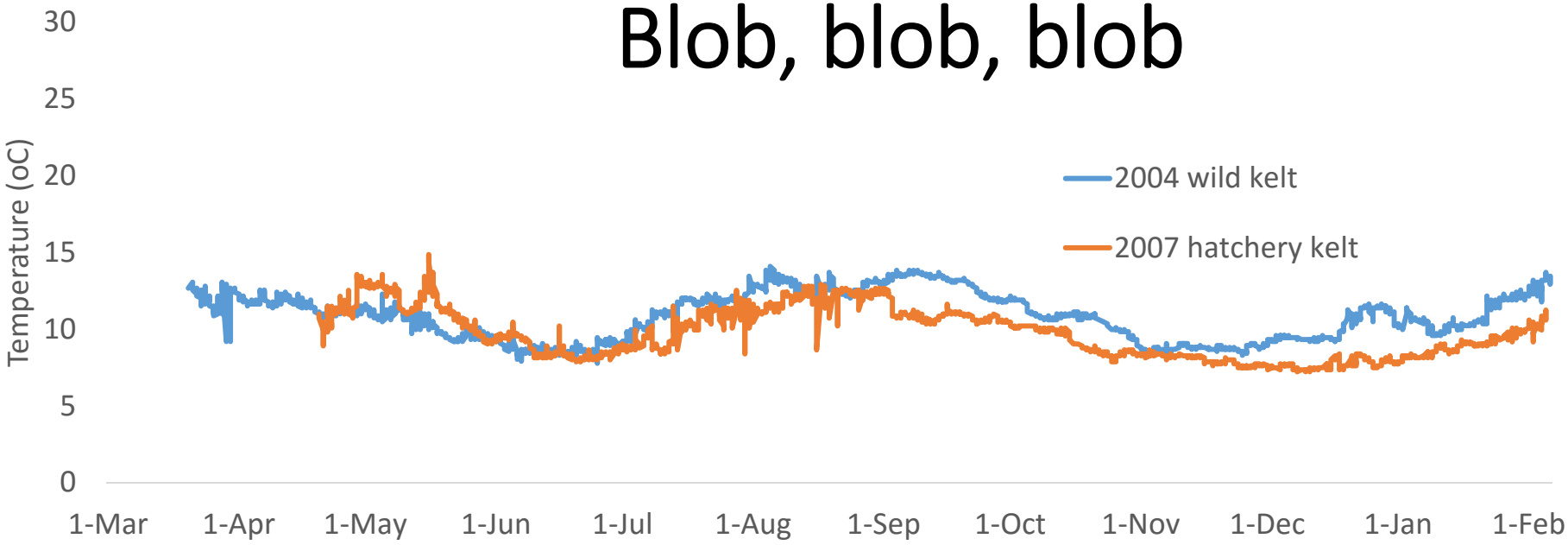
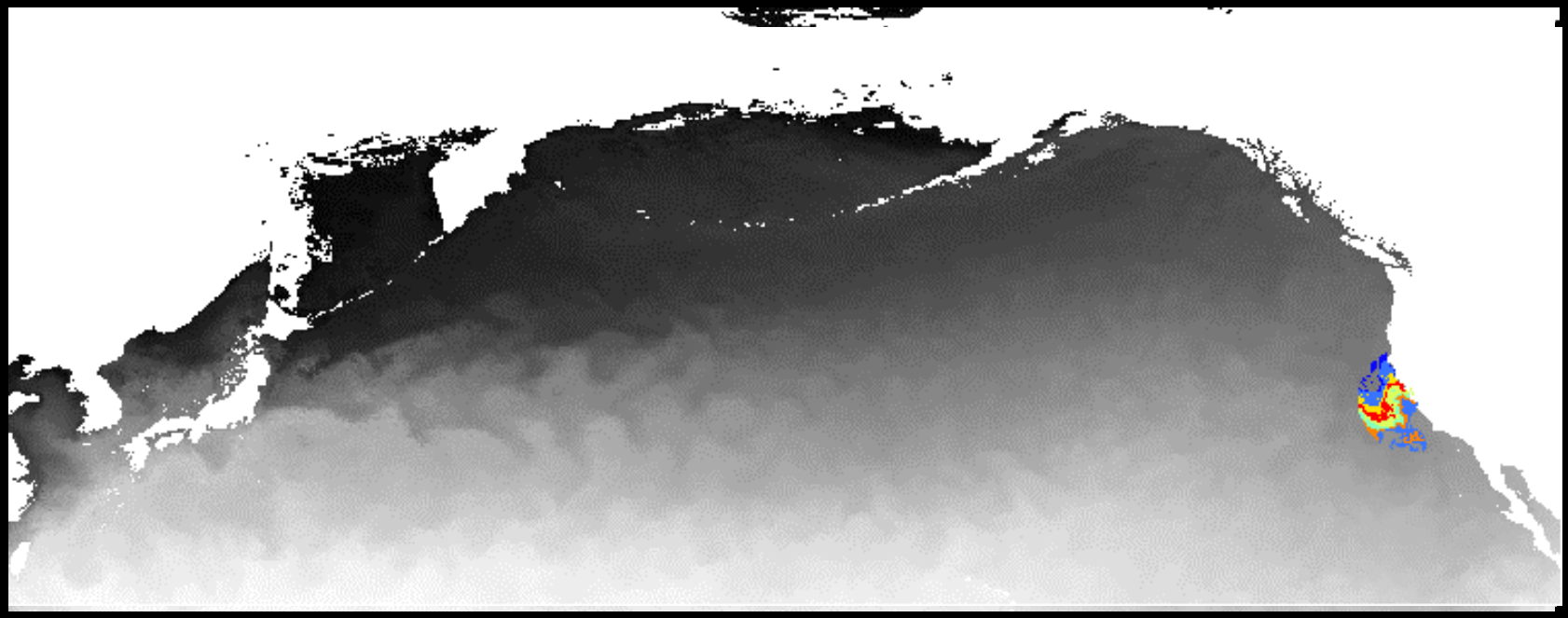
NOAA FISHERIES SERVICE

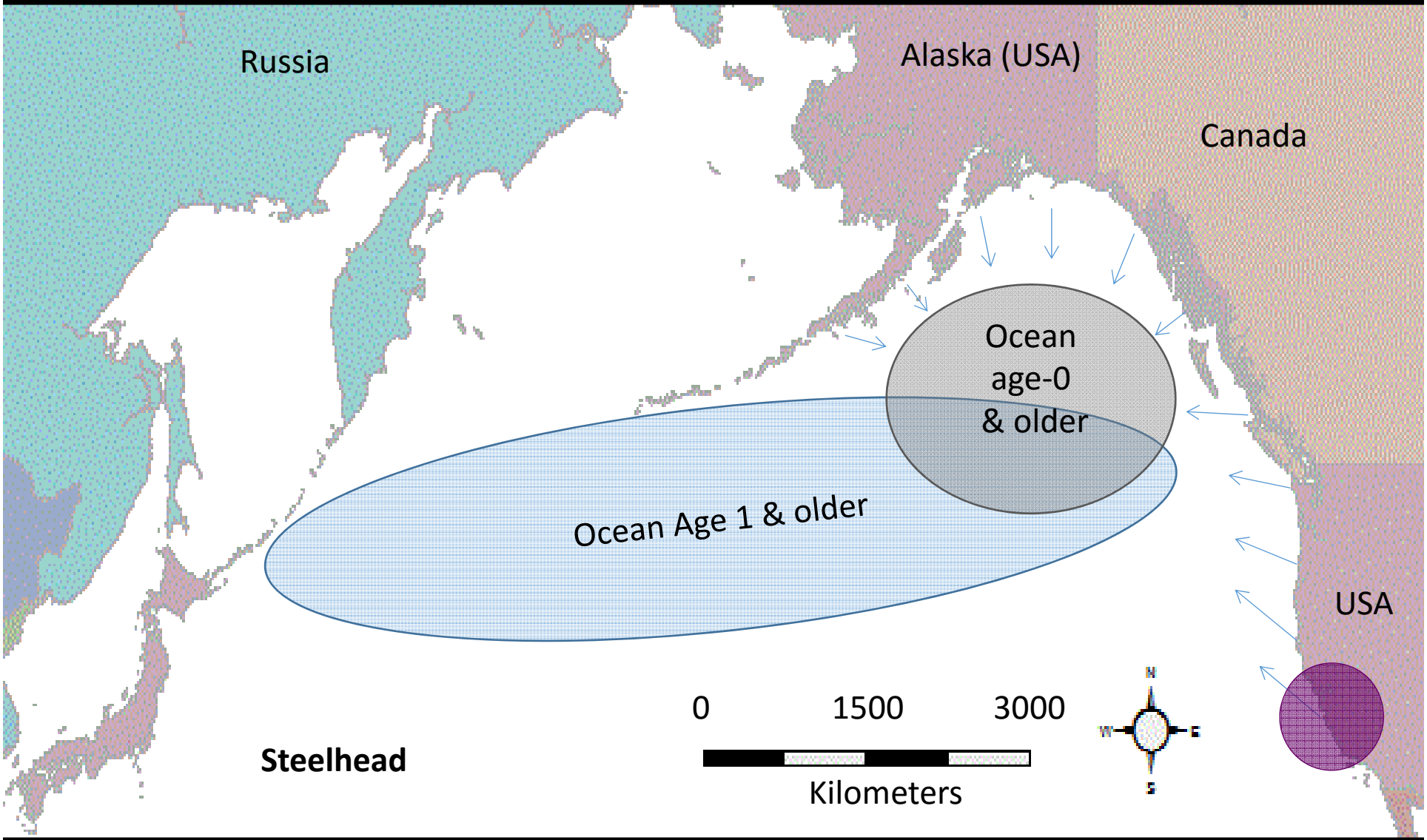
Half pounders, Climate Change and Blob, blob, blob





General Steelhead Ocean Distribution

(based on several works by Myers, Atcheson, Welch and Burgner)

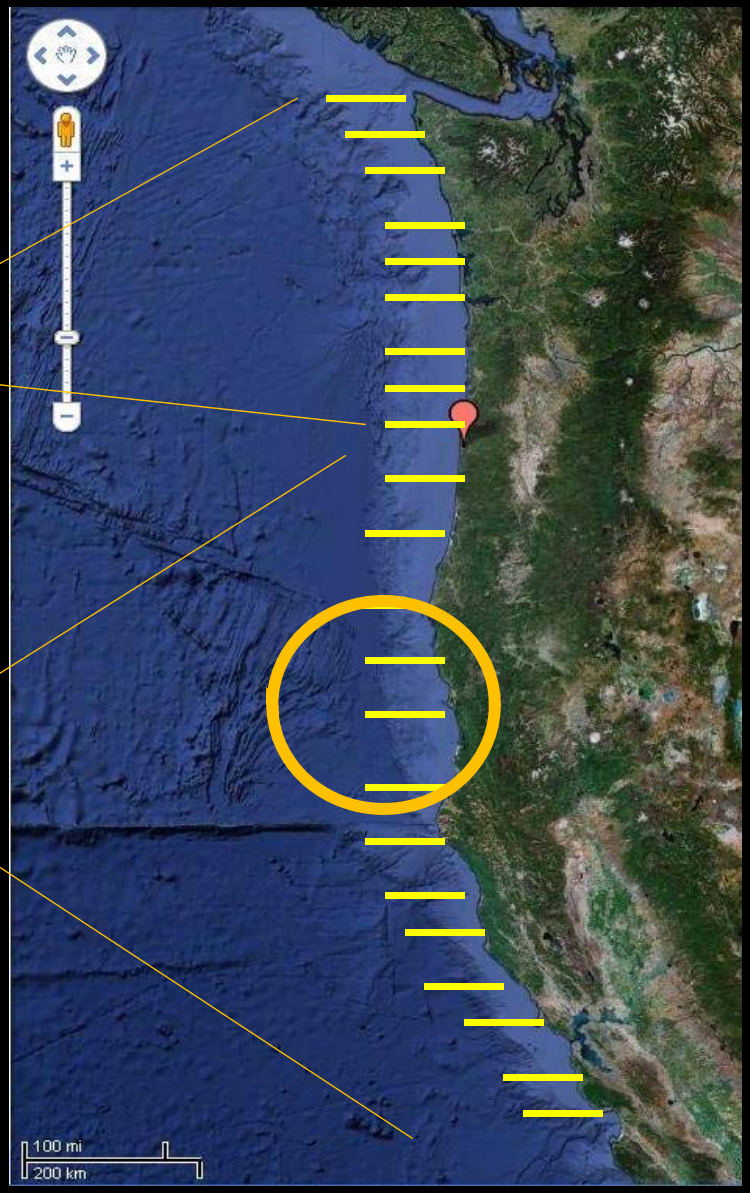


If they go to sea… then what?

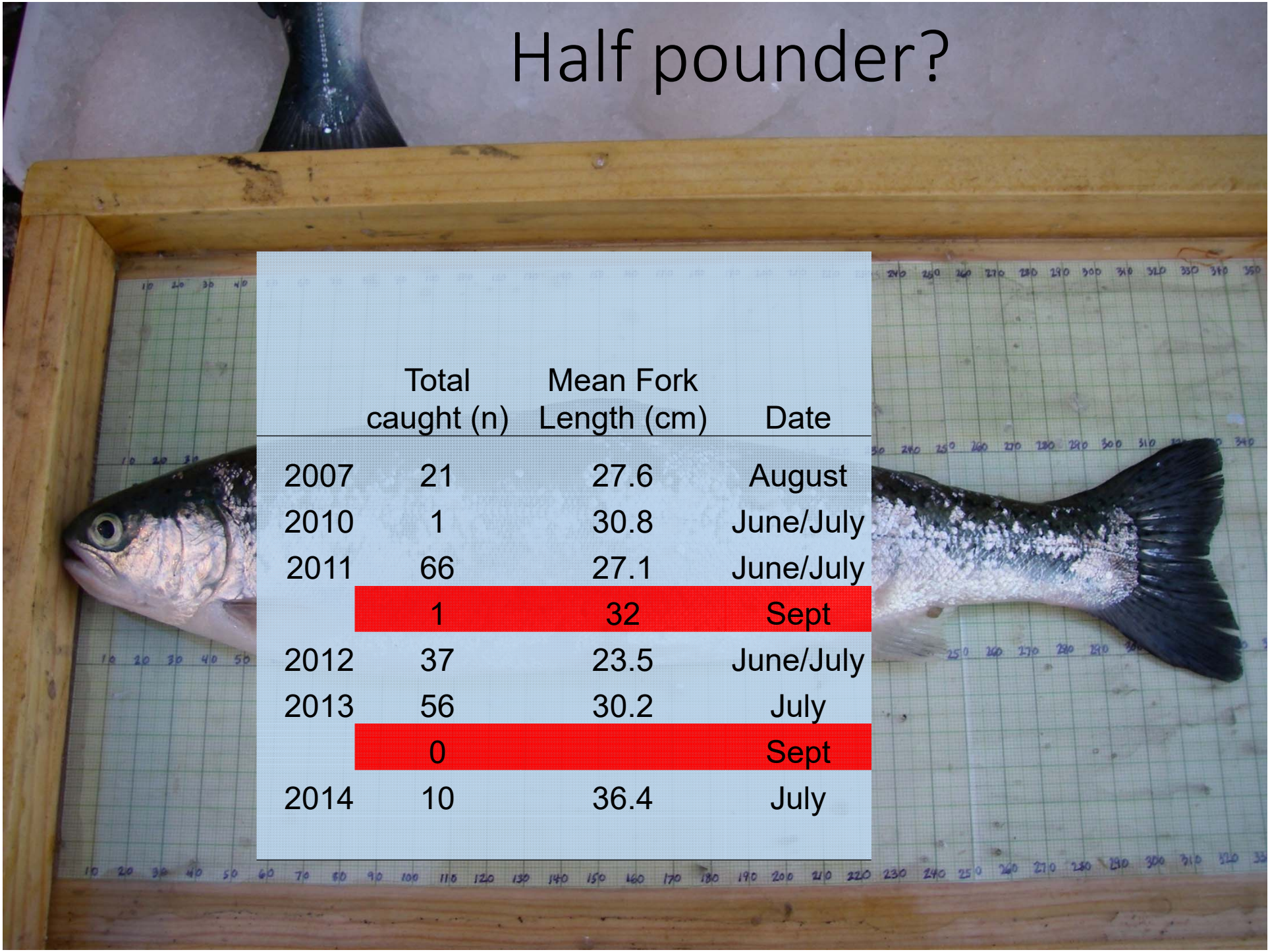
Ocean Surveys

NWFSC

SWFSC



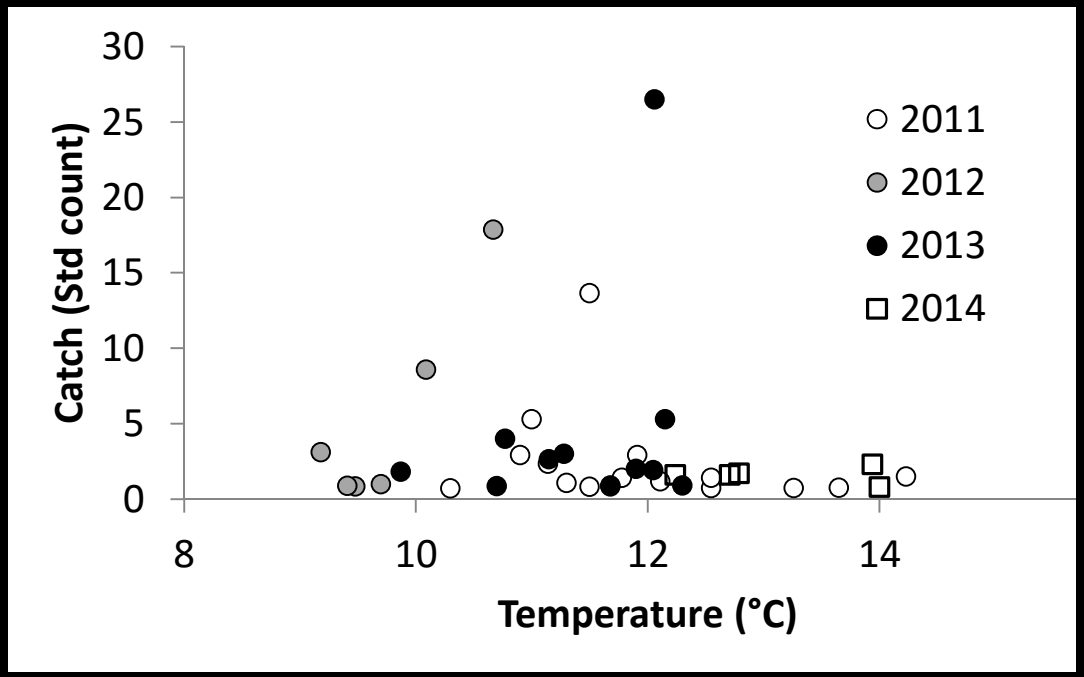
Half pounder?

