Initial OCNMS Community Analyses - FISH

FISH

ORDINATIONS BY TRANSECT

I limited the species to those see on at least 20 transects. I also removed transects with no fish sightings. Stress was 0.1180545, which is good. The model converged.

```
##
## Call:
## metaMDS(comm = fish_matrix, distance = "bray", k = 3, trymax = 100,      autotransform = TRUE)
##
## global Multidimensional Scaling using monoMDS
##
## Data:     wisconsin(sqrt(fish_matrix))
## Distance: bray
##
## Dimensions: 3
## Stress:     0.1180545
## Stress type 1, weak ties
## Two convergent solutions found after 80 tries
## Scaling: centring, PC rotation, halfchange scaling
## Species: expanded scores based on 'wisconsin(sqrt(fish_matrix))'
```

The nMDS ordination does not show any clear patterns. I would suggest that this means that there is too much variation at the transect level to see any really obvious patterns. I suppose Cape Alava might be a bit farther to the upper right than other sites, and it diesn't overlap much with Tatoosh.

I've only plotted mds1 vs mds2 at present.

The figure below separates years. The nMDS is the same. I've just plotted years separately for clarity. There are no patterns that jump out at me.

BY YEAR, SITE, DEPTH ZONE

I averaged the observations by site, year, and depth to partly reduce the number of data points and to be better able to see any assemblage trends through time.

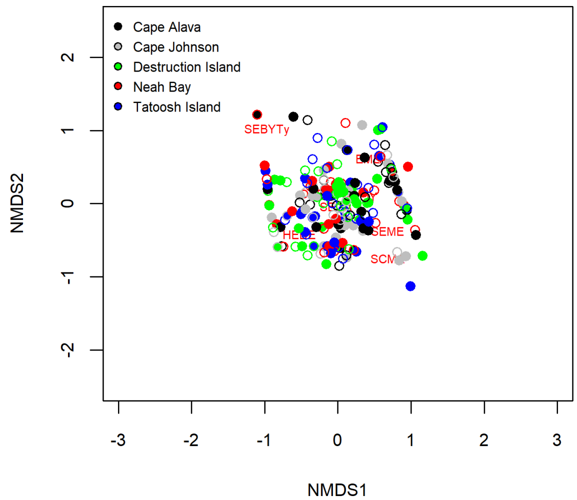


Figure 1: nMDS plot of fish assemblage structure. Colors indicate sites. Open circues = 5 m, closed circles = 10 m. Years are not differentiated in this figure.

