Behavior of Chinook Salmon in the Bering Sea as Inferred from Archival Tag Data

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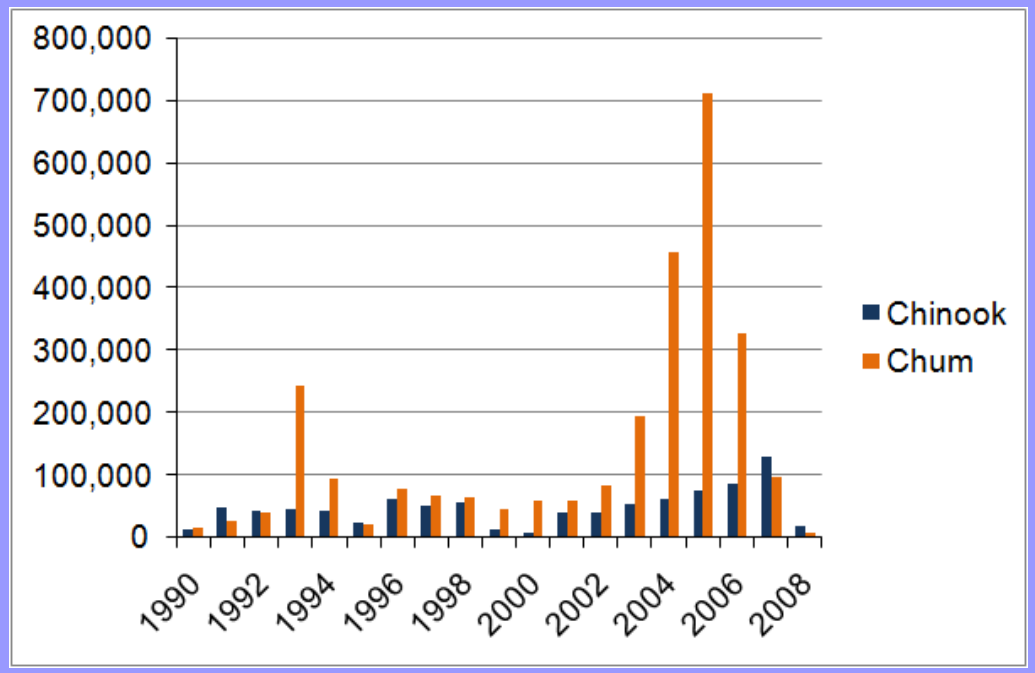
NPAFC

Acknowledgments

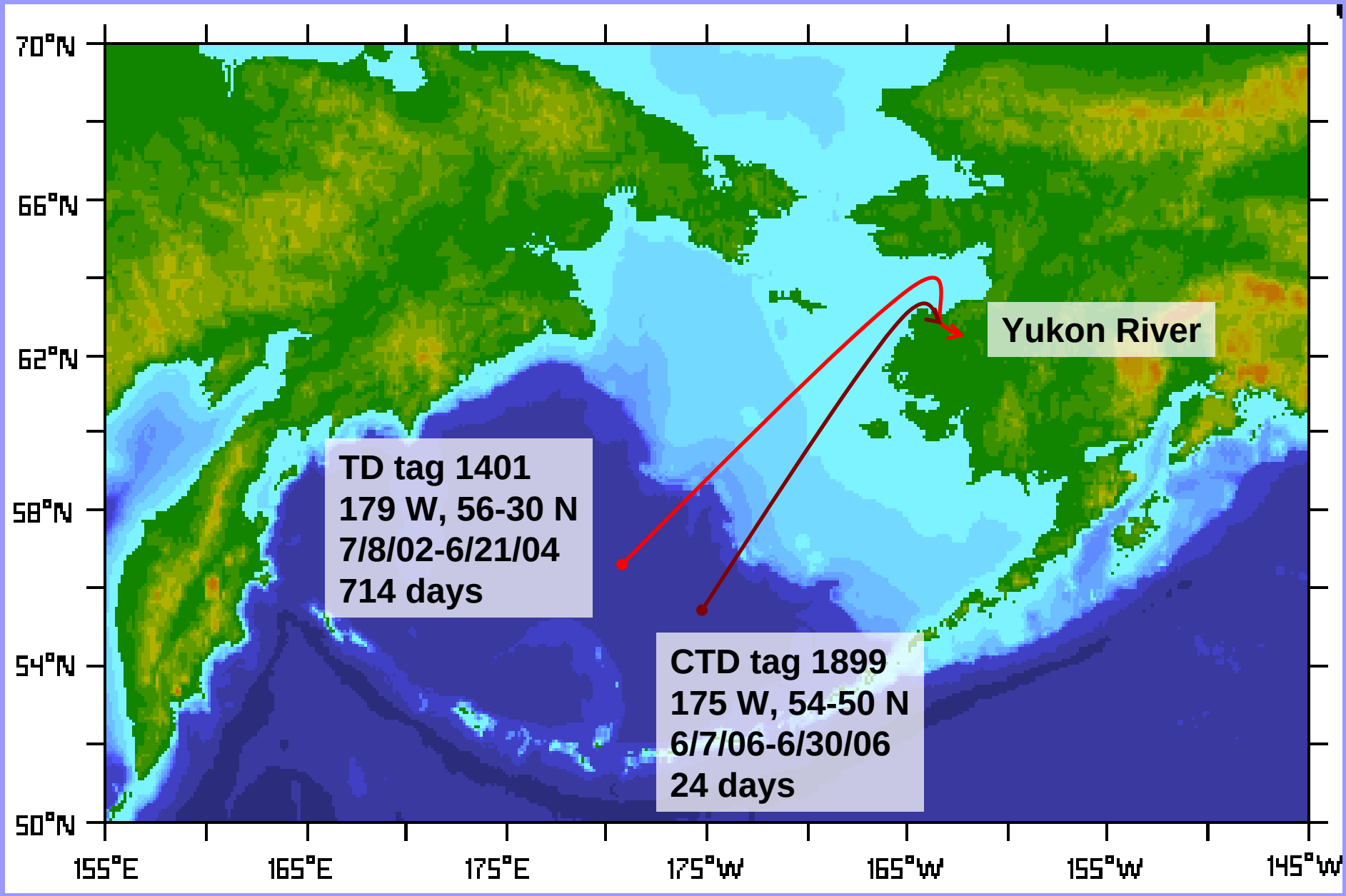
- Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative (AYKSSI)
- North Pacific Anadromous Fish Commission (NPAFC)
- NOAA: National Marine Fisheries Service, AFSC/ABL; PMEL
- Fisheries Research Agency; National Salmon Resources Center; HNFRI (Japan)
- North Pacific Research Board (NPRB)

Chinook Salmon

- Less abundant
- One of two main species in Eastern Bering Sea trawl bycatch
- Important for local economy and subsistence in Western Alaska
- Wide geographic range, with implications for response and adaptation to climate change



