Fish Analysis OCNMS

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10/07/2018

Exploratory analysis

These are some analyses based on the 2015-19 survey data for fish. I've done a bunch of processing in the Git repo (file "/GitHub/OCNMS/R scripts/Fish, Invert, Kelp Analysis/Swath Fish.R").

I first plotted a bunch of species together to look at the fish community. Then I plot individual species by site and time.

During the sampling, the sampling they observed a total of 31 species and species groups. A few of these are redundant, though. Here is how the sampling was distributed across sites and depths among years (underscores indicate sampling depth).

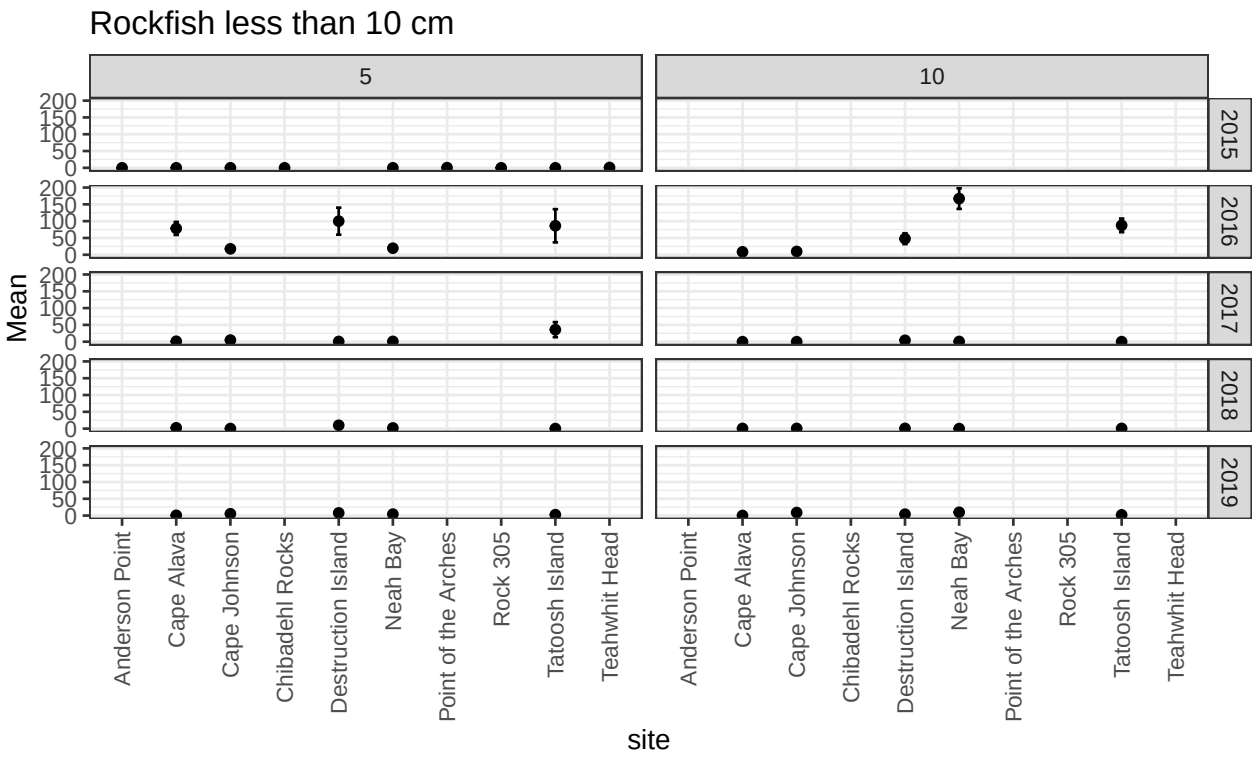
```
##                   site 2015_5 2016_5 2016_10 2017_5 2017_10 2018_5 2018_10
## 1   Destruction Island      0      4       6      8       6      8       7
## 2        Teahwhit Head      4      0       0      0       0      0       0
## 3         Cape Johnson      4      6       6      8       8      8       7
## 4             Rock 305      4      0       0      0       0      0       0
## 5           Cape Alava      4      6       6      8      11      8       8
## 6  Point of the Arches      6      0       0      0       0      0       0
## 7       Anderson Point      4      0       0      0       0      0       0
## 8       Tatoosh Island      4      4       4      6       7      8       7
## 9      Chibadehl Rocks      4      0       0      0       0      0       0
## 10            Neah Bay      7      4       6      8       8      7       8
##    2019_5 2019_10
## 1       8       8
## 2       0       0
## 3       8       7
## 4       0       0
## 5       8       8
## 6       0       0
## 7       0       0
## 8       8       6
## 9       0       0
## 10      7       8
```

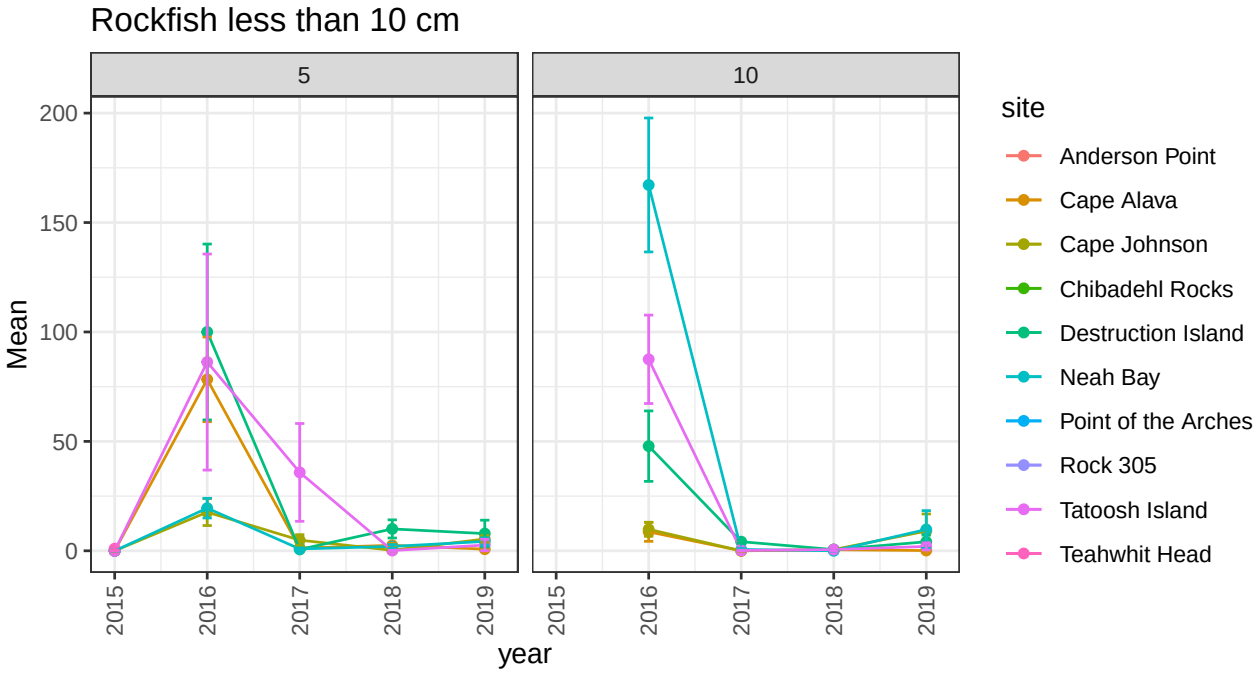
Here is a cheat sheet for species abbreviations and associated common names (ordered by abbreviation):

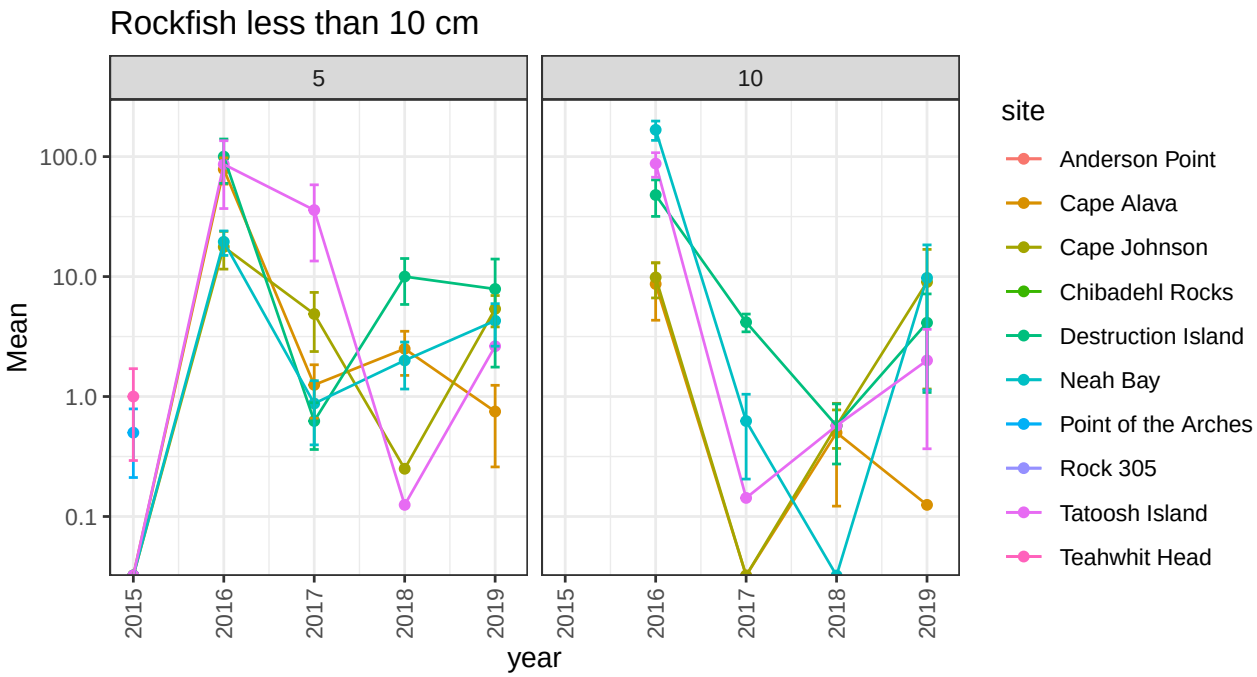
	species	common.name
1	ARHA	<NA>
2	AUFL	Tubesnout
3	BAITBALL	Bait, Sardines/Anchovies
4	CHNU	Mosshead warbonnet
5	CLUP	Sardines and anchovies
6	COTT	Sculpins
7	EMBI	Surfperches
8	EMLA	Striped Surfperch
9	ENBI	Buffalo Sculpin
10	HEDE	Kelp Greenling
11	HEHE	Red Irish Lord
12	HELA	Rock Greenling
13	HEST	Whitespotted greenling
14	JOZO	Longfin Sculpin
15	MYOPOL	<NA>
16	NO_ORG	No organisms present in this sample
17	OPEL	Lingcod
18	OXPI	Painted Greenling
19	RHNI	Blackeye Goby
20	RHVA	Pile perch
21	RIMU	Kelp clingfish
22	RYOY	Rockfish young of the year, unidentified sp.
23	SCMA	cabezon
24	SEBYTy	black and yellowtail rockfish YOY complex
25	SECA	copper rockfish
26	SEFL	Yellowtail rockfish
27	SEMA	Quillback rockfish
28	SEME	black rockfish
29	SEMY	blue rockfish
30	SENE	china rockfish
31	SEPIy	canary rockfish YOY
32	SYGI	<NA>

Small Rockfish (<10cm)

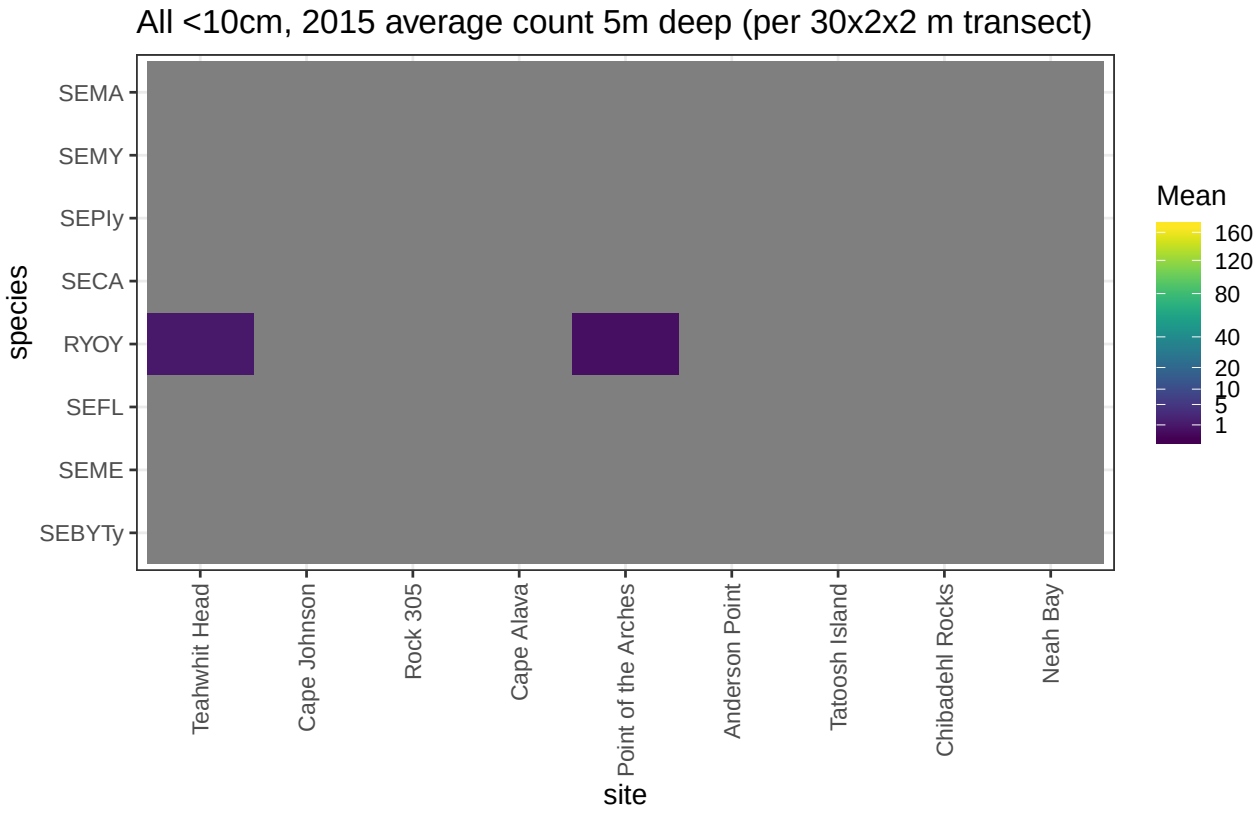
Here are the rockfish plotted in a couple different ways. This is for all small rockfish combined. I have included all transects here, not just those with visibility > 2m. See the end for information about the transects and visibility. In the bottom panel, the black boxes and error bars are simple the among site means and SE using the site means. For all panels, the 5 vs. 10 colums indicate water depth category.



