The effect of oceanographic structure on juvenile pollock and capelin distribution in the Gulf of Alaska

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(Alaska Fisheries Science Center)

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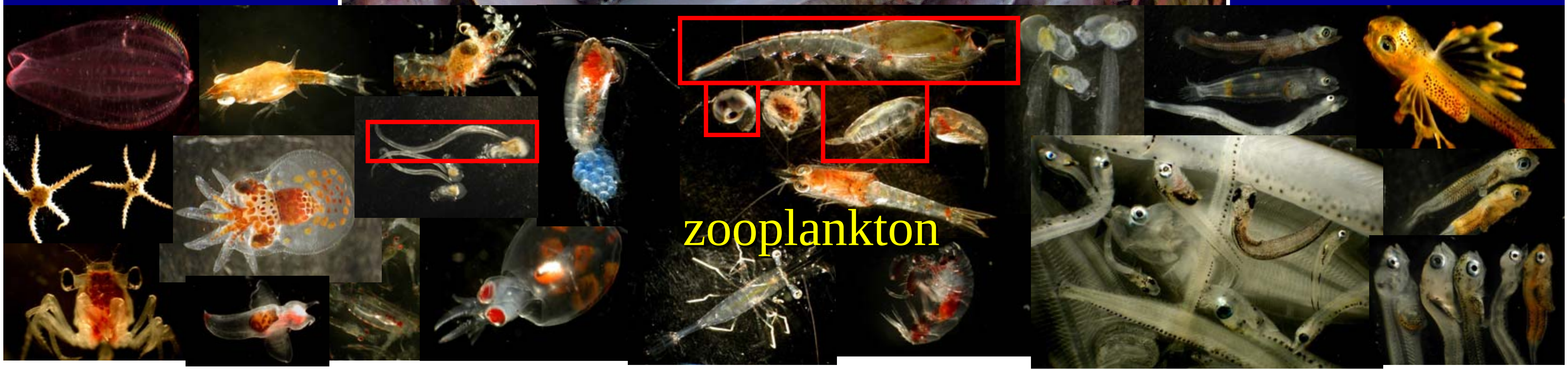
(Pacific Marine Environmental Laboratory)


mammals, birds, fishes


fisheries

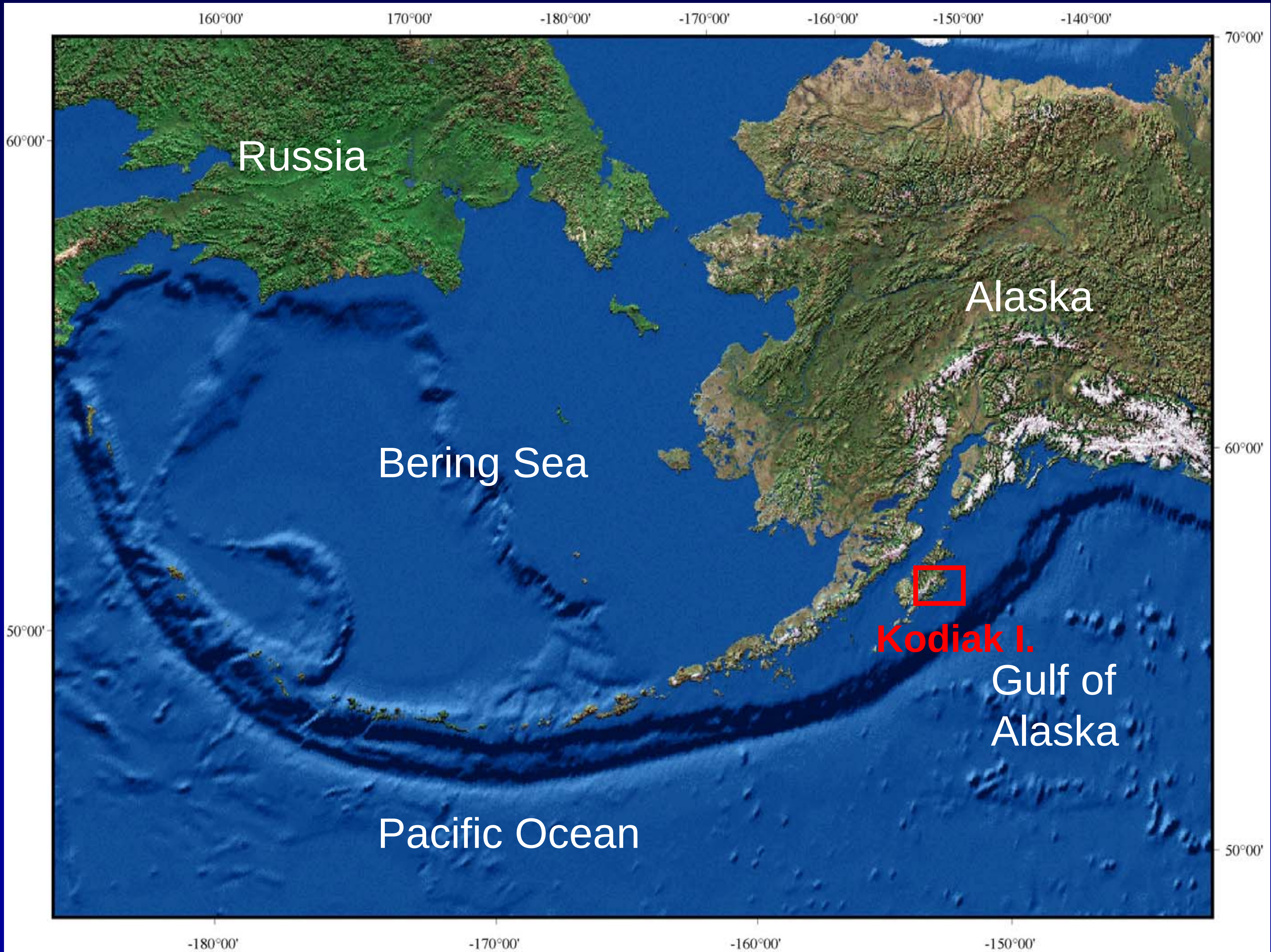

walleye pollock
capelin


zooplankton

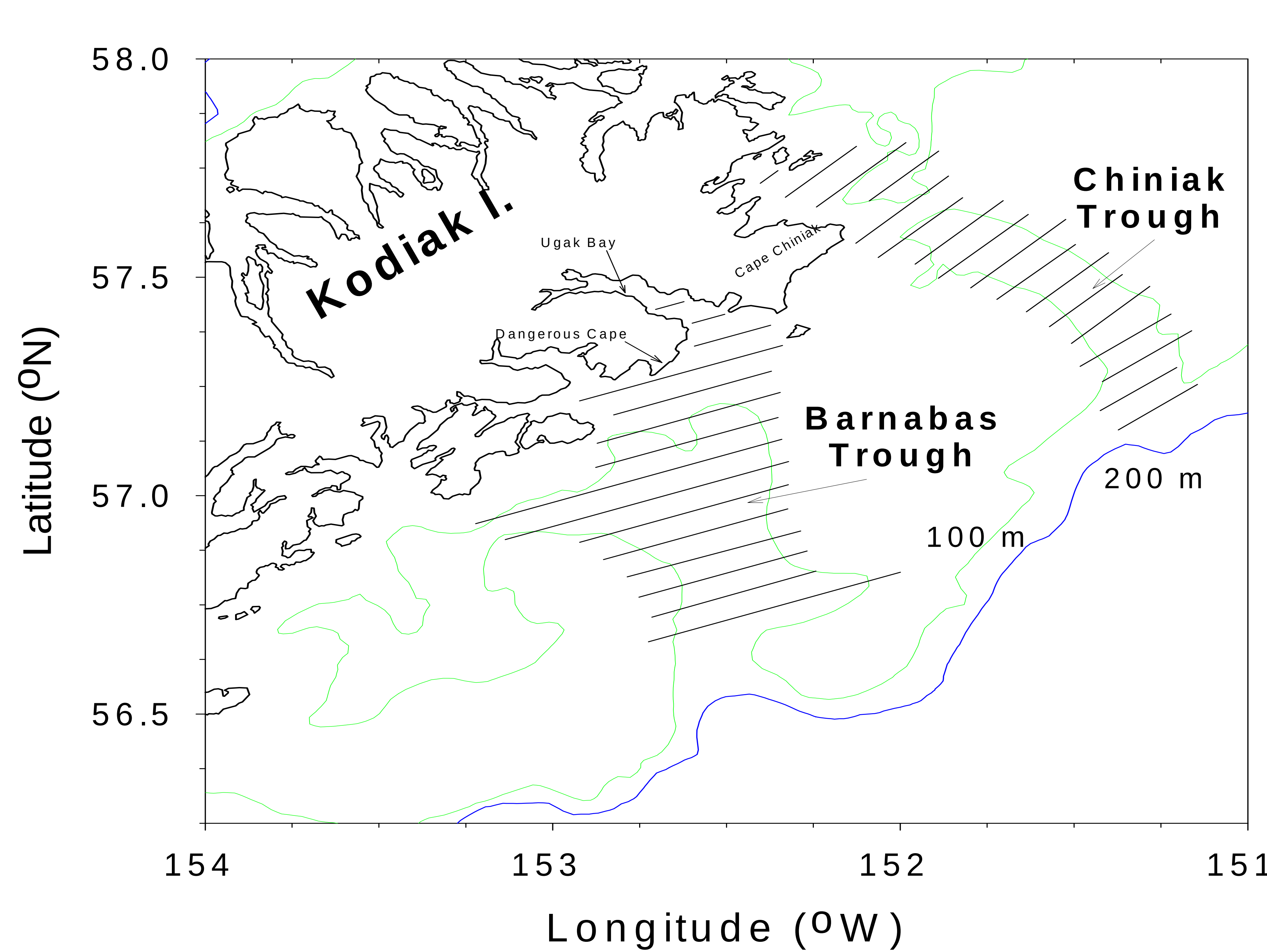
Outline

- Distribution and abundance of juvenile pollock and capelin relative to water mass properties
- Intra-annual variability (temporal scale: weeks)
- Interannual variability
- Community reorganization, interspecific competition and decadal-scale climate forcing

Study site


160°00'
170°00'
-180°00'
-170°00'
-160°00'
-150°00'
-140°00'
70°00'
60°00'
50°00'
Russia
Alaska
Bering Sea
Kodiak I.
Gulf of Alaska
Pacific Ocean
-180°00'
-170°00'
-160°00'
-150°00'

Study site



58.0
57.5
57.0
56.5
Latitude (^{O}N)
154
153
152
151
Longitude (^{O}W)
Kodiak I.
Ugak Bay
Cape Chiniak
Dangerous Cape
Chiniak Trough
Barnabas Trough
100 m
200 m

Methods

- Summer 2000-2002, 2004 NOAA Vessel *Miller Freeman*
- Echo integration-trawl (EIT)
  - Acoustics (38kHz) to assess distribution and abundance of fish
  - Trawls to confirm species, size and age
- Physical oceanography
  - CTD, XBT, MBT
  - Moorings
  - Drifters
- Multiple surveys ("passes")
  - Pass 1 : Aug 16-19, 2002
  - Pass 2 : Aug 22-24
  - Pass 3 : Aug 30-Sep 2

  - Pass 1 : Aug 15-17, 2004
  - Pass 2 : Aug 21-24
  - Pass 3 : Aug 26-30
  - Pass 4 : Sep 2-4

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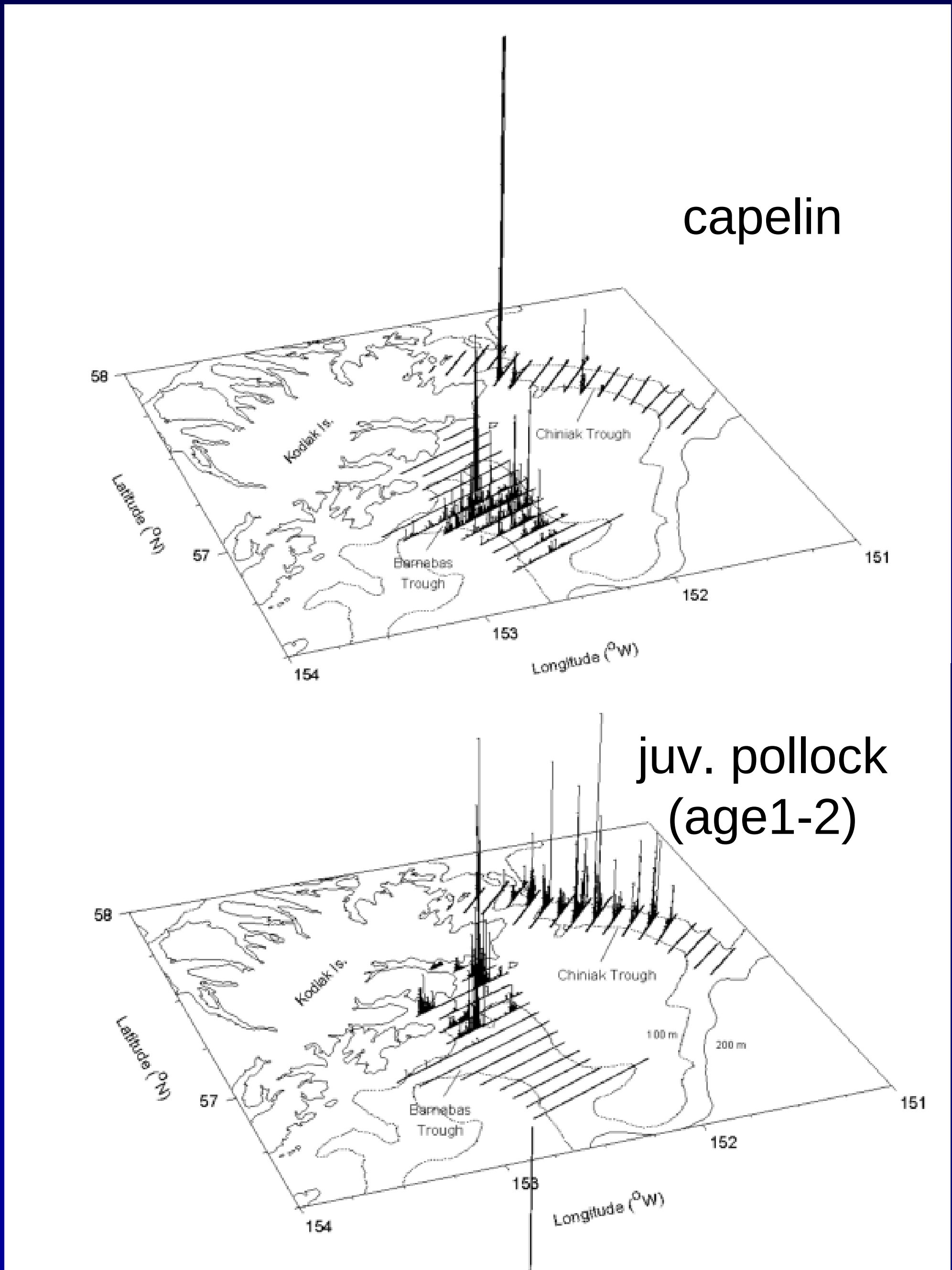
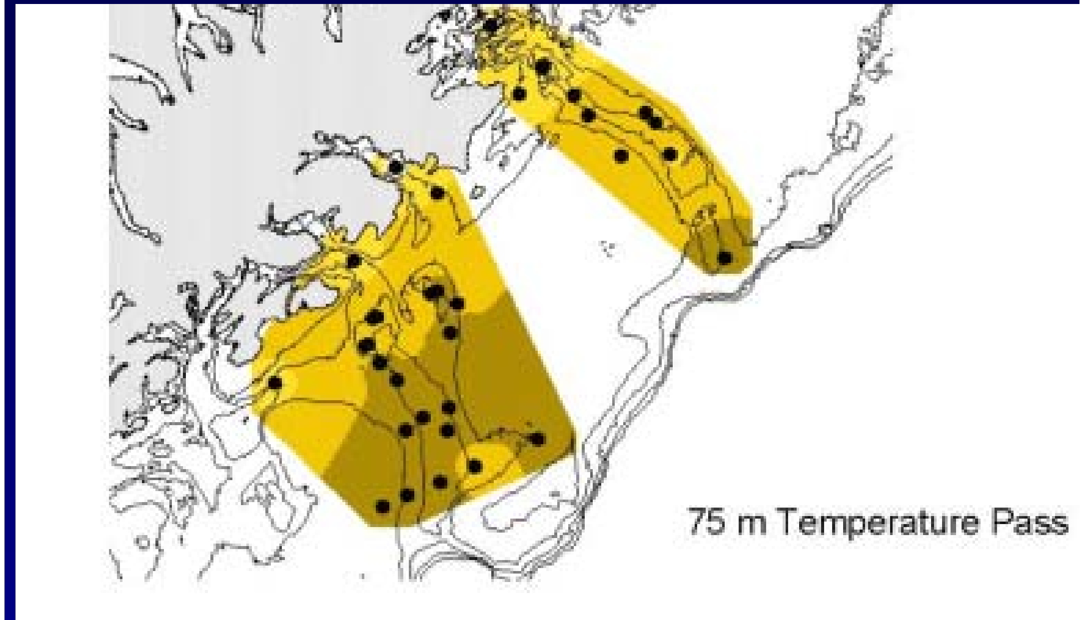
2000, 2001

