INVESTIGATING THE BACTERIAL TRENDS OF POSSESSION SOUND

Kara Anderson

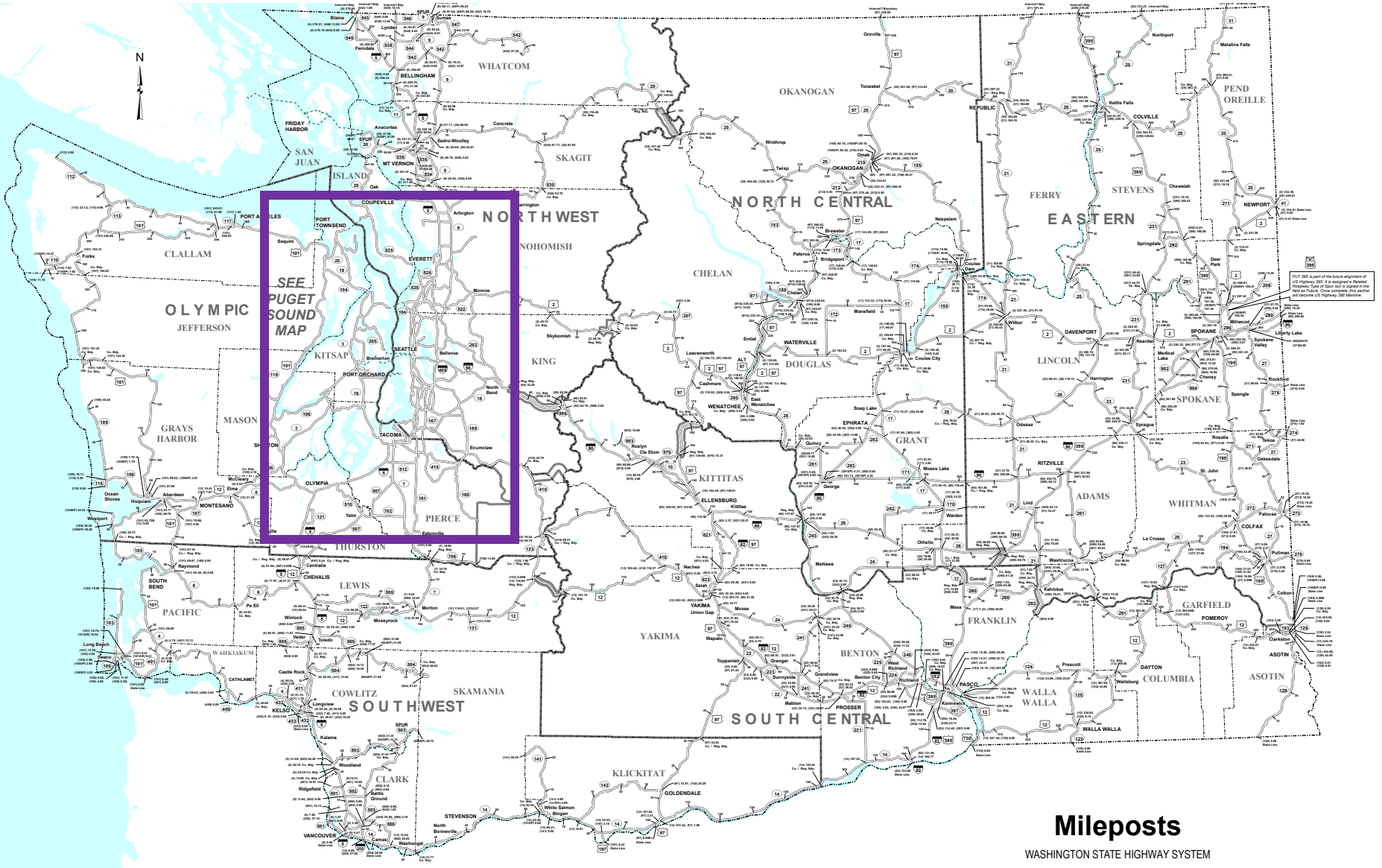
Ocean Research College Academy

OCEAN RESEARCH COLLEGE ACADEMY (ORCA)

- Dual-enrollment program for high school juniors and seniors
- Longitudinal study of the local Snohomish River estuary → Independent research
- National Science Foundation grants for a research lab and research vessel

GEOPATHS

- Three-year grant
- Funds summer scientific research opportunities
- Increase interest in undergraduate degrees in geoscience
- Provide experiences that:
  - Develop their expertise in geoscience
  - Enhance professional skills
  - Increase access to professional networks



