

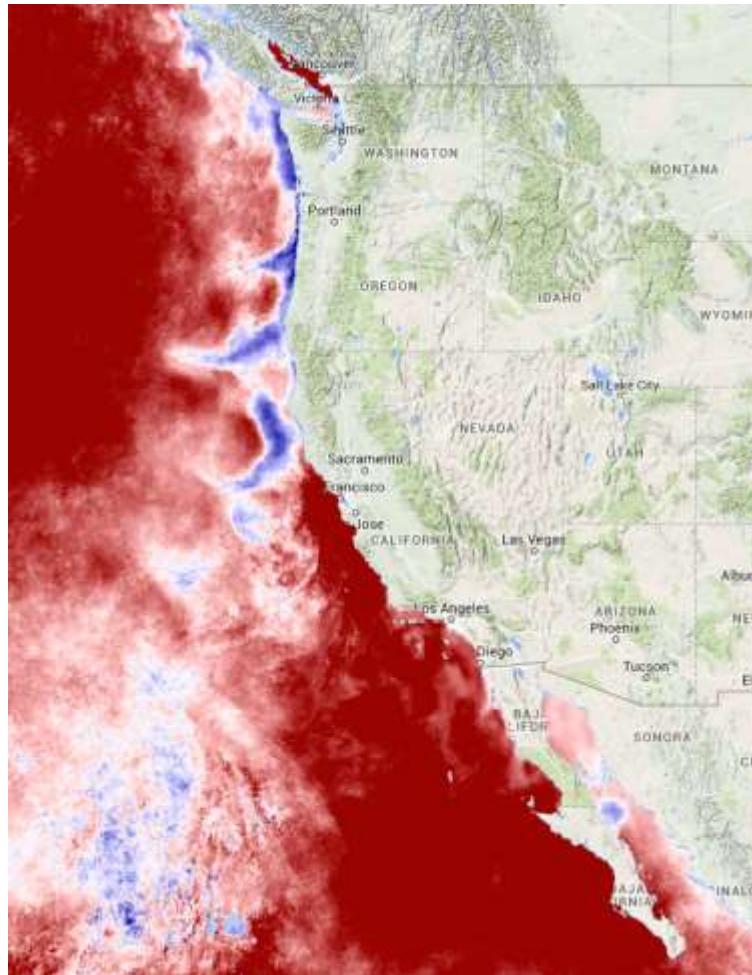
# Science Workgroup Meeting Estuary Monitoring Program

