Initial Results of Russian-American Long-term Census of the Arctic (RUSALCA)

Terry E. Whitledge, Kathleen Crane, Vladimir Smolin, Kevin Wood and Mikhail Zhdanov

*University of Alaska Fairbanks
*Arctic Research Office, NOAA
*Far Eastern Hydrometeorological Research Center
*Group Alliance, Moscow

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- Group Alliance, Moscow
- Arctic Research Office/NOAA
- Ocean Exploration Program/NOAA

Objectives

- Biophysical moorings in western Bering Strait
- High speed CTD transects across Herald shelf valley
- Enhance the knowledge of faunal distributions for the census of marine life
- Assess potential productivity changes accompanying global climate change in the subarctic/Arctic

Cruise Personnel	Citizenship	Position/Institution
Hydrographic Liason		
Vladimir Smolin	Russia	State Navigation and Hydrographic Research Institute of the Ministry of Defense of the Russian Federation
Alexandr Chemin	Russia	Navy Headquarters of the Russian Federation
Alexander Federov	Russia	State Navigation and Hydrographic Research Institute of the Ministry of Defense of the Russian Federation
Agency Oversight		
Kathleen Crane	USA	NOAA Arctic Research Office
Kevin Ray Wood	USA	NOAA Arctic Research Office
Mikhail Zhdanov	Russia	Group Alliance
News Media		
Jeffery Jones	Canada	Reporter, Reuters Canada Limited
Benthic Processes- Infauna		
Arianne Balsom	USA	Univ. of Tenn
Boris Sirenko	Russia	Zoological Inst.
Sergei Gagaev	Russia	Zoological Inst.

Benthic Epifauna		
Katrin Iken	Germany	University of Alaska
Bodil Bluhm	Germany	University of Alaska
Census of Arctic Zooplankton		
Russell Hopcroft	Canada	University of Alaska
Ksenia Kosobokova	Russia	Shirshov Oceanology Inst.
Biodiversity of Adult Fish		
David Stein	USA	NOAA
Catherine Mecklenburg	USA	Pt. Stephens Research
Boris Sheiko	Russia	Zoological Inst.
Biodiversity and Ecology of Juvenile Fish		
Brenda Holladay	USA	University of Alaska
Nutrient and Primary Productivity Studies		
Terry Whitledge	USA	University of Alaska
Sang Lee	Korea	University of Alaska
CTD and Video Plankton Recorder		
Marshall Swartz	USA	Woods Hole
Mark Dennett	USA	Woods Hole

Bering Strait- Physical Oceanography-Mooring

Sarah Thornton	Canada	Univ. of Alaska
Igor Lavrenov	Russia	AARI
Alexander Ipatov	Russia	AARI

Microbial reactions and fluxes

Alexander Savvichev	Russia	Inst. Of Microbiology
Igor Rusanov	Russia	Inst. Of Microbiology

Side looking sonar and video

Viacheslav Gladysh	Russia	VNIIOkeangeologia
Boris Smirnov	Russia	VNIIOkeangeologia

