottles or from the underway science seawater system. (Data are preliminary)

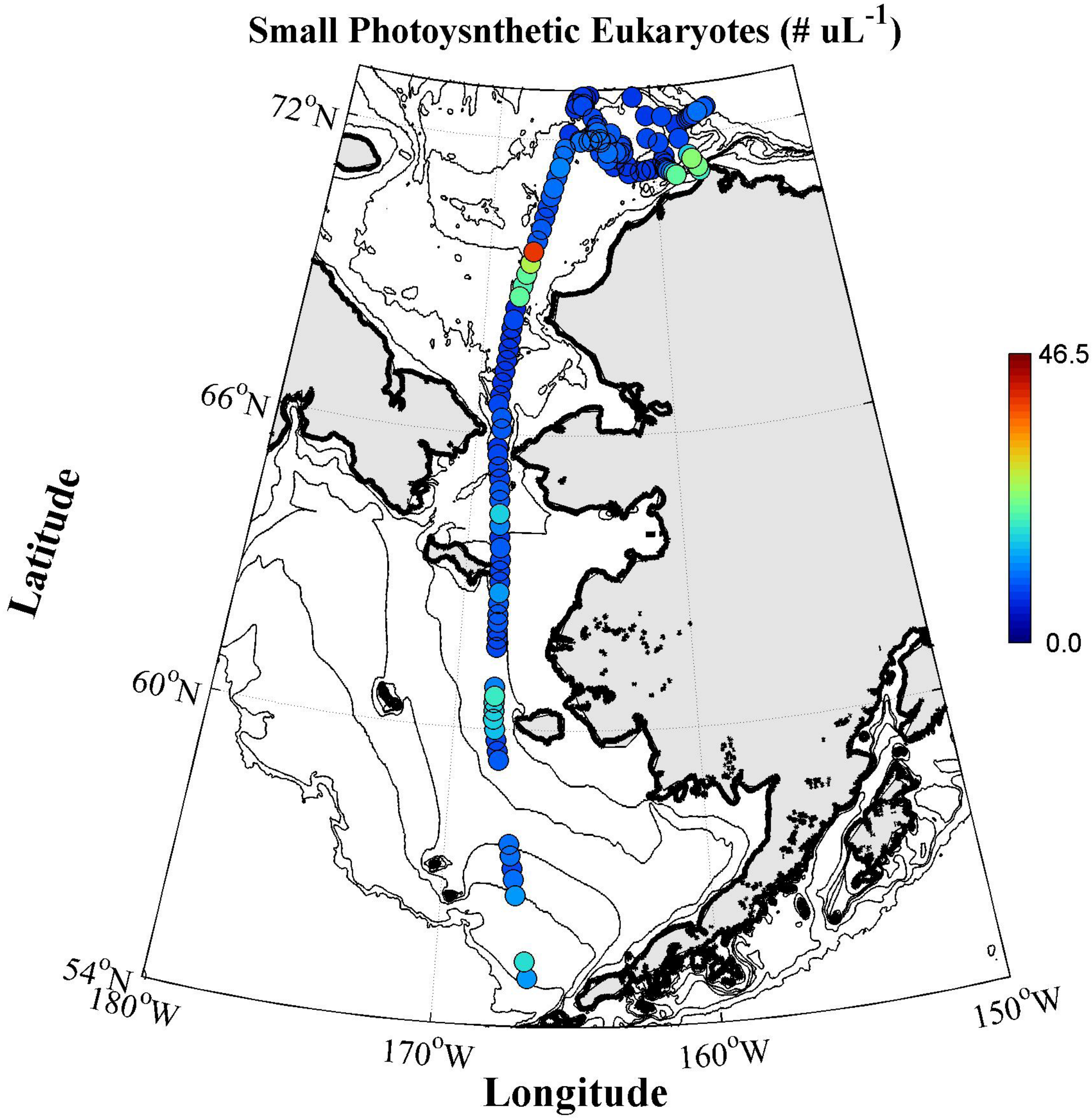


Figure 5. Abundances of *Synechococcus* as a function of temperature and salinity from water collected at all process stations using the Niskin bottles. (Data are preliminary)

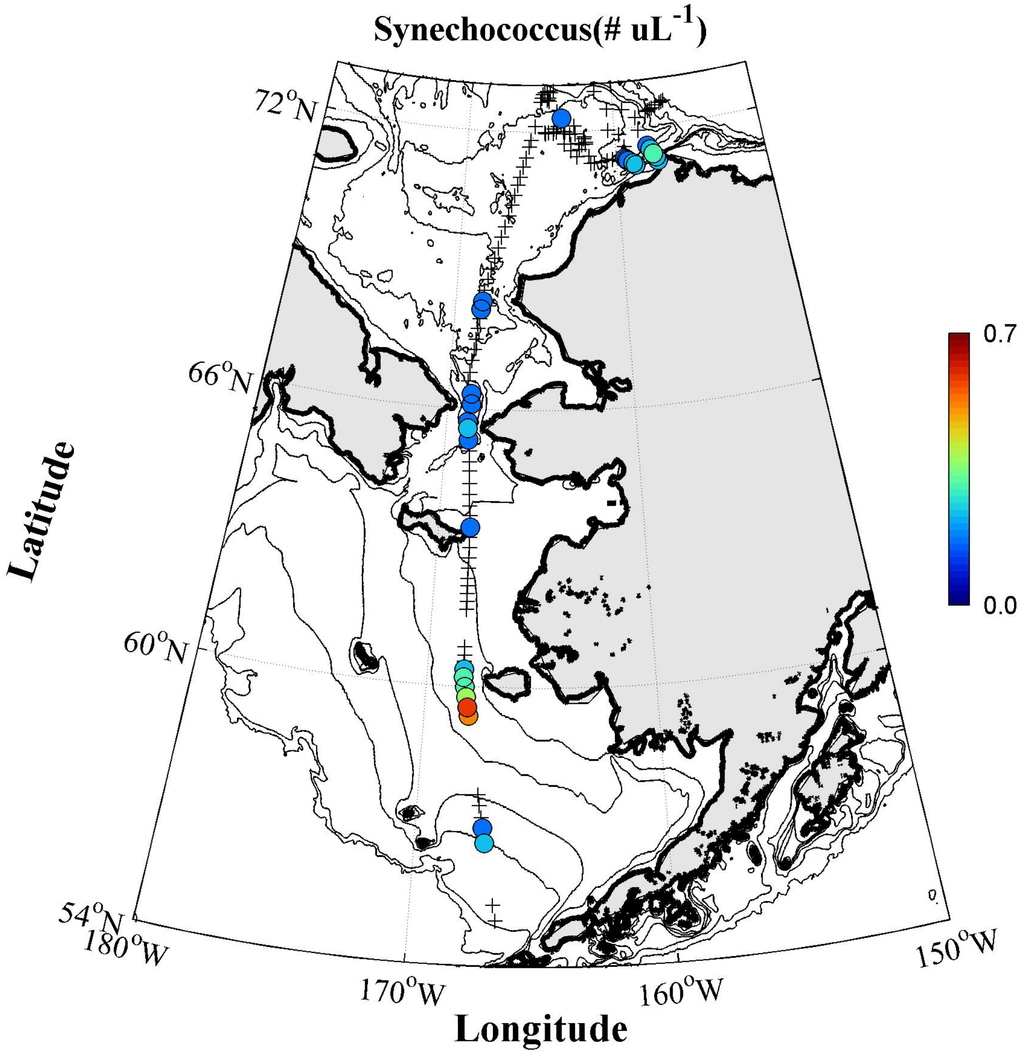


Figure 6. Abundances of small photosynthetic eukaryotes at 5 m on Hanna Shoal. (Data are preliminary)

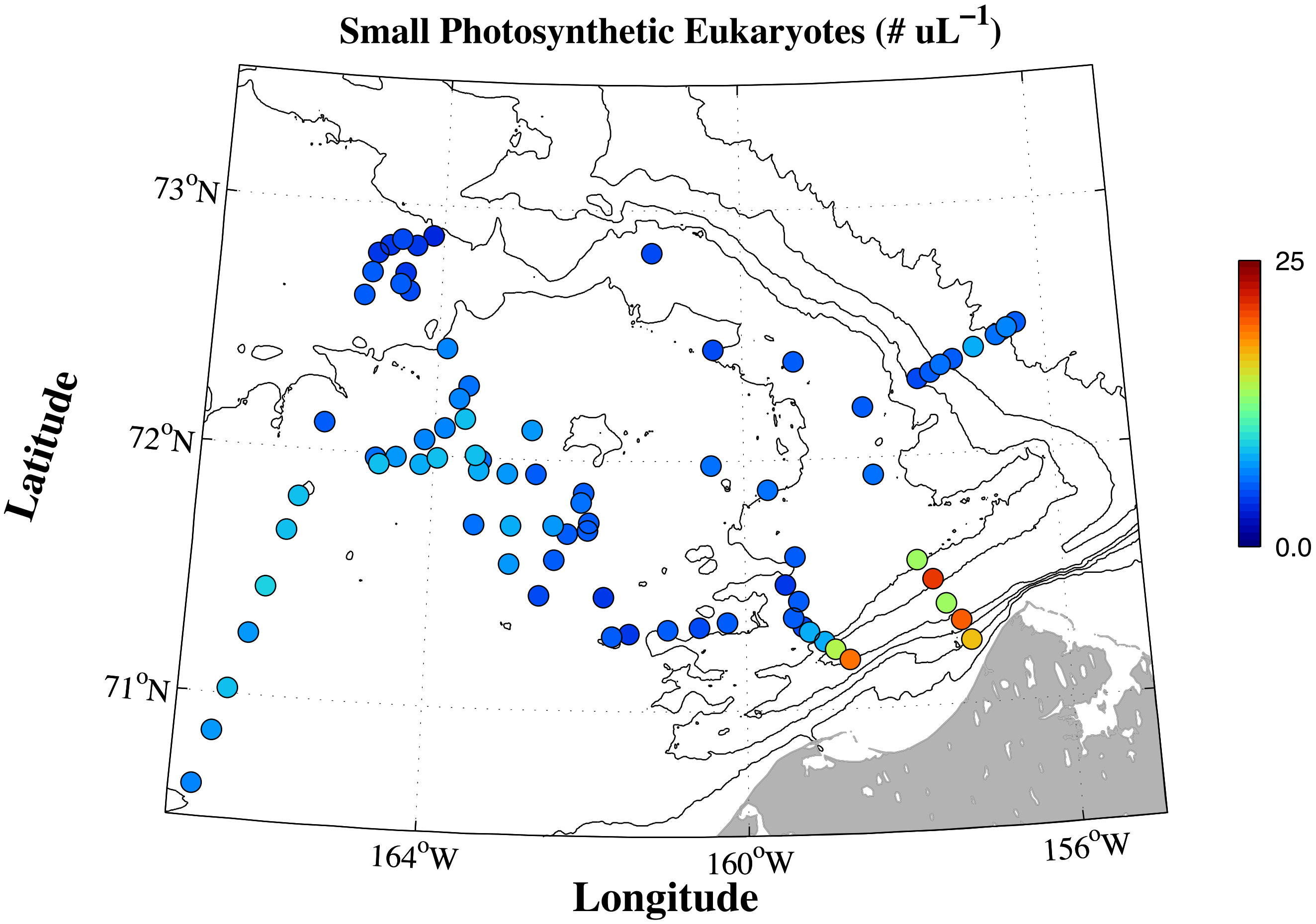


Figure 7. Abundances of large photosynthetic eukaryotes at 5 m on Hanna Shoal. (Data are preliminary)