Joe Needoba

10/25/2016

# How did the Blob influence the CRE?

August 2014



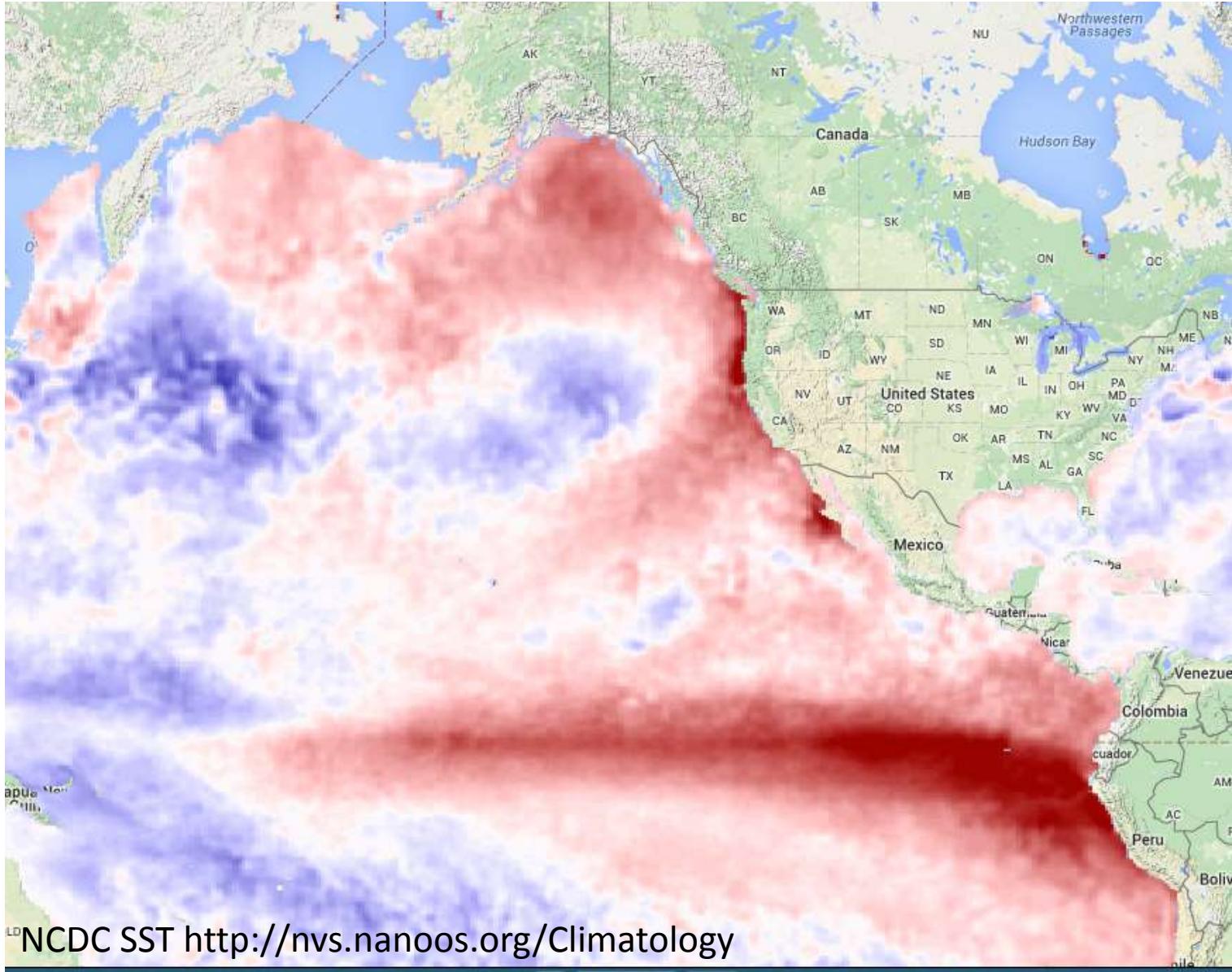
October 2014



# For the CRE, how does 2014-2015 compare to previous “anomalous” warm years?

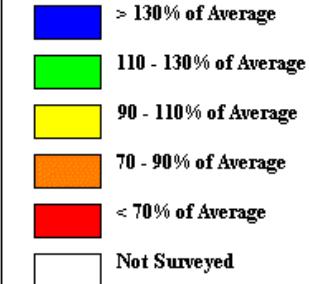
- **1997** Strong El Niño - warm ocean
- **2001** Low snowpack - warm river
- **2005** Delayed upwelling - warm ocean
- **2014-2015** The Blob - **warm ocean and river**
- **2016 –** Strong El Niño - warm ocean

# 1997 Strong El Niño - warm ocean

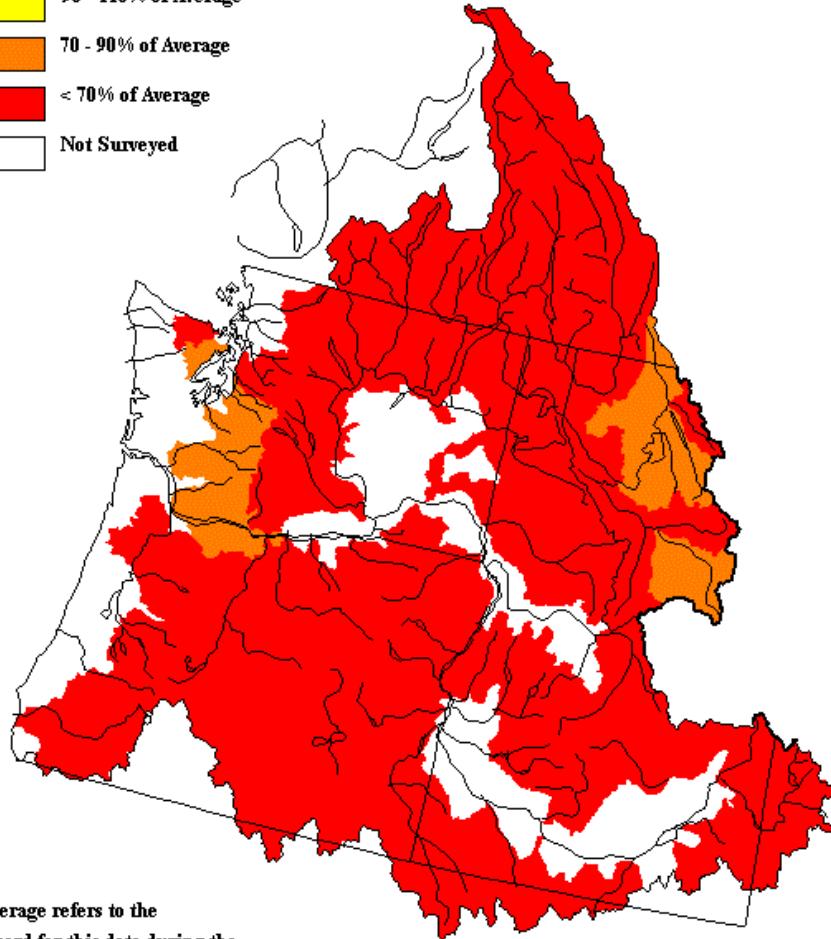


# 2001 Low snowpack - warm river

## Mountain Snow Water Equivalent as of May 1, 2001 (in relation to the average for this date)



Prepared by:  
USDA, Natural Resources Conservation Service  
National Water and Climate Center  
Portland, Oregon



[http://www.wcc.nrcs.usda.gov/ftpref/support/snow/snowpack\\_maps/columbia\\_river/wy2001/cusn0105.gif](http://www.wcc.nrcs.usda.gov/ftpref/support/snow/snowpack_maps/columbia_river/wy2001/cusn0105.gif)