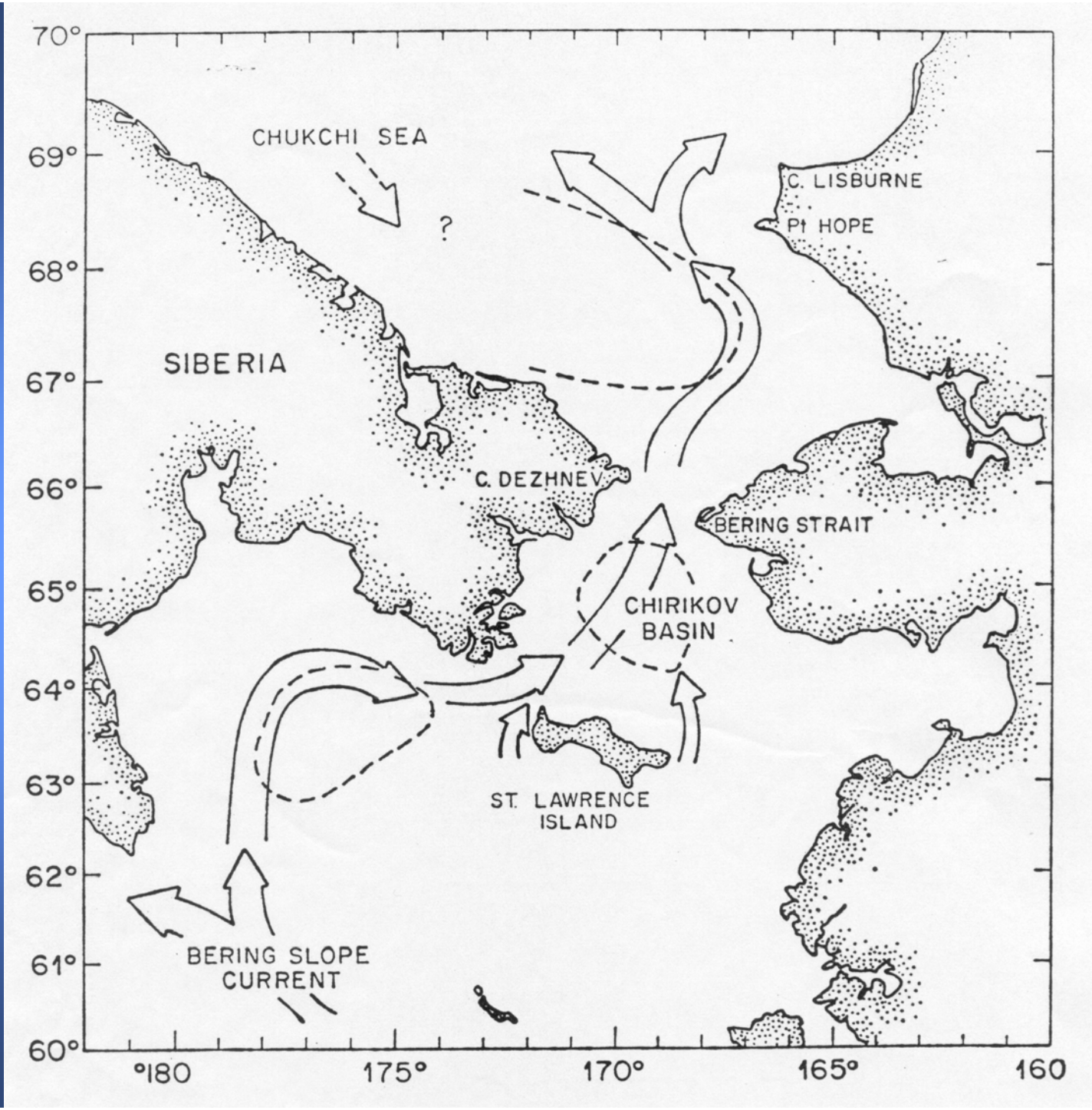
Paleoceanography

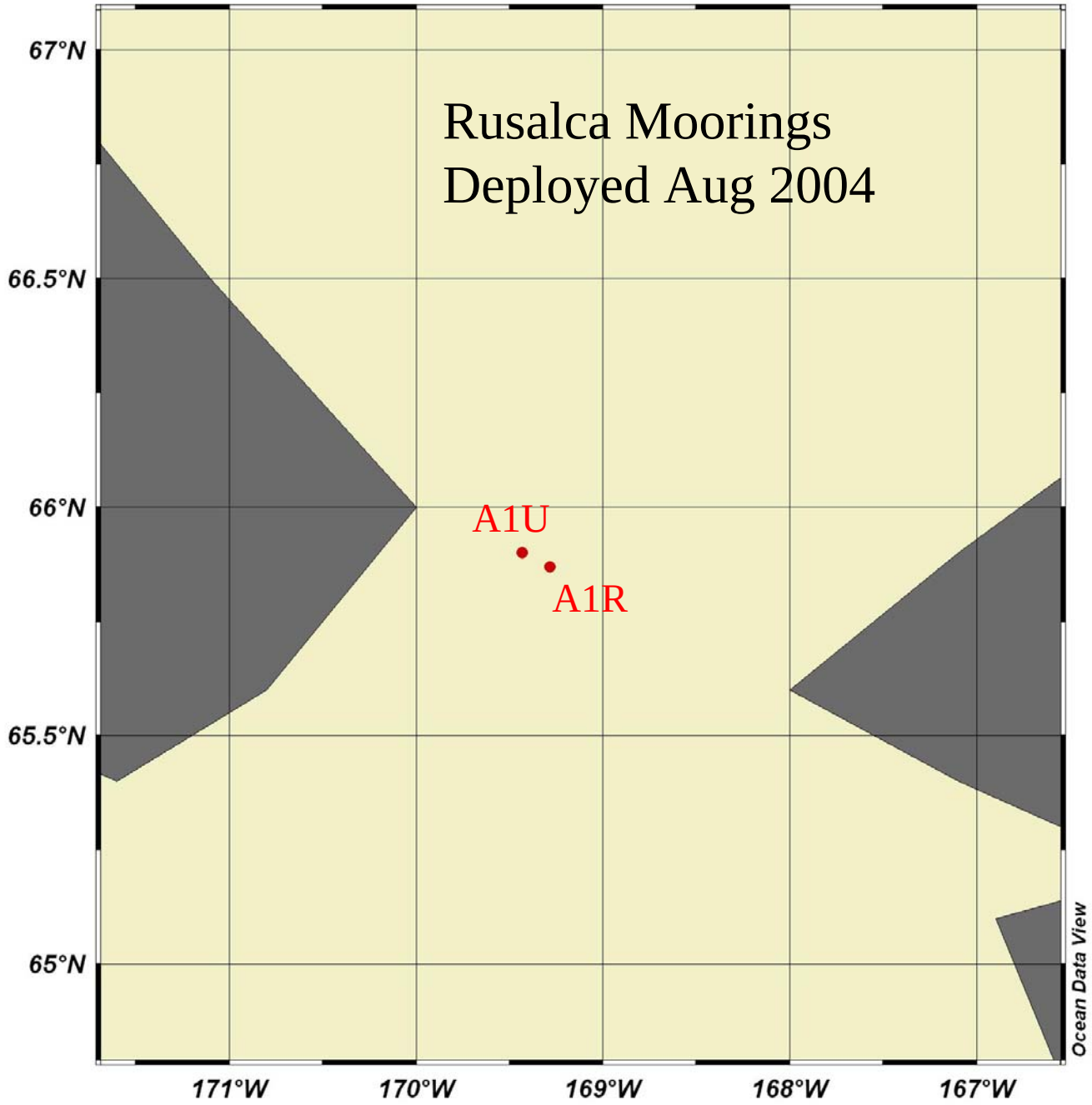
Vitaly Kaulio	Russia	VNIROkeangeologia

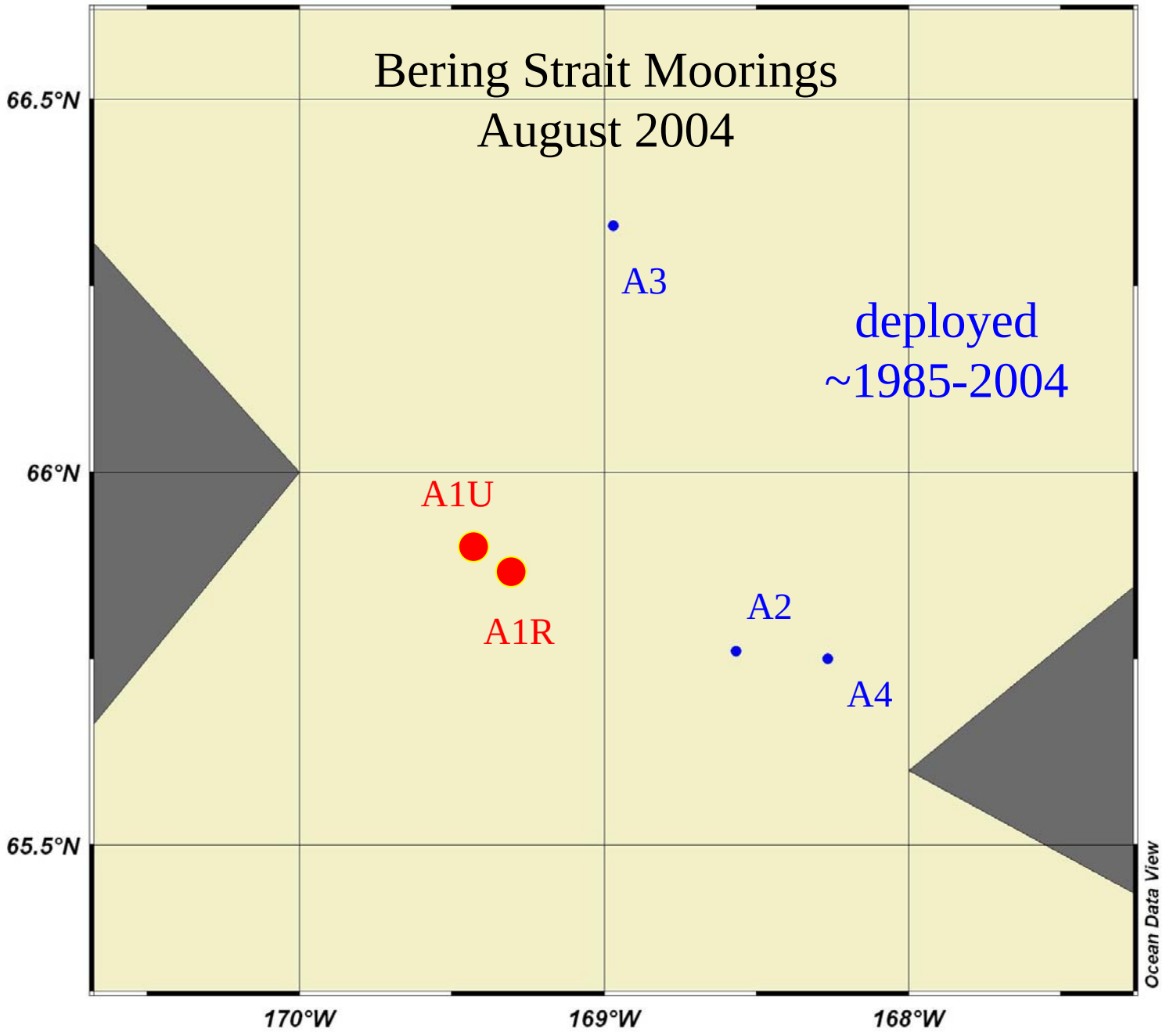
Atmospheric Contaminants

Maxim Ivanov	Russia	Pacific Oceanological Institute

Western Bering Strait Mooring Deployments


70°
69°
68°
67°
66°
65°
64°
63°
62°
61°
60°
°180
175°
170°
165°
160
CHUKCHI SEA
?
C. LISBURNE
Pt HOPE
SIBERIA
C. DEZHNEV
BERING STRAIT
CHIRIKOV
BASIN
ST. LAWRENCE
ISLAND
BERING SLOPE
CURRENT