Mileposts

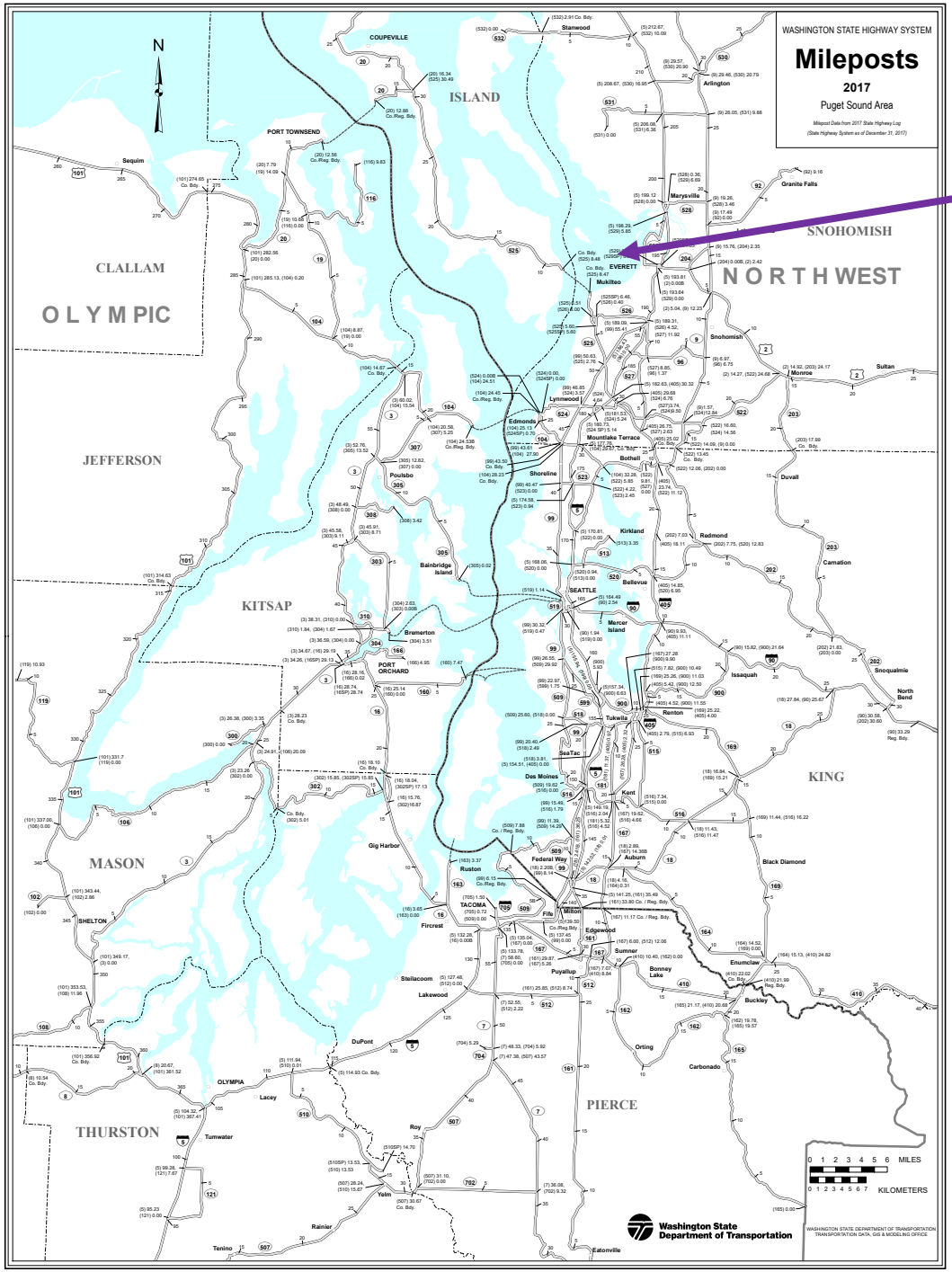
WASHINGTON STATE HIGHWAY SYSTEM

2017

Milepost Data from 2017 State Highway Log
(State Highway System as of December 31, 2017)

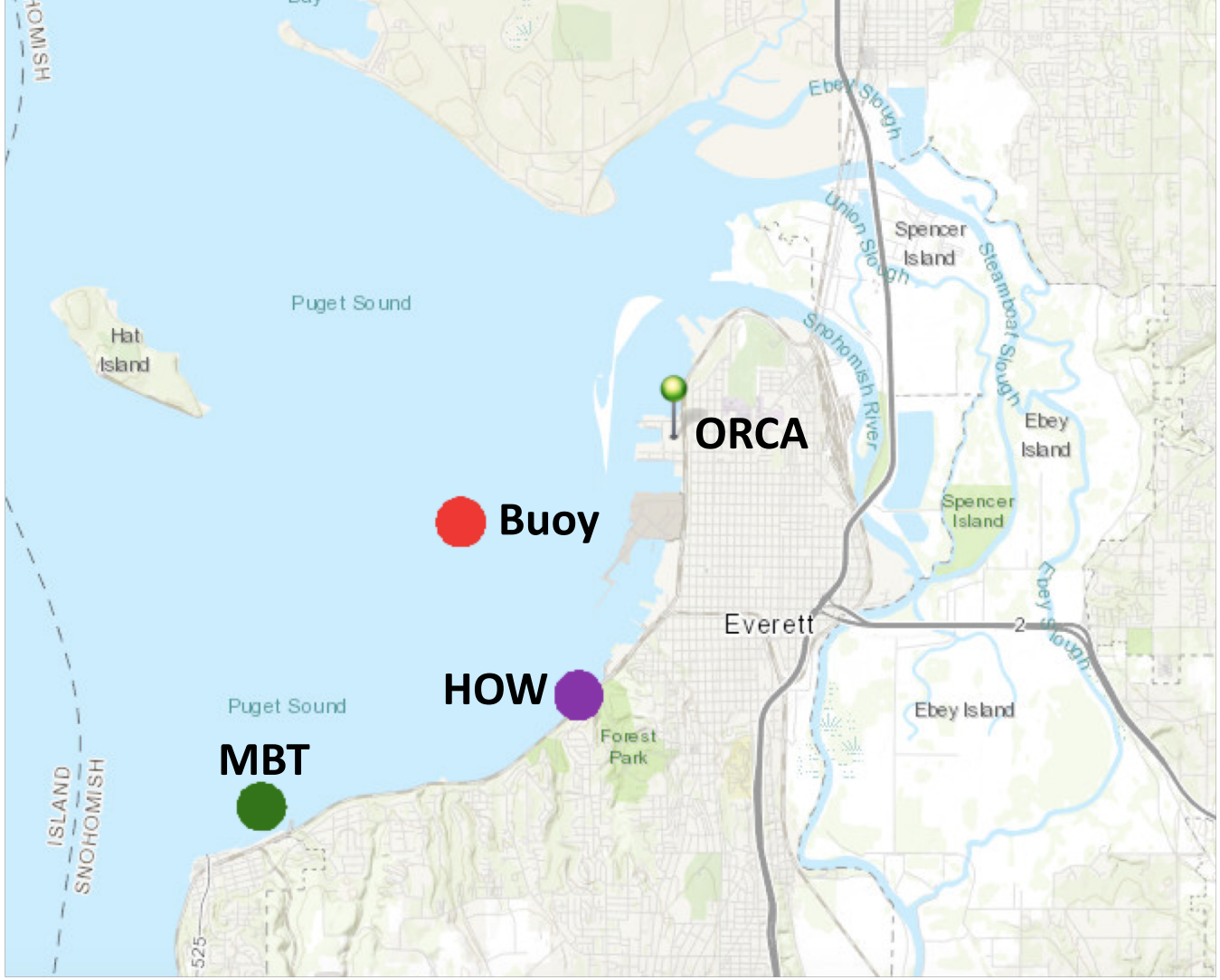
Washington State Department of Transportation