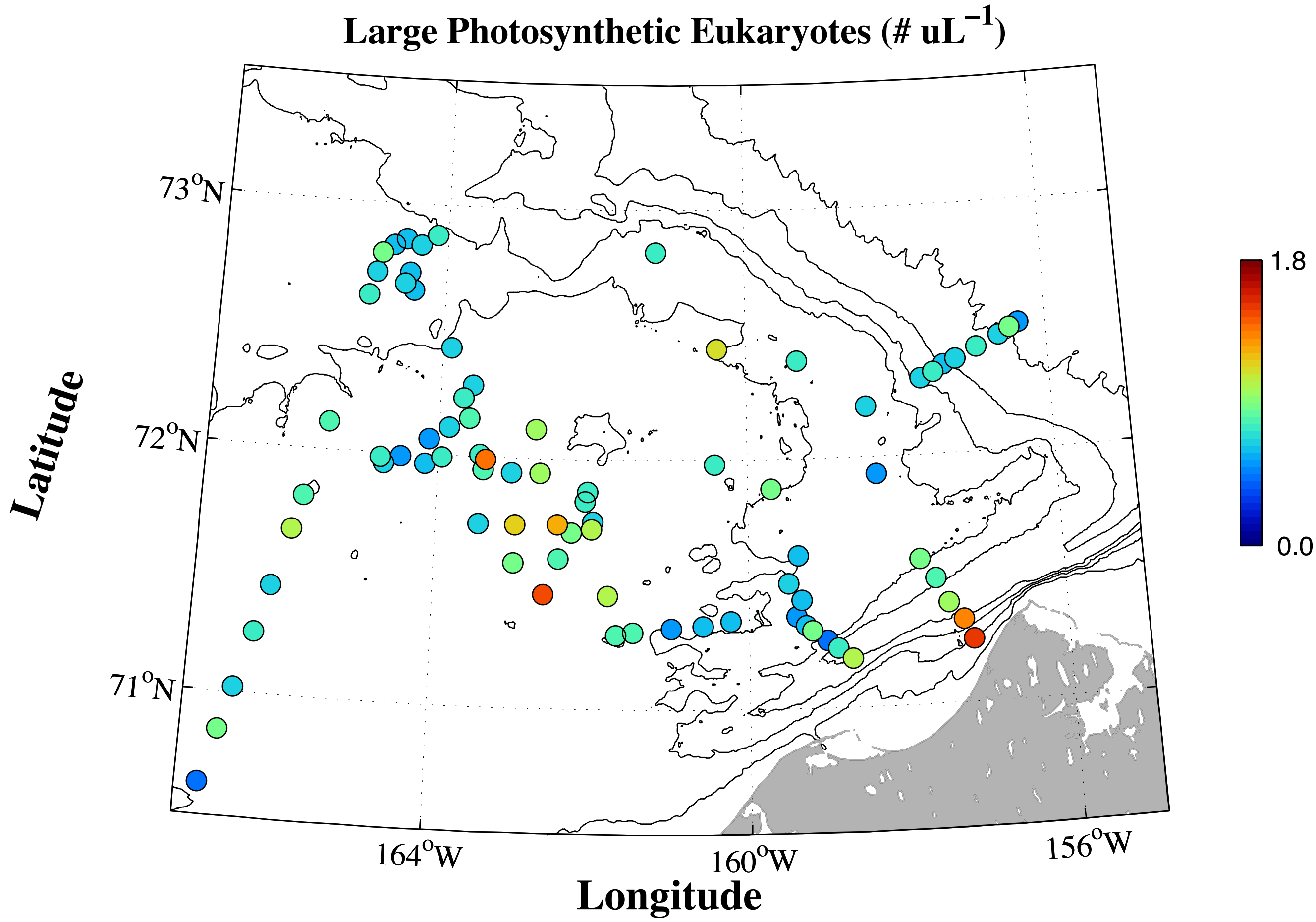


Figure 8. Abundances of *Synechococcus* at 5 m on Hanna Shoal. (Data are preliminary)

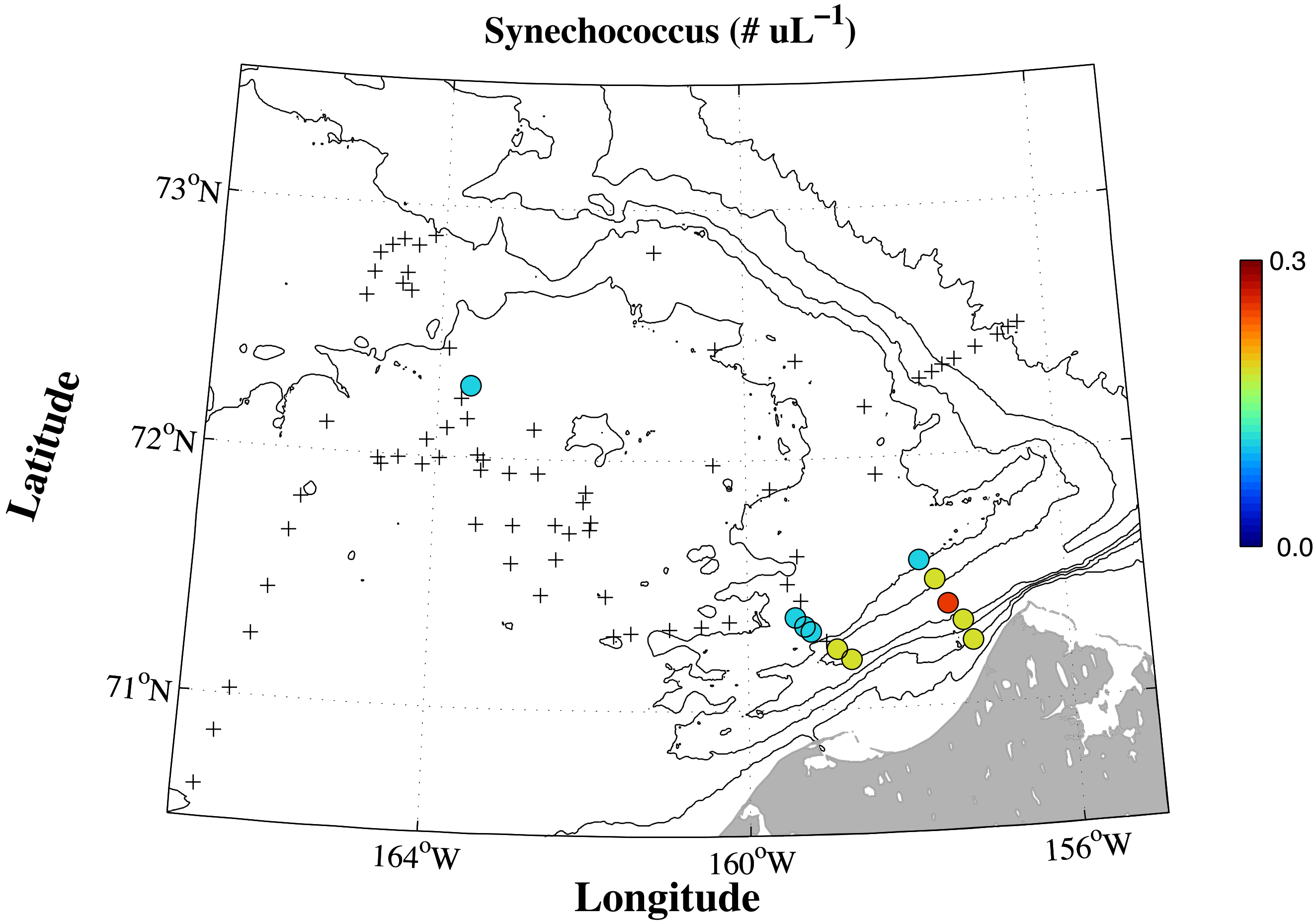


Figure 9. Abundances of small photosynthetic eukaryotes from the CTD casts plotted as a function of temperature and salinity. (Data are preliminary)

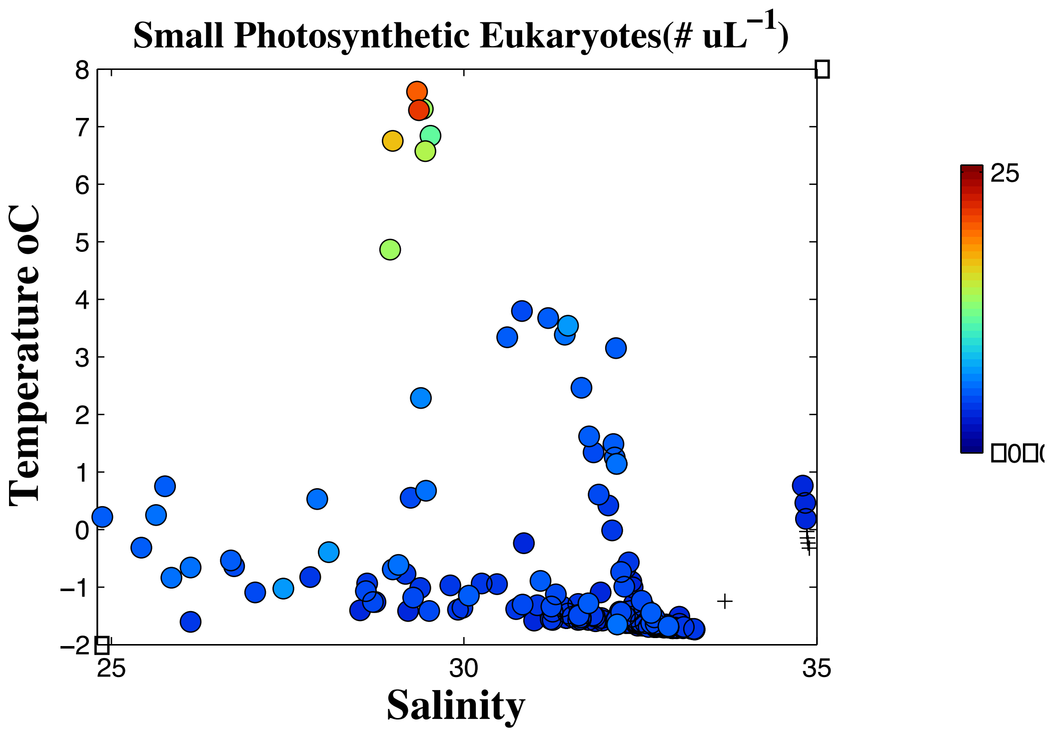


Figure 10. Abundances of large photosynthetic eukaryotes from the CTD casts plotted as a function of temperature and salinity. (Data are preliminary)