Rusalca Moorings
Deployed Aug 2004
A1U
A1R
67°N
66.5°N
66°N
65.5°N
65°N
171°W
170°W
169°W
168°W
167°W
Ocean Data View


Bering Strait Moorings
August 2004
66.5°N
66°N
65.5°N
170°W
169°W
168°W
A3
deployed
~1985-2004
A1U
A1R
A2
A4
Ocean Data View

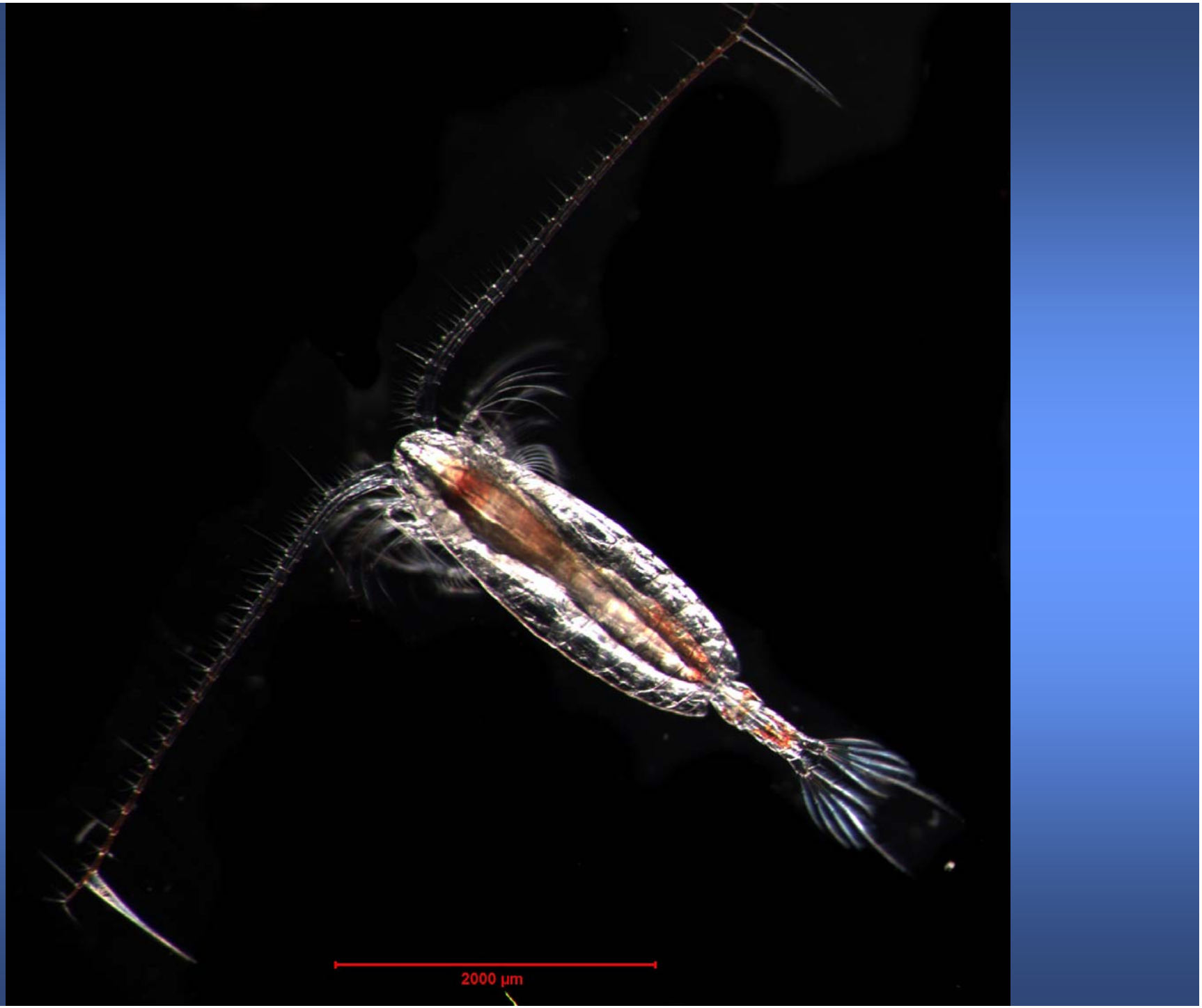
Faunal distributions for the census of marine life in the subarctic/Arctic