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
Transportation Data, GIS & Modeling Office



POSSESSION SOUND

K:\GIS_Branch\GIS_Carto\Products\Standard\Mileposts\Map\Products\Mileposts\Maps\Milepost\MapPugetSoundInset2017.pdf



SAMPLING LOCATIONS

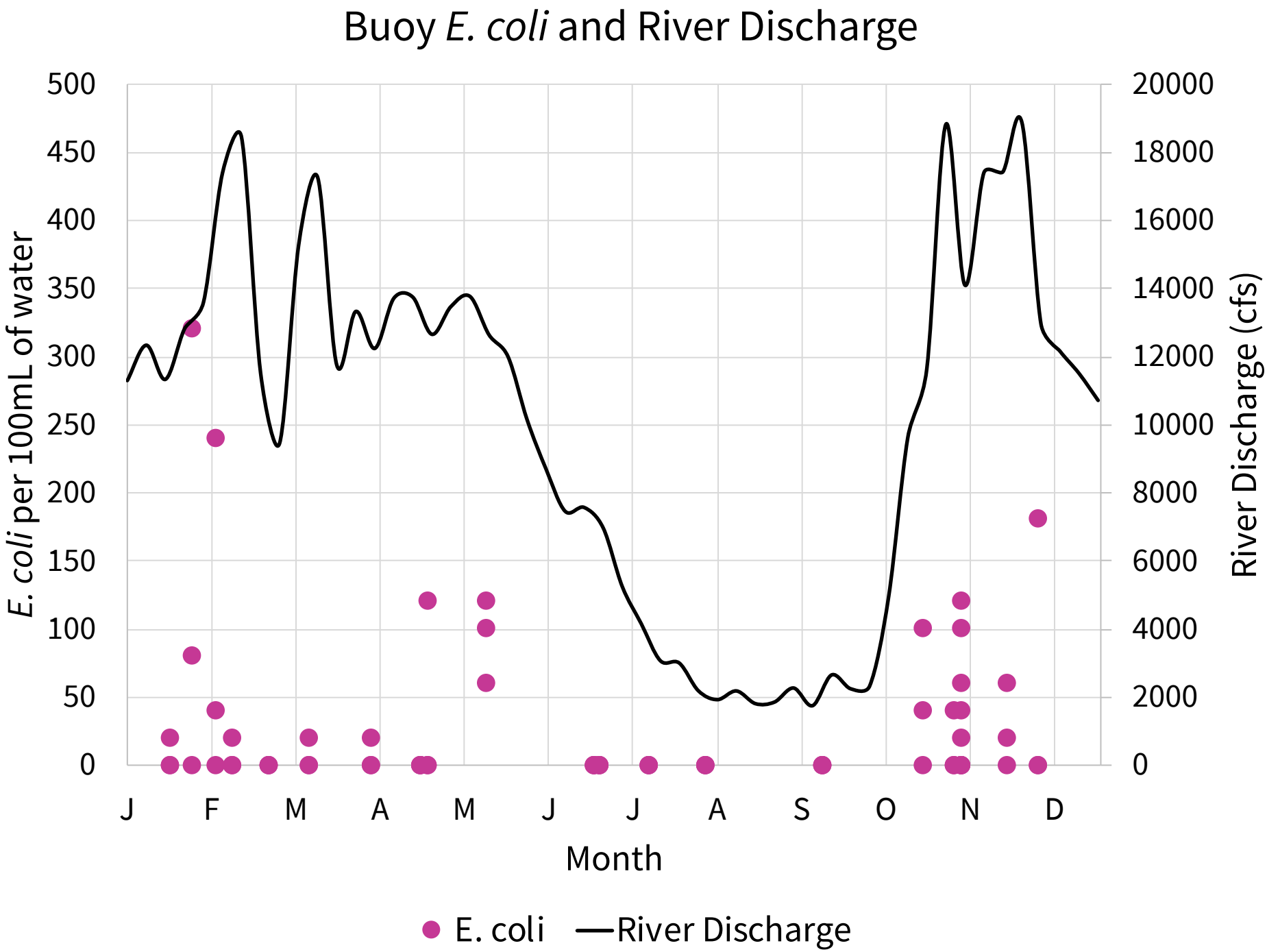
HYPOTHESIS

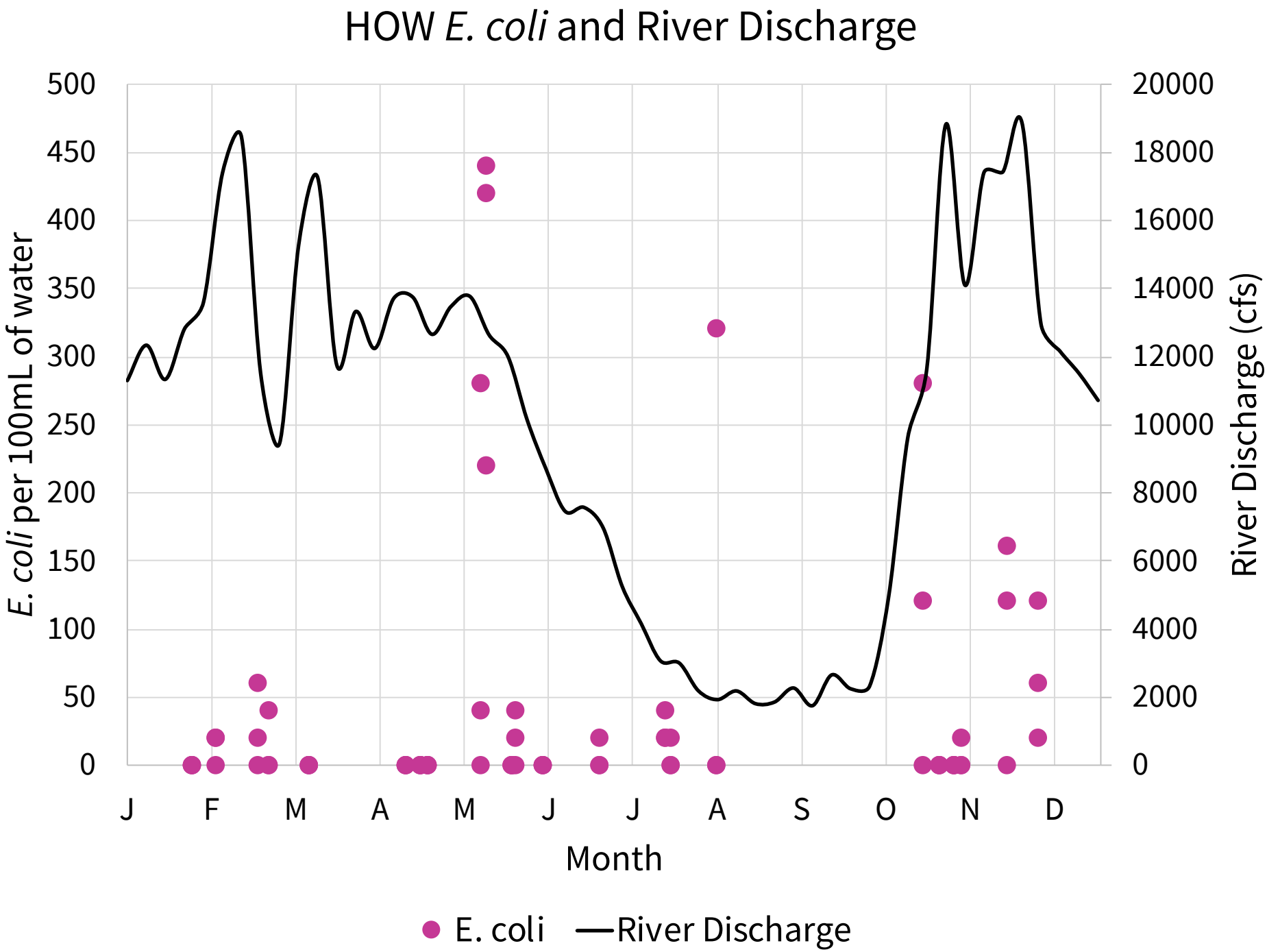
- Increased levels of river discharge
- Closer proximity to the mouth of the Snohomish River
- Closer proximity to combined sewer outflows, storm drains, and human-accessed beaches
- Flood tide

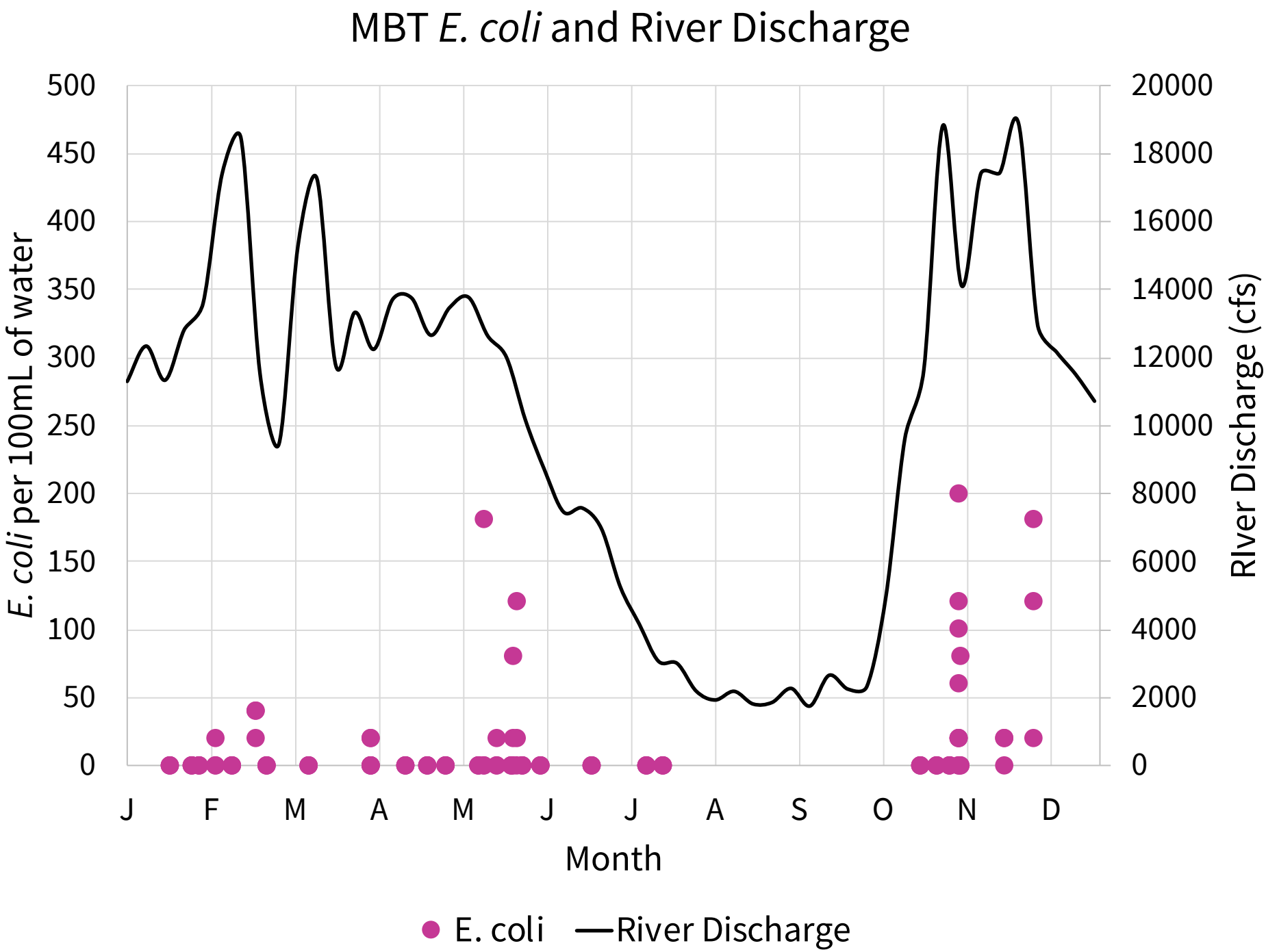
Sewer Outfall Locations
City of Everett
Public Works
Utility Mapping
July 2006
Legend
Force Main
Gravity Main