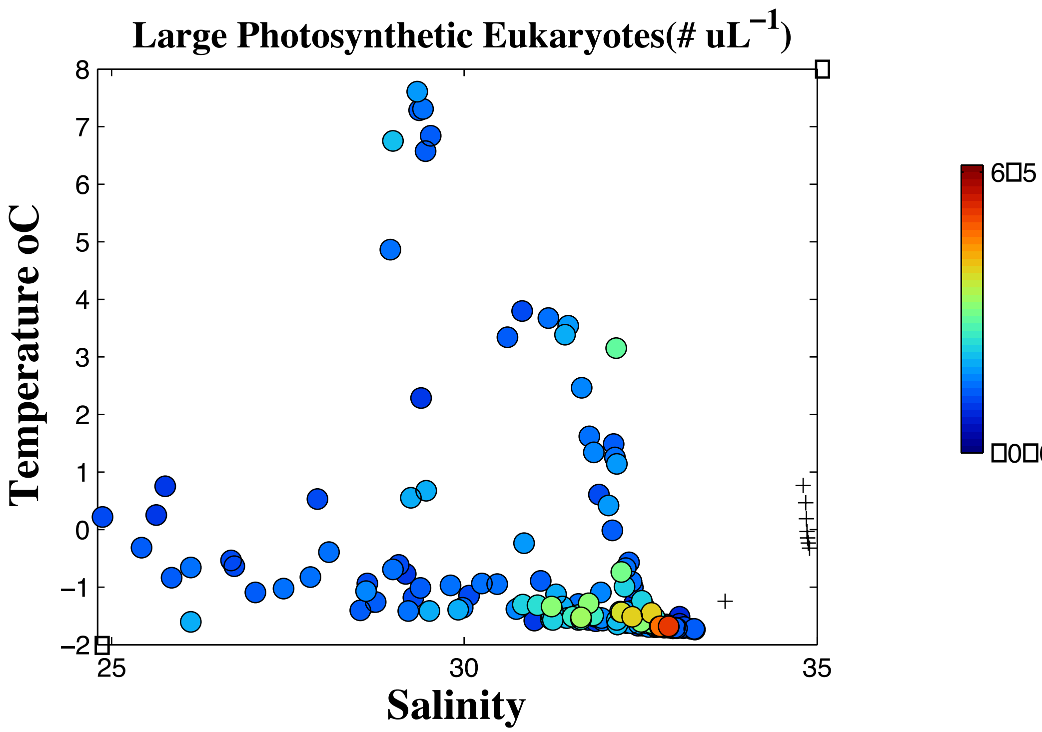
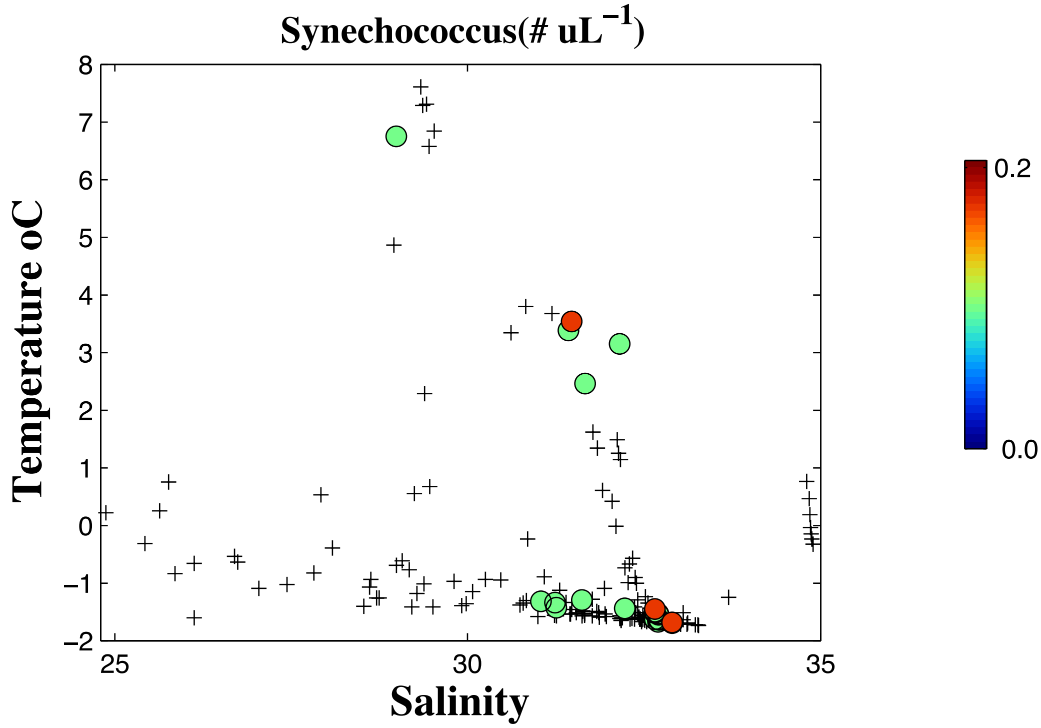


Figure 11. Abundances of *Synechococcus* from the CTD casts plotted as a function of temperature and salinity. (Data are preliminary)



Trace Metal Chemistry

John Trefry, PI
John Trefry, Bob Trocine, Austin Fox, Yuchao Yan, on-board team
Florida Institute of Technology

Samples of water, suspended matter, bottom sediments and biota were collected to investigate the biogeochemical cycles of several trace metals in the Chukchi Sea. A total of 75 water samples were collected using GO-FLO Niskin bottles at 13 stations (4-8 samples/station, Table 1). The water samples were filtered aboard ship in a laminar flow hood to obtain samples for dissolved and particulate metals and particulate organic carbon (POC). Water samples were collected at the Bering Strait to determine concentrations of dissolved and particulate metals and POC for inflowing water to the Chukchi Sea. The remaining samples were collected within the area of Hanna Shoal.

Concentrations of total suspended solids also will be determined for each water sample. Surface sediments (0-1 cm) were collected for metal analysis from the van Veen grab at 27 stations (Table 1). Sediment box cores were obtained for metal analysis at 11 stations and gravity cores were collected 2 stations (Table 1). The cores were sub-sectioned aboard ship in 1-cm thick layers over the top 10 cm and in 2-cm thick layers at depths >10 cm. These sediments will be analyzed for selected trace metals; some cores will be age-dated using ^{137}Cs and excess ^{210}Pb geochronology. We also made shipboard measurements of dissolved oxygen, Eh (redox potential) and pH in 9 sediment cores that were subsampled from the box cores.

A large selection of biota samples were collected throughout the study area (Table 1). The biota sampled include phytoplankton, zooplankton, arctic cod, snow crabs, whelk, bivalves, amphipods, crabs and other specimens. These samples will be analyzed for total and methyl Hg and several other metals.

Our at-sea results included data for dissolved oxygen, redox potential (Eh) and pH in sediments from the box cores. These measurements were made to help determine (1) whether surface enrichment of selected metals is linked to diagenesis rather anthropogenic input and (2) if regional patterns in As enrichment can be linked to predictable biogeochemical processes in the sediments.

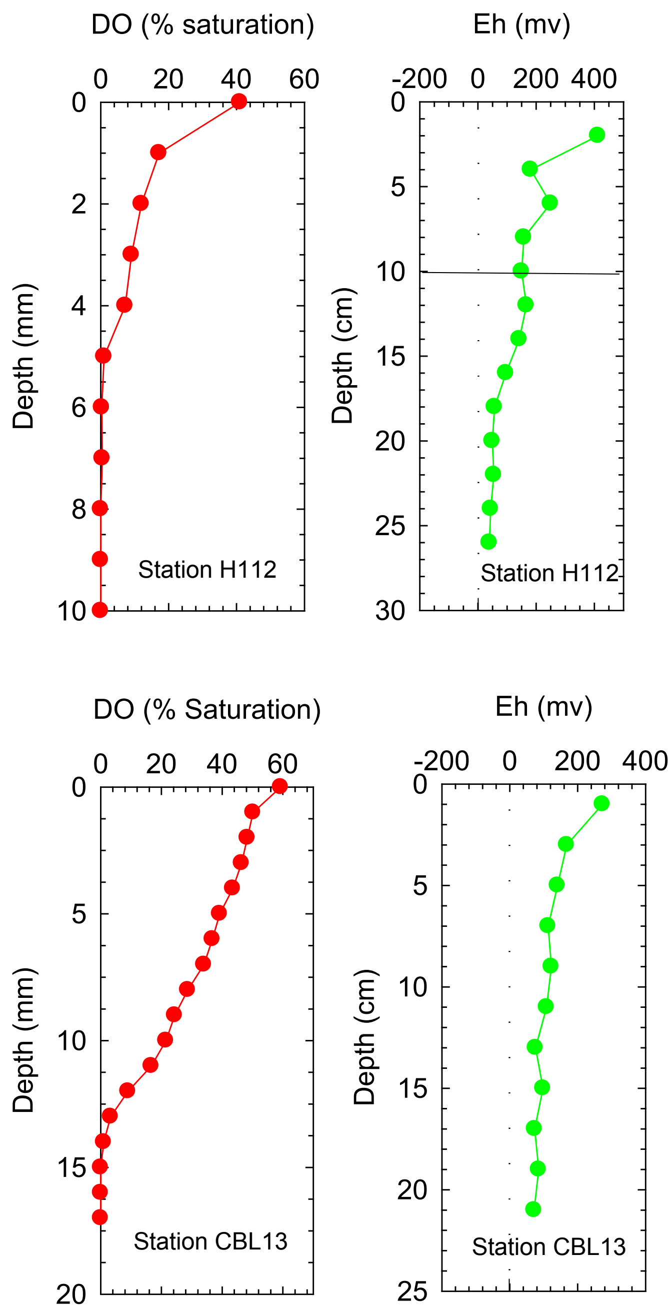
Vertical profiles for dissolved oxygen in the sediments showed that oxygen was depleted in the sediment column at depths of 4-15 mm (e.g., Figure 1). In general, the depth to zero oxygen in the sediments was less in the area to the west and northwest of Hanna Shoal and higher to the south and east of Hanna Shoal. Sources of oxygen to sediments include biological mixing with overlying water and photosynthesis by benthic algae. At station H112 (northwest of Hanna Shoal) the depth of zero oxygen was ~5 mm and the integrated oxygen was ~20 nmol cm^{-2} (Figure 1). In contrast, the depth of zero oxygen at station CBL 13, south of Hanna Shoal, was ~13 mm and the integrated oxygen value was ~100 nmol cm^{-2}.

Vertical profiles for Eh showed, as expected, a more reducing sedimentary environment in sediments with a more shallow depth for zero oxygen. Data for sediment oxygen and Eh will be used to interpret vertical profiles for sediment As and Mn. Previous results showed enrichment of As and Mn in surface sediments from the areas to the east and south of Hanna Shoal. Based on field measurements from the 2013 cruise, sediments from these areas are characterized by deeper penetration of dissolved oxygen, a process needed to bring about precipitation of As and Mn in surface sediment layers.

Table 1. Summary of samples collected in the Chukchi Sea for trace metal analysis during 2013 (*BC = box core, GC = gravity core).

Station Name	Station Number	Date	Water	Phyto	Zoop	Surface Sed	Sed Core	Sed Core*	Fish Cod	Crabs	Whelk	Bivalve	Shrimp	Other	Amph
BSR5	1	8/1/2013	8												
CBL11	2	8/2/2013	7	x	x	1	1	BC	x	x	x	x	x	X	x
H112	3	8/2/2013		x	x	1	1	BC		x		x	x	x	
H114	4	8/3/2013	7	x	x	1									
UTX1	12	8/4/2013		x	x	1			x	x	x	x		x	x
H6		8/4/2103							x	x	x	x	x	x	x
H7	14	8/4/2103	6	x	x	1	1	BC	x	x	x	x	x	x	
H17	15	8/4/2013		x	x	1			x	x	x	x	x	x	
HS3	17	8/5/2013	6	x	x	1	1	BC	x	x	x	x	x	x	x
UTX8	18	8/5/2013		x	x	1			x	x	x	x	x	x	x
UTX11	19	8/6/2013		x	x	1			x	x	x	x	x	x	x
CBL13	25	8/6/2013	7	x	x	1	1	BC	x	x	x	x	x	x	x
H111	36	8/7/2103	8	x	x	1	1	BC							
H109	37	8/7/2013		x	x	1			x	x	x	x	x	x	x
H108	38	8/7/2013				1									
BarC4	42	8/8/2013	6			1									
BarC5	43	8/8/3013		x	x	1	1	BC							
BarC9	47	8/8/2013				1									
H29	52	8/9/2013	7			1	1	BC	x	x	x	x	x	x	x
H32	53	8/9/2013		x	x	1			x	x	x		x	x	x
H106	54	8/9/2013				1									
H107	57	8/10/2103	6	x	x	1	1	BC	x	x	x		x	x	x
H33	58	8/10/2103		x	x	1			x	x	x	x	x	x	x
H28	63	8/11/2103	7	x	x	1	2	BC, GC	x	x	x	x	x	x	x
H15	64	8/11/2013		x	x	1				x	x	x	x	x	x
H27	65	8/11/2103		x	x	1	2	BC, GC	x	x		x	x	x	
H9	72	8/12/2013	4	x	x	1			x	x	x	x	x	x	x
H34	73	8/12/2013		x	x	1			x	x	x	x	x	x	x
H102		8/13/2103	4	x	x	1	1	BC	x	x			x	x	x
		TOTAL	75	23	22	27	11	-	19	21	18	19	20	21	18

Figure 1. Vertical profiles for dissolved oxygen in sediment cores from stations H112 and CBL13 near Hanna Shoal.