United States Department of Agriculture -- Natural Resources Conservation Service

in cooperation with

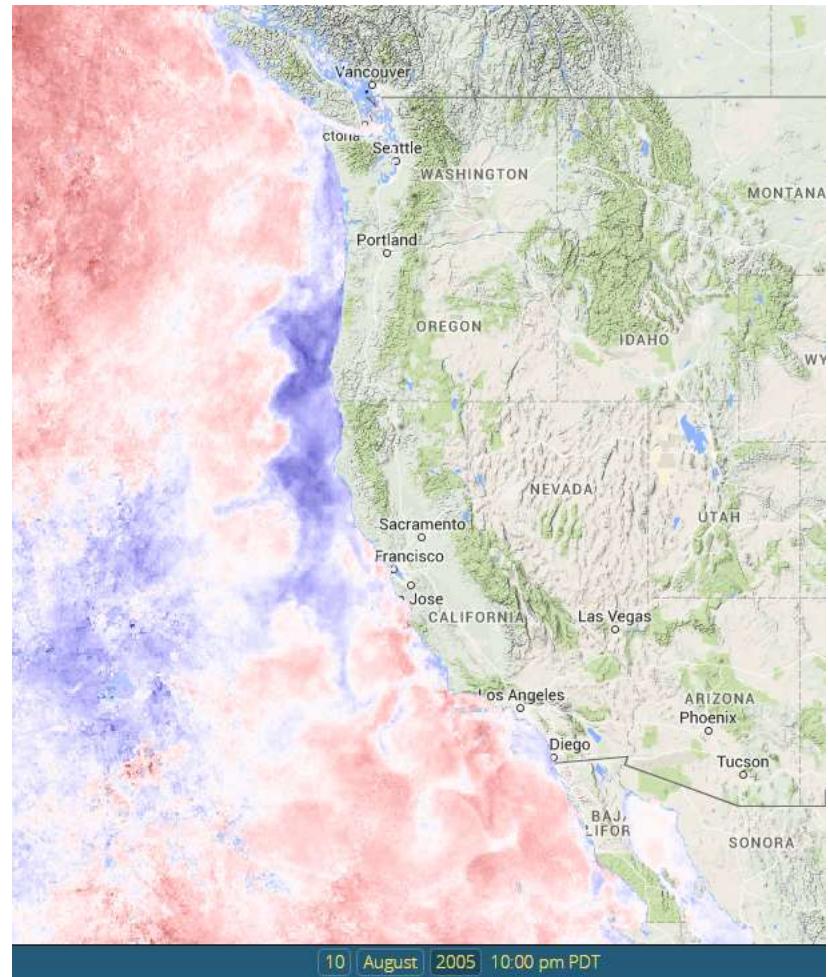
The Province of British Columbia -- Ministry of the Environment

# 2005 Delayed upwelling - warm ocean

May 2005



August 2005



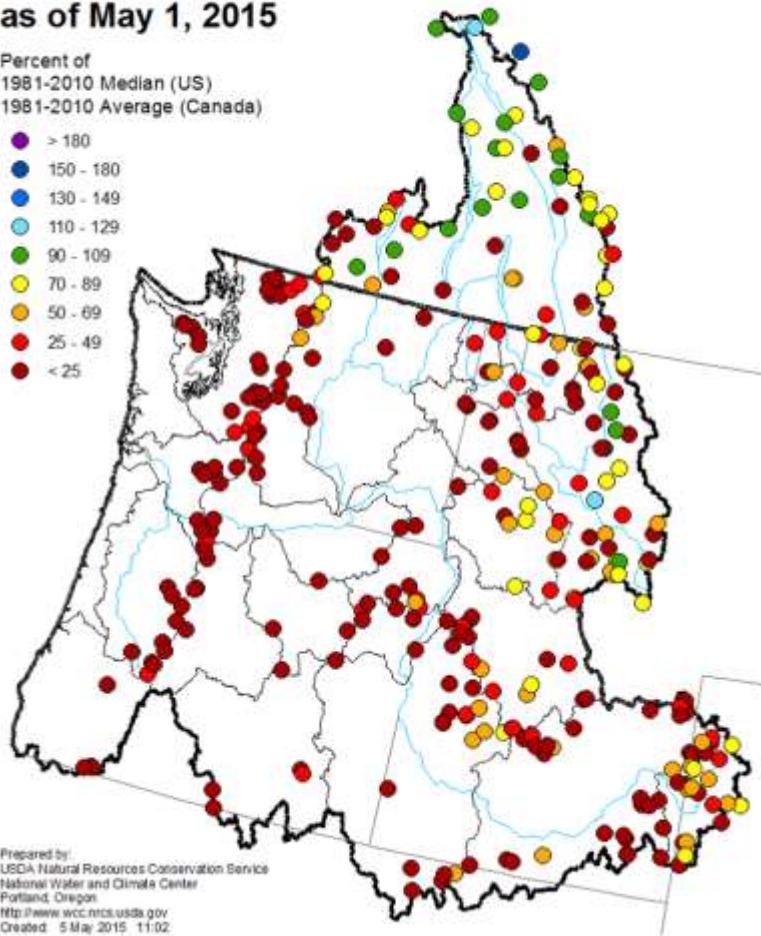
# 2014-2015 The Blob - warm ocean and river

