

# Ecosystem Monitoring Program 2019 Water Quality

Joe Needoba

OHSU-PSU School of Public Health

Oct 22, 2019

# Climate influences on Bonneville Discharge

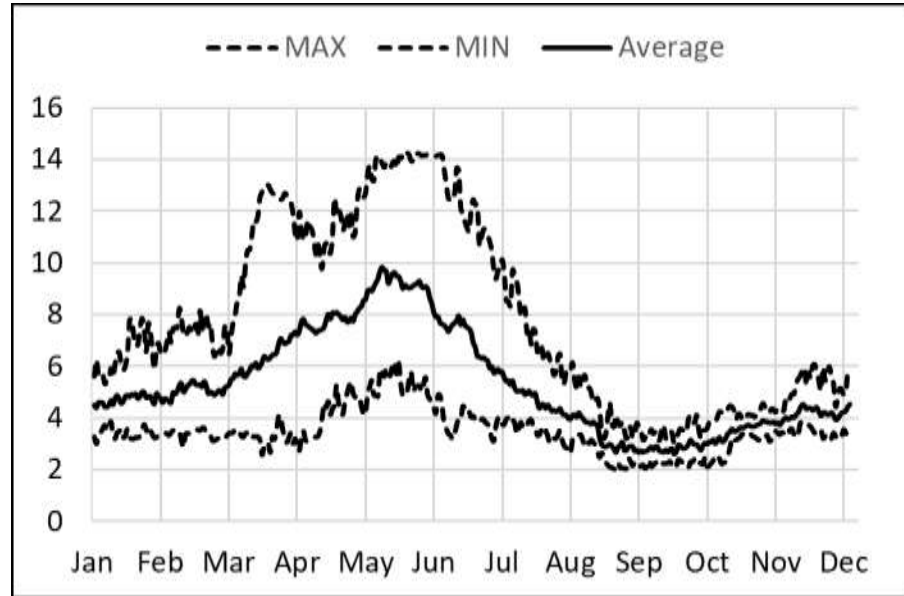
- Winter Snowpack
  - High snowpack from cold and wet winters
  - Low snowpack from warm winters, or cold and dry winters
- Spring transition
  - Determines characteristics of the freshet
- Summer drought
  - River flow between June - October

## 2019 was an “average” year for river flow at Bonneville

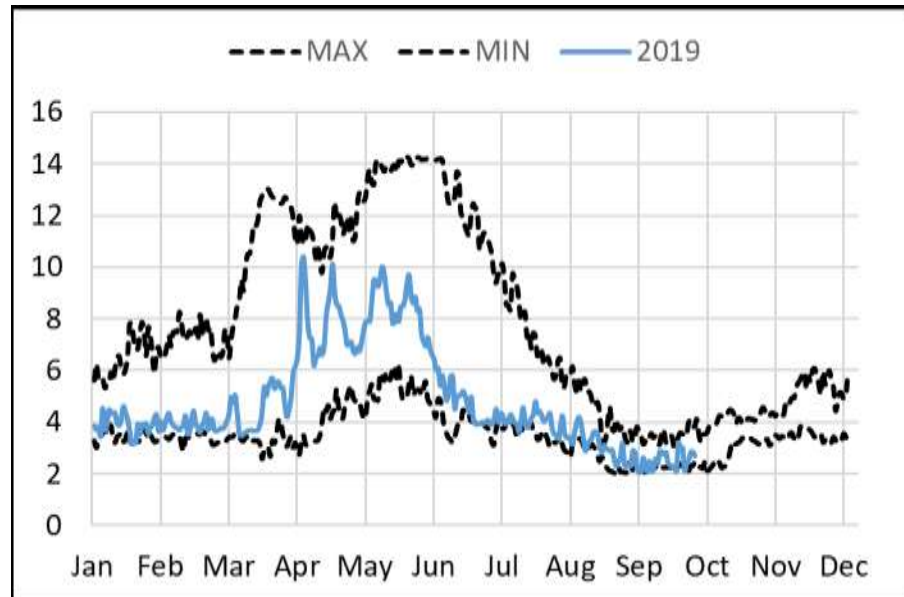
Max and Min calculated for  
each day between 2010-2019

- Winter Snowpack
- Spring transition
- Summer drought

Discharge ( $\text{m}^3 \text{s}^{-1}$ ) x 1000

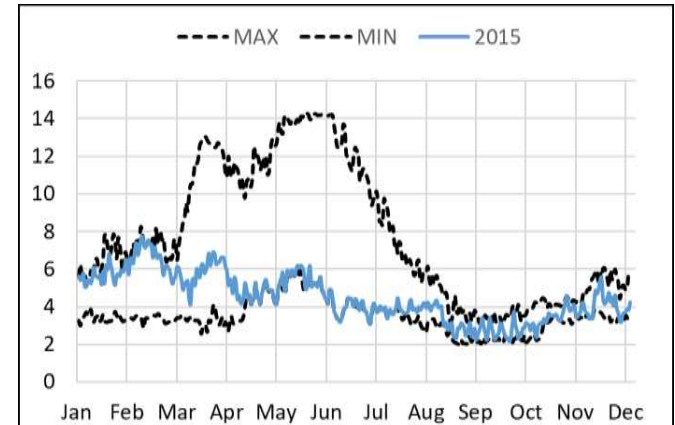


Discharge ( $\text{m}^3 \text{s}^{-1}$ ) x 1000

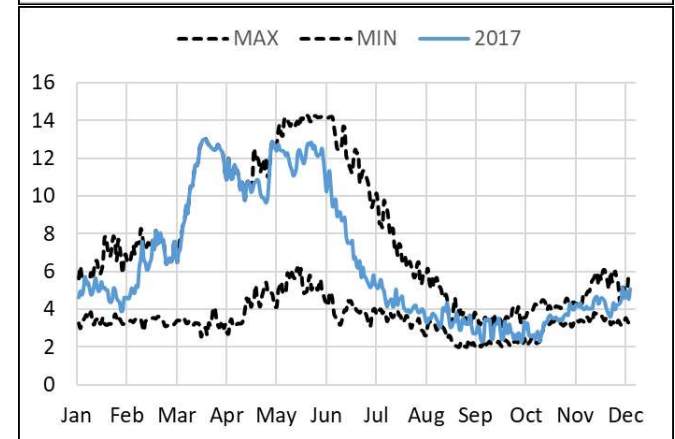


# River Flow Patterns at Bonneville

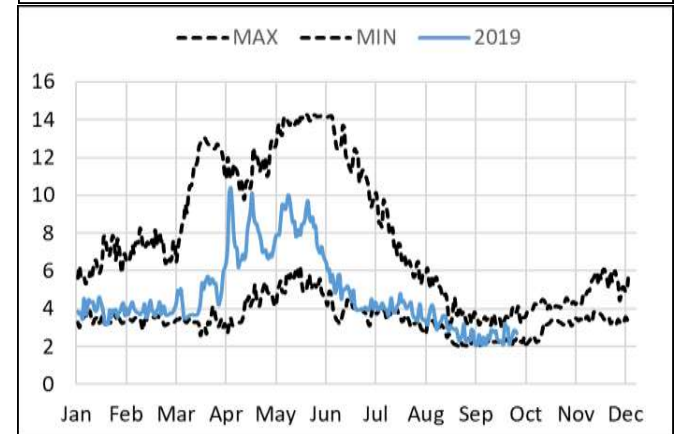
2015: Warm and rainy winter, low snowpack, summer drought