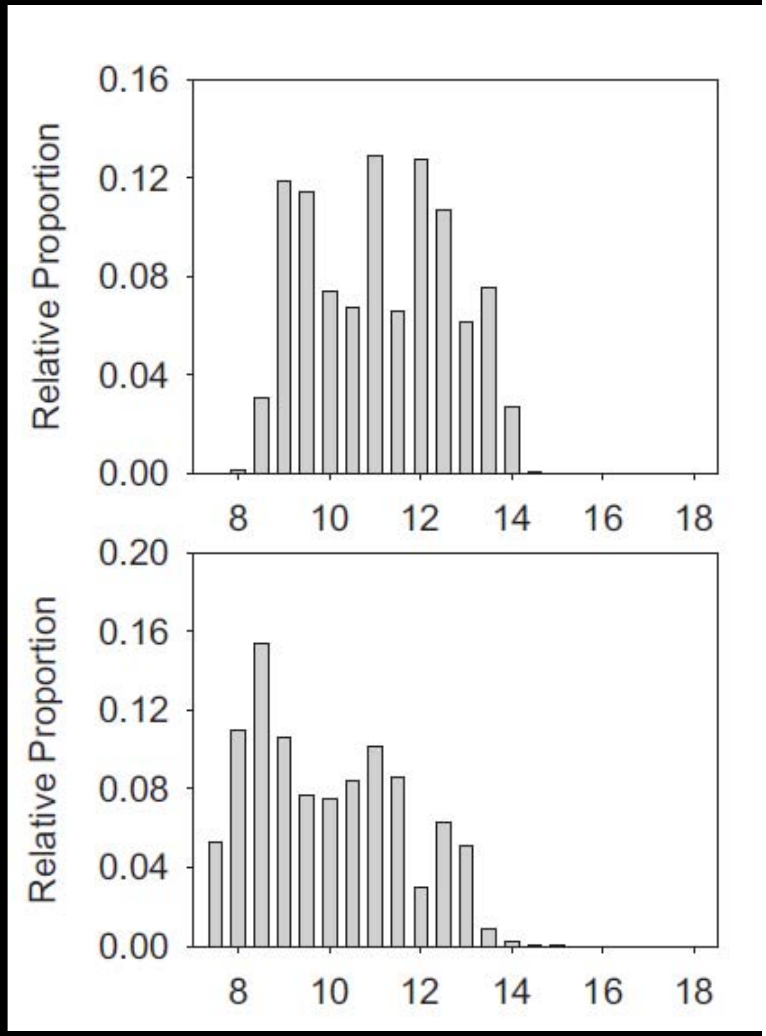


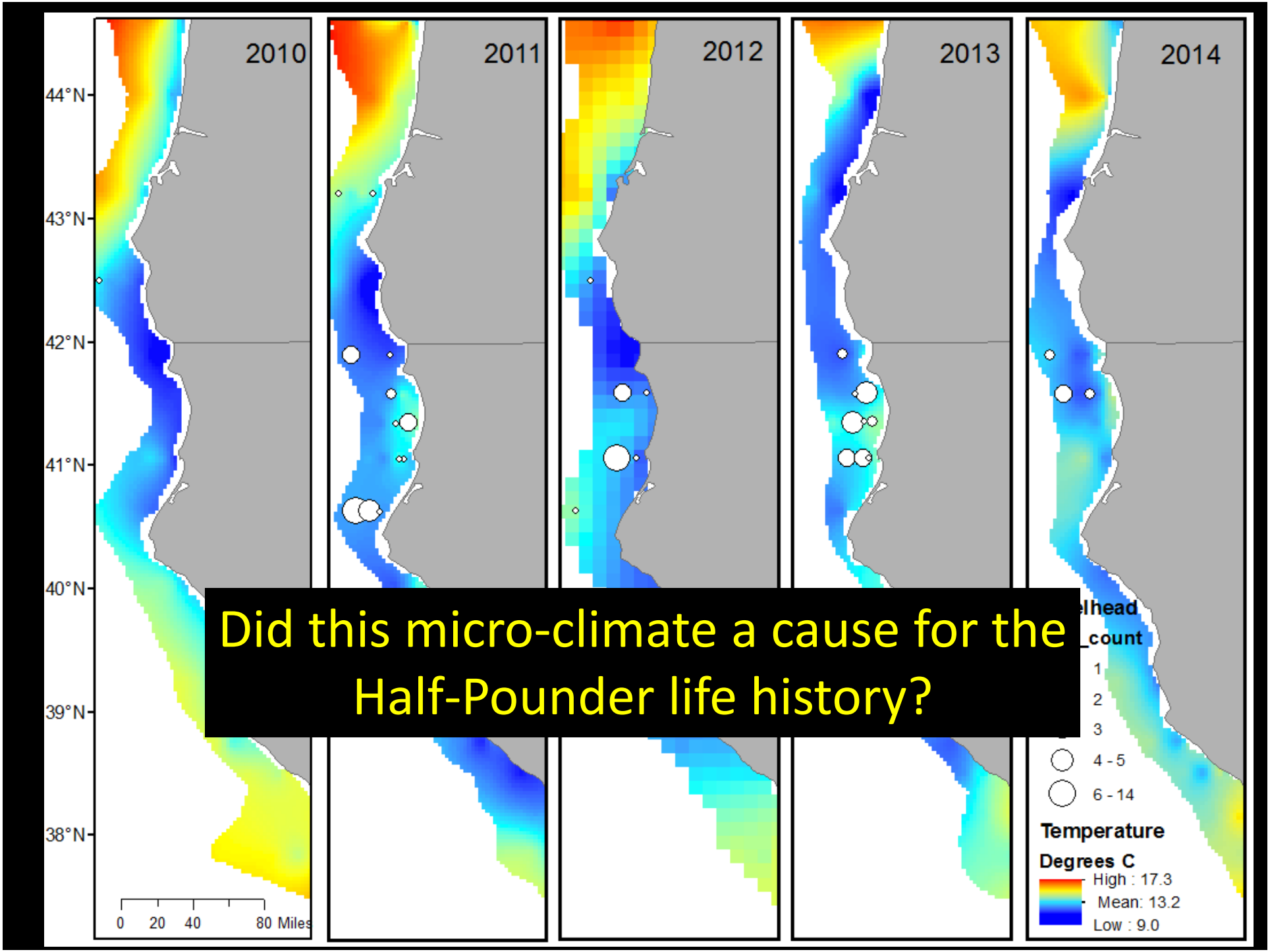
	Total caught (n)	Mean Fork Length (cm)	Date
2007	21	27.6	August
2010	1	30.8	June/July
2011	66	27.1	June/July
	1	32	Sept
2012	37	23.5	June/July
2013	56	30.2	July
	0		Sept
2014	10	36.4	July

Scott Creek Archival tag records

SST for California ocean caught fish






2010
2011
2012
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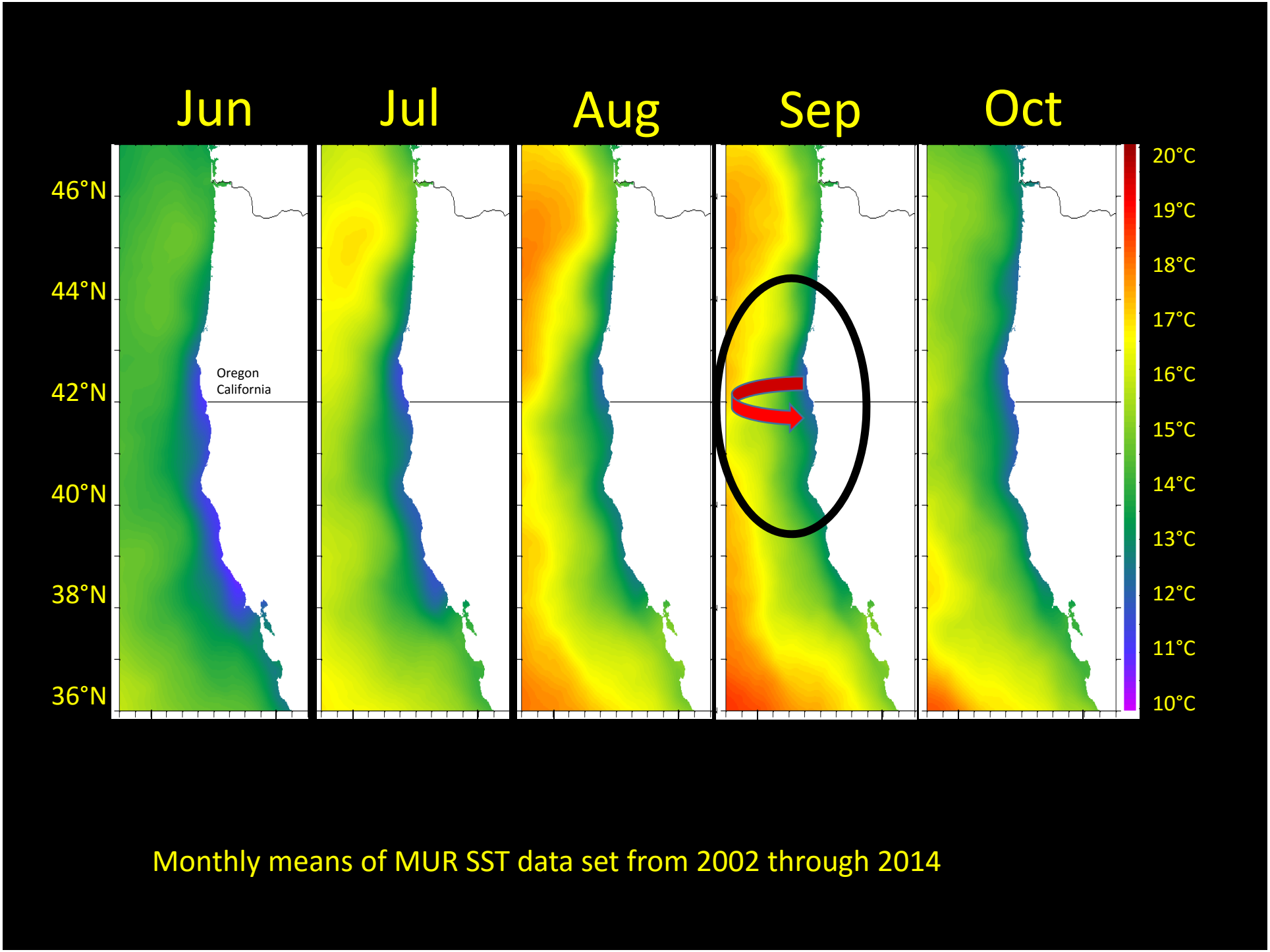
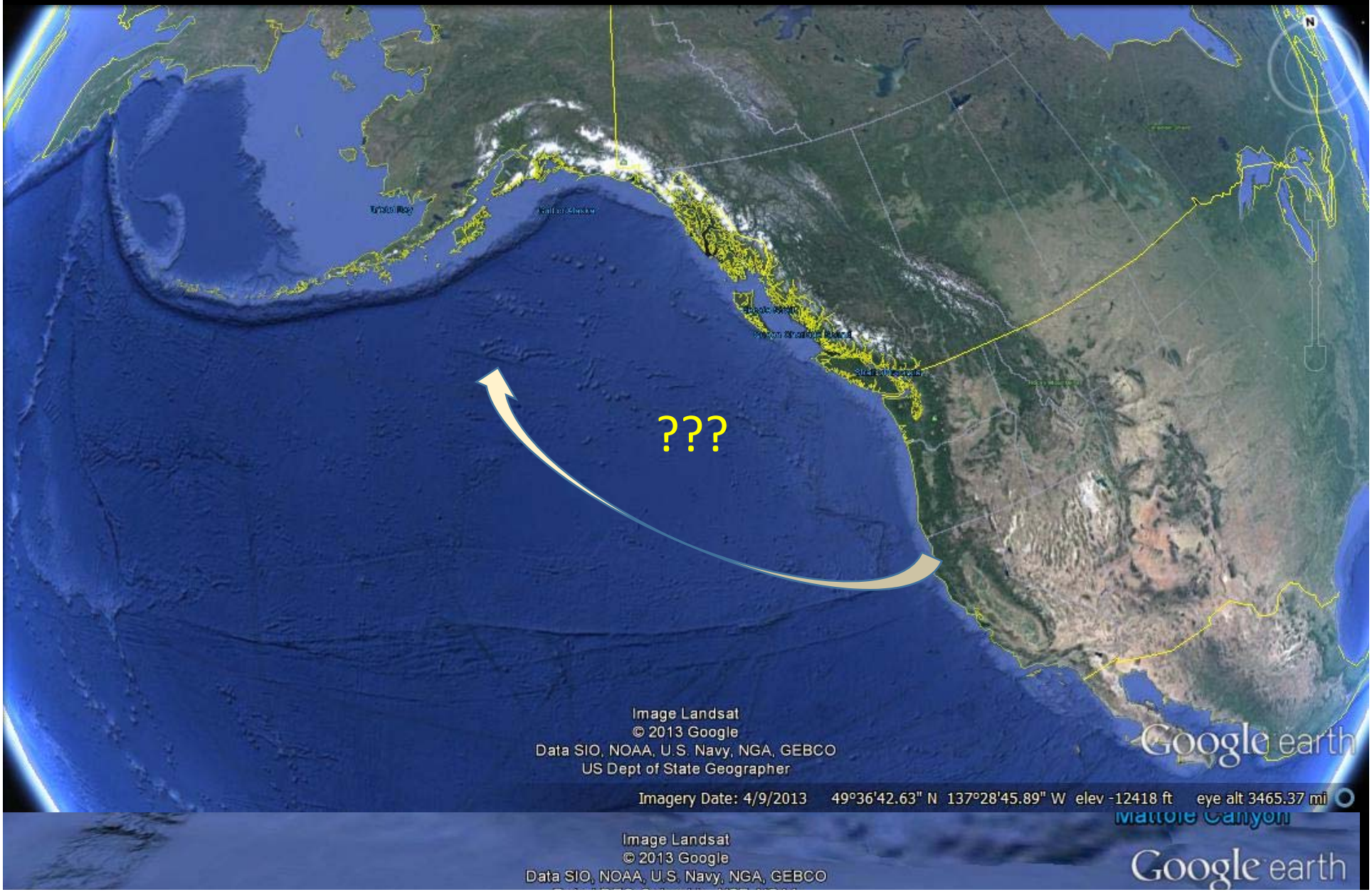
2014
44°N
43°N
42°N
41°N
40°N
39°N
38°N
0 20 40 80 Miles
Did this micro-climate a cause for the Half-Pounder life history?
lhead
_count
1
2
3
4 - 5
6 - 14
Temperature
Degrees C
High : 17.3
Mean: 13.2
Low : 9.0



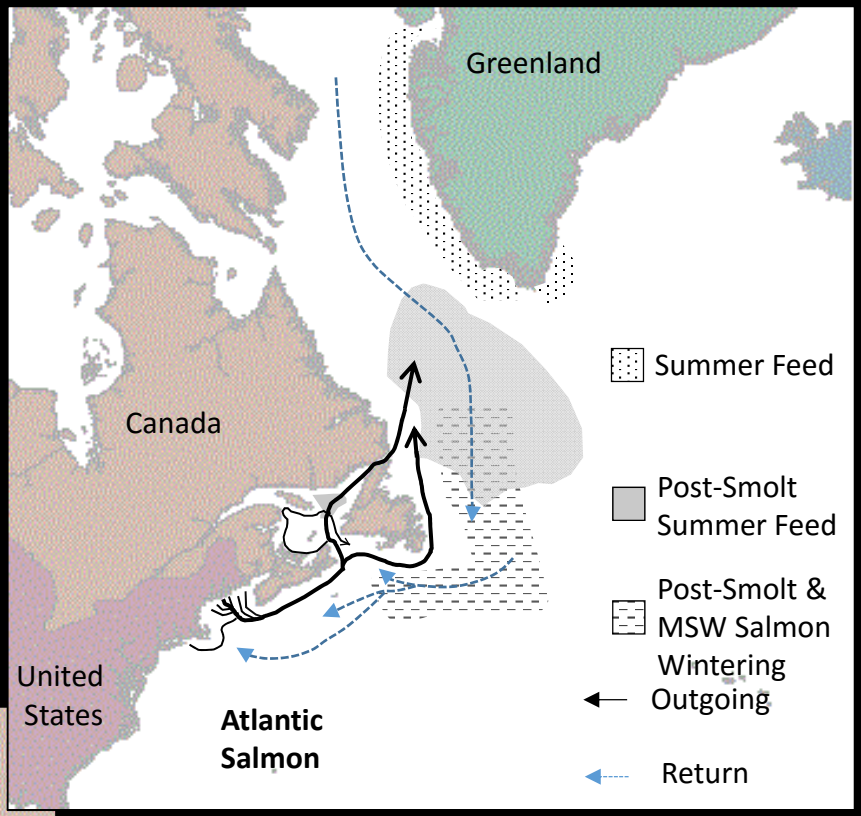
Monthly means of MUR SST data set from 2002 through 2014

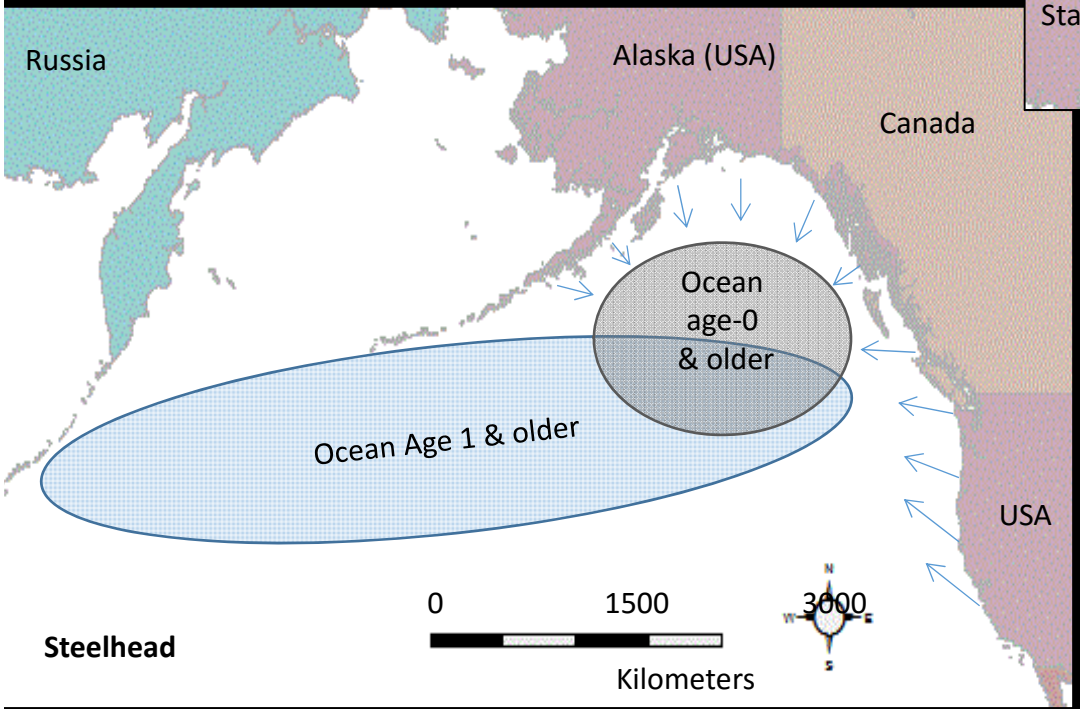
Where do they go in September?