October 2014

## Columbia River and Pacific Coastal Basins Mountain Snowpack as of May 1, 2015

Percent of  
1981-2010 Median (US)  
1981-2010 Average (Canada)

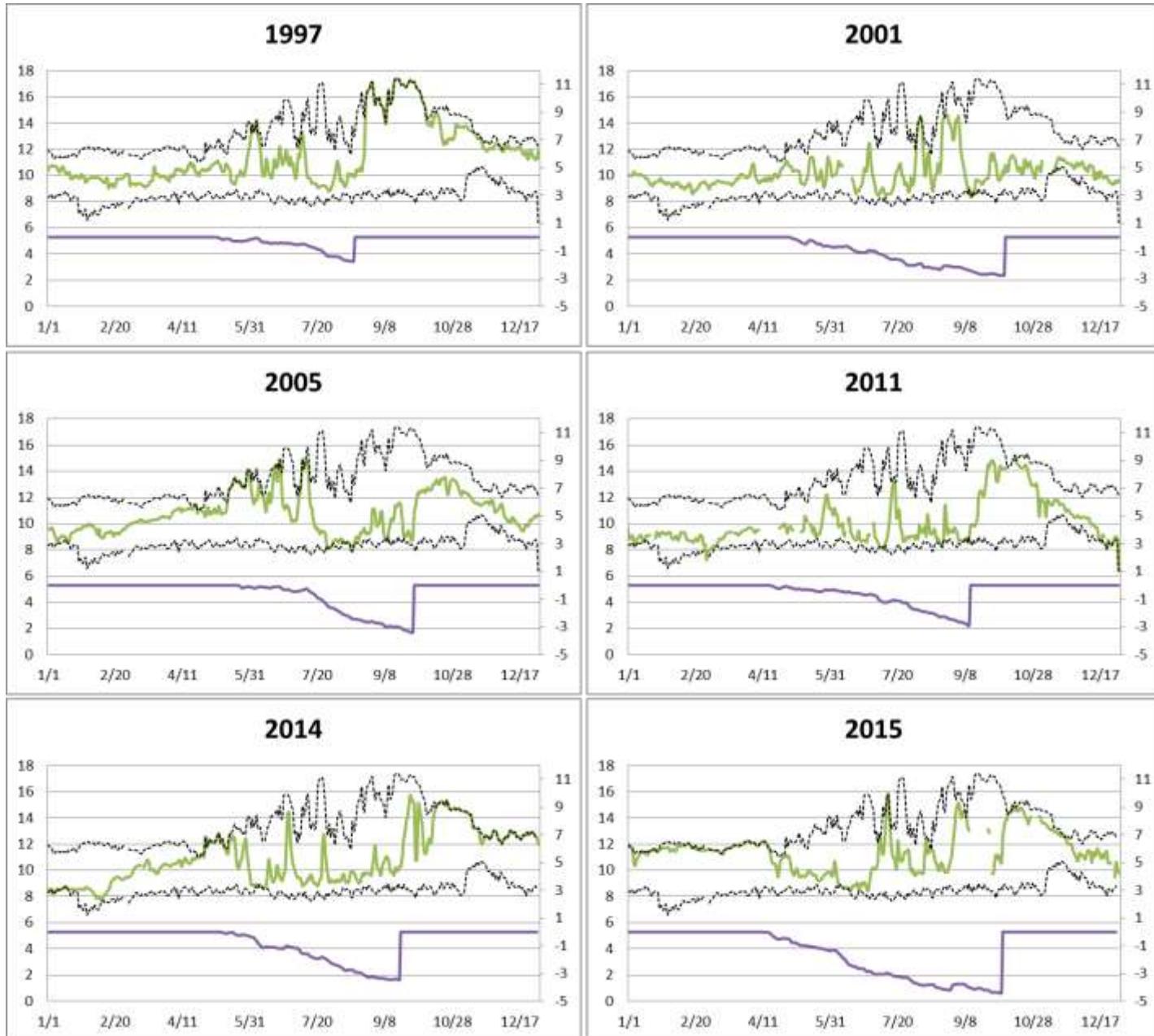
- > 180
- 150 - 180
- 130 - 149
- 110 - 129
- 90 - 109
- 70 - 89
- 50 - 69
- 25 - 49
- < 25