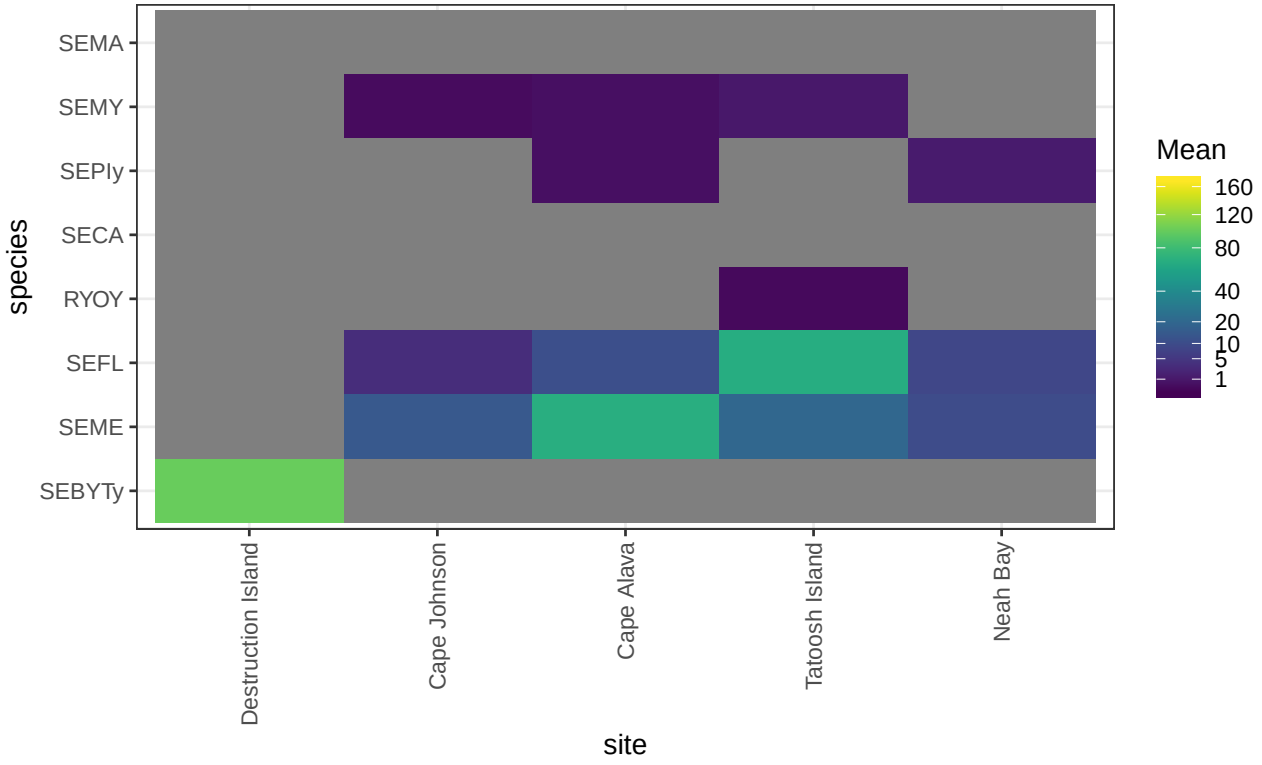




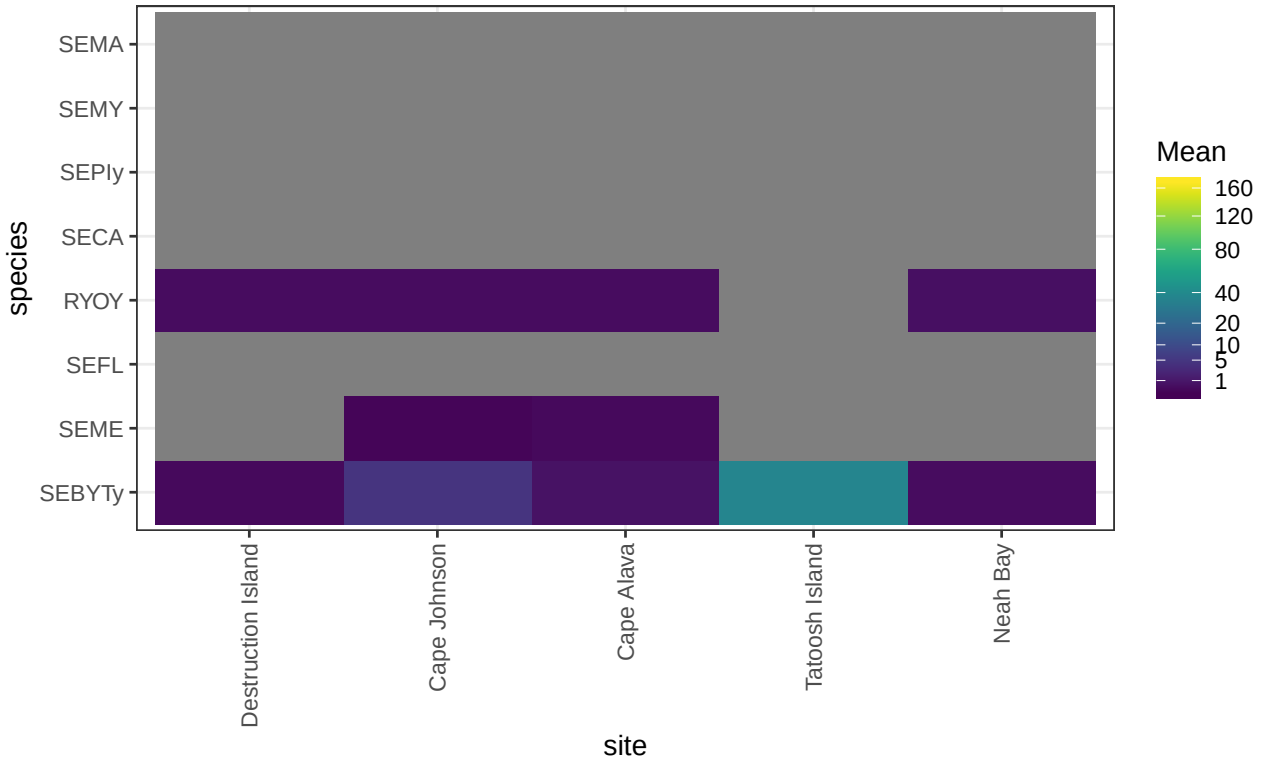
Here is why I didn't make plots of species by sub-types. Different levels of taxonomic specificity are available for different observers and years.



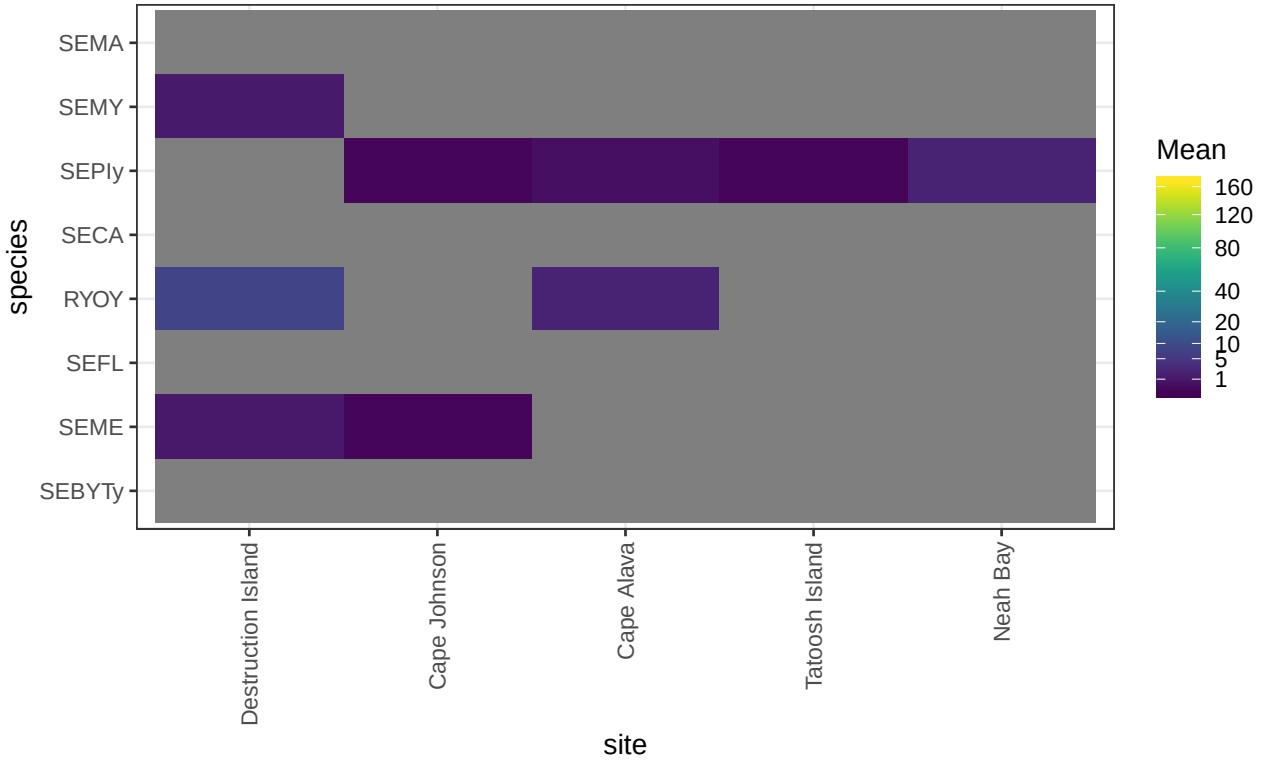
All <10cm, 2016 average count 5m deep (per 30x2x2 m transect)



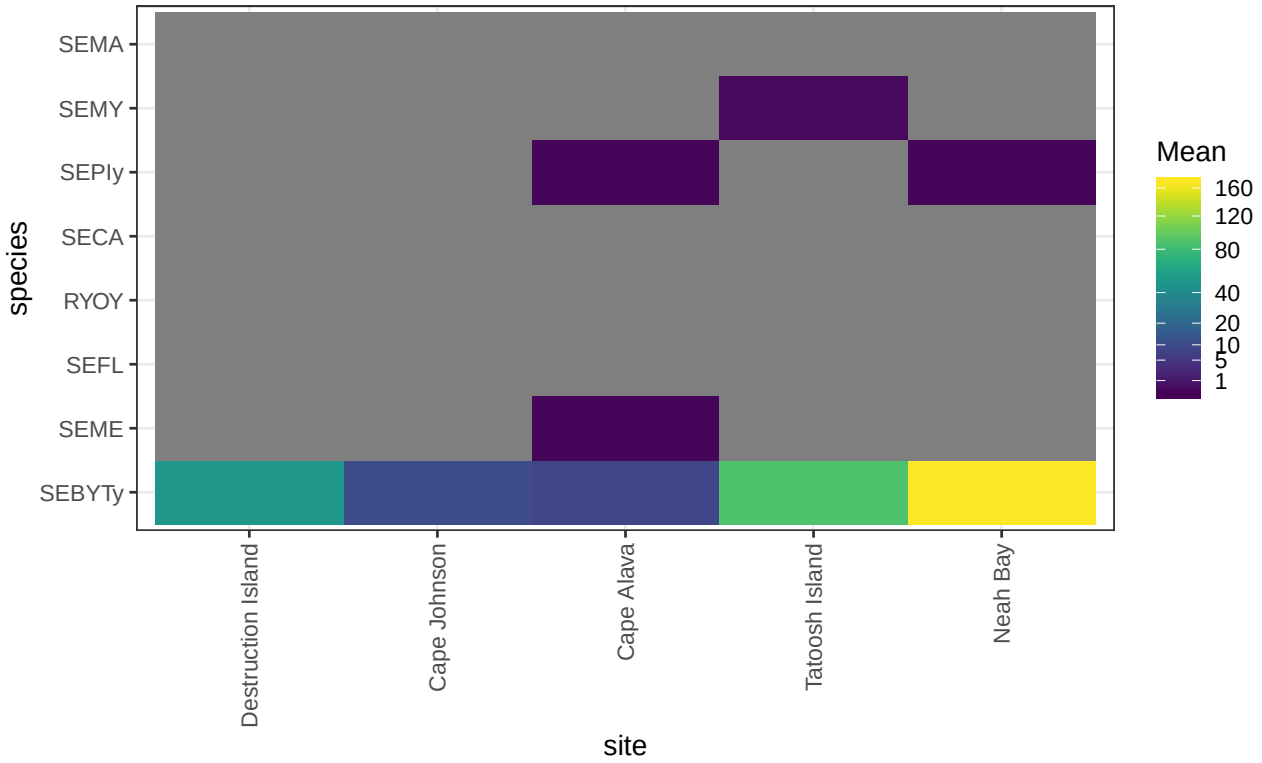
All <10cm, 2017 average count 5m deep (per 30x2x2 m transect)