Sewer CSO
Drainage Mains
N
S
E
W
PSO1
PSO2
PSO3
PSO4
PSO5
PSO6
PSO7
SRO1
SRO2
SRO3
SRO4
SRO7
SRO8
STEAMBOAT SLOUGH
UNION SLOUGH
JOHNSON SLOUGH
SMITH SLOUGH
SNOHOMISH RIVER
HELTERLAUSER LAGOON
Jetty Island
Port Gardner Bay
CITY OF EVERETT SEWAGE LAGOON
AERATION POND
Spencer Island
Smith Island
Ebey Island
Forgotten Creek
Pigeon Creek No. 1
Pigeon Cr. No. 2
View Ridge Cr.
Glenwood Cr.
RESERVOIR #1
RESERVOIR #4
RESERVOIR #2
RESERVOIR #5
10TH ST
19TH ST
23RD ST
41ST
52ND ST
EVERETT AVE
HEWITT AVE
PACIFIC AVE
N BROADWAY
E MARINE VIEW DR
W MARINE VIEW DR
COLBY AVE
BROADWAY AVE
WALNUT ST
RUCKER AVE
S 3RD AVE
S 2ND AVE
BEVERLY LA
BLVD
529
5
2
G:\Basemaps\Letter\Sewer\CSO_Locations_North.mxd