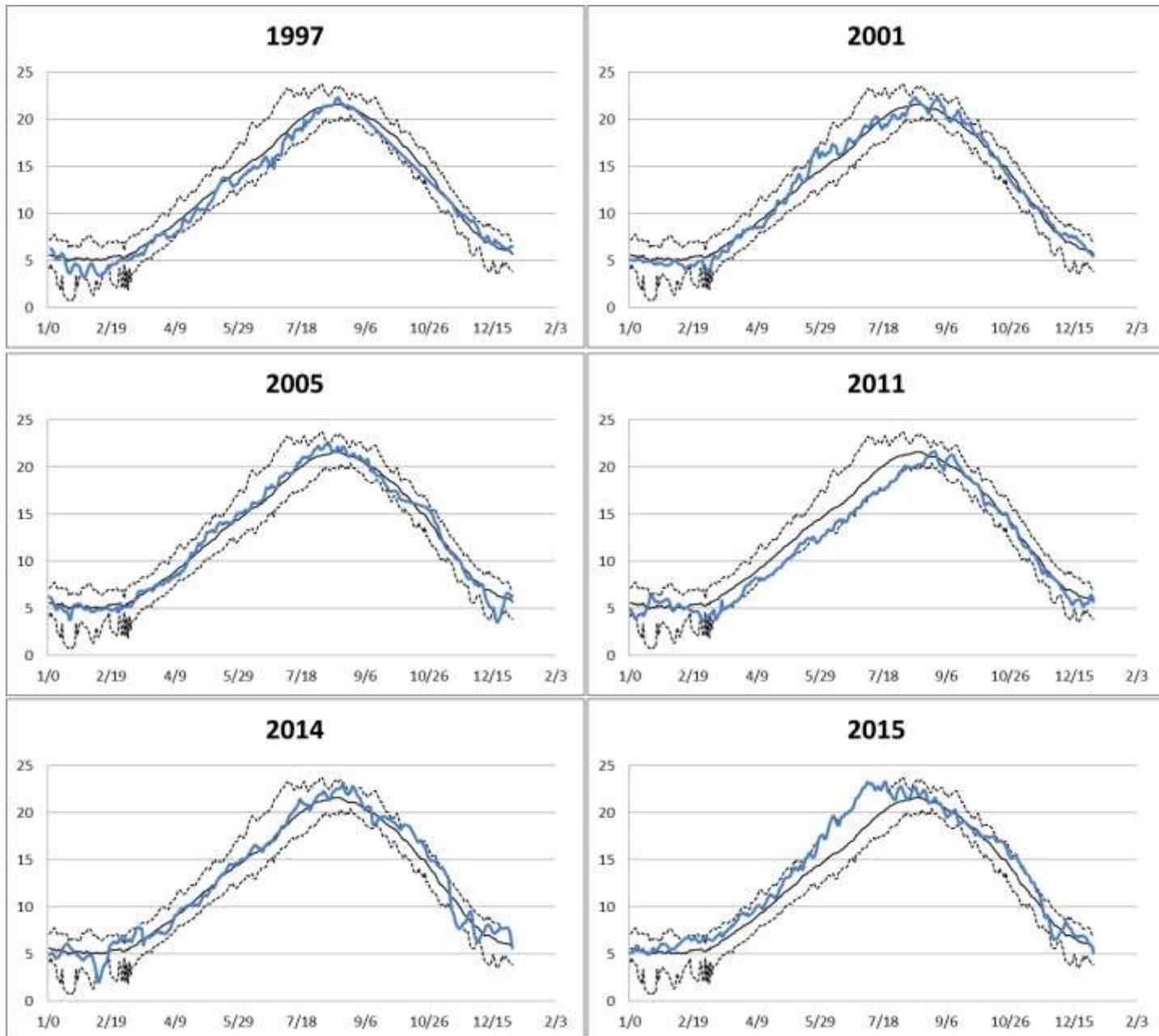
Prepared by:  
USDA Natural Resources Conservation Service  
National Water and Climate Center  
Portland, Oregon  
<http://www.wcc.nrcs.usda.gov>  
Created: 5 May 2015 11:02



# Estuary – Ocean temperature



# Main-stem River temperature



# Summary of Estuary Conditions

Year	Event	Ocean end member	River end member
1997	El Nino	Warm	Cold
2001	Small snowpack	Cold	Average
2005	Delayed upwelling	Warm	Average
2014	Upwelling - blob	Cold - Warm	Average
2015	Blob + small snowpack + unusual warm weather in spring	Warm	Warm