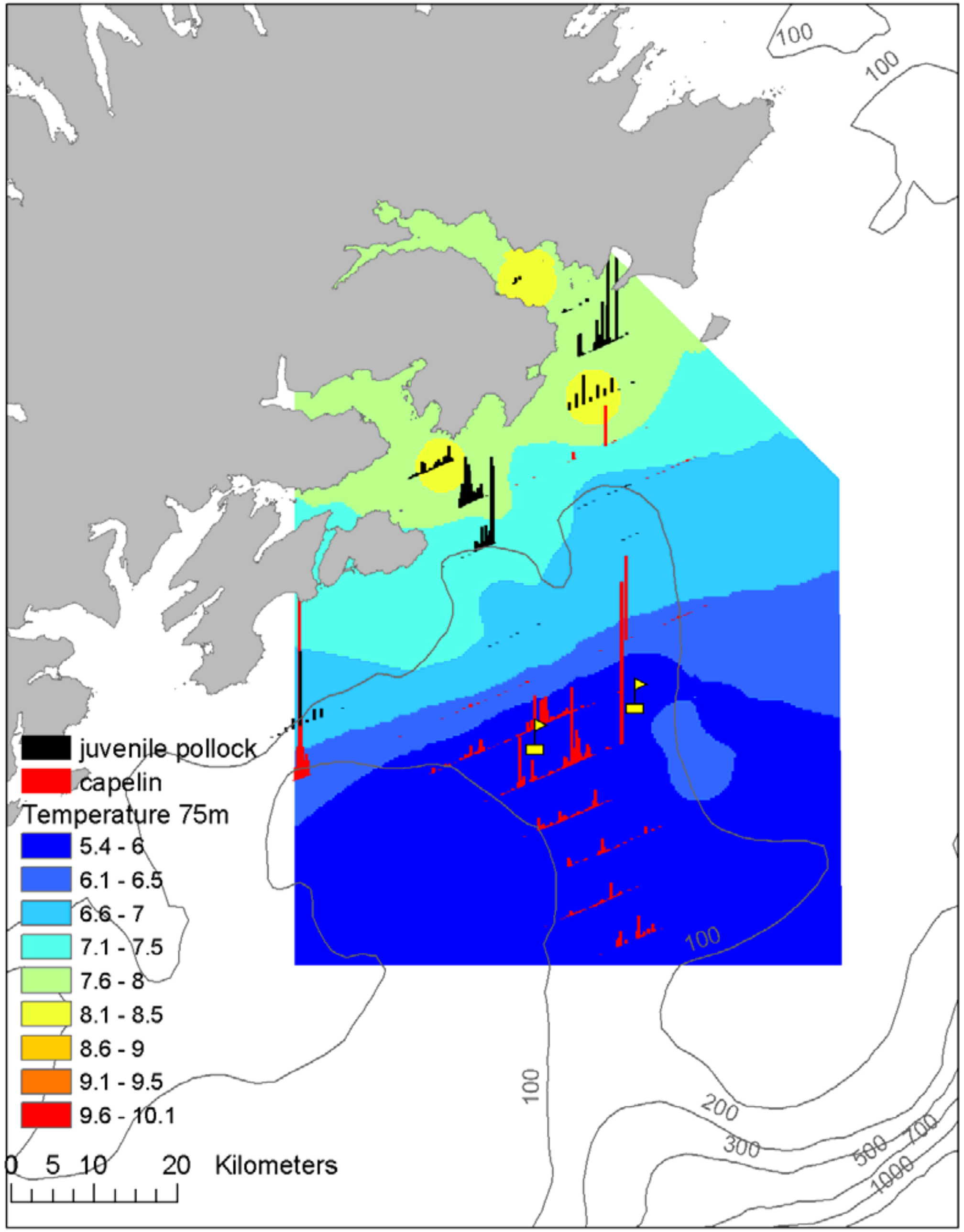




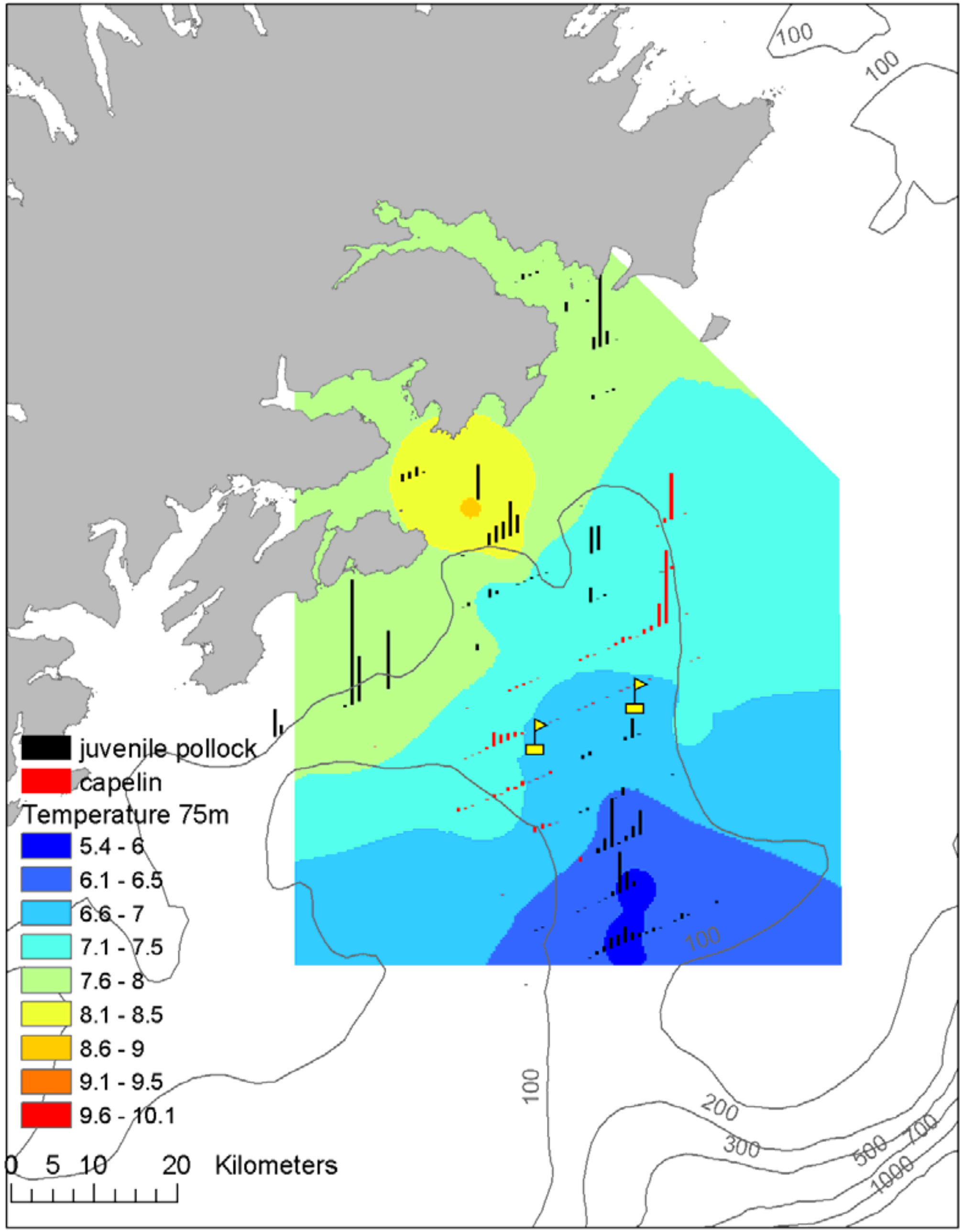
Hollowed, et al. *in revision*

Pass 1

Pass 3



juvenile pollock
capelin
Temperature 75m
5.4 - 6
6.1 - 6.5
6.6 - 7
7.1 - 7.5
7.6 - 8
8.1 - 8.5
8.6 - 9
9.1 - 9.5
9.6 - 10.1
0 5 10 20 Kilometers
100
200
300
500
700
1000



juvenile pollock
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Temperature 75m
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6.6 - 7
7.1 - 7.5
7.6 - 8
8.1 - 8.5
8.6 - 9
9.1 - 9.5
9.6 - 10.1
0 5 10 20 Kilometers
100
200
300
500
700
1000

Summer Currents

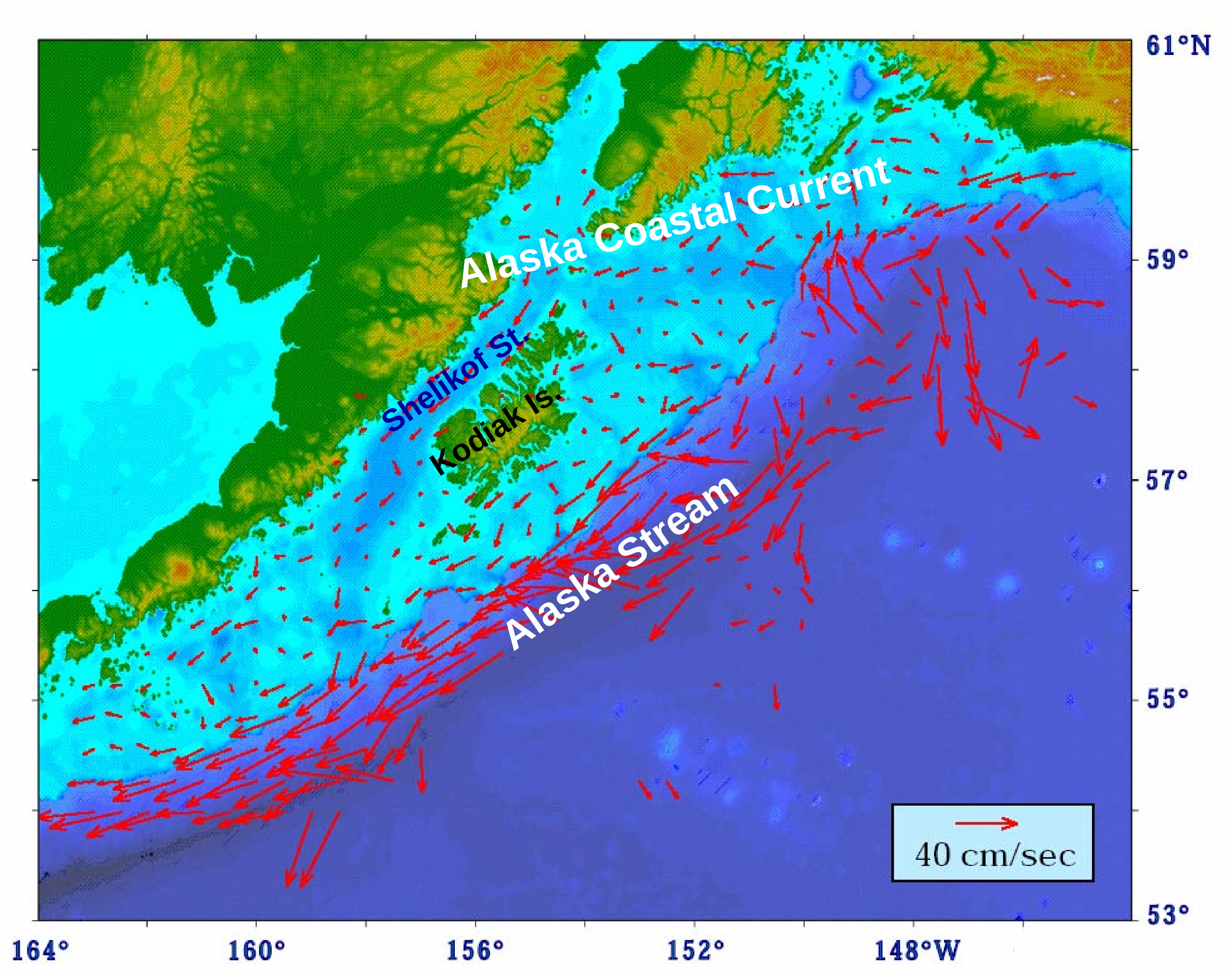
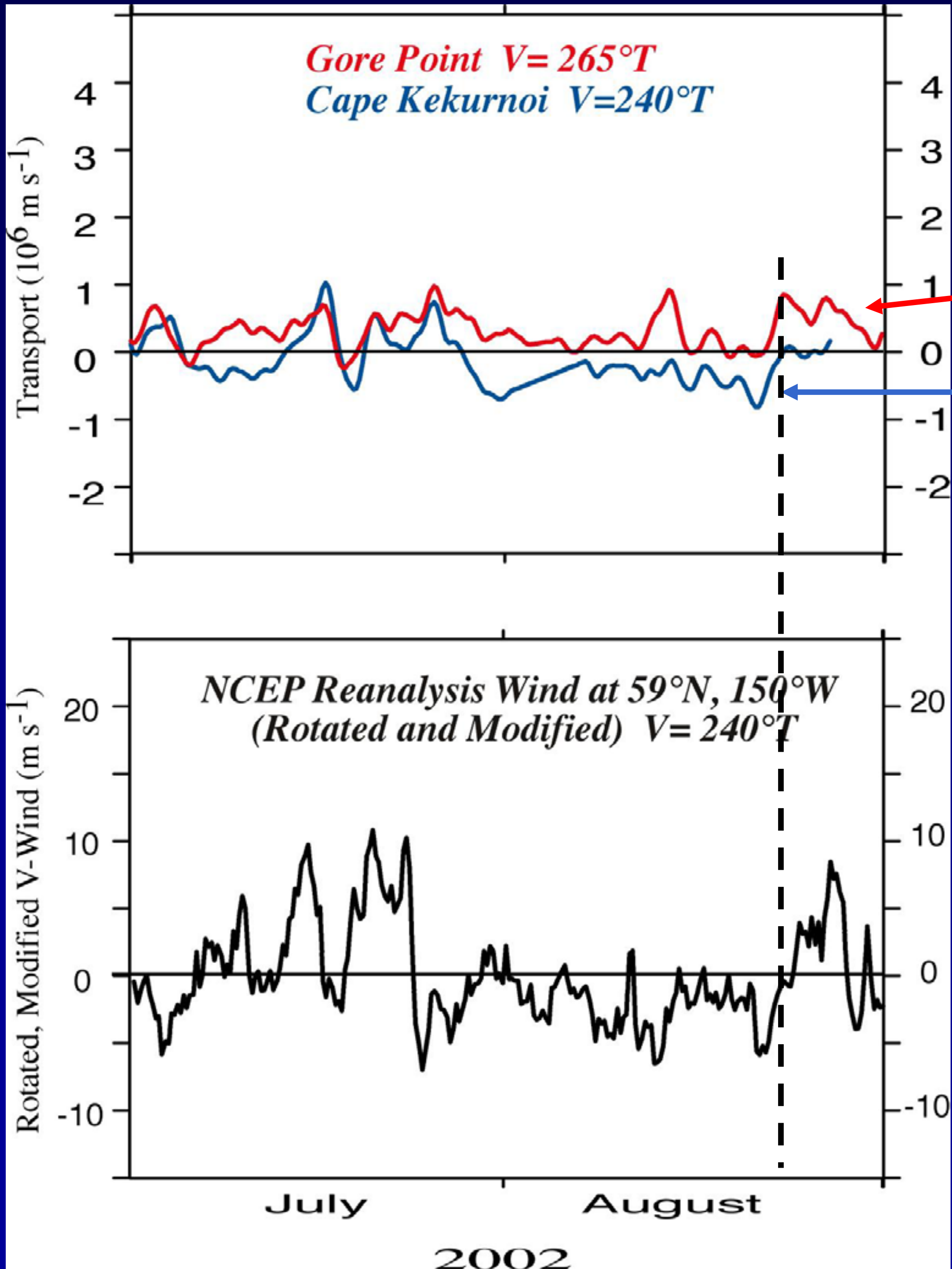