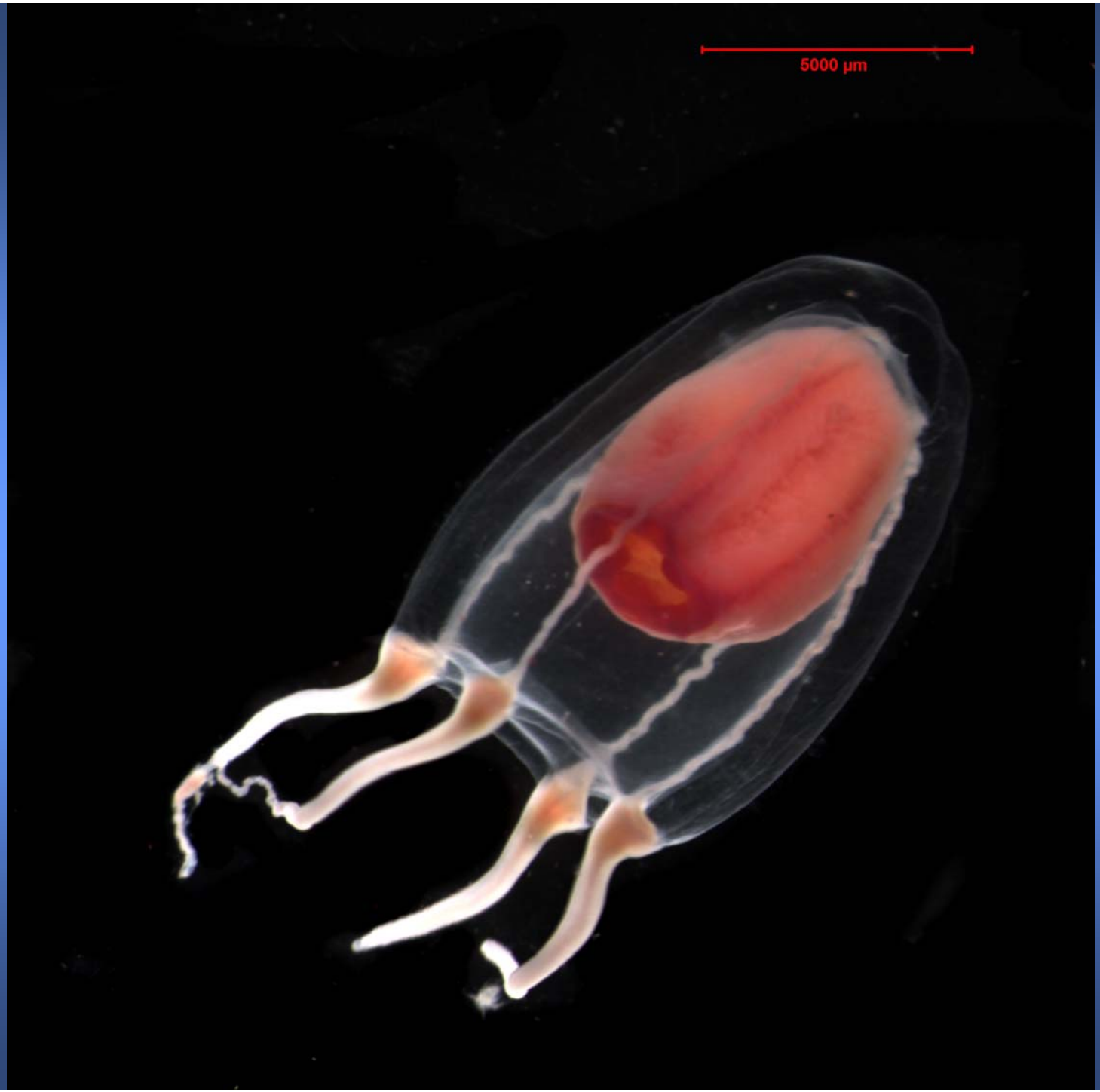

NorWesCo
STEEL


KATRIN


St. 106


5000 µm


2000 µm


5000 µm


5000 µm


5000 µm

High speed CTD transects across Herald shelf valley

Assess potential productivity changes accompanying

global climate change in the subarctic/Arctic

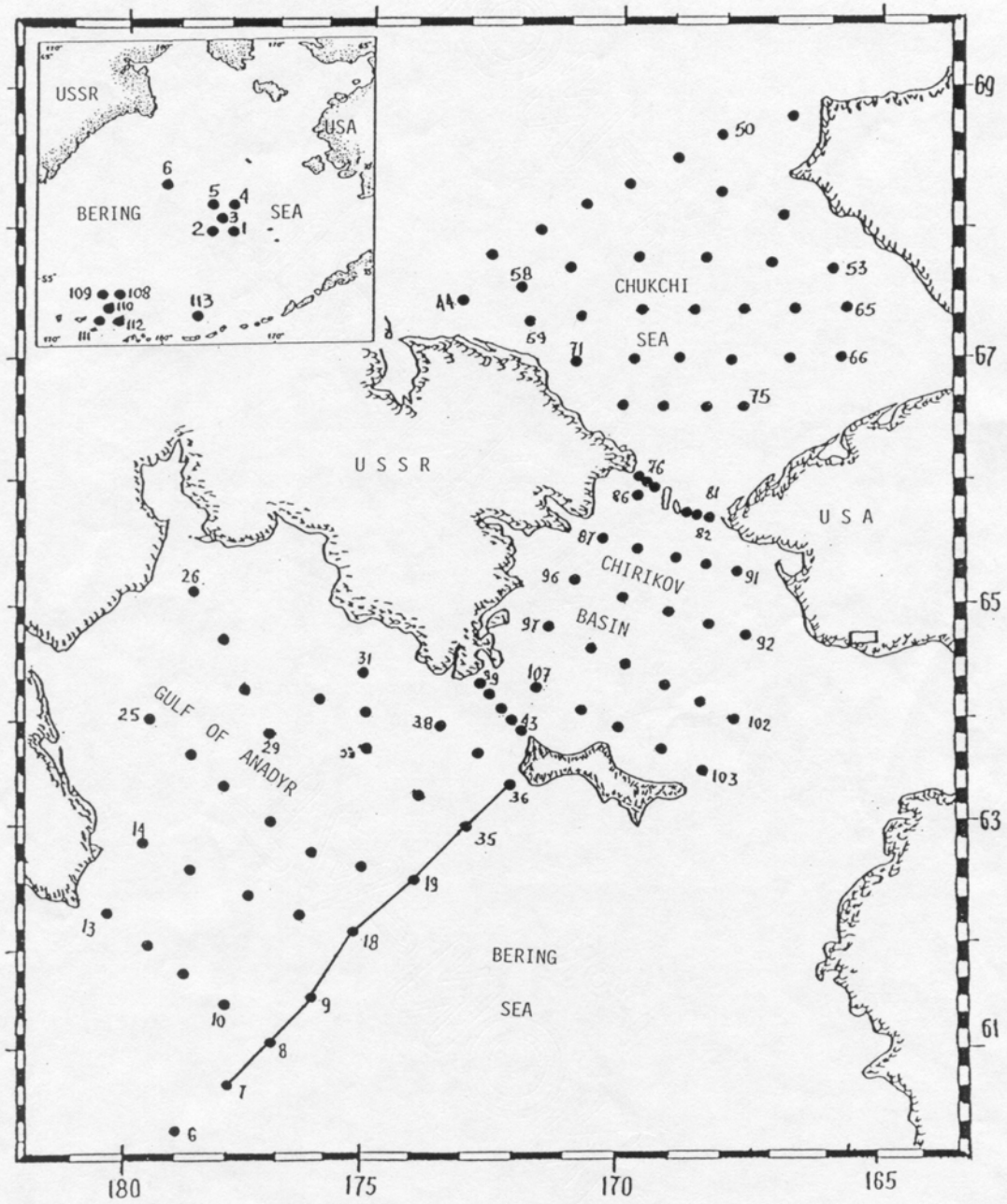
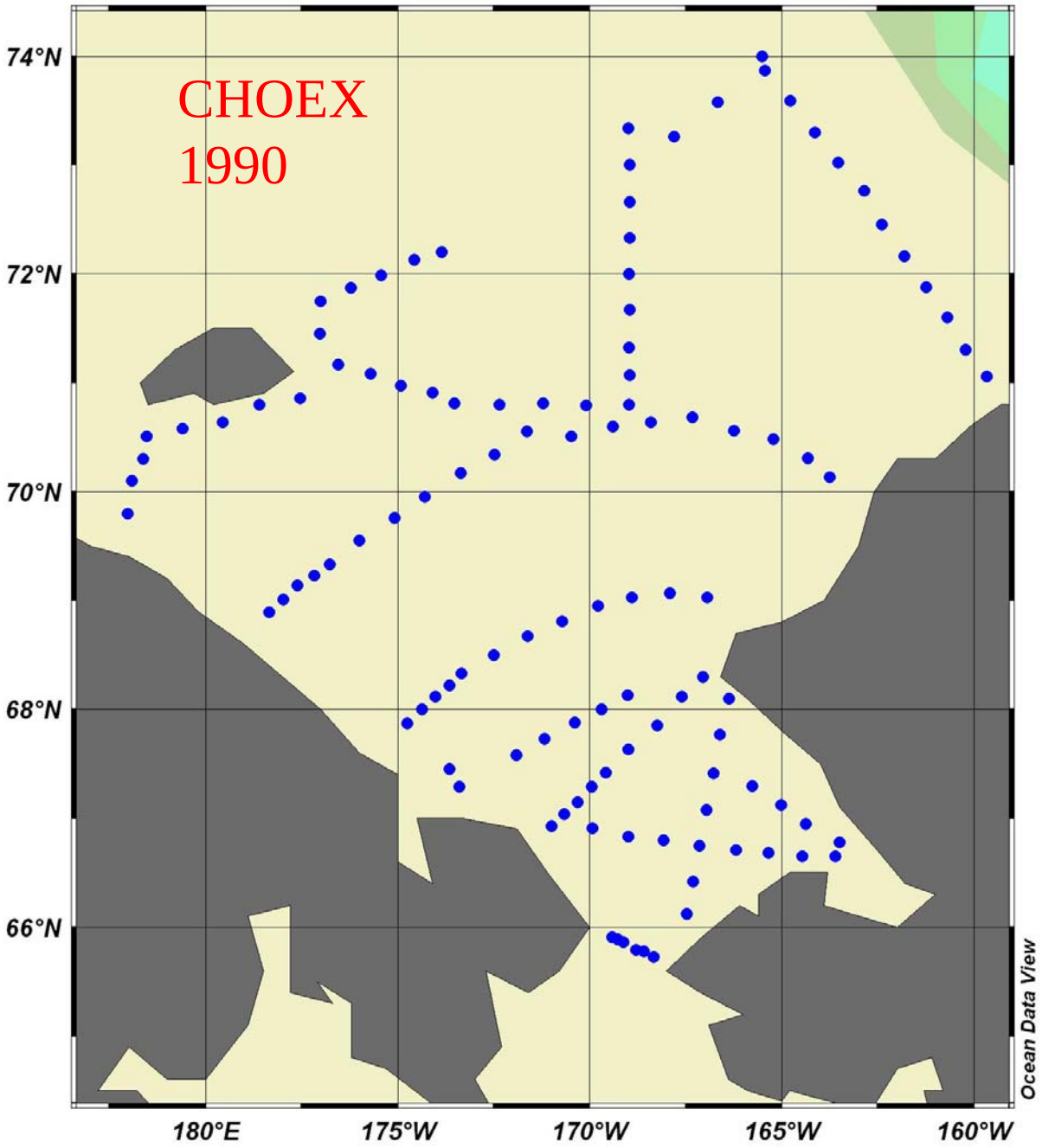