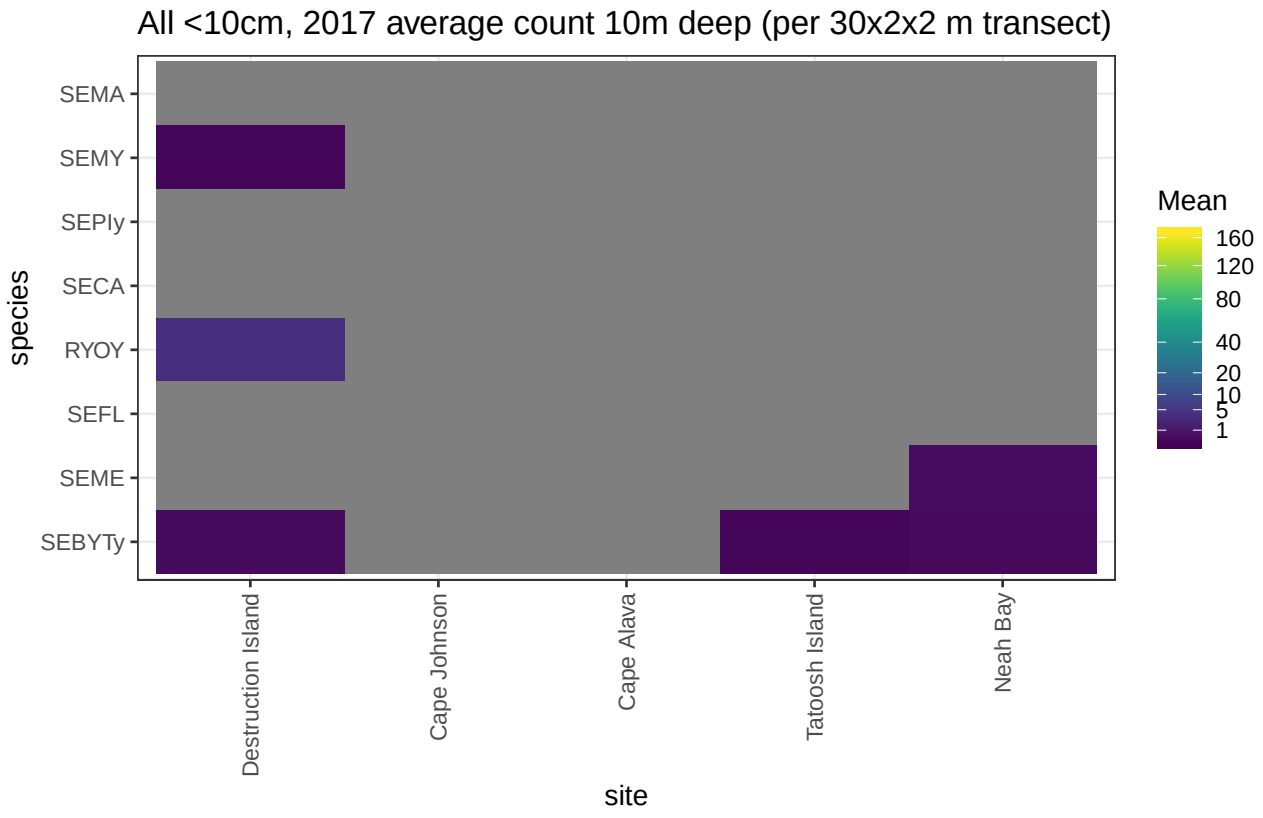


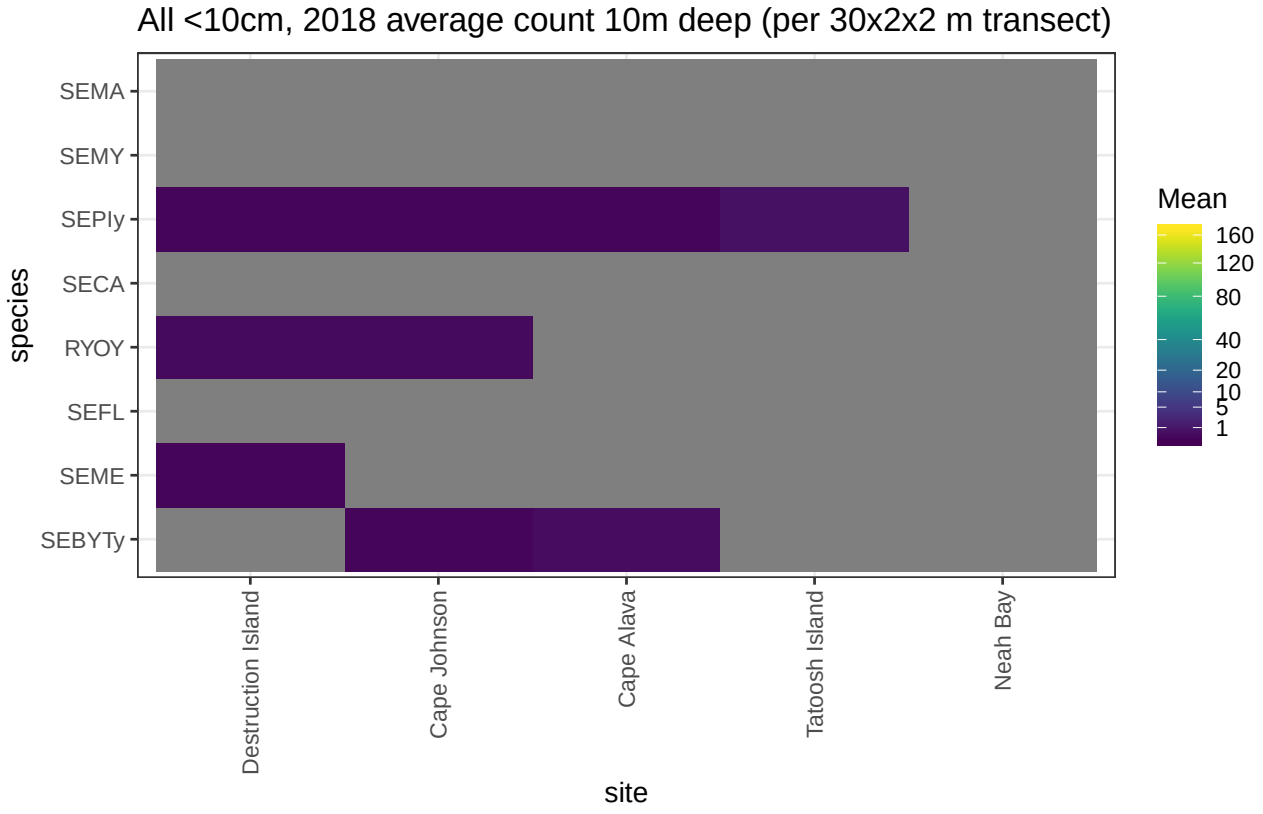
All <10cm, 2018 average count 5m deep (per 30x2x2 m transect)



All <10cm, 2016 average count 10m deep (per 30x2x2 m transect)

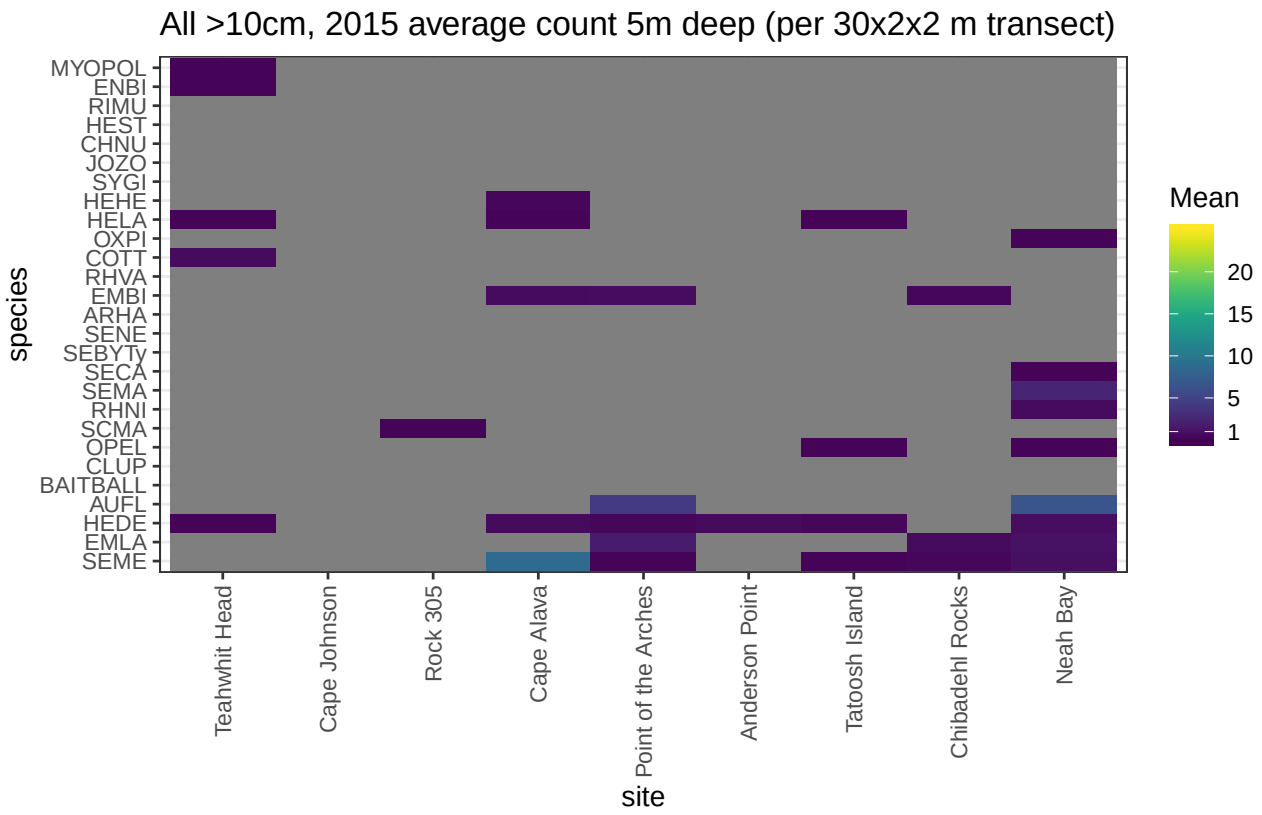


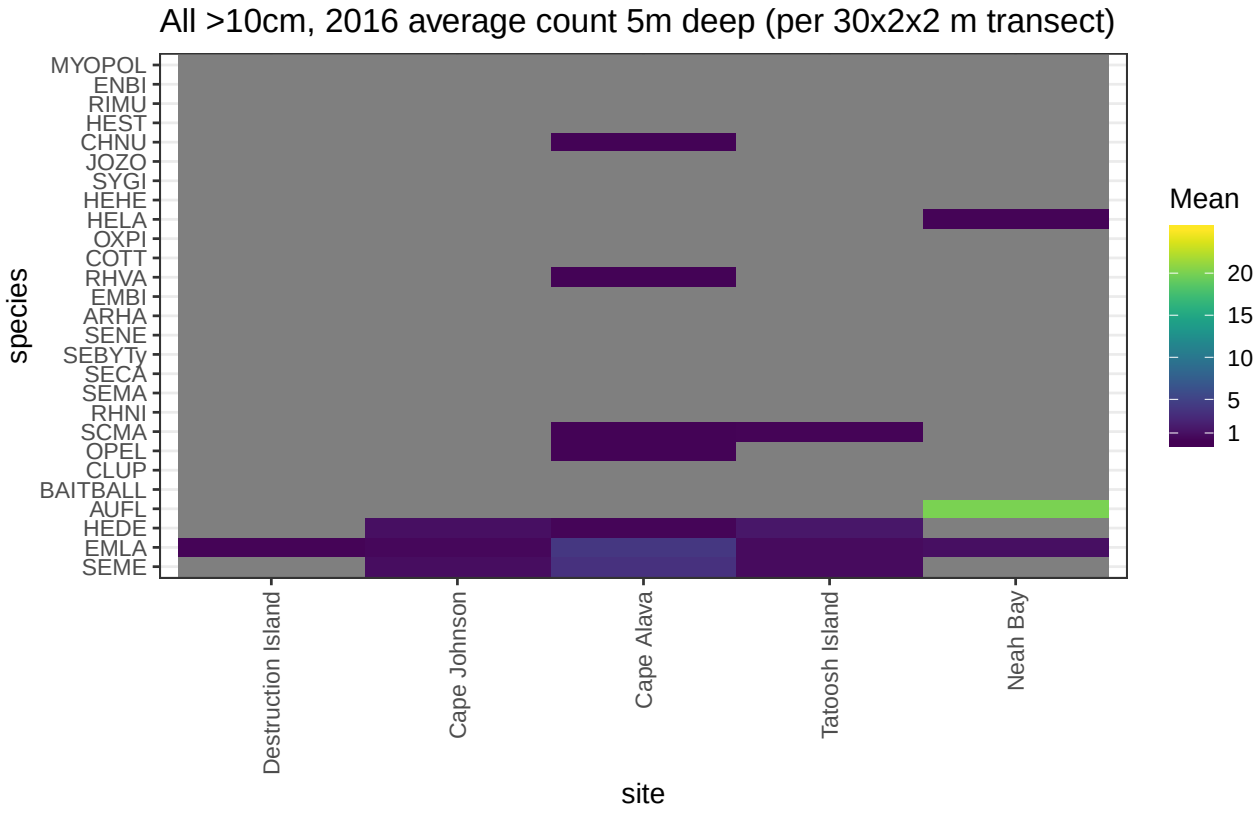

All <10cm, 2017 average count 10m deep (per 30x2x2 m transect)
species
SEMA
SEMY
SEPly
SECA
RYOY
SEFL
SEME
SEBYTy
Destruction Island
Cape Johnson
Cape Alava
Tatoosh Island
Neah Bay
site
Mean
160
120
80
40
20
10
5
1