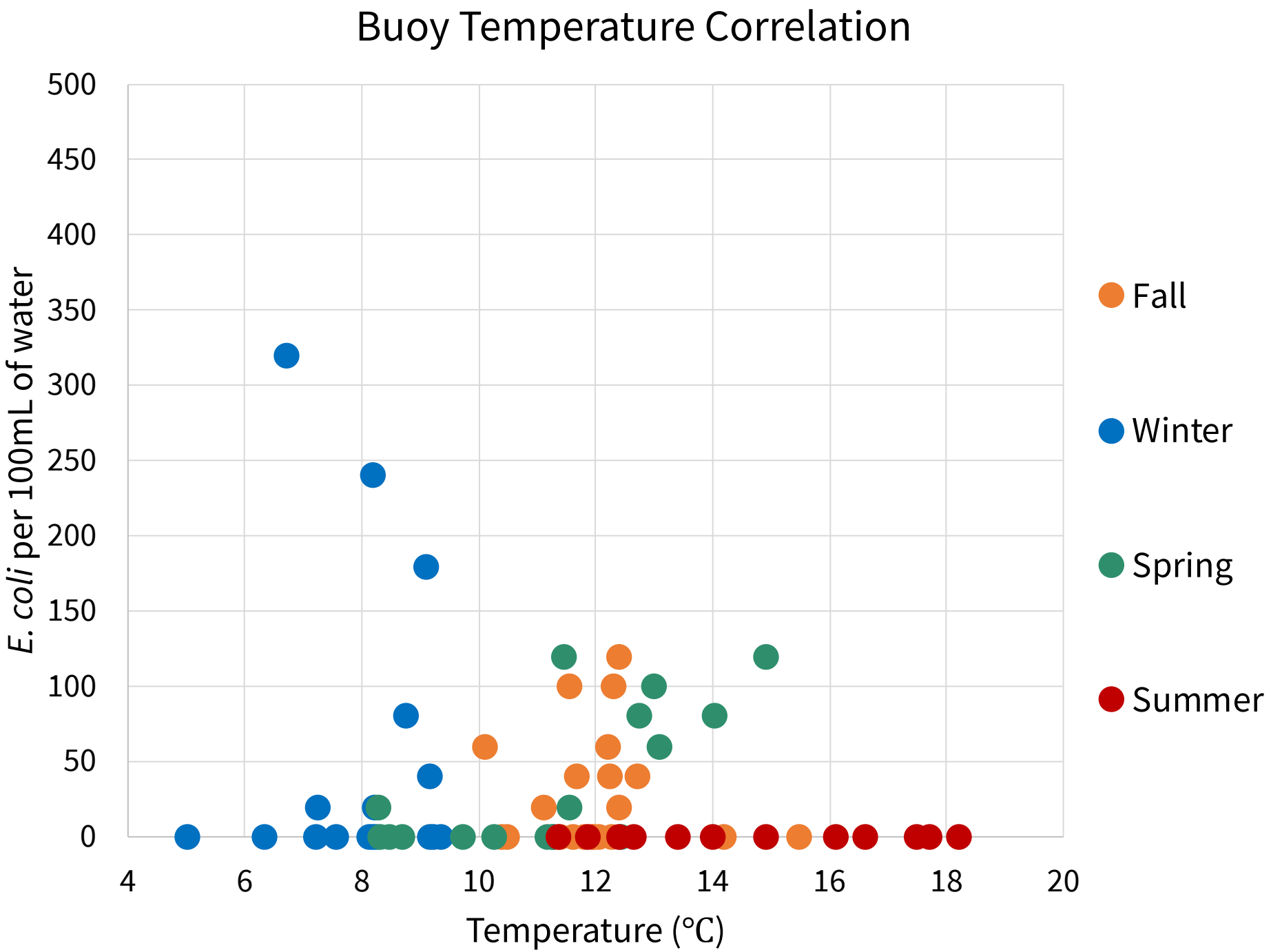
METHODS

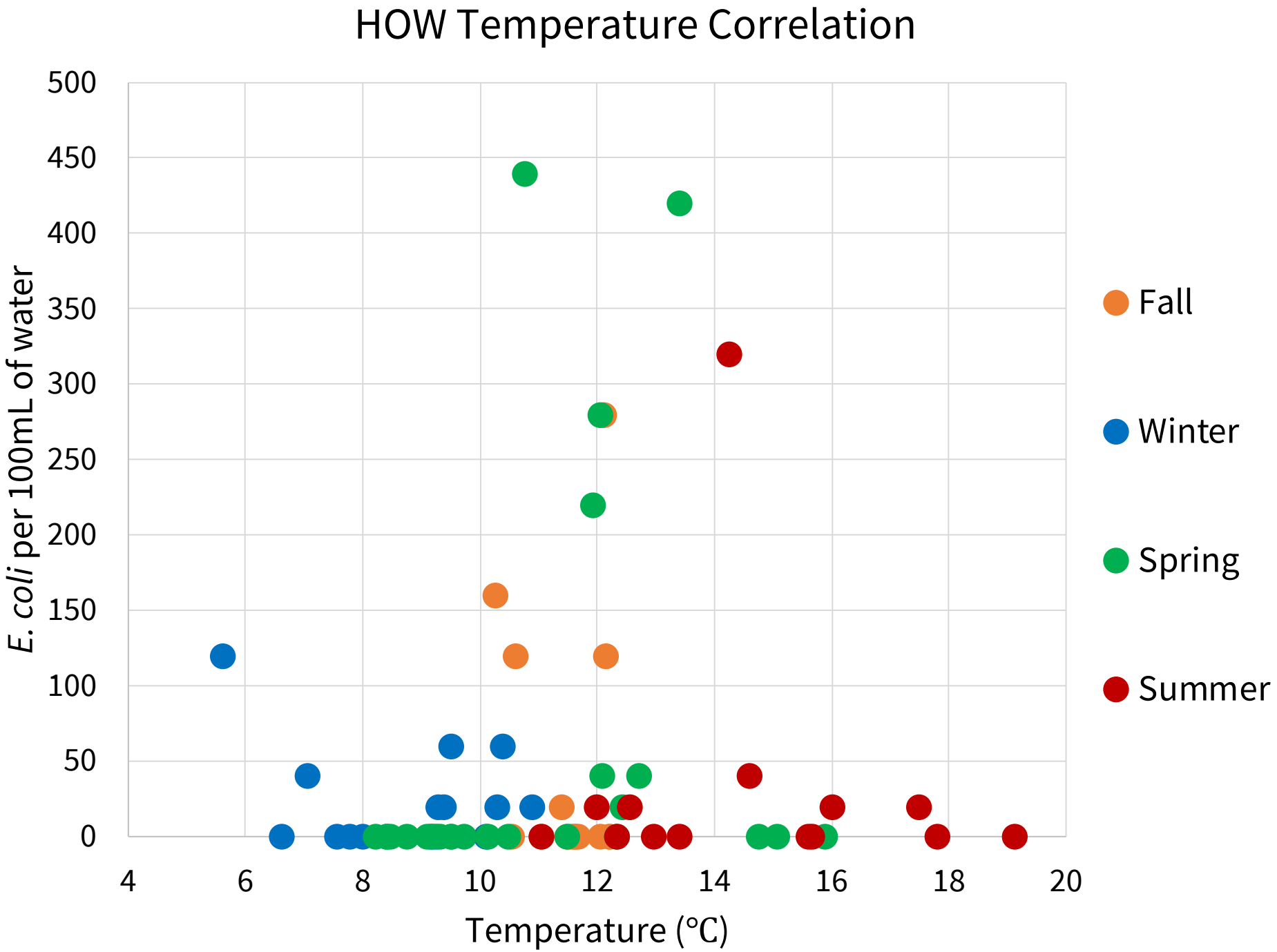
- ORCA students started collecting bacteria data in 2004
- Study focused on 2014-2018
- Niskin bottle used for water samples
- YSI 650 was utilized to test water chemistry parameters
- Coliscan® Easygel® Protocol for inoculation, incubation, and quantification
- Data reported in terms of *E. coli* per 100 mL of water