figure courtesy of N. Kachel

Wind and transport



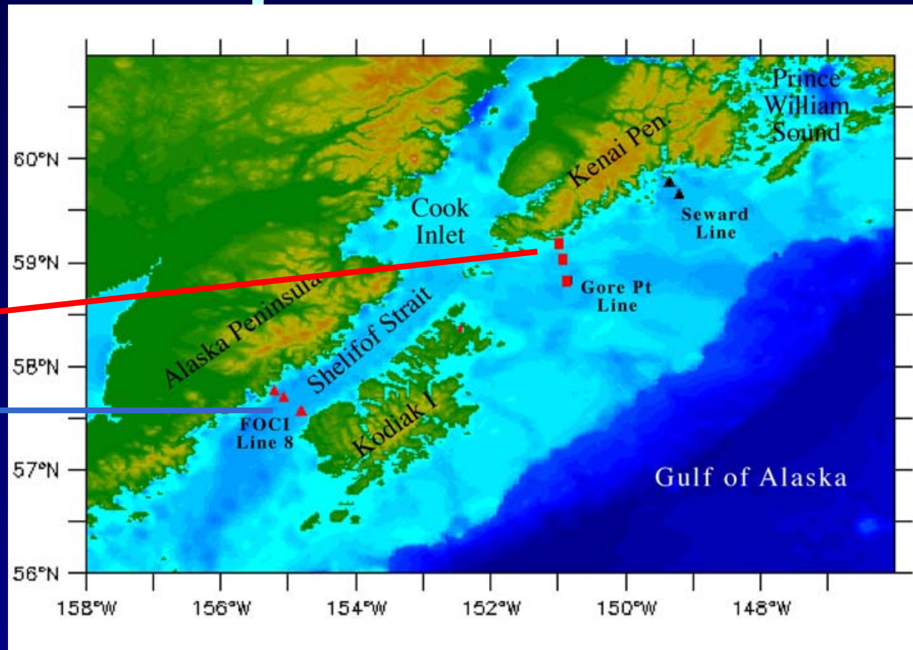


figure courtesy of N. Kachel

Outline

- Distribution and abundance of juvenile pollock and capelin relative to water mass properties
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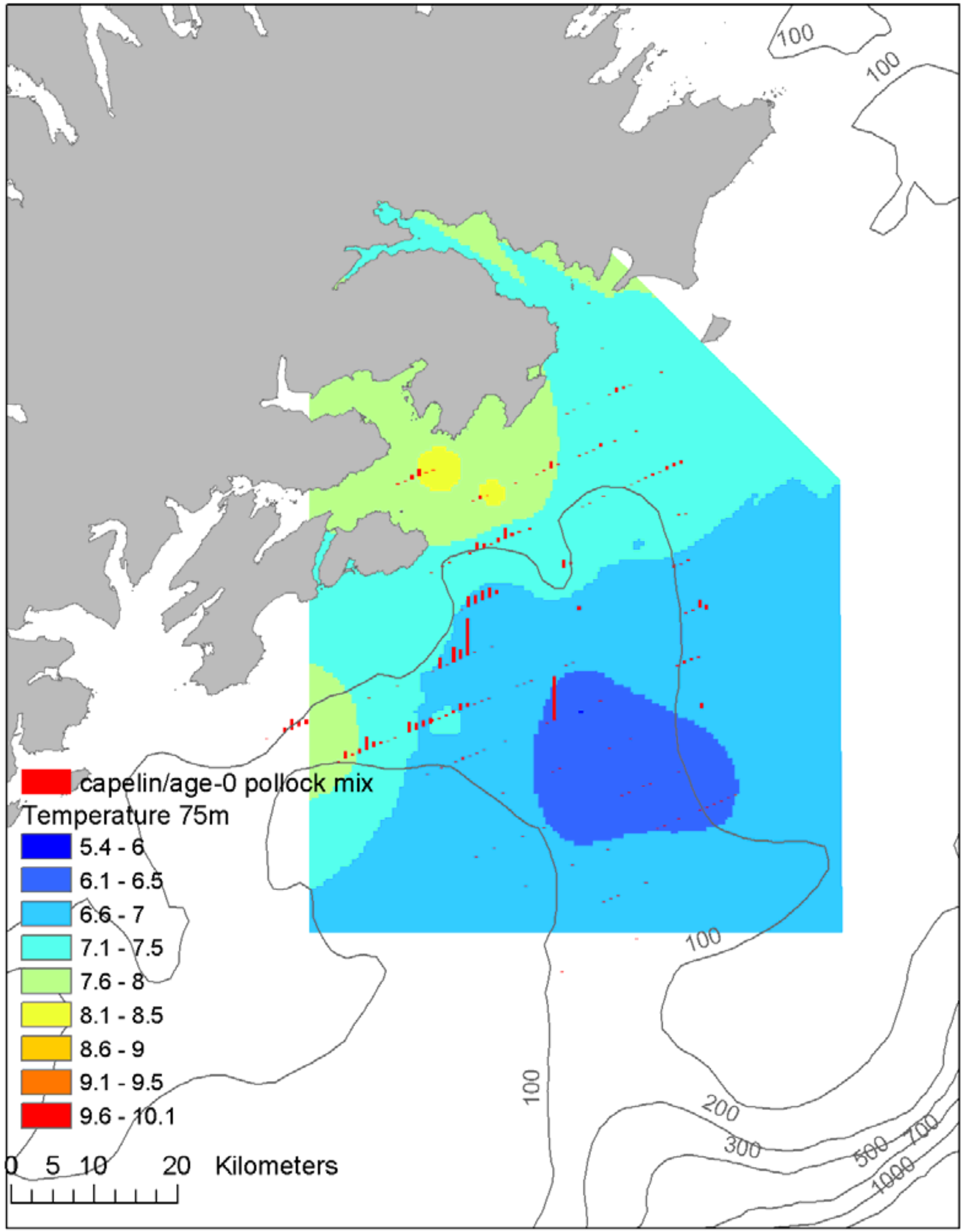
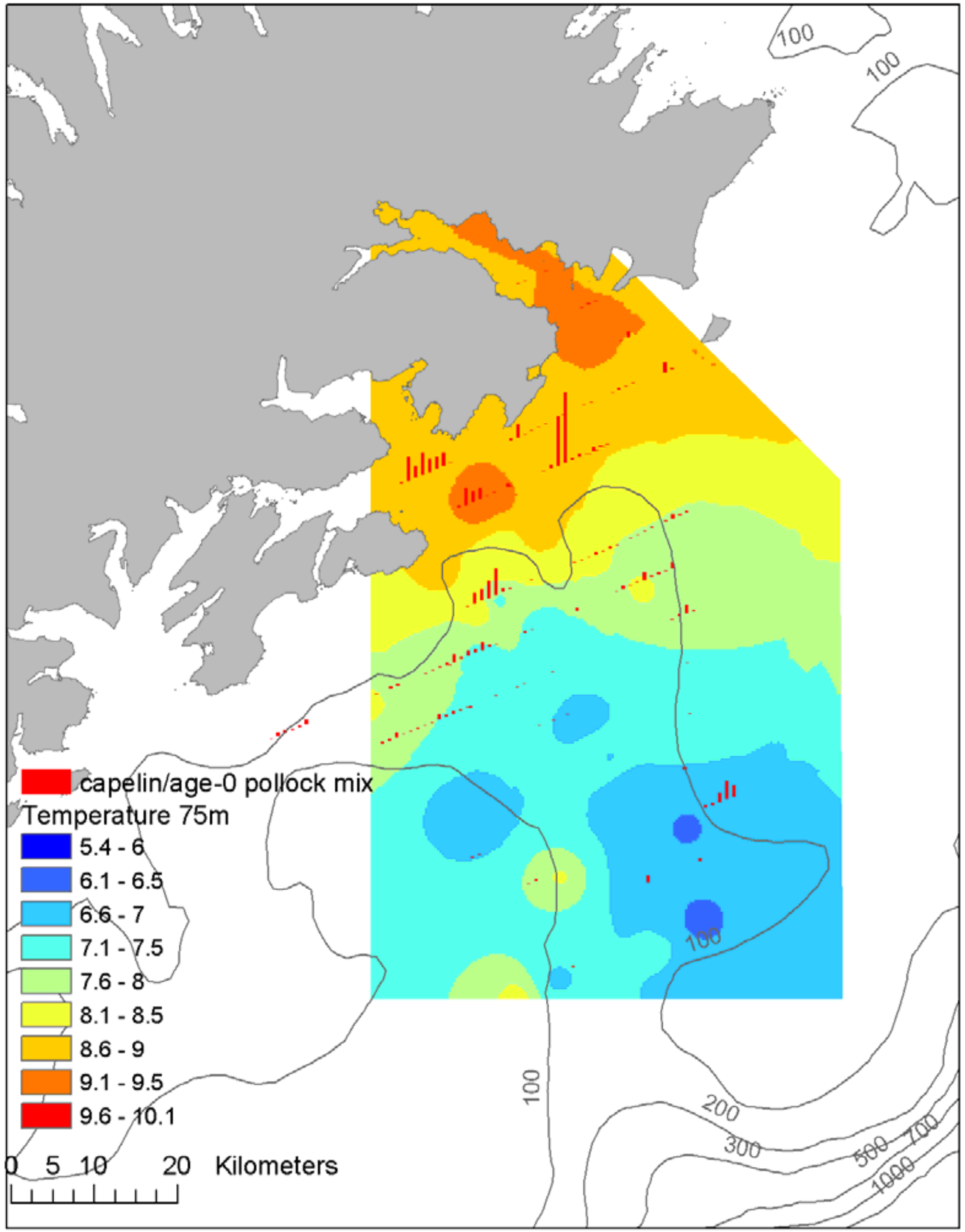
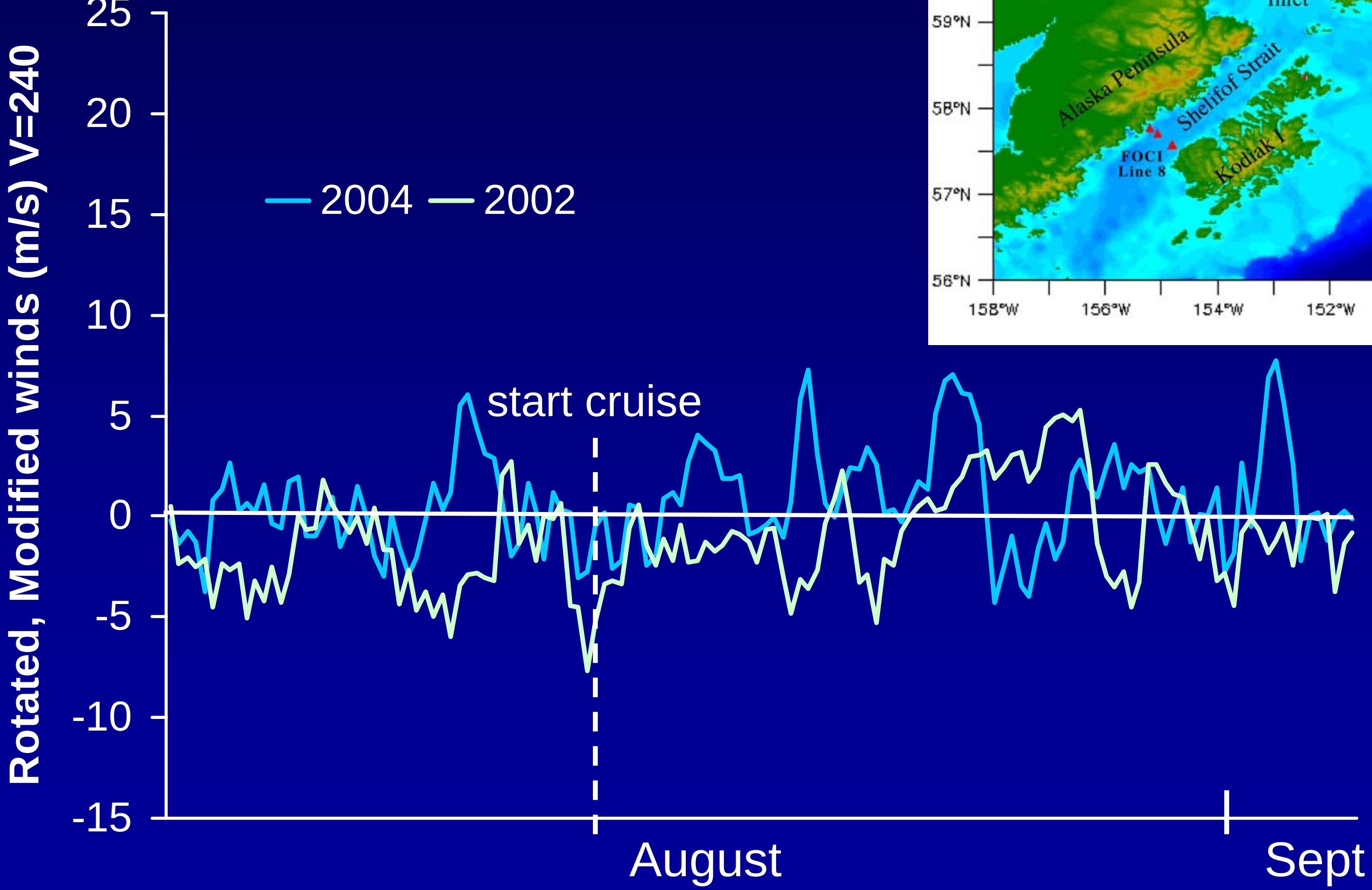
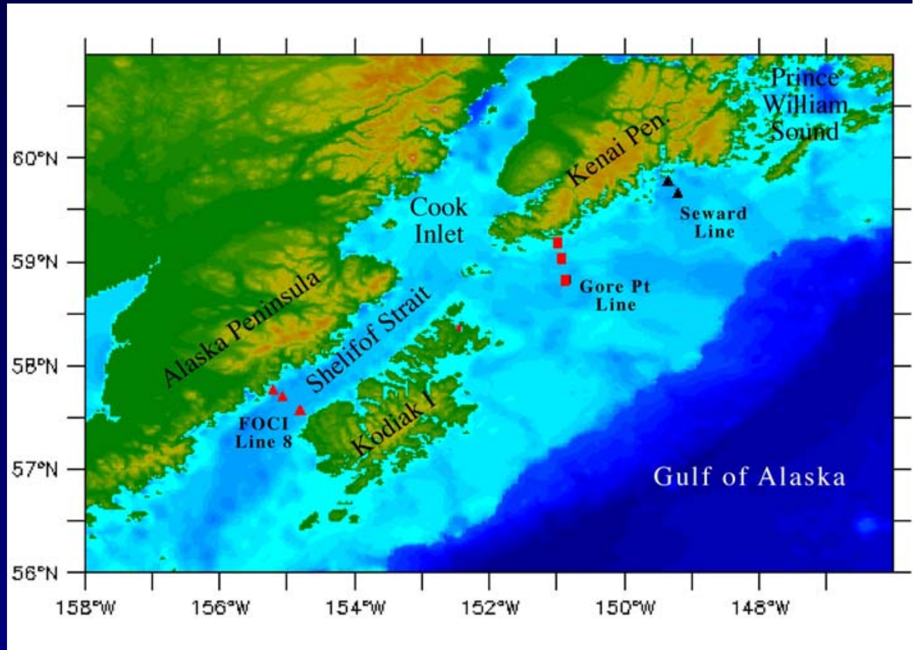
Pass 1, 2004 | Pass 3, 2004