Epibenthic communities of Hanna Shoals

Brenda Konar (PI), Alexandra Ravelo, Kim Powell, Tanja Shoellmeier on-board team

University of Alaska Fairbanks

The overall goal of the epibenthic component of the Hanna Shoals project is to describe the community structure of the organisms that inhabit the seafloor surface within the Hanna Shoals study area. As a second goal, we will also use physical data collected during the cruise to determine which drivers are most important in influencing community structure. To accomplish the first goal, epibenthic trawls were completed with a plumb staff beam trawl at 25 stations within the study area between Aug 2 and 13, 2013 (Table 1). An additional 21 stations were sampled in 2012. See below for details on trawling methodology. To accomplish our second goal, we will use physical data (sediment and water) collected by other PIs on the cruise. These data will be acquired from them and analyzed with our data at a later date.

Trawl water depths in 2013 ranged from 39 to 65 m. This year we used a TDR (time depth recorder) to determine the actual times that the trawl was on the seafloor. Trawl times were typically 2.5 minutes. Eleven trawls were subsampled due to high catches. Trawl distances will be calculated from the TDR and the speed of the ship, and from the change in latitude and longitude while the trawl was on the bottom. Trawl catches will be standardized by distance trawled. Photographs were taken of all catches.

All epibenthic organisms within each trawl were identified to the lowest possible taxa (usually species), weighed, and counted. For the 46 taxa that can be measured (length), size frequencies were also recorded. True crabs (snow and lyre crabs) were sexed and all data collected were recorded by sex. Gravid females were also noted. A total of 56,804 individuals were counted and weighed (over 56,000 kg total) during the cruise, from 108 taxa. The number of taxa will likely change as a few organisms, particularly gastropods, were vouchered and will be brought back to UAF for further identification.

Of the stations trawled, 13 were sampled during a previous COMIDA studies cruise in the Chukchi Sea (Table 1; years 2009, 2010 and/or 2011). These resampled stations will allow for an investigation of inter-annual variation and can be considered to be the beginning of a long-term data set for epifaunal data in this region. This has become a third goal of this study. Our preliminary data show that there can be much temporal variation in community structure (Figure 1), but this varies among stations.

Since brittle stars (*Ophiura sarsii)* are so dominant in the NE Chukchi Sea epibenthic community, we have started to examine various aspects of the population dynamics of this species. The primary goal here is to describe its age, size structure and productivity. During the 2013 Hanna Shoal cruise, size frequency data of a subsample of up to 350 specimens were collected per station at 20 stations, totaling 6,457 specimens measured throughout the region. These size frequency data show that there is variability in histograms from site to site but when the region is combined, multiple peaks are found (Figure 2). From the specimens measured, a variable number were collected at each station and subsequently frozen. These frozen samples will be transported to the University of Alaska Fairbanks for aging and productivity analysis. The questions we expect to answer with these data are 1) what is the size and age distribution of the population of *O. sarsii* in the NE Chukchi Sea?, and 2) what is the productivity of the population of *O. sarsii* in the NE Chukchi Sea?

In addition to population dynamics, we also would like to determine how metabolic and calcification rates of *O. sarsii* will respond to increasing water temperatures, which is expected to occur within the next decade. For this, eighteen *O. sarsii* were collected from each of four different stations in the Hanna Shoal study area. After collection, the ophiuroids were placed in an ambient seawater filled cooler to equilibrate for approximately 2 hours. After this time, the ophiuroids were slowly brought up to one of three experimental temperatures over eight hours. These temperature treatments were 1) ambient (3°C), 2) three degrees above ambient (6°C), and 3) six degrees above ambient temperature (9°C). Half of the individuals also had 75% of one arm removed to determine how the added stress of an amputation would impact metabolic and calcification rates with increasing temperatures. For the actual experiment, one ophiuroid was placed in an air-tight glass jar for four hours to determine their oxygen consumption. Within each temperature treatment, there were three control jars with no organism, three jars with an intact ophiuroid, and three jars with an ophiuroid that had an arm removed. In total, there were four trials. Ophiuroids were then frozen for later calcification rate analysis. Preliminary figures suggest that oxygen consumption increases both with increasing stress and temperature (Figure 3).

Epibenthic Report Figures and Tables

Figure 1. Changes in proportional abundance of dominant taxa at CBL15 over time.

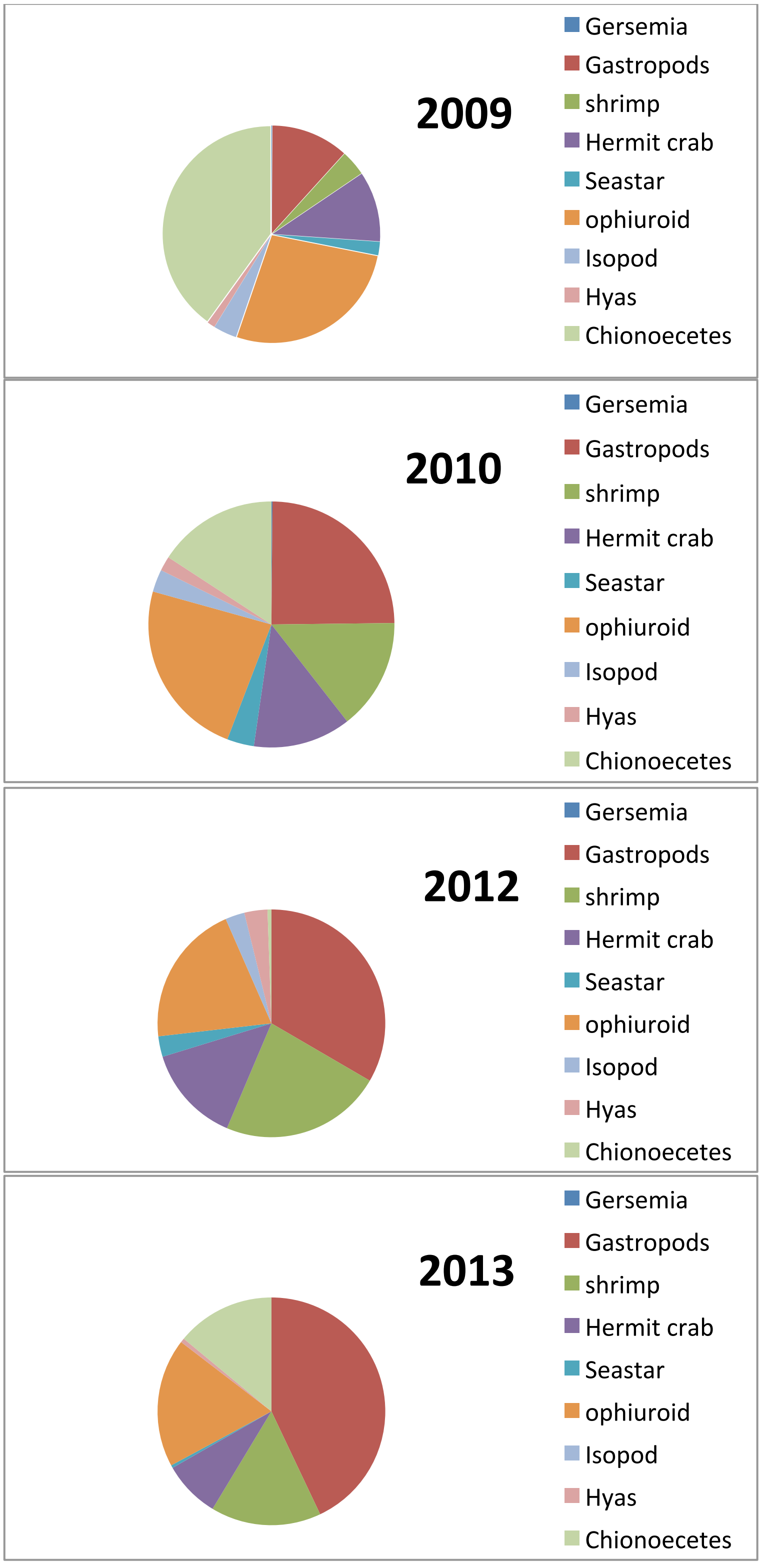


Figure 2. *Ophiura sarsii* size frequency from two different stations. Top graph is from H7 and the bottom graph is from UTX11.

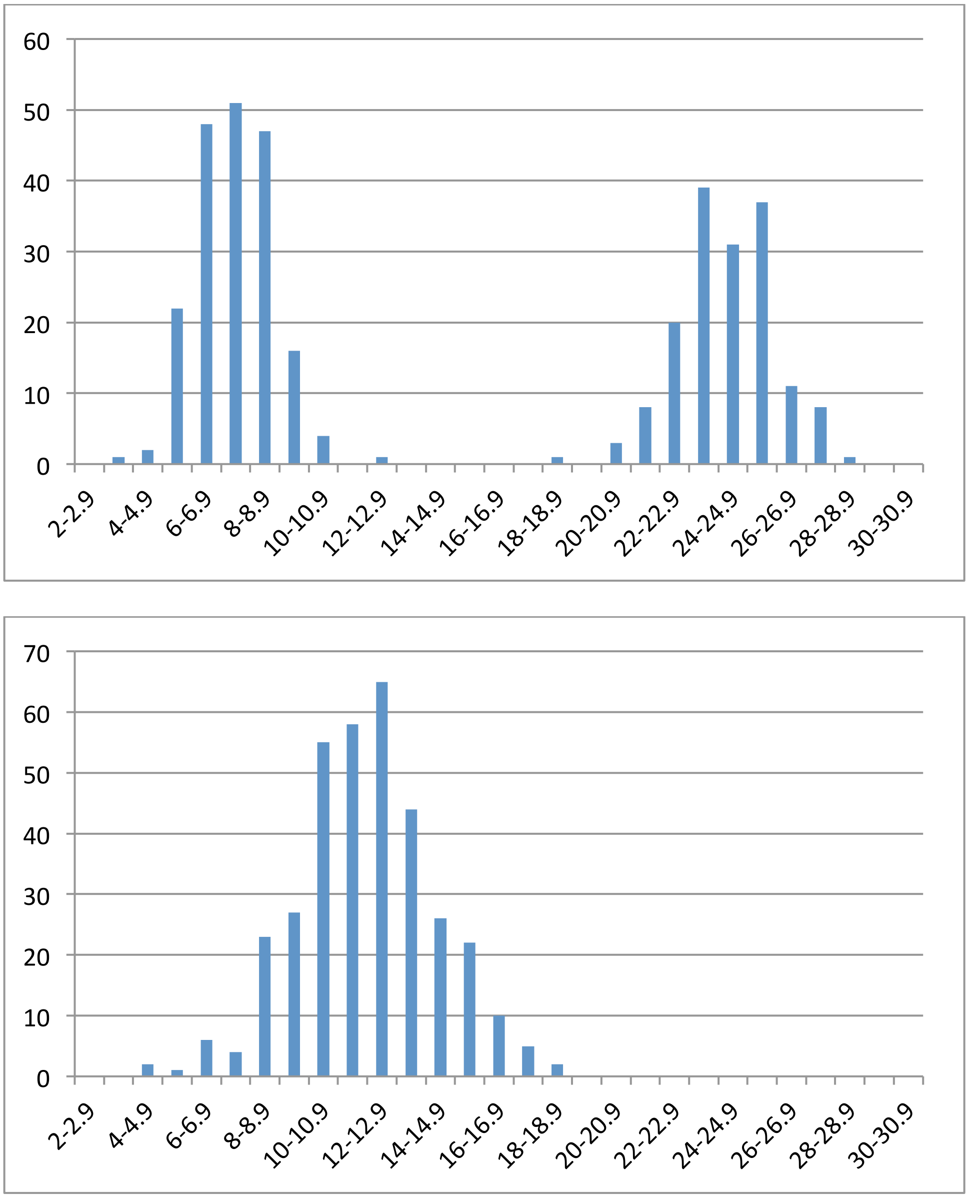


Figure 3. Oxygen consumption of *Ophiura sarsii* with increasing stress and temperature. Controls = closed chambers with no *O. sarsii,* Whole = undamaged *O. sarsii, Cut* = *O. sarsii* with 75% of one leg amputated.