Salmon bycatch in US Bering Sea groundfish fisheries

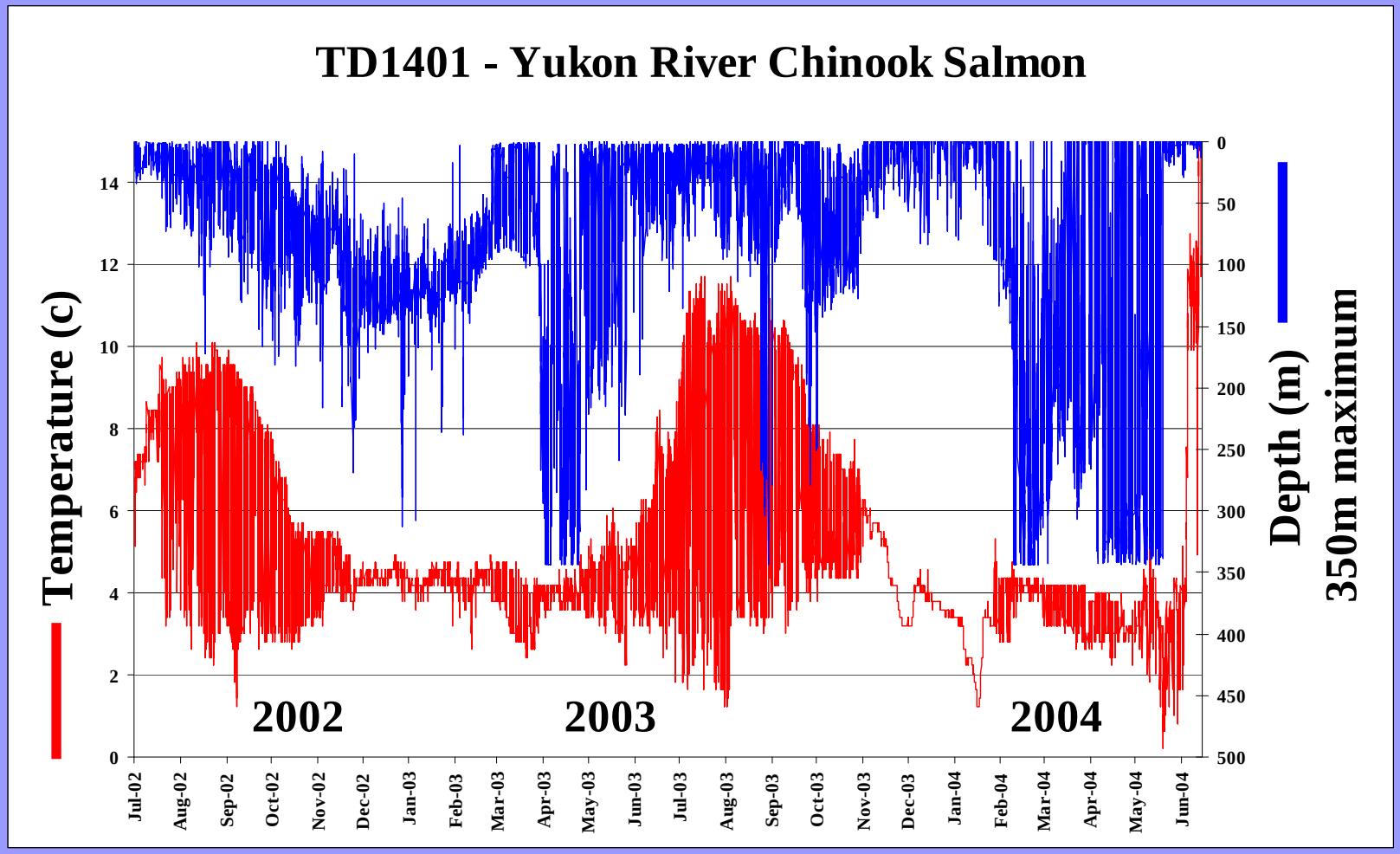


Base map courtesy PMEL website

Immature

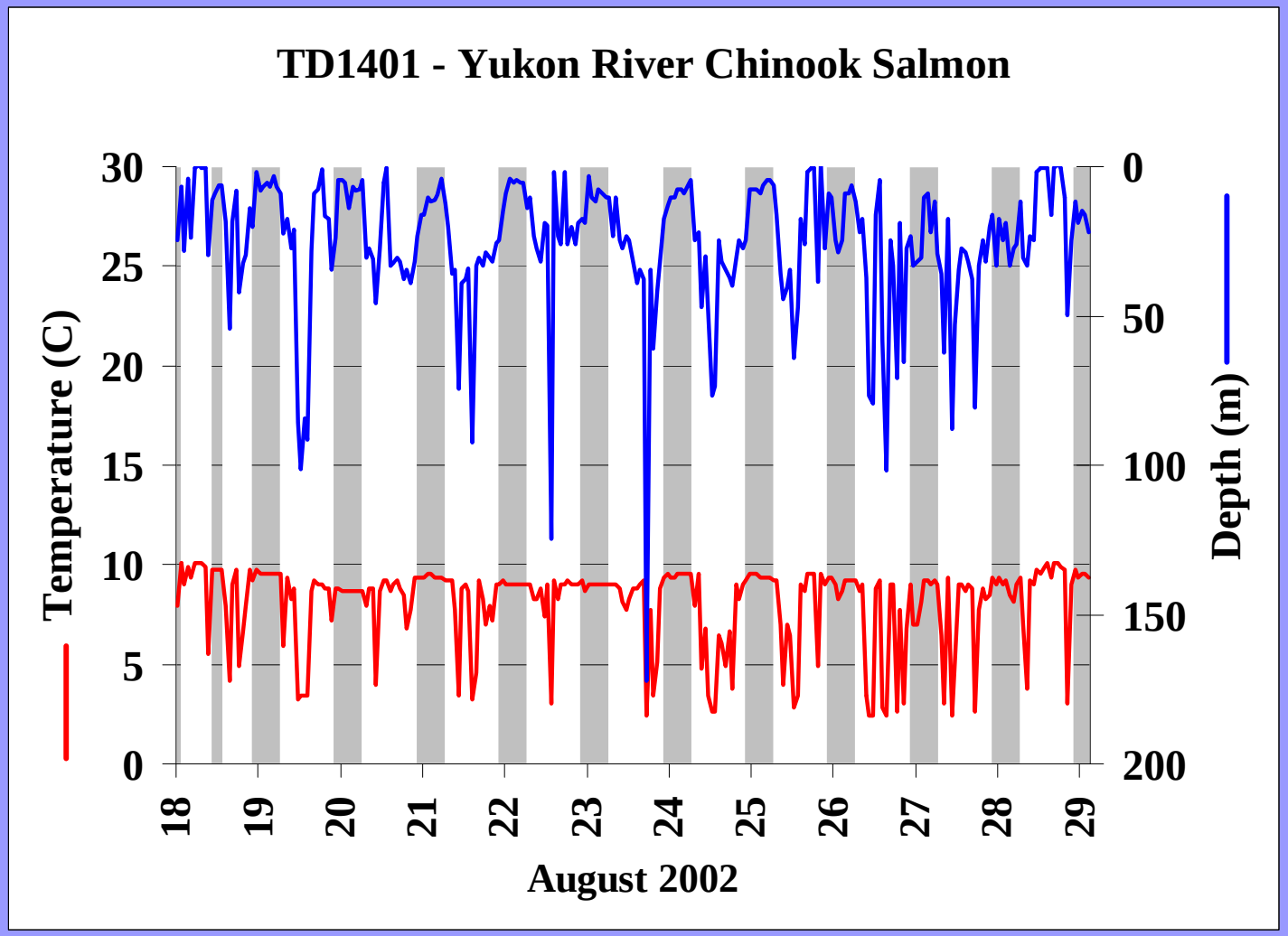
Maturing

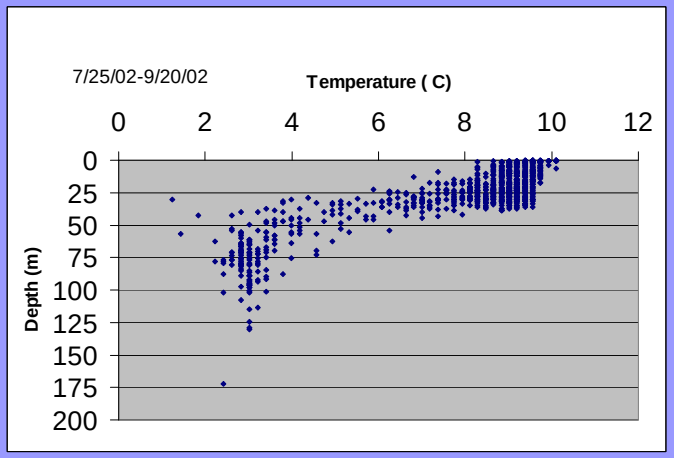
age 1.2 **age 1.3** **age 1.4**

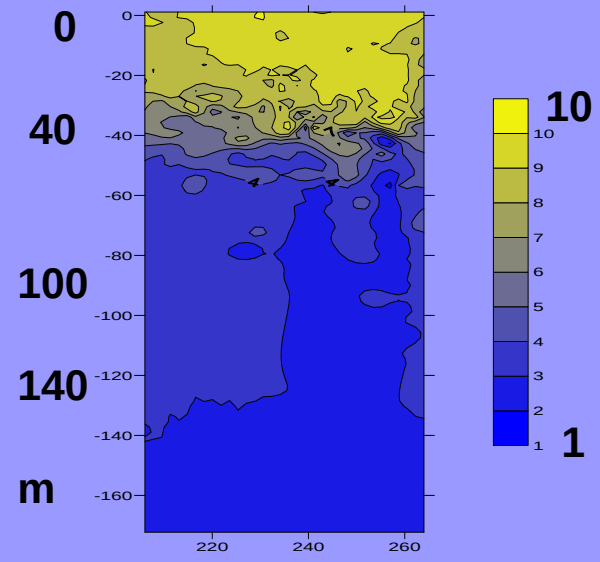


First Summer

Night: near surface
Day: few, large (100 m) vertical movements
large (6-8 ° C) temperature ranges

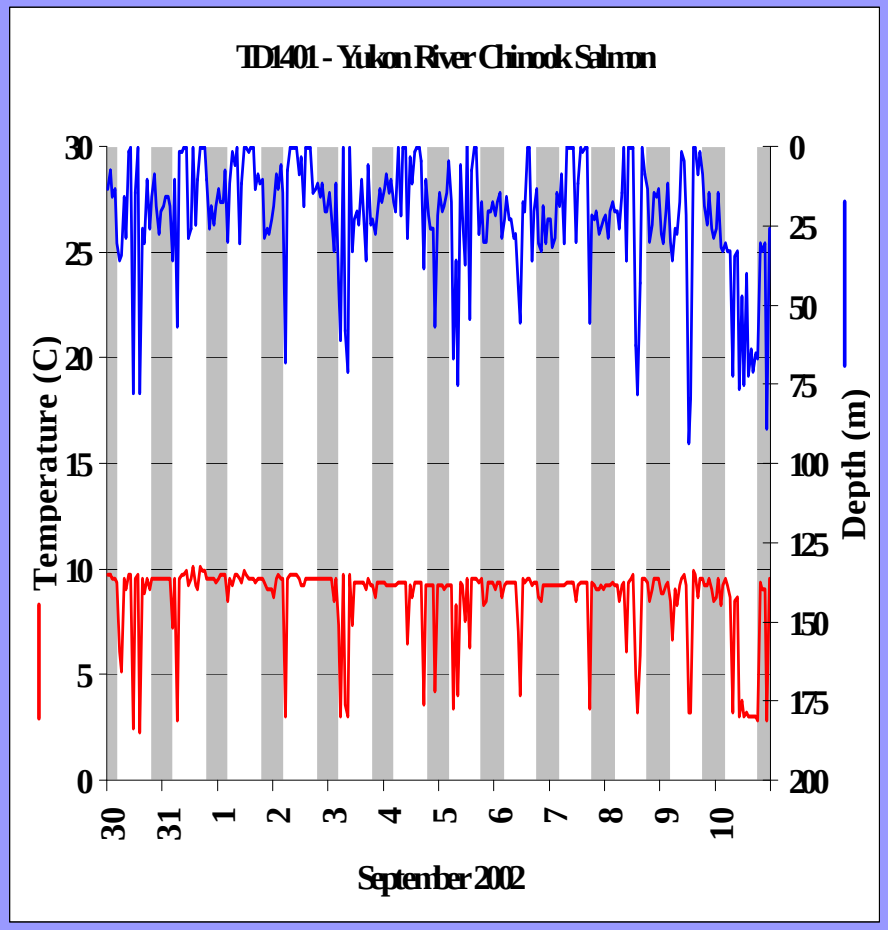




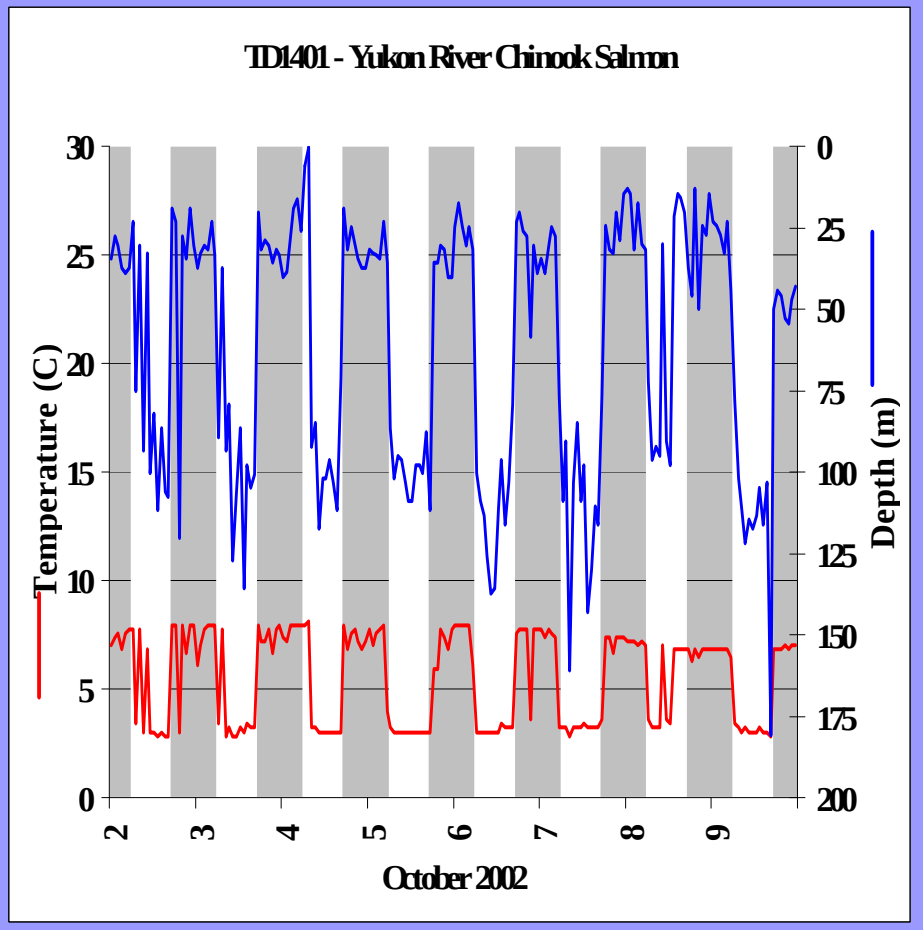


First Fall transition

Night: 25 m below surface
Day: small vertical movements, comes to the surface
Large (7 ° C) temperature range

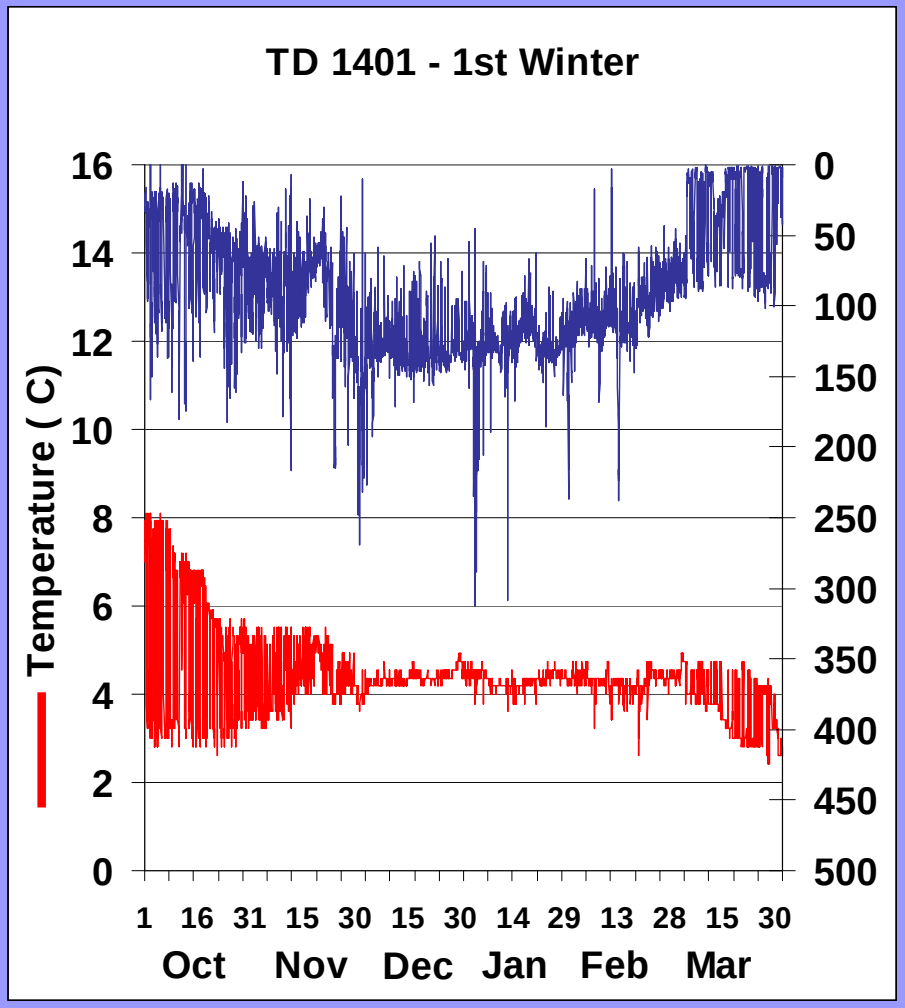


Night: 25 m below surface
Day: 100 m below surface
Smaller (5 ° C) temp range; cooler