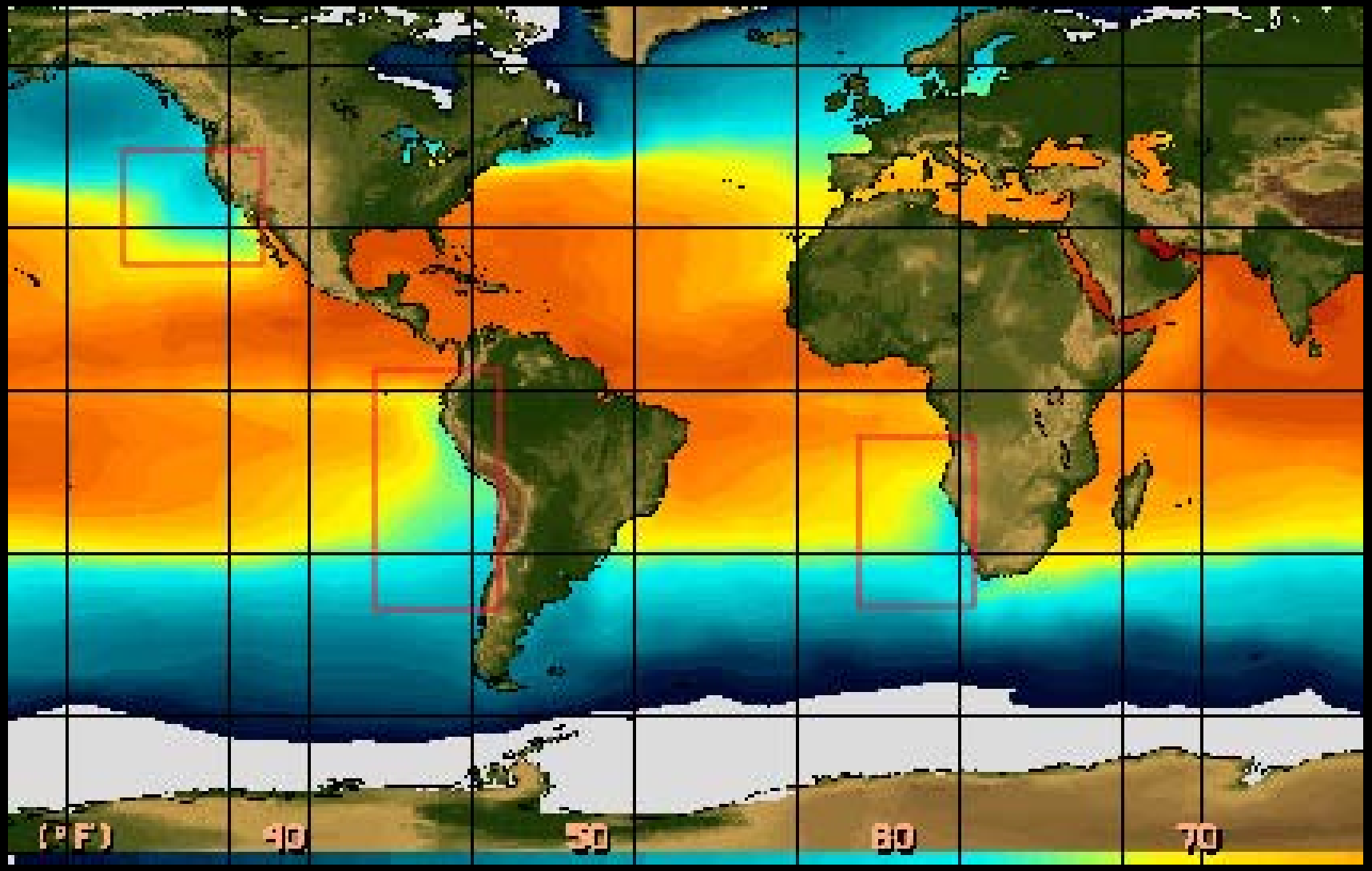
Comparing Atlantic Salmon and Steelhead

Marine Challenges

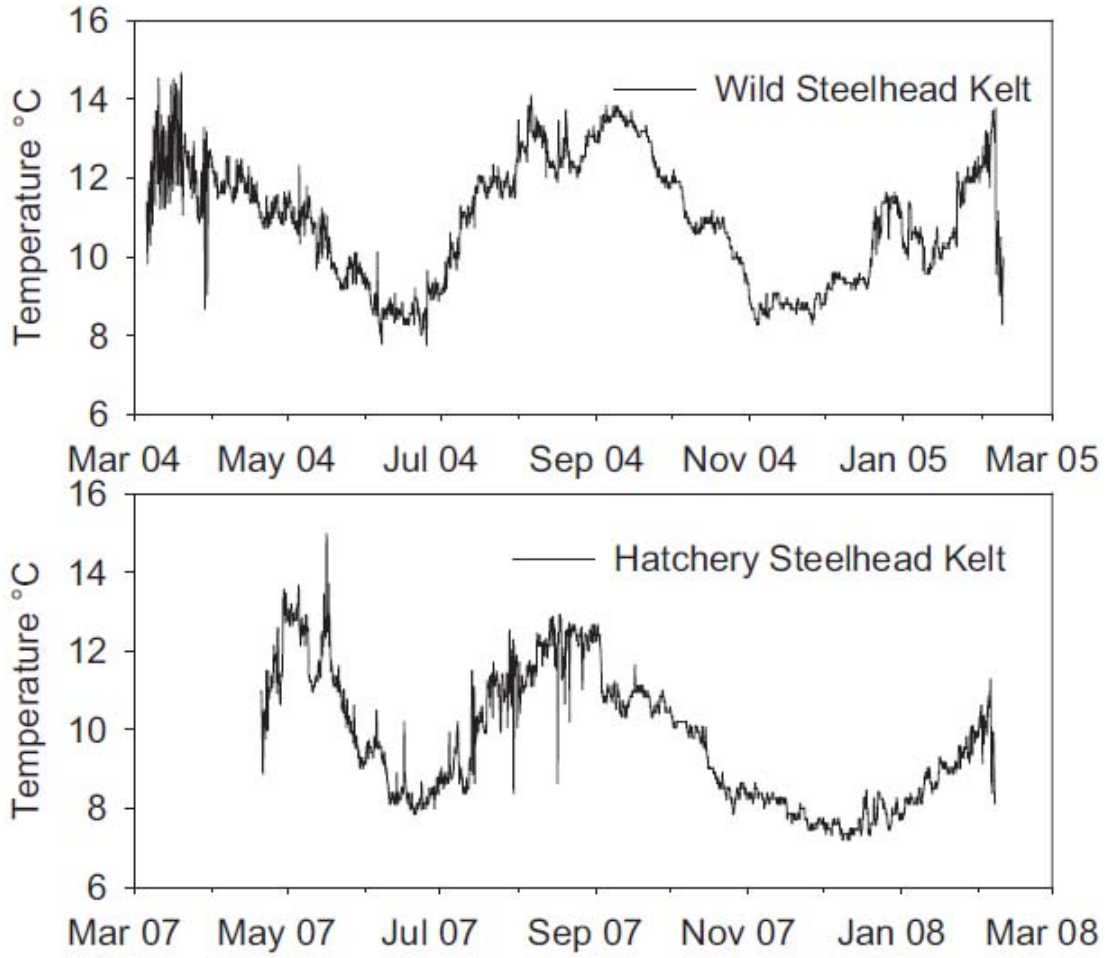


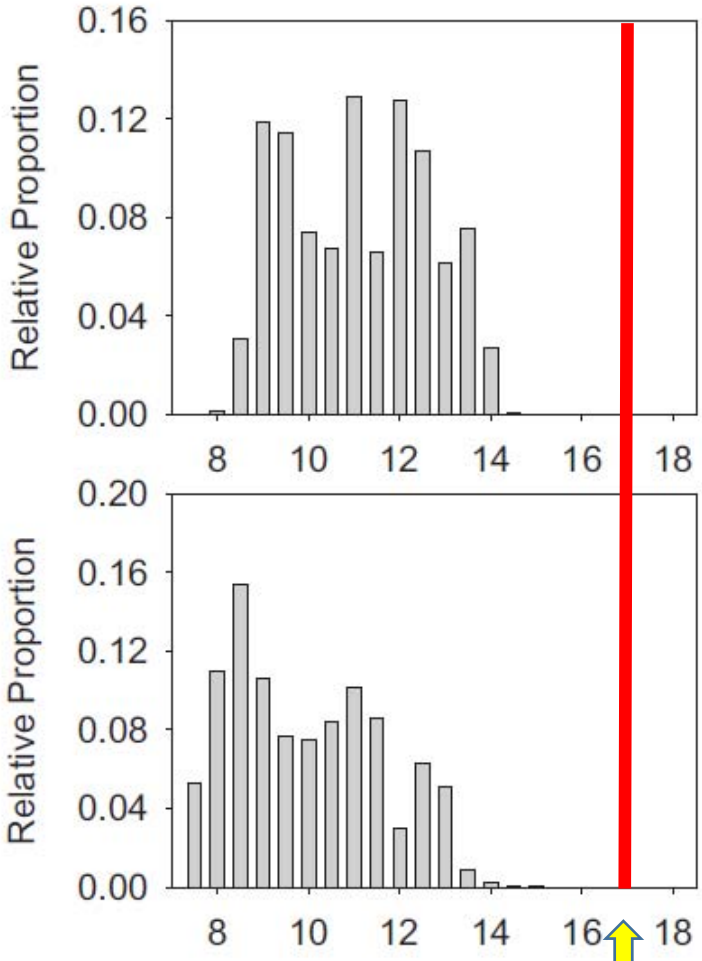


Upwelling Centers…..

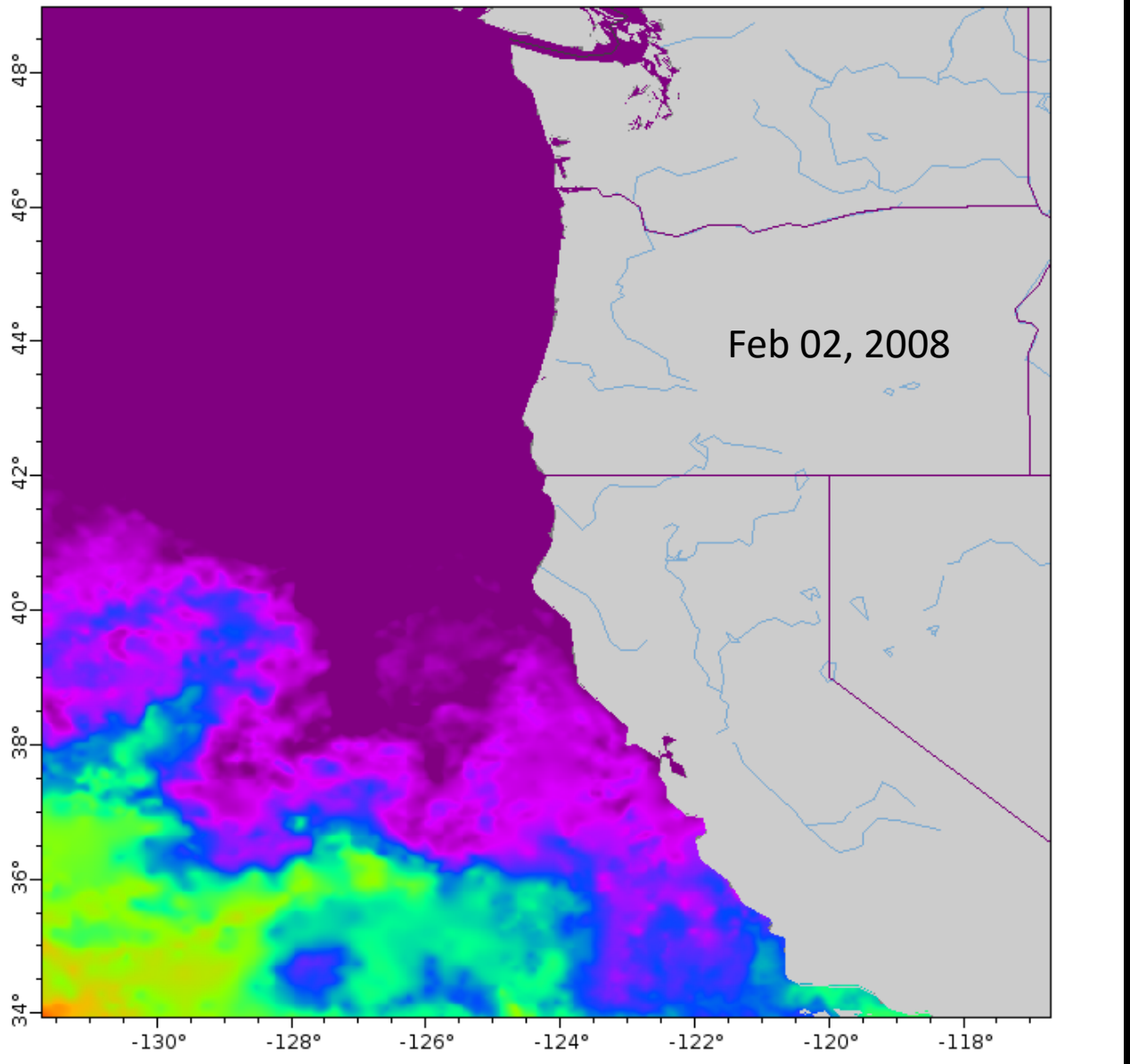


What is optimal temp for growth in Marine environment?





Wurtsbaugh and Davis 1977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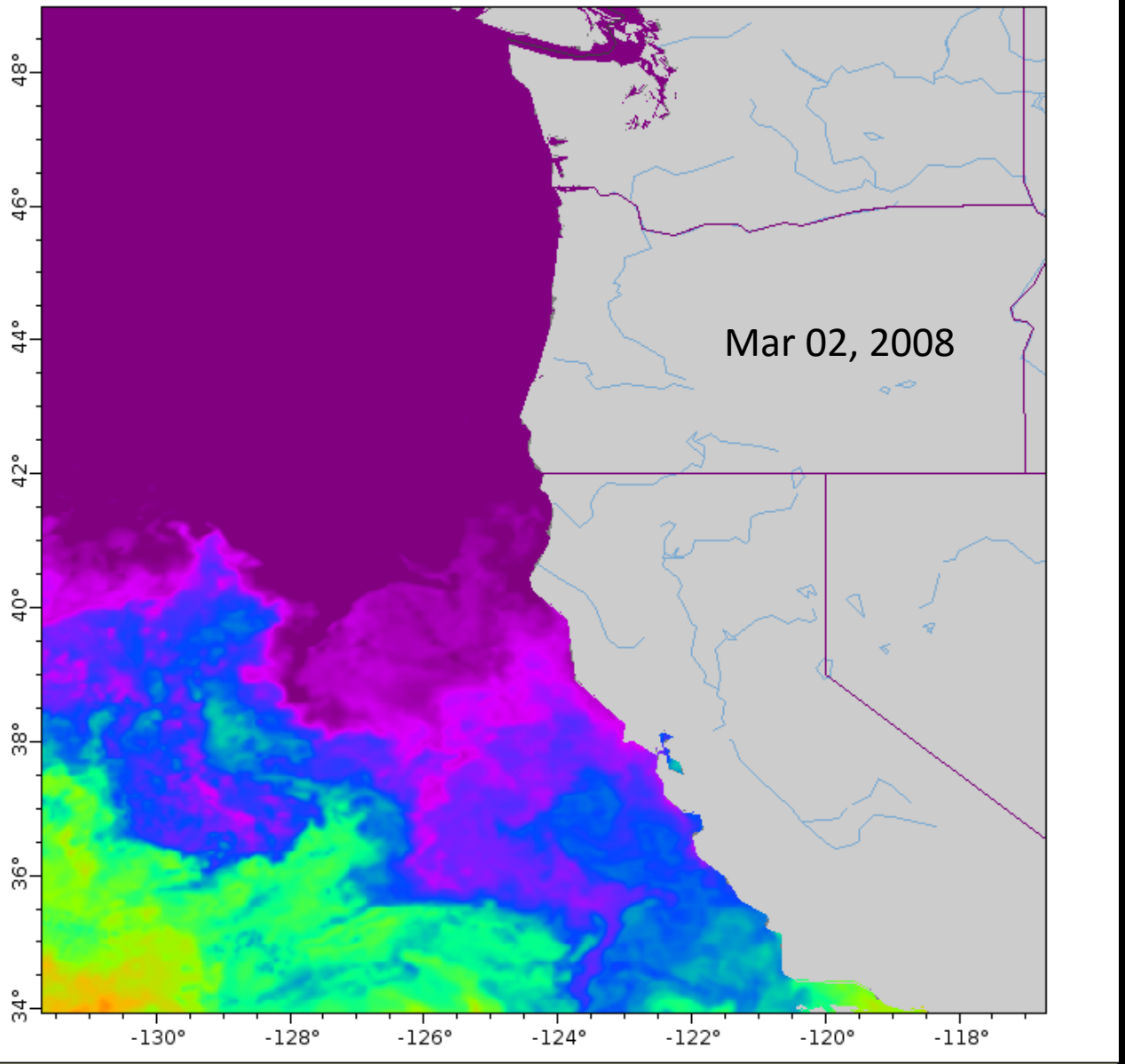
Analysed Sea Surface Temperature (degree_C)
Multi-scale Ultra-high Resolution (MUR) SST analysis, Global, 0.011 Degree, Daily
(2008-02-02T09:00:00Z)
Data courtesy of NASA JPL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Multi-scale Ultra-high Resolution (MUR) SST analysis, Global, 0.011 Degree, Daily
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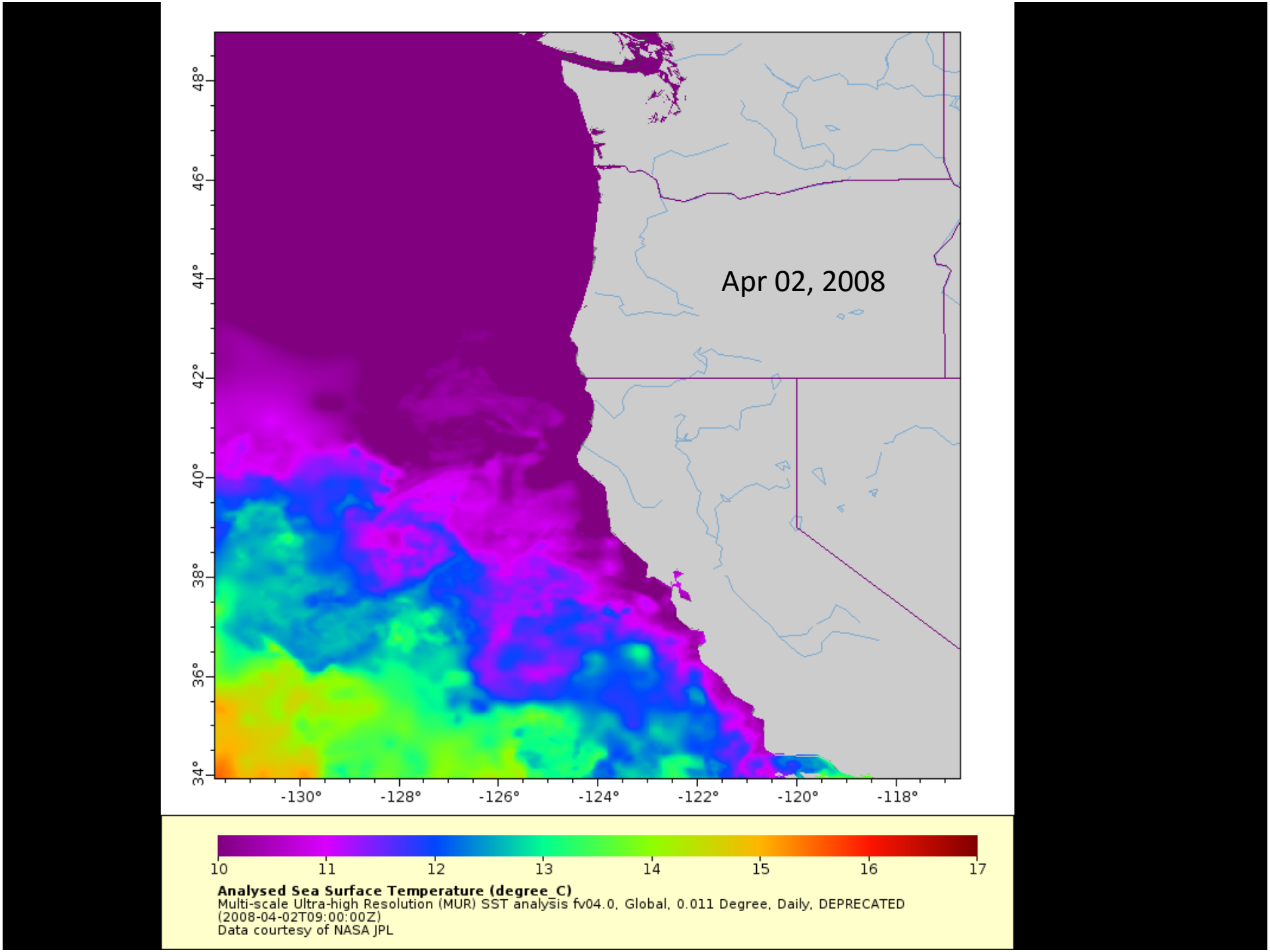
Data courtesy of NASA JPL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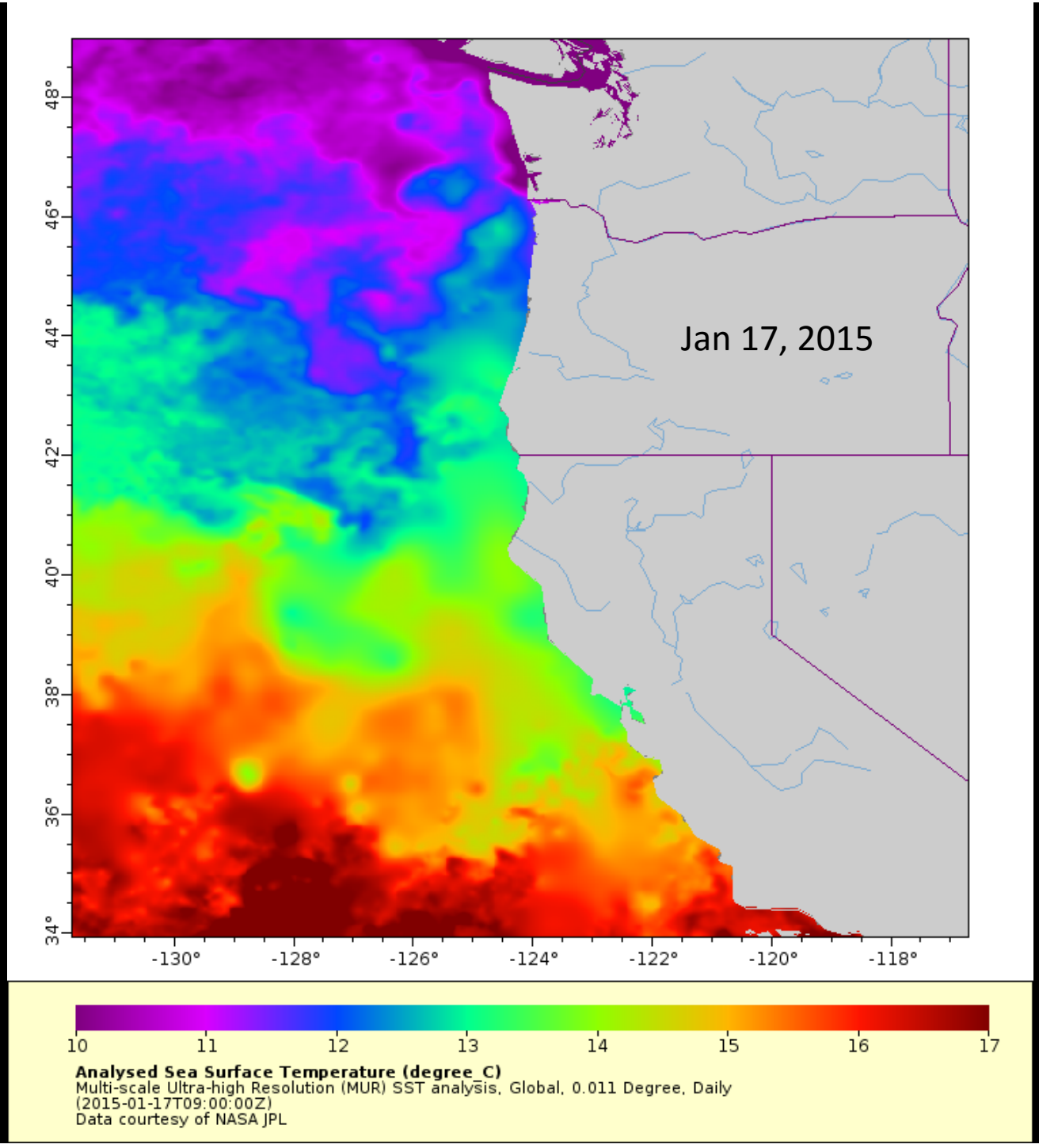
Analysed Sea Surface Temperature (degree_C)
Multi-scale Ultra-high Resolution (MUR) SST analysis fv04.0, Global, 0.011 Degree, Daily, DEPRECATED
(2008-04-02T09:00:00Z)
Data courtesy of NASA JPL