2017: High precipitation, large snowpack



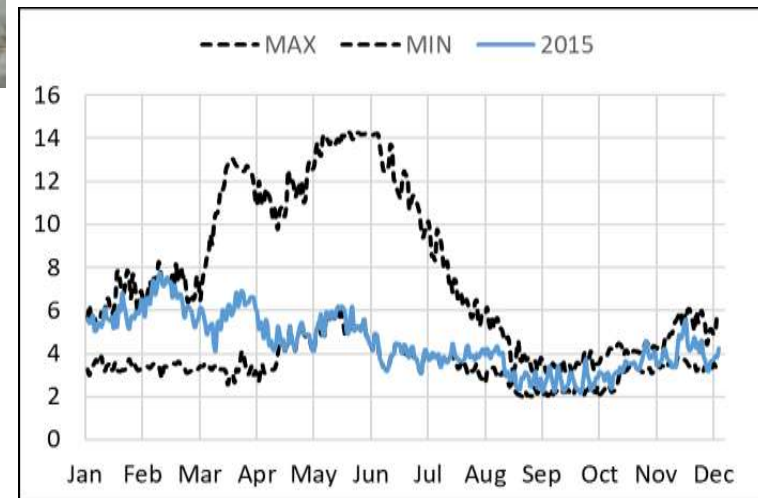
2019: Closer to an “average” year





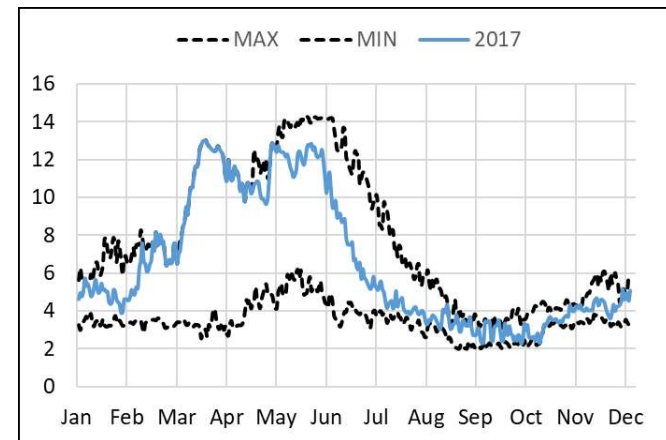


Franz Lake – 2015  
4/29/2015





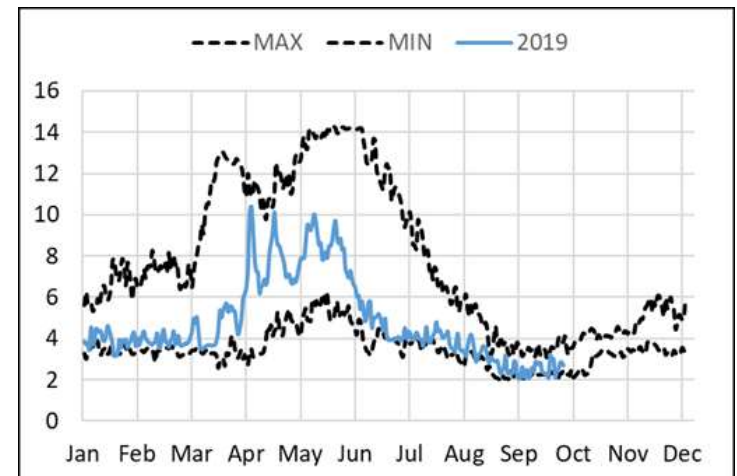
Franz Lake – 2017  
3/16/2017



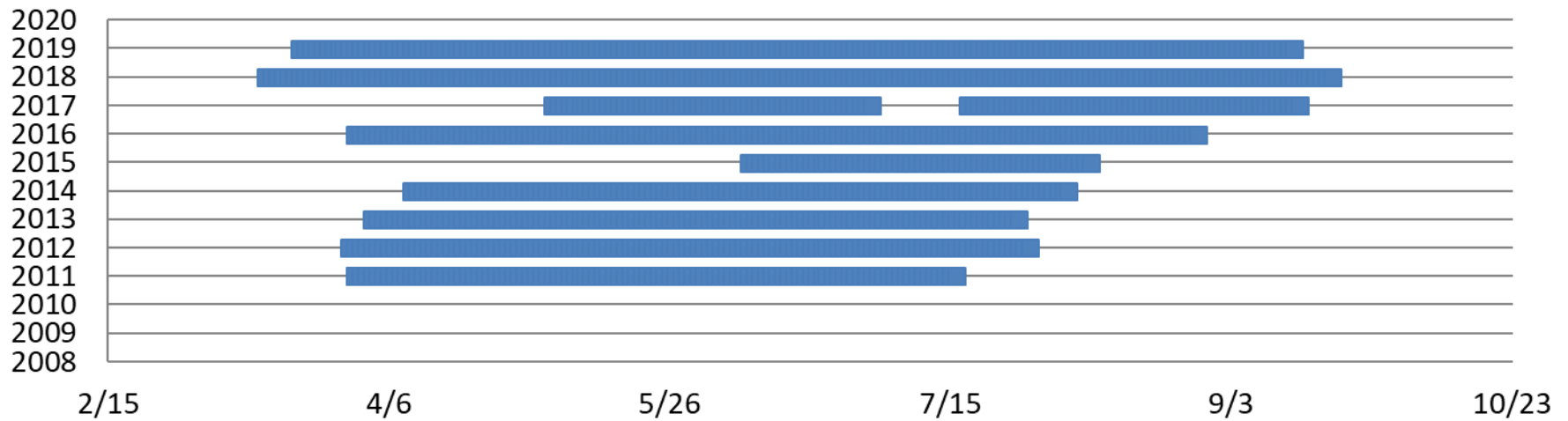




Franz Lake – 2019  
3/20/2019



## Franz Sonde Deployment Periods



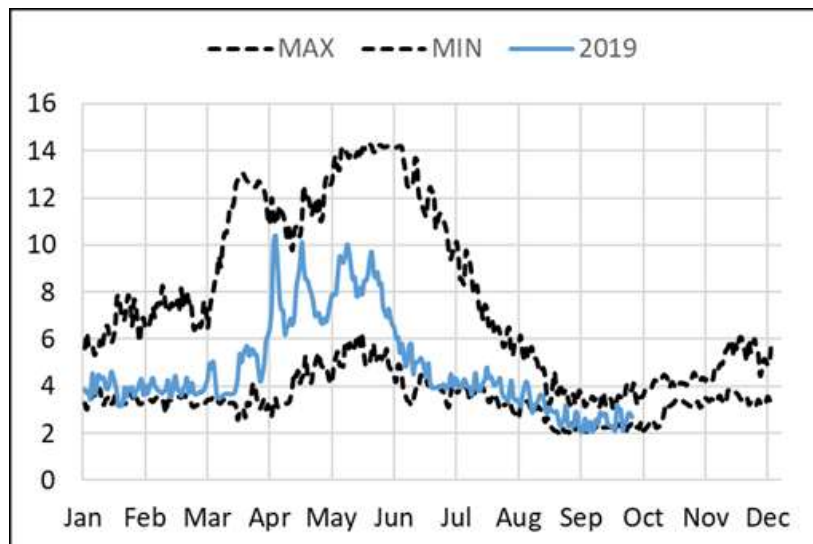
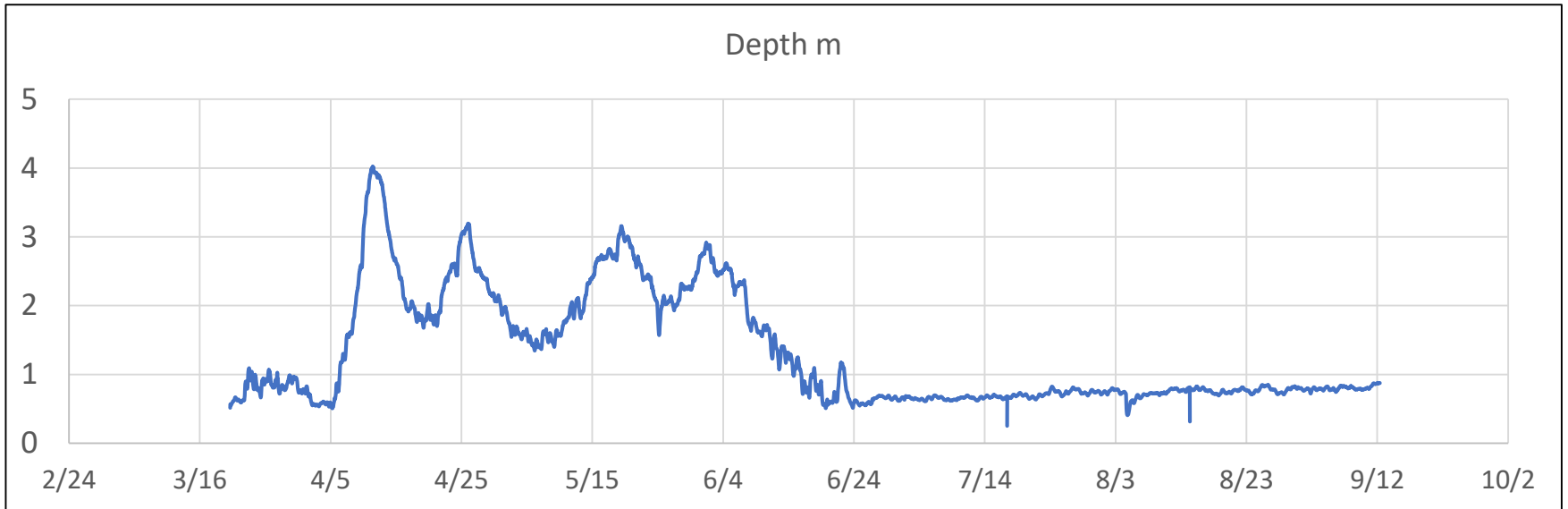
## Sonde paramaters (2017 -2019)

|                        |
|------------------------|
| EXO2 Sonde             |
| Optical DO             |
| pH                     |
| Total Algae BGA-PC     |
| Conductivity/Temp      |
| Wiper                  |
| Depth Non-Vented 0-10m |

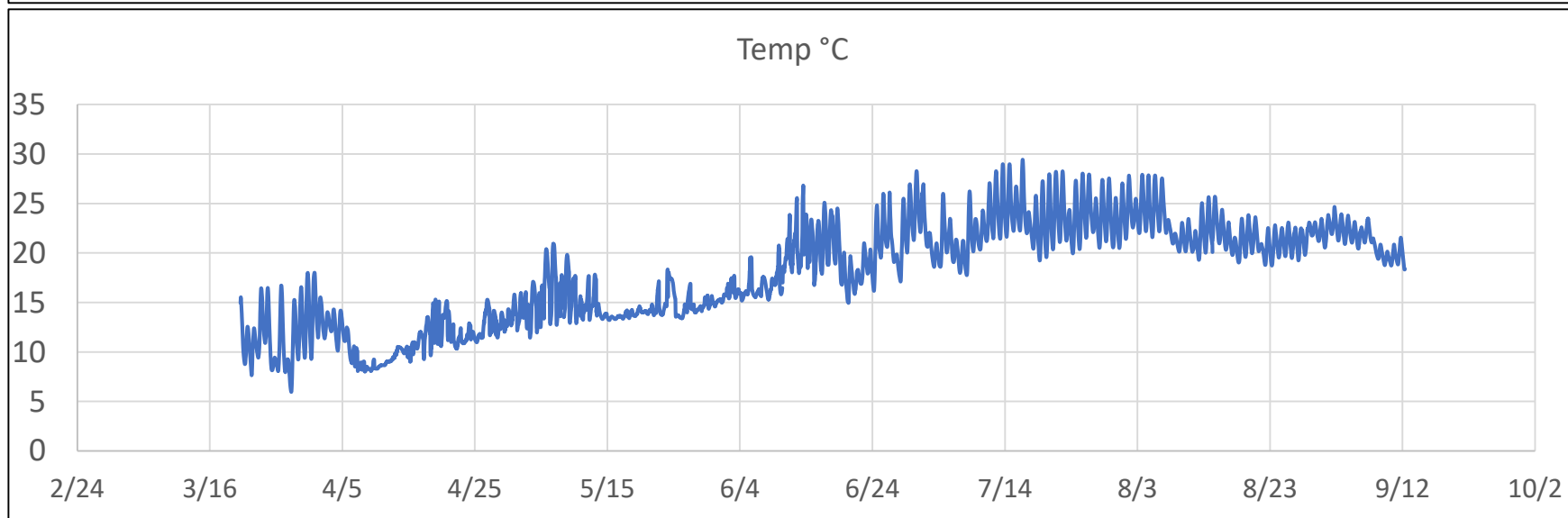
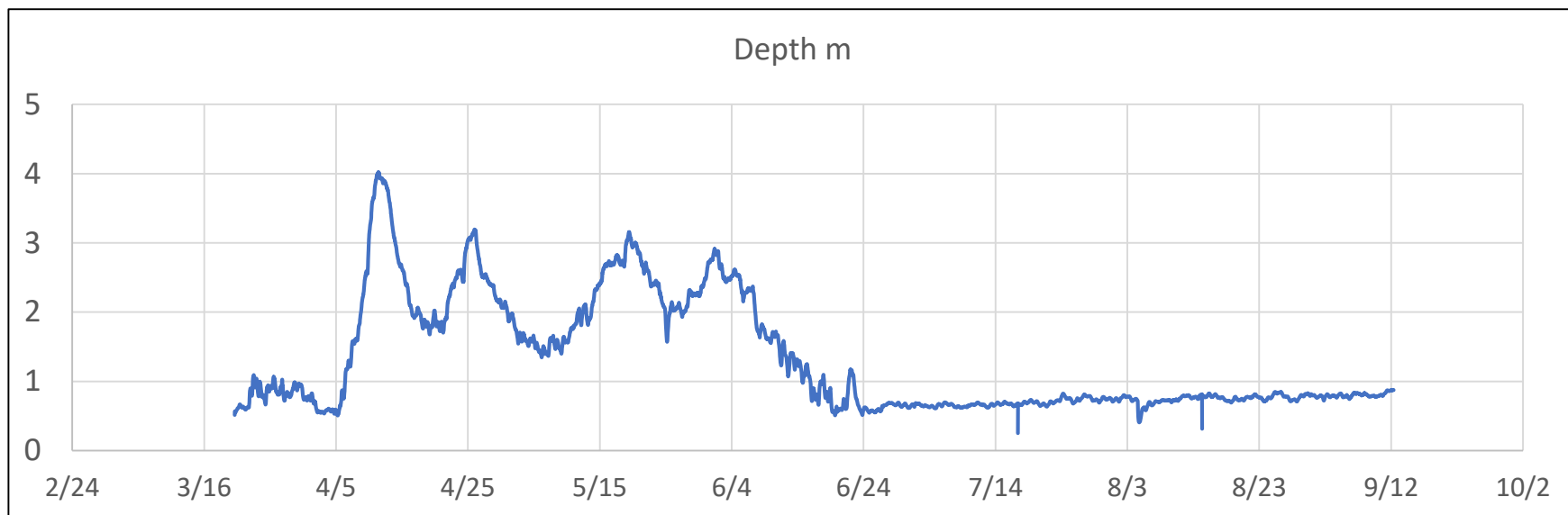