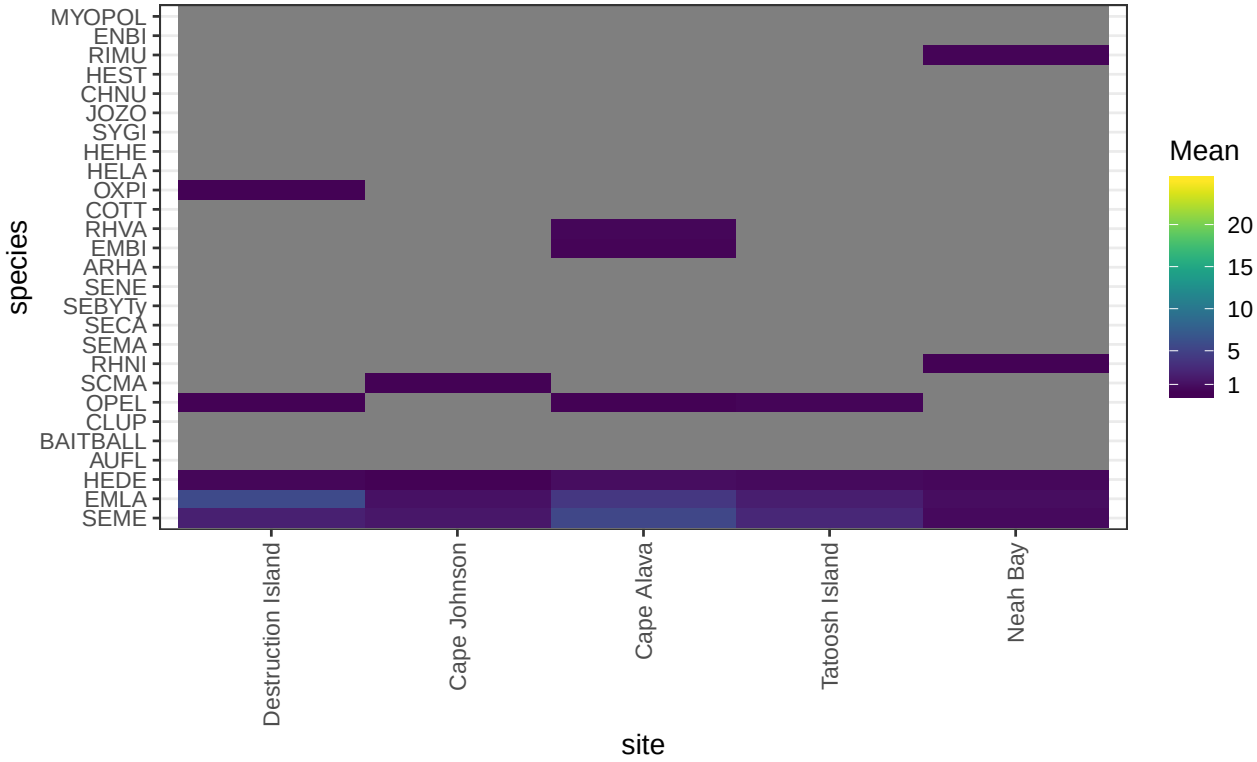

All <10cm, 2018 average count 10m deep (per 30x2x2 m transect)
species
SEMA
SEMY
SEPly
SECA
RYOY
SEFL
SEME
SEBYTy
Destruction Island
Cape Johnson
Cape Alava
Tatoosh Island
Neah Bay
site
Mean
160
120
80
40
20
10
5
1

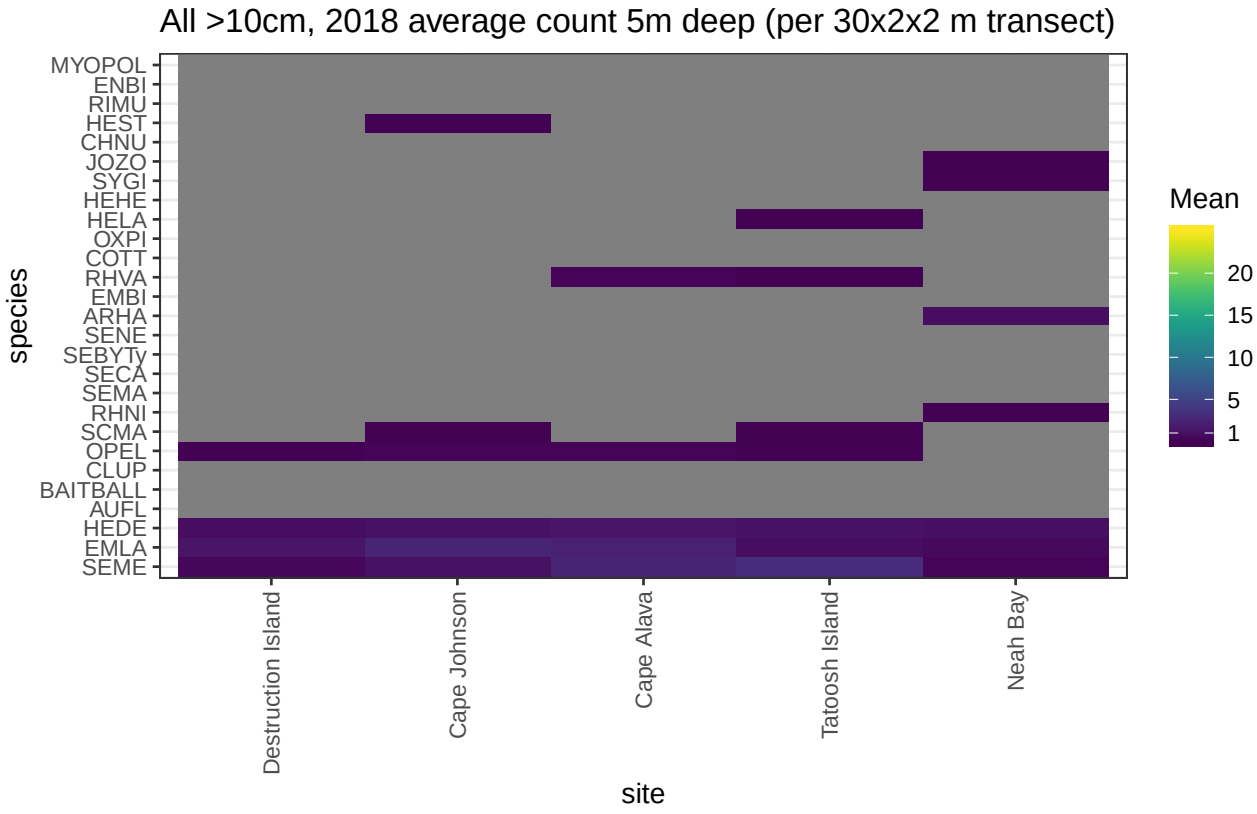
All Other Fish Except small rockfish

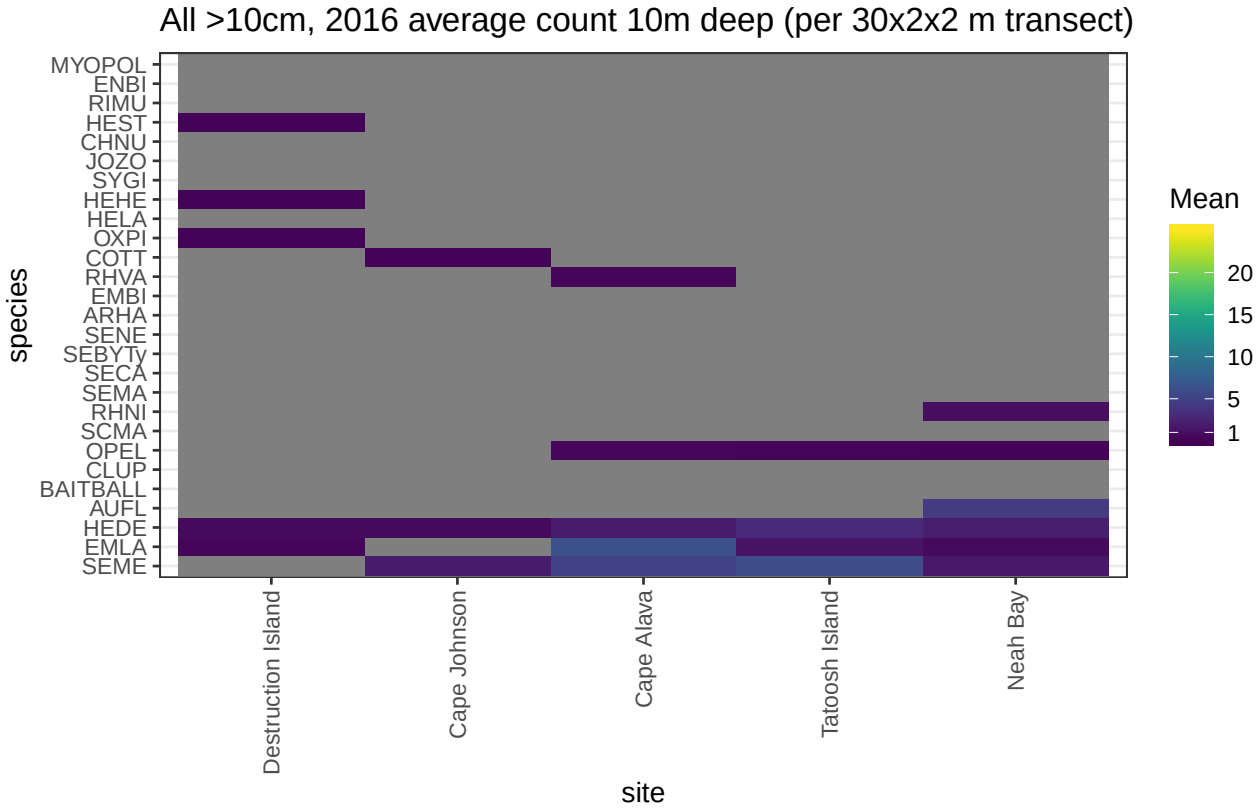
Here, here are the fish > 10 cm. In general, you will notice a lot of grey in the figures. This means most species were not observed in any transect at that site-year combination.



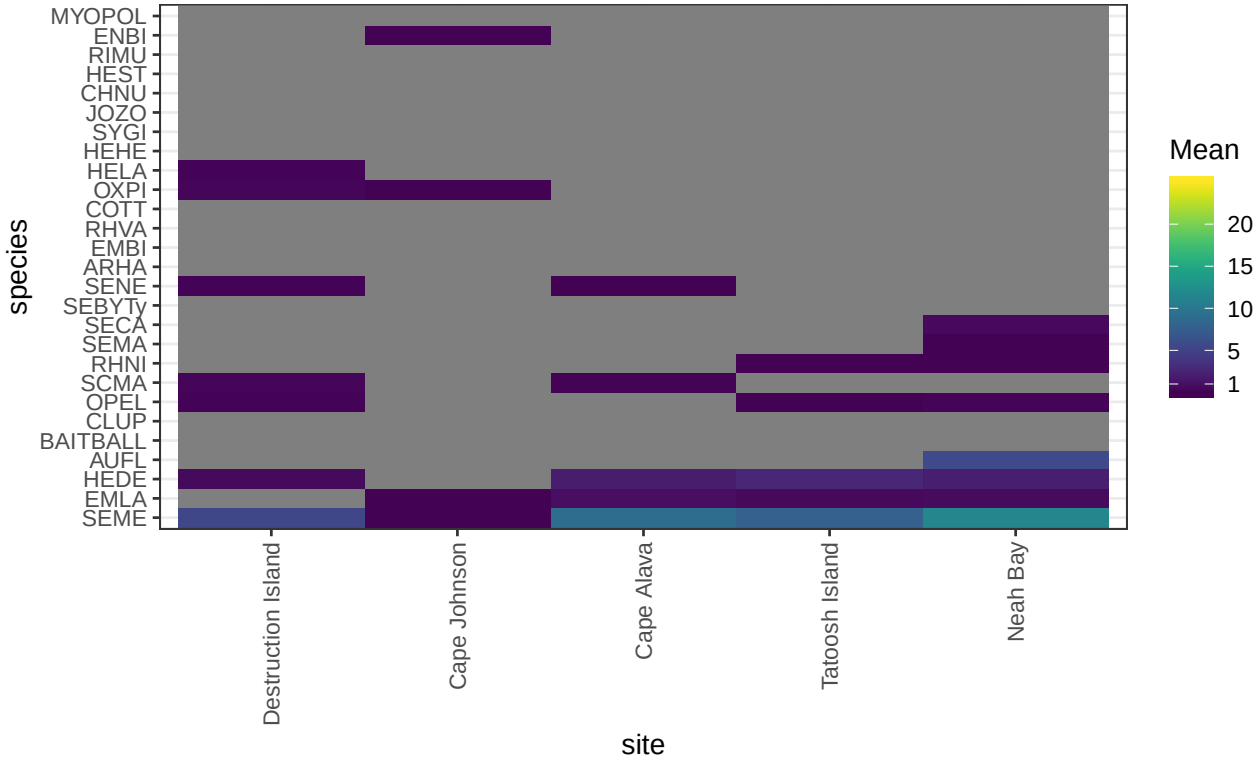

All >10cm, 2016 average count 5m deep (per 30x2x2 m transect)
species
MYOPOL
ENBI
RIMU
HEST
CHNU
JOZO
SYGI
HEHE
HELA
OXPI
COTT
RHVA
EMBI
ARHA
SENE
SEBYTy
SECA
SEMA
RHNI
SCMA
OPEL
CLUP
BAITBALL
AUFL
HEDE
EMLA
SEME
Destruction Island
Cape Johnson
Cape Alava
Tatoosh Island
Neah Bay
site
Mean
20
15
10
5
1