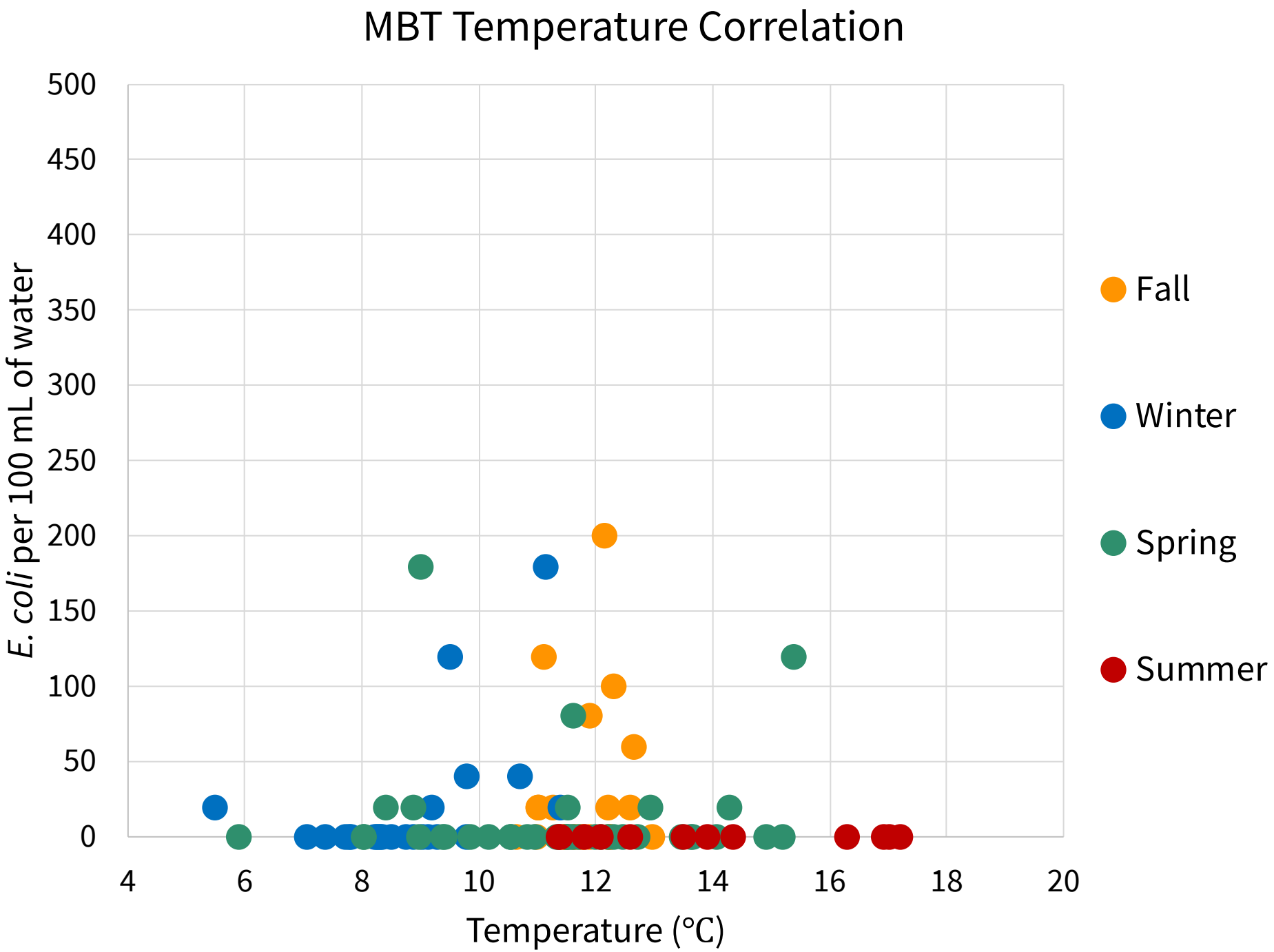

Buoy E. coli and River Discharge
E. coli per 100mL of water
River Discharge (cfs)
500
450
400
350
300
250
200
150
100
50
0
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
E. coli
River Discharge