Year	EOT-US	EOT-DS	Upwelling	R-Temp	Freshet	CRB SWE	CRB Precip	PDX air temp
Avg	24 ± 13	25 ± 36	-3.0 ± 0.8	76 ± 12	7.0 ± 2.0	104 ± 29	101 ± 19	37 ± 14
1997	54 (2.3)	56 (0.9)	-1.7 (1.5)	69 (-0.5)	10.7 (1.9)	163 (2.0)	147 (2.4)	52 (1.07)
1998	13 (-0.8)	90 (1.8)	-3.0 (-0.0)	85 (0.76)	7.5 (0.3)	99 (-0.1)	94 (-0.3)	48 (0.79)
1999	2 (-1.7)	0 (-0.6)	-2.9 (0.0)	58 (-1.4)	8.3 (0.7)	157 (1.8)	128 (1.4)	34 (-0.2)
2000	28 (0.3)	5 (-0.5)	-2.7 (0.3)	81 (0.44)	6.1 (-0.5)	114 (0.4)	102 (0.1)	31 (-0.4)
2001	22 (-0.1)	0 (-0.6)	-2.7 (0.3)	86 (0.85)	3.6 (-1.8)	60 (-1.4)	60 (-2.0)	24 (-0.9)
2002	9 (-1.1)	0 (-0.6)	-3.8 (-1.0)	73 (-0.2)	7.2 (0.1)	126 (0.8)	108 (0.4)	28 (-0.6)
2003	11 (-1.0)	22 (-0.0)	-3.4 (-0.5)	82 (0.52)	6.3 (-0.4)	88 (-0.5)	92 (-0.4)	44 (0.50)
2004	33 (0.7)	1 (-0.6)	-1.7 (1.5)	81 (0.44)	6.1 (-0.5)	95 (-0.3)	93 (-0.3)	51 (1.00)
2005	42 (1.4)	23 (-0.0)	-3.3 (-0.5)	79 (0.27)	5.6 (-0.7)	59 (-1.5)	72 (-1.4)	38 (0.07)
2006	23 (-0.1)	0 (-0.6)	-5.1 (-2.7)	77 (0.11)	7.4 (0.2)	135 (1.1)	118 (0.9)	33 (-0.2)
2007	35 (0.8)	3 (-0.6)	-3.0 (-0.0)	77 (0.11)	6.1 (-0.5)	83 (-0.7)	103 (0.1)	40 (0.21)
2008	13 (-0.8)	7 (-0.4)	-3.6 (-0.8)	72 (-0.2)	7.7 (0.4)	141 (1.3)	113 (0.6)	36 (-0.0)
2009	20 (-0.3)	0 (-0.6)	-2.8 (0.1)	85 (0.76)	6.3 (-0.3)	112 (0.3)	99 (-0.0)	54 (1.22)
2010	23 (-0.1)	18 (-0.1)	-2.7 (0.3)	47 (-2.3)	6.3 (-0.4)	77 (-0.9)	77 (-1.1)	27 (-0.7)
2011	13 (-0.8)	26 (0.0)	-2.9 (0.1)	59 (-1.3)	10.4 (1.7)	130 (0.9)	121 (1.1)	38 (0.07)
2012	15 (-0.7)	0 (-0.6)	-3.2 (-0.3)	59 (-1.3)	9.2 (1.2)	119 (0.5)	109 (0.5)	38 (0.07)
2013	42 (1.4)	14 (-0.2)	-2.9 (0.1)	84 (0.68)	6.7 (-0.1)	88 (-0.5)	96 (-0.2)	57 (1.43)
2014	31 (0.5)	73 (1.3)	-3.4 (-0.5)	86 (0.85)	7.3 (0.1)	103 (-0.0)	97 (-0.1)	60 (1.65)
2015	33 (0.7)	134 (3.0)	-4.4 (-1.7)	102 (2.15)	4.7 (-1.1)	44 (-2.0)	92 (-0.4)	66 (2.08)

# Table Headings

Heading descriptions:

EOT-US: # days during upwelling season (May-Sept) the estuary-ocean temp was > 1 STD warmer than average for 1997-2015

EOT-DS: # days during downwelling season (Oct-Apr) the estuary-ocean temp was > 1 STD warmer than average for 1997-2015

Upwelling: a measure of seasonal upwelling inferred from cumulative wind stress on Oregon coast (1985-2015) (Pierce and Barth)

R-temp: # days that the river temp was >19 C May –Sep (data 1992-2015)

Freshet: cumulative river discharge ( $m^3 \times 10^{10}$ ) for May – Aug (1964-2015)

April CRB SWE: % of median (1981-2010) snow water equivalent across all Columbia River sub-basins (1981-2010)

April CRB Precip: % of median (1981-2010) cumulative precipitation across all Columbia River sub-basins

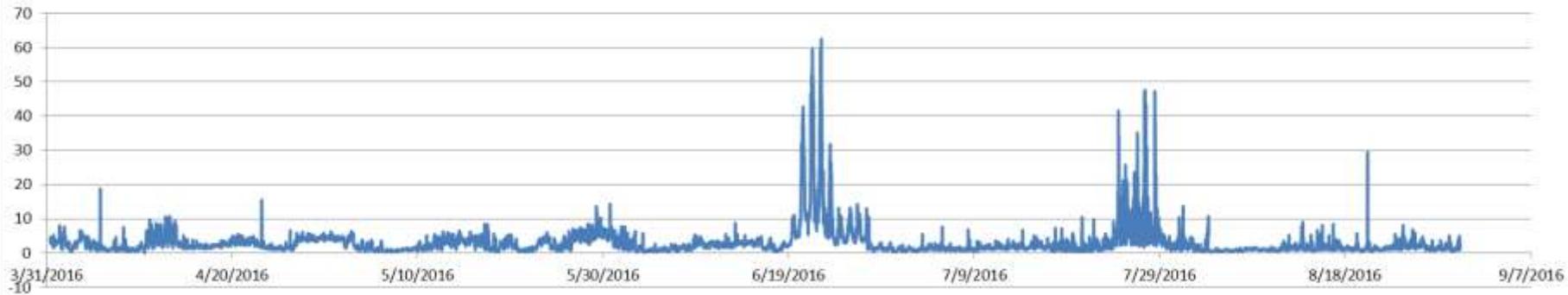
PDX air: # of days daily minimum air temperature > 58 F (1981-2015)