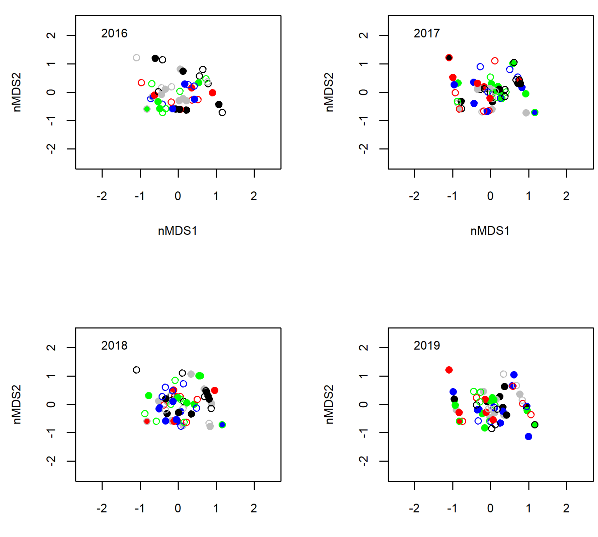
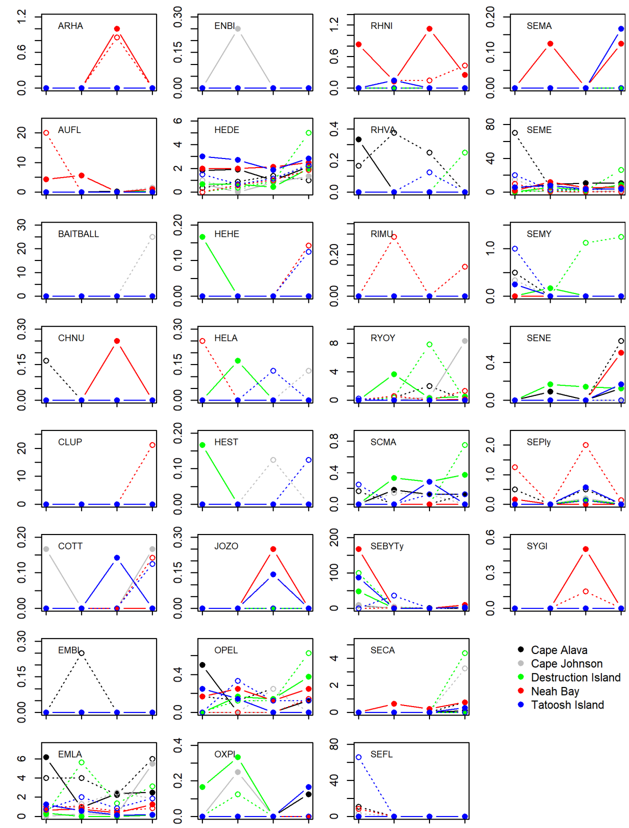
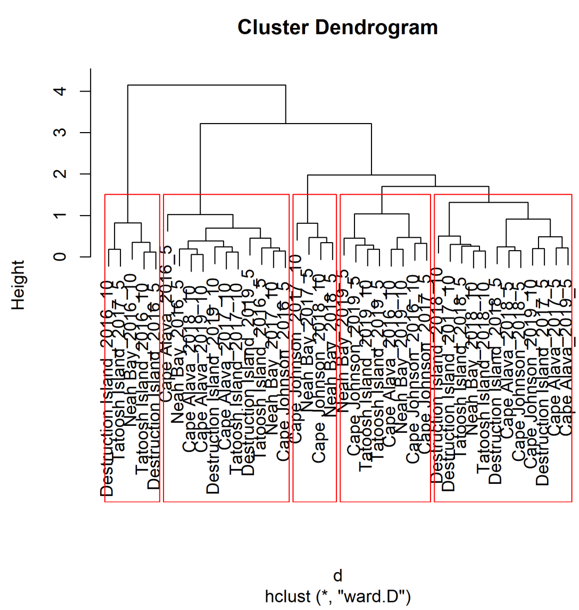


Figure 2: nMDS plot of fish assemblage structure. Colors indicate sites. Open circues = 5 m, closed circles = 10 m. Years are not differentiated in this figure.



This model converged and had a stress of 0.1632153, which is less than 0.2, so OK. There still appears to be a lot of overlap among sites, but the differenfes among depths is more apparent for some sites.

I also ran some cluster analyses, which is a typical add-on to an nMDS analysis. I ran two version. The differences don't really matter. Key point is that both suggest that the biggest difference, the biggest branching, was 2016 for some sites and depths versus everyting else.