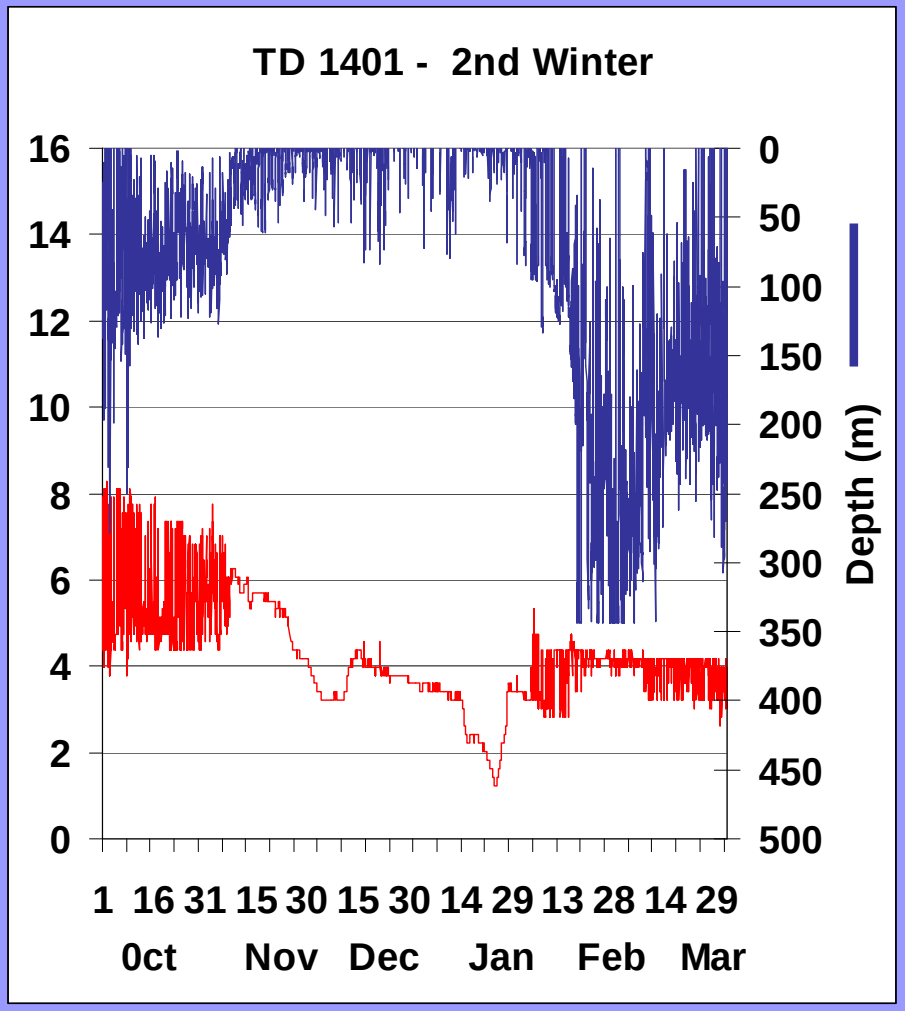


Successive Winters

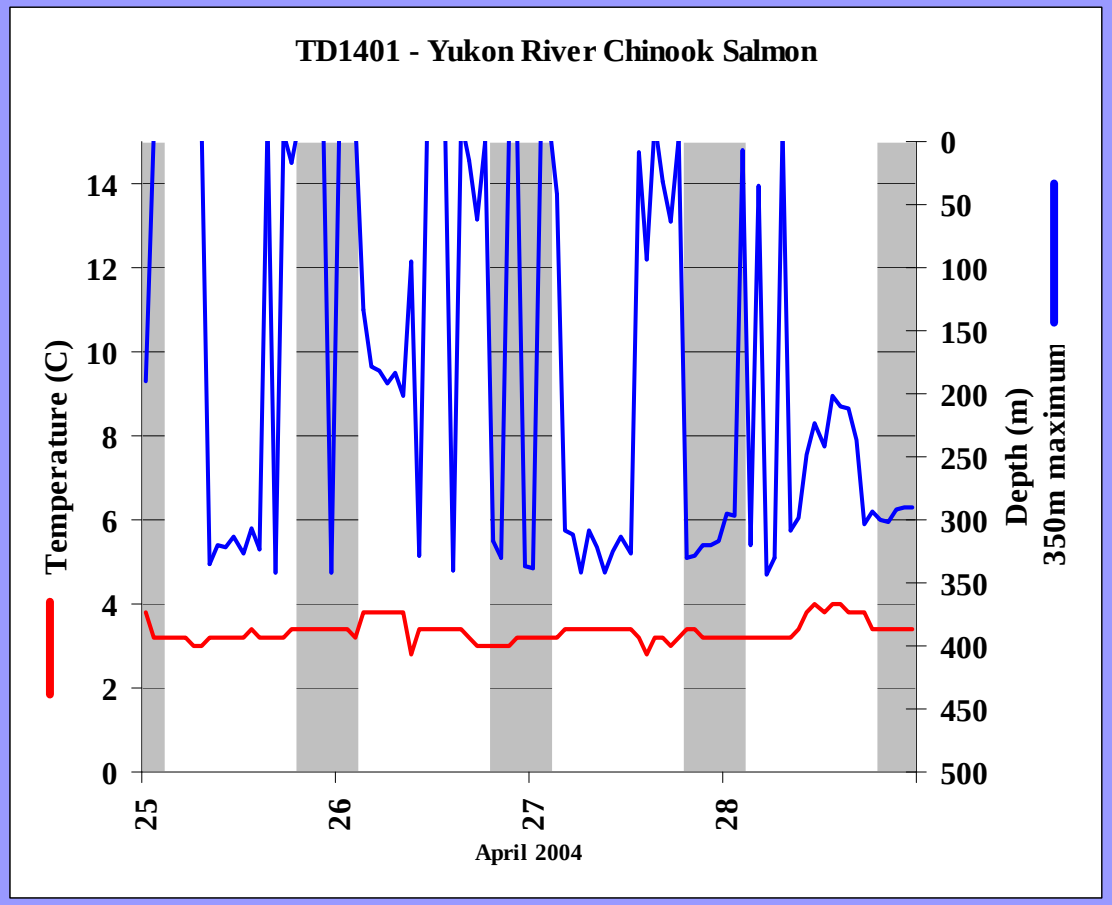
125 m below surface all winter
small (50 m) upward movements during day
constant (4 ° C) temperature



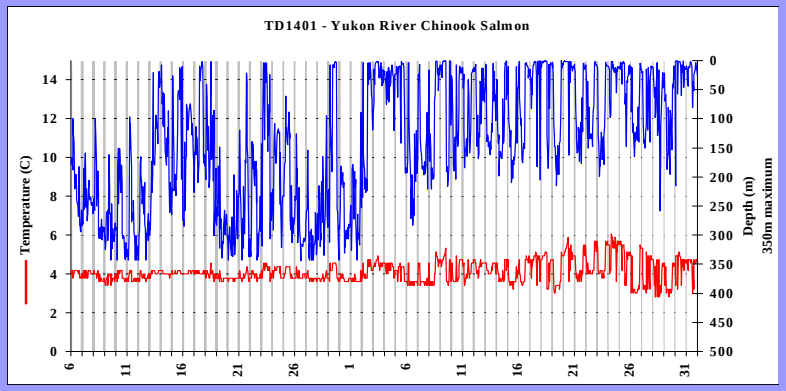
near surface all winter
small (40 m) downward movements during day
declining colder temperature, no daily range



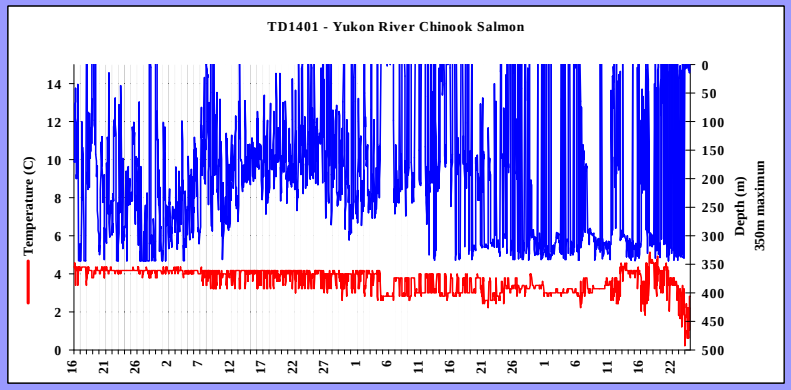
Deep Dive Periods after Winter



April-May 2003



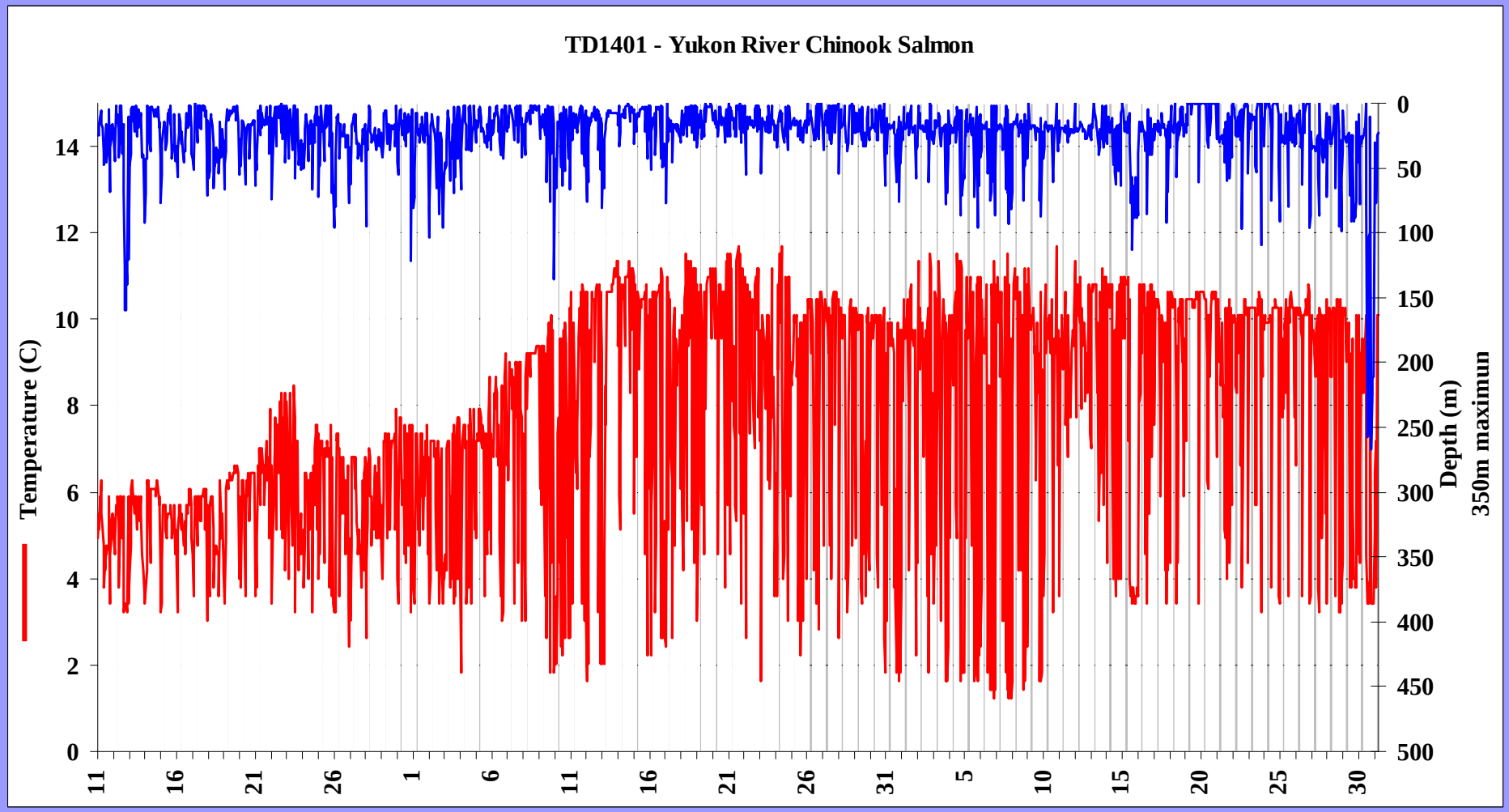
February-May 2004



Second Summer – 2003

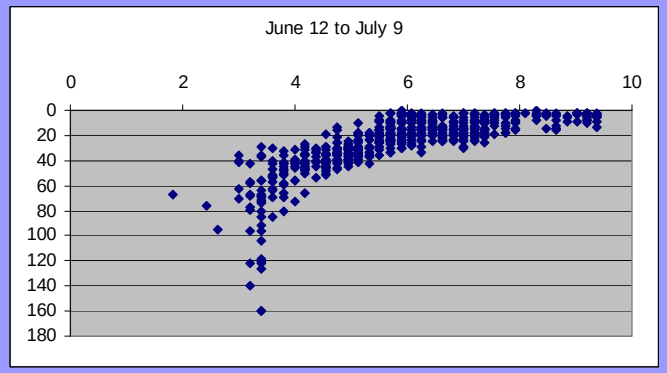
moderate vertical movement (to 50-100 m)