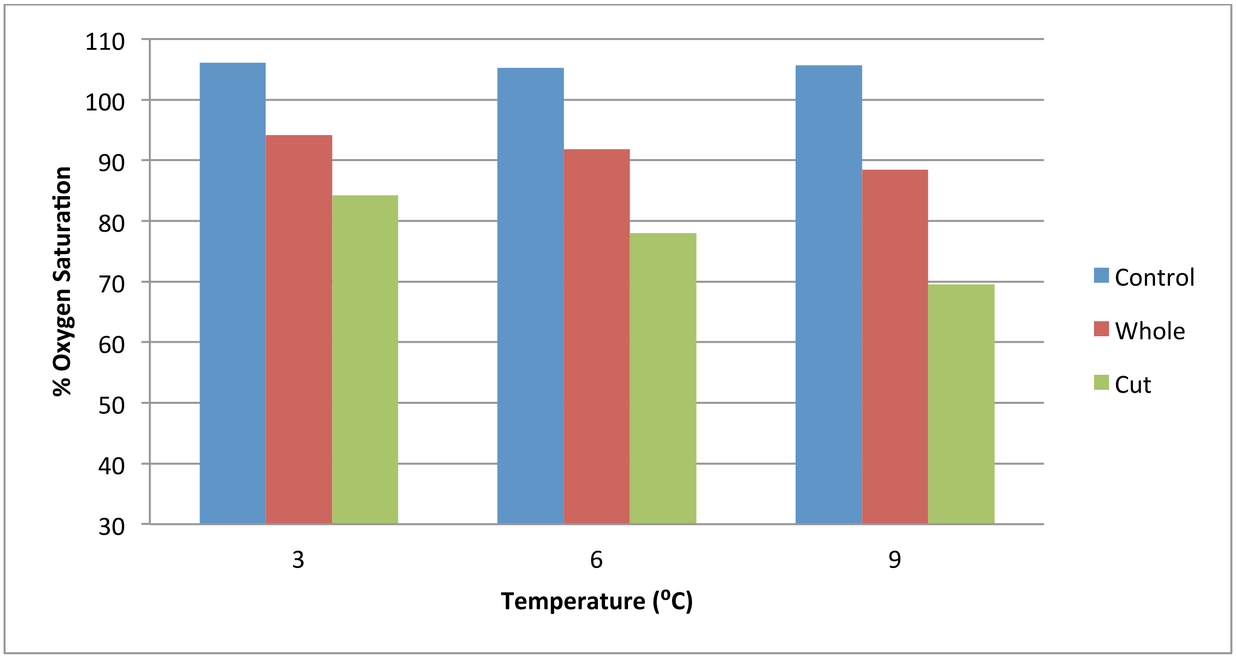


Table 1. Stations sampled by date.

Station name	years resampled	date	water depth (m)	TDR bottom time (min)	sub-sampled ?
CBL 11	2009, 2010, 2012	8/2/2013	45.8	11	no
H 112	new	8/3/2013	62.8	5	no
UTX 1	2009	8/4/2013	41.1	8	no
H 6	2012	8/4/2013	40.2	8	no
H 7	new	8/4/2013	40.0	7	1/2
H 17	new	8/4/2013	40.1	6 1/2	1/2
H S3	2010	8/5/2013	43.0	9	1/2
UTX 8	2009, 2010	8/5/2013	41.0	6 1/2	no
UTX 11	2009, 2010	8/5/2013	46.3	6 1/2	1/2
CBL 13	2009, 2010	8/6/2013	50.0	5 1/2	1/2
CBL 14	2009, 2010, 2012	8/7/2013	54.0	2 1/2	1/2
H 108	2012	8/7/2013	52.0	5	no
Bar 10	2012	8/9/2013	65.0	3.4	no
H 29	new	8/9/2013	63.0	5	no
H 32	2012	8/9/2013	54.0	4 1/2	1/2
CBL 15	2009, 2010, 2012	8/10/2013	46.0	5	1/2
H 107	new	8/10/2013	54.0	5	1/2
H 33	new	8/10/2013	52.0	4	1/2
H 28	new	8/11/2013	52.0	7	1/2
H 15	new	8/11/2013	49.0	5	no
H 27	new	8/11/2013	52.2	5	no
H 9	new	8/12/2013	39.0	6	no
H 34	new	8/12/2013	40.7	6 1/2	no
H 20	2012	8/13/2013	46.0	3 1/2	no
H 102	new	8/13/2013	62.3	4	no

HEALY 1301: Marine Mammal Watch Summary **Sue E. Moore**

A watch for marine mammals was conducted from the bridge of the HEALY (height = 18.3m) during the transit from Dutch Harbor to the Hanna Shoal study area, and on transits between sampling stations in the study area, whenever viewing conditions permitted. Most watches were conducted between 0630 and 2130, and included periodic scans around the ship when on station. The lone marine mammal watch stander was aided in spotting mammals by two seabird observers, the ship's crew and 'visiting scientists'. The purpose of the watch is to detect marine mammals and identify sightings to species at temporal and spatial sampling scales coincident with the oceanographic sampling. The overarching goal is to improve integration of higher-trophic species with measures of biophysical variability in the Pacific Arctic marine ecosystem.

A total of 115 h of watch effort was completed, with *ca.*65 h (65%) in the Hanna Shoal study area (Table 1). Fog sometimes reduced viewing range to <1km, which curtailed watch effort; fog was especially prevalent from 8-12 August. In addition, the Hanna Shoal study required long on-station sampling periods, when only brief around-the-ship scan sampling could be conducted.

Marine mammal observations are summarized by species as the total number of sightings/total number of animals seen (Table 1). Walruses were the principal species detected, due largely to the prevalence of sea ice over Hanna Shoal. Most walrus were seen resting on sea ice, with surface cover of 10-80% common over much of the study area. The walrus 'high-count day' (5 August) corresponded to transits between stations H3-UTX8-UTX11, along the southwest flank of the shoal, where sea ice averaged 30-40% surface cover. In addition to resting walrus, there were several observations of very dense in-water surface-active groups (dubbed 'walrus spas'); also noted was the synchronous diving of 'braces' of 3-5 walrus females with calves 'tucked' between their shoulders. Ringed and bearded seals were also common in the Hanna Shoal study area, with a 'high-count day' for both species (3 August*****) corresponding transits to and from station #114; a 2nd 'high-count day' for ringed seals corresponded to the transit from H34 to the HSNE40 mooring on 12 August. Four polar bears were seen on 3 August*****, two single bears and one pair judged to be a sow and her juvenile cub. Two more polar bears were seen on 6 August, near 71° 40N 162° 20W; this pair too was judged to be a sow accompanied by a juvenile cub. Lastly, two ribbon seals were seen in the Hanna Shoal study area, one each on 4 & 12 August. The first seal was resting on ice, the second swimming among ice floes as the ship approached the HSNE40 mooring. No cetaceans were seen in the Hanna Shoal study area.

At the outset of the cruise (29 July), 28 humpback whales and 15 Dall's porpoise were seen north of Unimak Pass, as the ship departed Dutch Harbor. On 30 July, a remarkable assemblage of cetaceans and seabirds was observed in the SE Bering Sea southwest of Nunivak Island, between *ca*. 58°30N 167°50W x 59°10N x 168°00W, where the surface water temperature (as measured by sensors on HEALY), dropped abruptly from 11°C to 5°C (Fig. MM-1). The multi-species assemblage consisted of 6 fin whales, 4 humpback whales and 3 minke whales, accompanied by thousands of ancient murrlets and least auklets. Both whales and seabirds appeared to be actively feeding in a prey patch that extended *ca.* 45-55 km (25-30 nm) along the track of the ship, as judged by the extent of the cold-water feature and the distribution of the whales and seabirds. On 31 July, 63 gray whales were seen between King Island and Bering Strait in the northern Bering Sea. These whales too appeared to be feeding, with mud plumes noted at the surface attracting feeding seabirds and repeated flukes-up diving by individual whales in the same locale. Three gray whale calves were seen among these whales, two of them seemingly unattended. Several gray whales evidenced 'snorkeling' behavior (shallow surfacing, w/ no visible blow), as noted last year in this area. The 'high-count day' for gray whales (1 August) occurred as the ship transited the southern Chukchi Sea, where 267 feeding whales were seen over a 2.5h period between 67°37.5N x 168°39.3W and 68°08.2N x 168° 29.7W (ref.: map in Seabird report). Four cow-calf pairs were among the feeding whales. Gray whales fed singly and in groups of 3-4 whales; head lunging and social behaviors were also seen. Skeins of red phalaropes followed gray whales as they surfaced from feeding dives. Three humpback whales, one fin whale and two minke whales were also in this 'hot spot' area, which corresponds to DBO Region 3.

On the last day of the cruise (14 August), 80 spotted seals and three harbor porpoise were seen near the BarC 10 station, seemingly feeding on 'boils' of forage fishes. The seals were in groups of 10s and 20s, and the harbor porpoise were seen on the edges of two of these seal aggregations. Other highlights included the count of 22 gray whales, distributed very near shore in a 'line' along the coast; subsequent discussion with researchers sampling the coastal zone for fishes suggests these whales may be feeding on capelin, or sand lance which can occur in the near shore zone in dense schools. Lastly, roughly 70 walruses were seen sitting on small ice floes as the ship maneuvered into position at its nearshore anchor site.

Table 1. HEALY 1301: Marine Mammal Watch Summary
Hours of watch effort (EFT) and number of sightings/number of animals, by species

	EFT	GW	HW	FW	MW	HP	DP	WS	BS	RS	SP	PN	PB
7/29	4.8		3/28				2/15					1/5 SSL	
7/30	10.0		2/4	2/6	3/3						3/6	3/3 FS	
7/31	14.6	17/63				2/5					2/2	4/4	
8/1	12.5	21/267	1/3	1/1	1/2			1/1* dead			2/3	½	
8/2	4.5									2/2			
8/3	11.5							11/520	4/7	15/24			3/4
8/4	5.0							22/1110		2/2		1/1 Ribbon	
8/5	6.9							30/6080	2/2	5/7			
8/6	7.5							2/13	2/2			½	1/2
8/7	4.0									8/14		3/3	
8/8	1.0											1/1	

8/9	2.7									1/1			
8/10	2.5							4/150*					
8/11	3.2							1/1		1/1		1 /2	
8/12	4.8							5/90		13/27		1/1 Ribbon	
8/13	12.2									3/3		1 /2	
8/14	7.3	4/22				2/3		3/70	2/3		4/80	3/8	
Total	**115**	**42/352**	**6/35**	**3/7**	**4/5**	**4/8**	**2/15**	**79/8,035**	**10/14**	**50/81**	**11/91**	**21/34** 2R	**4/6**

KEY: GW=gray whale; HW=humpback whale; FW=fin whales; MW=minke whale; HP=harbor porpoise; DP=Dall's porpoise; WS=walrus; BS=bearded seal; RS=ringed seal; SP=spotted seal; PN=unID Pinniped FS=Fur seal, SSL = Steller sea lion, Ribbon = Ribbon Seal; PB=polar bear. Note: walrus counts were estimated to the nearest 10 when large groups were encountered.