Figure 1. Hydrographic and biological station locations sampled in the Bering/Chukchi Seas during 26 July-2 September 1988.


CHOEX
1990
74°N
72°N
70°N
68°N
66°N
180°E
175°W
170°W
165°W
160°W
Ocean Data View

Primary product of the Bering and Chukchee seas (mgC/m^2 per day)

	32	104	106	109	112	45	49	50	53	55	57	59	64	68	69	74
0,5	350	77	86	2.5	5.0	36	20	21	31	37	21	30	3.6	2.9	112	97
5	270	57	67	4.8	10.5	27	19	26	50	76	23	33	82	14	150	104
10	120	-	26	1,7	-	16	16	28	53	140	-	-	290	13	9	130
15	46	8.5	10	0.5	1.2	5	15	9.4	46	290	-	-	206	-	9	75
25	3.5	0.5	0.3	0.00	0.04	14	5	2.6	34	130	75	195	42	0.4	24	18
45	-	-	-	-	-	0.11	0.4	0	0.9	-	-	-	-			
0 2	3210	680	720	38	100	420	404	390	1400	4700	1070	2400	200		970	2020
P/B	-	0.52	0.92	0.07	0.25	0.08	-	3.0	1.7	0,29	0,2	0,86	0,43		0.32	1.0
	-	1.3	0.78	0.56	0,40	5.0	-	0.13	0.84	16	5.0	2.8	0.46		3.0	1,9

Korsak (in press)

Areal primary productivity by region. Numbers in parentheses indicate the mean ± standard deviation.

	Station	mg C m^{-2} d^{-1}	mg C m^{-2} hr^{-1}
Bering Shelf	4	918.33	91.81
" "	6	105.63	11.02
" "	9	744.33	60.38
" "	18	1222.98	111.71
" "	19	751.85	82.53
Bering Shelf	35	483.13	56.93
		(704.37 ± 381)	(69.1 ± 34.95)
Station 36	36	15252.19	1596.61
Bering Deep	109	1885.09	256.12
" "	112	1769.59	140.00
Bering Deep	113	2041.39	273.99
		(1898.7 ± 136)	(223.4 ± 72.8)
Gulf of Anadyr	24	3599.01	405.45
" " "	27	548.11	71.99
Gulf of Anadyr	32	1698.07	173.52
		(1948.4 ± 1540)	(216.9 ± 170.9)
Anadyr Strait	41	1722.97	175.39
Bering Strait	83	206.92	24.90
Bering Strait	86	1417.18	164.80
Chukchi Sea	45	503.55	72.66
" "	49	1222.03	127.40
" "	50	375.61	51.03
" "	55	5450.28	396.71
" "	57	264.88	32.71
" "	59	1949.28	302.77
" "	64	150.64	18.41
" "	69	4444.64	521.93
Chukchi Sea	74	241.80	32.32
		(1622 ± 1987)	(172.9 ± 186.8)
Chirikov Basin	89	3163.37	346.09
" "	96	760.05	81.91
" "	100	604.25	89.60
" "	102	143.00	23.76
Chirikov Basin	106	494.46	39.73
		(1033 ± 1212)	(116.2 ± 131.5)

Zeeman (in press)