2015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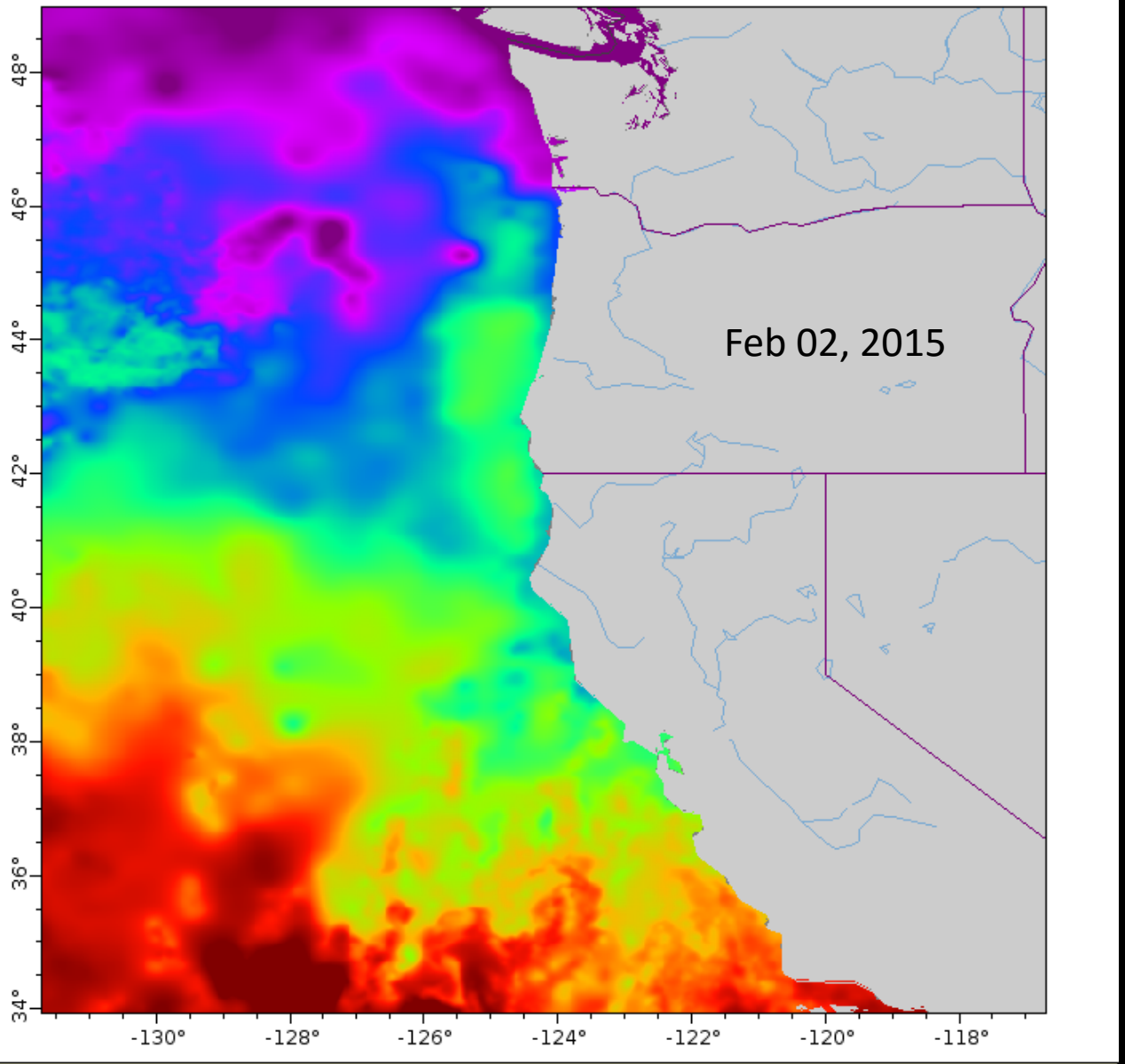
Multi-scale Ultra-high Resolution (MUR) SST analysis, Global, 0.011 Degree, Daily
(2015-01-17T09:00:00Z)
Data courtesy of NASA JPL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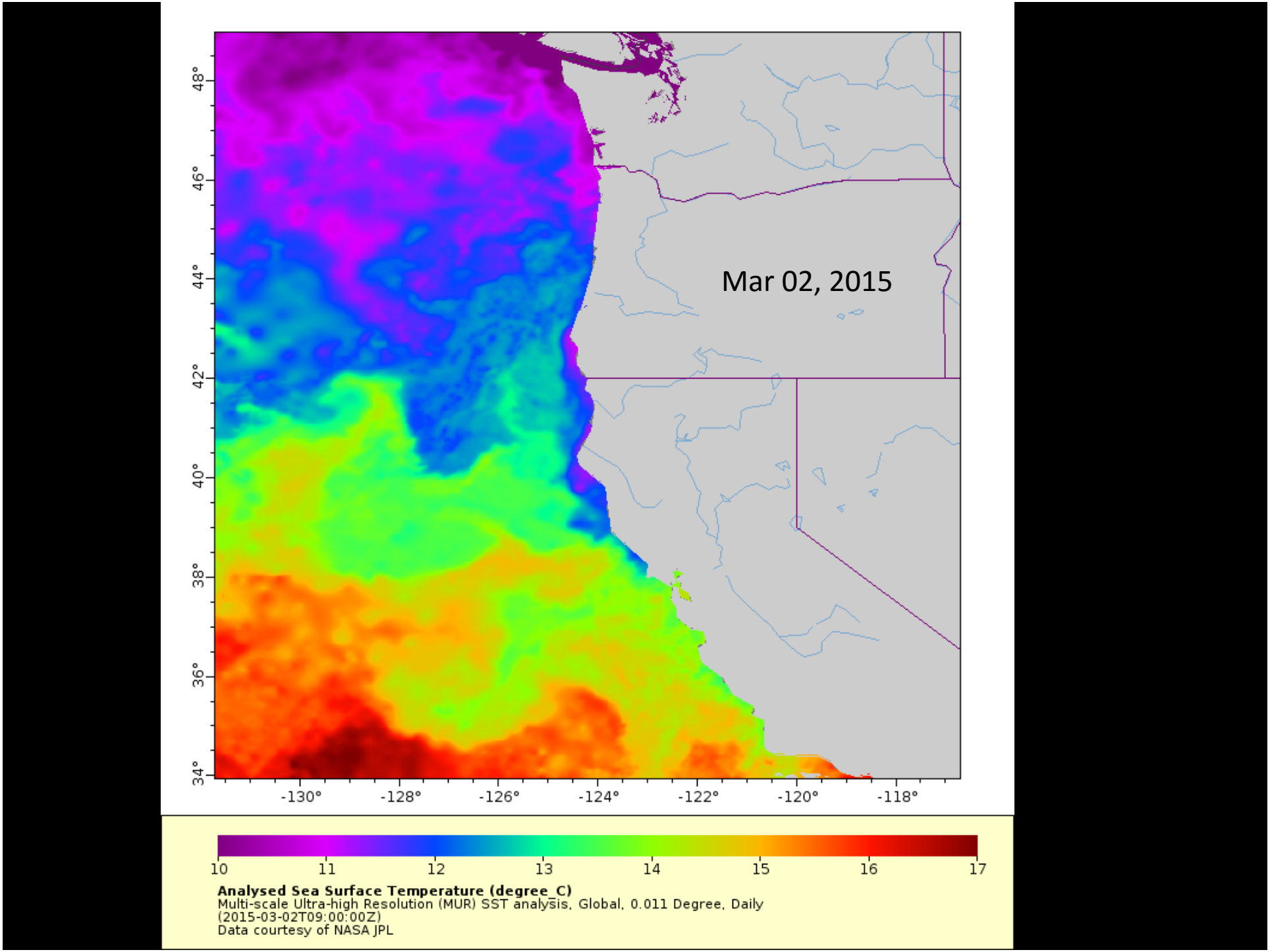
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Analysed Sea Surface Temperature (degree_C)
Multi-scale Ultra-high Resolution (MUR) SST analysis, Global, 0.011 Degree, Daily
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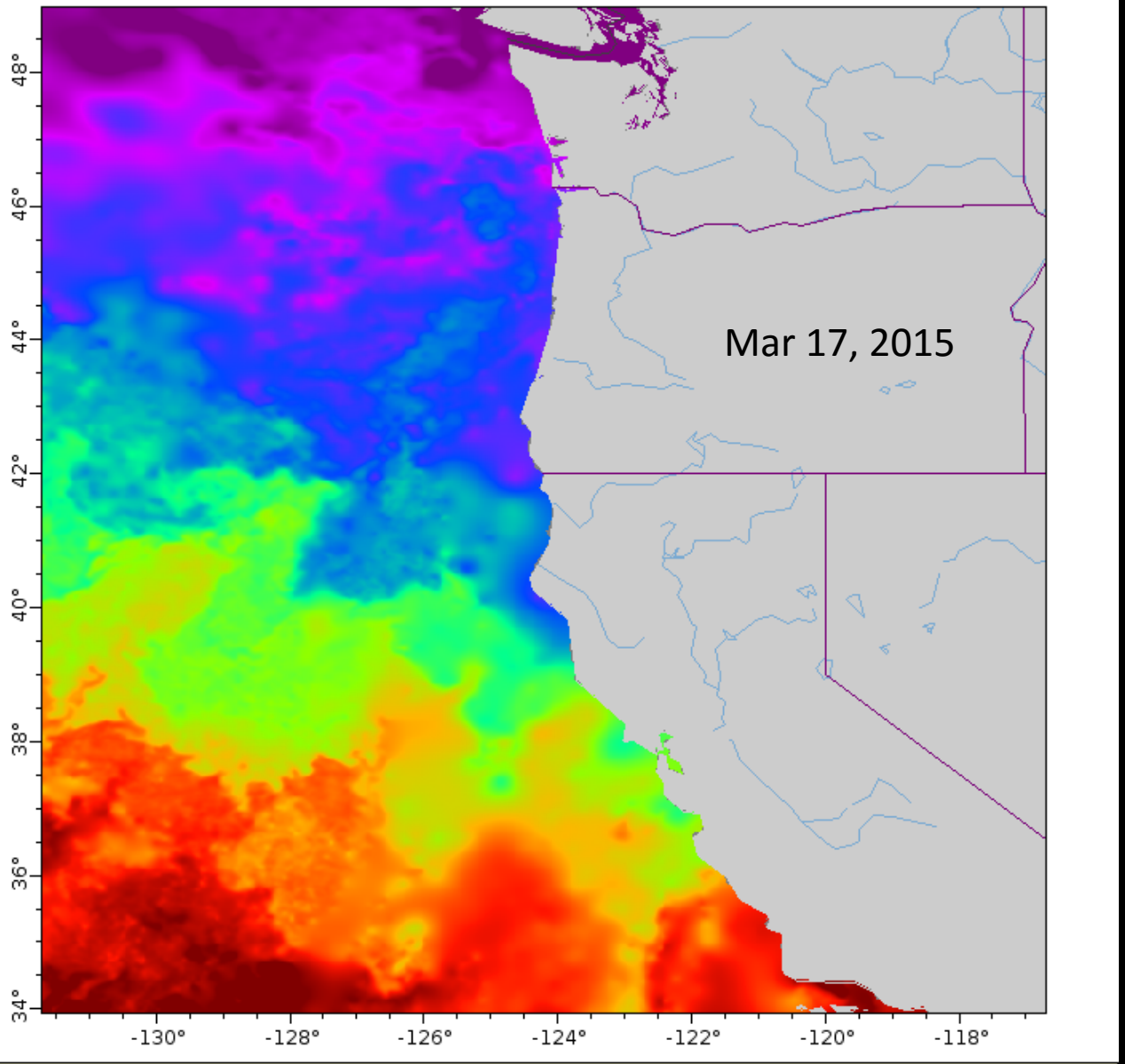
Data courtesy of NASA JPL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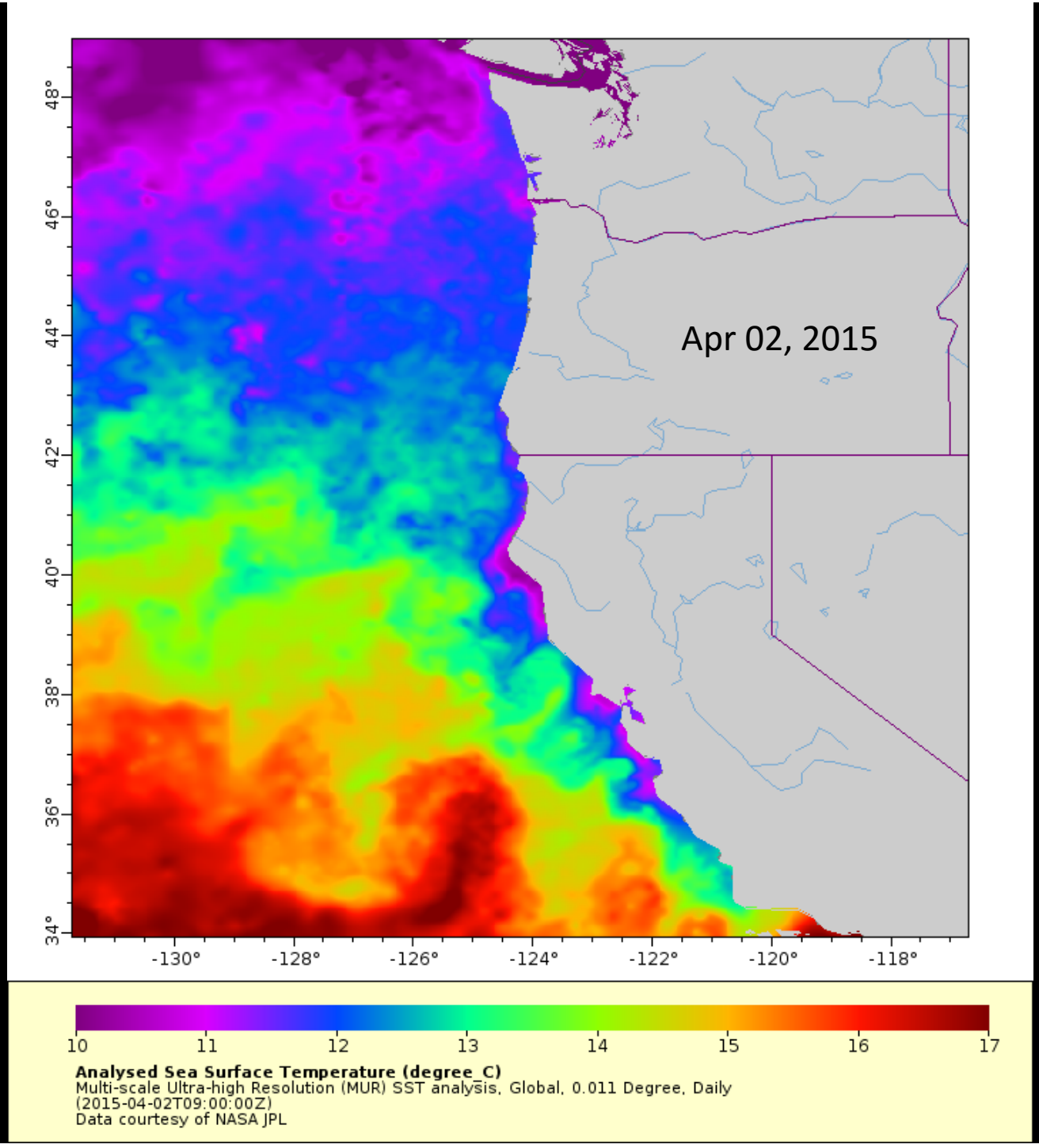
Analysed Sea Surface Temperature (degree_C)
Multi-scale Ultra-high Resolution (MUR) SST analysis, Global, 0.011 Degree, Daily
(2015-03-17T09:00:00Z)
Data courtesy of NASA JPL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Analysed Sea Surface Temperature (degree_C)
Multi-scale Ultra-high Resolution (MUR) SST analysis, Global, 0.011 Degree, Daily
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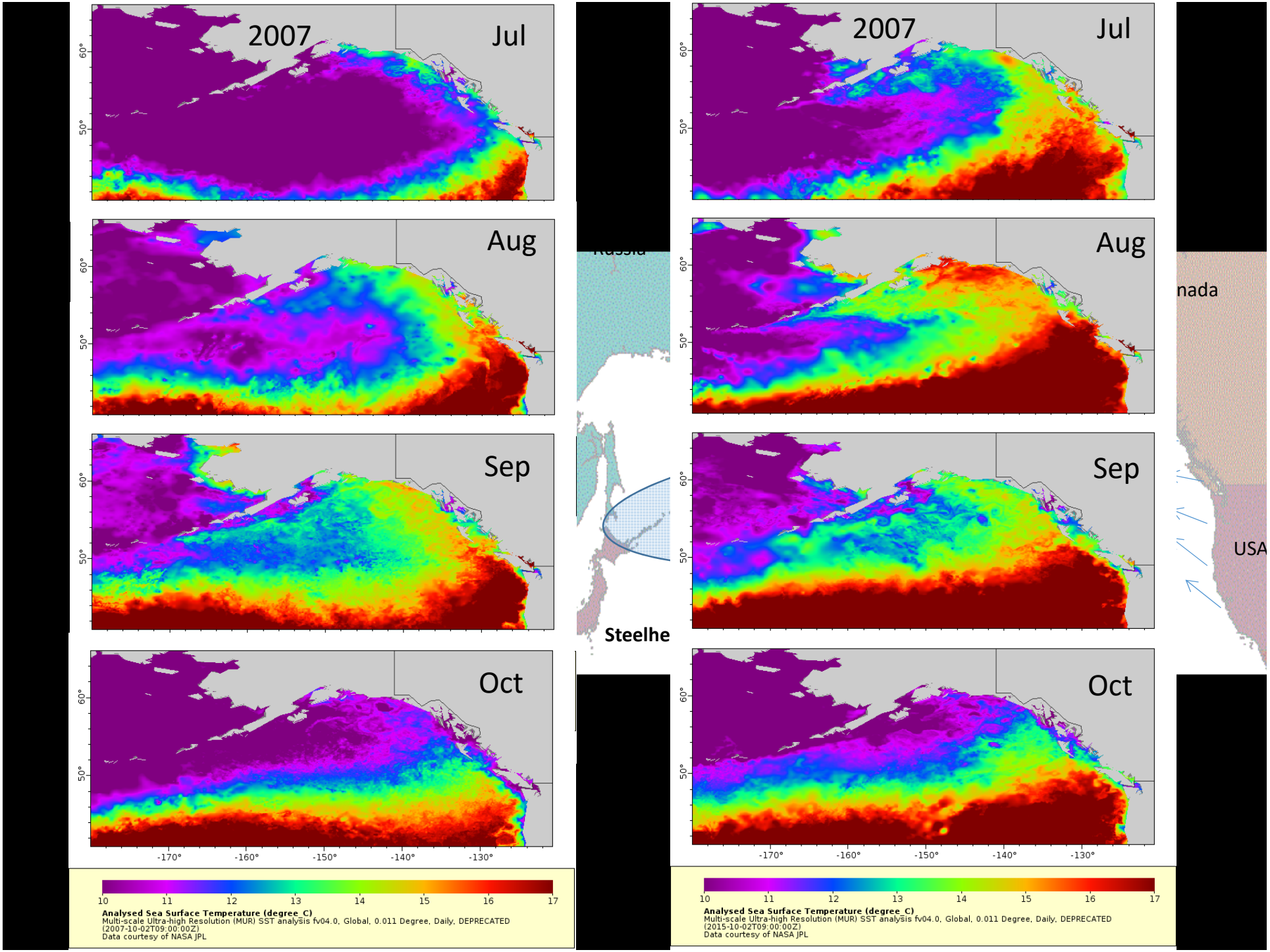
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Analysed Sea Surface Temperature (degree_C)
Multi-scale Ultra-high Resolution (MUR) SST analysis fv04.0, Global, 0.011 Degree, Daily, DEPRECATED
(2007-10-02T09:00:00Z)
Data courtesy of NASA JPL
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Analysed Sea Surface Temperature (degree_C)
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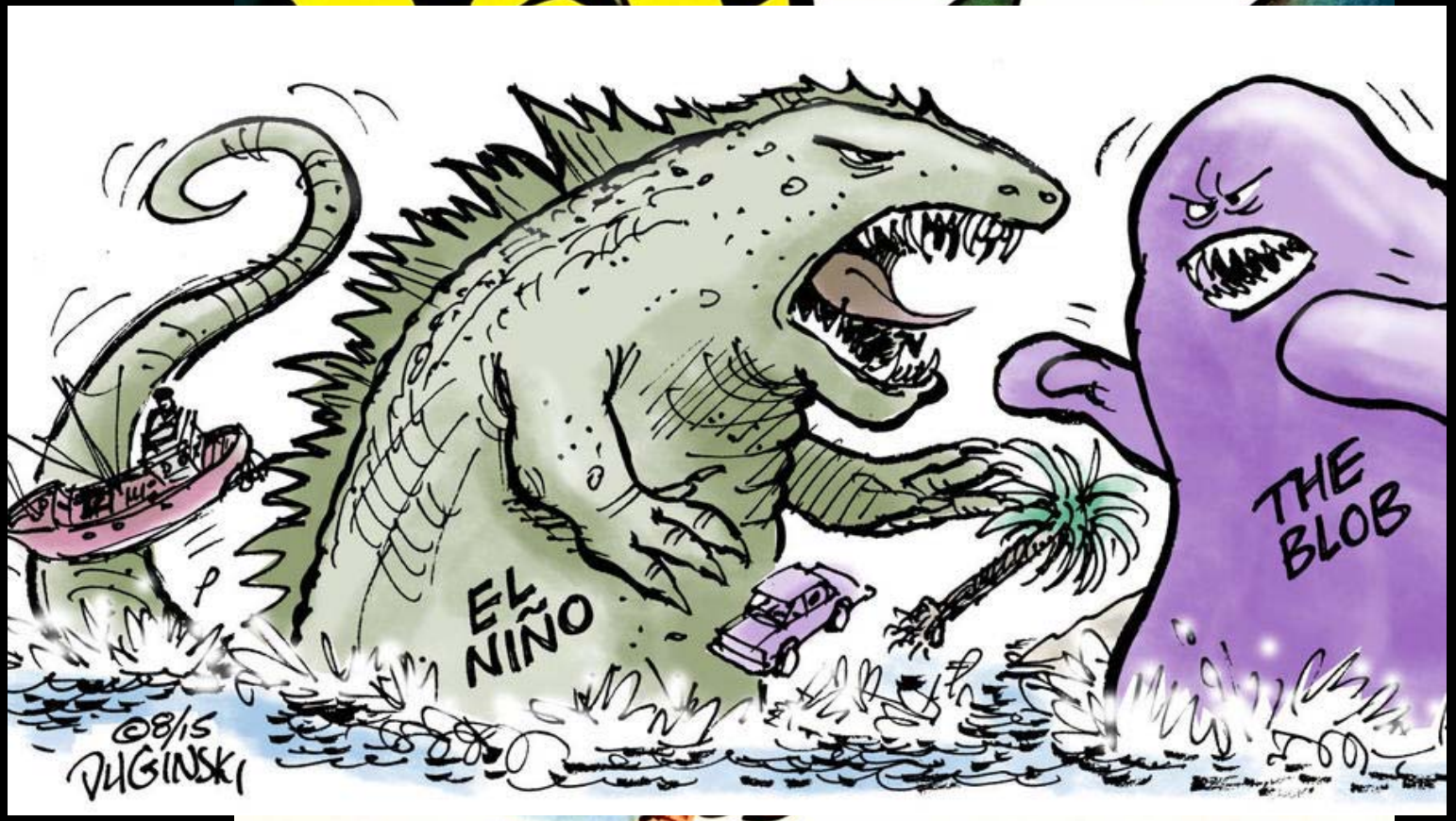
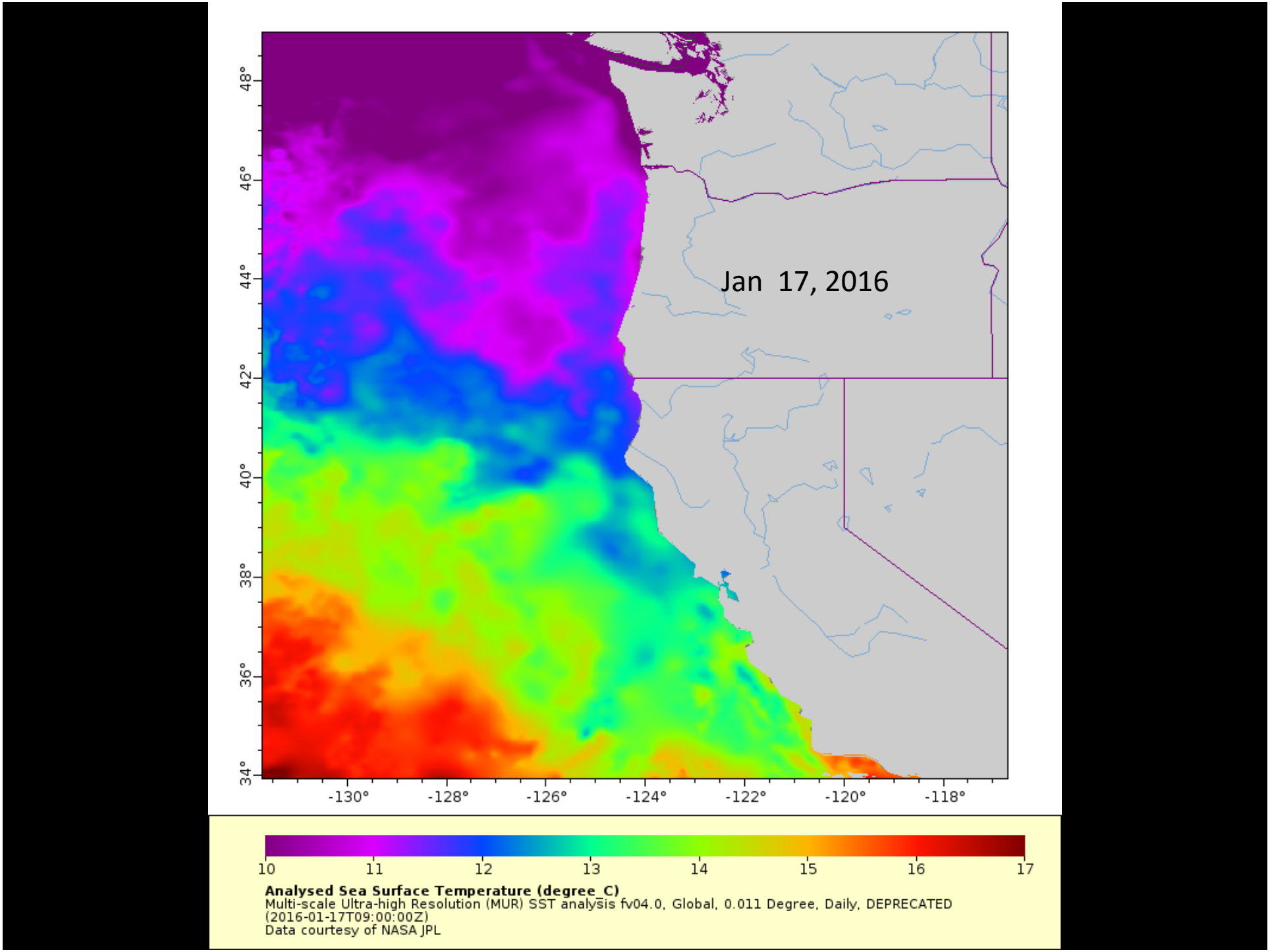
Data courtesy of NASA JPL