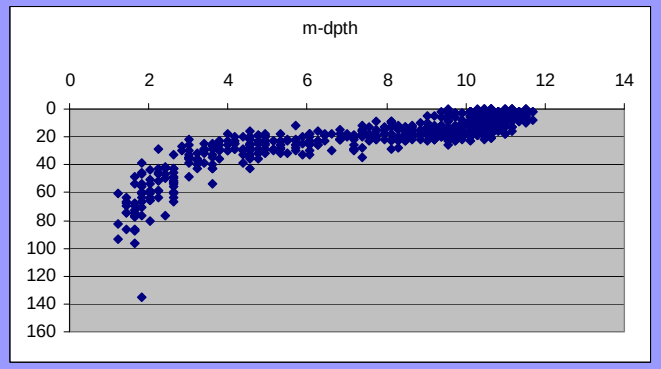
but wide temperature range (2-11 ° C)

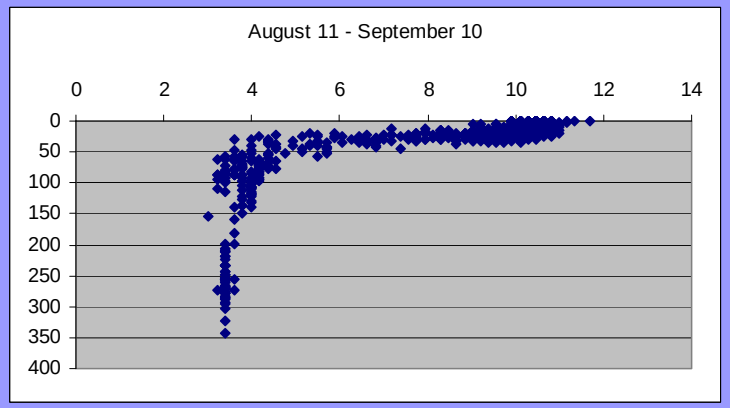


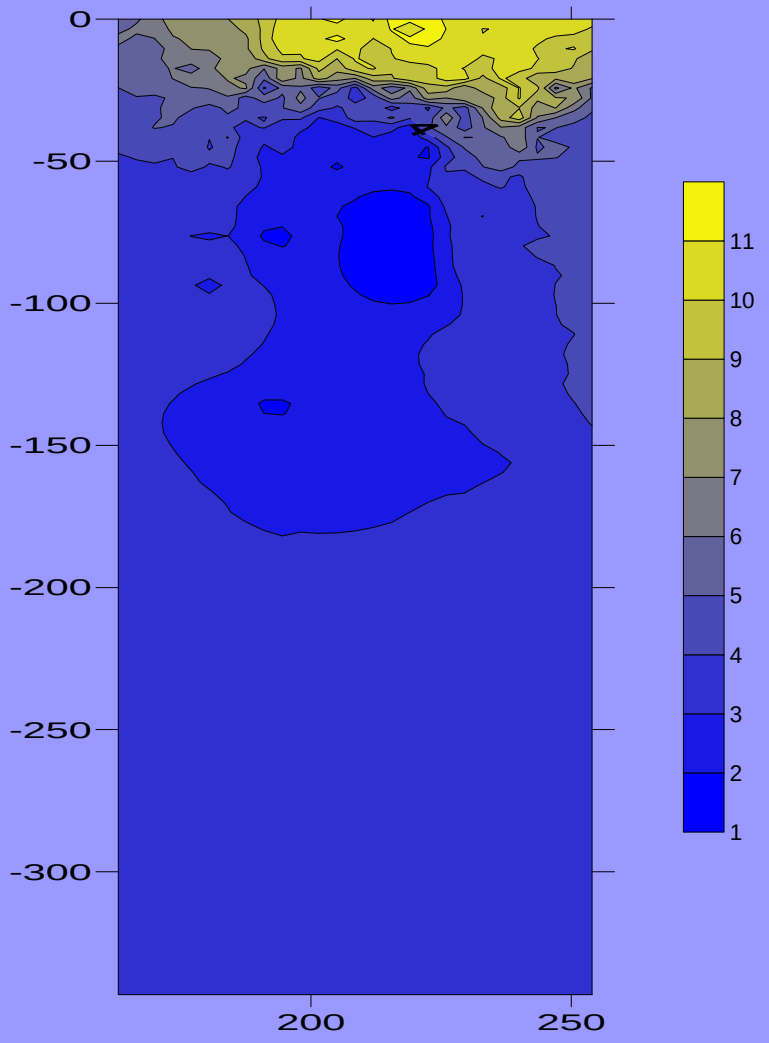
2nd Summer – 2003

moves to stratified area with cold water near surface in mid-summer



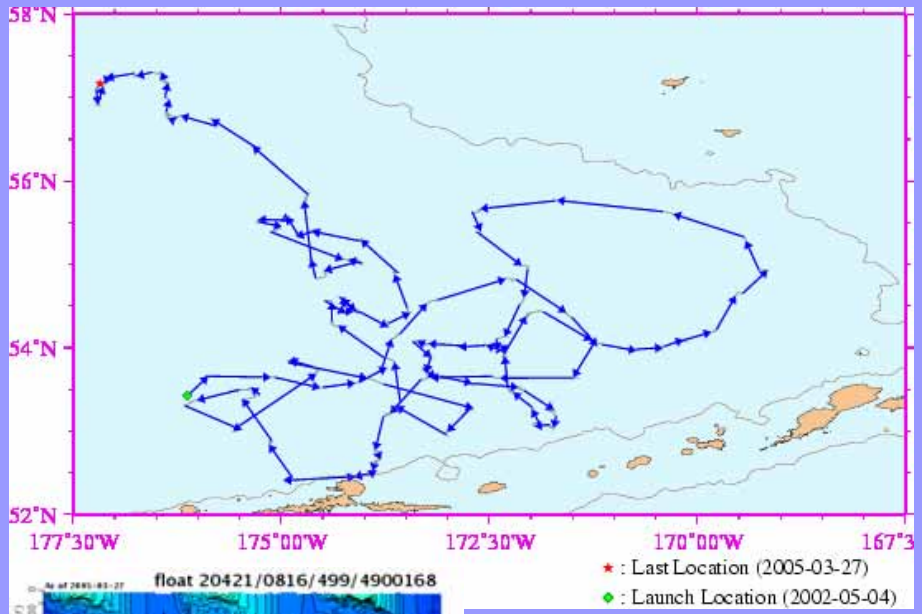


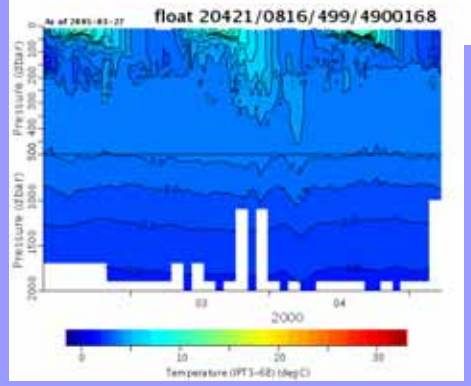




Data Sources

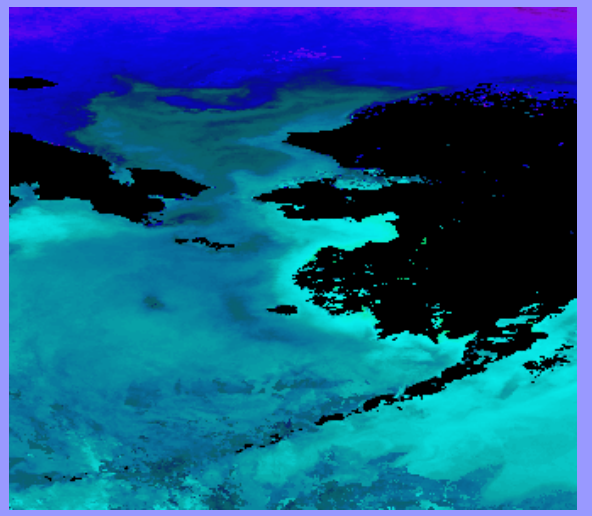
Argo floats