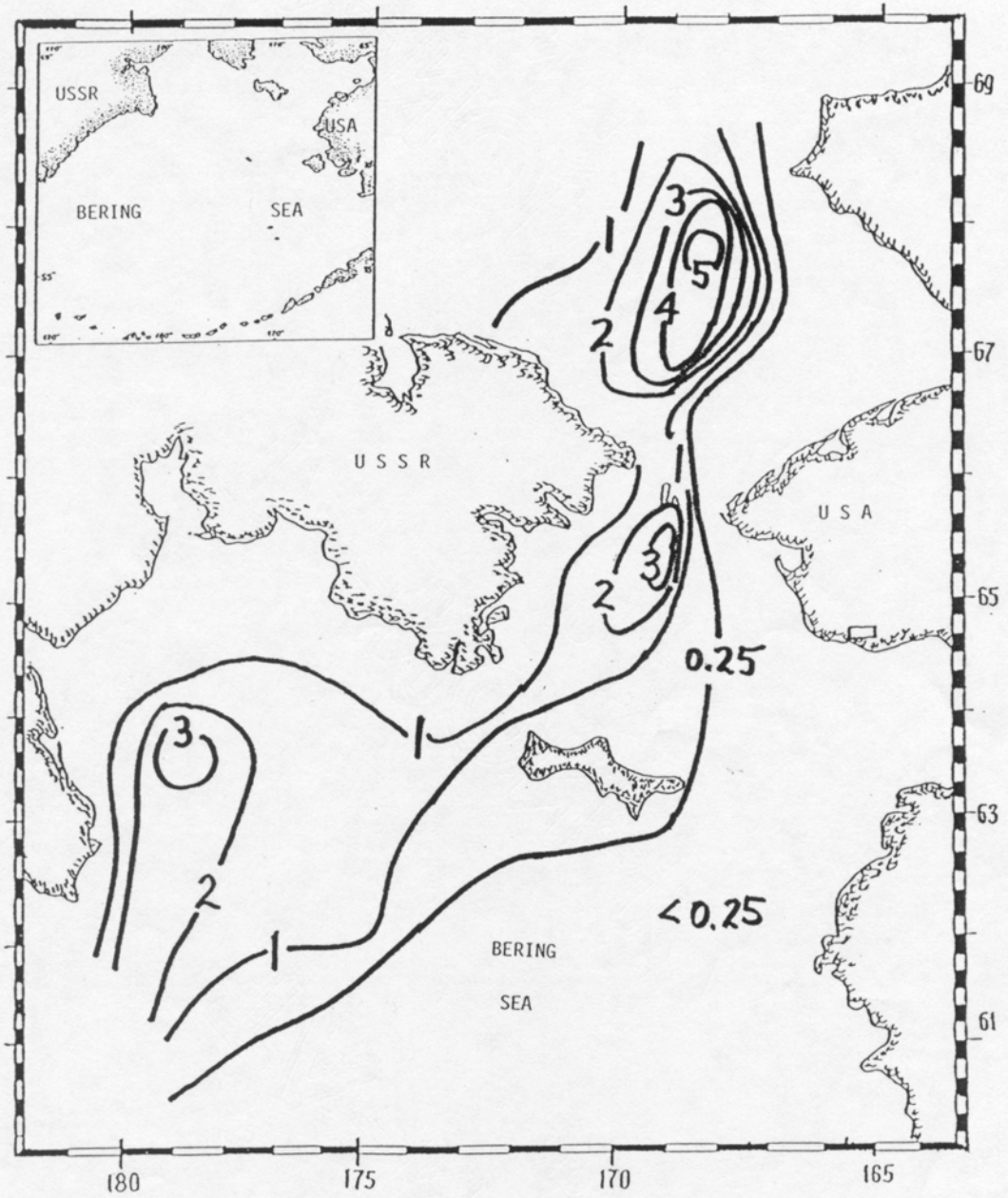
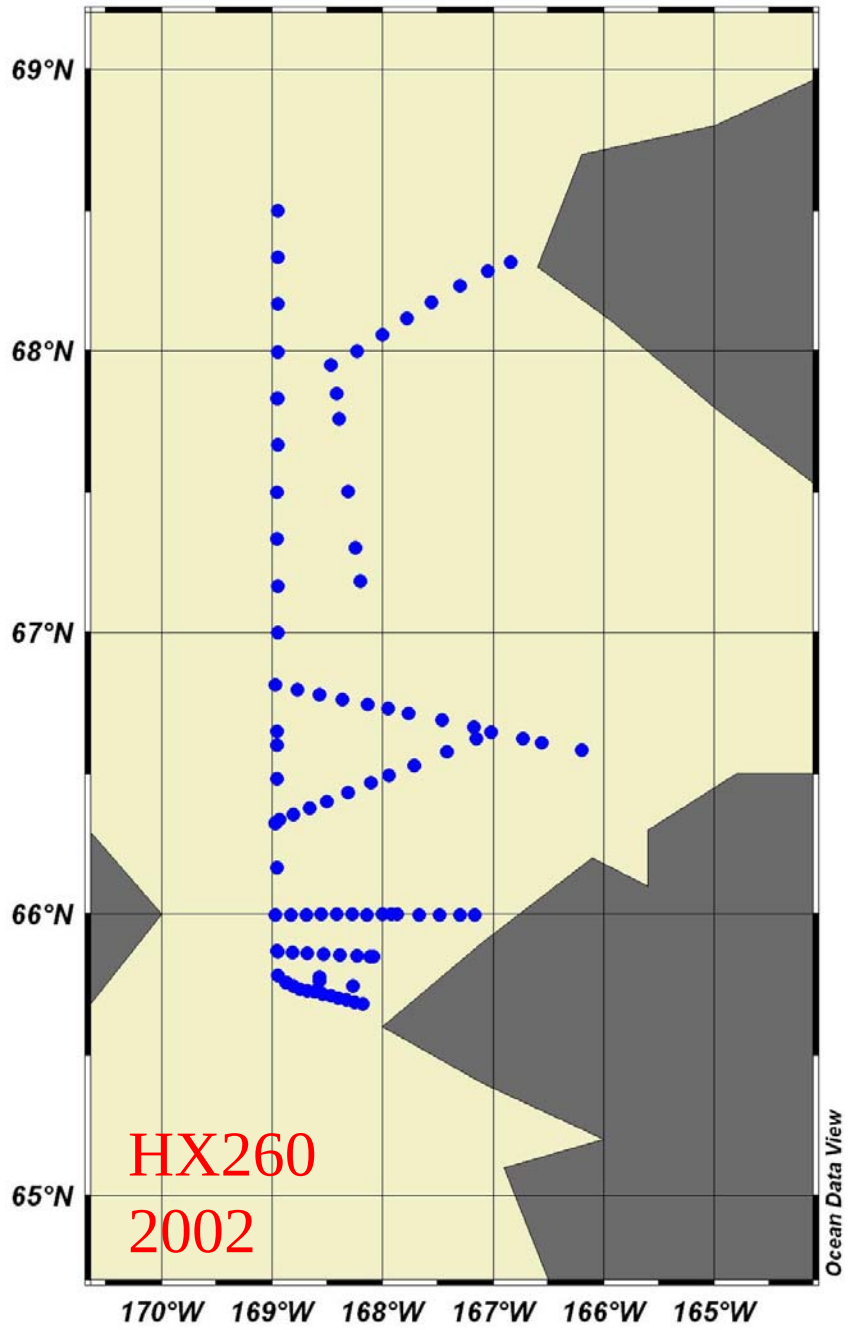
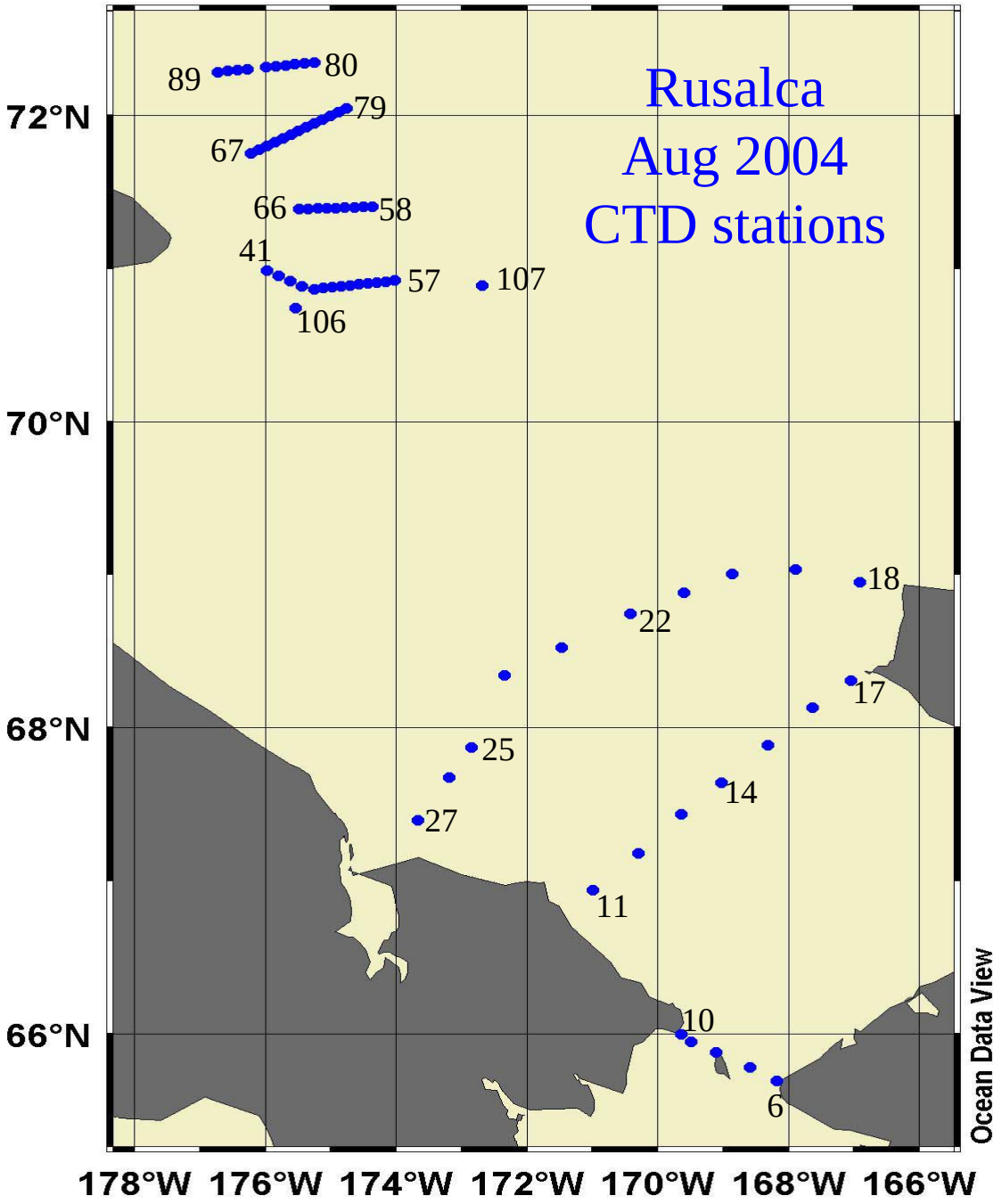
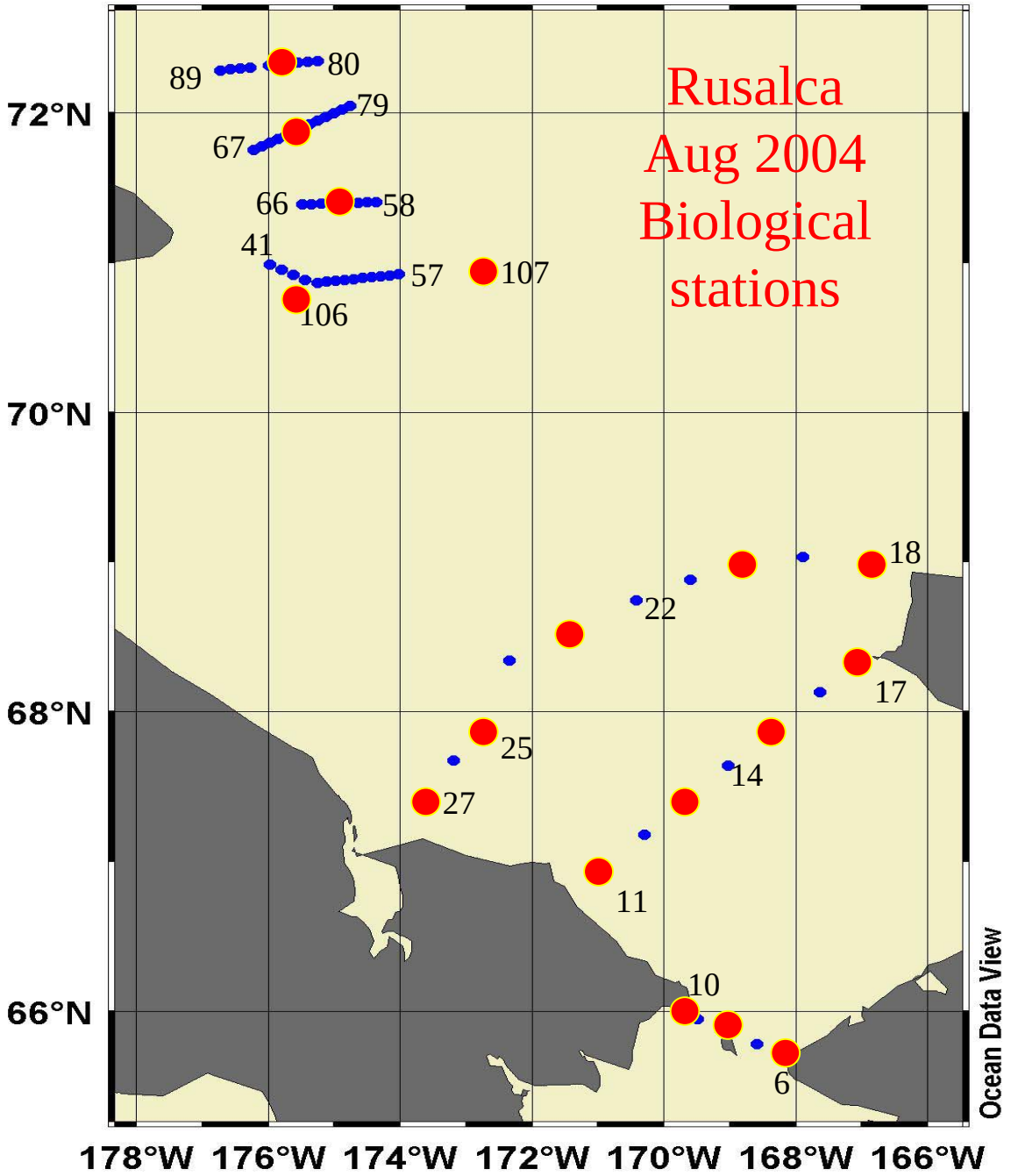
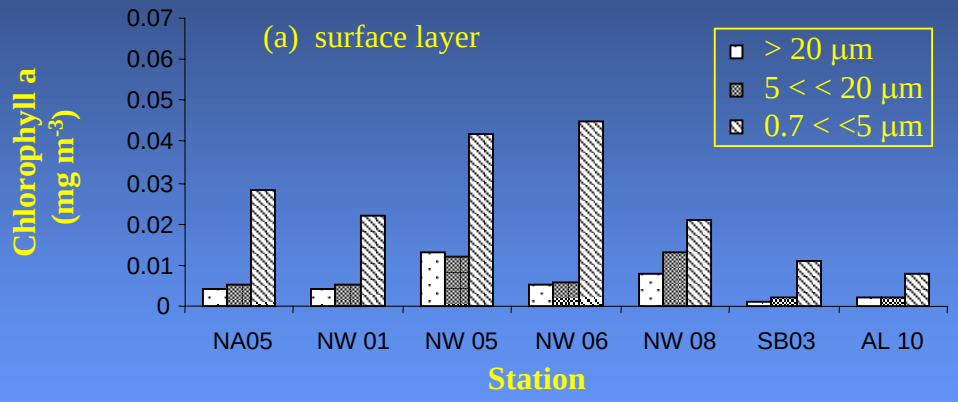