## Franz Lake Sonde Data 2019



# Franz Lake Sonde Data 2019

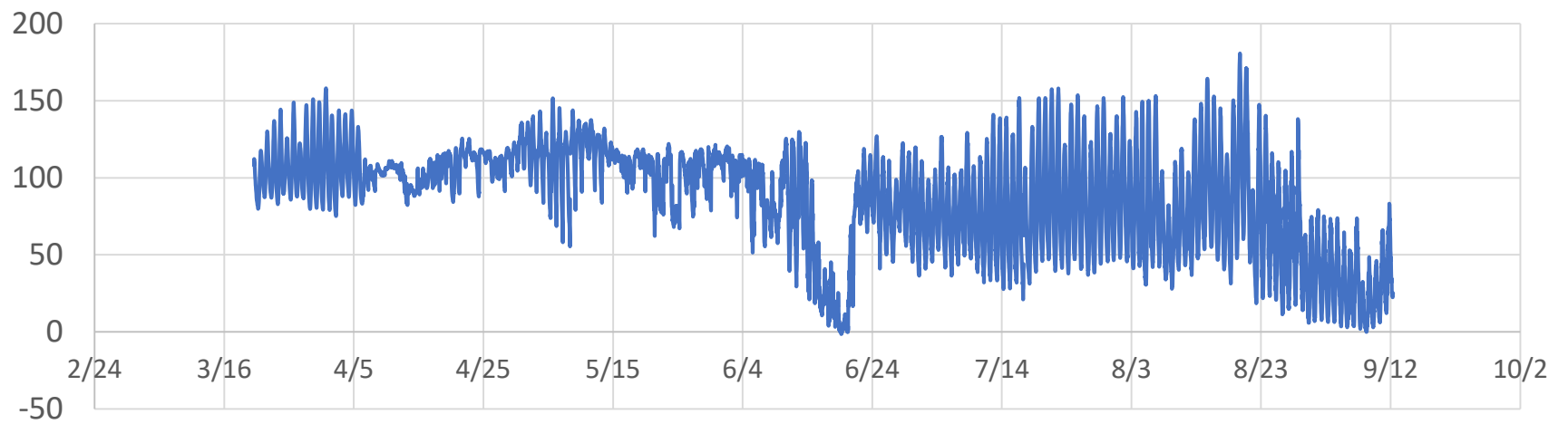


# Franz Lake Sonde Data 2019

Depth m



ODO % sat

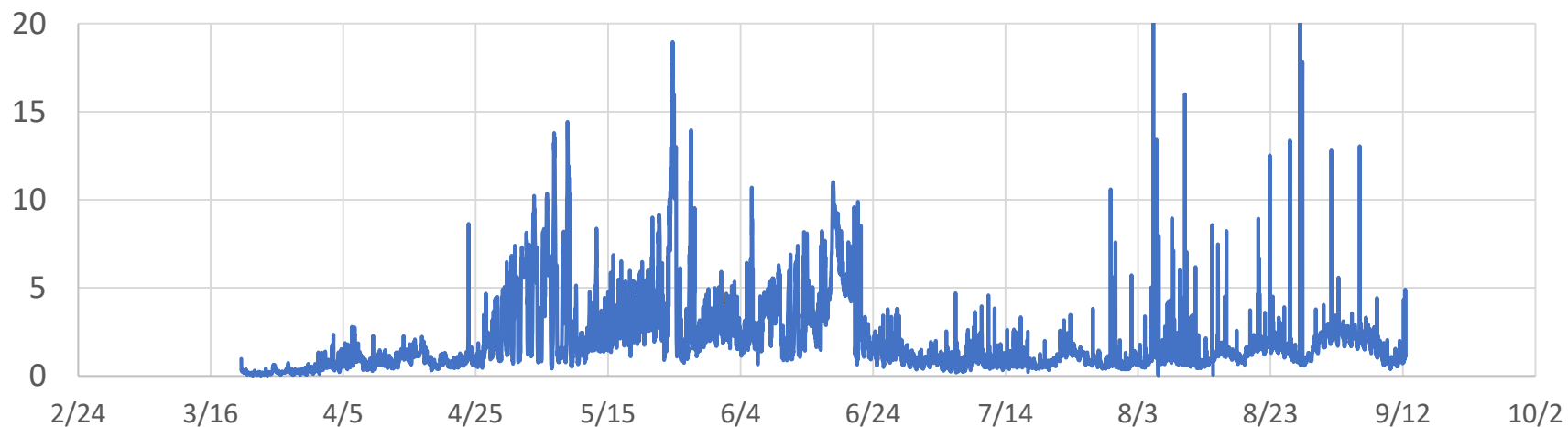


# Franz Lake Sonde Data 2019

Depth m



Chlorophyll RFU



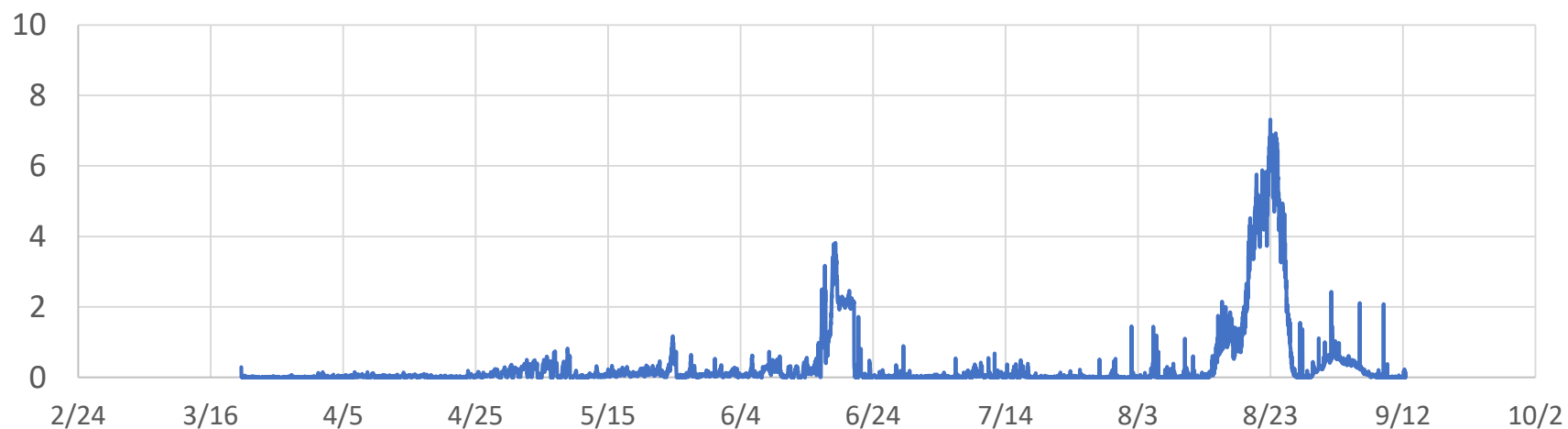


# Franz Lake Sonde Data 2019

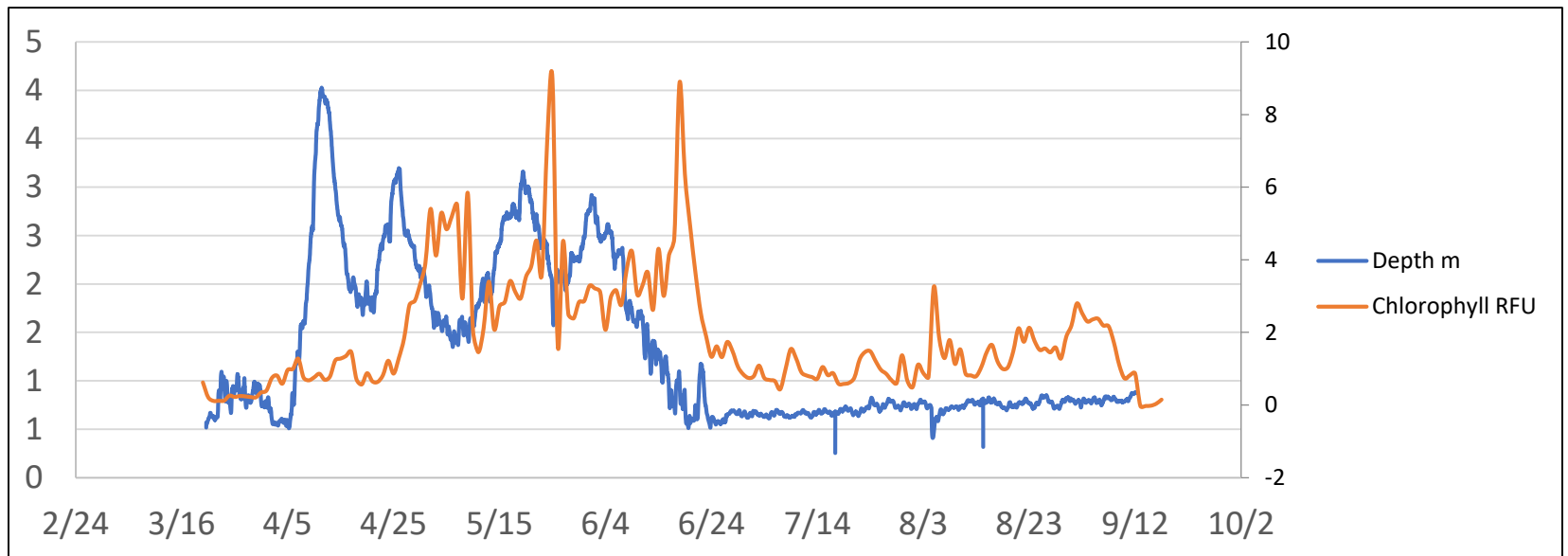
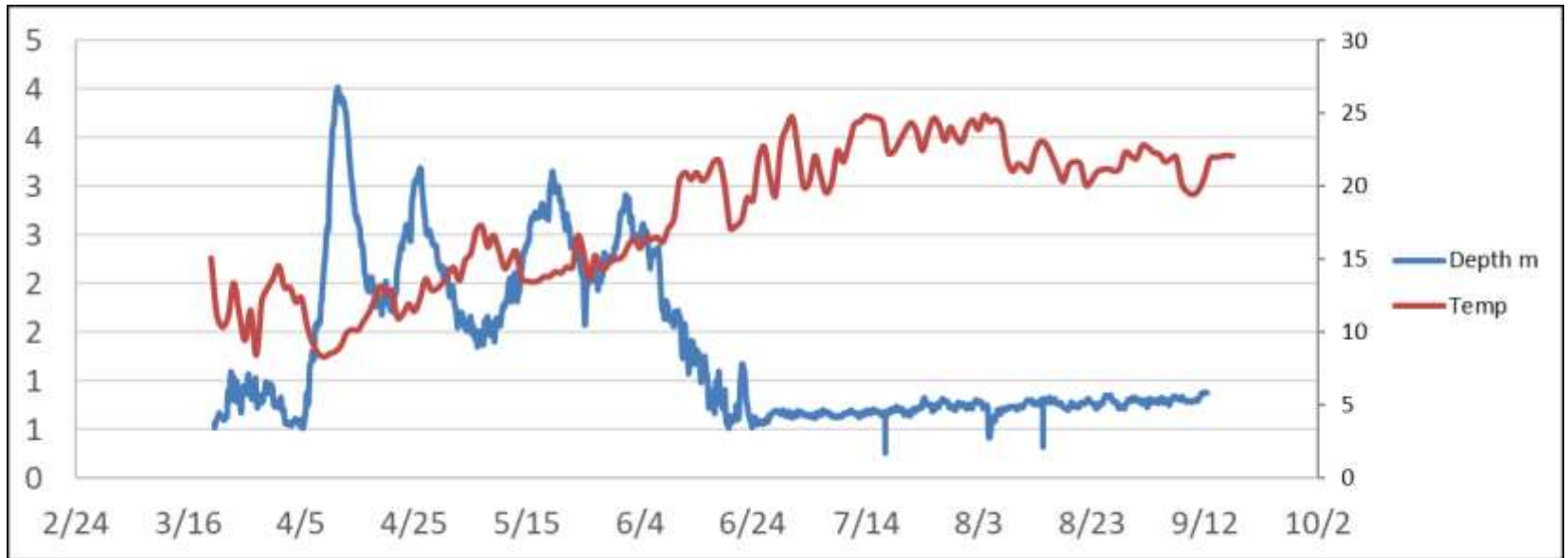
Depth m



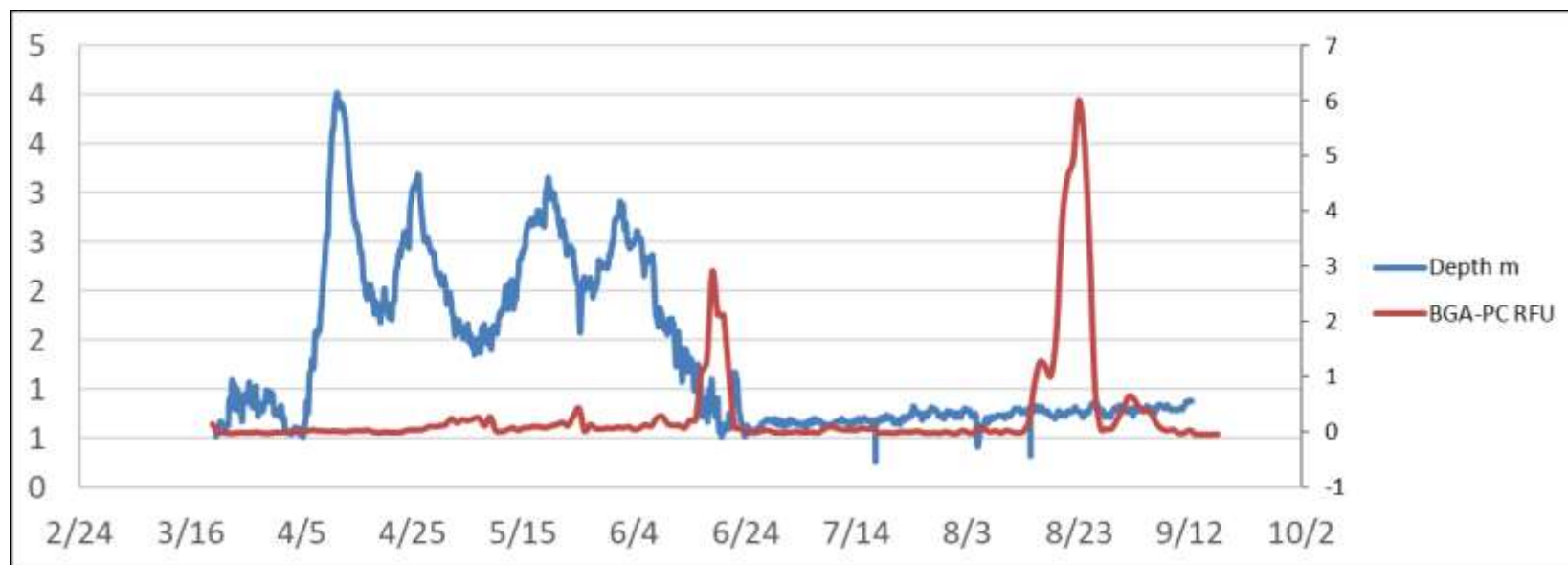
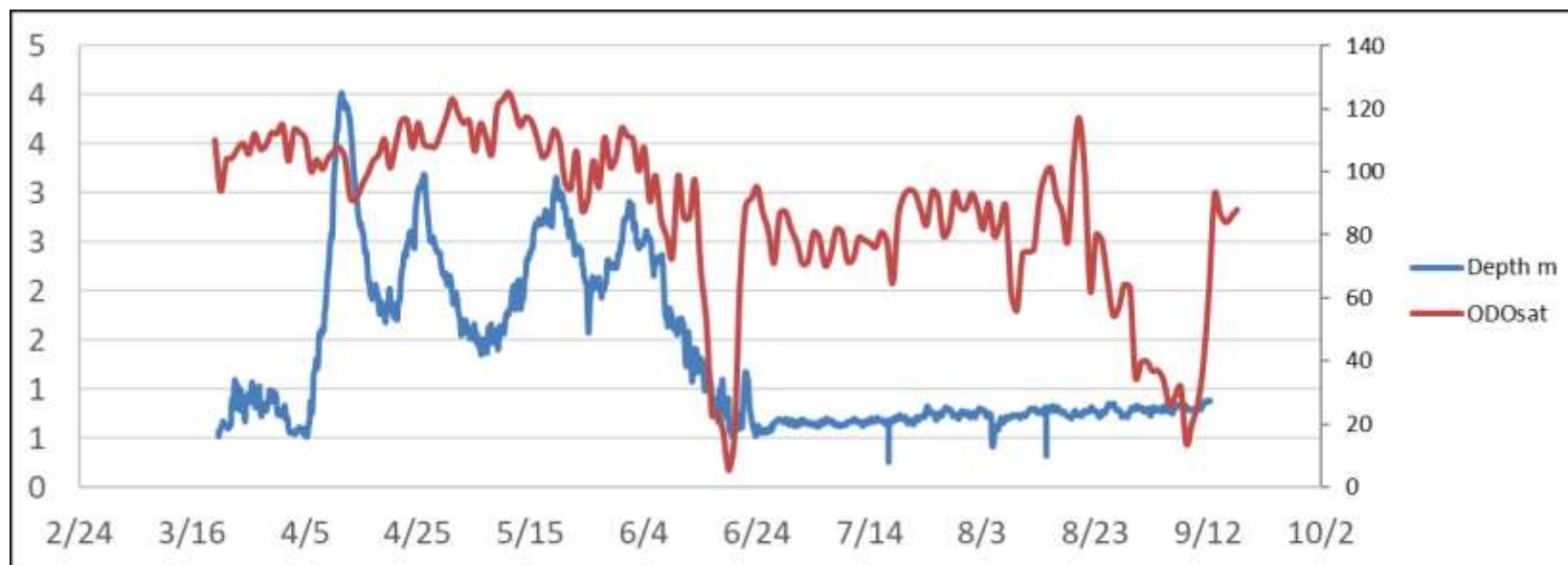
BGA-PC RFU