# Sonde Data

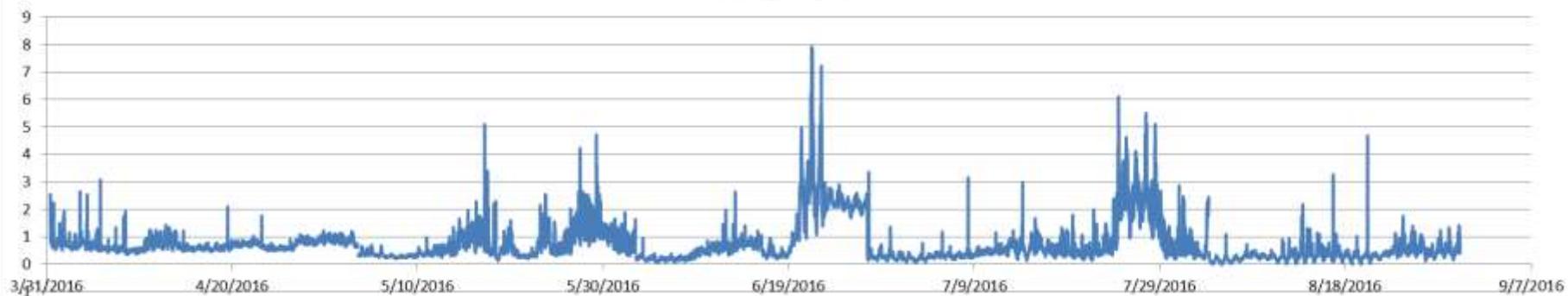


# Campbell 2016

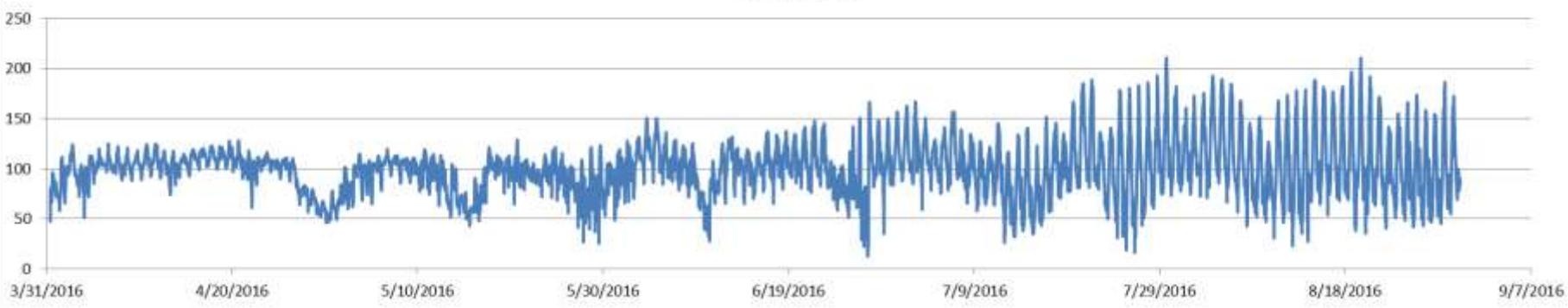
**Chlorophyll RFU**



**BGA-PC RFU**

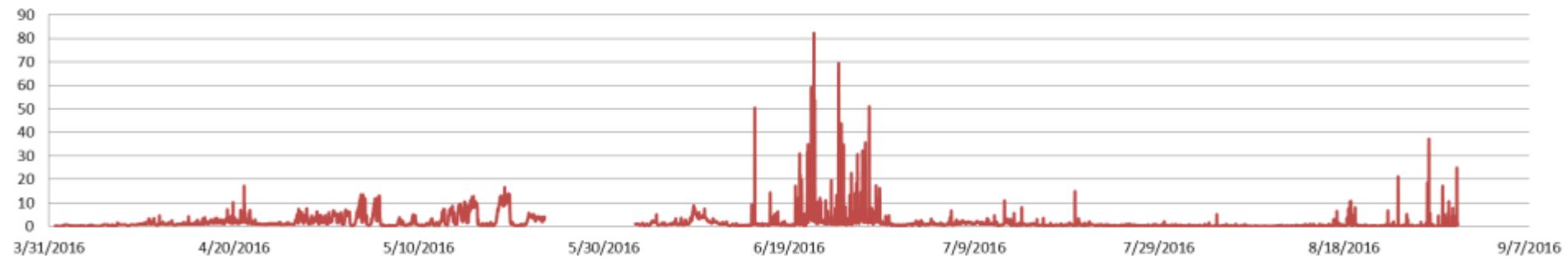


**ODO % sat**

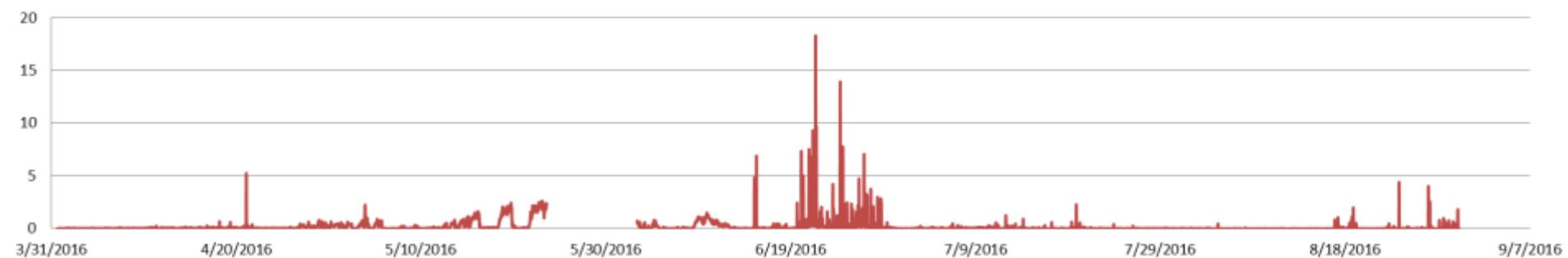