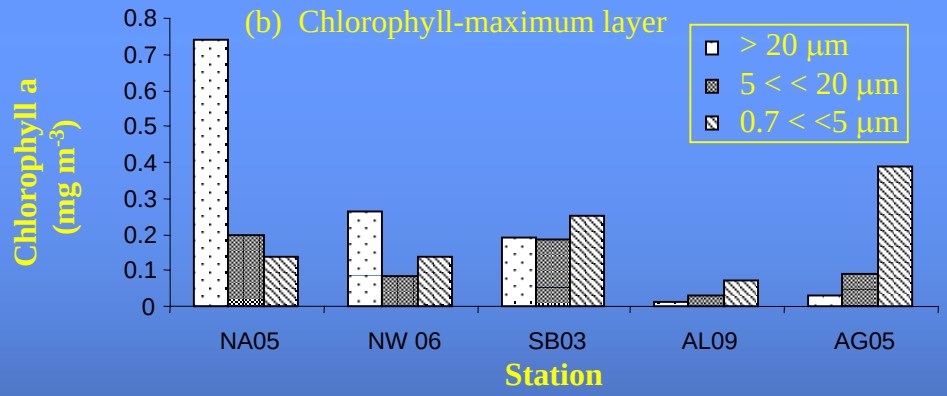
Figure 6. Primary production (g C/m^2/day) for Bering/Chukchi Seas for 1-23 August 1988 (after Zeeman, in press; and Korsak, inpress).