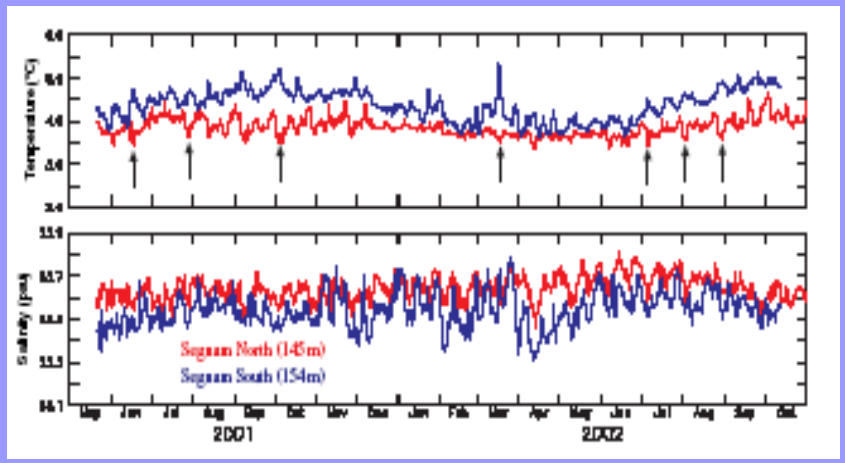
PMEL float 20421

Satellite data

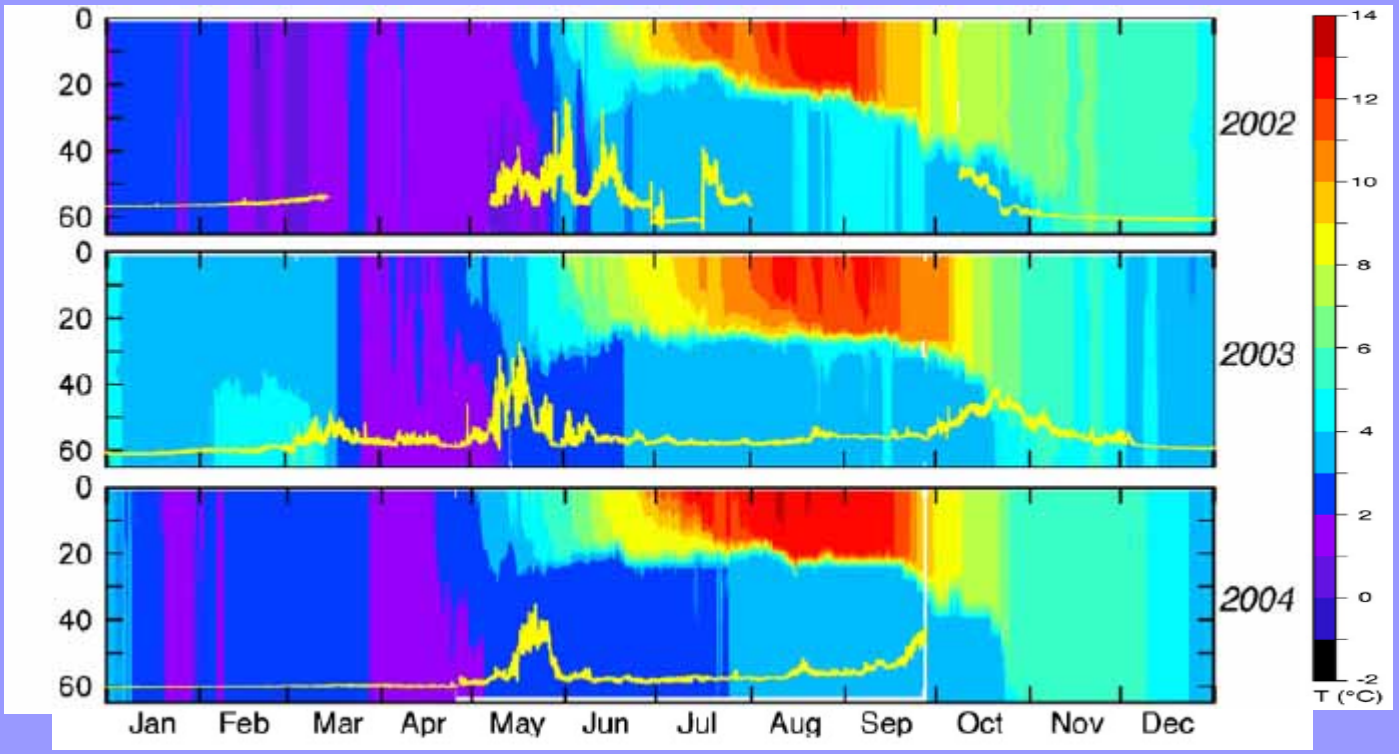


MODIS

Moorings



Seaguam Pass



mooring M2

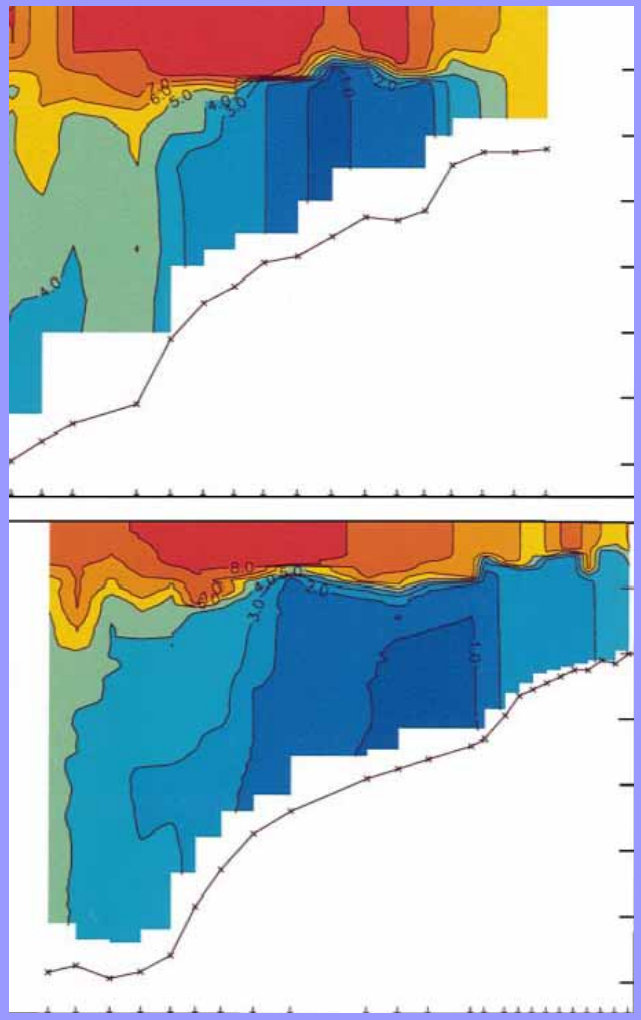
Stabeno et al. 2007

E. Bering Shelf

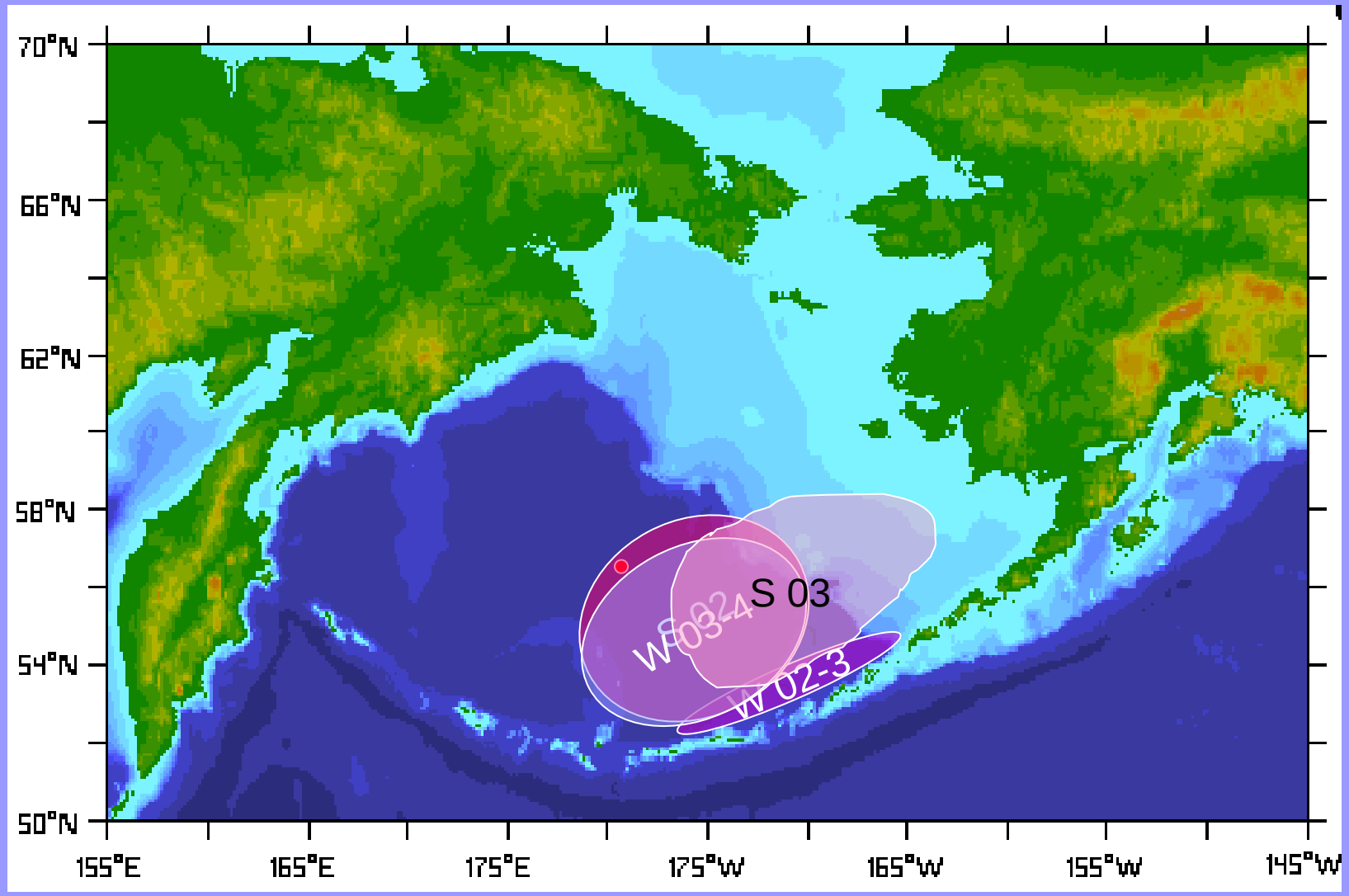
winter mixed

summer stratified

with cold pool



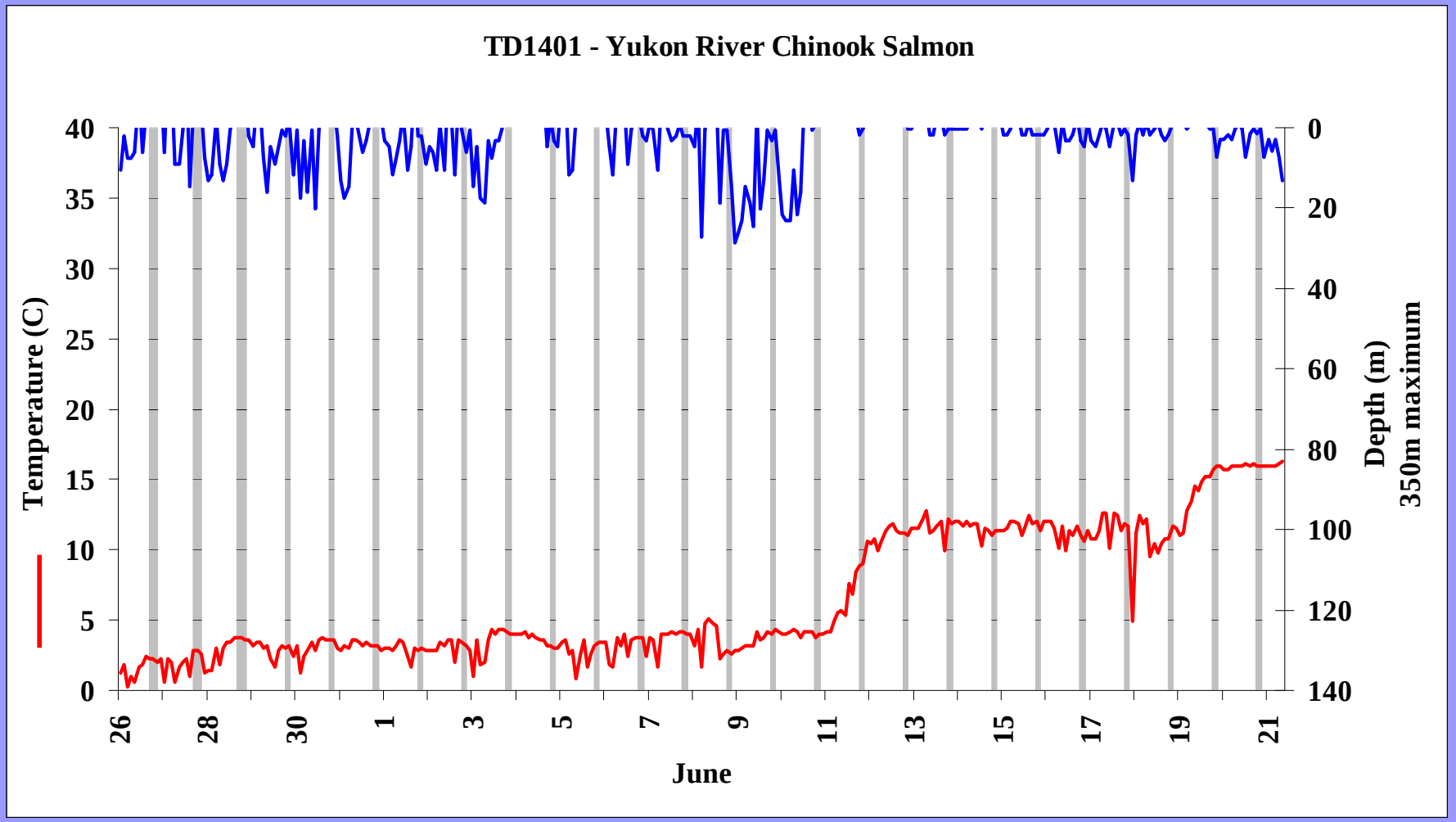
cross-shelf transect
summer
0-140 m
Stabeno et al. 2001