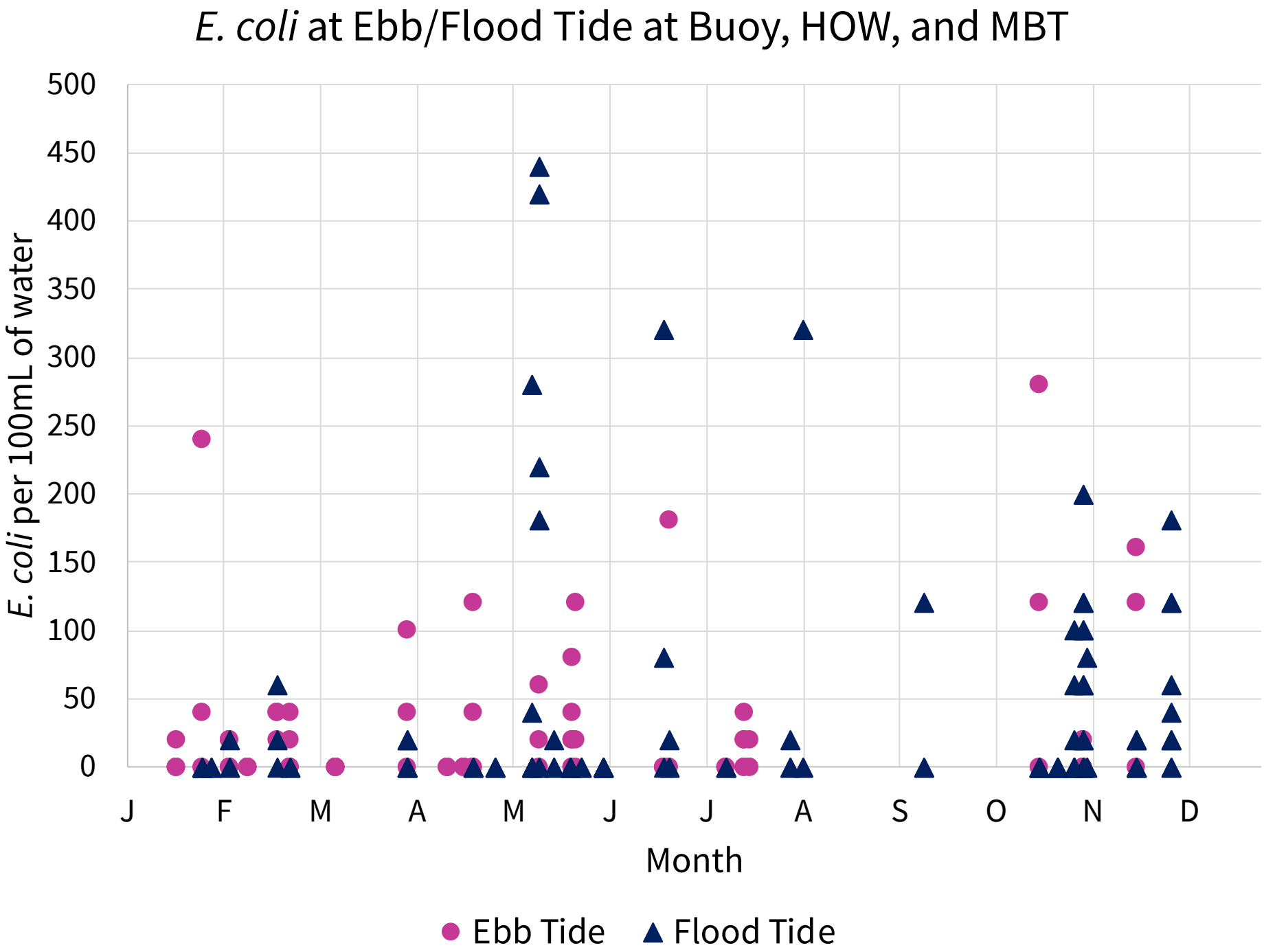

HOW E. coli and River Discharge
E. coli per 100mL of water
River Discharge (cfs)
500
450
400
350
300
250
200
150
100
50
0
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
E. coli
River Discharge