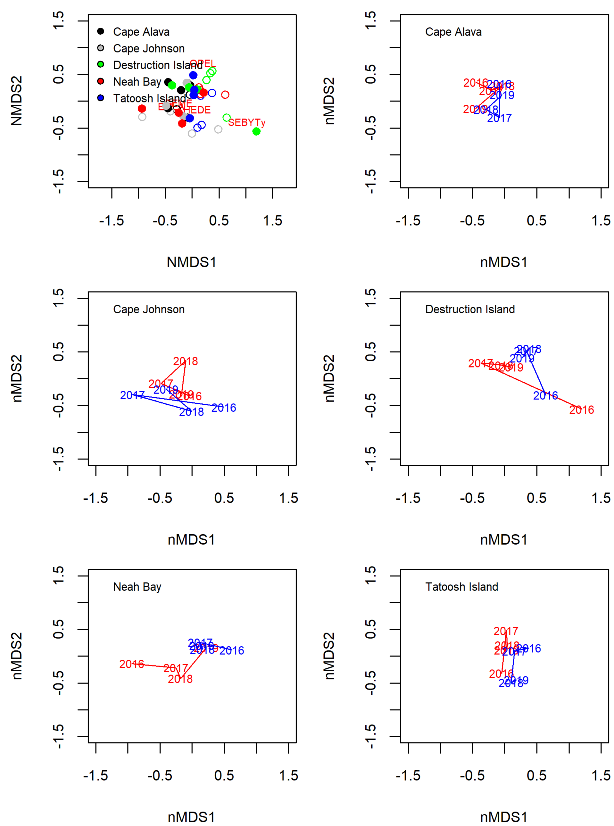
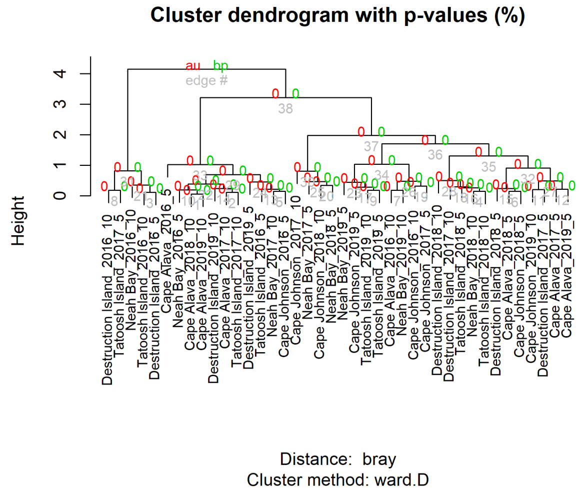


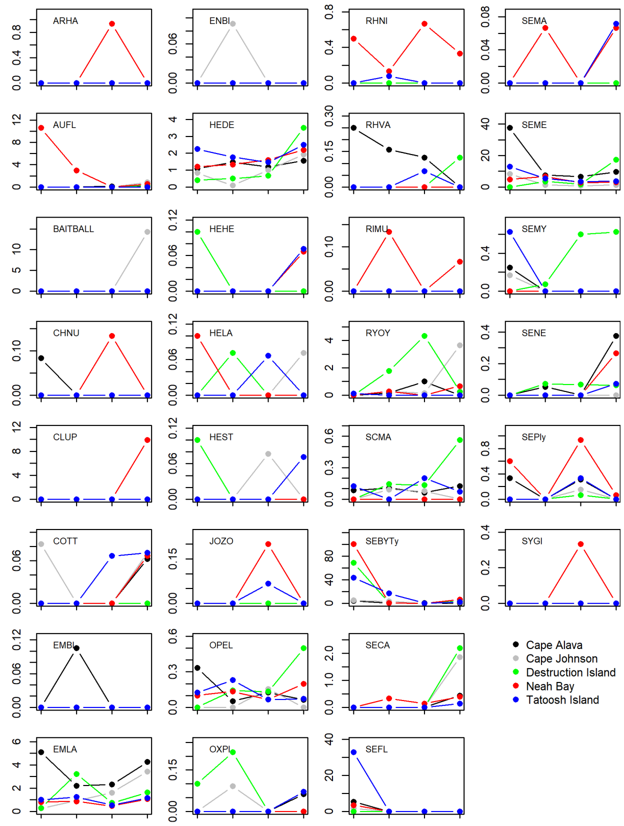
Figure 3: nMDS plot of fish assemblage structure. In the first, pane, colors indicate sites, open circues = 5 m, and closed circles = 10 m. In the additional planes, red = 5 m, blue = 10 m. All figures are from the same nMDS.