70°N
66°N
62°N
58°N
54°N
50°N
155°E
165°E
175°E
175°W
165°W
155°W
145°W
S 03
W 02-3

Return to Yukon – TD 1401 May-June 2004

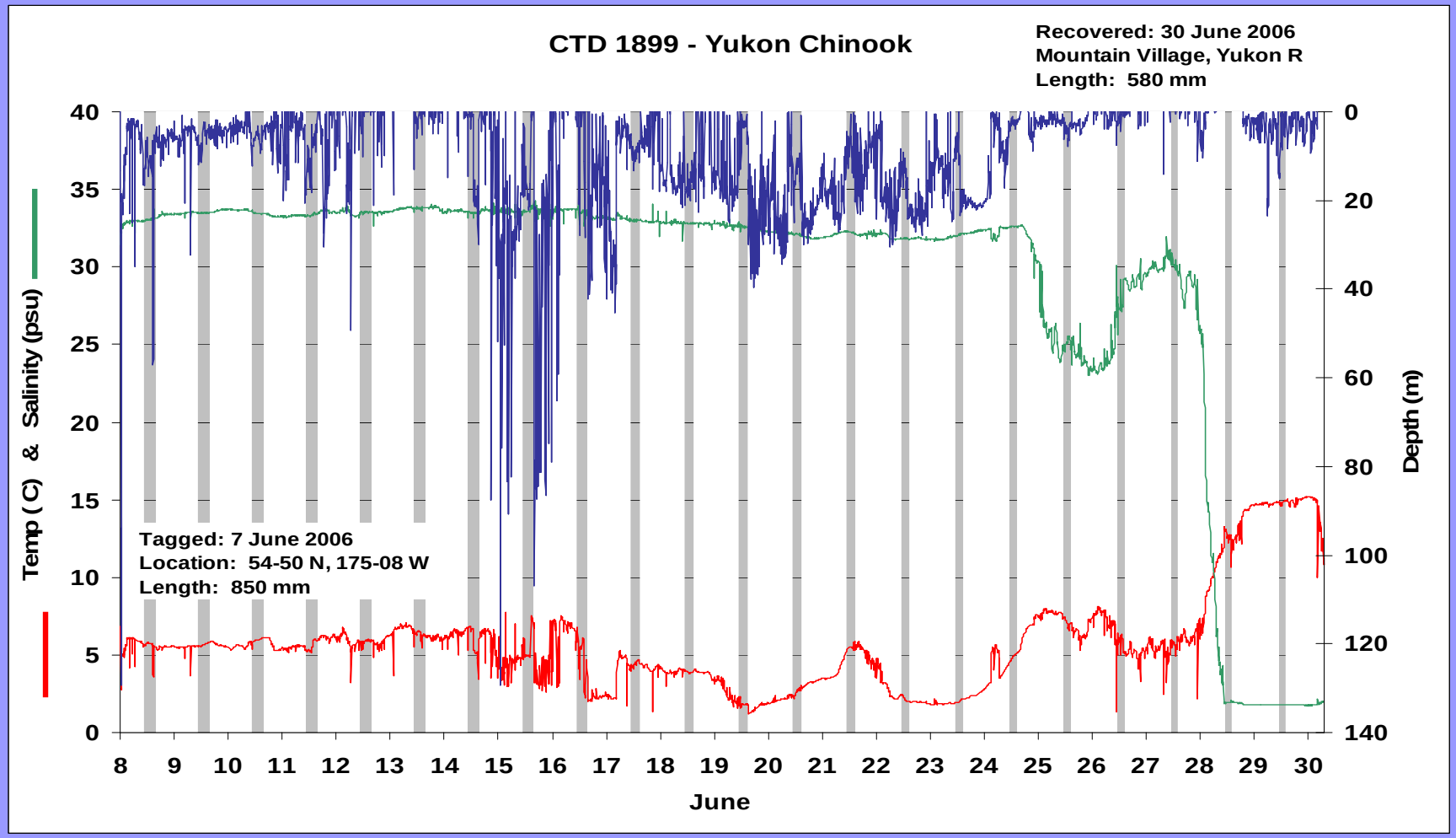
shallow (20 m)

cool (2-4 ° C) until reaches coastal areas (10-12 ° C) and river (16 ° C)



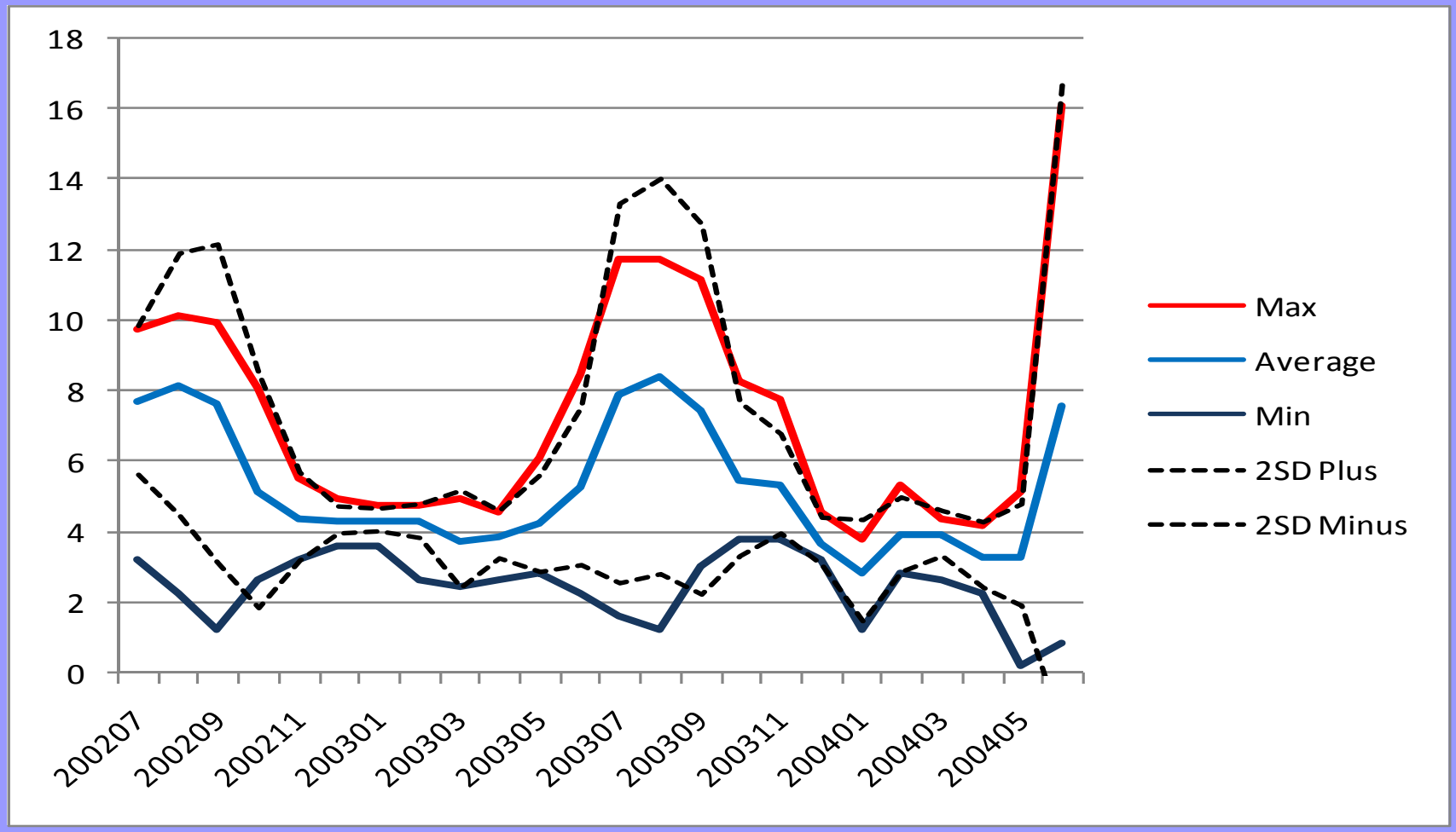
Return to Yukon – CTD 1899 June 2006

shallow (20-30 m) except for 2 days with dives to 100 m (shelf break?)
warmer in basin (6 ° C) until reaches shelf (2-6 ° C) and river (14 ° C)
traveling 1040 km in 24 days, at 47 km/d (2 km/h)



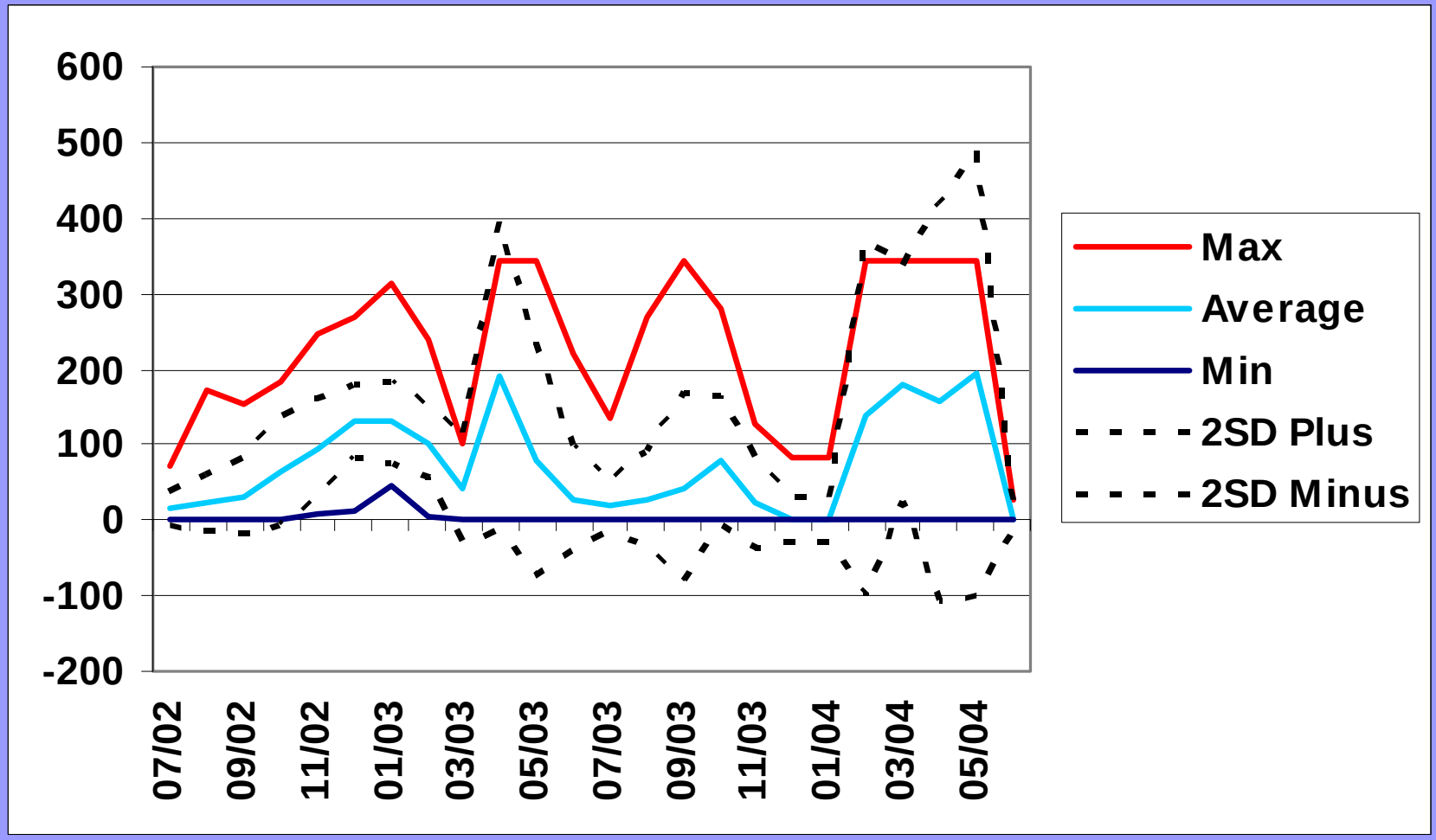
Monthly Temperatures

Summer: wide (8-10 ° C) ranges (8 ° C average in August)
Winter: narrow (2 ° C) ranges



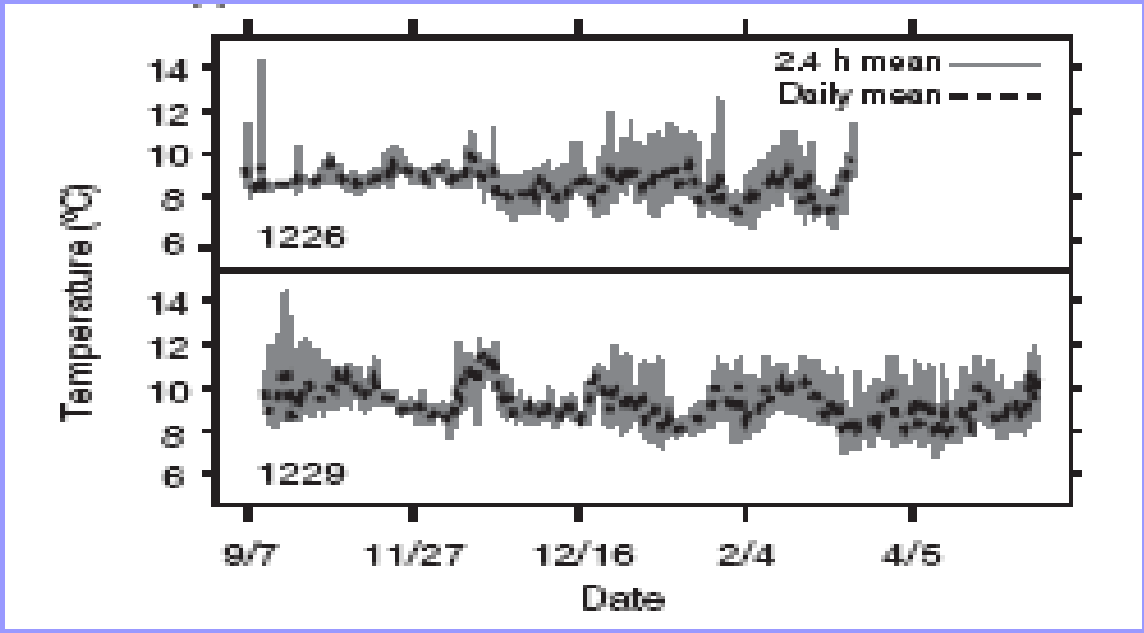
Monthly Depth

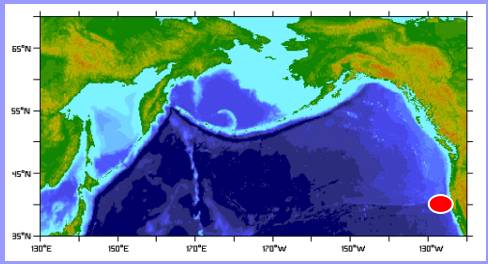
Summer: shallower
Late winter/spring: deeper
but highly variable, wide ranges