2016 Year 2

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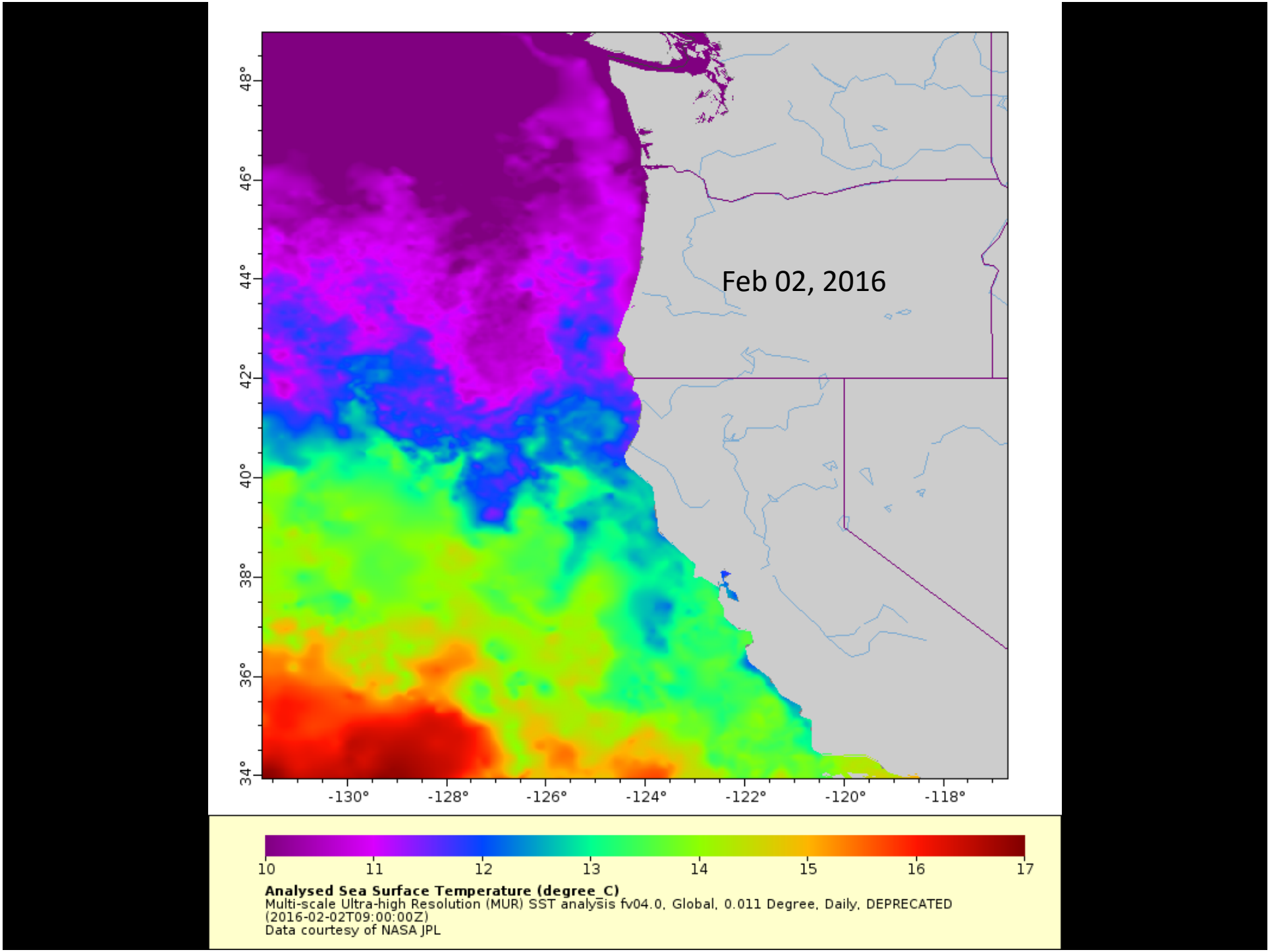
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Analysed Sea Surface Temperature (degree_C)
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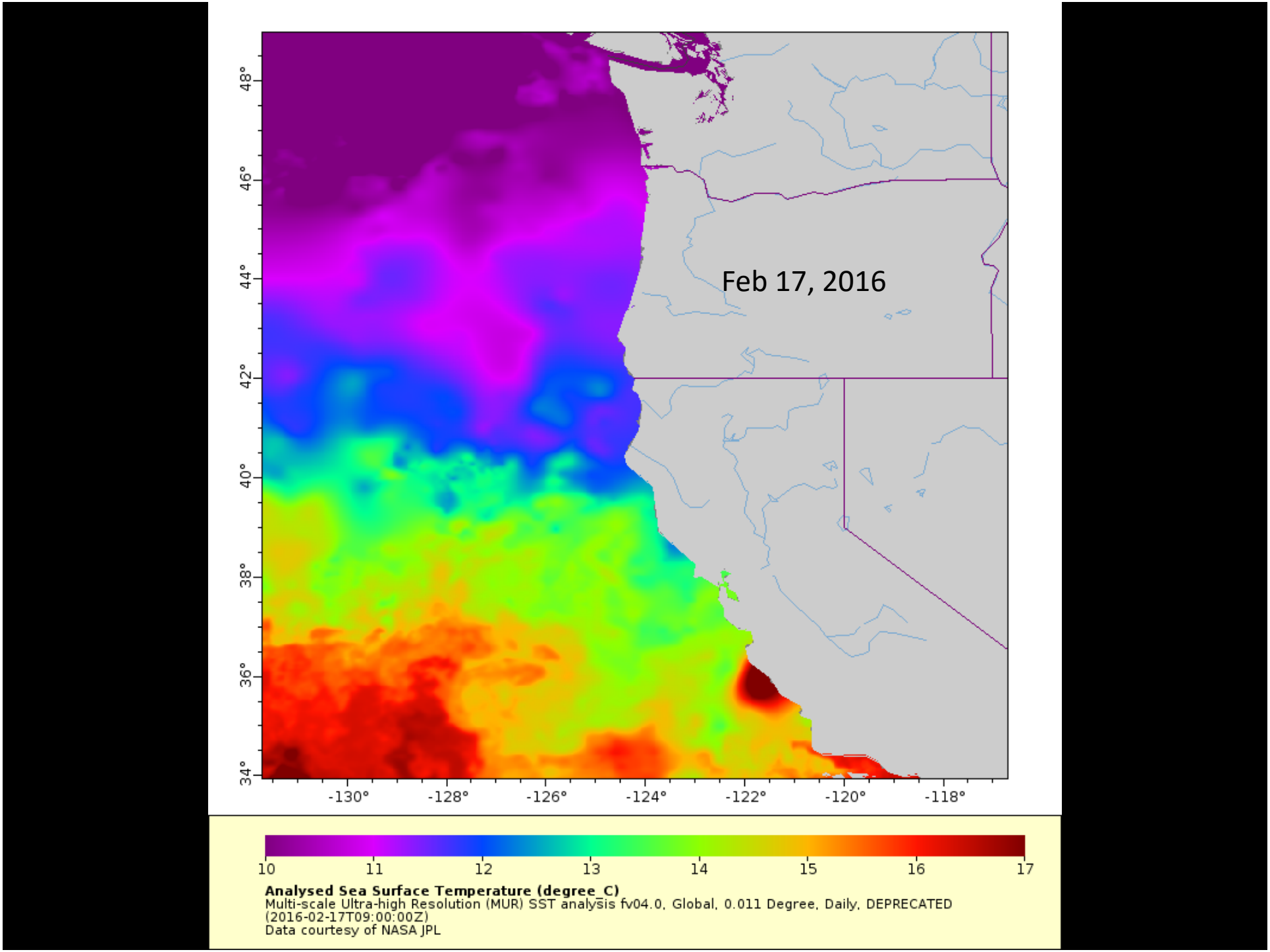
(2016-02-02T09:00:00Z)
Data courtesy of NASA JPL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Analysed Sea Surface Temperature (degree_C)
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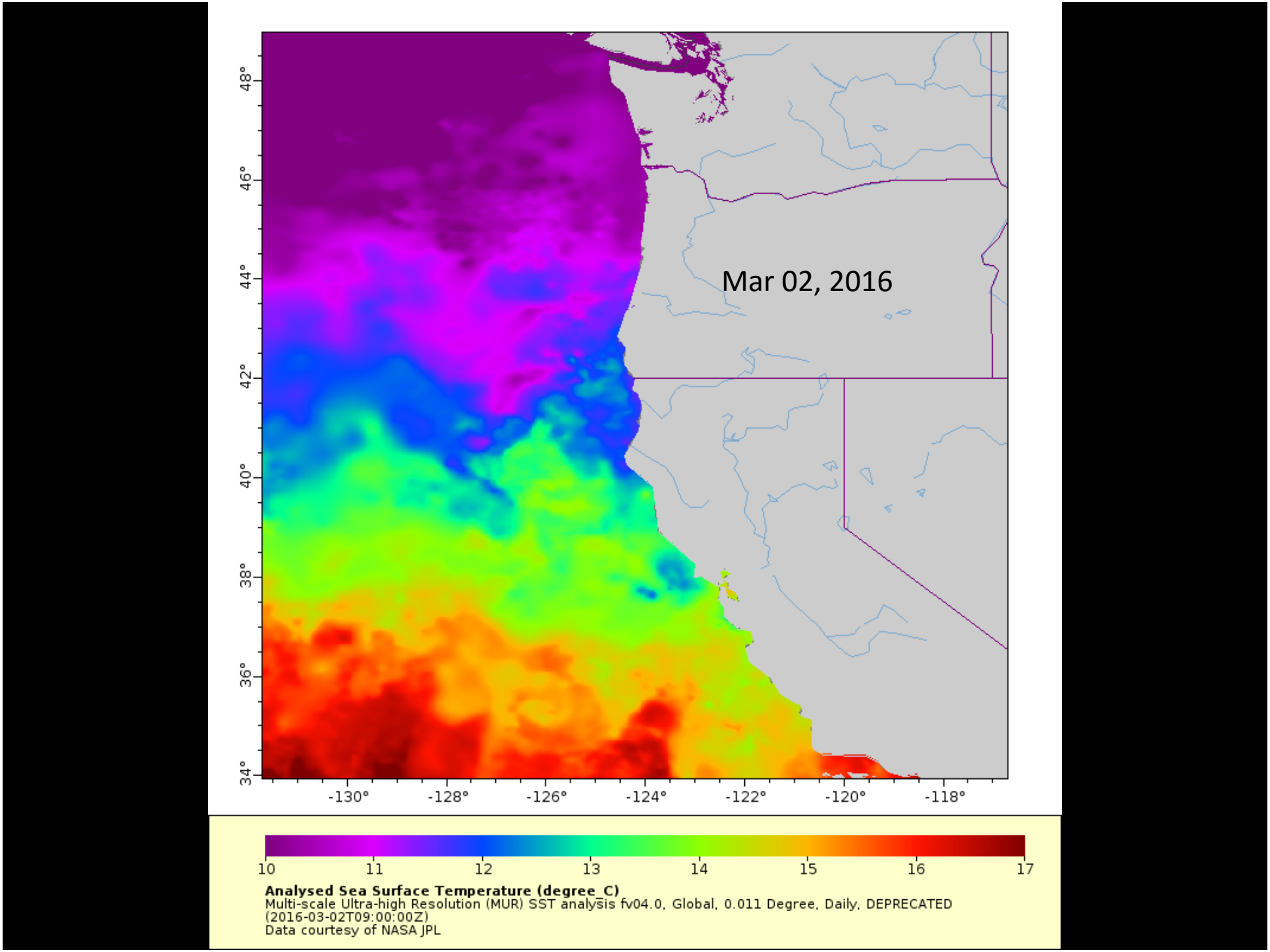
Data courtesy of NASA JPL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Analysed Sea Surface Temperature (degree_C)
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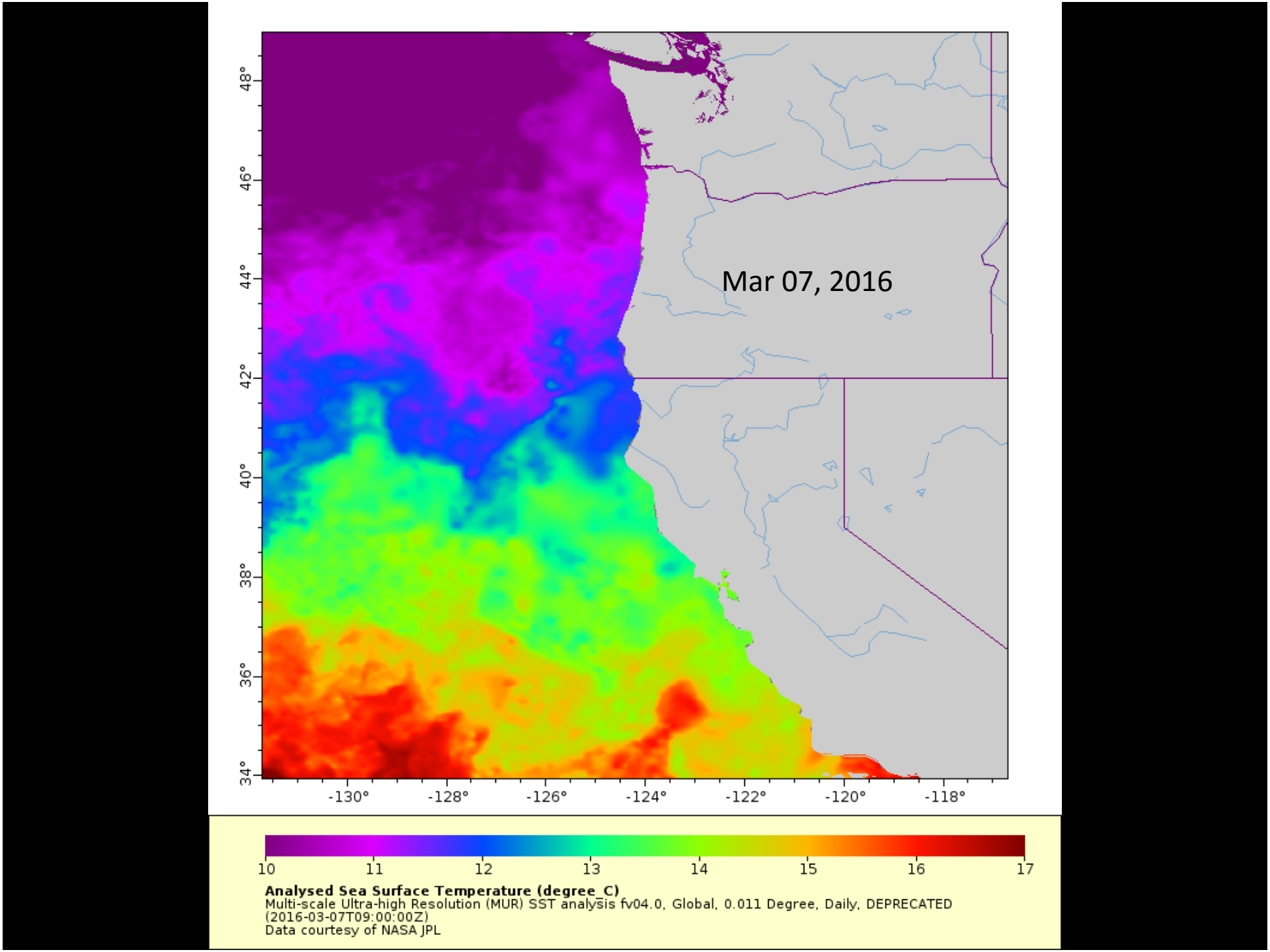
Data courtesy of NASA JPL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Analysed Sea Surface Temperature (degree_C)
Multi-scale Ultra-high Resolution (MUR) SST analysis fv04.0, Global, 0.011 Degree, Daily, DEPRECATED
(2016-03-07T09:00:00Z)
Data courtesy of NASA JPL