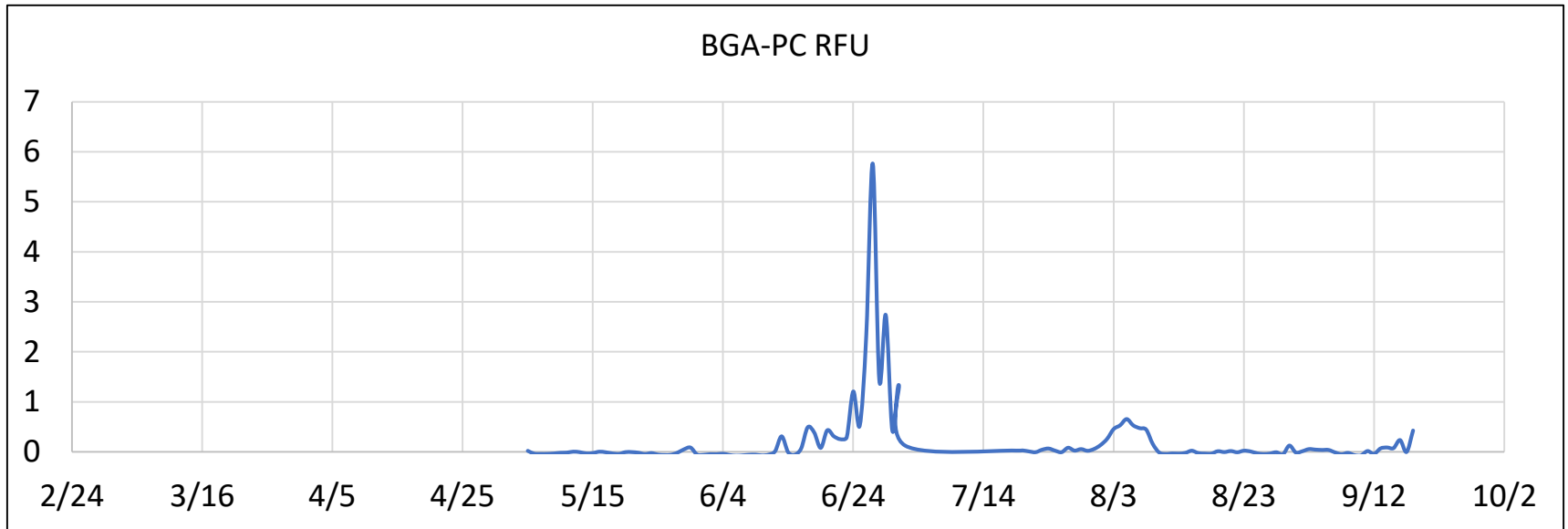
## Franz Lake Sonde Data 2019



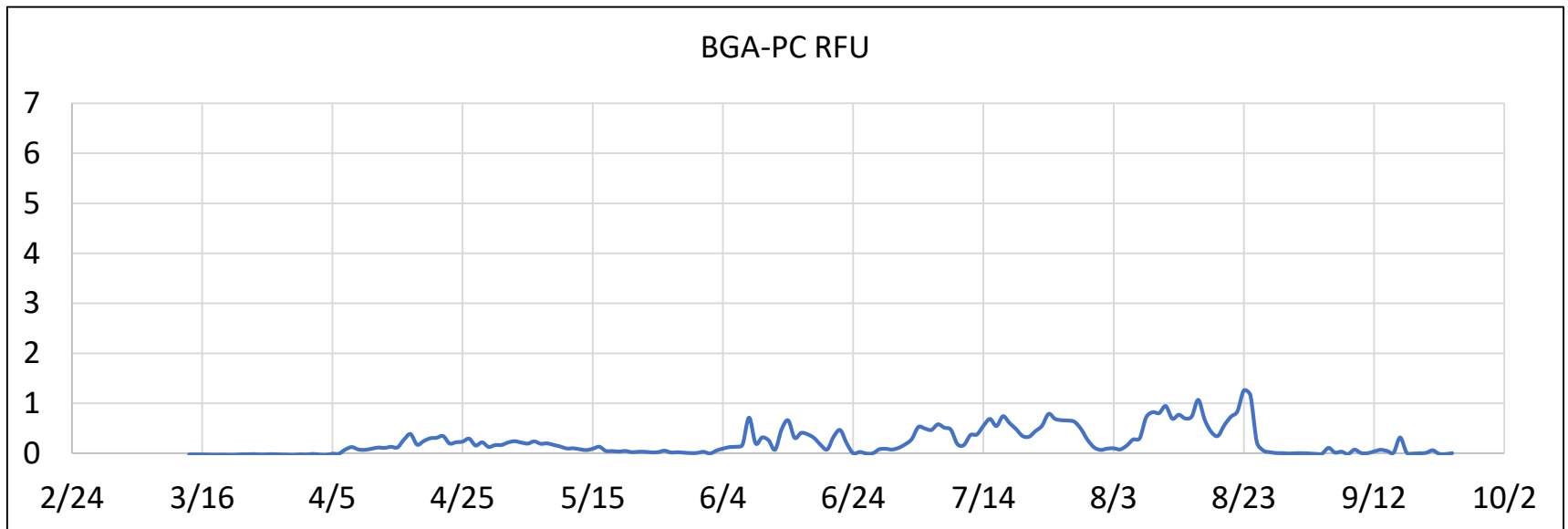
## Franz Lake Sonde Data 2019



## Franz Lake 2017



## Franz Lake 2018



# Drivers of river flow at Beaver Army Terminal

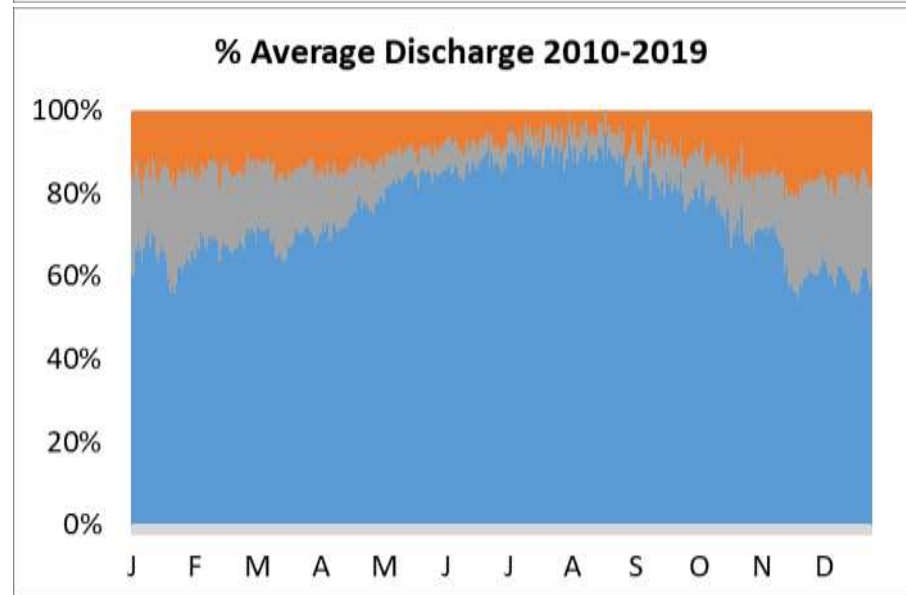
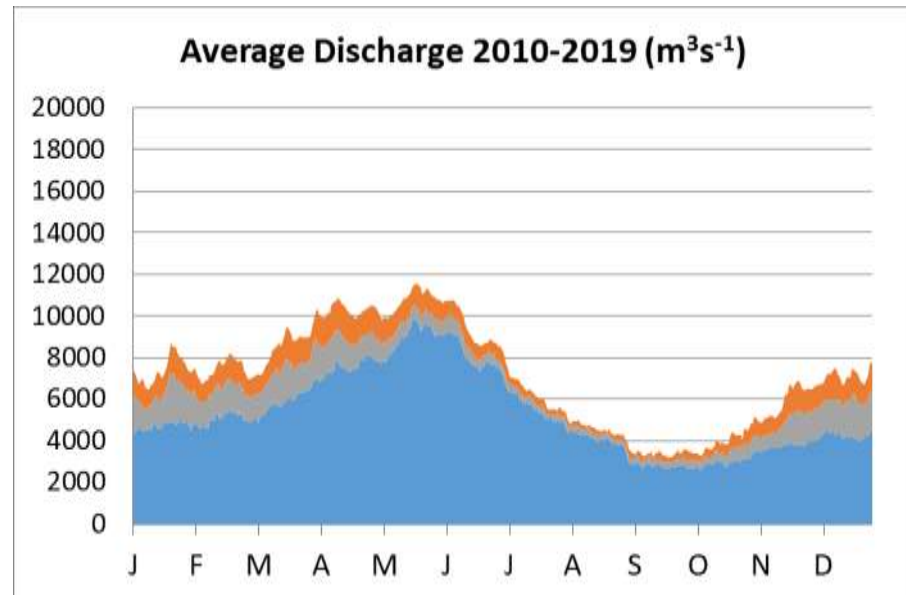
- Size of freshet at Bonneville
- Winter Rainfall
  - Willamette and other Tributaries in Lower Columbia
- Summer drought
  - River flow between June - October



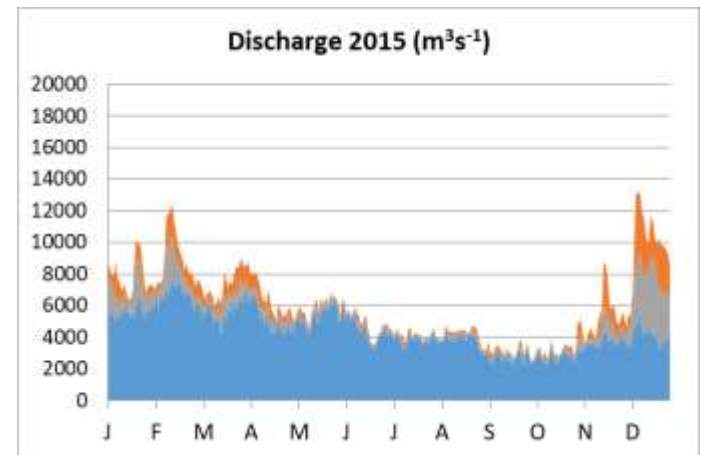
# River Flow Characteristics at Beaver Army Terminal

- Bonneville
- Willamette
- Other tributaries

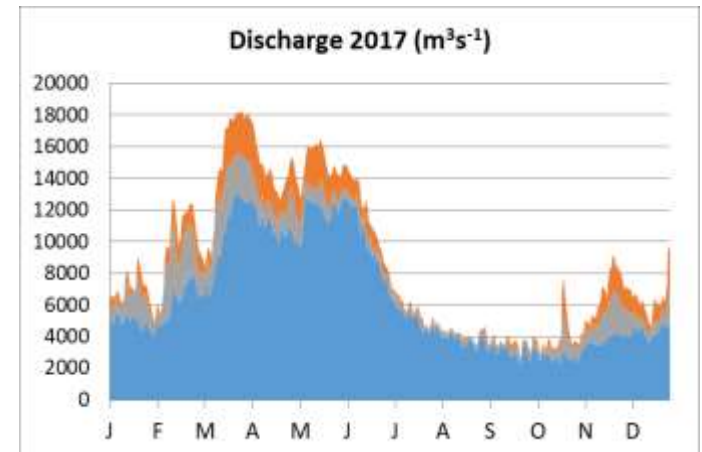
Trib = (BAT – Willamette)



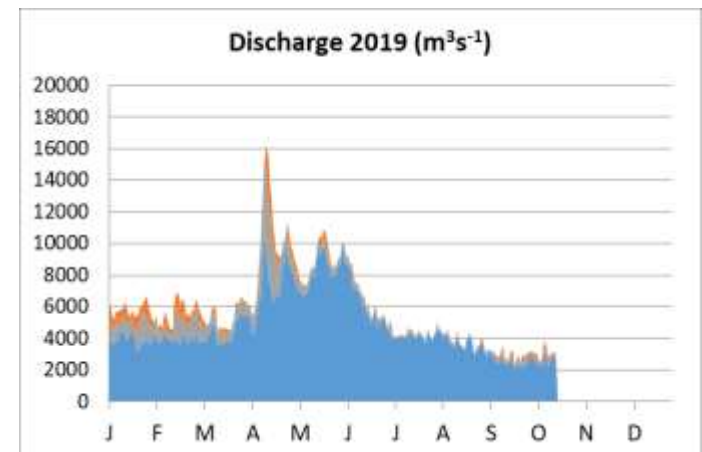
2015: Winter rain events in Willamette and other tributaries