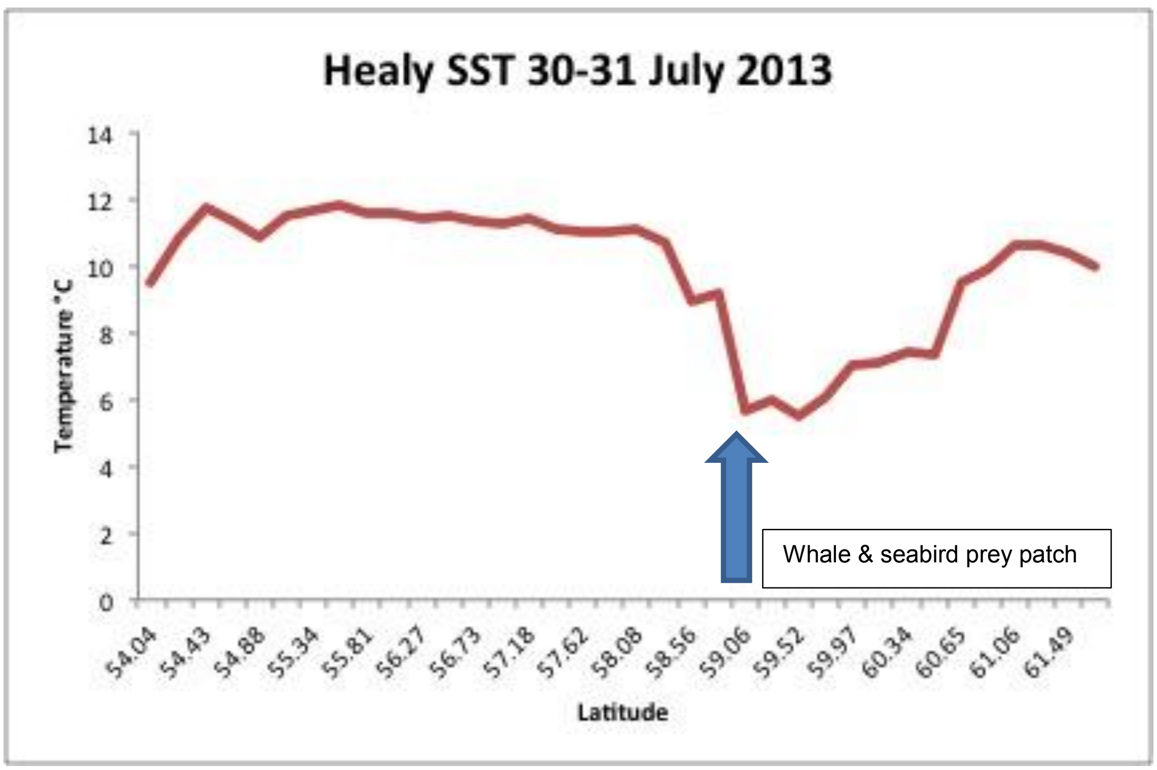


Figure MM-1. Abrupt drop in temperature coincident with a whale and seabird feeding assemblage, southwest of Nunivak Island in the southeastern Bering Sea.

Marine Bird and Mammal Surveys

Kathy Kuletz, PI
Charlie Wright and Marty Reedy, on-board team
Maps by Elizabeth Labunski
Migratory Bird Management, U.S. Fish and Wildlife Service, Anchorage, AK

Background

In conjunction with the COMIDA project, C. Wright and M. Reedy surveyed marine birds and mammals concurrent with oceanographic and biological sampling conducted onboard the *USCGC Healy*. Surveys were conducted while the ship transited from Dutch Harbor, through the Bering Strait, during COMIDA sampling of the Hanna Shoal study area, and final transit to Barrow. Processed data will be archived in the North Pacific Pelagic Seabird Database (USFWS and USGS, Anchorage, Alaska) and with the Bureau of Ocean Energy Management (BOEM). These surveys were funded by BOEM under project title ‘Seabird Distribution and Abundance in the Offshore Environment’ (BOEM study AK-10-10).

Methods

We conducted surveys 30 July – 14 August 2013, although this report only summarizes surveys through 12 August. We used standard U.S. Fish and Wildlife Service (USFWS) protocols. Observations were made from the port side of the bridge during daylight hours while the ship was underway. An observer scanned the water ahead of the ship using hand-held 10x42 binoculars when necessary for identification and recorded all birds and mammals within a 300-m, 90° arc from the bow to the beam. We used strip transect methodology and three distance bins extending from the vessel: 0-100 m, 101-200 m, and 201-300 m. During this cruise we frequently had to reduce the transect window to 200 m or 100 m due to heavy fog, and in some cases could not survey at all. Unusual sightings beyond 300 m or on the starboard side (‘off transect’) were recorded for rare birds, large bird flocks, and mammals. We recorded the animal’s behavior (flying, on water, on ice, foraging). Birds on the water were counted continuously, whereas flying birds were recorded during quick ‘Scans’ of the transect window, with scan intervals based on ship speed. Observations were entered directly into a GPS-integrated laptop computer using the program DLOG3 (Ford Ecological Consultants, Inc.). Location data was also recorded automatically at 20 second intervals, and included continuous records on weather, Beaufort Sea State, ice coverage, glare, and observation conditions. For this report we divided the survey into three areas: the Bering Sea (Dutch Harbor to St. Lawrence Island), the Bering Strait (north side of St. Lawrence Island and through the Bering Strait) and Hanna Shoal (transits among Hanna Shoal stations and the Barrow DBO line (the DBO having not been surveyed as of this report).

Preliminary Results

We completed 57 transects covering approximately 1859 km, of which 571 km were in waters with some ice. We recorded a total of 9,576 birds on transect and an additional 2,071 birds off transect, with red phalaropes accounting for 44% of all birds on transect (Table 1). We identified a total of 31 avian species, with the highest species richness in the southern Bering Sea region (24 spp.). The northern Bering Sea and Hanna Shoal regions had 16 spp. and 21 spp. respectively (Table 2). Based on a rough approximation of density using linear km surveyed, the northern Bering Sea around St. Lawrence/ Bering Strait was exceptionally high at ~14 birds/km. Red phalaropes predominated in this area, and accounted for 42% of all identified birds in that region. *Aethia* spp., especially least auklets, also contributed 42% of the birds in this area. The southern Bering Sea had ~ 7 birds/km and the Hanna Shoal region ~ 3 birds/km surveyed.

We recorded 14 species of marine mammals, with 940 animals on transect, primarily Pacific walrus. Another 6,826 mammals were recorded off transect, with 6,385 of those being walrus (Table 3). We recorded 6 polar bears off transect in the Hanna Shoal region. Large whales included 6 fin whales and 34 humpback whales (most off transect) in the southern Bering Sea and over 300 gray whales (12 on transect), primarily in the Hanna Shoal region (Table 3).

Notable observations:

Dutch Harbor to St Lawrence
Short-tailed shearwaters were numerous (n=1204) as we left Dutch Harbor, but their counts tapered off significantly as we traveled north. An intriguing foraging event that included >900 ancient murrelets over the course of three hours occurred on 30 June southwest of Nunivak Island (Fig. 1); this species was not encountered for the rest of the cruise. Marine mammals were also present at this same foraging event, including fin whale, humpback whale, minke whale, spotted seal, and northern fur seal. On-board investigator Michael Gonsior (Chesapeake Bay Laboratories) noted that his real-time water monitoring indicated a large presence of organic matter during our transit through this mega-flock. Sue Moore (NOAA), the on-board marine mammal PI, noted that an abrupt drop in water temperature, from 12°C to 6°C, coincided with the increase in bird and mammal foraging activity.

St. Lawrence/Bering Strait
The relatively high densities of *Aethia* auklets (Table 2), especially least auklets, in the Bering Strait region (Fig. 2) was likely due to large seabird colonies on St. Lawrence Island, the Diomede islands and coastal bluffs from Cape Thompson to Cape Lisburne. Phalarope were observed throughout the survey, but were most numerous above and below the Bering Strait (Fig. 3). There appeared to be a foraging relationship between phalaropes and gray whales (Fig. 3), with the birds following individual whales as they stirred up the ocean bottom. Similar foraging aggregations were not seen in this same

area during a survey by a USFWS observer aboard the Japanese *R/V Oshoro Maru* between 5-20 July (E. Labunski, USFWS, pers.comm.). While phalarope phenology and migration are certainly variables to consider, it could be informative to examine the physical and biological characteristics between the two time periods.

Hanna Shoal

Walrus counts were exceptionally high this year with >7000 individuals counted on and off transect (Table 3). The 'off transect' walrus counts were augmented by observations contributed by Sue Moore, who was conducting marine mammal watches from the bridge. Many of the animals in the water were paired adult/calf walrus. The walrus were all observed among and on ice floes in the Hanna Shoal area, particularly on the southern edge of the shoal. Of the six polar bears recorded there were two sow/cub pairs.

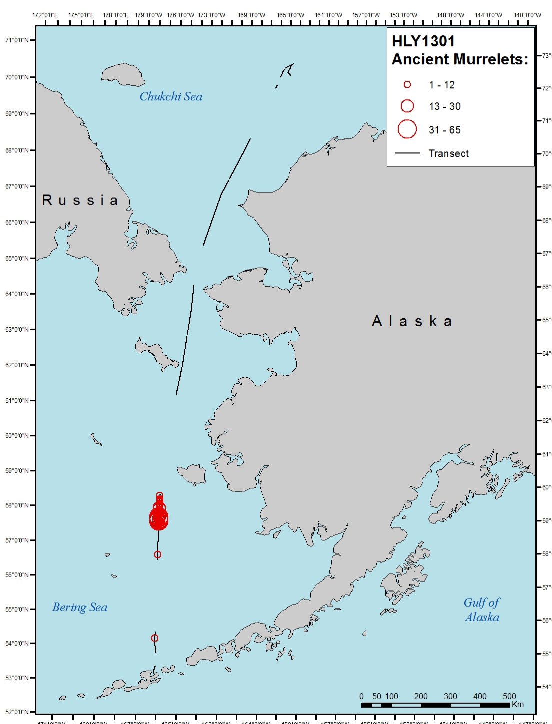


Fig. 1. Distribution of ancient murrelets during HLY1301 seabird surveys.

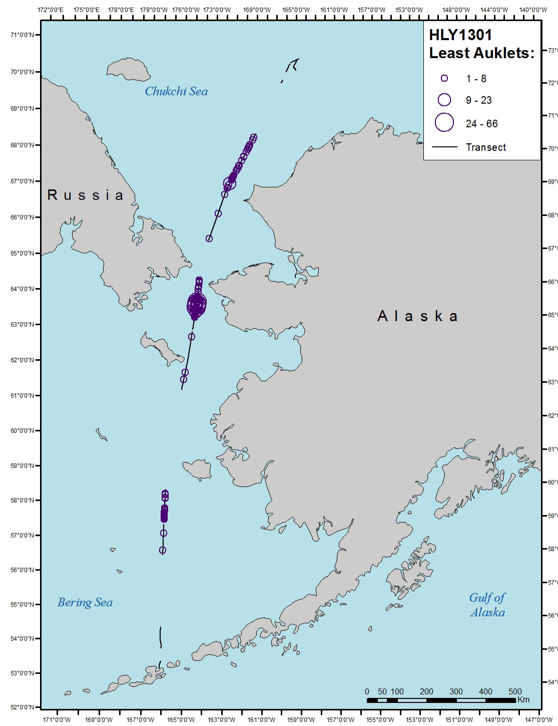


Fig. 2. Distribution of least auklets during HLY1301 seabird surveys.

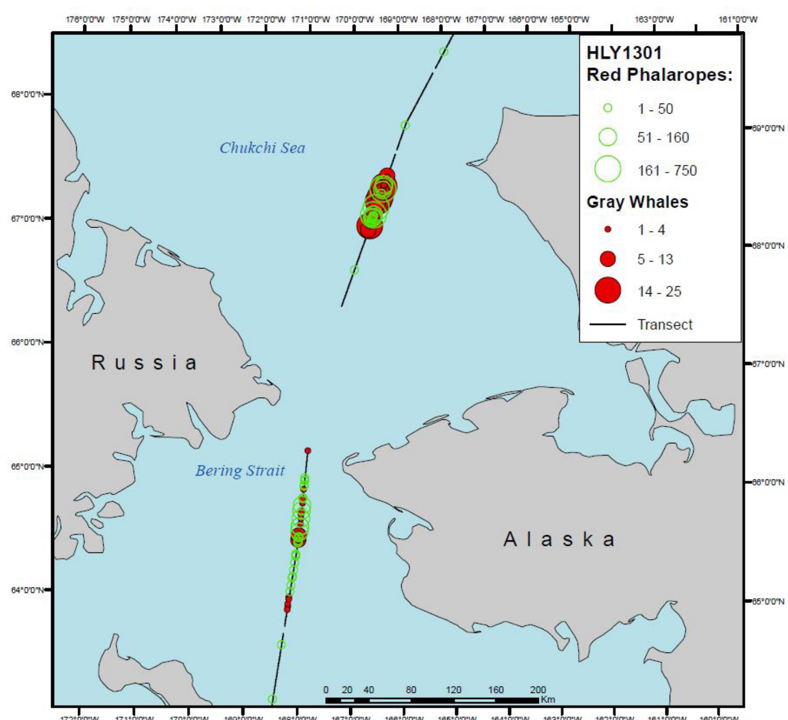


Fig. 3 Distribution of red phalaropes and gray whales observed during HLY1301 seabird

Table 1. Total marine birds counted on and off transect during HLY 1301 COMIDA (30 July-12 August 2013).