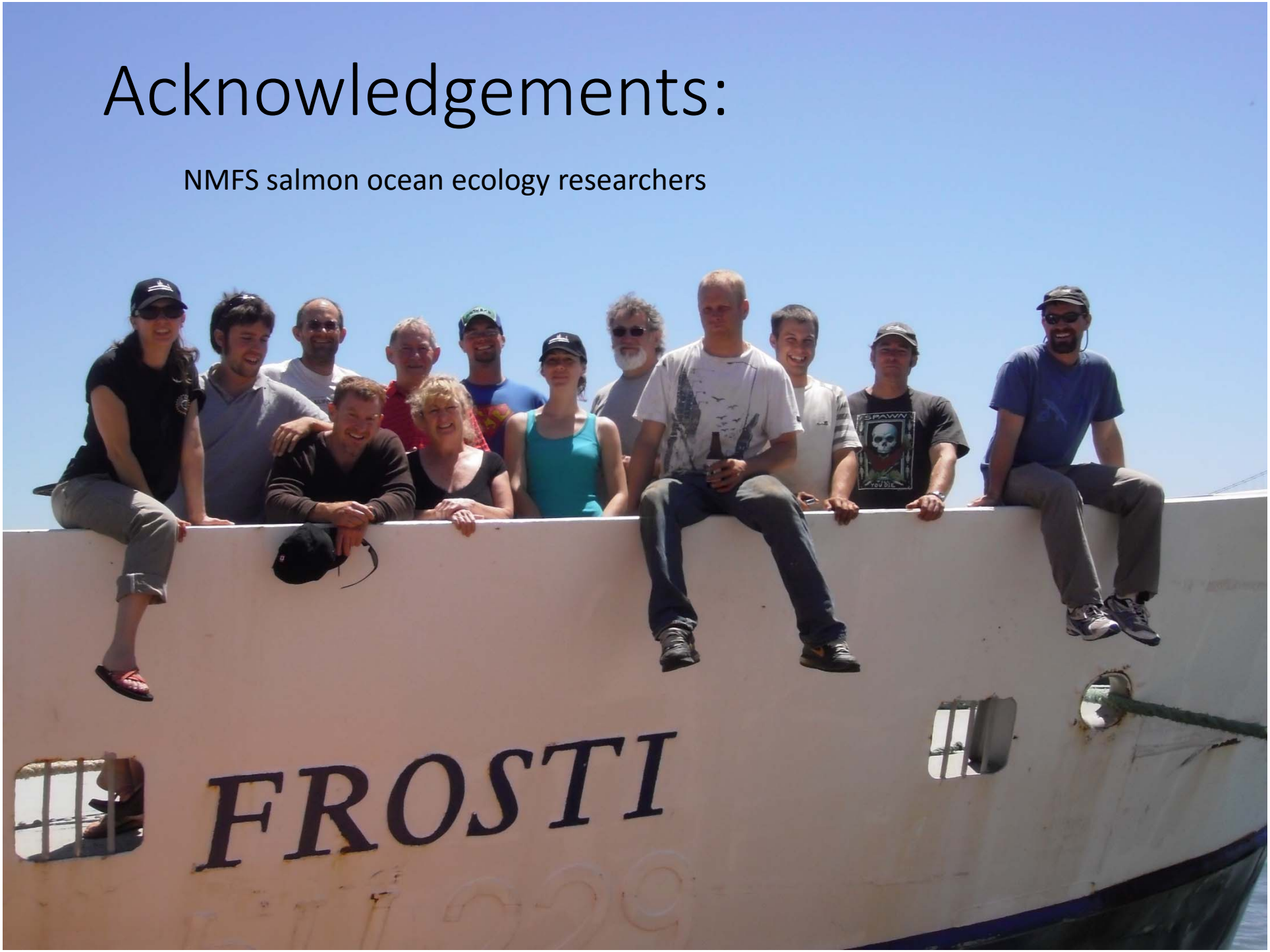
Questions for us?

- Hayes and Kocik? Loosers…
- Freshwater and marine temp tolerance the same?
- Do fish actively seek sup-optimal cool water?
- Why?
  - Food?
  - Physiology?

- Implications for anadromous life history?

Acknowledgements:

NMFS salmon ocean ecology researchers



Extreme Surface orientation in Steelhead

FISHERIES OCEANOGRAPHY

FISHERIES OCEANOGRAPHY

Fish. Oceanogr. 21:5, 321–335, 2012

Potential trophodynamic and environmental drivers of steelhead (*Oncorhynchus mykiss*) productivity in the North Pacific Ocean

MARGARET E. ATCHESON, KATHERINE W. MYERS,* NANCY D. DAVIS AND NATHAN J. MANTUA

School of Aquatic and Fishery Sciences, University of Washington, Box 355020, Seattle, WA 98195-5020, U.S.A.

identification is needed to *link* these potential drivers of productivity to individual populations.

Key words: central North Pacific, climate, diet, Gulf of Alaska, isotope, ocean, pink salmon, squid, steelhead

The Province

FRIDAY, FEBRUARY 20, 2015

VANCOUVER, BRITISH COLUMBIA

Fisherman 'disgusted' to find garbage inside steelhead he caught on Vedder River

FISH & PLASTIC CHIPS

PAGE 3

Jordan Butt displays the chips of plastic he found in a steelhead he caught on the Vedder River in Chilliwack.

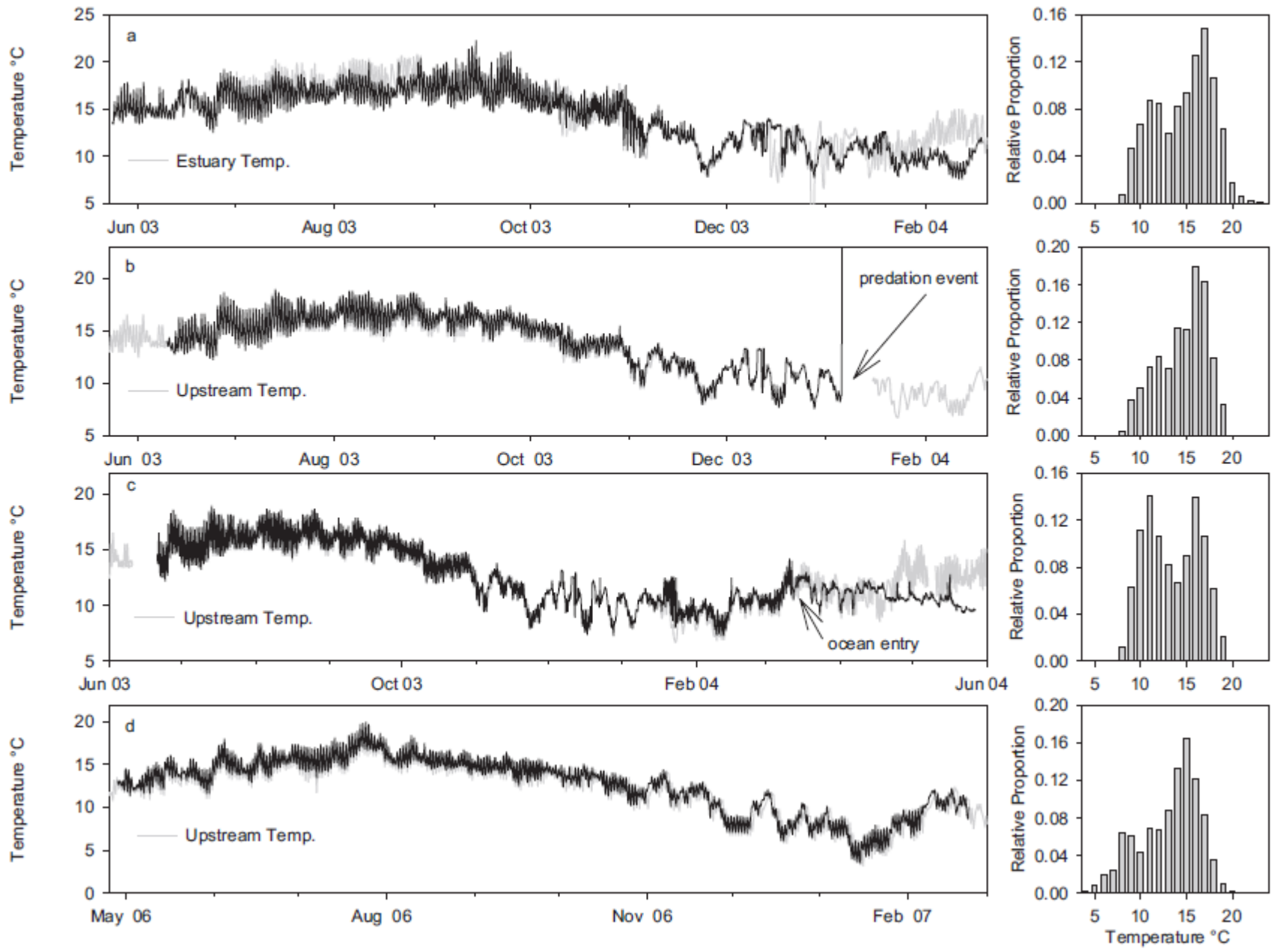
Fish is found stuffed with garbage

VEDDER RIVER: Chilliwack fisherman finds plastic in catch, suspects steelhead ingested objects in ocean

NICK EAGLAND

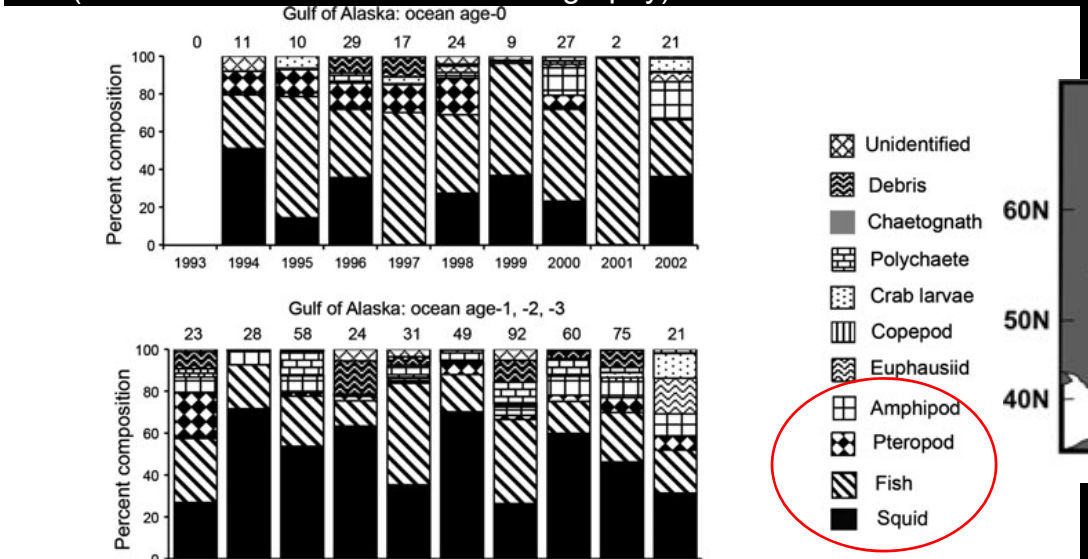
Fisherman Jordan Butt was shocked when he cut open a steelhead salmon he
been torn apart by more than a dozen shards of plastic, some the

Increased catch in 2011?


a
Estuary Temp.
Temperature °C
Jun 03
Aug 03
Oct 03
Dec 03
Feb 04
Relative Proportion
b
Upstream Temp.
predation event
Jun 03
Aug 03
Oct 03
Dec 03
Feb 04
c
Upstream Temp.
ocean entry
Jun 03
Oct 03
Feb 04
Jun 04
d
Upstream Temp.
May 06
Aug 06
Nov 06
Feb 07
Temperature °C

Diet difference between coastal and pelagic stocks?

Gulf of Alaska and Central Northern Pacific
(Atcheson et al 2012 Fish Oceanography)



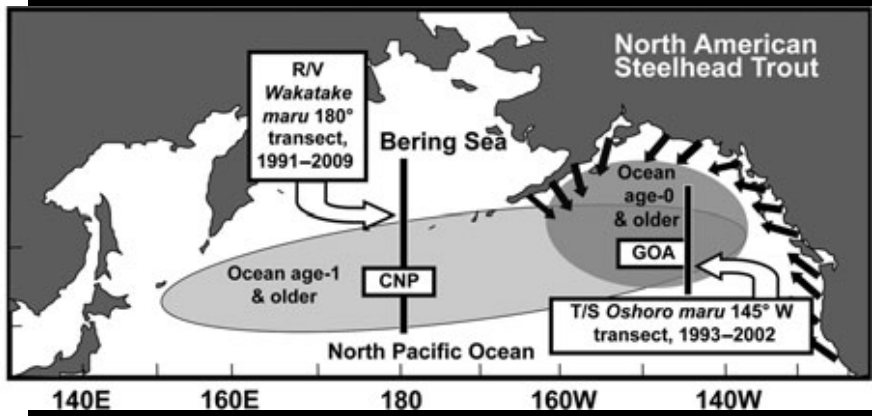


Fig 1& 2 from Atcheson et al 2012

NWFSC OR/WA Coast (Daly et al 2014)