BY YEAR & SITE

For fish I also then just averaged the data by site. Looking at the univariate plots there are a few potentially interesting bits:

- Recruitment pulses in SEPIy (canary rockfish recruits) are coherent along the coast across years. The absolute values differ among sites, but good years (2016 & 2018) are good at all sites. In 2018, there appears to be increasing recruitment as one moves north.
- The pulse of SEBYTy (black and yellow tail recruits) was also coherent (high in 2016, low otherwise), but doesn't show any north-south trend.
- The same is not true for RYOY (rockfish recruits).
- Some species we saw early but observations decreased over time: SEFL (yellowtail rf), OXPI (painted greenling), and SEME (black rf).
- Some species have increased observations over time: COTT (sculpins), SENE (china rf), HEDE (kelp greenling), SECA (copper rf)
- Several species had big jumps in 2017 in esp Neah Bay. These include: ARHA (scaley sculpin), SYGI (manacled sculpin), JOZO (longfin sculpin), CHNU (mosshead warbonnett), RHNI (black eyed goby). These are all small fish. My guess is that this is an observer effect, but I haven't looked at the data that closely yet.



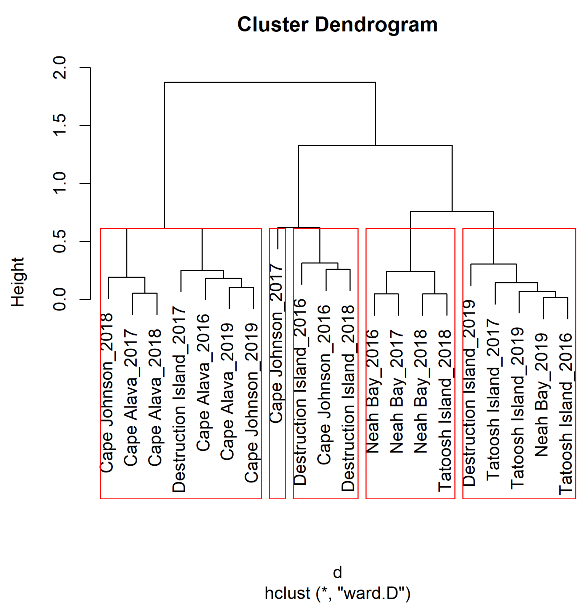

```
## Run 0 stress 0.07758521
## Run 1 stress 0.1299819
## Run 2 stress 0.07758514
## ... New best solution
## ... Procrustes: rmse 0.000123451  max resid 0.000327117
## ... Similar to previous best
## Run 3 stress 0.1233768
## Run 4 stress 0.1117452
## Run 5 stress 0.1148043
## Run 6 stress 0.07758513
## ... New best solution
## ... Procrustes: rmse 7.025313e-05  max resid 0.0001722
## ... Similar to previous best
## Run 7 stress 0.07758514
## ... Procrustes: rmse 0.0001132429  max resid 0.0003055944
## ... Similar to previous best
## Run 8 stress 0.3597986
## Run 9 stress 0.0775851
## ... New best solution
## ... Procrustes: rmse 7.290053e-05  max resid 0.0001968574
## ... Similar to previous best
## Run 10 stress 0.07758524
## ... Procrustes: rmse 0.0001192562  max resid 0.0003201144
## ... Similar to previous best
## Run 11 stress 0.0775851
## ... Procrustes: rmse 2.103342e-05  max resid 4.788037e-05
## ... Similar to previous best
```

```
## Run 12 stress 0.07758511
## ... Procrustes: rmse 1.489416e-05  max resid 3.274669e-05
## ... Similar to previous best
## Run 13 stress 0.1148015
## Run 14 stress 0.07758511
## ... Procrustes: rmse 4.691134e-05  max resid 0.0001271911
## ... Similar to previous best
## Run 15 stress 0.1184053
## Run 16 stress 0.118409
## Run 17 stress 0.0775851
## ... New best solution
## ... Procrustes: rmse 9.212309e-06  max resid 2.295598e-05
## ... Similar to previous best
## Run 18 stress 0.1184044
## Run 19 stress 0.1117448
## Run 20 stress 0.07758511
## ... Procrustes: rmse 2.194076e-05  max resid 4.912255e-05
## ... Similar to previous best
## *** Solution reached
```

I averaging transects by site x year produced a much better fit for the nMDS with a stress of 0.0775851. We can now start to actually see some differences among sites. Tatoosh and Neah Bay are similar. Cape Alava and Cap Johnson are similar to each other but different from Tatoosh and Neah Bay. Destruction Island is all over the place. Sites also show differences in how much they vary thought time.