2017: High precipitation, large snowpack

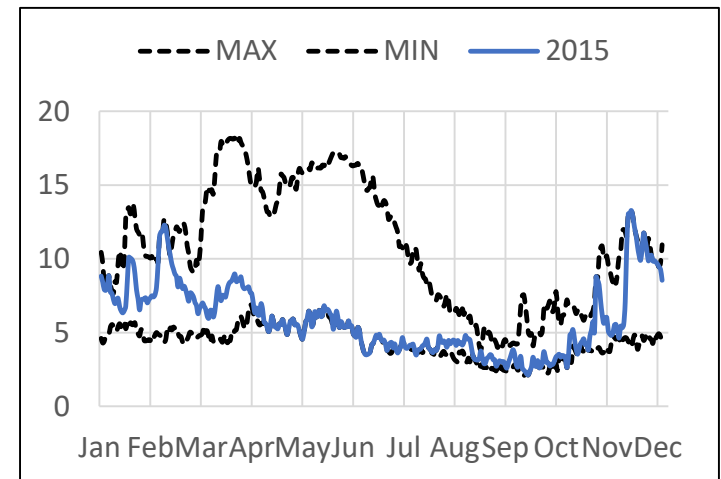


2019: Closer to an “average” year



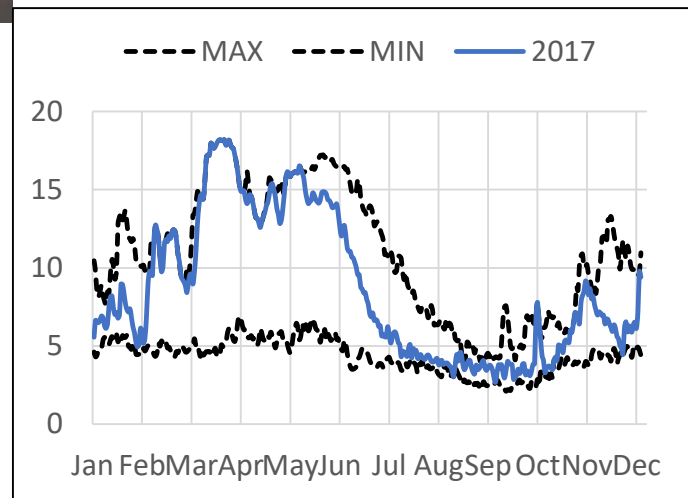


Campbell Slough 2015  
05/01/2015



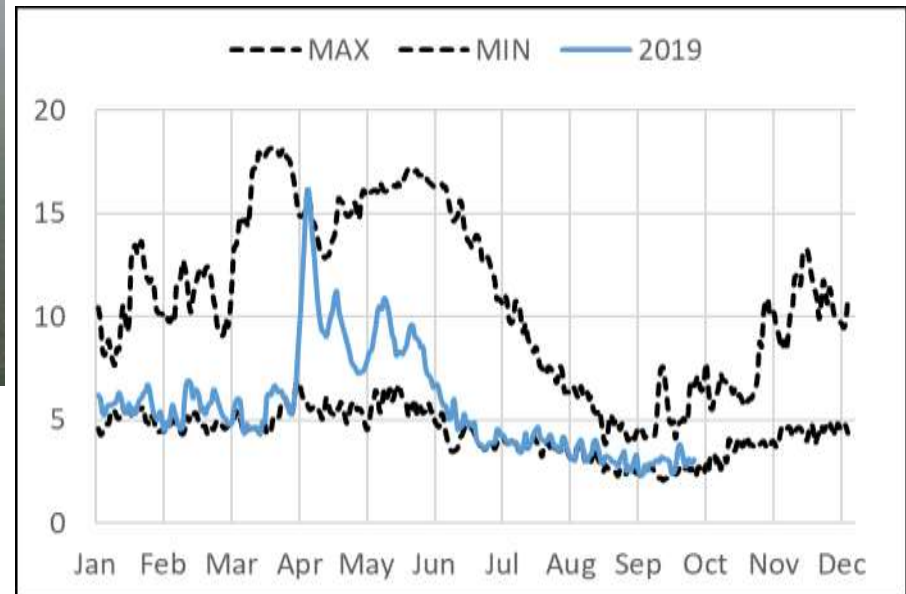


Campbell Slough 2017  
March 16, 2017

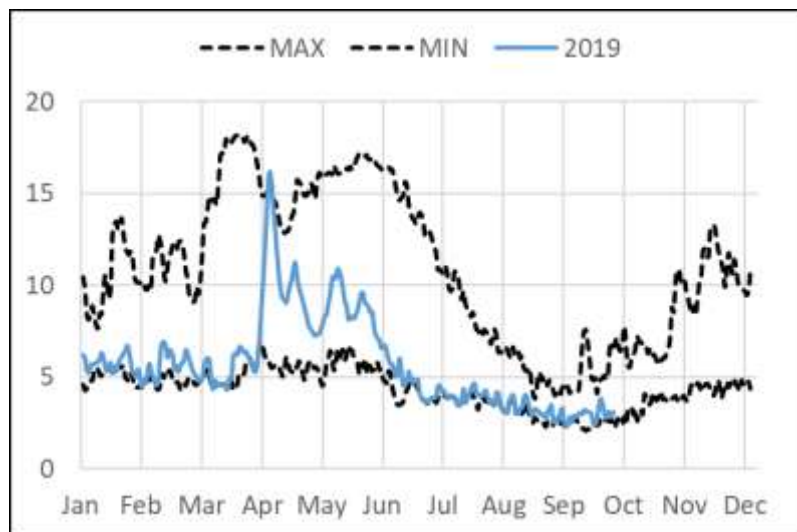
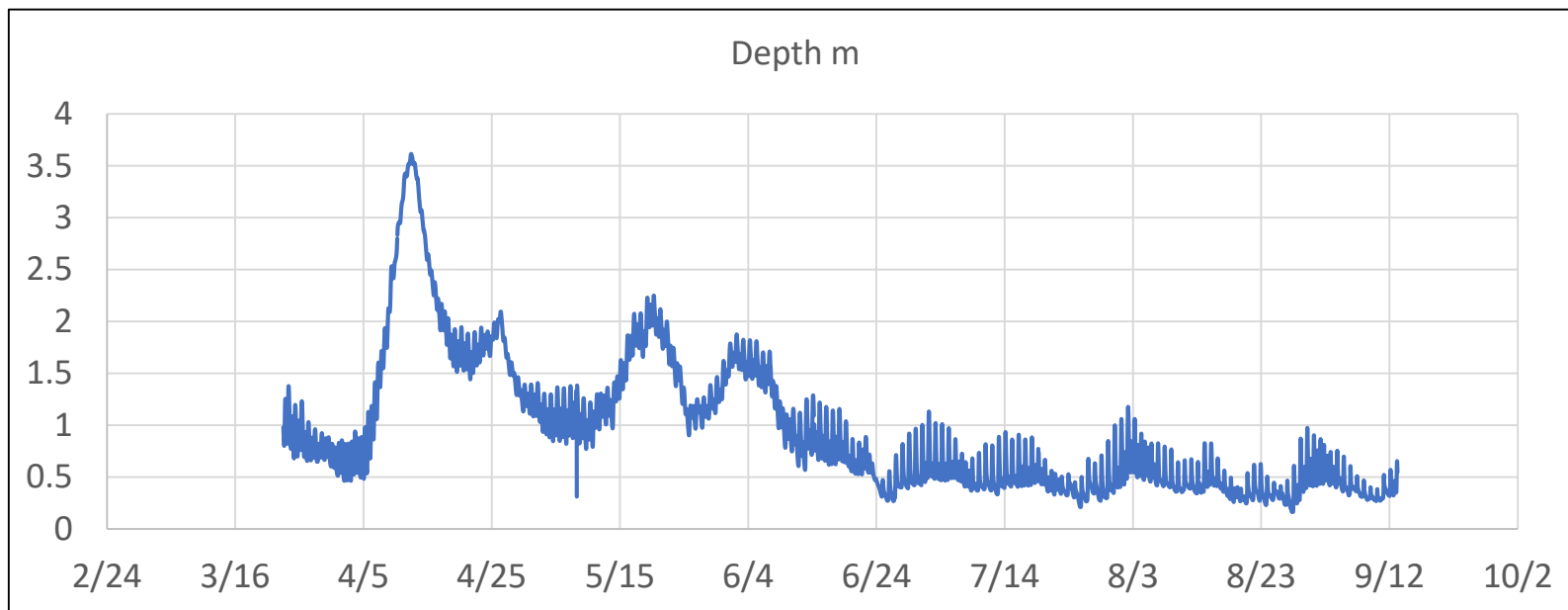




Campbell Slough 2019  
4/10/2019

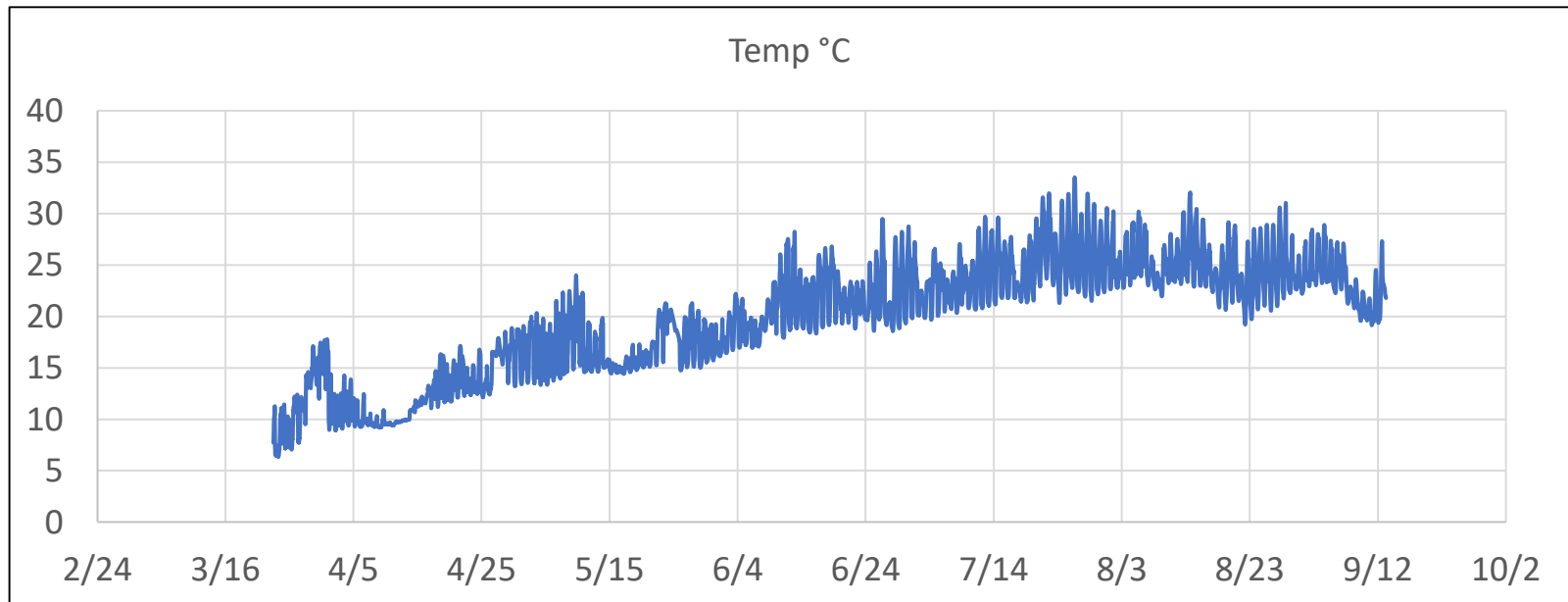
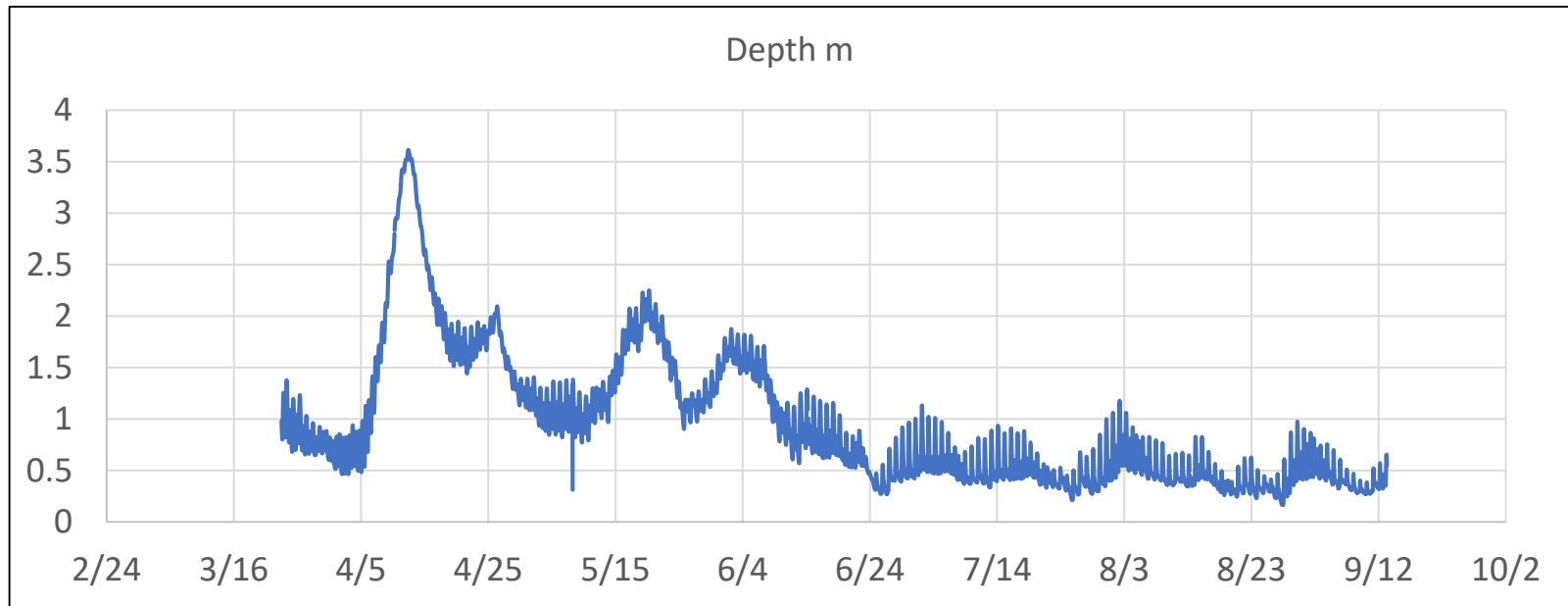