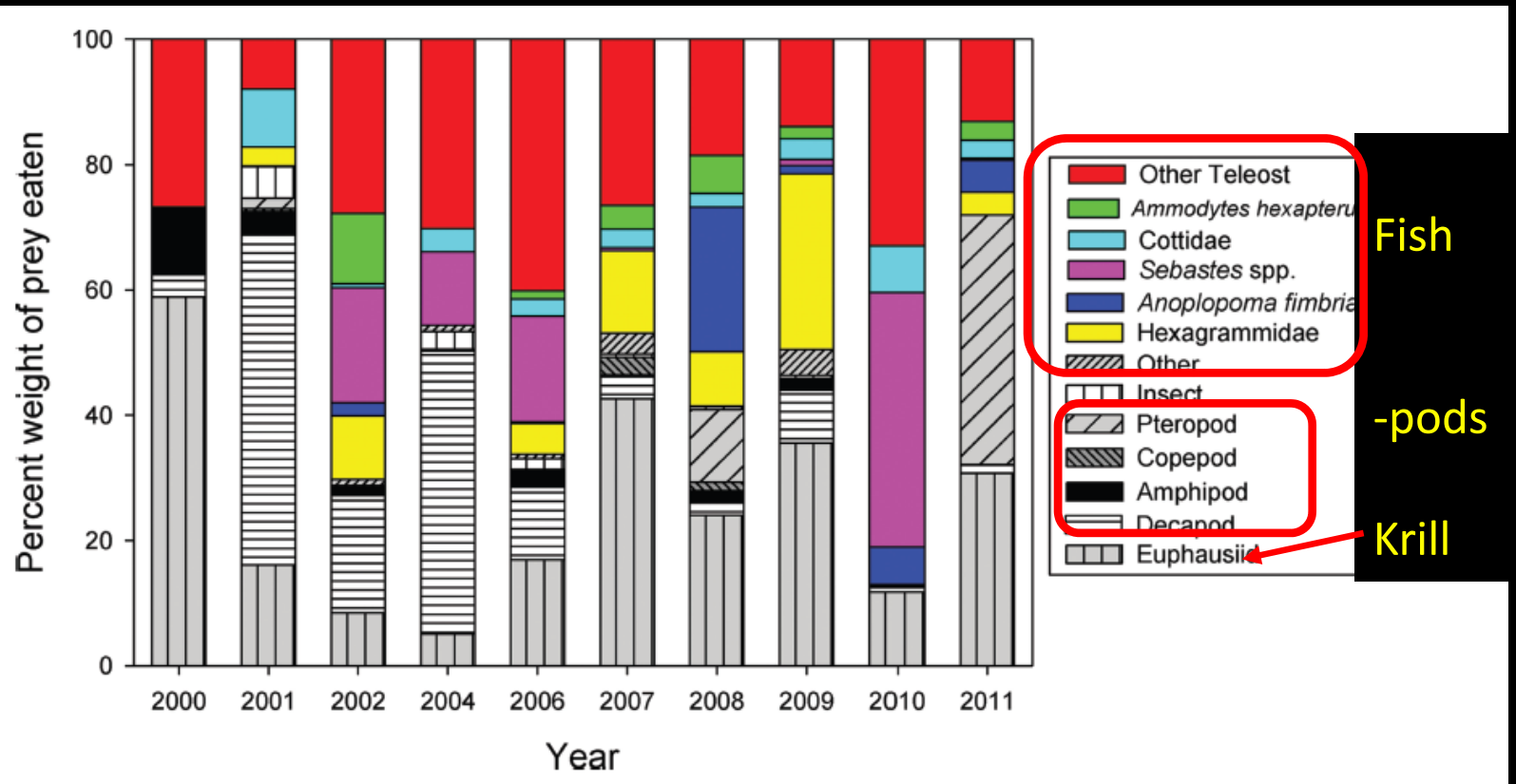
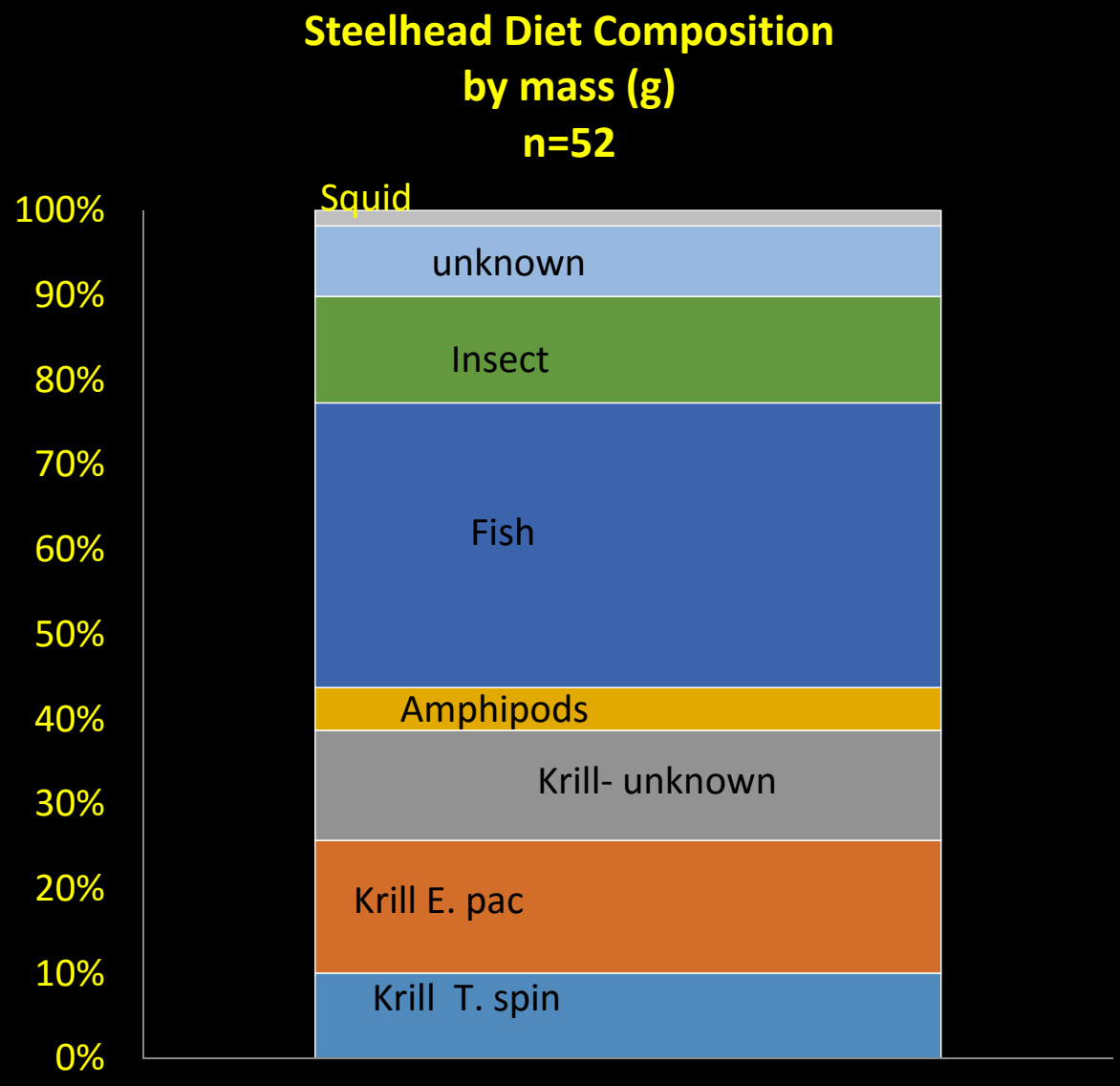
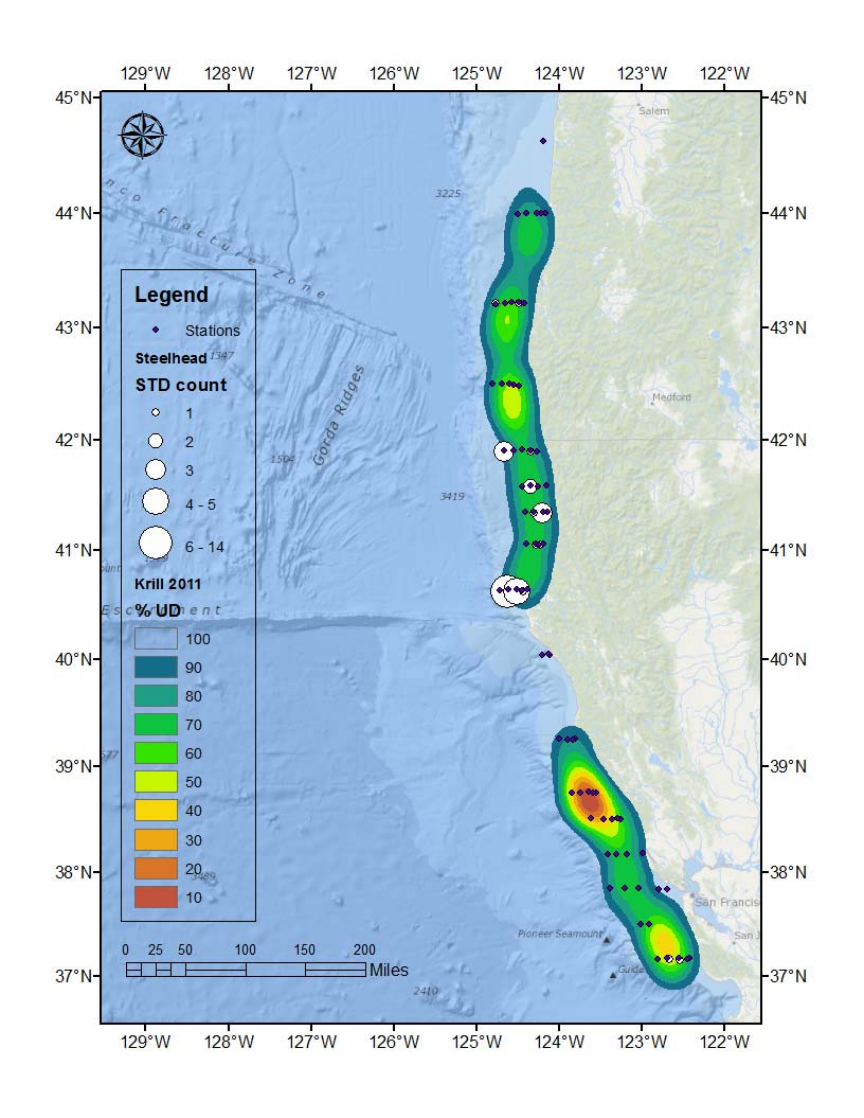


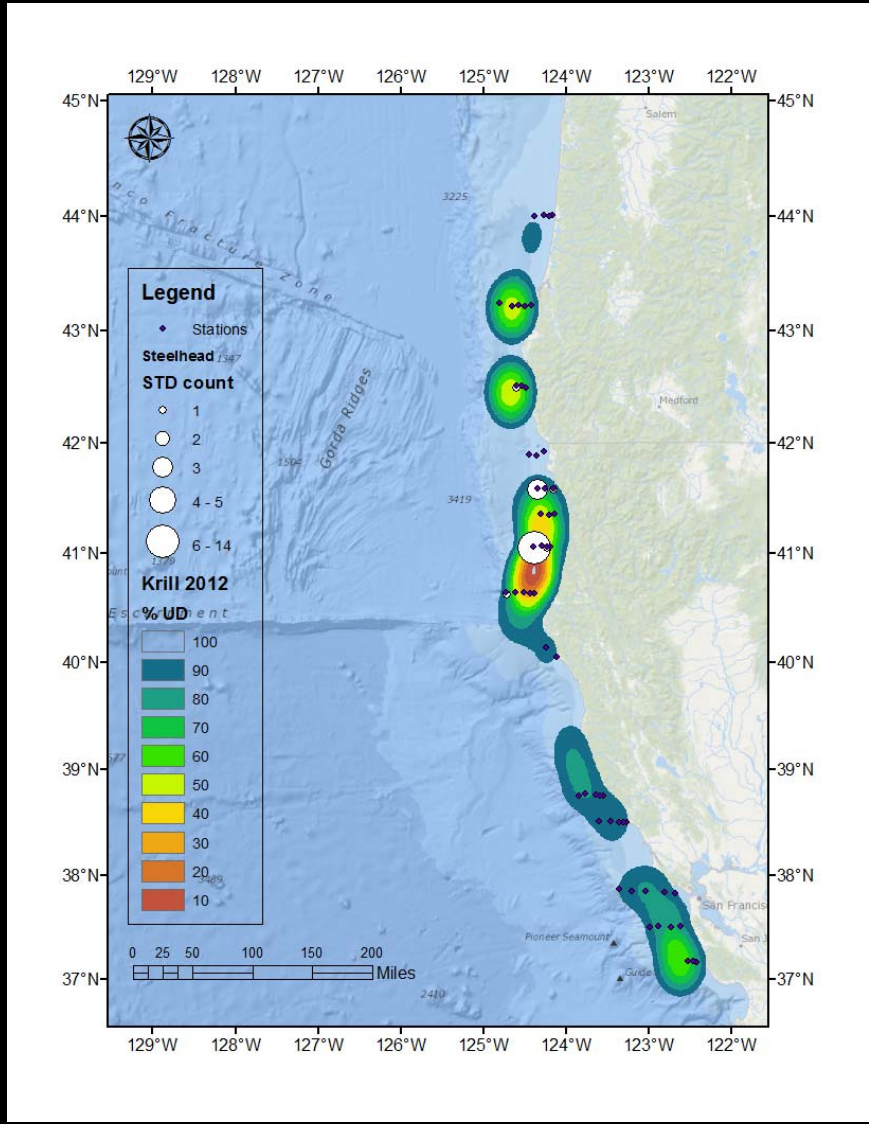
FIGURE 4. Composition of the diet consumed by juvenile steelhead off the coasts of Oregon and Washington, 2000–2011. Fish prey taxa are shown in color, whereas other taxa are shown in grayscale. The "other" category includes arachnids, cirripedes (barnacle larvae), mysids, polychaetes, isopods, and gelatinous material. The "other teleosts" category includes clupeids, gadids, salmonids, osmerids, and other unidentified fish (including fish tissue and parts). Unidentified crustacean parts and material, fish scales, unidentified material, plant material, and plastic were excluded from the analysis. See Appendix Table A.1 for common names of taxa.