All >10cm, 2017 average count 5m deep (per 30x2x2 m transect)
species
MYOPOL
ENBI
RIMU
HEST
CHNU
JOZO
SYGI
HEHE
HELA
OXPI
COTT
RHVA
EMBI
ARHA
SENE
SEBYTy
SECA
SEMA
RHNI
SCMA
OPEL
CLUP
BAITBALL
AUFL
HEDE
EMLA
SEME
Destruction Island
Cape Johnson
Cape Alava
Tatoosh Island
Neah Bay
site
Mean
20
15
10
5
1

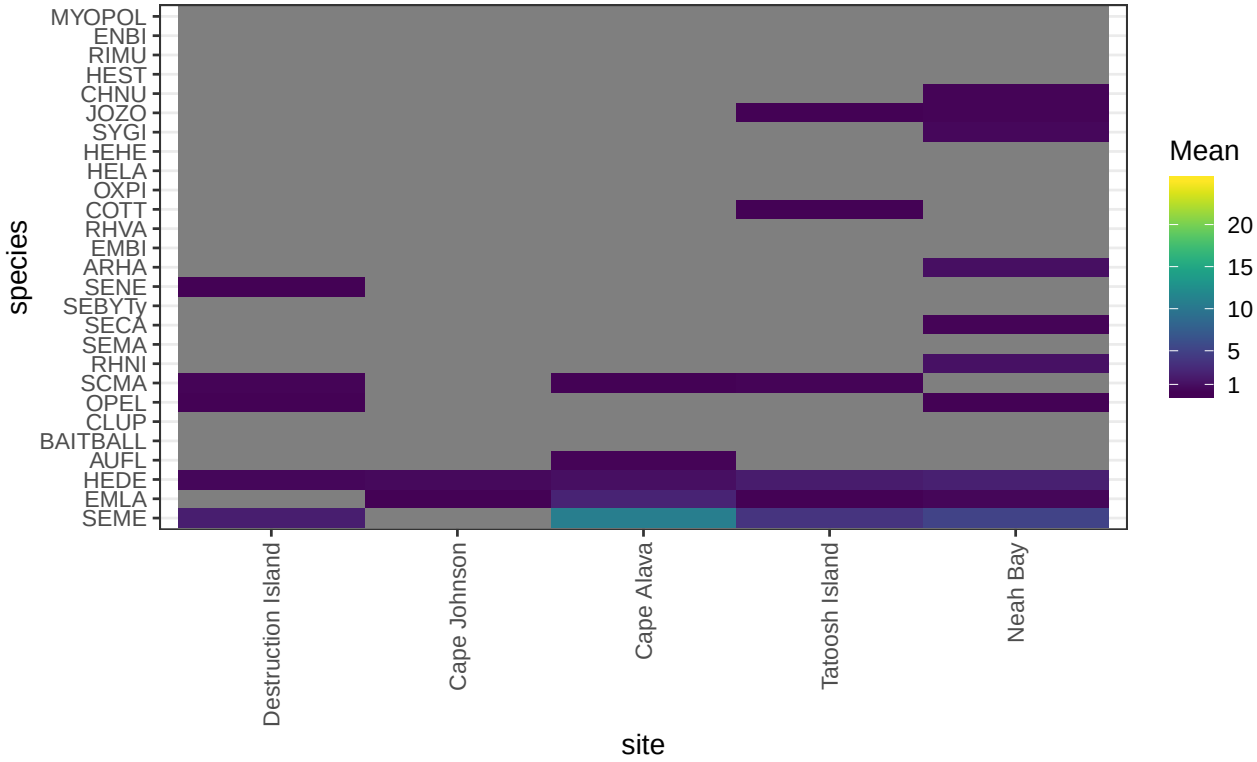

All >10cm, 2018 average count 5m deep (per 30x2x2 m transect)
species
MYOPOL
ENBI
RIMU
HEST
CHNU
JOZO
SYGI
HEHE
HELA
OXPI
COTT
RHVA
EMBI
ARHA
SENE
SEBYTy
SECA
SEMA
RHNI
SCMA
OPEL
CLUP
BAITBALL
AUFL
HEDE
EMLA
SEME
Destruction Island
Cape Johnson
Cape Alava
Tatoosh Island
Neah Bay
site
Mean
20
15
10
5
1


All >10cm, 2016 average count 10m deep (per 30x2x2 m transect)
species
MYOPOL
ENBI
RIMU
HEST
CHNU
JOZO
SYGI
HEHE
HELA
OXPI
COTT
RHVA
EMBI
ARHA
SENE
SEBYTy
SECA
SEMA
RHNI
SCMA
OPEL
CLUP
BAITBALL
AUFL
HEDE
EMLA
SEME
Destruction Island
Cape Johnson
Cape Alava
Tatoosh Island
Neah Bay
site
Mean
20
15
10
5
1

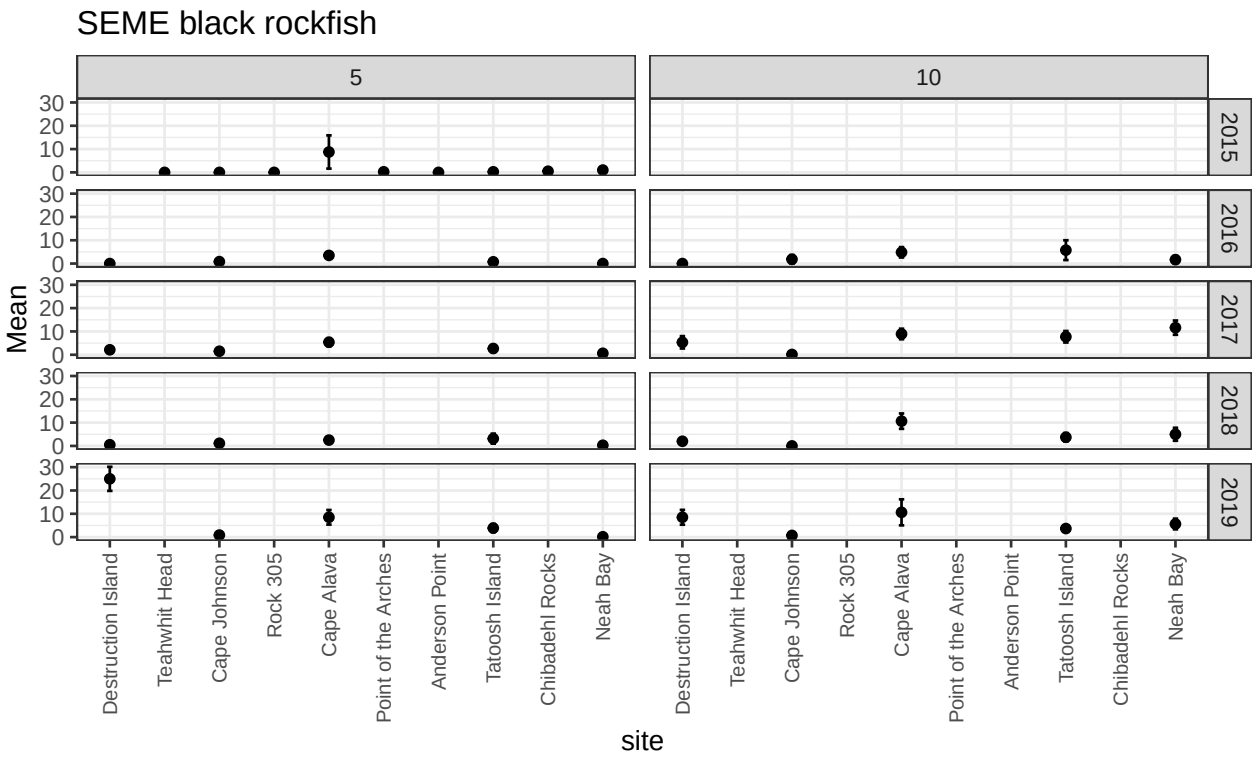
All >10cm, 2017 average count 10m deep (per 30x2x2 m transect)

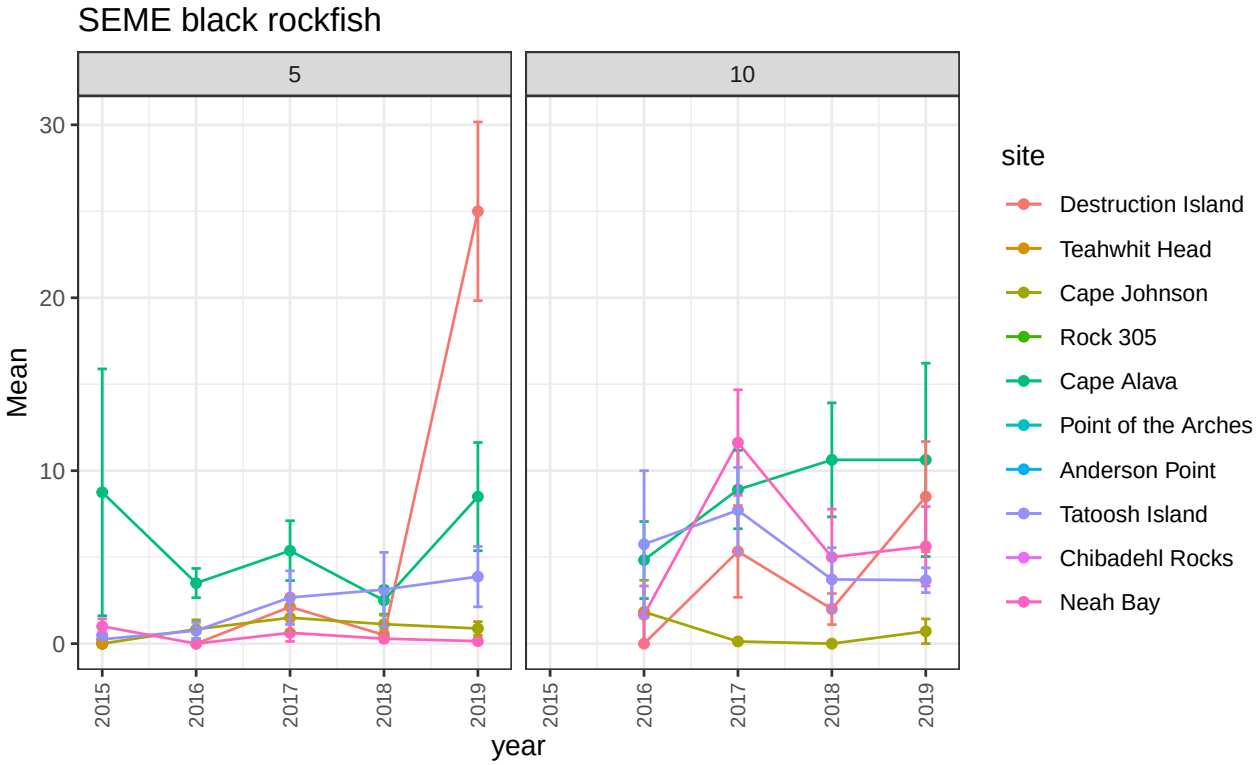


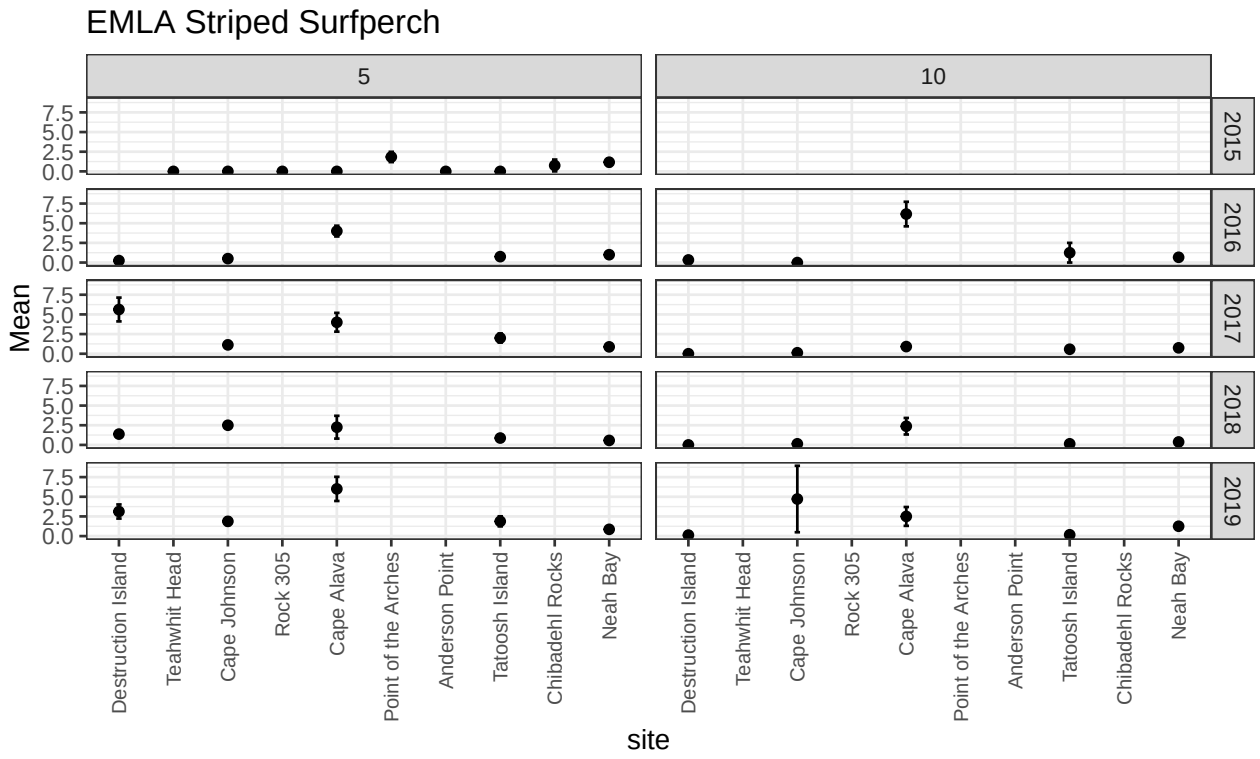
All >10cm, 2018 average count 10m deep (per 30x2x2 m transect)