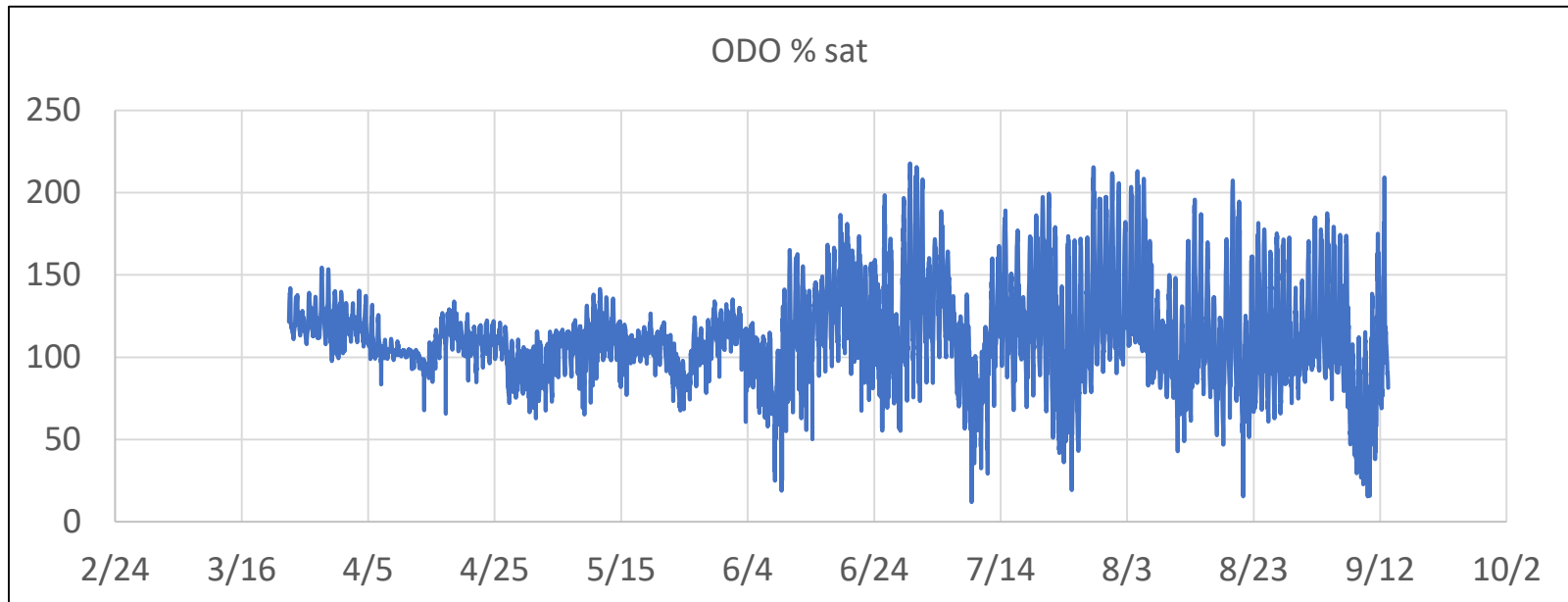
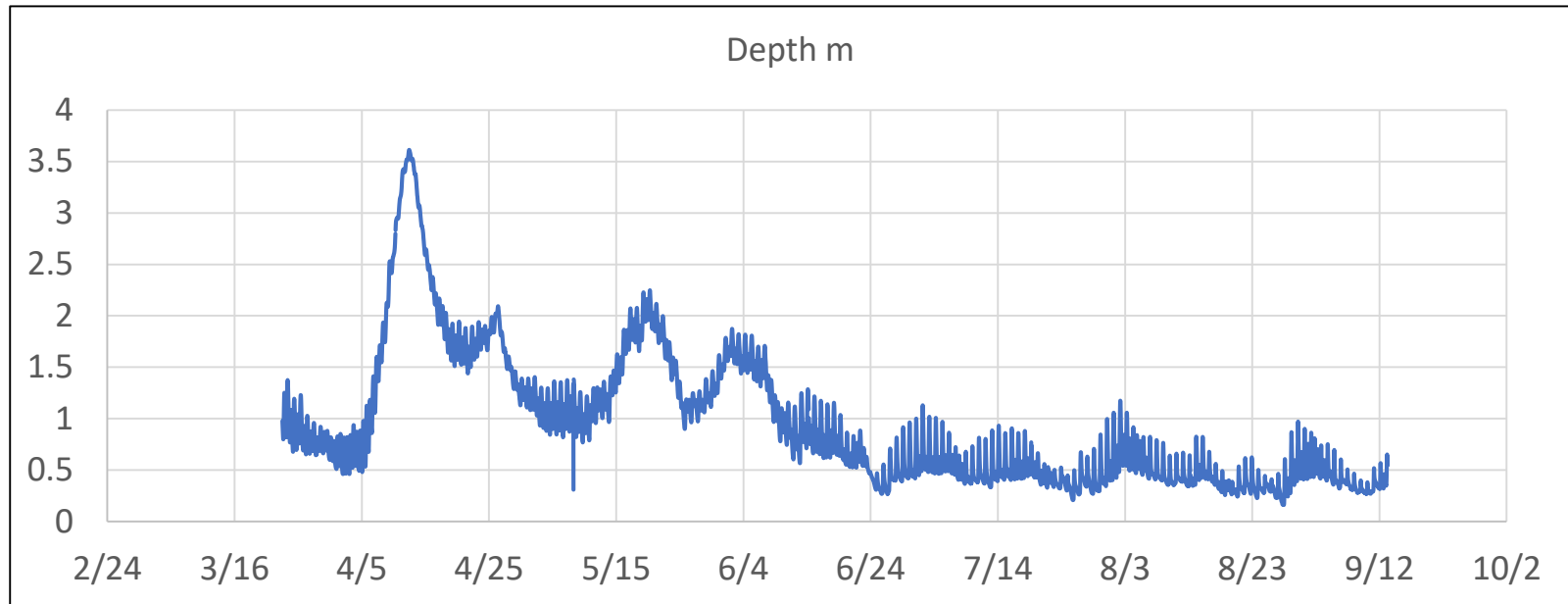




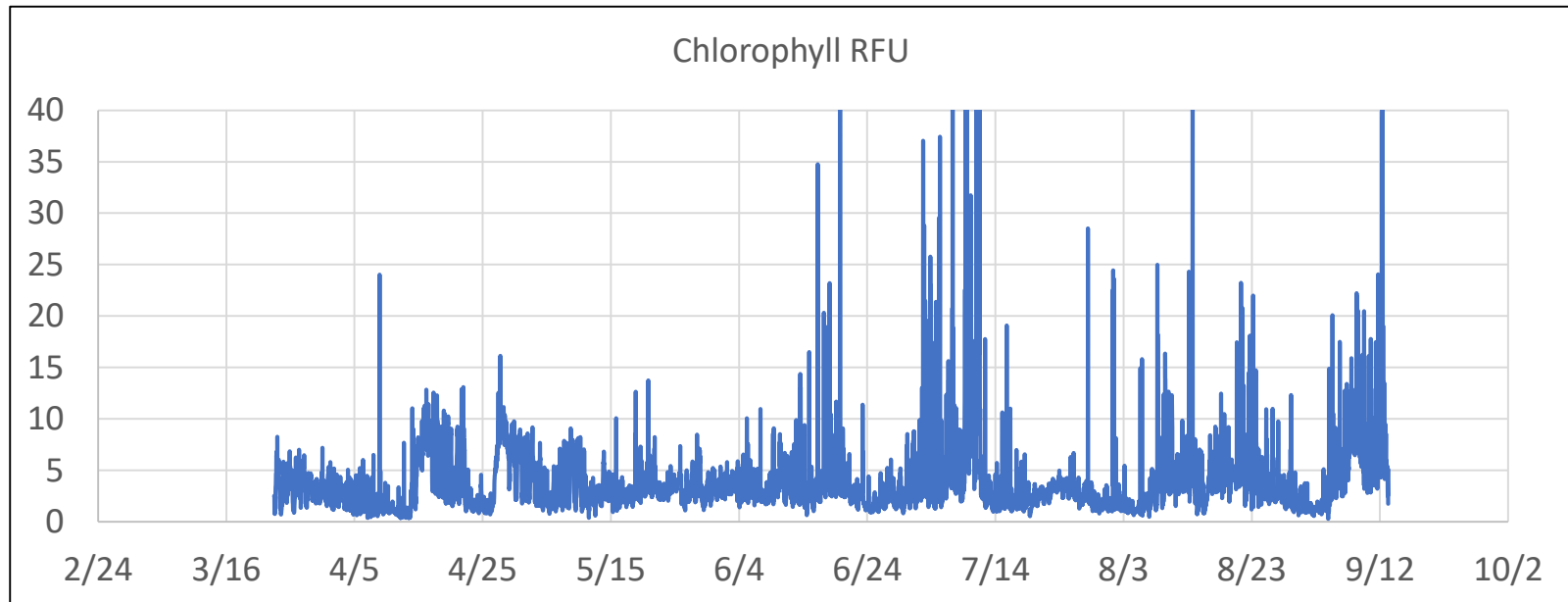
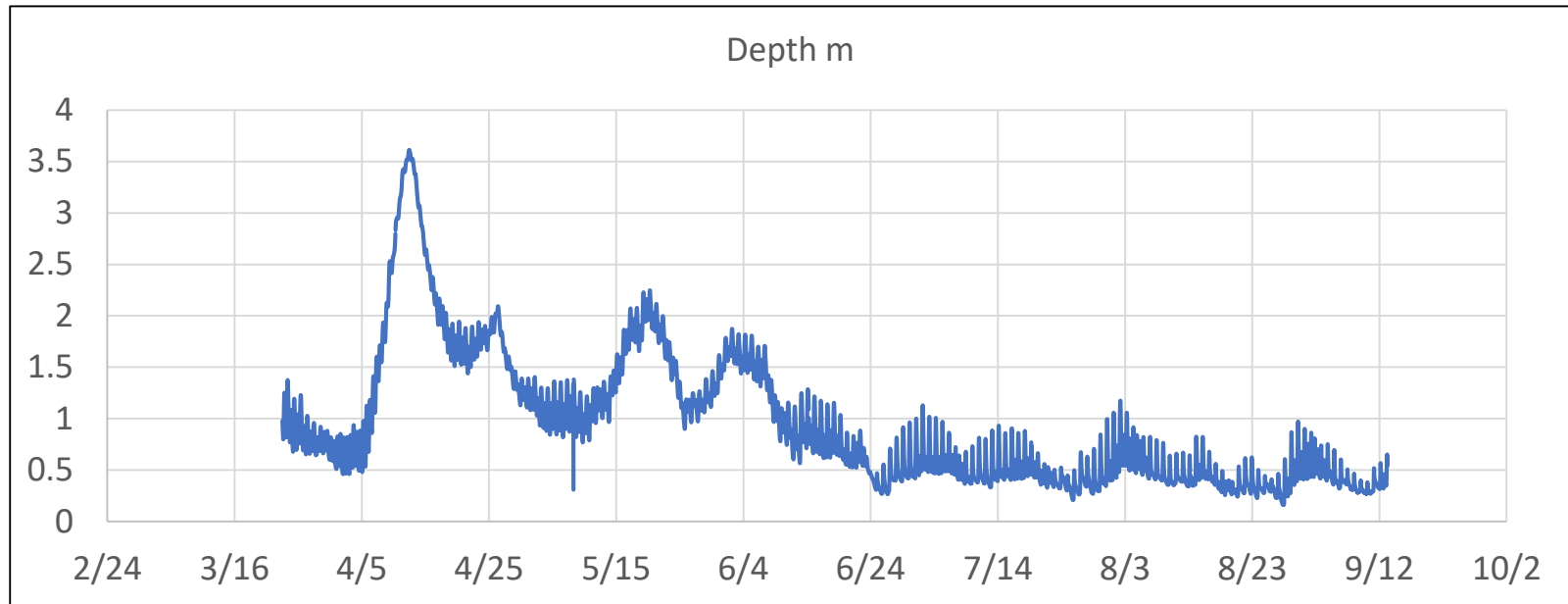
# Campbell Slough Sonde Data 2019