SWFSC Northern CA Fish

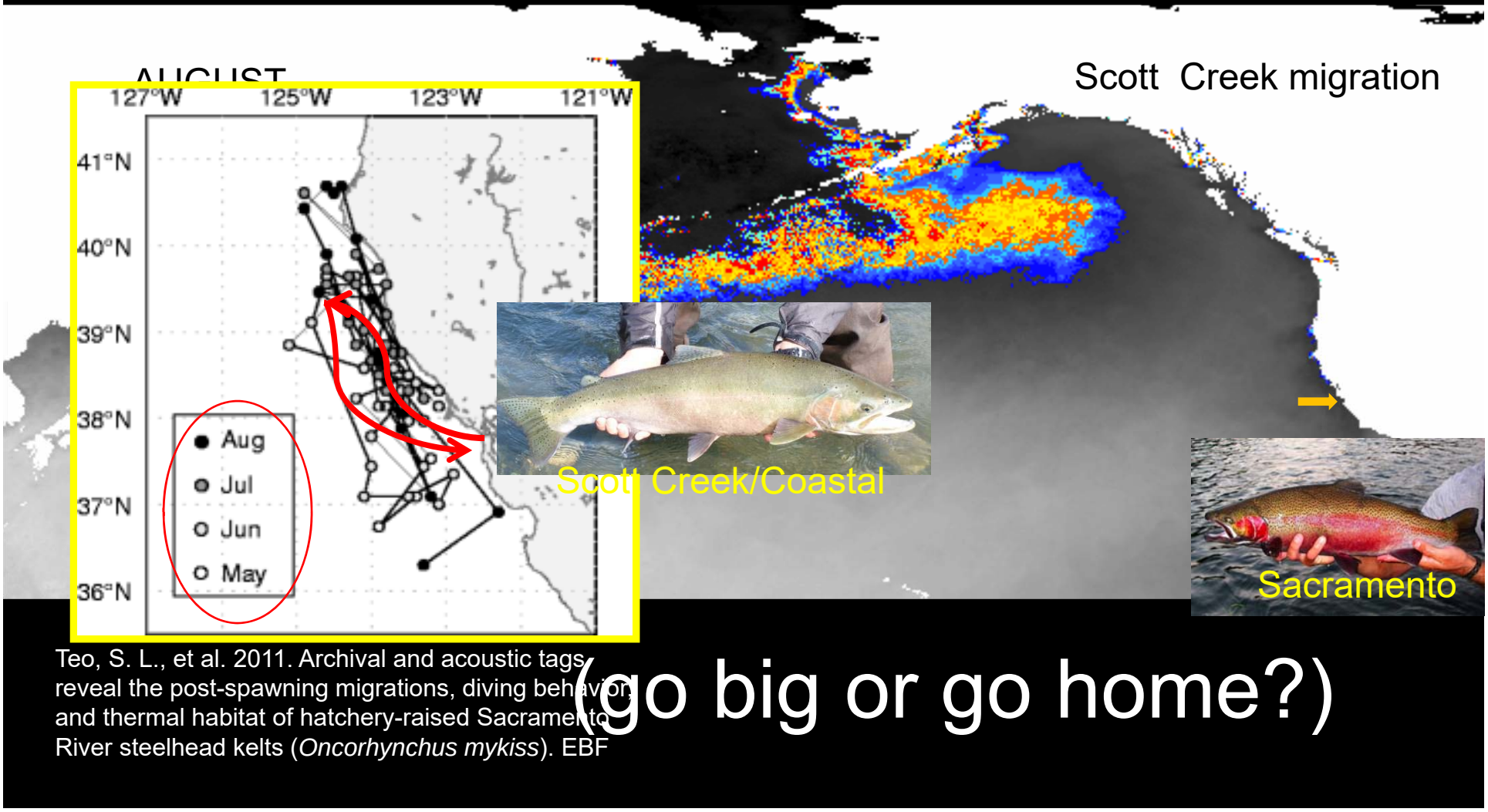


Steelhead vs ‘Krill’ distribution



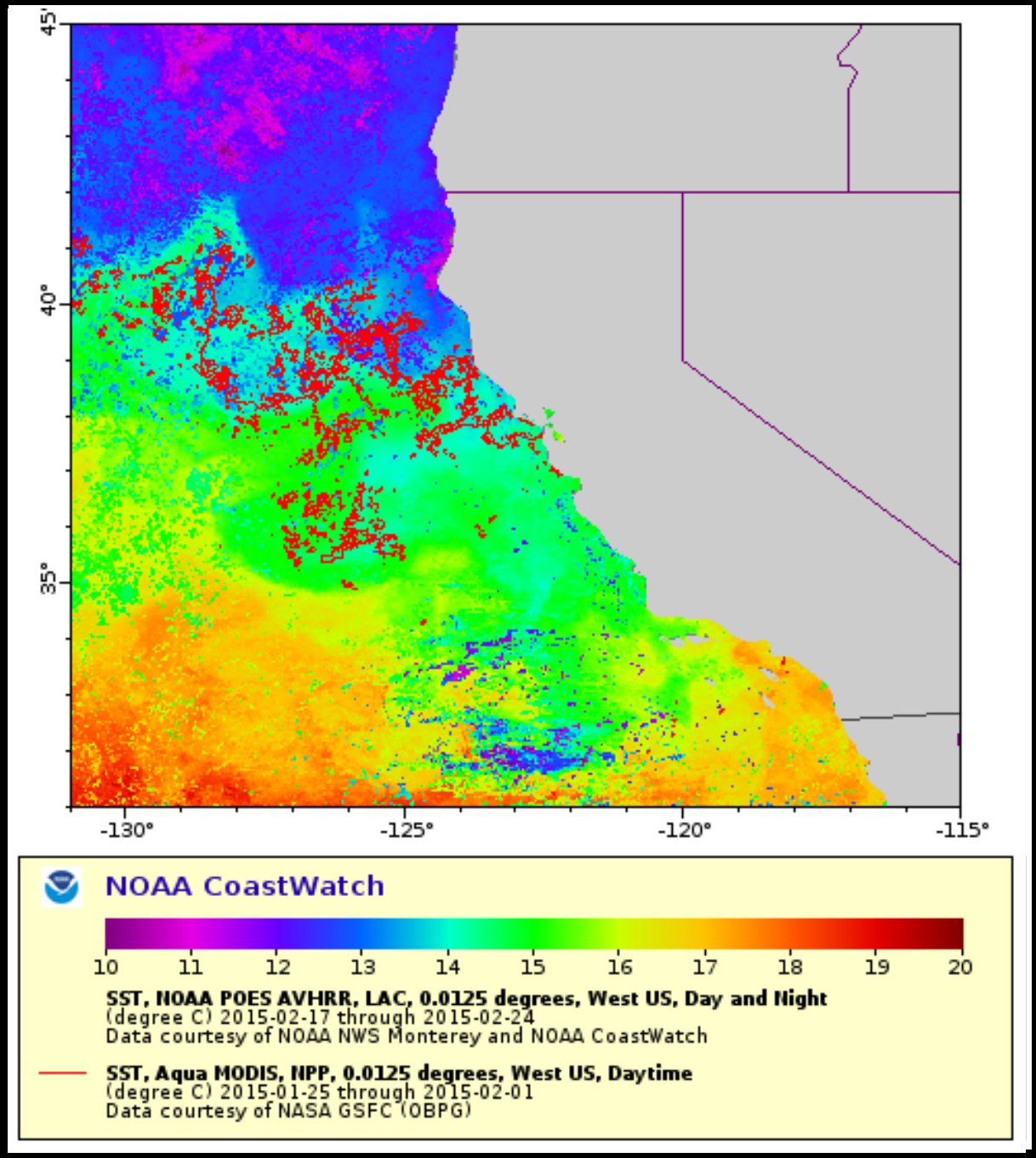


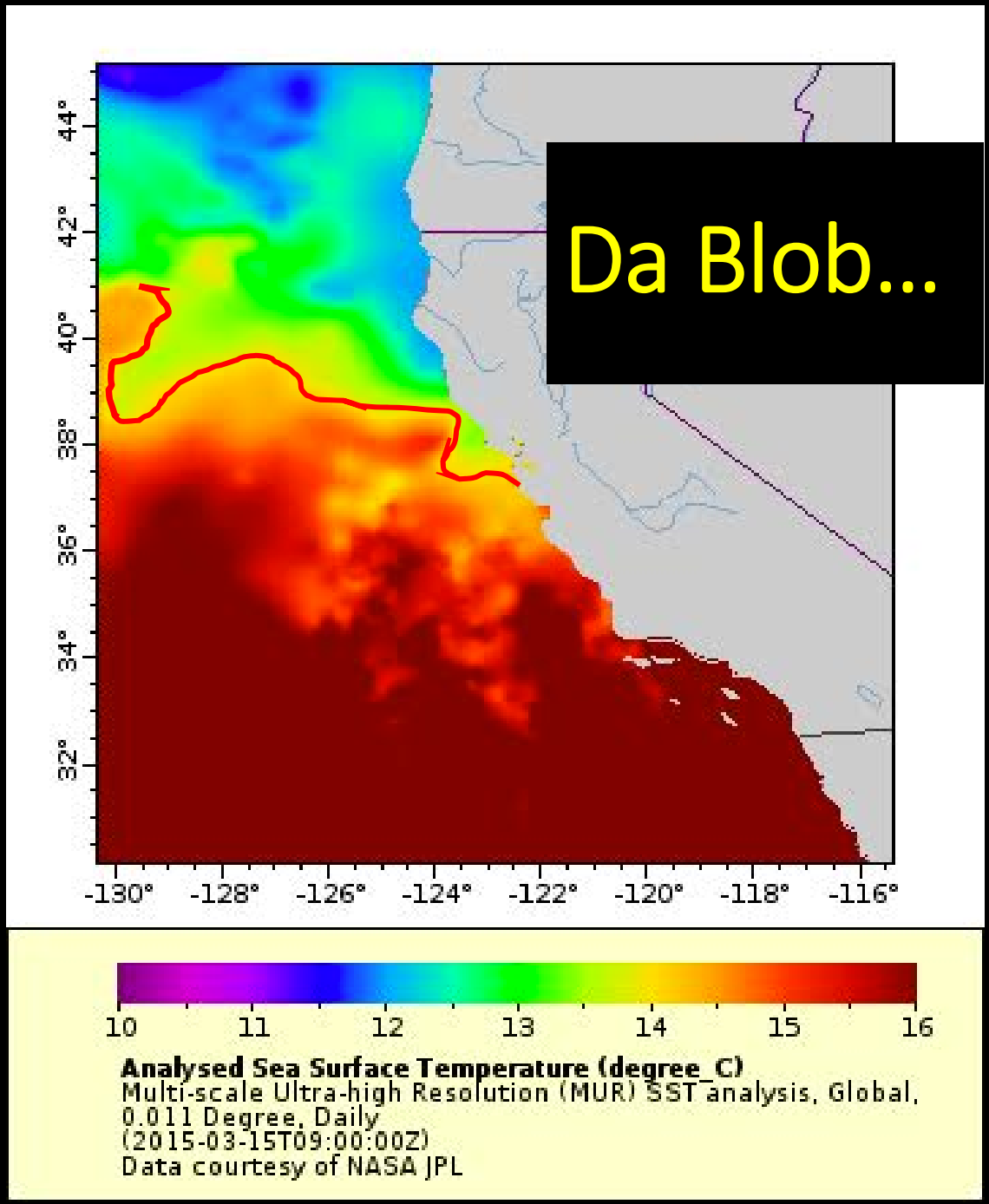
California Steelhead Marine Habitat Use



Teo, S. L., et al. 2011. Archival and acoustic tags reveal the post-spawning migrations, diving behavior, and thermal habitat of hatchery-raised Sacramento River steelhead kelts (*Oncorhynchus mykiss*). EBF

(go big or go home?)


45°
40°
35°
-130°
-125°
-120°
-115°
NOAA CoastWatch
10
11
12
13
14
15
16
17
18
19
20
SST, NOAA POES AVHRR, LAC, 0.0125 degrees, West US, Day and Night
(degree C) 2015-02-17 through 2015-02-24
Data courtesy of NOAA NWS Monterey and NOAA CoastWatch
SST, Aqua MODIS, NPP, 0.0125 degrees, West US, Daytime
(degree C) 2015-01-25 through 2015-02-01
Data courtesy of NASA GSFC (OBPG)


Da Blob...
44°
42°
40°
38°
36°
34°
32°
-130°
-128°
-126°
-124°
-122°
-120°
-118°
-116°
10
11
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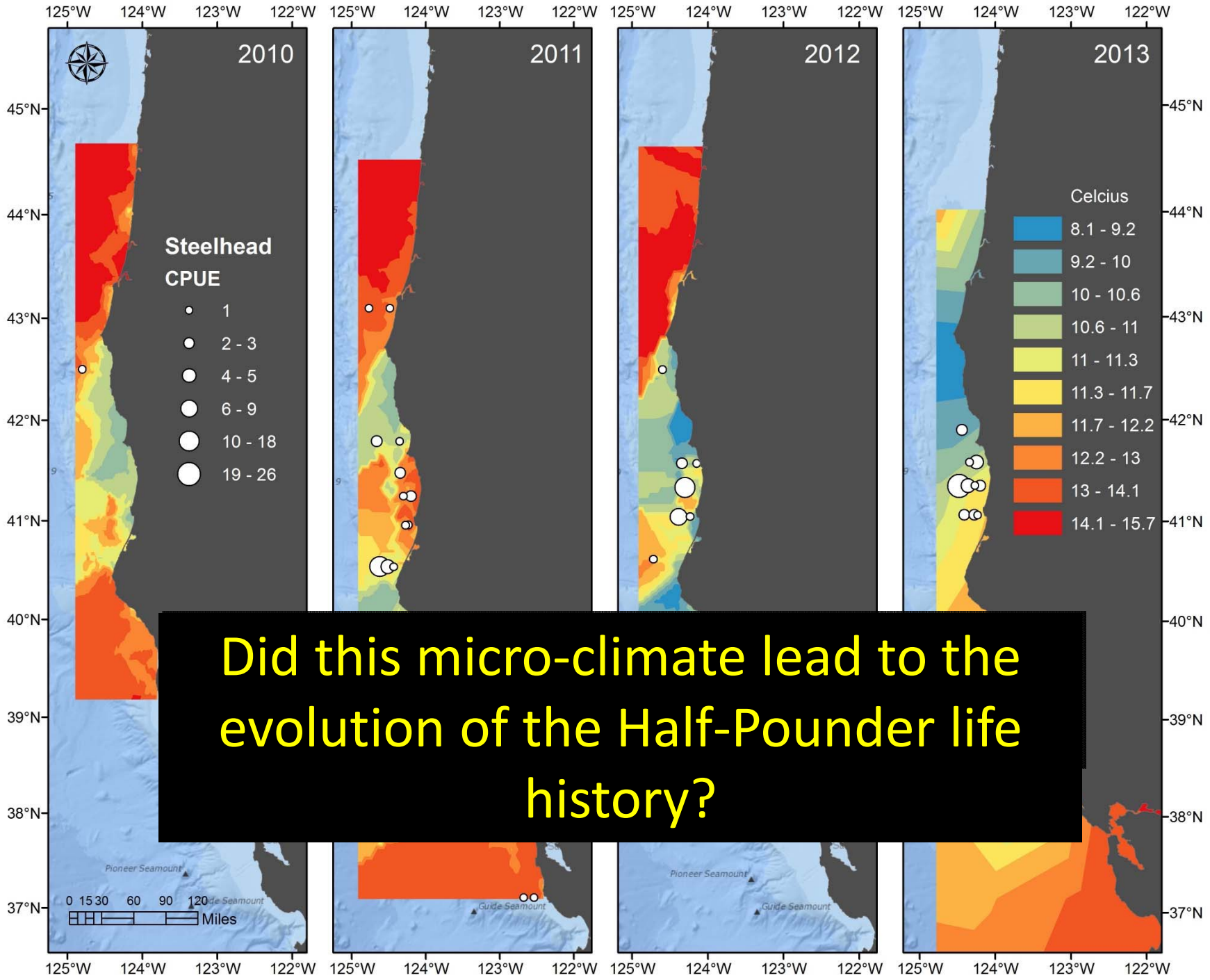
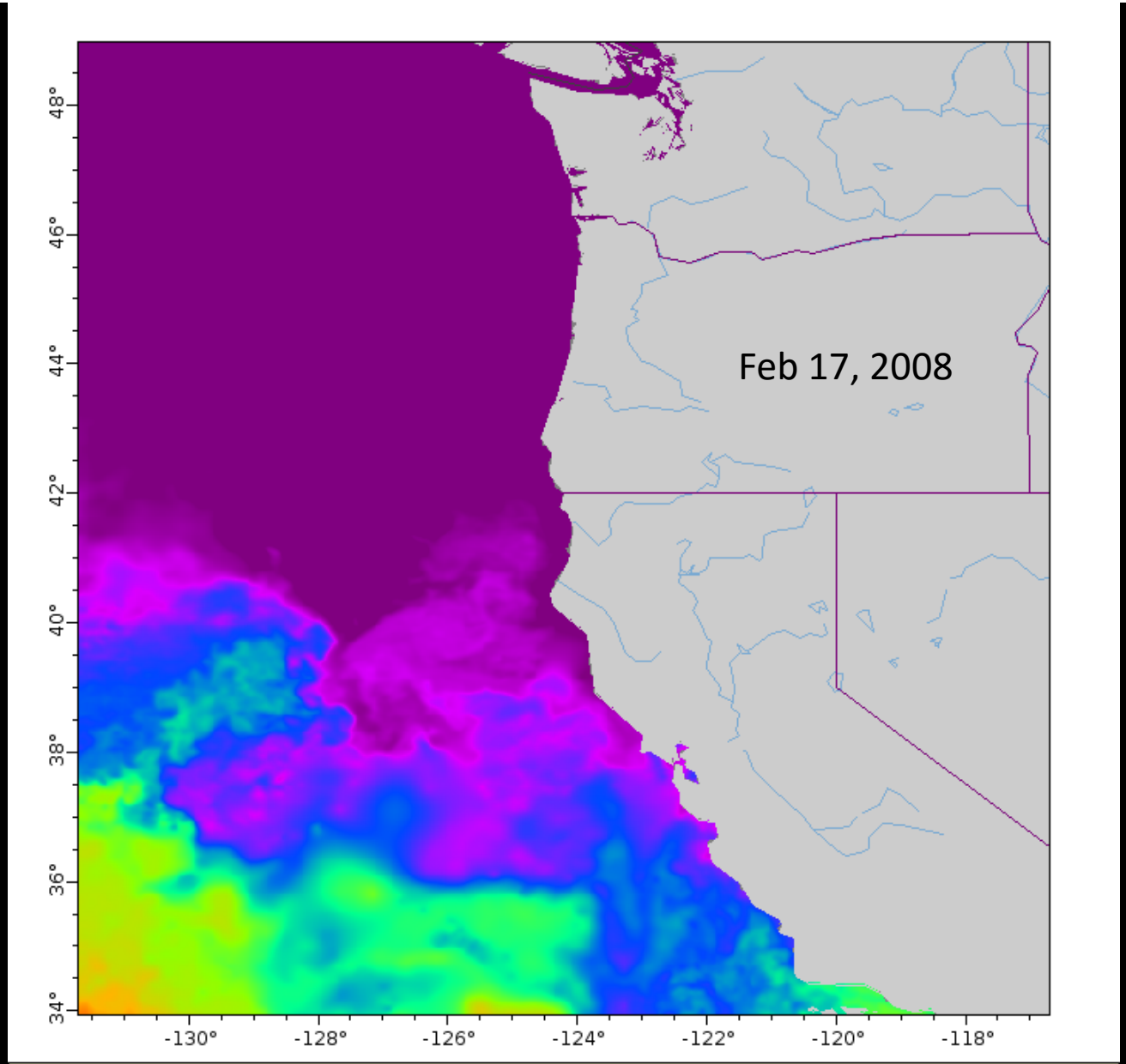
15
16
Analysed Sea Surface Temperature (degree_C)
Multi-scale Ultra-high Resolution (MUR) SST analysis, Global, 0.011 Degree, Daily
(2015-03-15T09:00:00Z)
Data courtesy of NASA JPL


NMFS
MUSTANG SURVIVAL
SALMON

Ocean Surveys



Did this micro-climate lead to the evolution of the Half-Pounder life history?


Feb 17, 2008
48°
46°
44°
42°
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36°
34°
-130°
-128°
-126°
-124°
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-120°
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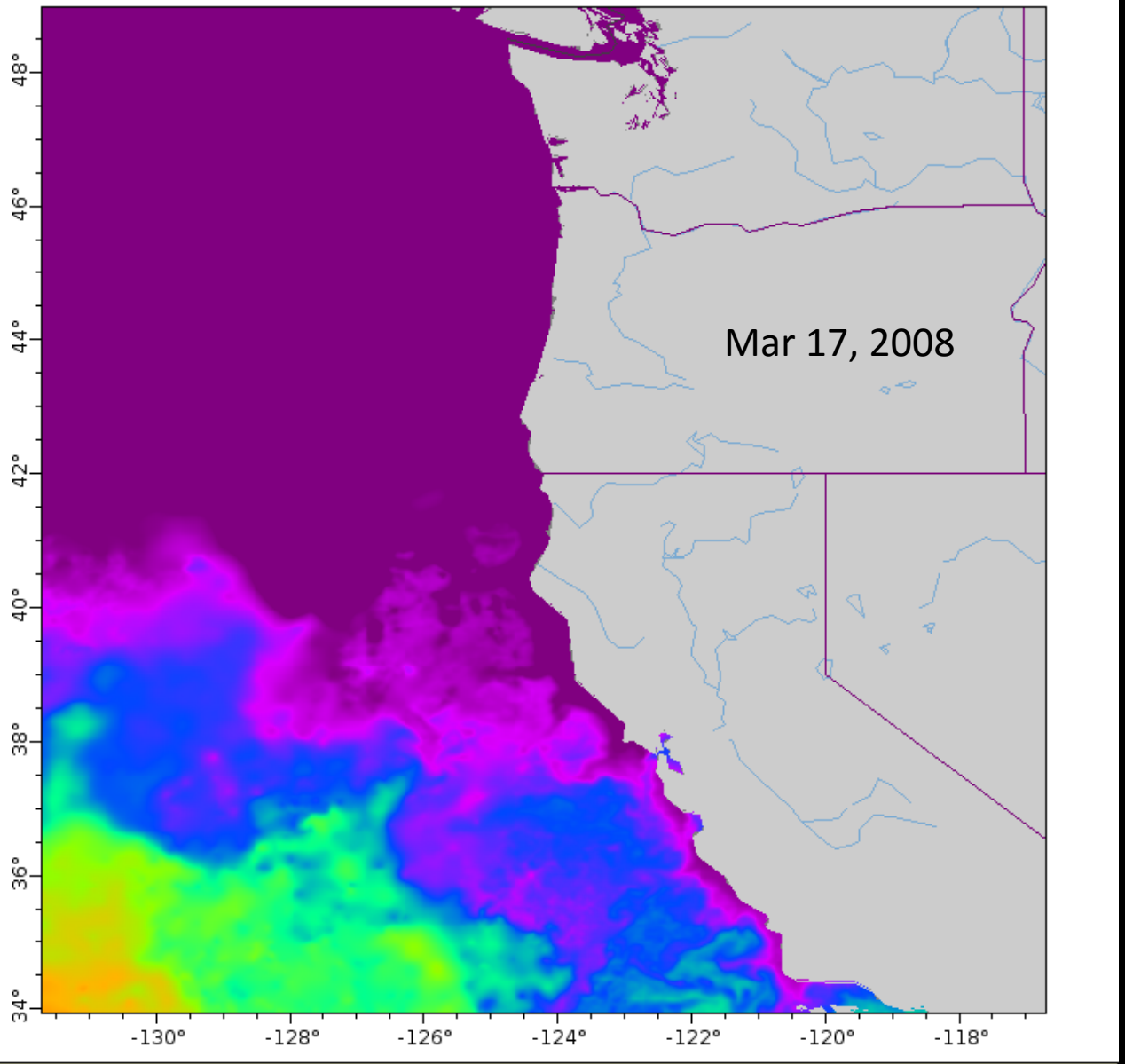
Analysed Sea Surface Temperature (degree_C)
Multi-scale Ultra-high Resolution (MUR) SST analysis, Global, 0.011 Degree, Daily
(2008-02-17T09:00:00Z)
Data courtesy of NASA JPL


Mar 17, 2008
48°
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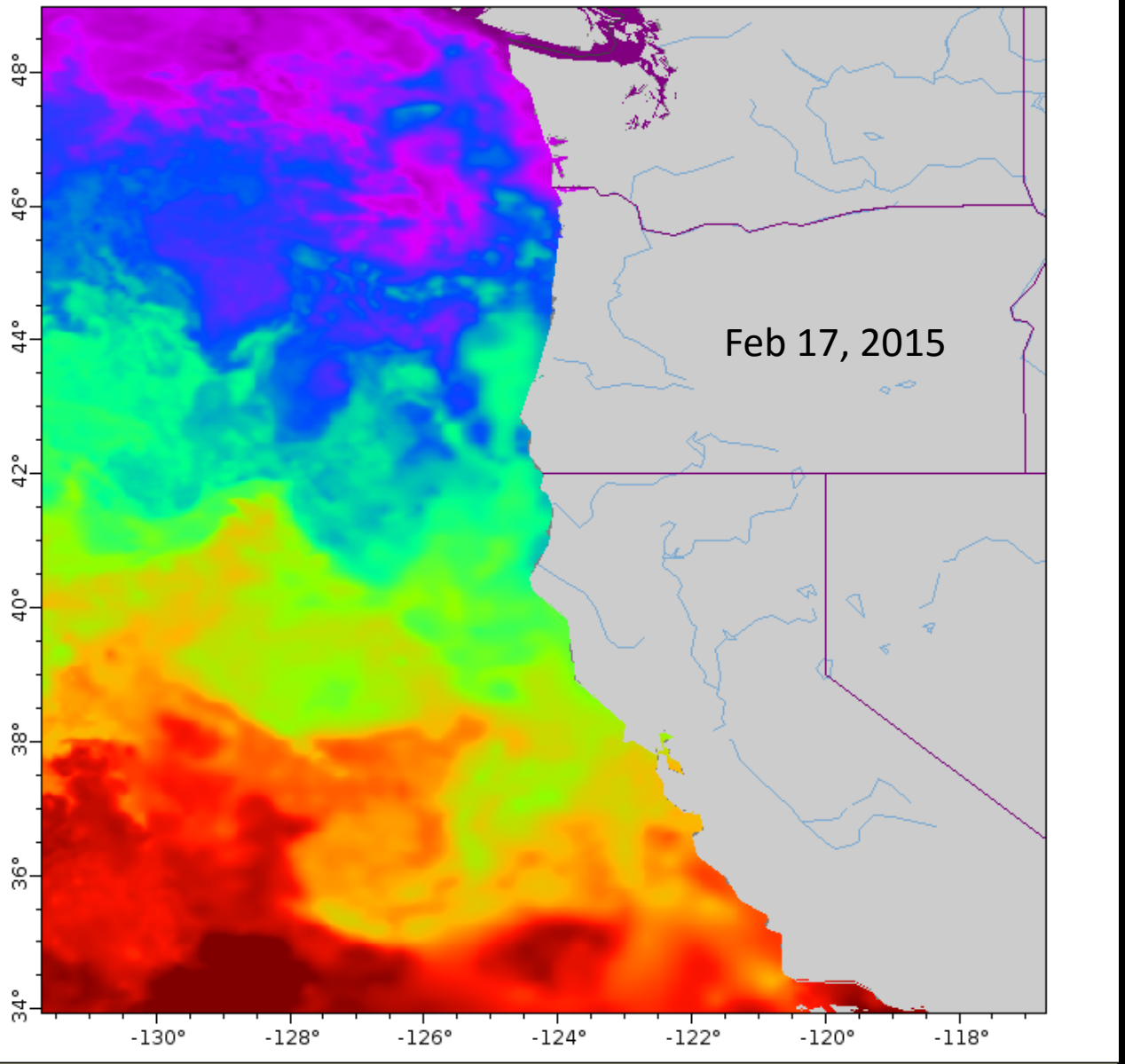
Analysed Sea Surface Temperature (degree_C)
Multi-scale Ultra-high Resolution (MUR) SST analysis, Global, 0.011 Degree, Daily
(2008-03-17T09:00:00Z)
Data courtesy of NASA JPL


Feb 17, 2015
48°
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17
Analysed Sea Surface Temperature (degree_C)
Multi-scale Ultra-high Resolution (MUR) SST analysis, Global, 0.011 Degree, Daily
(2015-02-17T09:00:00Z)
Data courtesy of NASA JPL