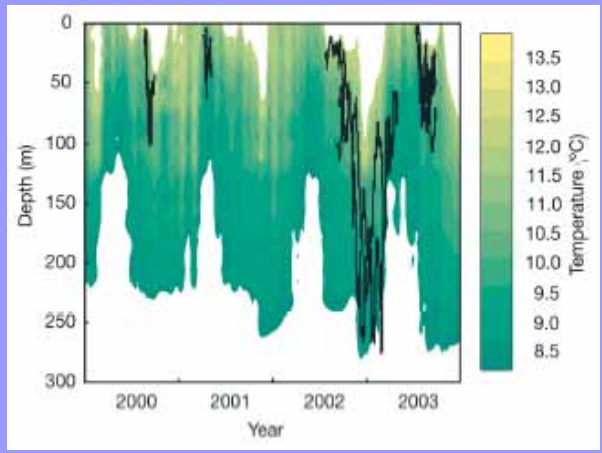
California Chinook Depths from Data Tags

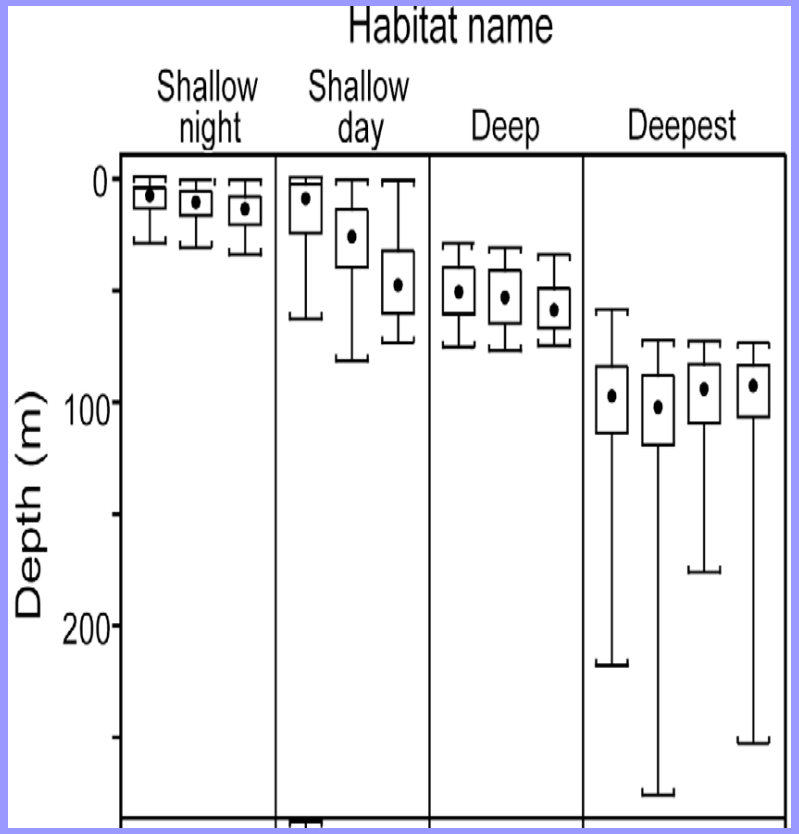
Chinook chose 8-12 ° C temperatures throughout the year





Hinke et al. 2005a,b





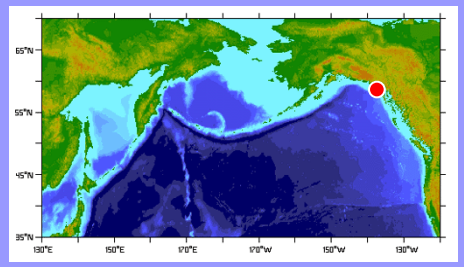
(night) (all hours)

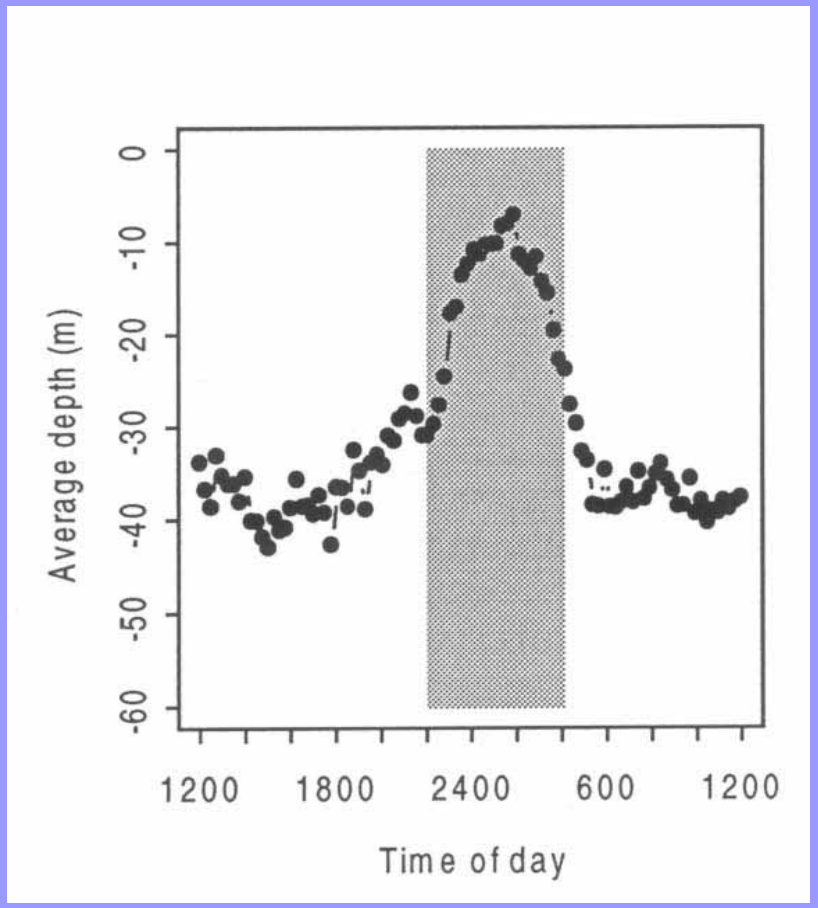
autumn

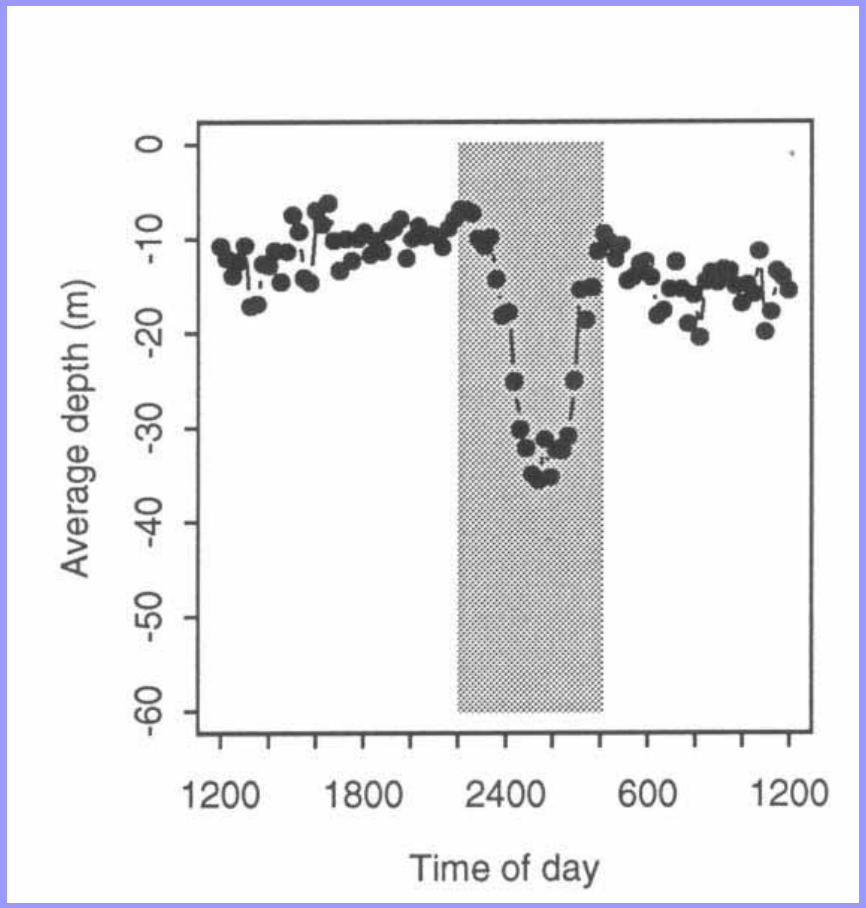
SE Alaska Chinook

spring-summer

day-deep, night-deep, mixed, and no-pattern behaviors





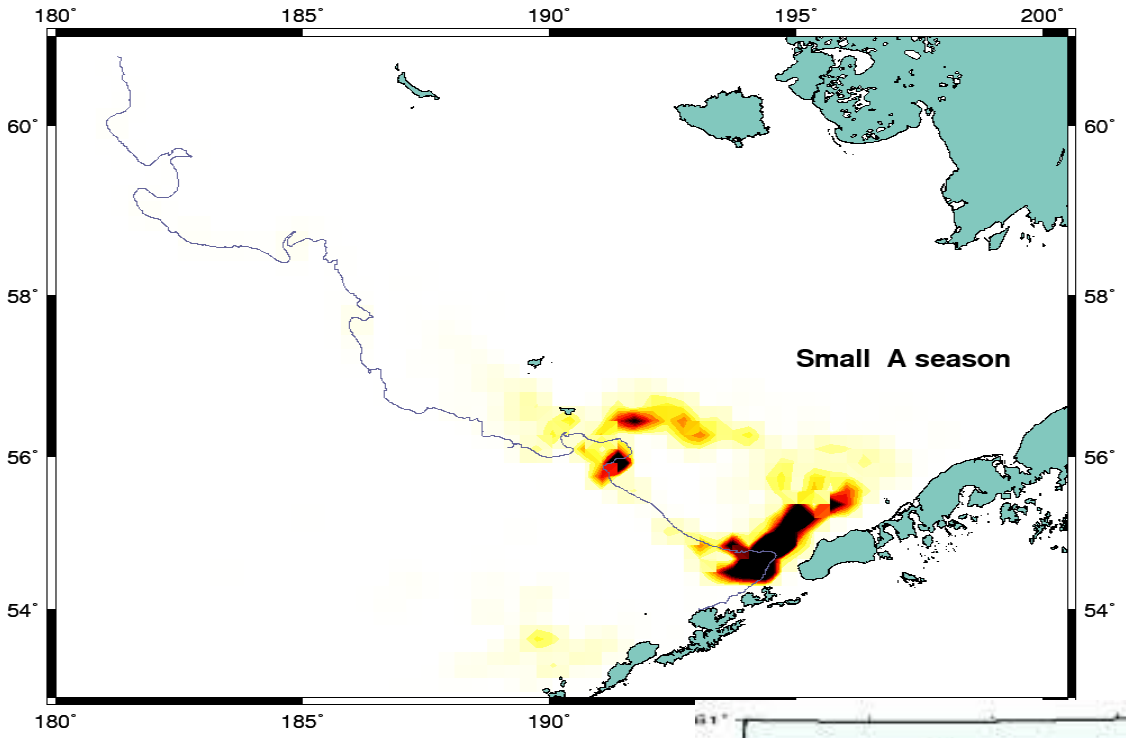


Murphy and Heard 2002

Proportion of Chinook By-Catch, EBS Trawl Fishing by season, age, and depth, 1997-1999