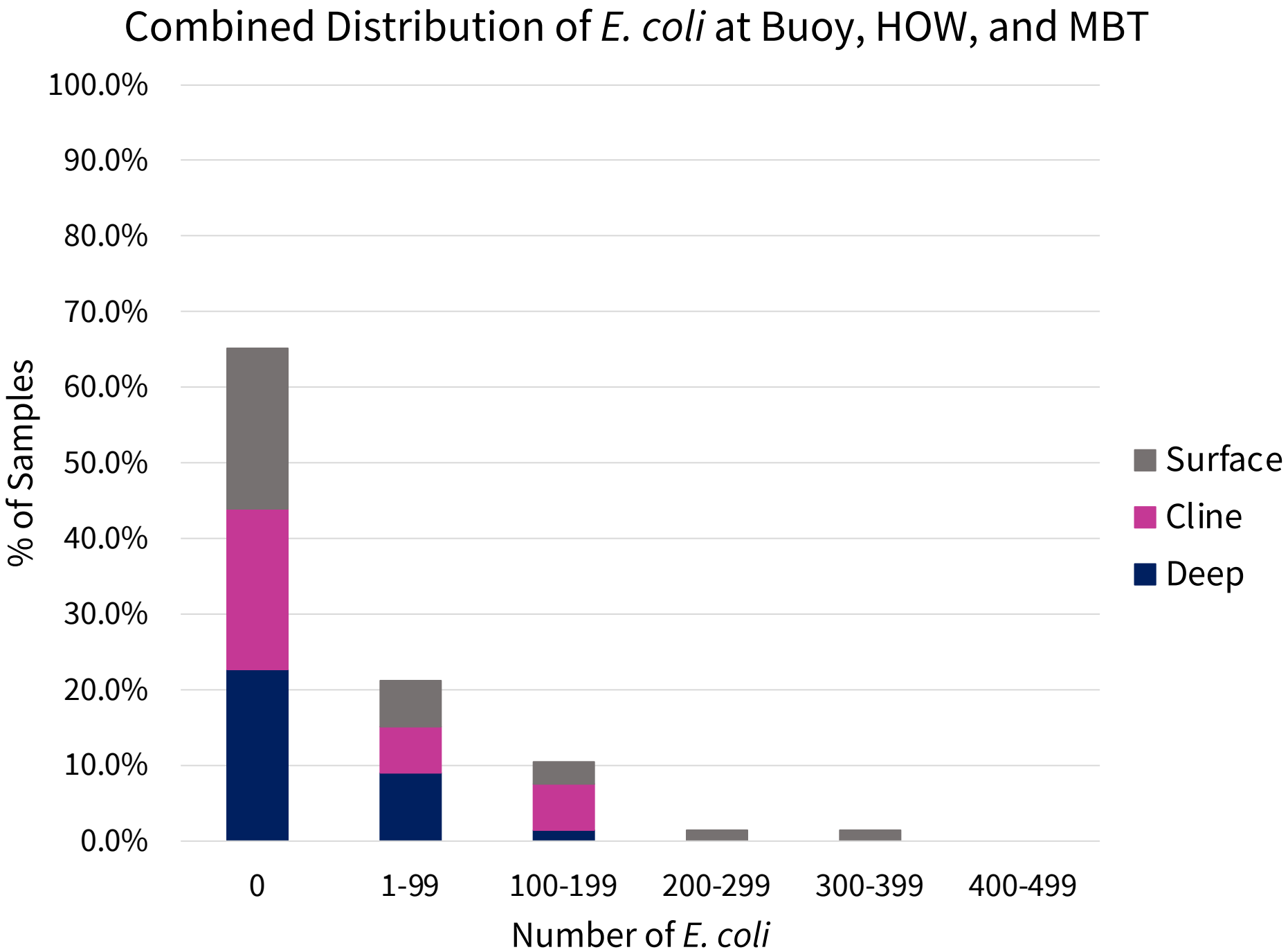

MBT E. coli and River Discharge
E. coli per 100mL of water
500
450
400
350
300
250
200
150
100
50
0
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
RIver Discharge (cfs)
J
F
M
A
M
J
J
A
S
O
N
D
Month
E. coli
River Discharge


Buoy Temperature Correlation
500
450
400
350
300
250
200
150
100
50
0
E. coli per 100mL of water
4
6
8
10
12
14
16
18
20
Temperature (°C)
Fall
Winter
Spring
Summer


HOW Temperature Correlation
500
450
400
350
300
250
200
150
100
50
0
E. coli per 100mL of water
4
6
8
10
12
14
16
18
20
Temperature (°C)
Fall
Winter
Spring
Summer


MBT Temperature Correlation
500
450
400
350
300
250
200
150
100
50
0
E. coli per 100 mL of water
4
6
8
10
12
14
16
18
20
Temperature (°C)
Fall
Winter
Spring
Summer


E. coli at Ebb/Flood Tide at Buoy, HOW, and MBT
E. coli per 100mL of water
500
450
400
350
300
250
200
150
100
50
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
Ebb Tide
Flood Tide


Combined Distribution of *E. coli* at Buoy, HOW, and MBT
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
% of Samples
0
1-99
100-199
200-299
300-399
400-499
Number of *E. coli*
Surface
Cline
Deep

NEXT STEPS

Ocean Research College Academy

DEPARTMENT OF ECOLOGY State of Washington

EVERETT COMMUNITY COLLEGE
Stay Close... Go Far

NSF Award #1801658

GRAVITY Consulting LLC

Port of EVERETT

ACKNOWLEDGMENTS