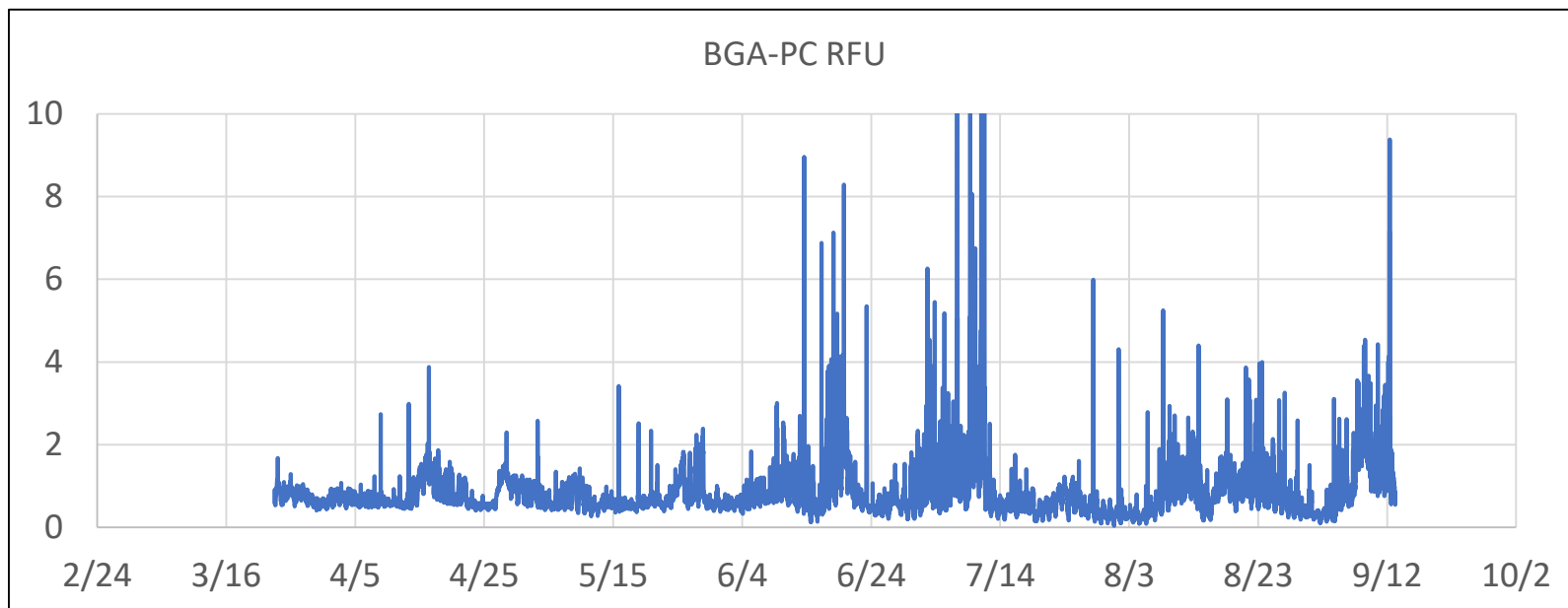
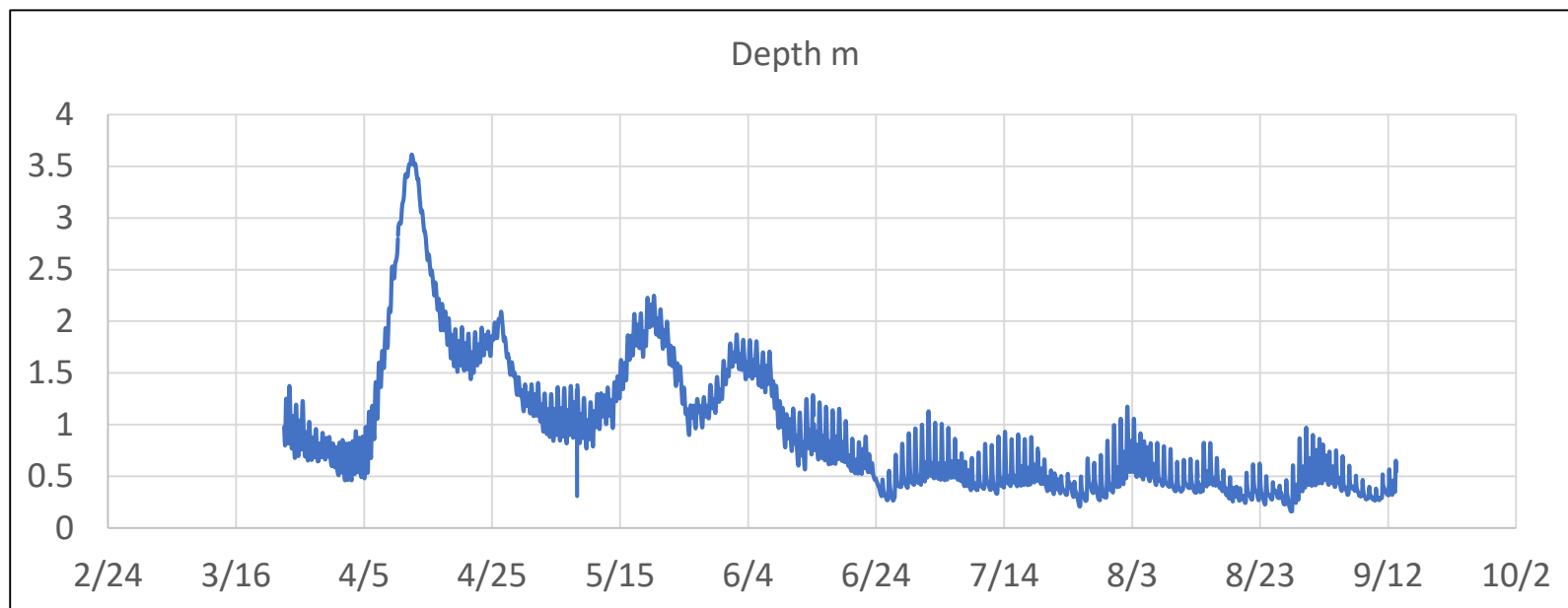
# Campbell Slough Sonde Data 2019



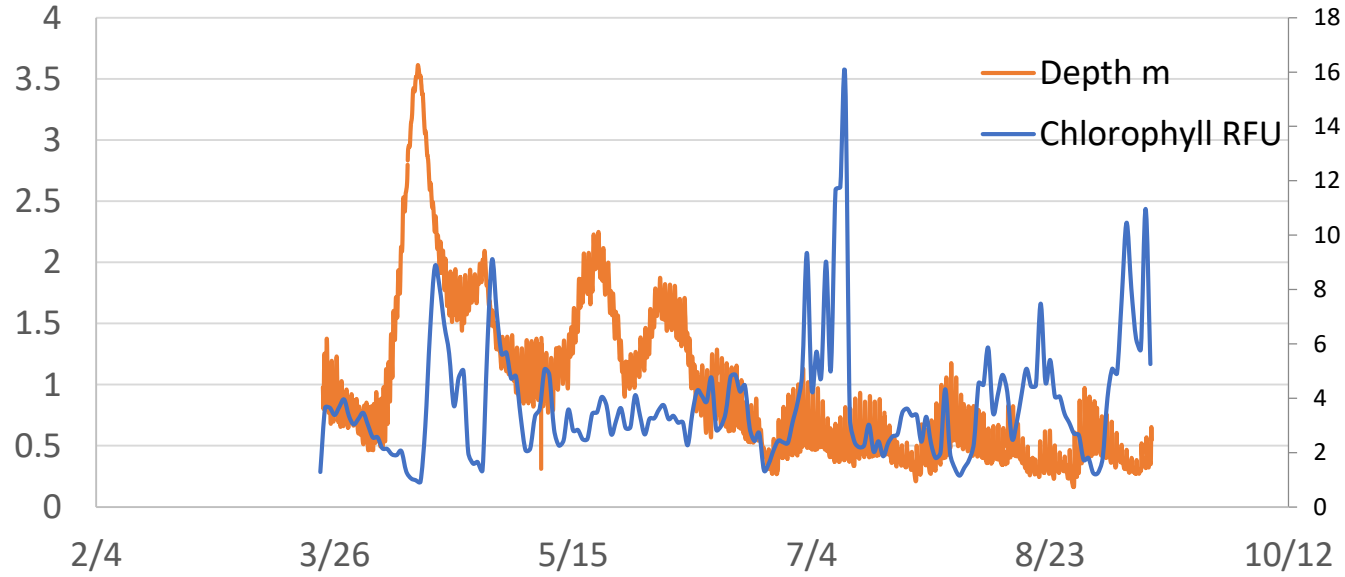
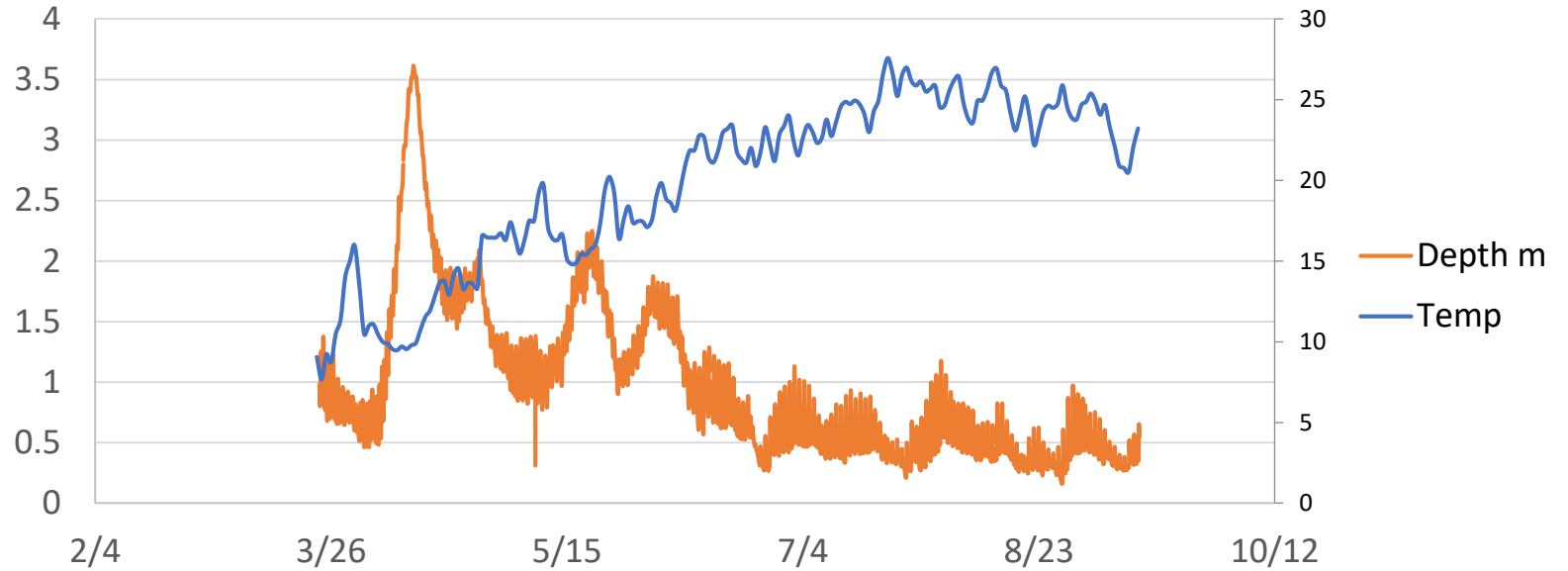
# Campbell Slough Sonde Data 2019