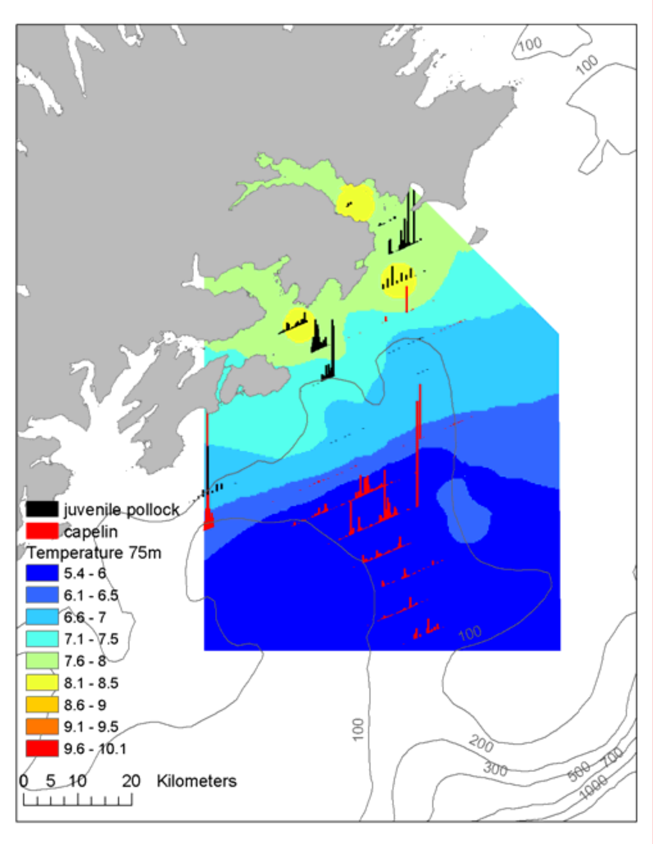
Wind

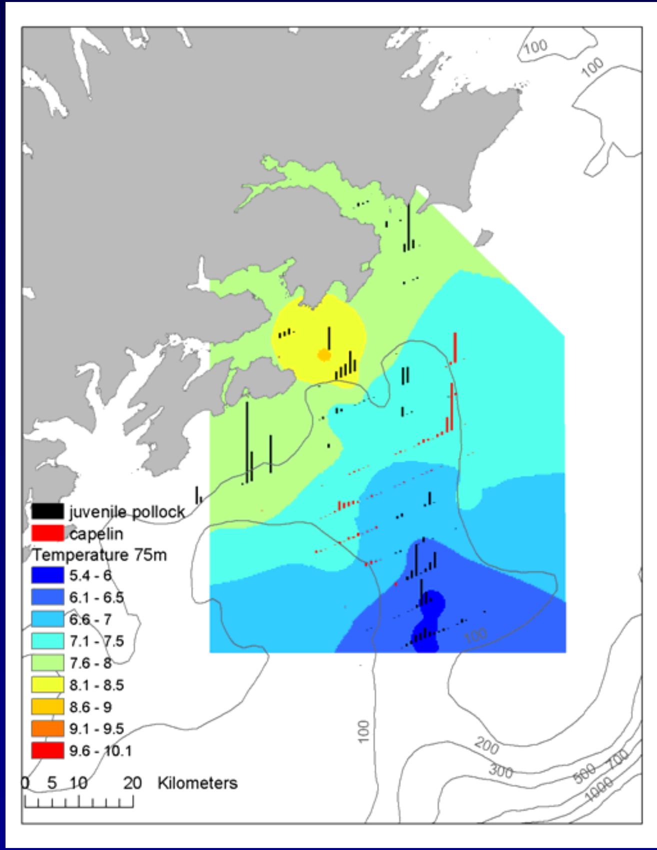


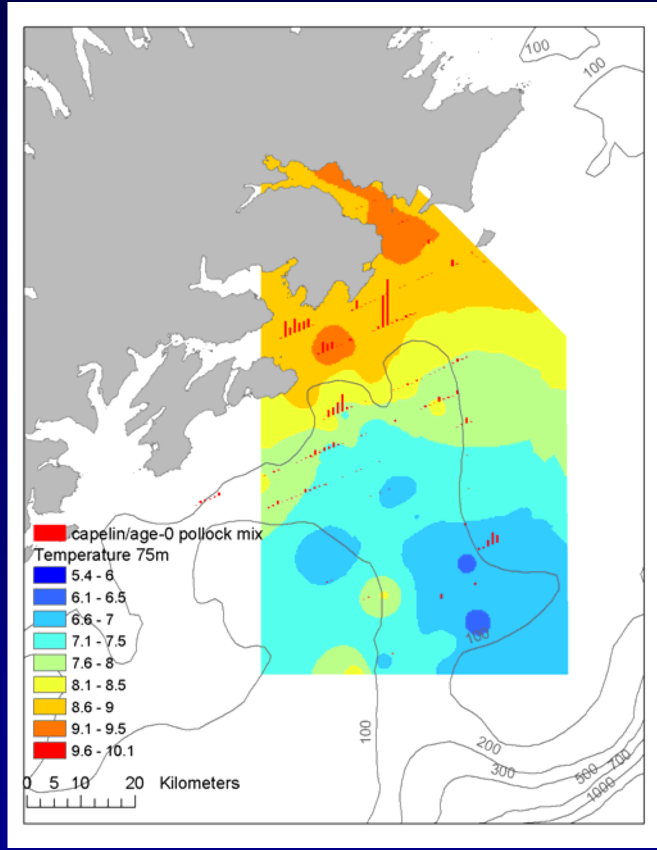


data courtesy of N. Kachel and M. Spillane

Pass 1, 2002   Pass 3, 2002   2004

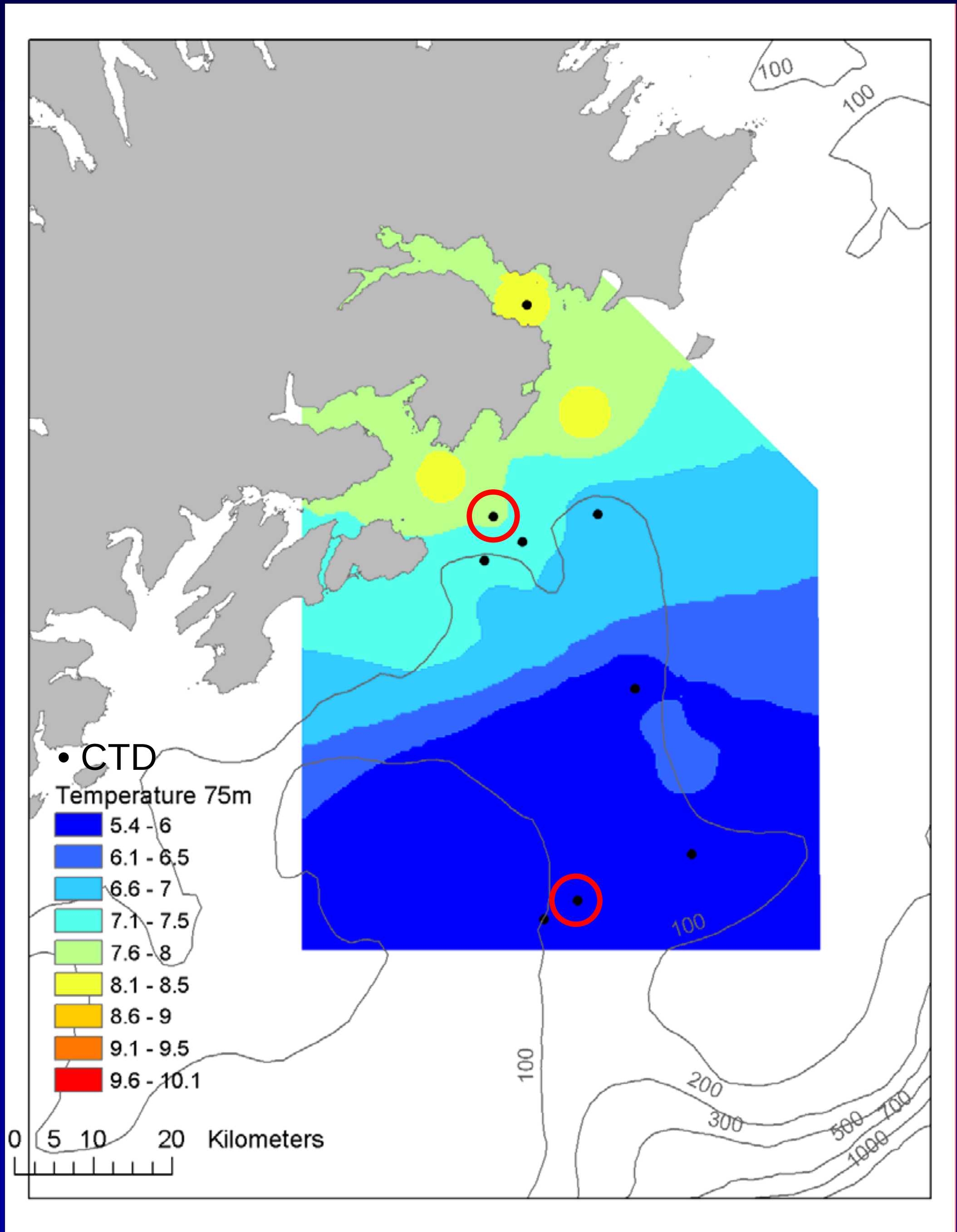






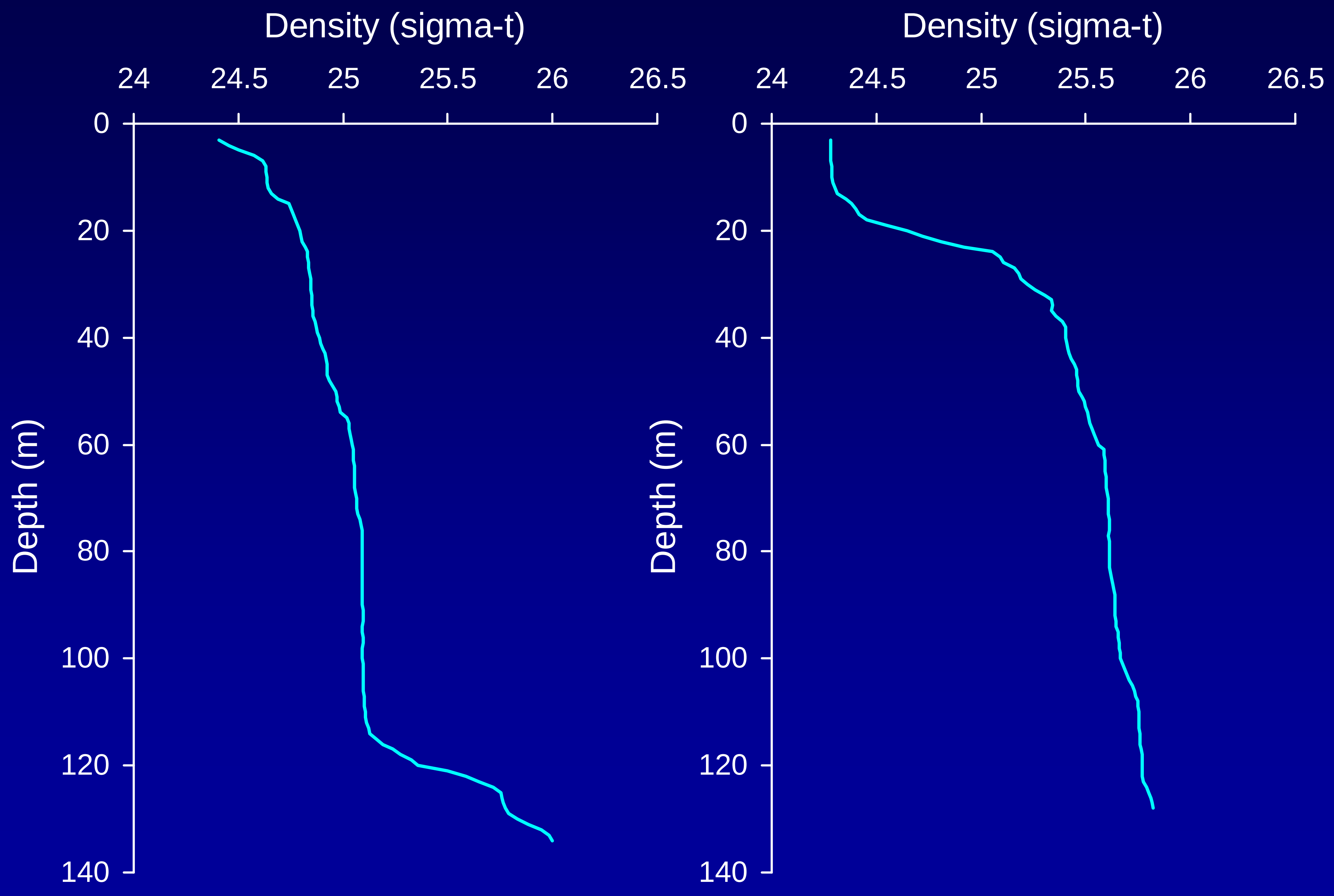
What’s so special about inshore (ACC) water?

Pass 1, 2002

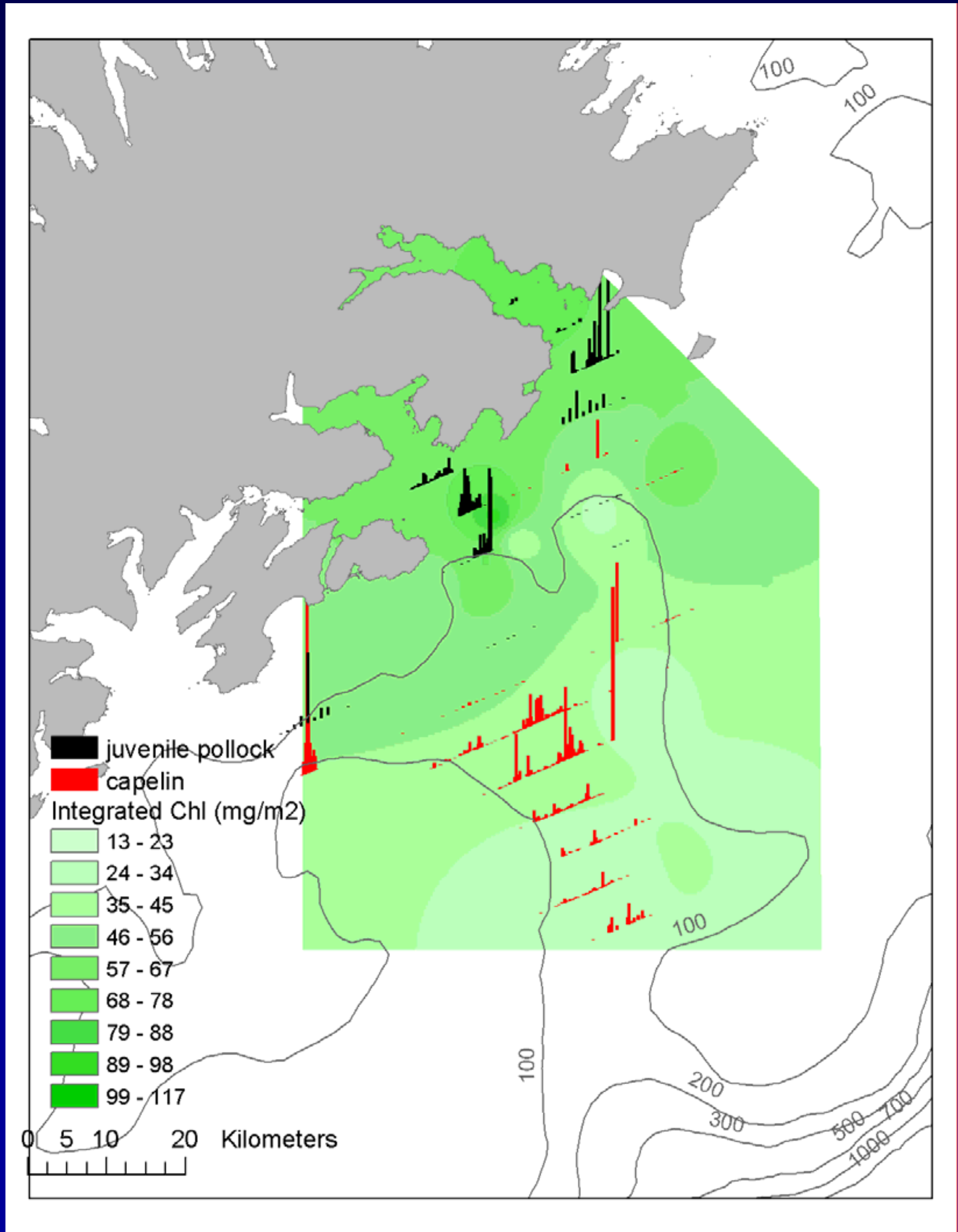


• CTD
Temperature 75m
5.4 - 6
6.1 - 6.5
6.6 - 7
7.1 - 7.5
7.6 - 8
8.1 - 8.5
8.6 - 9
9.1 - 9.5
9.6 - 10.1
0 5 10 20 Kilometers
100
100
100
100
200
300
500
700
1000

Inshore 2002 Offshore



Pass 1, 2002


juvenile pollock
capelin
Integrated Chl (mg/m2)
13 - 23
24 - 34
35 - 45
46 - 56
57 - 67
68 - 78
79 - 88
89 - 98
99 - 117
0 5 10 20 Kilometers
100
200
300
500
700
1000

Summary

- In 2002, juvenile pollock (age 1 and 2) were most abundant in warm, fresh water nearshore whereas capelin were most abundant in cool, salty water offshore
- Over a two-week period juvenile pollock distribution expanded with offshore expansion of warm, fresh waters. Capelin abundance decreased.
- Hypothesize that a wind-driven event resulted in increased transport of warm, fresh ACC water through the study area
- In 2004, juvenile pollock were not present and capelin (mixed with age-0 pollock) were most abundant in warm, fresh water nearshore
- Hypothesize that nearshore (ACC) waters are enriched feeding areas

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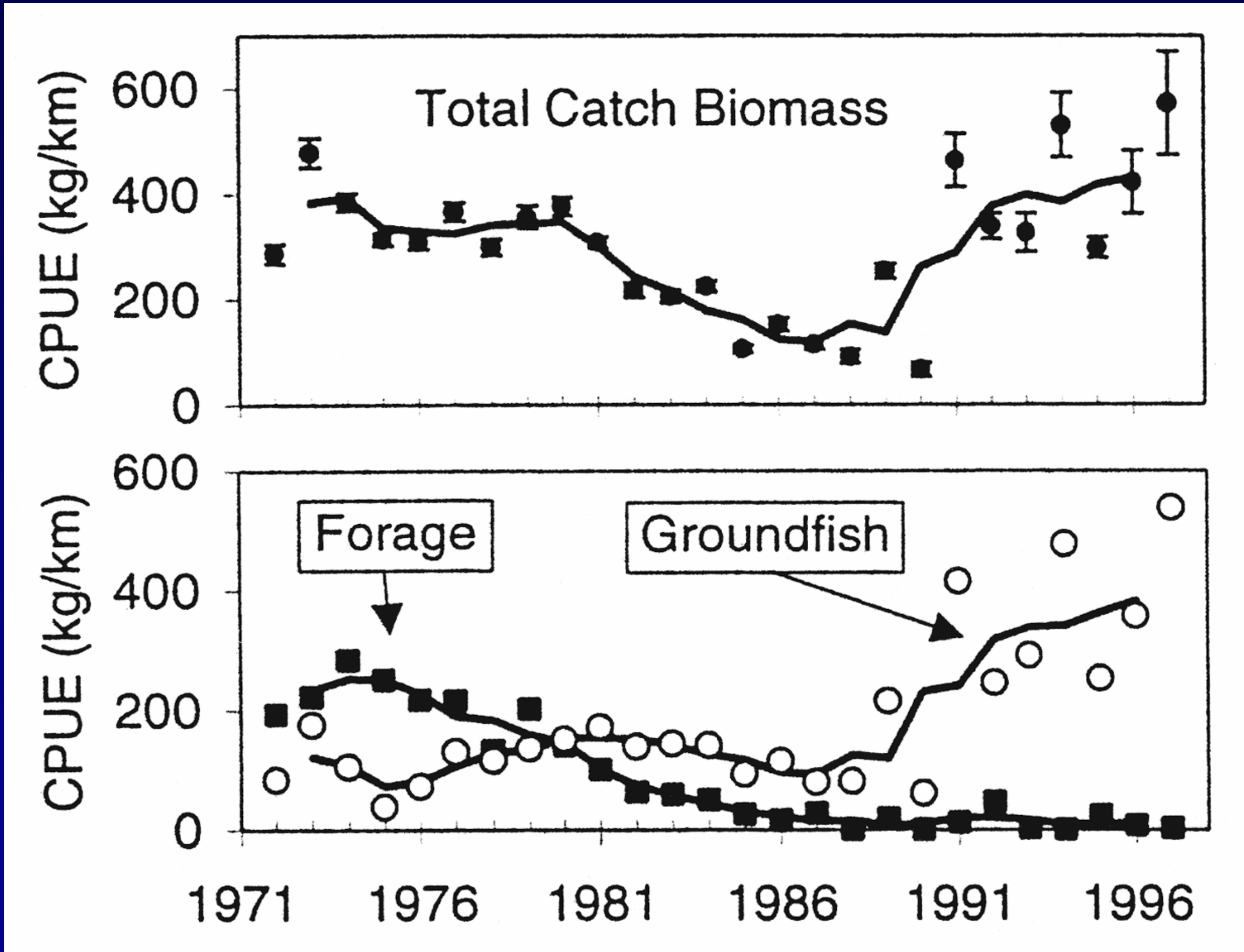
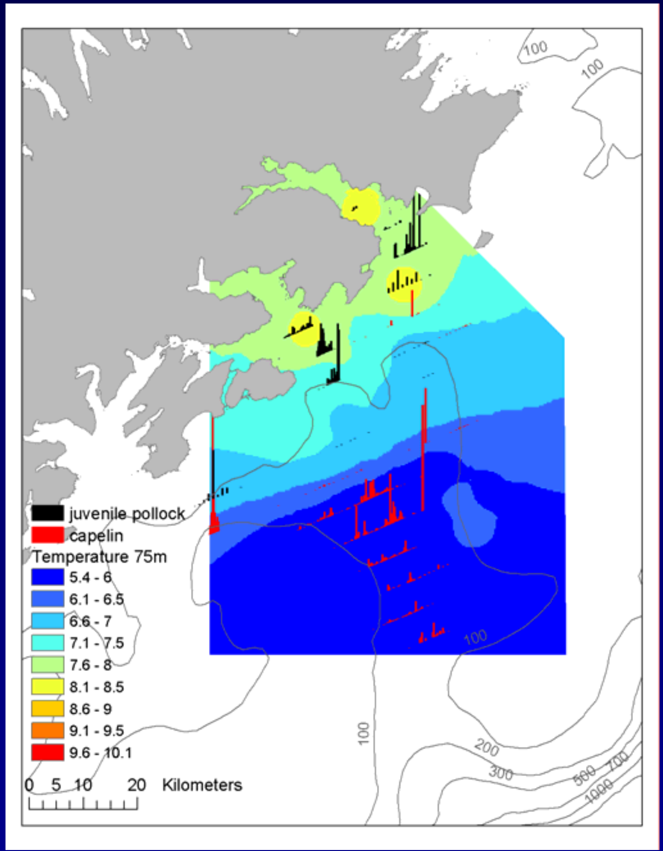
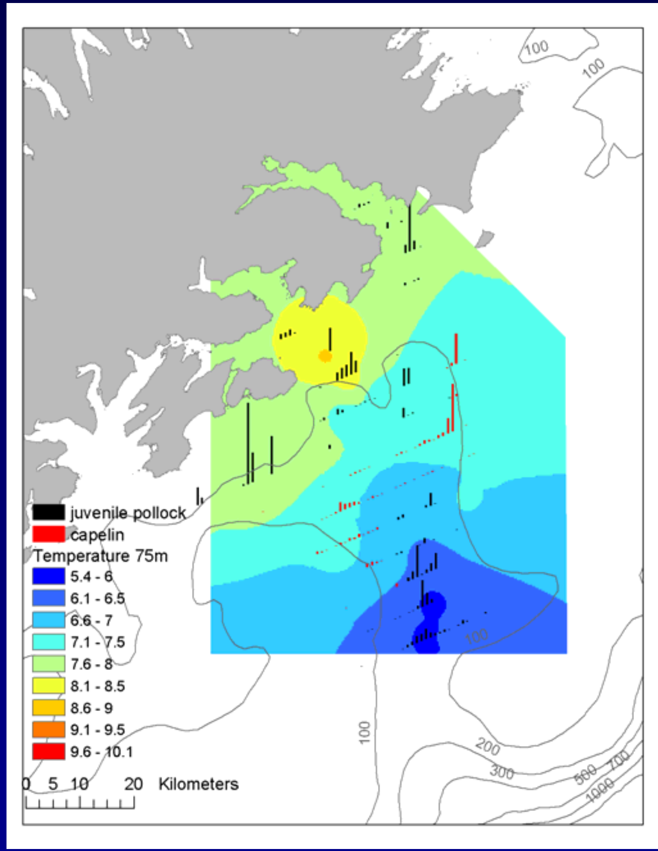
Community reorganization