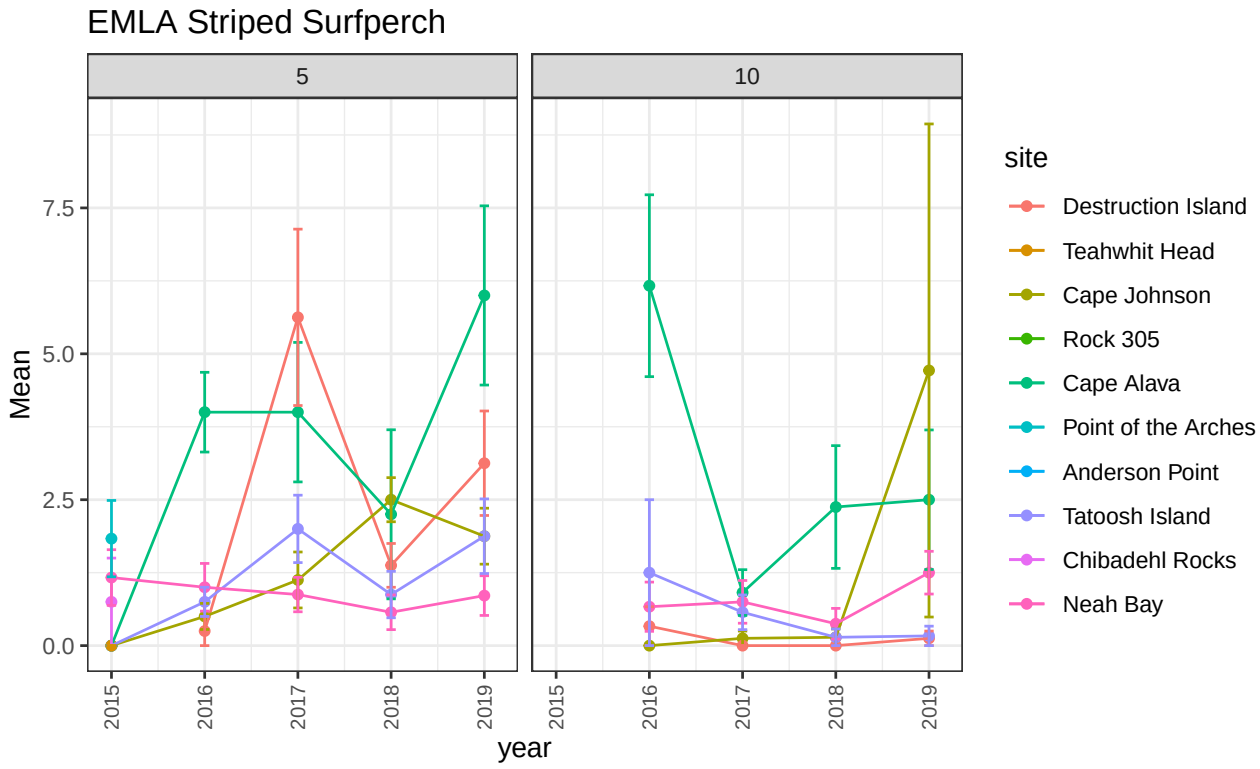


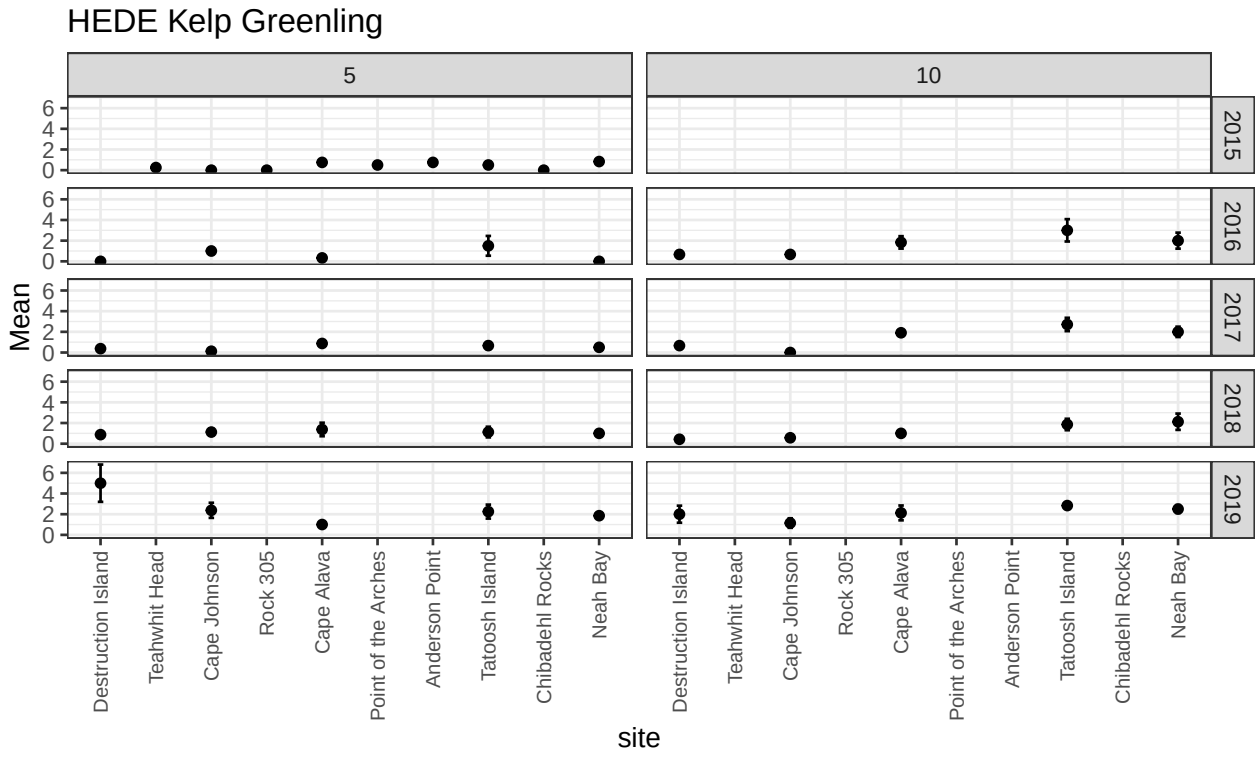
Example time series and spatial variation for the top 8 most common species.

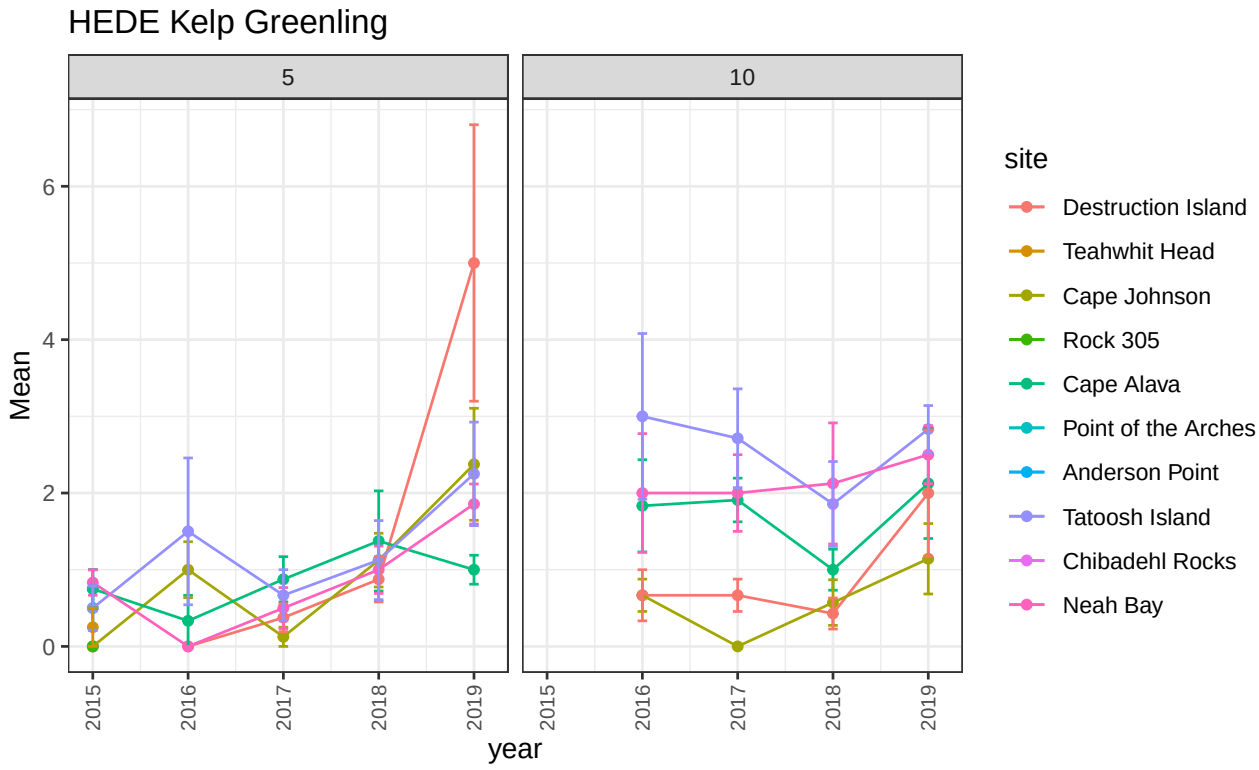


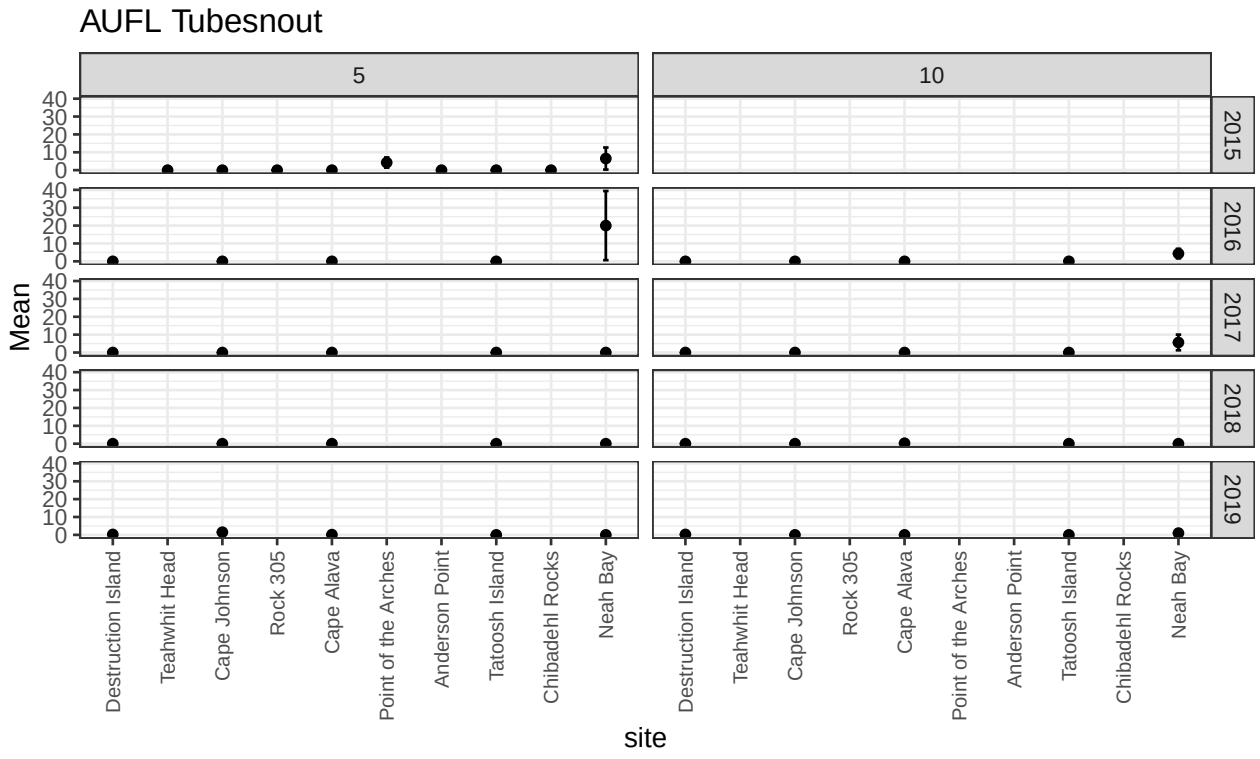


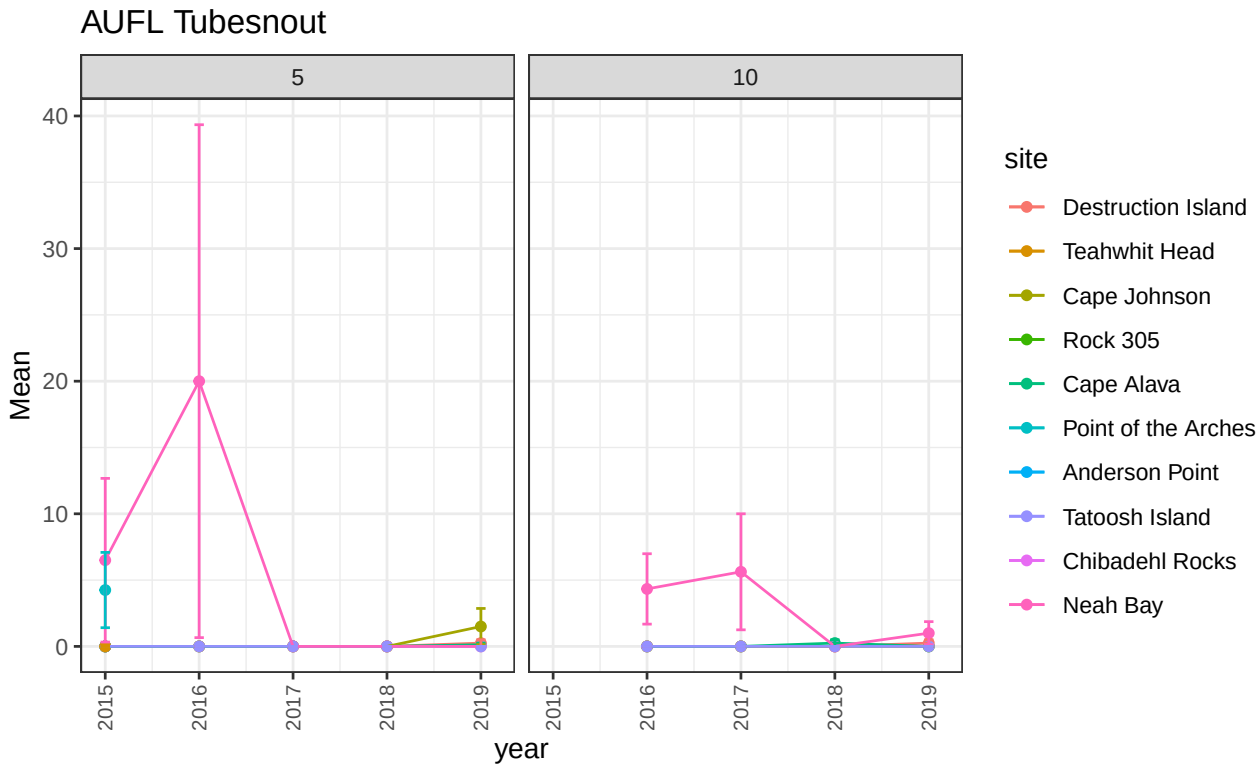

EMLA Striped Surfperch
5
10
2015
2016
2017
2018
2019
Mean
7.5
5.0
2.5
0.0
Destruction Island
Teahwhit Head
Cape Johnson
Rock 305
Cape Alava
Point of the Arches
Anderson Point
Tatoosh Island
Chibadehl Rocks
Neah Bay
site