# Franz 2016

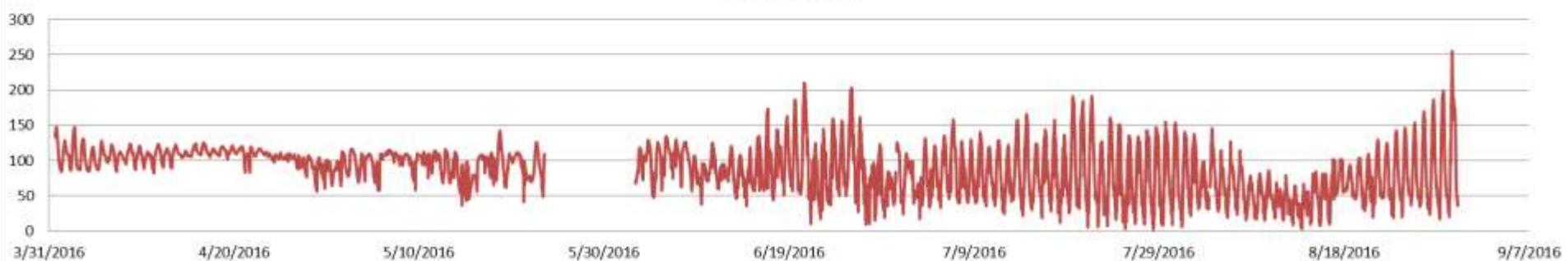
**Chlorophyll RFU**



**BGA-PC RFU**

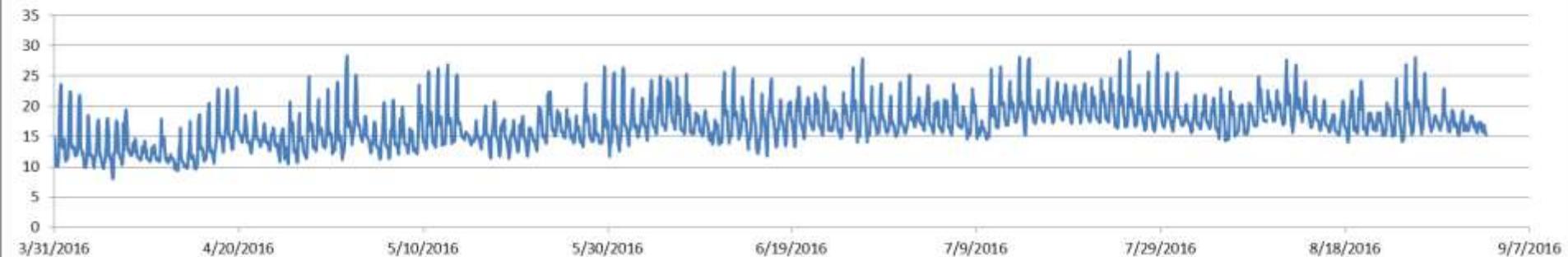


**ODO % sat**

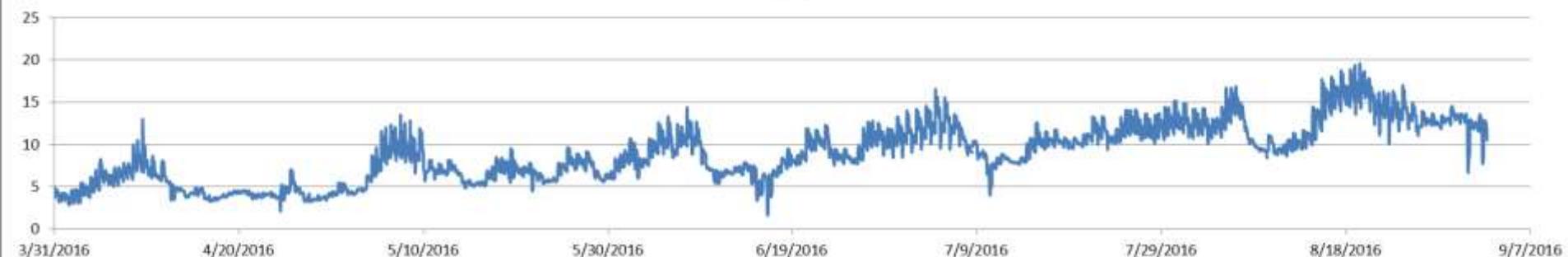


# Ilwaco 2016

**Temp**



**Salinity**



**ODOsat**