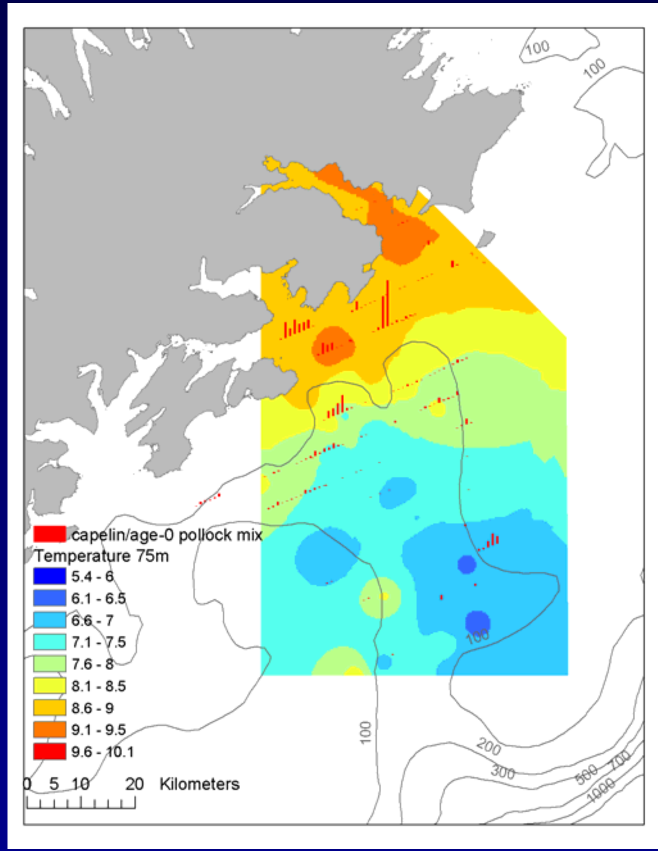


Anderson & Piatt, 1999

Pass 1, 2002 Pass 3, 2002 2004







Looks like competition

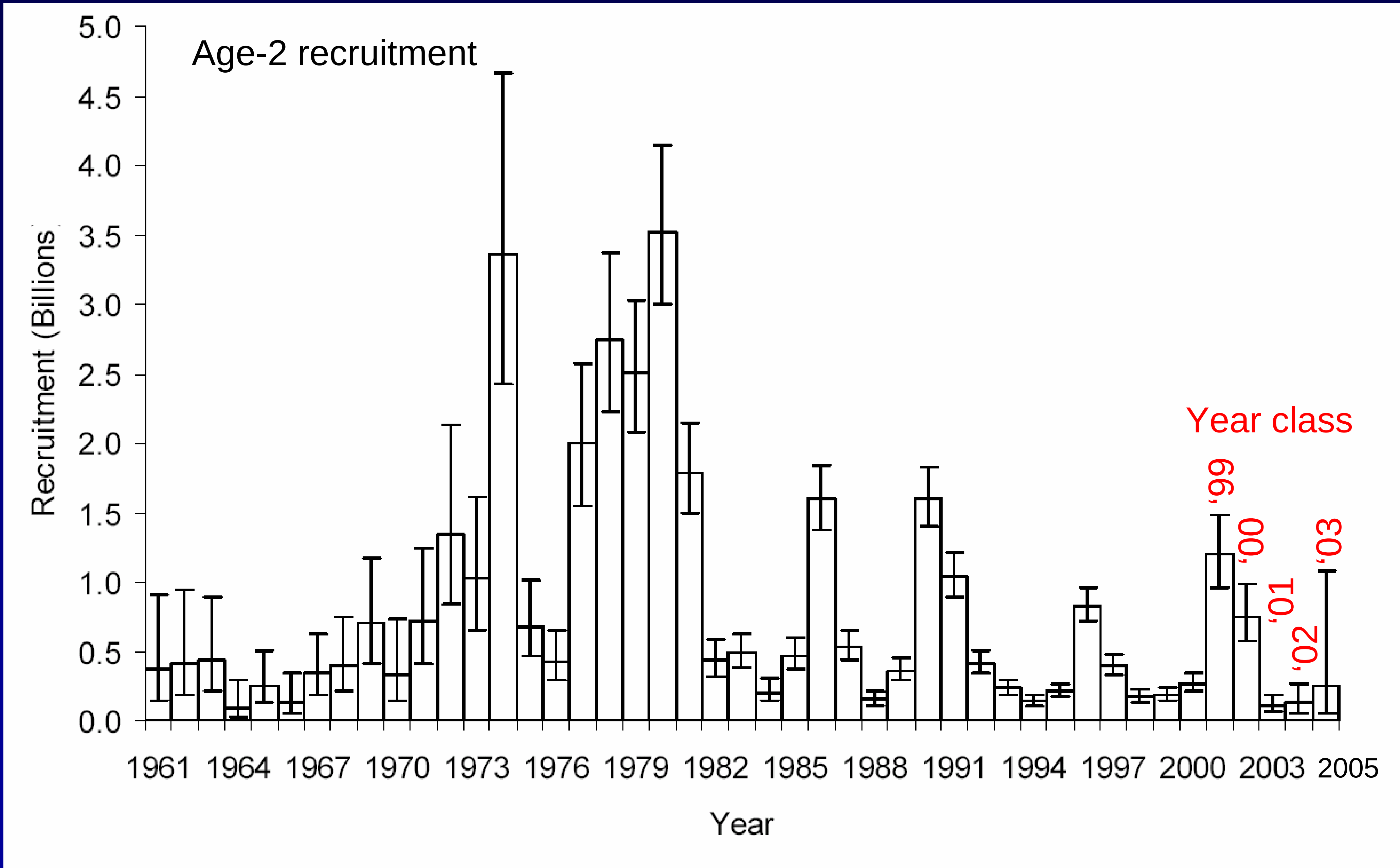
Community reorganization

- Links between decadal-scale climate and wind “events”
- Competition
  - Common, limiting prey resource(s)?
  - Zooplankton assemblages similar or different among water masses?
  - Future work with Wilson and Duffy-Anderson (NPRB funded)
    - Zooplankton distribution and abundance
    - Fish diet
- Interannual variability in age-1+ pollock distribution and abundance

Acknowledgements

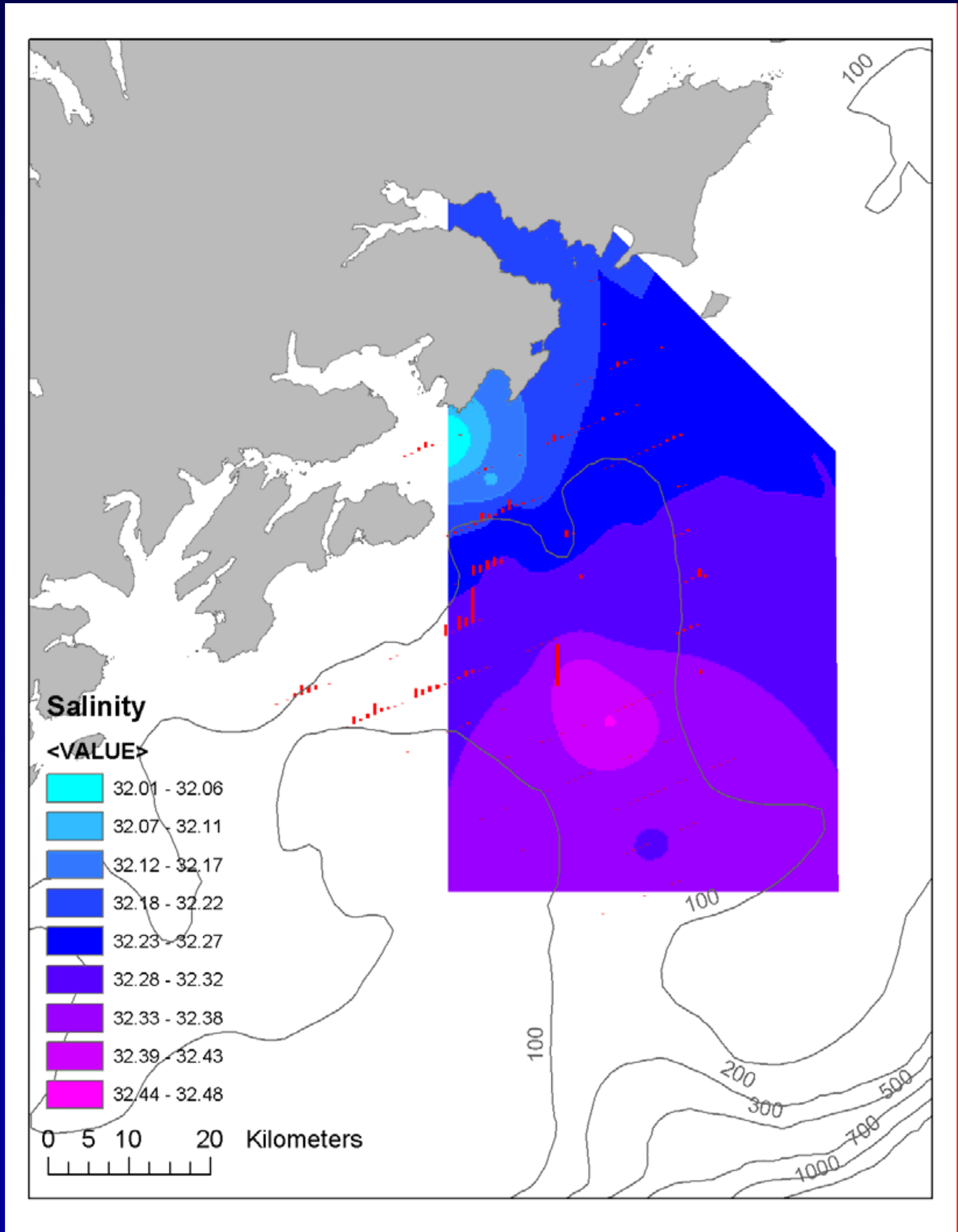
- Steller Sea Lion Research Initiative (SSLRI)
- GLOBEC-NEP
- NOAA Ship *Miller Freeman*

GOA stock assessment



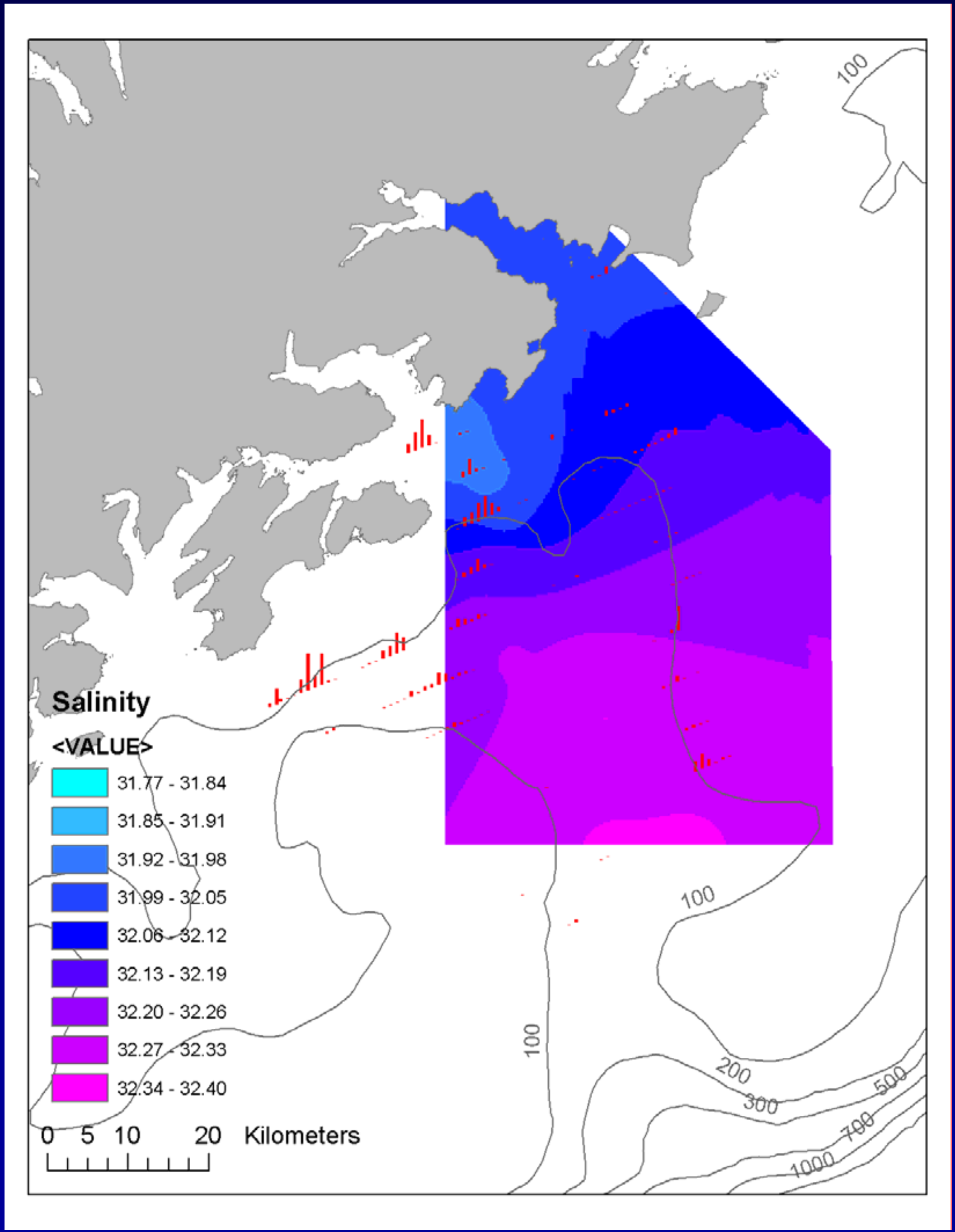
Dorn, et al. 2004. NPFMC Gulf of Alaska SAFE

Pass 1, 2004

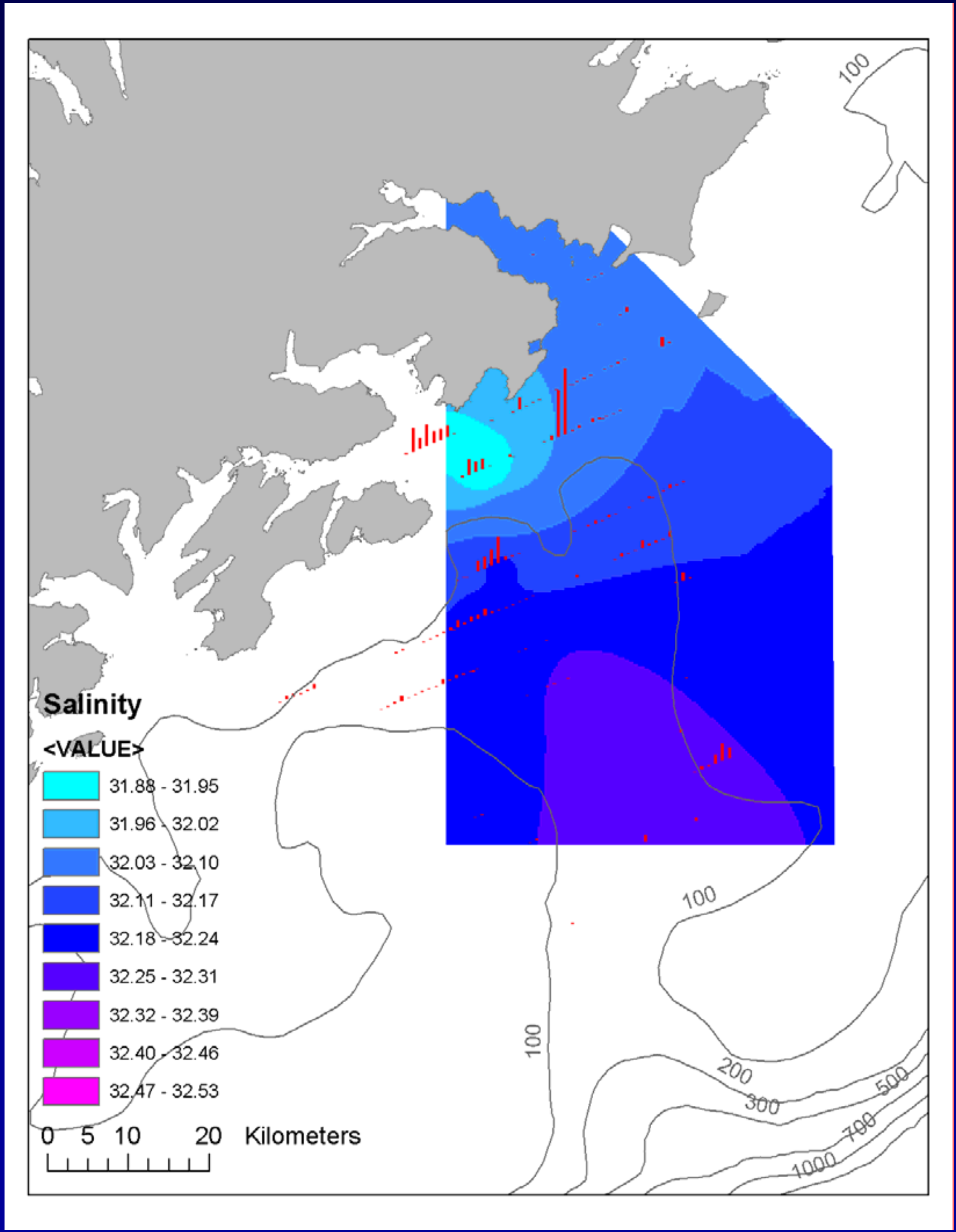


Salinity
<VALUE>
32.01 - 32.06
32.07 - 32.11
32.12 - 32.17
32.18 - 32.22
32.23 - 32.27
32.28 - 32.32
32.33 - 32.38
32.39 - 32.43
32.44 - 32.48
0 5 10 20 Kilometers
100
100
100
200
300
500
700
1000

Pass 2, 2004

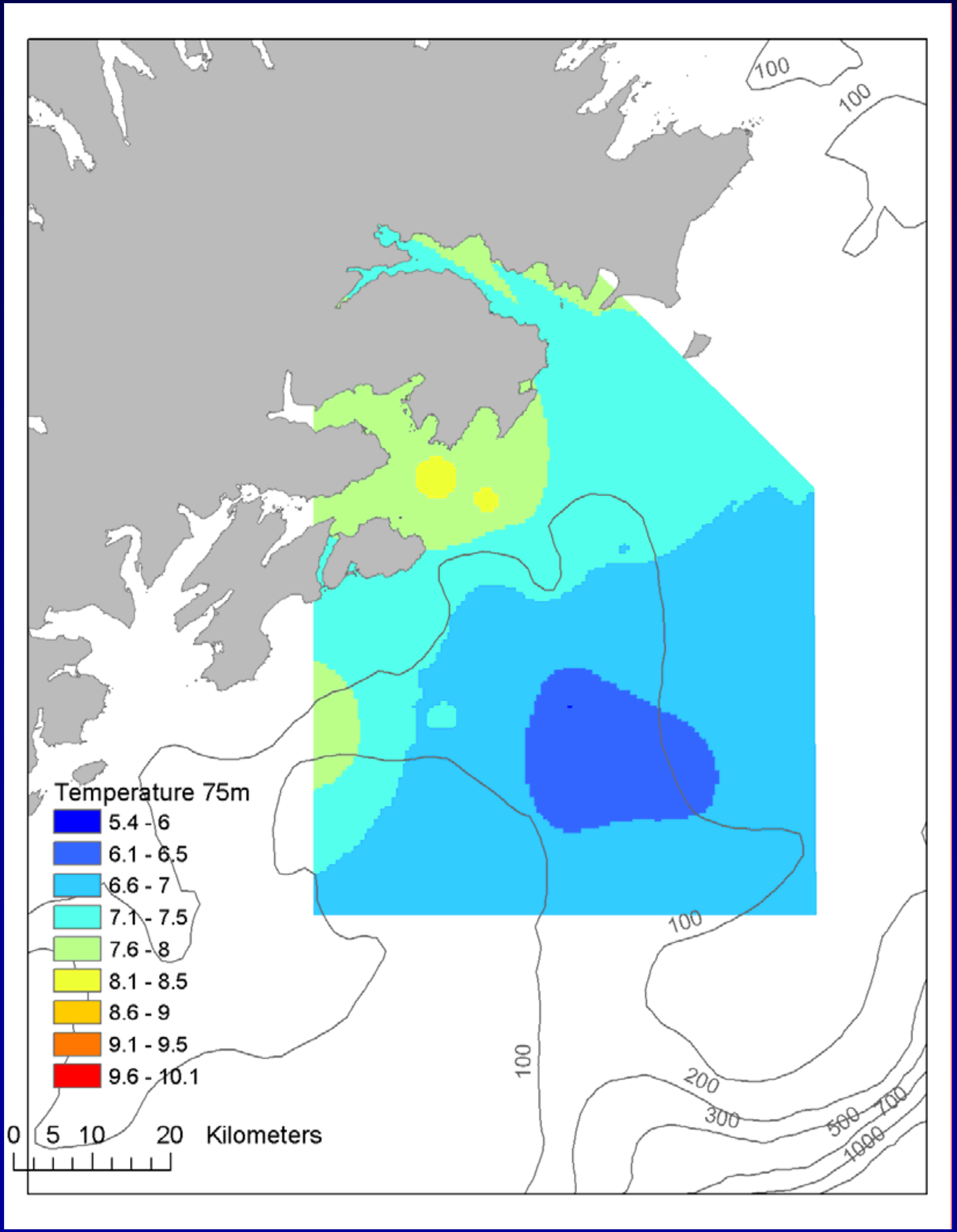

Salinity
<VALUE>
31.77 - 31.84
31.85 - 31.91
31.92 - 31.98
31.99 - 32.05
32.06 - 32.12
32.13 - 32.19
32.20 - 32.26
32.27 - 32.33
32.34 - 32.40
0 5 10 20 Kilometers
100
100
100
200
300
500
700
1000