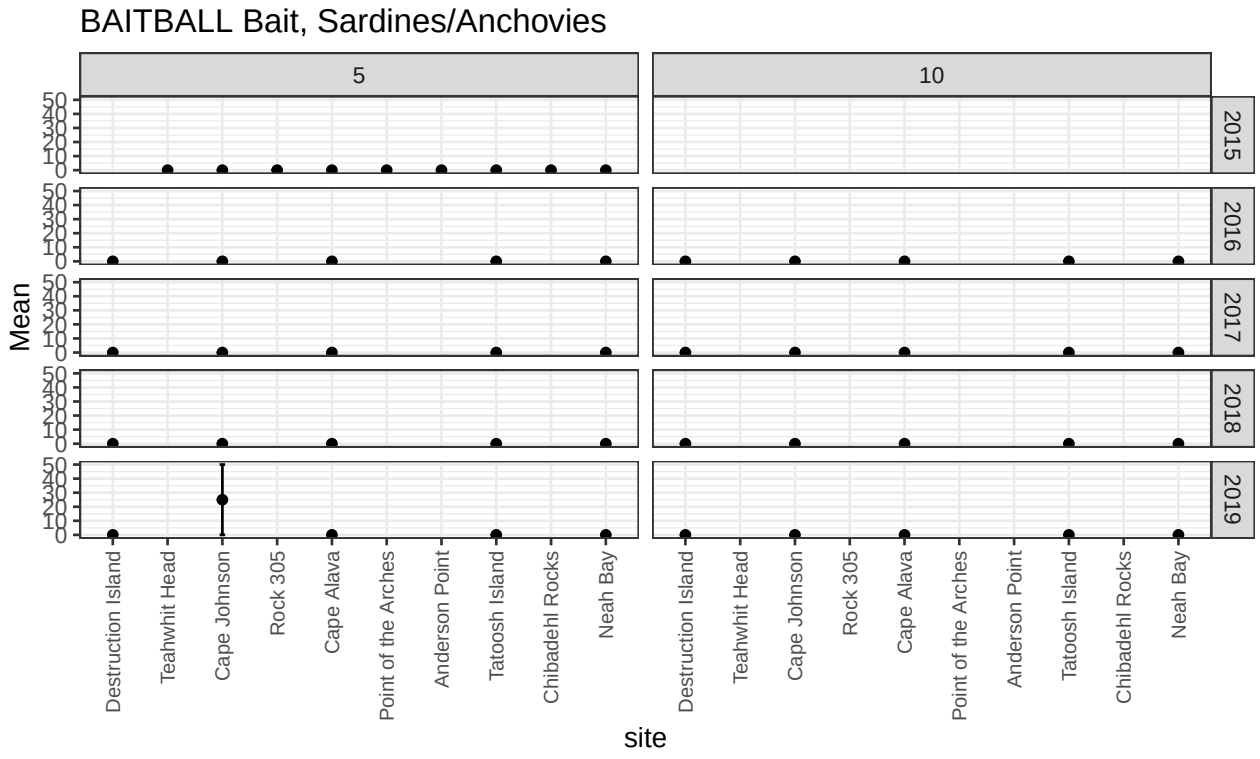

EMLA Striped Surfperch
5
10
Mean
7.5
5.0
2.5
0.0
2015
2016
2017
2018
2019
year
site
Destruction Island
Teahwhit Head
Cape Johnson
Rock 305
Cape Alava
Point of the Arches
Anderson Point
Tatoosh Island
Chibadehl Rocks
Neah Bay

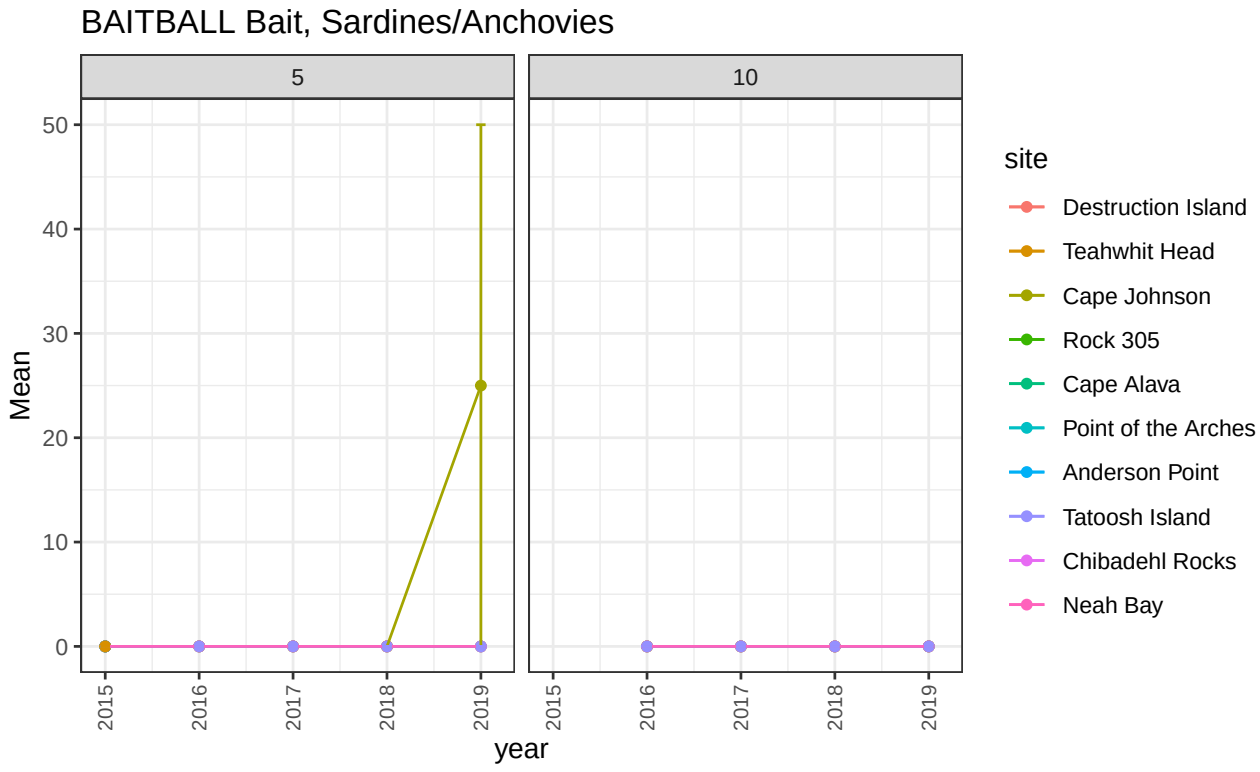

HEDE Kelp Greenling
5
10
2015
2016
2017
2018
2019
Mean
0
2
4
6
Destruction Island
Teahwhit Head
Cape Johnson
Rock 305
Cape Alava
Point of the Arches
Anderson Point
Tatoosh Island
Chibadehl Rocks
Neah Bay
site

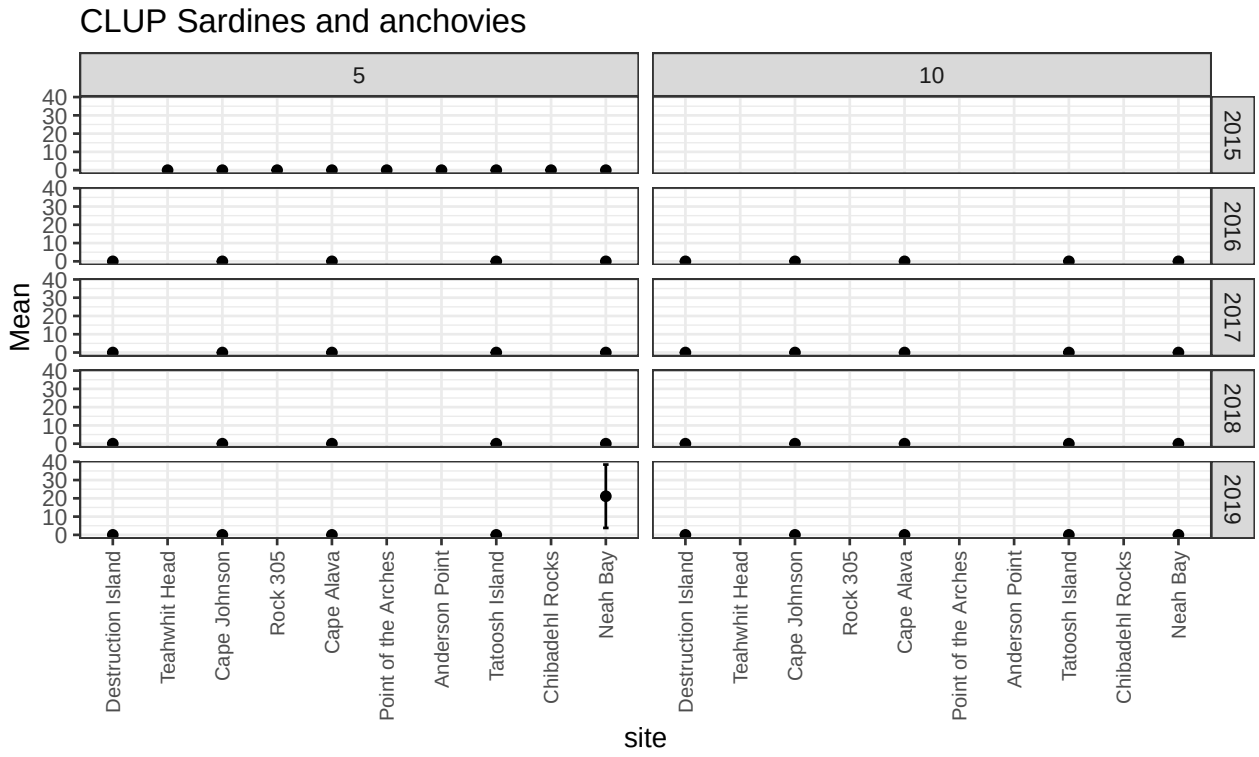

HEDE Kelp Greenling
5
10
Mean
0
2
4
6
2015
2016
2017
2018
2019
year
site
Destruction Island
Teahwhit Head
Cape Johnson
Rock 305
Cape Alava
Point of the Arches
Anderson Point
Tatoosh Island
Chibadehl Rocks
Neah Bay

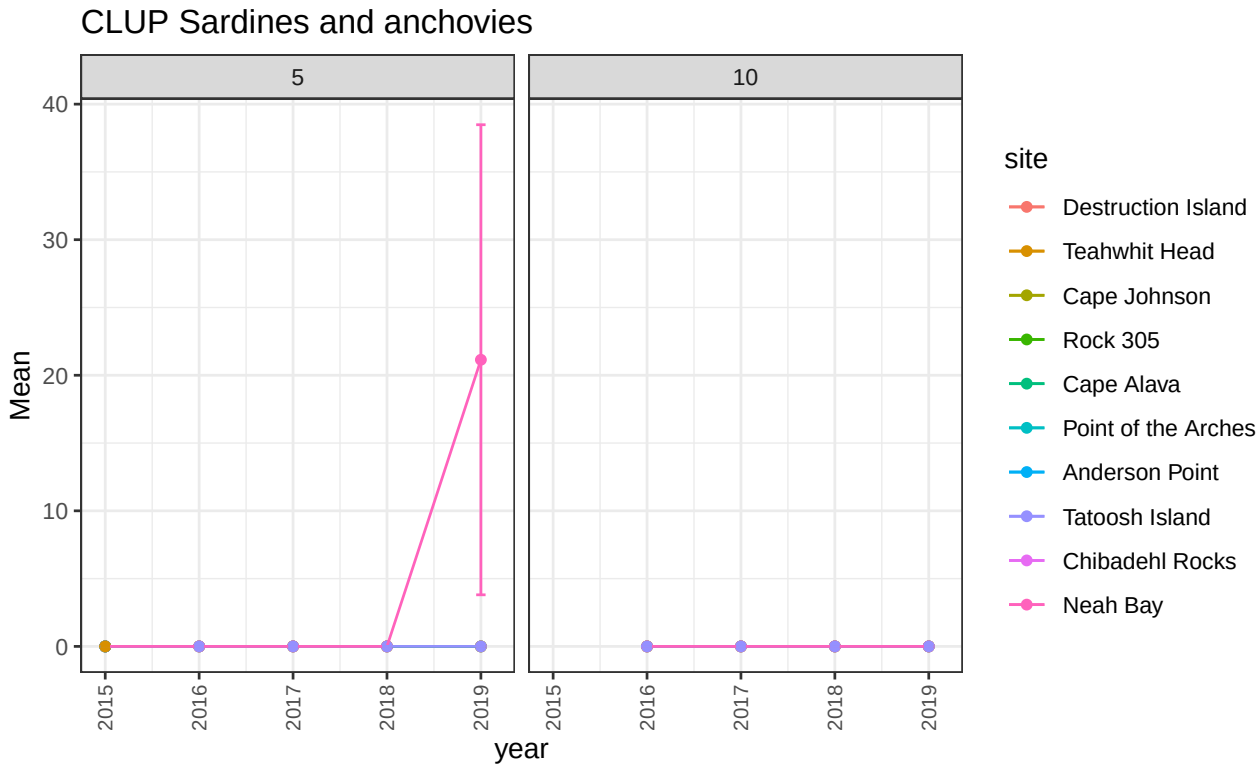

AUFL Tubesnout
5
10
2015
2016
2017
2018
2019
Mean
0
10
20
30
40
Destruction Island
Teahwhit Head
Cape Johnson
Rock 305
Cape Alava
Point of the Arches
Anderson Point
Tatoosh Island
Chibadehl Rocks
Neah Bay
site