Group	Common Name	Latin Name	On Tran		Off Tran		
			N	Percent	N	Percent	Total
Loon	Pacific Loon	*Gavia pacifica*	1	0.01			1
Procilarids	Northern Fulmar	*Fulmarus glacialis*	454	4.74	26	1.26	480
	Northern Fulmar Dec.	*Fulmarus glacialis*	3	0.03			3
	Unid. Dark Shearwater	*Puffinus spp.*	17	0.18			17
	Short-tailed Shearwater	*Puffinus tenuirostris*	1200	12.53			1200
	Fork-tailed Storm-petrel	*Oceanodroma furcata*	116	1.21	51	2.46	167
	Pelagic Cormorant	*Phalacrocorax pelagicus*			1	0.05	1
Seaducks	Unid. Eider	*Somateria spp.*			66	3.19	66
	Steller's Eider	*Polysticta stelleri*	1	0.01			1
	Common Eider	*Somateria mollissima*			20	0.97	20
	King Eider	*Somateria spectabilis*	37	0.39	29	1.40	66
	Spectacled Eider	*Somateria fischeri*			1	0.05	1
Shorebirds	Unid. Shorebird	*Charadii (Suborder)*	6	0.06	32	1.55	38
	Ruddy Turnstone	*Arenaria interpres*	1	0.01			1
	Red Phalarope	*Phalaropus fulicaria*	4182	43.67	790	38.15	4972
	Red-necked Phalarope	*Phalaropus lobatus*	3	0.03			3
Jaegers	Unid. Jaeger	*Stercorariidae (Family)*	2	0.02	1	0.05	3
	Pomarine Jaeger	*Stercorarius pomarinus*	41	0.43	18	0.87	59
	Parasitic Jaeger	*Stercorarius parasiticus*	4	0.04	2	0.10	6
	Long-tailed Jaeger	*Stercorarius longicaudus*	3	0.03	6	0.29	9
Larids	Sabine's Gull	*Xema sabini*	8	0.08	32	1.55	40
	Glaucous Gull	*Larus hyperboreus*	15	0.16	27	1.30	42
	Glaucous-winged Gull	*Larus glaucescens*	1	0.01	1	0.05	2
	Herring Gull	*Larus argentatus*	2	0.02			2
	Slaty-backed Gull	*Larus schistisagus*			3	0.14	3
	Unid. Kittiwake	*Rissa spp.*	15	0.16			15
	Black-legged Kittiwake	*Rissa tridactyla*	145	1.51	133	6.42	278
	Red-legged Kittiwake	*Rissa brevirostris*	6	0.06	1	0.05	7
	Arctic Tern	*Sterna paradisaea*	28	0.29	141	6.81	169
Alcids	Unid. Alcid	*Alcidae (Family)*	1	0.01			1
	Unid. Small Dark Alcid	*Alcidae (Family)*	50	0.52			50
	Unidentified Murre	*Uria spp.*	71	0.74	2	0.10	73
	Common Murre	*Uria aalge*	528	5.51			528
	Thick-billed Murre	*Uria lomvia*	175	1.83			175
	Black Guillemot	*Cepphus grylle*	12	0.13	9	0.43	21
	Pigeon Gillemot	*Cepphus columba*	2	0.02	1	0.05	3
	Marbled Murrelet	*Brachyramphus marmoratus*	4	0.04			4
	Ancient Murrelet	*Synthliboramphus antiquus*	941	9.83	100	4.83	1041
	Cassins Aukleet	*Ptychoramphus aleuticus*	12	0.13			12
	Parakeet Auklet	*Aethia psittacula*	170	1.78	2	0.10	172
	Crested Auklet	*Aethia cristatella*	196	2.05	572	27.62	768
	Least Auklet	*Aethia pusilla*	944	9.86	4	0.19	948
	Horn Puffin	*Fratercula corniculata*	40	0.42			40
	Tufted Puffin	*Fratercula cirrhata*	139	1.45			139
		Total	**9576**	**100**	**2071**	**100**	**11647**

Table 2. Marine bird observations, on transect only, for the three sub-regions used for seabird surveys during the HLY1201 COMIDA cruise, 30 July – 14 August 2013.

		Dutch Harbor to St. Lawrence Is		St. Lawrence through Bering Strait		Hanna Shoal area	
Common Name	**Latin Name**	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
Pacific Loon	*Gavia pacifica*					1	0.03
Northern Fulmar	*Fulmarus glacialis*	246	7.17	77	3.34	131	3.41
Northern Fulmar Dec.	*Fulmarus glacialis*	1	0.03			2	0.05
Unid. Dark Shearwater	*Puffinus spp.*	17	0.50				
Short-tailed Shearwater	*Puffinus tenuirostris*	1187	34.61	9	0.39	4	0.10
Fork-tailed Storm-petrel	*Oceanodroma furcata*	104	3.03	12	0.52		
Steller's Eider	*Polysticta stelleri*			1	0.04		
King Eider	*Somateria spectabilis*	37	1.08				
Unid. Shorebird	*Charadii (Suborder)*					6	0.16
Ruddy Turnstone	*Arenaria interpres*	1	0.03				
Red Phalarope	*Phalaropus fulicaria*	46	1.34	965	41.81	3171	82.62
Red-necked Phalarope	*Phalaropus lobatus*					3	0.08
Unid. Jaeger	*Stercorariidae (Family)*					2	0.05
Pomarine Jaeger	*Stercorarius pomarinus*	10	0.29	5	0.22	26	0.68
Parasitic Jaeger	*Stercorarius parasiticus*	1	0.03			3	0.08
Long-tailed Jaeger	*Stercorarius longicaudus*	2	0.06			1	0.03
Sabine's Gull	*Xema sabini*			3	0.13	5	0.13
Glaucous Gull	*Larus hyperboreus*					15	0.39
Glaucous-winged Gull	*Larus glaucescens*	1	0.03				
Herring Gull	*Larus argentatus*					2	0.05
Unid. Kittiwake	*Rissa spp.*	15	0.44				
Black-legged Kittiwake	*Rissa tridactyla*	74	2.16	15	0.65	56	1.46
Red-legged Kittiwake	*Rissa brevirostris*	6	0.17				
Arctic Tern	*Sterna paradisaea*	10	0.29	2	0.09	16	0.42
Unid. Alcid	*Alcidae (Family)*					1	0.03
Unid. Small Dark Alcid	*Alcidae (Family)*	33	0.96	17	0.74		
Unid. Murre	*Uria spp.*	28	0.82	18	0.78	25	0.65
Common Murre	*Uria aalge*	364	10.61	106	4.59	58	1.51
Thick-billed Murre	*Uria lomvia*	25	0.73	25	1.08	125	3.26
Black Guillemot	*Cepphus grylle*					12	0.31
Pigeon Guillemot	*Cepphus columba*	2	0.06				
Marbled Murrelet	*Brachyramphus marmoratus*	4	0.12				
Ancient Murrelet	*Synthliboramphus antiquus*	941	27.43				
Cassin's Auklet	*Ptychoramphus aleuticus*	12	0.35				
Parakeet Auklet	*Aethia psittacula*	43	1.25	108	4.68	19	0.50
Crested Auklet	*Aethia cristatella*	43	1.25	126	5.46	27	0.70
Least Auklet	*Aethia pusilla*	79	2.30	771	33.41	94	2.45
Horned Puffin	*Fratercula corniculata*	10	0.29	6	0.26	24	0.63
Tufted Puffin	*Fratercula cirrhata*	88	2.57	42	1.82	9	0.23
	Total	**3430**	**100**	**2308**	**100**	**3838**	**100**

Table 3. Numbers of marine mammals recorded on and off transect for three sub- regions during seabird surveys on the HLY1301 COMIDA cruise, 30 July – 12 August 2013.

		Dutch Harbor to St. Lawrence Is.		St. Lawrence Is through Bering Strait		Hannah Shoal Study Area	
Common Name	*Latin Name*	on	off	on	off	on	off
Unid. Porpoise	*Phocoenidae spp.*				1		
Harbor Porpoise	*Phocoena phocoena*				2		
Dall's Porpoise	*Phocoenoides dalli*	6					
Unid. Whale	*Cetacea (Order)*						2
Minke Whale	*Balaenoptera acutorostrata*		3				2
Gray Whale	*Eschrichtius robustus*			4	36	8	260
Fin Whale	*Balaenoptera physalus*	1	5				
Humpback Whale	*Megaptera novaeangliae*		34		3		
Unid. Pinniped	*Caniformia (Suborder)*	1				7	4
Steller Sea Lion	*Eumetopias jubatus*	1	1				
Northern Fur Seal	*Callorhinus ursinus*	2	2				
Walrus	*Odobenus rosmarus*					880	6385
Walrus Dec.	*Odobenus rosmarus*						2
Unid. Seal	*Phocidae (Family)*	1	1	6		5	8
Spotted Seal	*Somateria fischeri*	2	3	3	1	1	2
Ringed Seal	*Pusa hispida*					10	55
Ribbon Seal	*Histriophoca fasciata*						1
Bearded Seal	*Erignathus barbatus*					2	7
Polar Bear	*Ursus maritimus*						6
Total Marine mammals		**14**	**49**	**13**	**43**	**913**	**6734**

UTMSI Healy 1301 Cruise Report COMIDA 2013

Trophic structure, faunal inventory, and sediment associated biogeochemical processes: Ken Dunton, Amber Hardison, Susan Schonberg, Philip Bucolo, Nathan McTigue, Jordann Young, Christina Bonsell (University of Texas at Austin Marine Science Institute, UTMSI):

During the HEALY1301 COMIDA cruise, the University of Texas at Austin Marine Science Institute (UTMSI) contingent sampled physical, chemical, and biological parameters of the water column, surface sediments, and the associated fauna of the eastern Chukchi Sea. The primary focus of these efforts was to (1) elucidate the trophic structure and sediment processes of the system, (2) quantitatively characterize benthic infaunal abundance, biomass, and diversity through analysis of grab samples to the lowest taxonomic level, and (3) conduct benthic nitrogen cycling process studies. Trophic structure work was accomplished through the collection of primary producers (phytoplankton, sediment microphytobenthos, and sea ice algae) and primary and secondary trophic level consumers for future analysis of their respective $\delta^{13}C$ and $\delta^{15}N$ isotopic signatures. In order to interpret biogeochemical sediment processes, the team measured nitrogen transformation, photosynthetic potential and changes in oxygen concentrations throughout the sediment associated biofilm. Results from these efforts will serve as a baseline to assess the current state of the Chukchi system and future ecological changes resulting from natural and/or anthropogenic sources.

Collections of POM, water column chlorophyll, phytoplankton, and zooplankton

Vertical profiles of station hydrography measuring salinity, temperature, dissolved oxygen, turbidity, chlorophyll *a*, phycoerythrin, pH, and PAR were recorded from every station including the 30 processing stations sampled by UTMSI (Table 1) during CTD water column collection casts. During these casts, we collected water from the depth of chlorophyll *a* maximum concentration in the pelagic, and 5 m above benthos at 23 stations. Water was filtered onto four 25mm GF/F filters per depth and immediately frozen to assess:

1) Particulate organic carbon and nitrogen (C:N) to quantify natural abundances of water column $\delta^{13}C$ and $\delta^{15}N$.
2) Water column chl *a* concentrations quantifying pigment concentrations at these depth across the region.
3) Concentrations of accessory pigments indicative of particular algal groups as well as phaeophytin, and phaeophorbide indicative of chl *a* senescence in the water column.