Pass 3, 2004



Salinity
<VALUE>
31.88 - 31.95
31.96 - 32.02
32.03 - 32.10
32.11 - 32.17
32.18 - 32.24
32.25 - 32.31
32.32 - 32.39
32.40 - 32.46
32.47 - 32.53
0 5 10 20 Kilometers
100
100
100
200
300
500
700
1000

Pass 1, 2004



100
100
100
100
200
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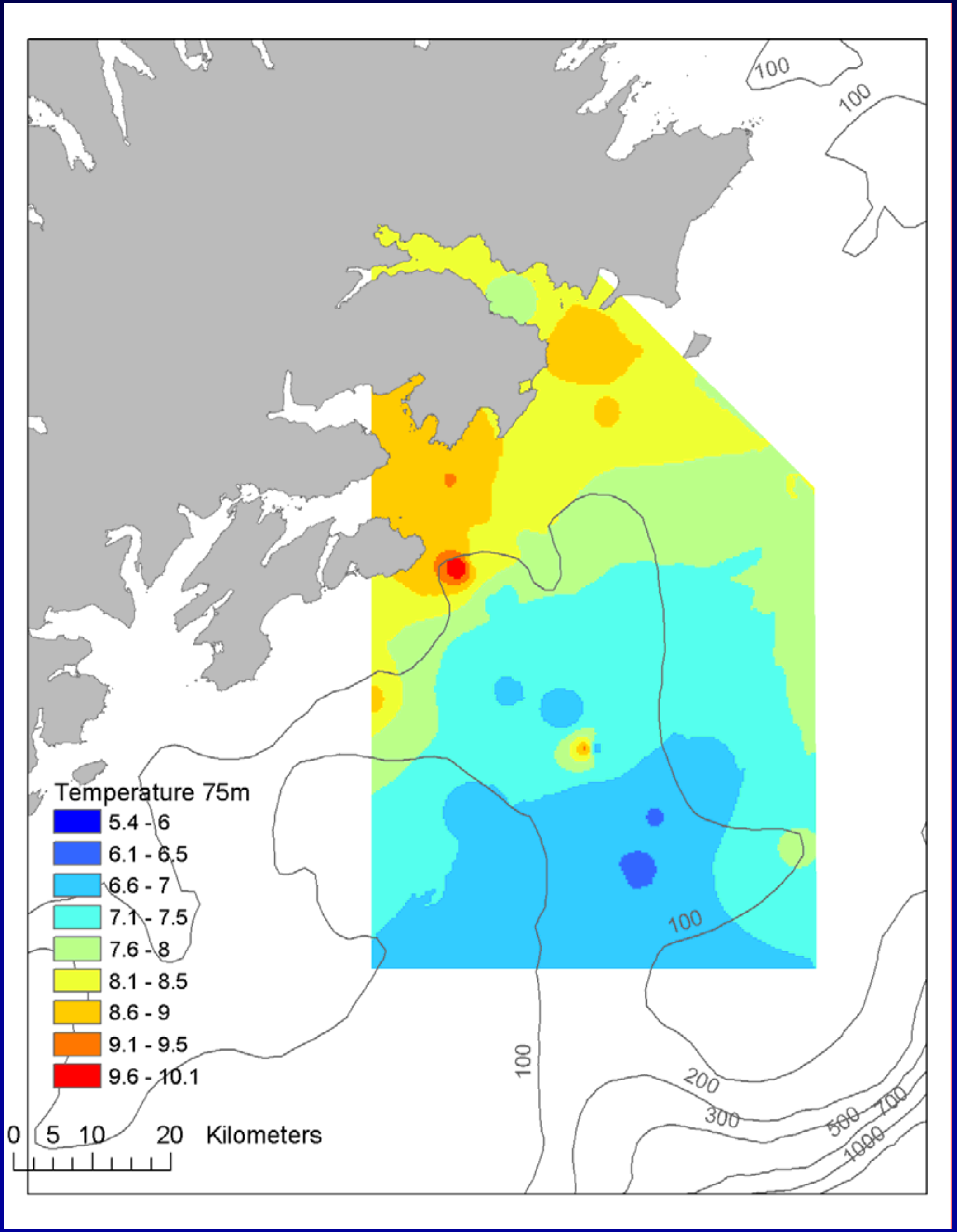
500
700
1000
Temperature 75m
5.4 - 6
6.1 - 6.5
6.6 - 7
7.1 - 7.5
7.6 - 8
8.1 - 8.5
8.6 - 9
9.1 - 9.5
9.6 - 10.1
0 5 10 20 Kilometers

Pass 2, 2004



Temperature 75m
5.4 - 6
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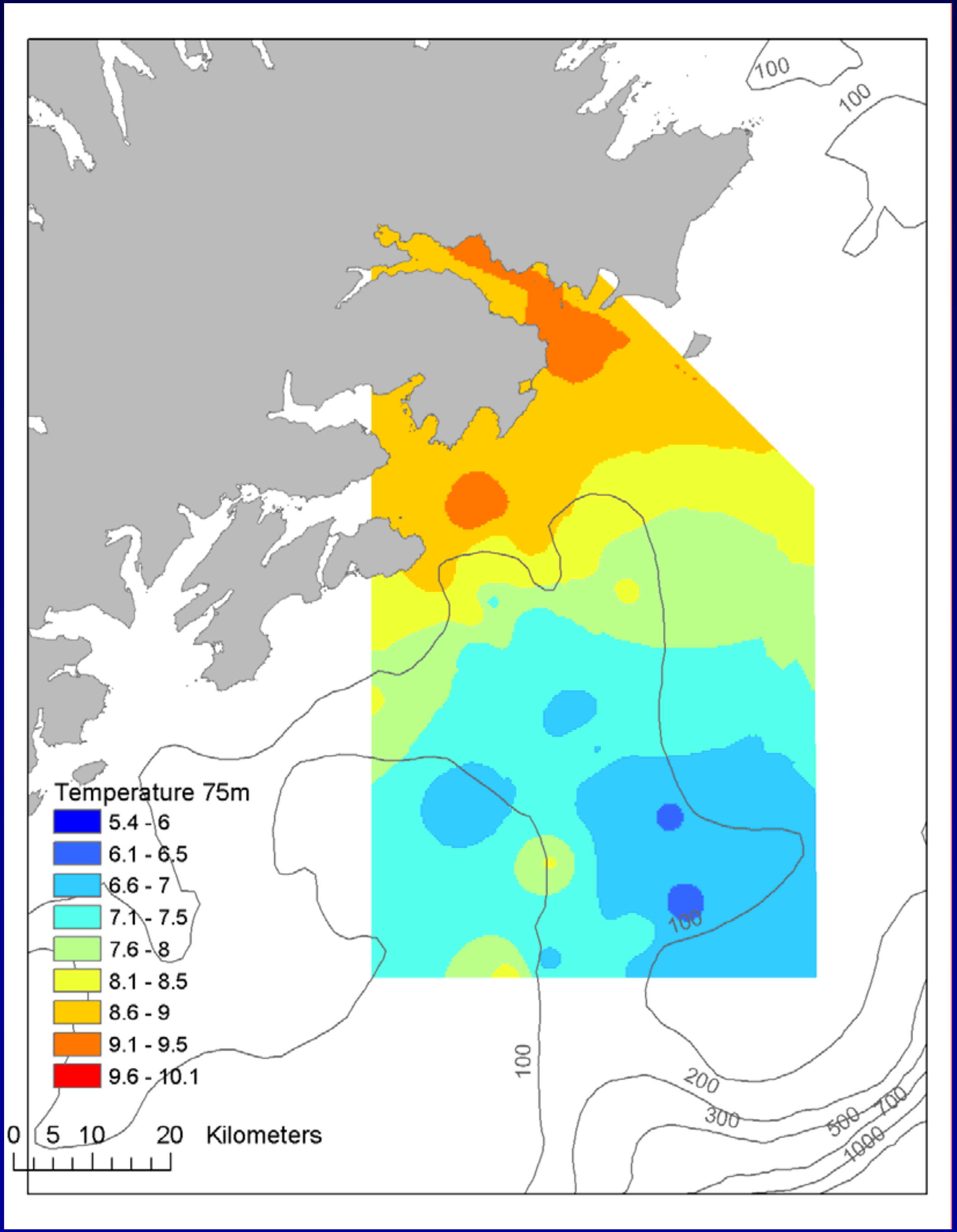
7.1 - 7.5
7.6 - 8
8.1 - 8.5
8.6 - 9
9.1 - 9.5
9.6 - 10.1
0 5 10 20 Kilometers
100
100
100
100
200
300
500
700
1000

Pass 3, 2004


Temperature 75m
5.4 - 6
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6.6 - 7
7.1 - 7.5
7.6 - 8
8.1 - 8.5
8.6 - 9
9.1 - 9.5
9.6 - 10.1
0 5 10 20 Kilometers
100
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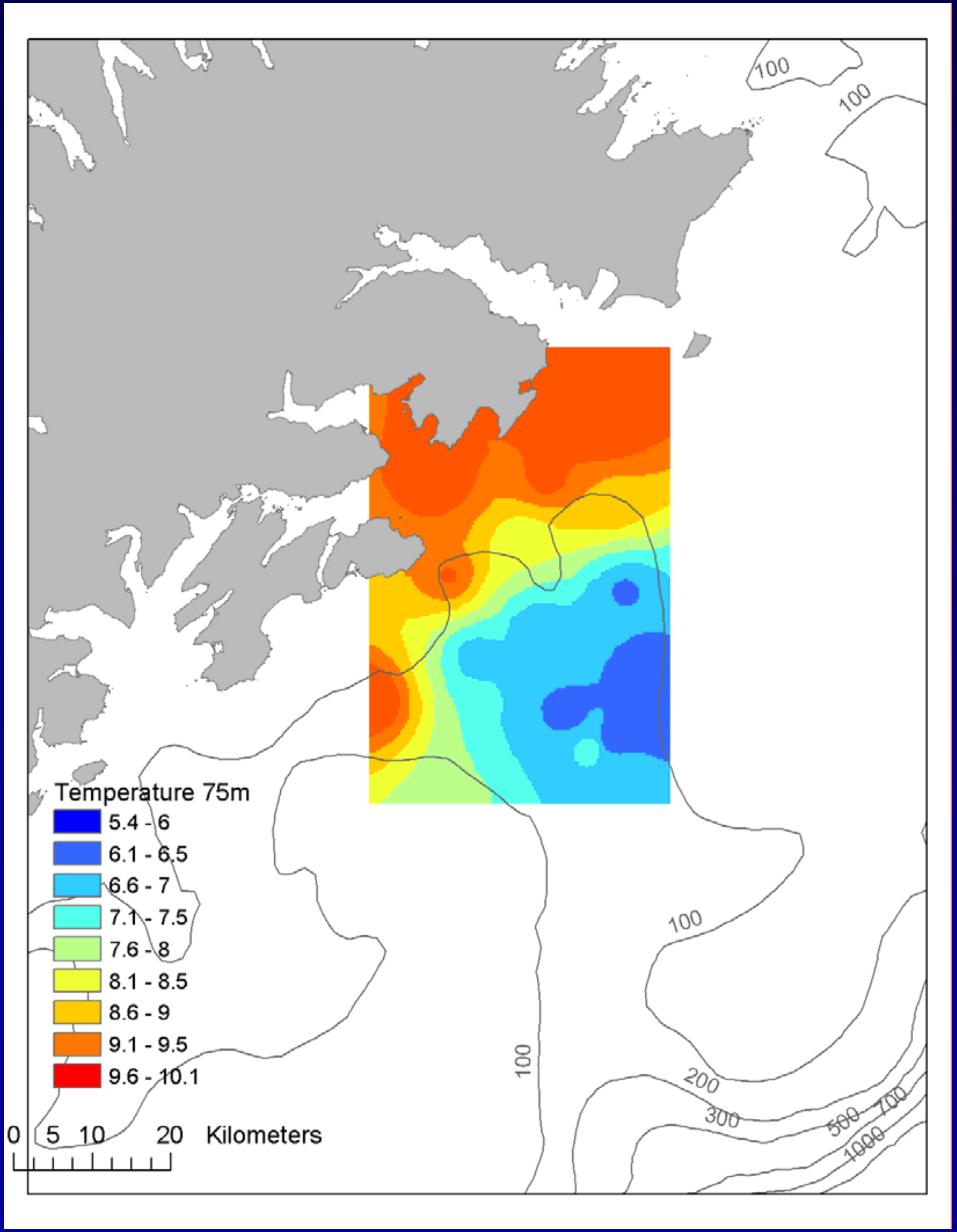
500
700
1000

Pass 4, 2004



Temperature 75m
5.4 - 6
6.1 - 6.5
6.6 - 7
7.1 - 7.5
7.6 - 8
8.1 - 8.5
8.6 - 9
9.1 - 9.5
9.6 - 10.1
0 5 10 20 Kilometers
100
100
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100
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300
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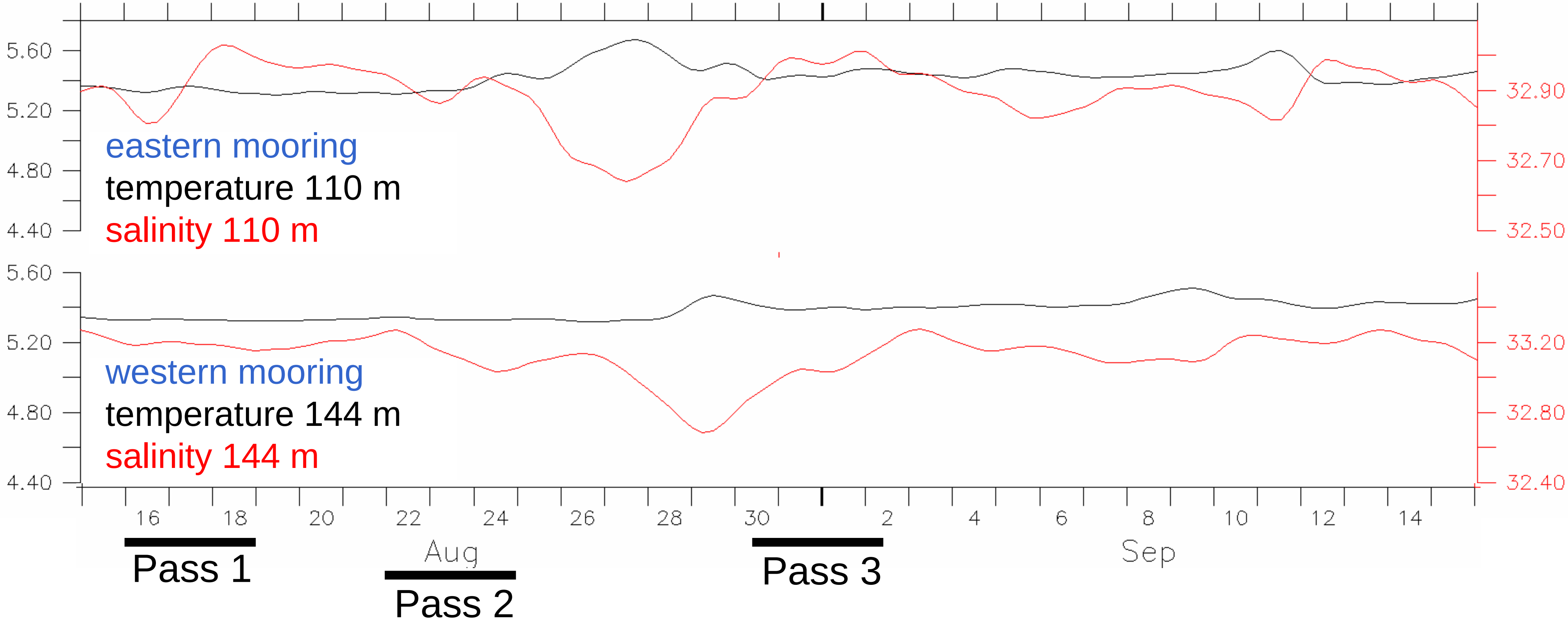
700
1000

Moorings


5.60
5.20
4.80
4.40
32.90
32.70
32.50
eastern mooring
temperature 110 m
salinity 110 m
5.60
5.20
4.80
4.40
33.20
32.80
32.40
western mooring
temperature 144 m
salinity 144 m
16
18
20
22
24
26
28
30
2
4
6
8
10
12
14
Aug
Sep
Pass 1
Pass 2
Pass 3