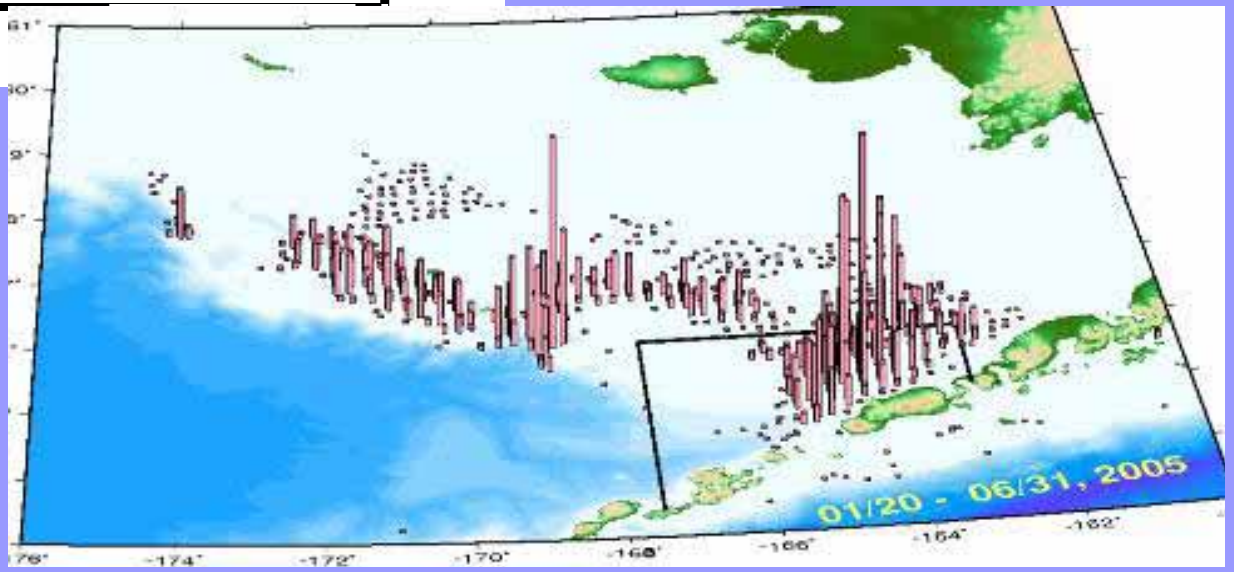
		Jan-Feb					Sept-Oct		
Ocean ages	.1	.2	.3-.5	All Ages		.1	.2	.3-.4	All Ages
N=	39	279	2,197	2,515		368	1,455	517	2,340
Depths									
0-25		.01	.02	.02					
25-50	.80	.42	.58	.57		.33	.19	.24	.22
50-100	.10	.25	.31	.30		.36	.58	.62	.56
100-200	.03	.05	.02	.02		.30	.23	.14	.22
200-300	.08	.27	.06	.09		.01			

40-80% at 50-400 m, slightly deeper Sept-Oct, more older fish in winter, younger in summer-fall



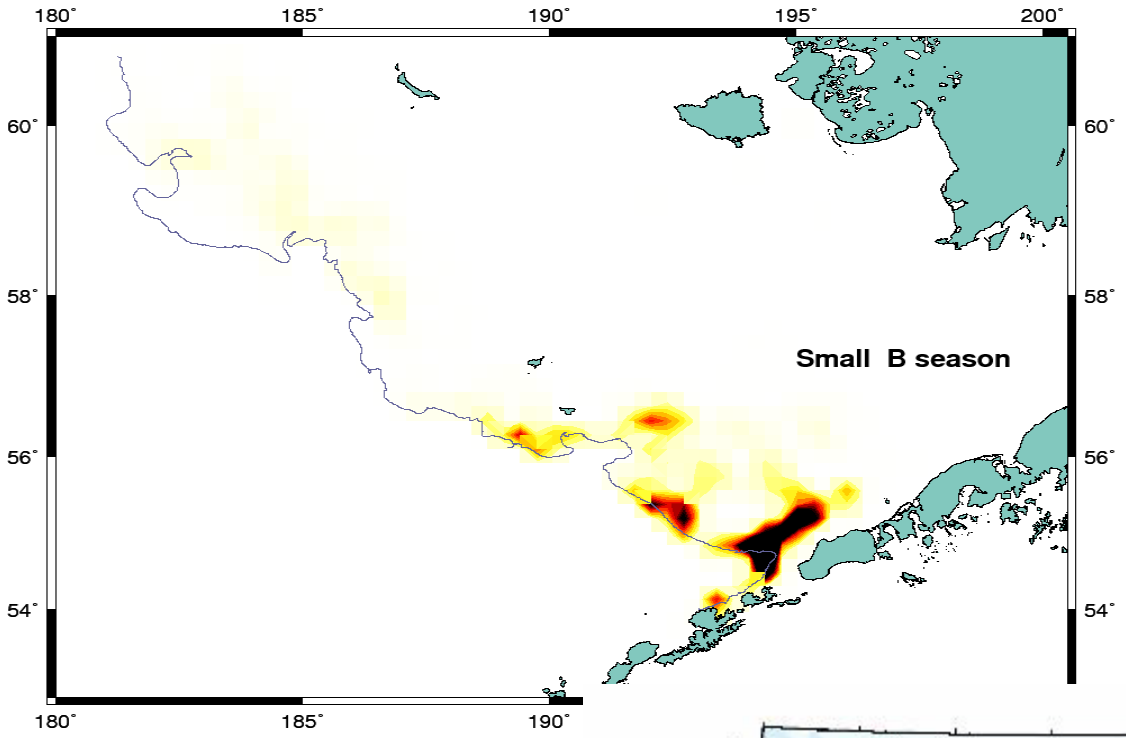
Distribution of small (<63 cm, mostly ocean age .2) Chinook bycatch in winter groundfish fishery, 1991-2007

figure courtesy J. Ianelli, NOAA/AFSC



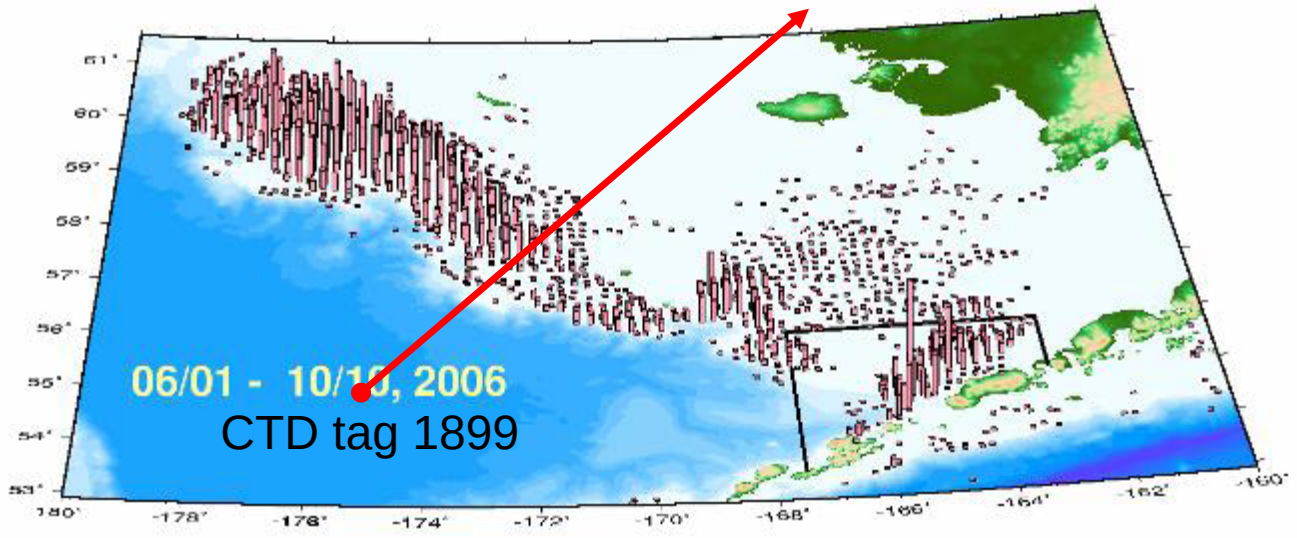
Winter Pollock fishery distribution, 2005

figure courtesy AFSC website



Distribution of small (<63 cm, mostly ocean age .2) Chinook bycatch in summer groundfish fishery, 1991-2007

figure courtesy J. Ianelli, NOAA/AFSC



Summer Pollock fishery distribution, 2006

figure courtesy AFSC website

Summary

- **Highly variable behavior, with season and life history (and geographic range)**
- **Tolerate (choose?) wide range of temperatures (1-16 ° C) and depths (0-350+ m)**
- **Distribution much wider than trawl fishery area**
- **BUT only one tag with long-term data**
  (19 released in 2008, 31 planned for 2008)

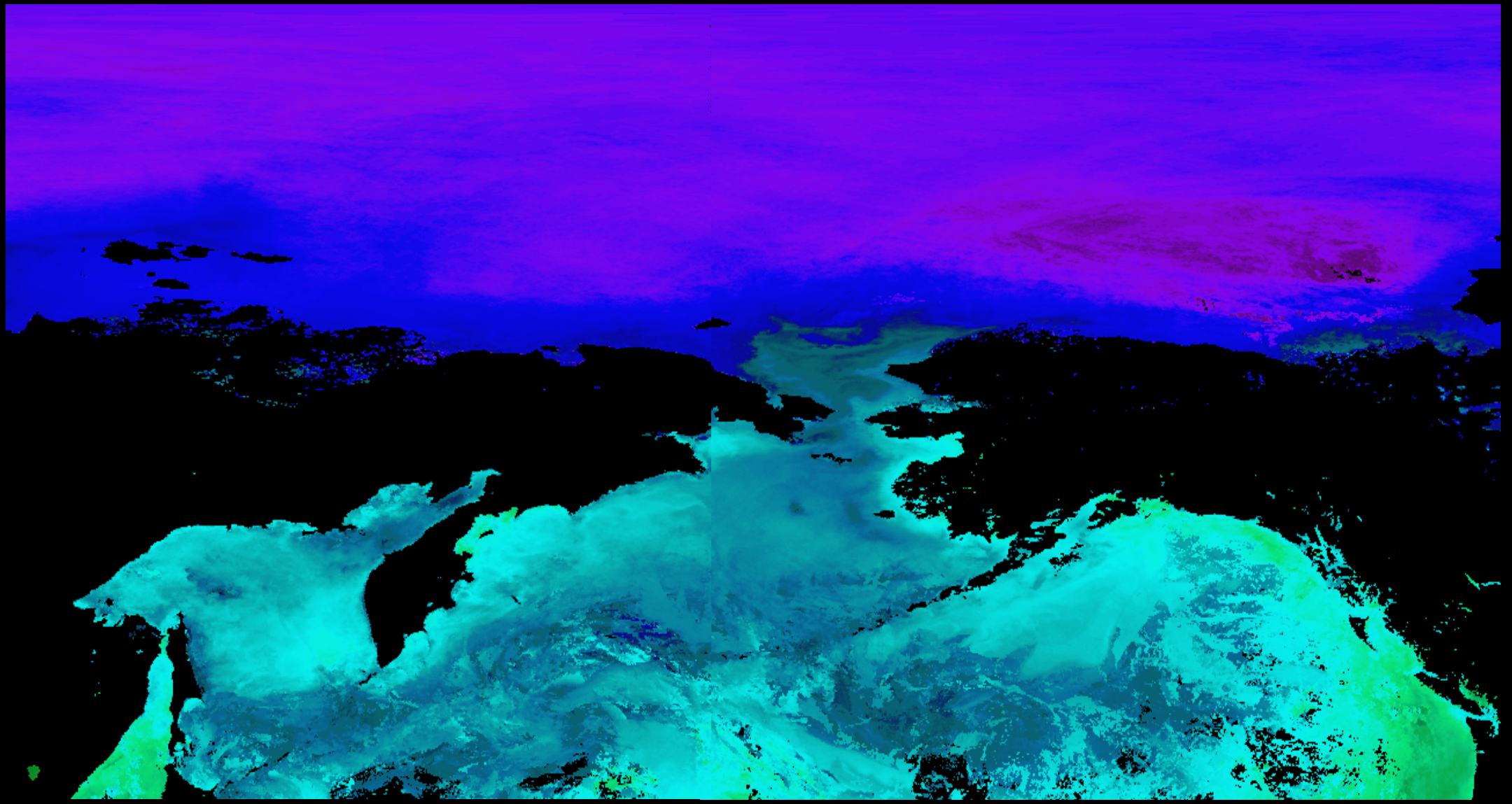
Future of Chinook in Bering Sea?

Favorable factors:

- Wide range of distribution
- Wide range of behaviors

Unfavorable factors:

- Low abundance
- Vulnerable to trawl fishery



Thank you!