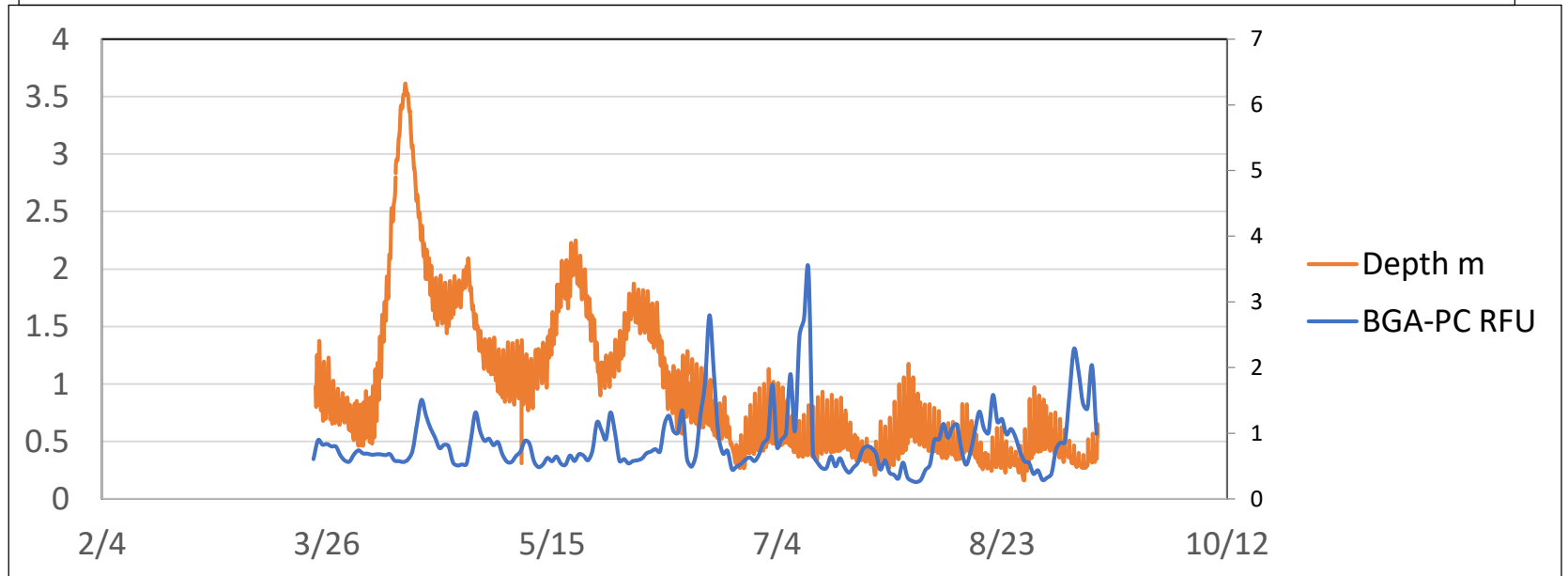
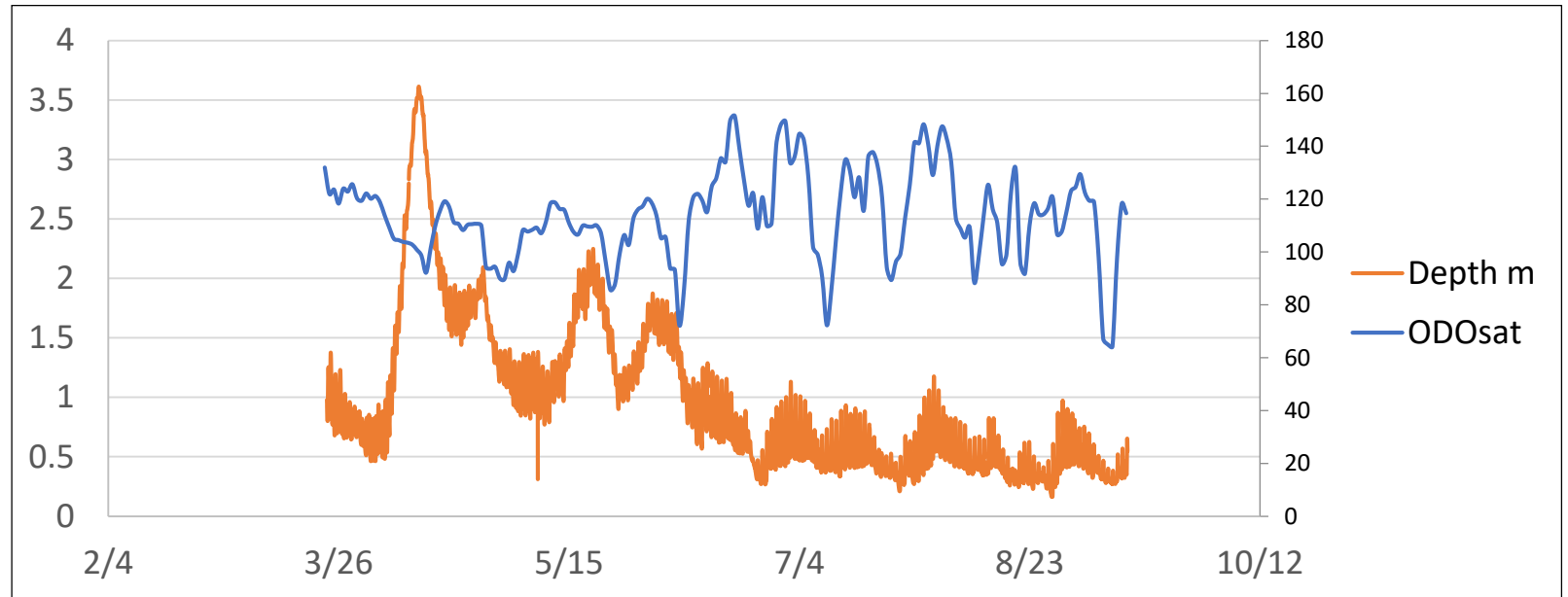
# Campbell Slough Sonde Data 2019



# Campbell Slough Sonde Data 2019



# Campbell Slough Sonde Data 2019





## EMP Sites, % Days/Month Temperature > 19°C

| Date     | Ilwaco | Welch | Whites | Campbell | Franz |  | Date     | Ilwaco | Welch | Whites | Campbell | Franz |
|----------|--------|-------|--------|----------|-------|--|----------|--------|-------|--------|----------|-------|
| Apr-2010 | #N/A   | #N/A  | #N/A   | 0        | #N/A  |  | Apr-2015 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  |
| May-2010 | #N/A   | #N/A  | #N/A   | 0        | #N/A  |  | May-2015 | #N/A   | #N/A  | #N/A   | 32       | #N/A  |
| Jun-2010 | #N/A   | #N/A  | #N/A   | 13       | #N/A  |  | Jun-2015 | 17     | #N/A  | 100    | 90       | 100   |
| Jul-2010 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  |  | Jul-2015 | 74     | #N/A  | 100    | 100      | 100   |
| Aug-2010 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  |  | Aug-2015 | 56     | #N/A  | 100    | 100      | 100   |
| Sep-2010 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  |  | Sep-2015 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  |
| Apr-2011 | 0      | #N/A  | 0      | #N/A     | 0     |  | Apr-2016 | 0      | 0     | 0      | 0        | 0     |
| May-2011 | 0      | #N/A  | #N/A   | 0        | 0     |  | May-2016 | 0      | 0     | 0      | 19       | 0     |
| Jun-2011 | 0      | #N/A  | 0      | 0        | 0     |  | Jun-2016 | 10     | 13    | 0      | 87       | 55    |
| Jul-2011 | 13     | #N/A  | 0      | 58       | 0     |  | Jul-2016 | 55     | 100   | 87     | 100      | 97    |
| Aug-2011 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  |  | Aug-2016 | 23     | 100   | 100    | 100      | 100   |
| Sep-2011 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  |  | Sep-2016 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  |
| Apr-2012 | 0      | #N/A  | 0      | 0        | 0     |  | Apr-2017 | 0      | 0     | 0      | 0        | #N/A  |
| May-2012 | 0      | #N/A  | 0      | 0        | 0     |  | May-2017 | 0      | 0     | 0      | 0        | 0     |
| Jun-2012 | 0      | #N/A  | 0      | 3        | 0     |  | Jun-2017 | 7      | 0     | 0      | 33       | 13    |
| Jul-2012 | 3      | #N/A  | #N/A   | 77       | 43    |  | Jul-2017 | 42     | 87    | 94     | 100      | 93    |
| Aug-2012 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  |  | Aug-2017 | 29     | 100   | 100    | 100      | 100   |
| Sep-2012 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  |  | Sep-2017 | 0      | 82    | 90     | 100      | 78    |
| Apr-2013 | 0      | #N/A  | 0      | 0        | 0     |  | Apr-2018 | 0      | 0     | 0      | 0        | 0     |
| May-2013 | 0      | #N/A  | 0      | 0        | 0     |  | May-2018 | 0      | 0     | 0      | 0        | 0     |
| Jun-2013 | 23     | #N/A  | 4      | 53       | 27    |  | Jun-2018 | 27     | 17    | 3      | 63       | 30    |
| Jul-2013 | 20     | #N/A  | 80     | 100      | 96    |  | Jul-2018 | 68     | 97    | 100    | 100      | 100   |
| Aug-2013 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  |  | Aug-2018 | 29     | 100   | 100    | 100      | 90    |
| Sep-2013 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  |  | Sep-2018 | 0      | 46    | 57     | 95       | 42    |
| Apr-2014 | #N/A   | #N/A  | #N/A   | 0        | 0     |  | Apr-2019 | 0      | 0     | 0      | 0        | 0     |
| May-2014 | #N/A   | #N/A  | 0      | 0        | 0     |  | May-2019 | 3      | 0     | 0      | 16       | 0     |
| Jun-2014 | #N/A   | #N/A  | 0      | 23       | 0     |  | Jun-2019 | 27     | 13    | 7      | 83       | 57    |
| Jul-2014 | #N/A   | #N/A  | 86     | 100      | 94    |  | Jul-2019 | 71     | 90    | 97     | 100      | 100   |
| Aug-2014 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  |  | Aug-2019 | 81     | 100   | 100    | 100      | 100   |
| Sep-2014 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  |  | Sep-2019 | 18     | 90    | #N/A   | 100      | 100   |

# EMP Sites, % Days/Month Temperature > 22°C

| Date     | Ilwaco | Welch | Whites | Campbell | Franz | Date     | Ilwaco | Welch | Whites | Campbell | Franz |
|----------|--------|-------|--------|----------|-------|----------|--------|-------|--------|----------|-------|
| Apr-2010 | #N/A   | #N/A  | #N/A   | 0        | #N/A  | Apr-2015 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  |
| #####    | #N/A   | #N/A  | #N/A   | 0        | #N/A  | #####    | #N/A   | #N/A  | #N/A   | 0        | #N/A  |
| Jun-2010 | #N/A   | #N/A  | #N/A   | 0        | #N/A  | Jun-2015 | 0      | #N/A  | 14     | 83       | 67    |
| Jul-2010 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  | Jul-2015 | 0      | #N/A  | 77     | 100      | 77    |
| Aug-2010 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  | Aug-2015 | 0      | #N/A  | 19     | 96       | 91    |
| Sep-2010 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  | Sep-2015 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  |
| Apr-2011 | 0      | #N/A  | 0      | #N/A     | 0     | Apr-2016 | 0      | 0     | 0      | 0        | 0     |
| #####    | 0      | #N/A  | #N/A   | 0        | 0     | #####    | 0      | 0     | 0      | 0        | 0     |
| Jun-2011 | 0      | #N/A  | 0      | 0        | 0     | Jun-2016 | 0      | 0     | 0      | 17       | 14    |
| Jul-2011 | 0      | #N/A  | 0      | 4        | 0     | Jul-2016 | 0      | 0     | 0      | 77       | 48    |
| Aug-2011 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  | Aug-2016 | 0      | 13    | 0      | 90       | 33    |
| Sep-2011 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  | Sep-2016 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  |
| Apr-2012 | 0      | #N/A  | 0      | 0        | 0     | Apr-2017 | 0      | 0     | 0      | 0        | #N/A  |
| #####    | 0      | #N/A  | 0      | 0        | 0     | #####    | 0      | 0     | 0      | 0        | 0     |
| Jun-2012 | 0      | #N/A  | 0      | 3        | 0     | Jun-2017 | 0      | 0     | 0      | 0        | 0     |
| Jul-2012 | 3      | #N/A  | #N/A   | 77       | 43    | Jul-2017 | 0      | 0     | 6      | 94       | 93    |
| Aug-2012 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  | Aug-2017 | 0      | 13    | 48     | 100      | 81    |
| Sep-2012 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  | Sep-2017 | 0      | 0     | 15     | 69       | 28    |
| Apr-2013 | 0      | #N/A  | 0      | 0        | 0     | Apr-2018 | 0      | 0     | 0      | 0        | 0     |
| #####    | 0      | #N/A  | 0      | 0        | 0     | #####    | 0      | 0     | 0      | 0        | 0     |
| Jun-2013 | 0      | #N/A  | 0      | 7        | 0     | Jun-2018 | 0      | 0     | 0      | 20       | 0     |
| Jul-2013 | 0      | #N/A  | 0      | 78       | 46    | Jul-2018 | 0      | 6     | 10     | 97       | 77    |
| Aug-2013 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  | Aug-2018 | 0      | 16    | 52     | 90       | 58    |
| Sep-2013 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  | Sep-2018 | 0      | 0     | 0      | 47       | 0     |
| Apr-2014 | #N/A   | #N/A  | #N/A   | 0        | 0     | Apr-2019 | 0      | 0     | 0      | 0        | 0     |
| #####    | #N/A   | #N/A  | 0      | 0        | 0     | #####    | 0      | 0     | 0      | 0        | 0     |
| Jun-2014 | #N/A   | #N/A  | 0      | 0        | 0     | Jun-2019 | 0      | 0     | 0      | 33       | 10    |
| Jul-2014 | #N/A   | #N/A  | 0      | 87       | 48    | Jul-2019 | 3      | 10    | 13     | 97       | 81    |
| Aug-2014 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  | Aug-2019 | 0      | 19    | 43     | 100      | 42    |
| Sep-2014 | #N/A   | #N/A  | #N/A   | #N/A     | #N/A  | Sep-2019 | 0      | 0     | #N/A   | 77       | 53    |

Thanks to the field team!

OHSU

Tawnya Peterson

Angie Munguia

Lyle Cook

Taylor Dodrill

LCEP

Sara Kidd

Sneha Rao Manohar

CREST

Narayan Elasmar

April Silva

NOAA

Reagan McNatt

Susan Hinton