Winter Currents

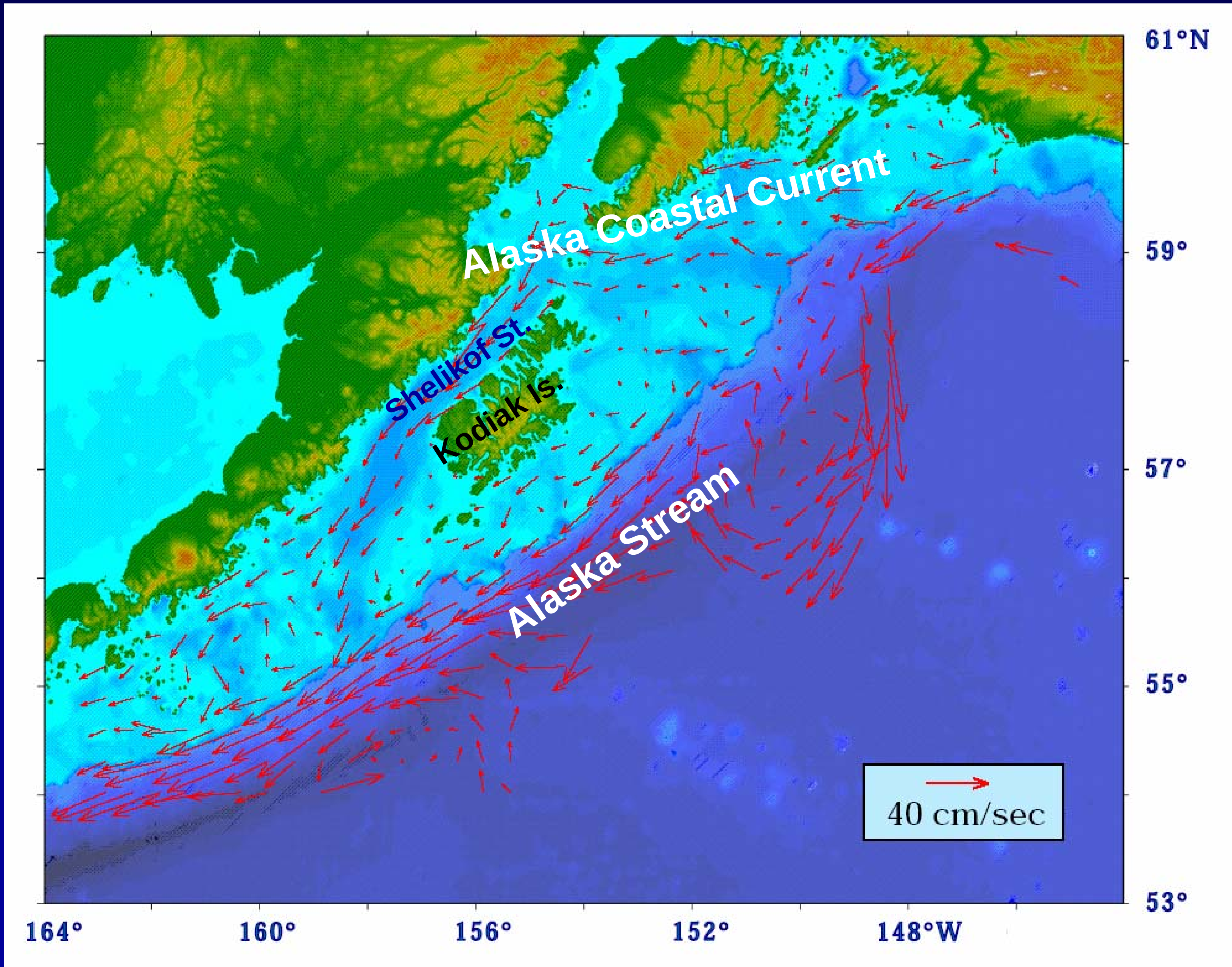
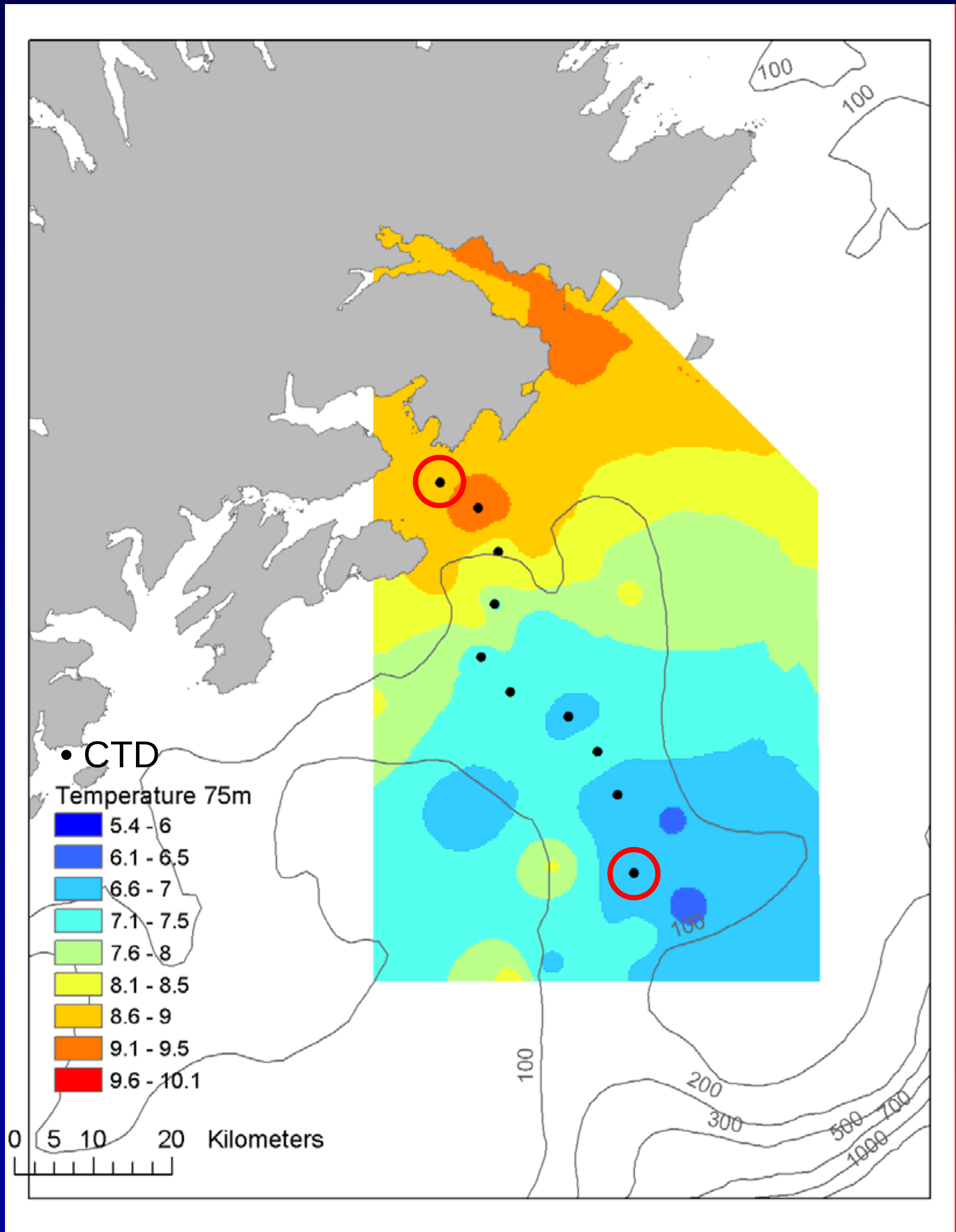


figure courtesy of N. Kachel

Pass 3, 2004



100
100
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500
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1000
• CTD
Temperature 75m
5.4 - 6
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6.6 - 7
7.1 - 7.5
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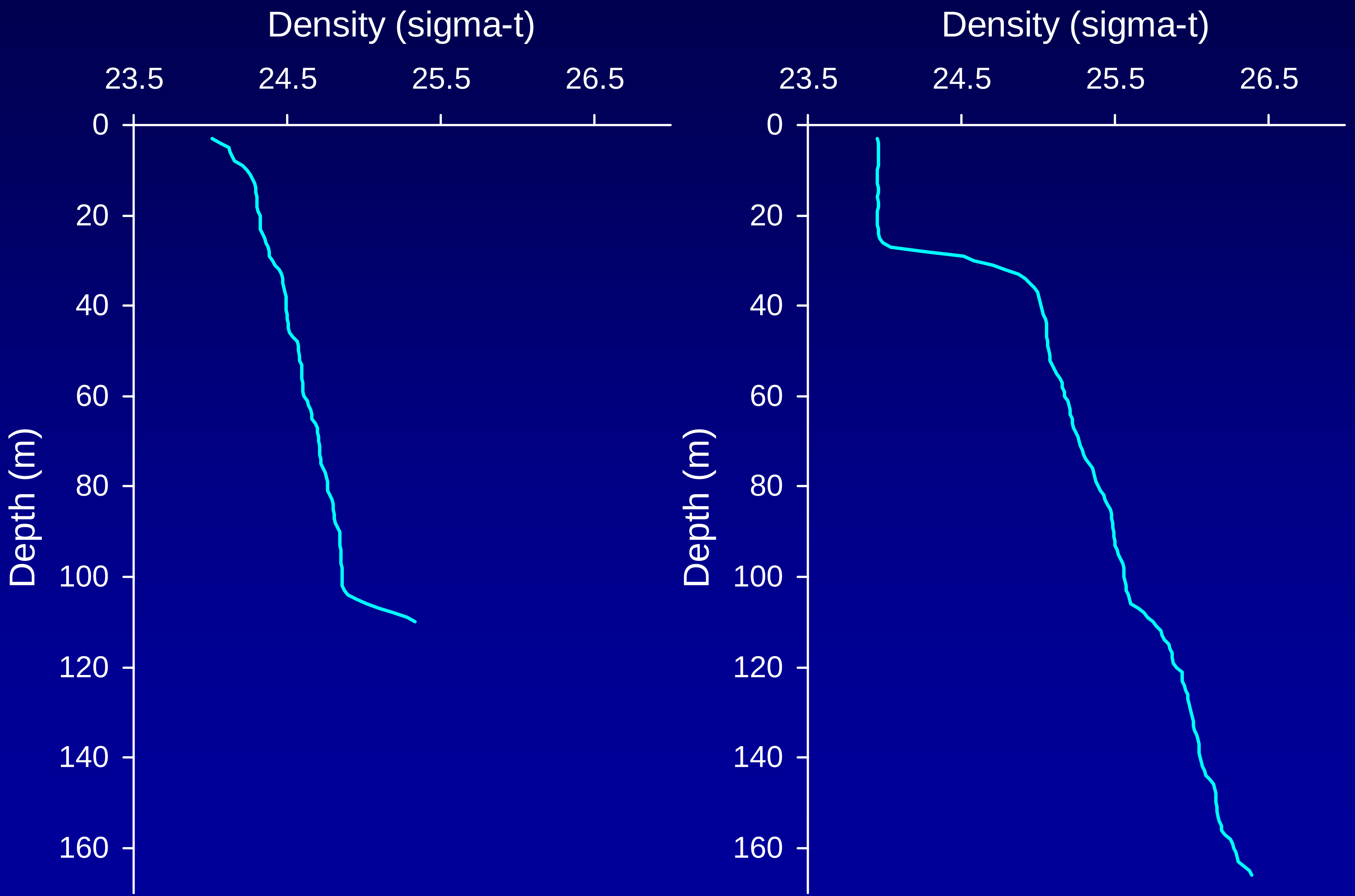
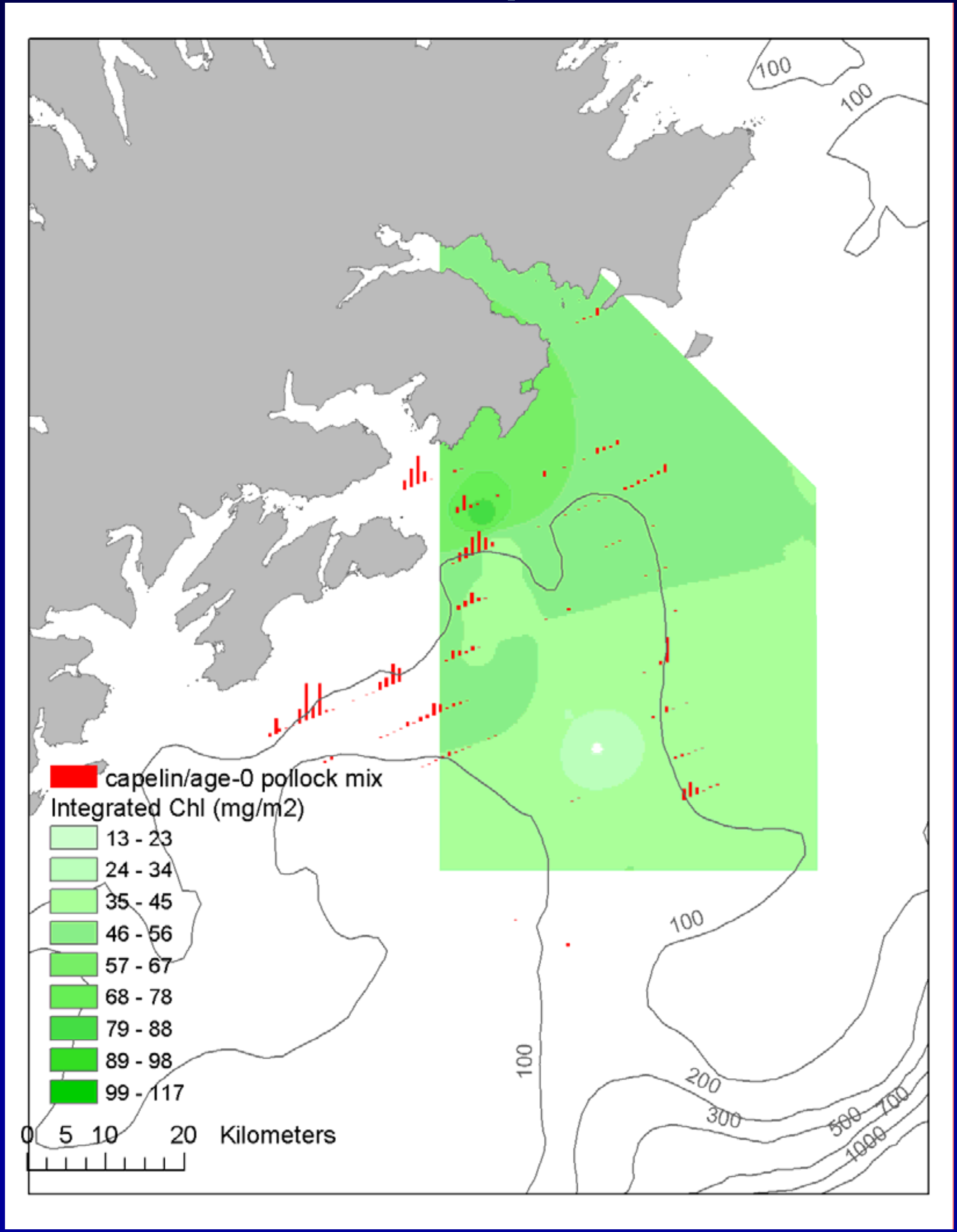
8.1 - 8.5
8.6 - 9
9.1 - 9.5
9.6 - 10.1
0 5 10 20 Kilometers

Inshore 2004 Offshore



Pass 2, 2004


capelin/age-0 pollock mix
Integrated Chl (mg/m2)
13 - 23
24 - 34
35 - 45
46 - 56
57 - 67
68 - 78
79 - 88
89 - 98
99 - 117
0 5 10 20 Kilometers
100
100
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700
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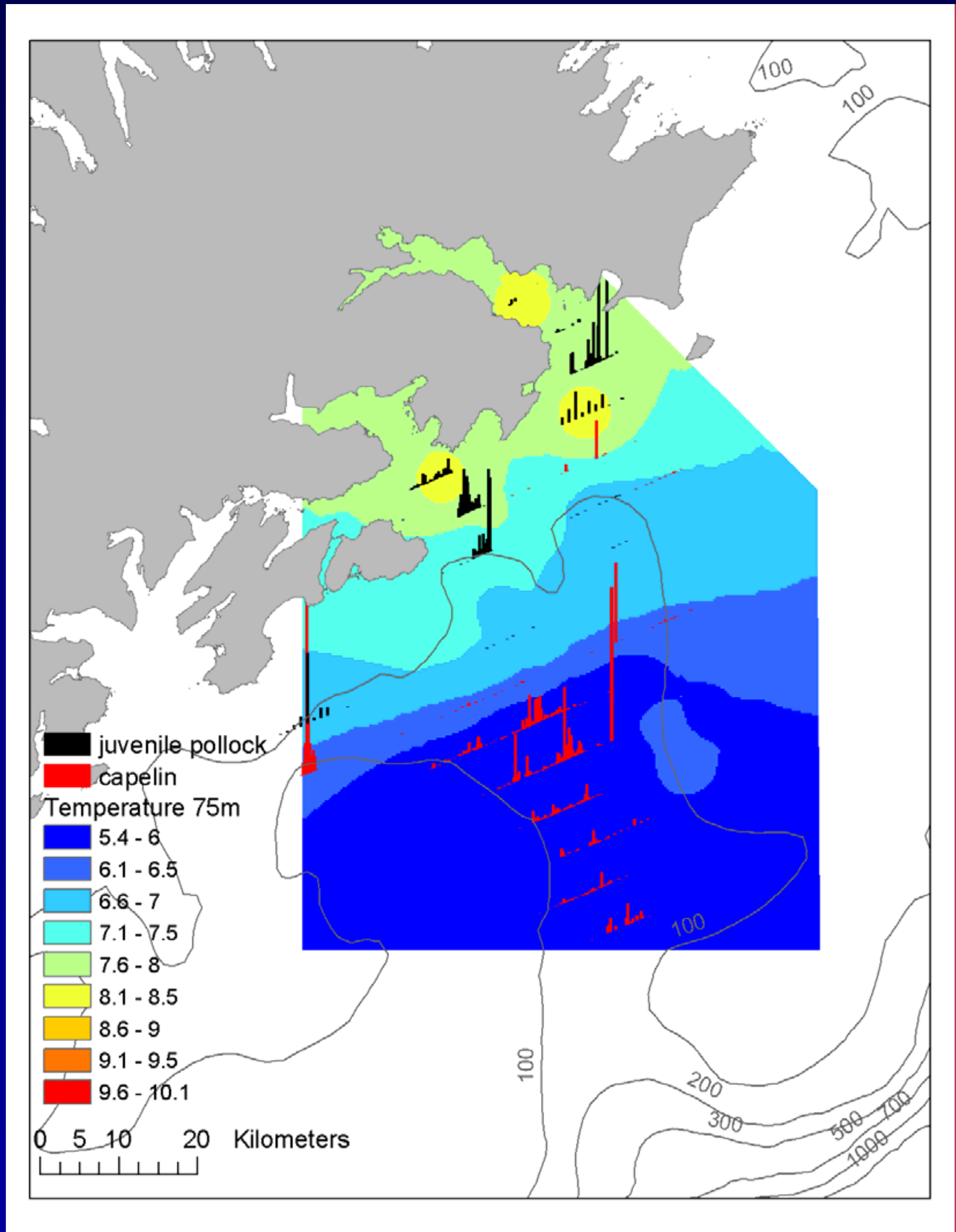
Pass 1, 2002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8.6 - 9
9.1 - 9.5
9.6 - 10.1
0 5 10 20 Kilometers
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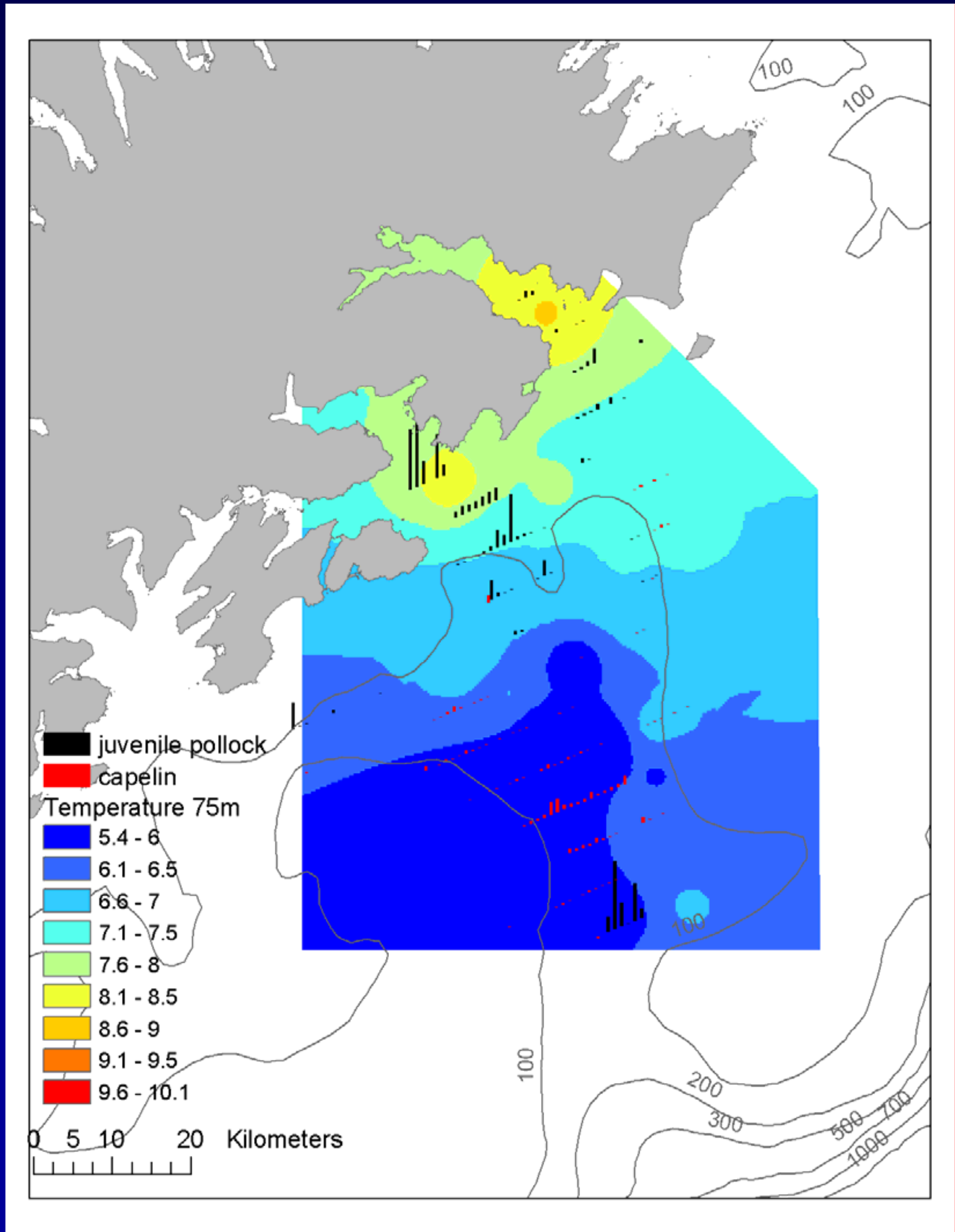
Pass 2, 2002