Samples from a 20 µm plankton and 250 µm zooplankton ring net tows were obtained at 23 and 22 stations respectively (Table 1). Phytoplankton was concentrated through a 65 and 20 µm sieve and divided amongst cruise members upon request. For our purposes, one of two aliquots of phytoplankton were either filtered through a 47mm GF/F filter and immediately frozen for isotopic $\delta^{13}C$ and $\delta^{15}N$ analysis at UTMSI (22 stations), or used to quantify effective quantum yield using a PAM fluorometer (19 stations). Zooplankton samples from 22 stations were sorted, identified, and frozen for isotopic $\delta^{13}C$ and $\delta^{15}N$ analysis at UTMSI (Table 1).

Surface sediments

Surface sediments (1-2 cm) were subsampled via 20 cc or 60 cc syringe core from double van Veen grabs deployed at 22 stations (table 1). Cores targeted:

1) sediment chl *a* concentrations (20 cc)
2) C:N for $\delta^{13}C$ and $\delta^{15}N$ isotopic analysis (20 cc)
3) sediment NH_4^+ (60 cc)
4) concentrations of accessory pigments indicative of particular algal groups, and chl a breakdown products phaeophytin and phaeophorbide indicative of chl *a* senescence in the benthos (20 cc)
5) sediment grain size analysis

Two replicate samples for each parameter were collected at all 22 stations (Table 1) and immediately frozen for future analysis.

Nitrogen cycling in surface sediments and relation to sediment organic matter lability

During the HEALY1301 cruise, shallow sediment cores with intact sediment-water interfaces were collected from five stations (CBL11, H17, CBL13, H29, H33) and used to elucidate nitrogen transformation pathways in surface sediments around Hanna Shoal (Table 1). This work builds on work conducted in the northeast Chukchi Sea by A. Souza and W. Gardner during the COMIDA CAB 2010 project. At each station, six cores were collected using a stainless steel HYPOX corer and incubated for four days in the shipboard environmental chamber following Gardner and McCarthy (2009). Continuous flow of unfiltered, aerated bottom water was established for the incubations, and cores were subjected to one of three treatments: feed water was either (1) left unamended, as a control, (2) spiked with $^{15}NH_4^+$, or (3) spiked with $^{15}NO_3^-$. We collected samples from each core over four days and will measure the concentration and ^{15}N content of various dissolved nitrogen species to estimate rates of nitrification, denitrification, nitrogen fixation, annamox, and dissimilatory nitrate reduction to ammonium (DNRA). 720 time-point samples were collected during the research cruise and brought back to UTMSI for analysis. An additional goal of this project is to explore the influence of organic matter quantity and quality on nitrogen cycling. To that end, we collected undisturbed surface sediments (0-1 cm) at the beginning and end of the incubations and will characterize sediment organic matter lability using various organic biomarkers.

Sediment oxygen depth profiles

At each of the five stations used for the nitrogen study, we collected 2 additional cores using the HYPOX corer and conducted triplicate oxygen depth profiles at 500 µm increments using a Unisense oxygen microsensor and micromanipulator. The depth of oxygen penetration into the sediments is a reflection of sediment reactivity as well as sediment bioturbation/bioirrigation, and it will be critical to interpreting the nitrogen transformation pathways measured in the nitrogen flow-through incubations. At the 5 stations, oxygen penetration depths varied between 3 and 8 mm.

Photosynthetic potential of the microphytobenthos

Multi-Haps cores were deployed at 17 stations to collect intact surface sediments in order to target the photosynthetic potential of the microphytobenthos. Each Haps core was dark adapted in the shipboard environmental chamber for at least 3 hours before measuring effective quantum yield and electron transport rates at a range of light intensities (0 – 20 µmol photons m^{-2} s^{-1}) using a PAM fluorometer. Although these chlorophyll fluorescence measurements provide a proxy for photosynthetic primary light reaction, carbon fixation is not directly measured. Although we could not measure true carbon fixation via typical ^{14}C experimental treatments, we were able to quantify production of O_2 by the microphytobenthos at 5 stations (Table 1). Using the Unisense oxygen microsensor and micromanipulator, O_2 concentrations 1 mm into the sediments were recorded continuously every 10 seconds for 3 hours under dark conditions to measure community respiration, which was immediately followed by no less than 4 hours under a 1.5 µmol photons m^{-2} s^{-1} light treatment. Preliminary data reveal O_2 concentration increases in CBL13, H28, H29 sediments during light treatments indicating possible photosynthetic activity of this community at light regimes observed at these depths.

Ice algae collection and analysis

At processing station H33, two zodiacs were deployed off Healy for ice algae collections from ice floes. Teams returned to Healy with coolers of ice and ice was distributed to interested science parties. For our purposes, ice was melted, filtered on 47 mm GF/F filters and frozen for isotopic $\delta^{13}C$ and $\delta^{15}N$ analysis at UTMSI as well as ice algal identification. In addition, large pieces of ice containing dense communities of ice algae were transported back to UTMSI on ice for further algal identifications.

Benthic infaunal and epifaunal invertebrate and fish collections

Benthic infaunal invertebrates were collected from three replicate van Veen grabs from 20 stations (Table 1). Samples were sieved using a low-flow sieve table to ensure gentle handling of soft-tissue invertebrates (*i.e*. polychaetes) to aid in taxonomy. Infaunal organisms were sorted and preliminarily identified to lowest possible taxonomic level and preserved in 80% ethanol onboard the Healy. These samples will be used to create an inventory of species occurrence and to develop a quantitative assessment of spatial patterns of abundance, biomass and diversity of the benthic infaunal communities. One additional double van Veen grab was collected and sieved at each station to provide infaunal invertebrates for isotopic analyses. Samples were sorted, identified, dried at 60°C, and transported to UTMSI for $\delta^{13}C$ and $\delta^{15}N$ analyses.

In collaboration with Dr. Konar's team, invertebrate samples were collected from each of 25 stations. A selection of organisms were collected from each trawl based on several factors such as their ubiquity across the study area, their trophic level and/or feeding mode, their uniqueness within the study area, and their inclusion in previous arctic studies. Organisms were sorted, identified, dried at 60°C, and transported to UTMSI for $\delta^{13}C$ and $\delta^{15}N$ analyses.

Separate fish trawls were not conducted for this survey. However, all fish caught in the 3m beam trawl by Dr. Konar's epibenthic invertebrate component were separated and immediately sorted by species, measured, and frozen for future examination. For some species, subsamples were provided from the catch to other researchers as part of the overall Hanna Shoal COMIDA project (e.g. for metals and organic chemical contaminants and for stable isotope analyses). Although fish caught were small (mainly < 100mm) and sparse (often less than 20 fish per catch), each catch was relatively diverse. Eelblennies (*Anisarchus medius* and *Lumpenus fabricii*), eelpouts (mainly *Lycodes polaris*), snail fish (*Liparis tunicatus*), and arctic cod (*Boreogadus saida*) were fairly ubiquitous across the study area. Other relatively common fish were sculpins (mainly *Gymnocanthus tricuspis),* Bering Flounder (*Hippoglossoides robustus*), and arctic alligatorfish (*Ulcina orlikii*). At one shallow site where sand dominated the benthic sediments, Pacific sandlance (*Ammodytes hexapteras*) dominated the catch.

PolarTREC Outreach

Reports on scientific operations and daily life aboard the Healy were described in 18 journals and included over 100 photos prepared by Andrea Skloss. Journals were posted while Healy was underway on the PolarTREC website: www.polartrec.com/expeditions/chukchi-sea-ecosystem-study. These journals targeted a member of each science team. During the cruise journals were read by the families of the science party and Coast Guard, children in private schools, colleagues, and fellow science teachers.

Table 1: Station listings and parameters collected at each station for UTMSI while aboard USCGV Healy during COMIDA 2013, Healy cruise 1301.

Station designation	CTD vertical profiles	H_2O filtered: chl a, HPLC, POM at surface, chl	Plankton tow (20µ net)	Zooplankton tow (250µ net)	Van Veen and Double van Veen Grab: sediment infauna ID, $\delta^{13}C$ and $\delta^{15}N$ of	Multi- Happs Core for microphytobenthic	Epibenthic trawl for invert ID, $\delta^{13}C$ and $\delta^{15}N$ and for fish ID, length and	Lander Core to measure N cycling	O2 production experiments from Multi- Happs or lander cores
1-BRS5	x	x	x						
2-CBL11	x	x	x	x	x	x	x	x	
3-H112	x	x	x	x	x	x	x		
12-UTX1	x	x	x	x			x		
14-H7	x	x	x	x	x	x	x		
15-H17	x	x	x	x	x	x	x	x	
17-HS3	x	x	x	x	x	x	x		
18-UTX8	x	x	x	x	x	x	x		
19-UTX11	x	x	x	x	x		x		
25-CBL13	x	x	x	x	x	x	x	x	x
28-CBL14							x		
36-H111	x	x	x	x	x		x		
37-H109	x	x	x	x	x	x	x		
380H108							x		
39-BARC1	x					x			
40-BARC2	x		x	x	x				
41- BAR3	x	x							
47-BARC9	x	x	x	x	x				
48-BARC10							x		
52-H29	x	x	x	x	x	x	x	x	x
53-H32					x				
56-CBL15					x				
57-H107	x	x	x	x	x	x	x		
58-H33	x	x	x	x	x	x	x	x	x
63-H28	x	x	x	x	x	x	x		x
64-H15	x	x	x	x	x	x	x		
65-H27	x	x	x	x	x	x	x		x
72-H9	x	x	x	x	x	x	x		
73-H34	x	x	x	x	x	x	x		
81-H102	x	x	x	x	x	x	x		

Artist's Report
USCGC Healy Chukchi Sea Survey
July 29 – August 15, 2013

I was deployed aboard the Ice Breaker Healy under the aegis of the Coast Guard Art Program (COGAP) to gather reference materials for a painting depicting Coast Guard support for Arctic research.

Additionally, I produced an artist's sketchbook that featured thirty drawings with explanatory text for the *Compass*, the official blog of the U.S. Coast Guard. These drawings are posted at: http://coastguard.dodlive.mil/tag/bob-selby/. The sketchbook approach allowed a close focus upon individual crewmembers and scientists that invited viewers to contemplate the extraordinary collaboration of the Healy and science.

Respectfully submitted,

Bob Selby
Champlain College
Burlington, Vermont

Report of Carolyn Marks Blackwood
www.cmblackwood.com

I am a Fine Art photographer who specializes in Abstraction in Nature, with Series that include Ice, Water, Clouds, Fog, etc. I presently show with The Alan Klotz Gallery in New York City, and with the Carrie Haddad Gallery in Hudson, New York. Another gallery in London will be added this fall.
The purpose of this trip on the Healy has been twofold. I wanted to start a new series of Arctic abstractions - To try to capture the beauty and the spirit of this place, which now seems more ephemeral than ever.
In return for this opportunity, I have offered my services as a photographer to the Scientists, with the expressed purpose of taking photos that they could use to Illustrate their work and process on a science cruise in the Arctic.
These photos can be used by the different science groups in anyway they see fit. I am gratefully giving the rights to these photographs to the Scientists.
In addition, there was also a special request for me to show Women Scientists at Work and I have prepared a special group of photographs for this purpose.
I have presented the scientists with some initial photos, which I have processed and I am sharing while we are still onboard. I will prepare the rest in a timely manner after I am home and in my studio. I will go thru the many thousands of photos I have taken and send any other photographs that I think appropriate to the chief scientists in each group by the end of August.
As for my Arctic Abstractions, I hope to have a show of them within the next year, in New York City. I will give notice to all interested parties if and when a show takes place.