69°N
68°N
67°N
66°N
65°N
170°W
169°W
168°W
167°W
166°W
165°W
HX260
2002
Ocean Data View


Rusalca
Aug 2004
CTD stations
89
80
79
67
66
58
41
57
107
106
18
22
17
25
14
27
11
10
6
72°N
70°N
68°N
66°N
178°W
176°W
174°W
172°W
170°W
168°W
166°W
Ocean Data View


Rusalca
Aug 2004
Biological
stations
89
80
79
67
66
58
41
57
107
106
18
22
17
25
14
27
11
10
6
72°N
70°N
68°N
66°N
178°W
176°W
174°W
172°W
170°W
168°W
166°W
Ocean Data View


(a) surface layer
> 20 µm
5 < < 20 µm
0.7 < <5 µm
Chlorophyll a (mg m-3)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
NA05
NW 01
NW 05
NW 06
NW 08
SB03
AL 10
Station


(b) Chlorophyll-maximum layer
> 20 µm
5 < < 20 µm
0.7 < <5 µm
Chlorophyll a (mg m-3)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
NA05
NW 06
SB03
AL09
AG05
Station

	Open Water						Below Ice		
	Surface			Chlorophyll-maximum layer			Surface		
	Mean	S.D.	n	Mean	S.D.	n	Mean	S.D.	n
Temperature (°C)	-1.19	0.22	6	-0.89	0.34	6	-0.62		1
Salinity (‰)	26.96	0.66	6	31.75	0.21	6	26.42		2
Light (µ E/ m^2 s)	963	364	8	19	7	8	29	17	3
Nitrate (µ mol/l)	0.02	0.04	6	4.52	2.37	6	0	0	3
Ammonium (µ mol/l)	0.21	0.16	6	0.40	0.36	6	0.18	0.24	2
Total Chl a (mg Chl a/m^3)	0.04	0.02	8	0.60	0.31	6	0.02	0.01	3
Biomass of large (>20 µm) phytoplankton (%)	13.6	4.9	7	33.7	28	5	21	7.6	3
Biomass of small (0.7 - 5 µm) phytoplankton (%)	69.3	10.6	7	44.4	26	5	49	13	3
C/N ratio (atom/atom)	8.57	2.53	8	7.86	2.53	5	10.9	0.9	3
Assimilated C/N ratio (atom/atom)	15.9	11	7	3.6	9.1	3	13.8	9.37	3
POC/Chl a (w/w)	314	216	8	16.8	11.2	5	181	25	3
PON/Chl a (w/w)	26	18	8	2.3	2.3	5	14	0.8	3
Carbon specific uptake (h^{-1})	0.000679	0.00037	9	0.0036	0.00034	3	0.000228	0.000161	3
Carbon absolute uptake (mg C/m^3 h)	0.040	0.027	9	0.257	0.079	3	0.0125	0.0114	3
Nitrate specific uptake (h^{-1})	0.000291	0.00023	9	0.002354	0.003081	3	0.000084	0.000054	3
Nitrate absolute uptake (mg NO_3/m^3 h)	0.001008	0.00118	9	0.0144	0.0153	3	0.000288	0.000209	3
Ammonium specific uptake (h^{-1})	0.001138	0.00047	9	0.006851	0.00704	3	0.000284	0.000031	3
Ammonium absolute uptake (mg	0.001	0.00	7	0.068	0.050	3	0.0007	0.000	3

primary production results

- Nutrient concentrations were found to limit PP in surface layer while light was limiting in the chlorophyll maximum
- High chlorophyll was observed on the bottom of ice and in chlorophyll maximum at 50m
- Small phytoplankton (<5µm) was >70% of biomass in surface and 44% in the chlorophyll maximum layer
- f-ratio was 0.22-0.26
- Estimated annual production was 1.04 gC m^{-2}

Implications of climate change to primary production

- 2-3% of surface irradiation passed through 2.3 m of ice
- Light at depth of chl max was 2% of surface
- In situ incubations indicate that 30% reduction in ice thickness will increase PP by 2-3 fold
- Less ice cover may increase the growing season but increase nutrient limitation