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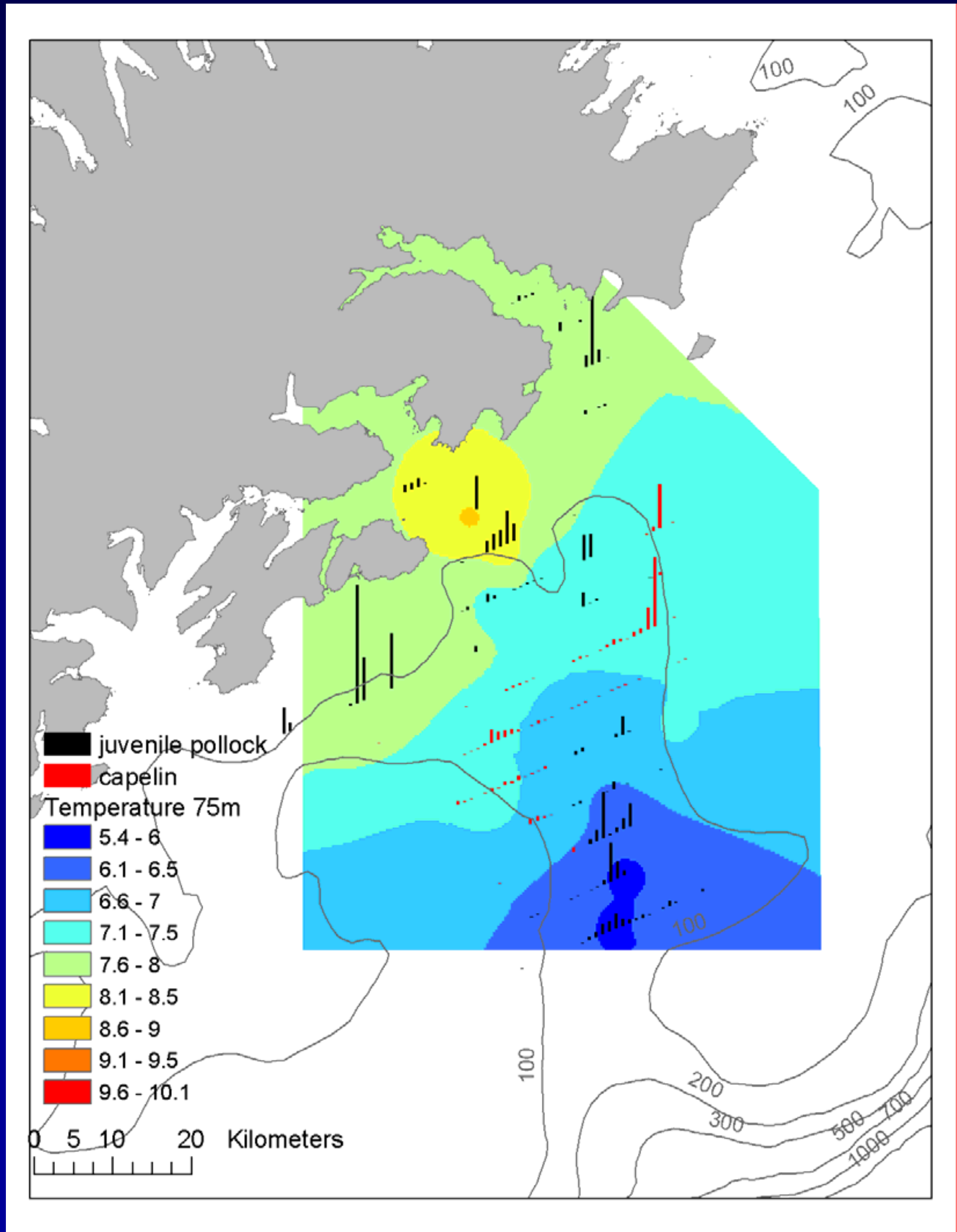
Pass 3, 2002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0 5 10 20 Kilometers
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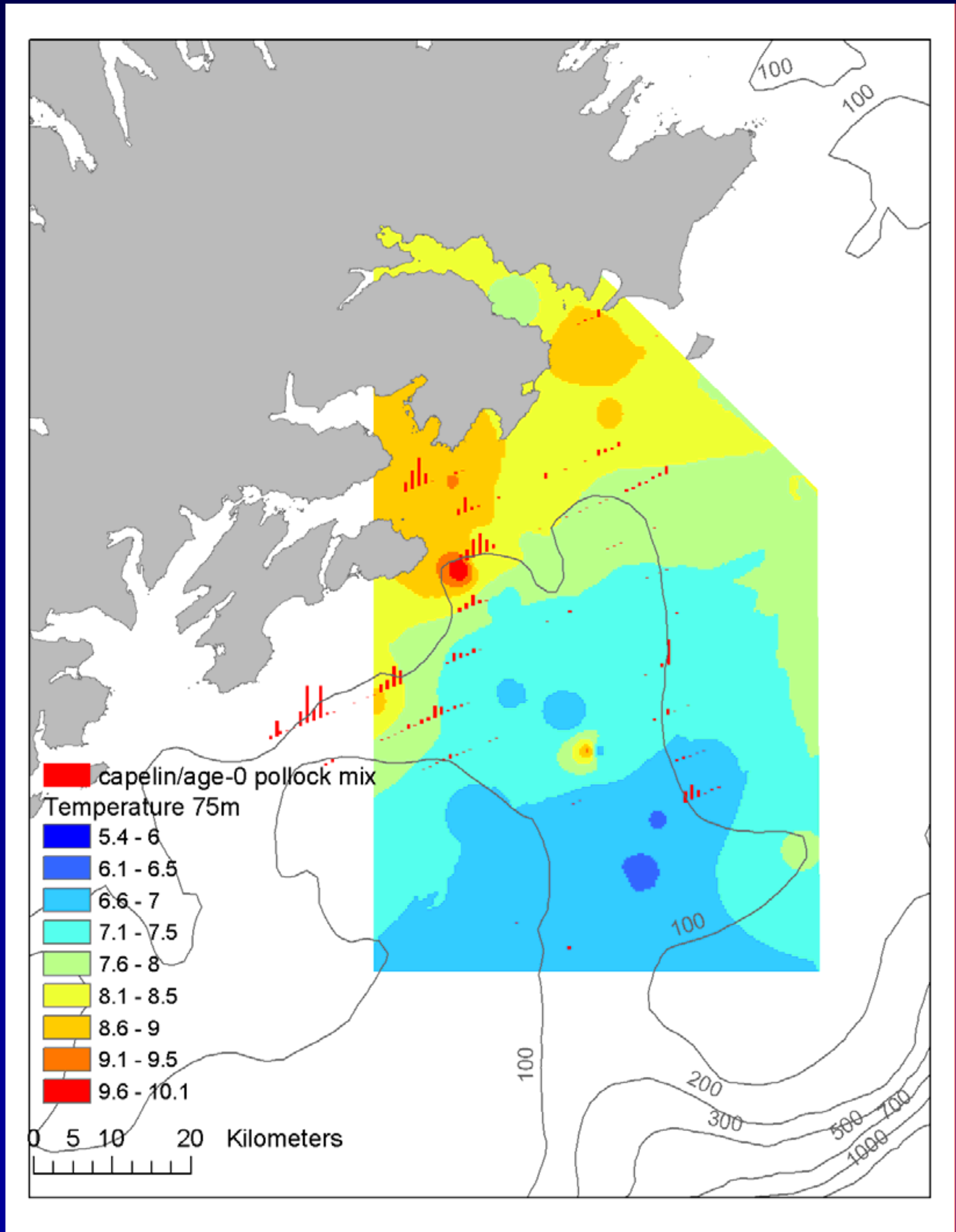
700
1000

Pass 2, 2004


capelin/age-0 pollock mix
Temperature 75m
5.4 - 6
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7.6 - 8
8.1 - 8.5
8.6 - 9
9.1 - 9.5
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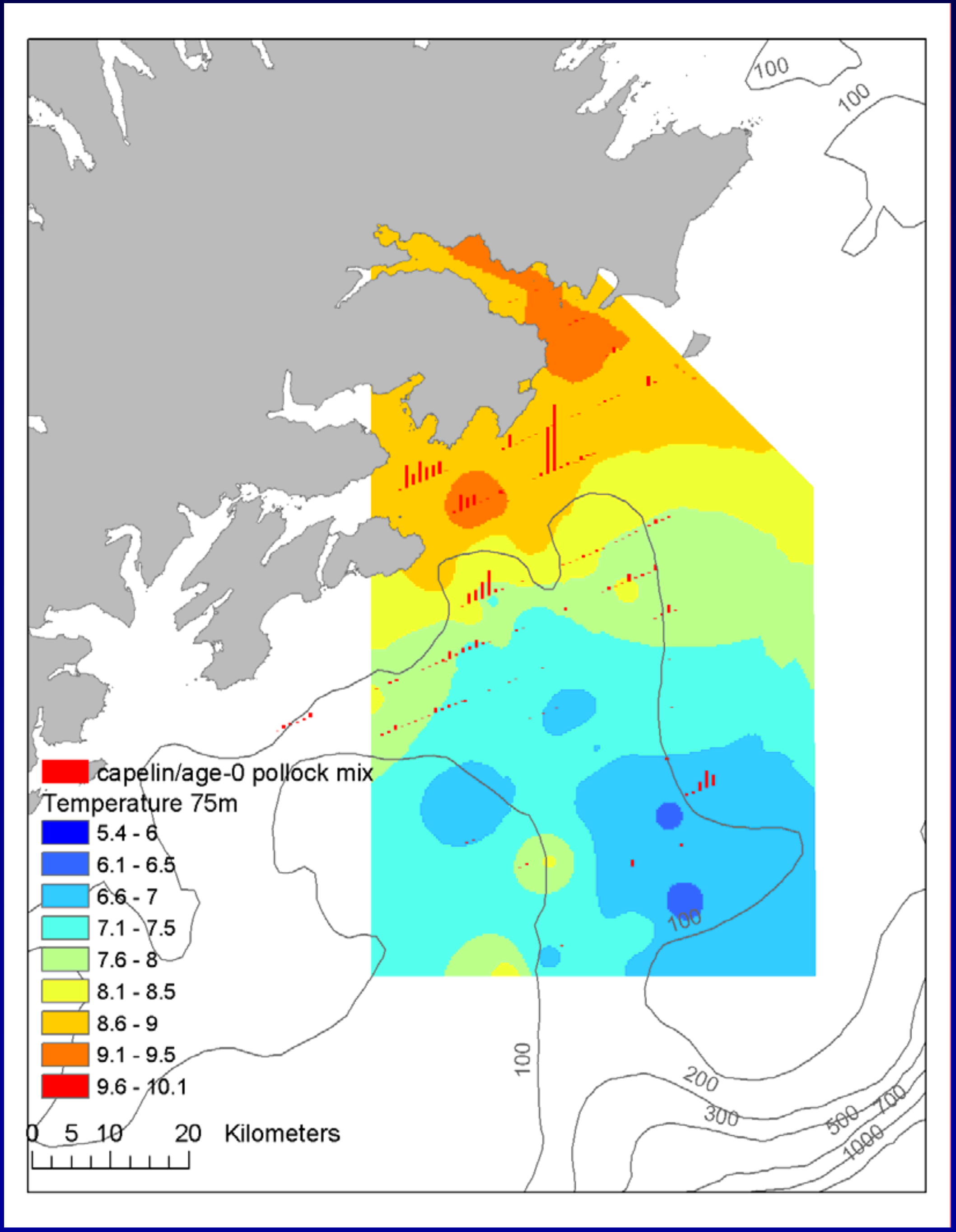
0 5 10 20 Kilometers
100
100
100
100
200
300
500
700
1000

Pass 3, 2004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0 5 10 20 Kilometers
100
100
100
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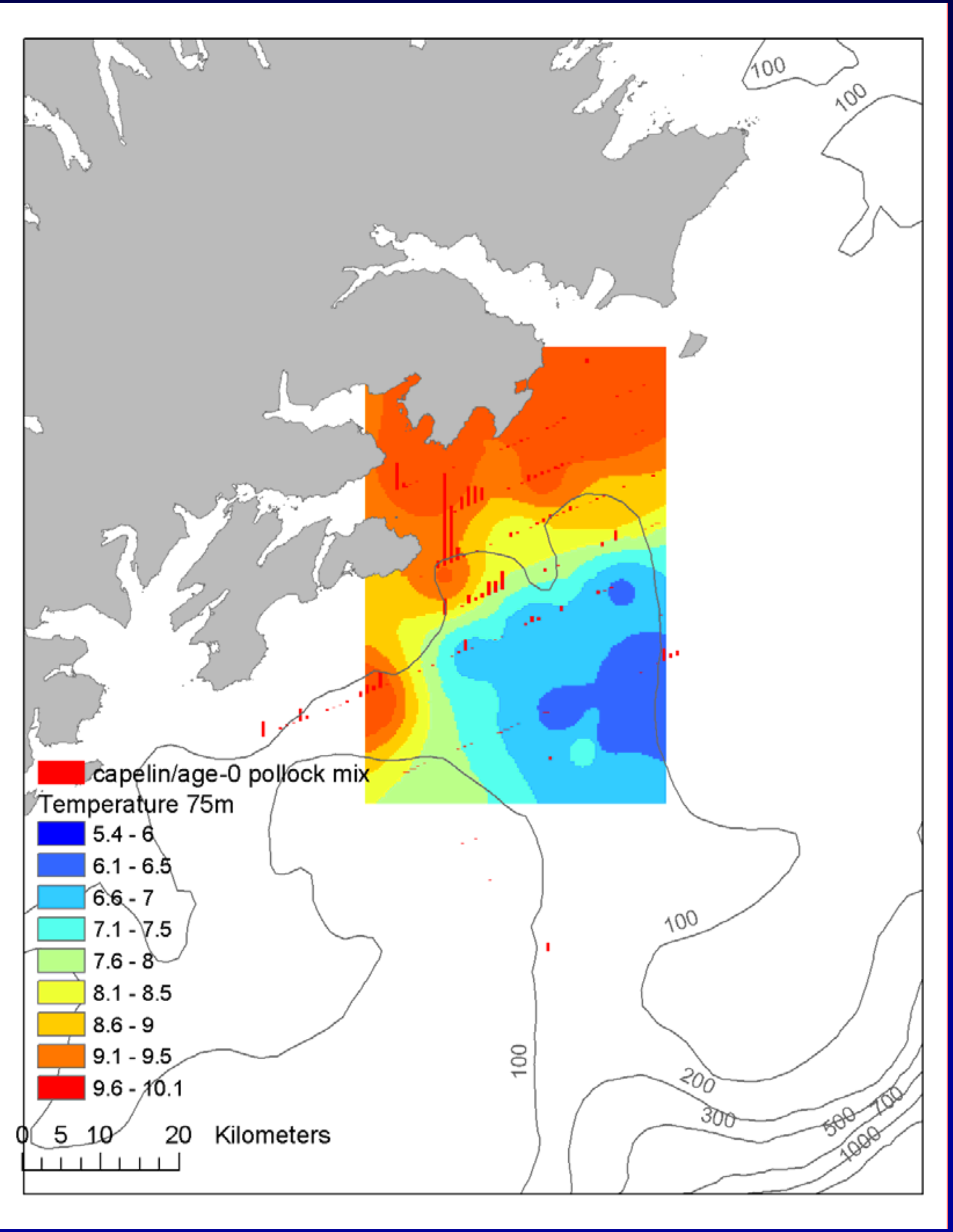
700
1000

Pass 4, 2004


capelin/age-0 pollock mix
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6.6 - 7
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7.6 - 8
8.1 - 8.5
8.6 - 9
9.1 - 9.5
9.6 - 10.1
0 5 10 20 Kilometers
100
100
100
100
200
300
500
700
1000