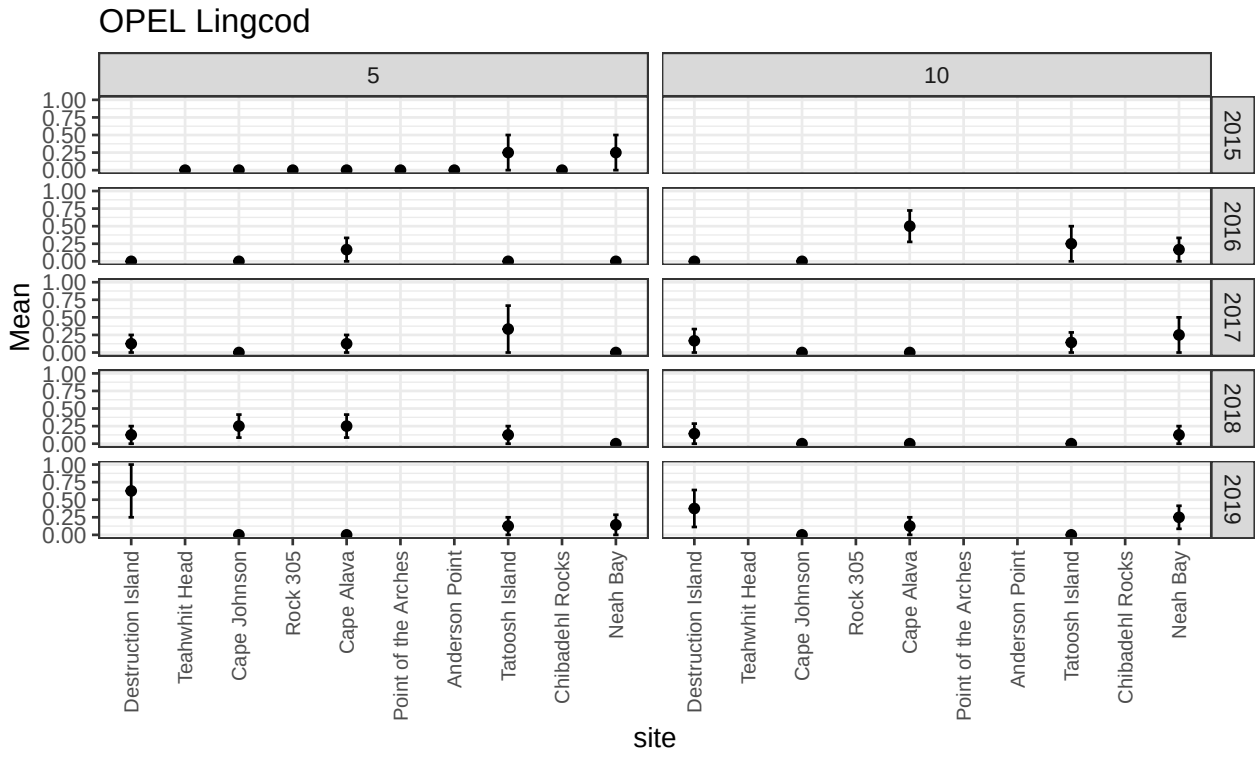

AUFL Tubesnout
5
10
Mean
0
10
20
30
40
2015
2016
2017
2018
2019
year
site
Destruction Island
Teahwhit Head
Cape Johnson
Rock 305
Cape Alava
Point of the Arches
Anderson Point
Tatoosh Island
Chibadehl Rocks
Neah Bay

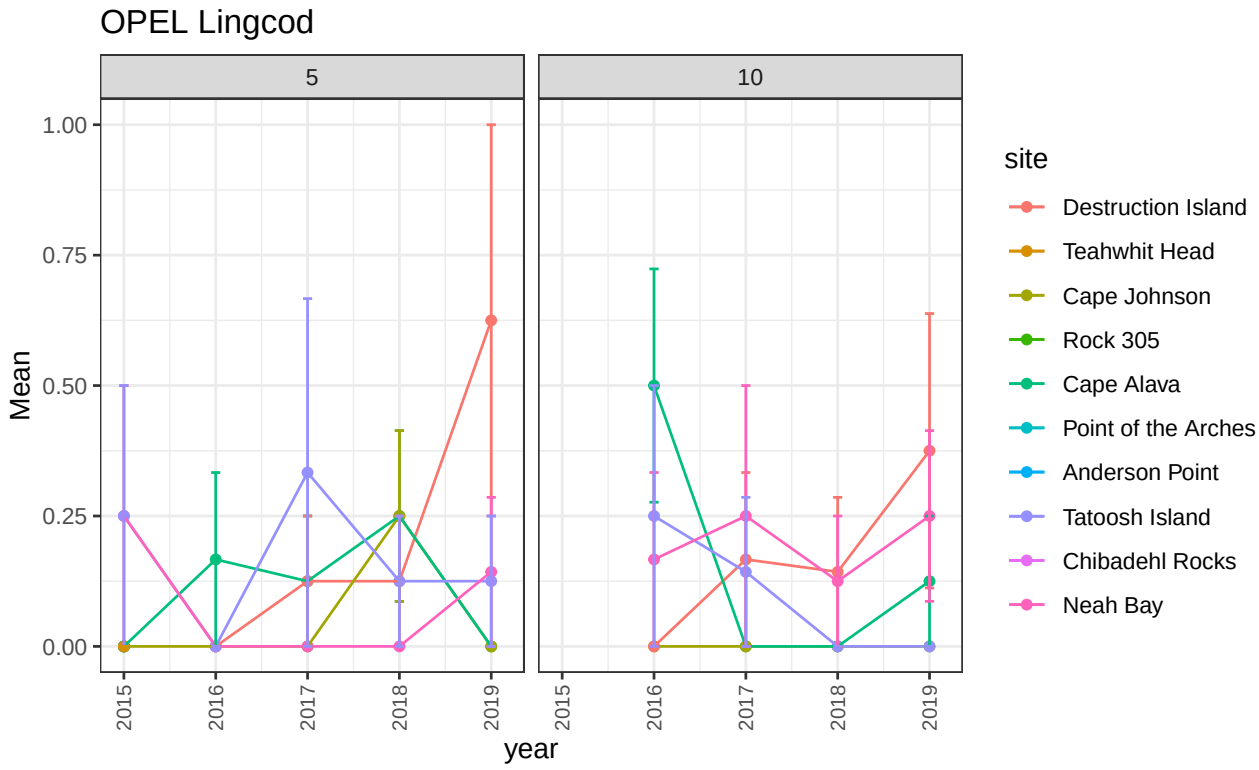

BAITBALL Bait, Sardines/Anchovies
5
10
2015
2016
2017
2018
2019
Mean
0
10
20
30
40
50
Destruction Island
Teahwhit Head
Cape Johnson
Rock 305
Cape Alava
Point of the Arches
Anderson Point
Tatoosh Island
Chibadehl Rocks
Neah Bay
site

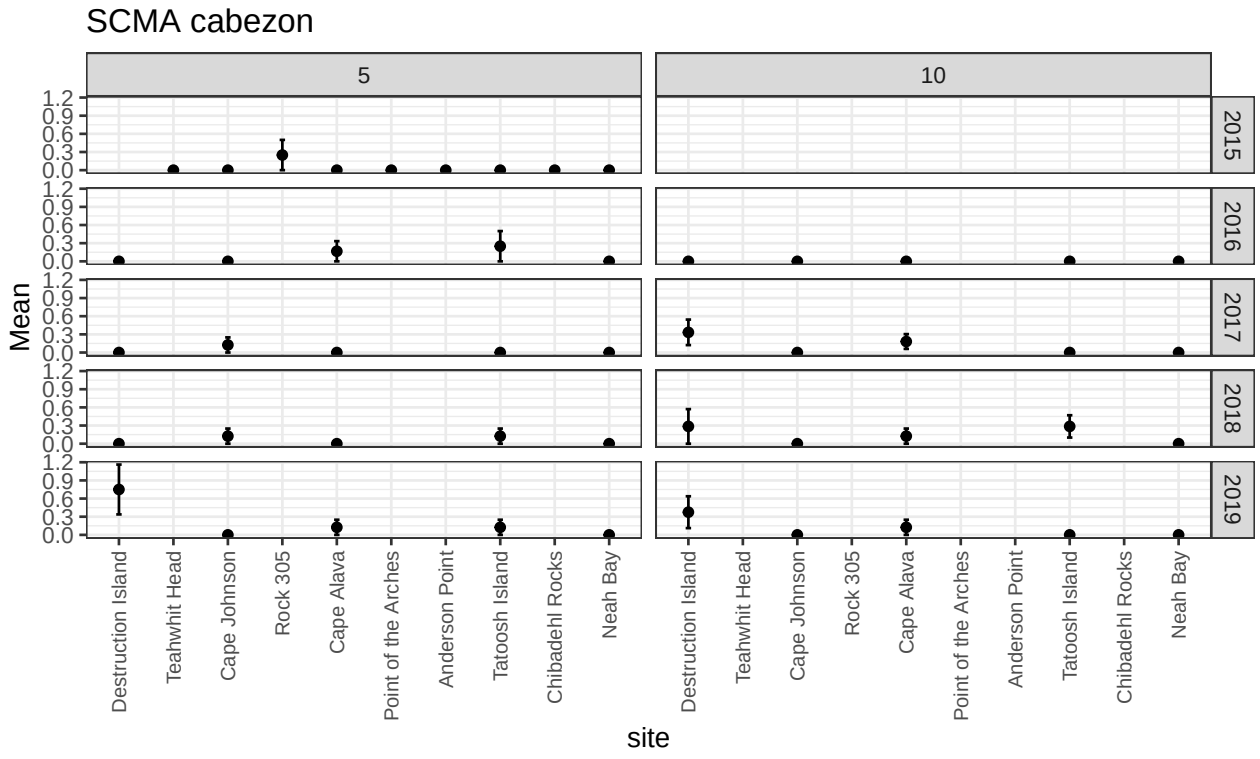

BAITBALL Bait, Sardines/Anchovies
5
10
Mean
0
10
20
30
40
50
2015
2016
2017
2018
2019
year
site
Destruction Island
Teahwhit Head
Cape Johnson
Rock 305
Cape Alava
Point of the Arches
Anderson Point
Tatoosh Island
Chibadehl Rocks
Neah Bay


CLUP Sardines and anchovies
5
10
2015
2016
2017
2018
2019
Mean
0
10
20
30
40
Destruction Island
Teahwhit Head
Cape Johnson
Rock 305
Cape Alava
Point of the Arches
Anderson Point
Tatoosh Island
Chibadehl Rocks
Neah Bay
site


CLUP Sardines and anchovies
5
10
Mean
0
10
20
30
40
2015
2016
2017
2018
2019
year
site
Destruction Island
Teahwhit Head
Cape Johnson
Rock 305
Cape Alava
Point of the Arches
Anderson Point
Tatoosh Island
Chibadehl Rocks
Neah Bay


OPEL Lingcod
5
10
2015
2016
2017
2018
2019
Mean
1.00
0.75
0.50
0.25
0.00
Destruction Island
Teahwhit Head
Cape Johnson
Rock 305
Cape Alava
Point of the Arches
Anderson Point
Tatoosh Island
Chibadehl Rocks
Neah Bay
site


OPEL Lingcod
5
10
Mean
1.00
0.75
0.50
0.25
0.00
2015
2016
2017
2018
2019
year
site
Destruction Island
Teahwhit Head
Cape Johnson
Rock 305
Cape Alava
Point of the Arches
Anderson Point
Tatoosh Island
Chibadehl Rocks
Neah Bay


SCMA cabezon
5
10
2015
2016
2017
2018
2019
Mean
0.0
0.3
0.6
0.9
1.2
Destruction Island
Teahwhit Head
Cape Johnson
Rock 305
Cape Alava
Point of the Arches
Anderson Point
Tatoosh Island
Chibadehl Rocks
Neah Bay
site


SCMA cabezon
5
10
Mean
0.0
0.3
0.6
0.9
1.2
2015
2016
2017
2018
2019
year
site
Destruction Island
Teahwhit Head
Cape Johnson
Rock 305
Cape Alava
Point of the Arches
Anderson Point
Tatoosh Island
Chibadehl Rocks
Neah Bay

Some plots on visibility by site and depth zone

These suggest to me that the 2m cut off that PISCO uses is going to be problematic... there are a lot of surveys that are right on the cusp of 2m visibility.