Looking at the cluster figures we can see that Tatoosh and Neah Bay are generally different than the other locations and more like each other than other sites, although Destruction Island and Cape Alava can "wander into" that cluster in some years.

One thing that is interesting, is that Tatoosh and Neah Bay are pretty similar to themselves every year. The scale of variation is less, especially for Tatoosh.



However, the pvclust approach, which gives a p-valye, suggests these clusters are not super different.

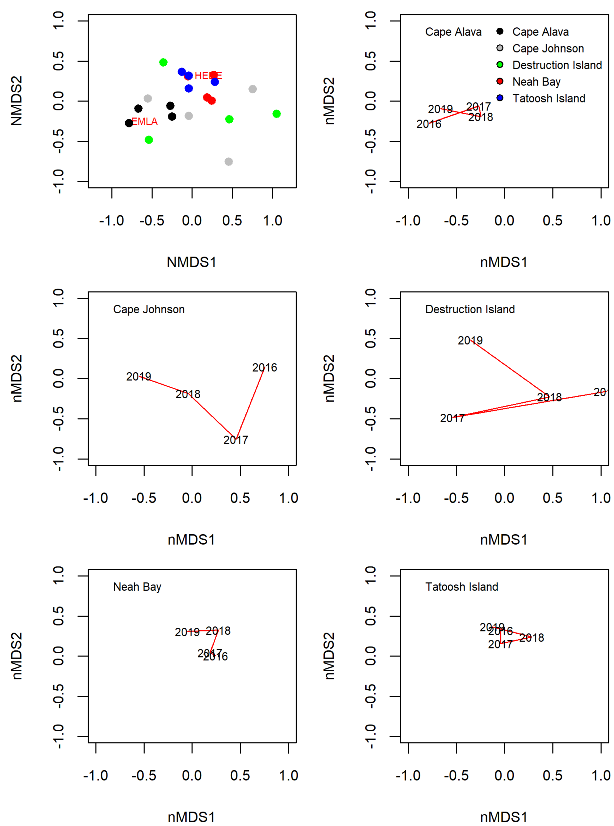
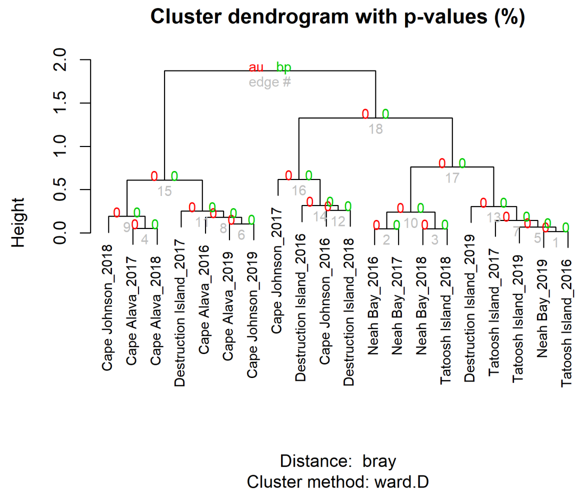


Figure 4: nMDS plot of fish assemblage structure. In the first, pane, colors indicate sites, open circues = 5 m, and closed circles = 10 m. In the additional planes, red = 5 m, blue = 10 m. All figures are from the same nMDS.



Canonical/Constrained Analysis of Principal Cordinates and PerMANOVA

with Depth zone

nMDS is an unconstrained ordination. That is, it has not specific hypotheses and doesn't recognize existing groups. We (I) just add them later in terms of coloring the points.

I also did constrained ordinations and perMANOVAs to determine whether we could really tell apart the site,years, depths. Constrained ordinations start with hypothesis and then try to draw the factors axes in a way to separate the categories.

However, the PerMANOVA did not detect any differences when site x year x depth was included. I need to run some model selection. At a minimum, I suspect there will be a depth effect if we remove some factors.

```
## Permutation: free
## Number of permutations: 999
##
## Terms added sequentially (first to last)
##
##                  Df SumsOfSqs MeanSqs F.Model      R2 Pr(>F)
## year              3     0.659 0.21963 0.89933 0.01024  0.545
## site              4     0.982 0.24555 1.00546 0.01527  0.475
## zone              1     0.553 0.55314 2.26501 0.00860  0.052 .
## year:site        12     2.788 0.23237 0.95152 0.04335  0.559
## year:zone         3     0.554 0.18469 0.75628 0.00861  0.710
## site:zone         4     0.538 0.13462 0.55122 0.00837  0.916
## year:site:zone   12     2.574 0.21450 0.87833 0.04001  0.726
## Residuals       228    55.681 0.24421         0.86555
## Total           267    64.330                 1.00000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## Overall classification success (m=2) : 7.08955223880597 percent
## Cape Alava_2016 (n=12) correct: 0 percent
## Cape Alava_2017 (n=18) correct: 16.6666666666667 percent
## Cape Alava_2018 (n=16) correct: 37.5 percent
## Cape Alava_2019 (n=16) correct: 25 percent
```

```
## Cape Johnson_2016 (n=12) correct: 0 percent
## Cape Johnson_2017 (n=11) correct: 0 percent
## Cape Johnson_2018 (n=13) correct: 0 percent
## Cape Johnson_2019 (n=14) correct: 0 percent
## Destruction Island_2016 (n=10) correct: 0 percent
## Destruction Island_2017 (n=14) correct: 0 percent
## Destruction Island_2018 (n=14) correct: 0 percent
## Destruction Island_2019 (n=16) correct: 12.5 percent
## Neah Bay_2016 (n=10) correct: 0 percent
## Neah Bay_2017 (n=13) correct: 30.7692307692308 percent
## Neah Bay_2018 (n=15) correct: 0 percent
## Neah Bay_2019 (n=15) correct: 0 percent
## Tatoosh Island_2016 (n=8) correct: 0 percent
## Tatoosh Island_2017 (n=12) correct: 0 percent
## Tatoosh Island_2018 (n=15) correct: 0 percent
## Tatoosh Island_2019 (n=14) correct: 0 percent
```

```
##             Df Pillai approx F num Df den Df Pr(>F)
## y[, group]  19 0.1543   1.0912     38    496 0.3305
## Residuals  248
```

The CAP plot using all the data and categories doesn't show any patterns. Note also that the pvalues is non-significant. However, I suspect that if we reduce the number of groups to say site x year or site x depth that the result will be significant.

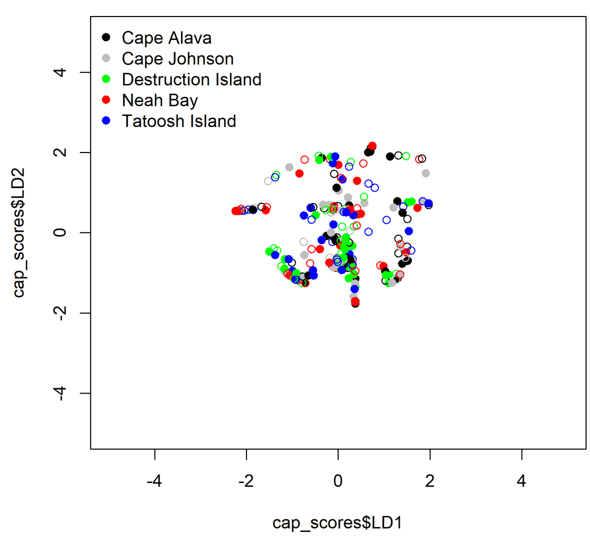


Figure 5: Plot of the first and second linear dimensions from a constrained analysis of principal coordinates. Sqrt transform, Bray-Curtis distance. Open circles = 5 m, Closed circles - 10 m.

Averaging the CAP results by year x site cleans up the presentation a bit. Cape Alava is off the the right and Neah Bay is off to the left, for example.

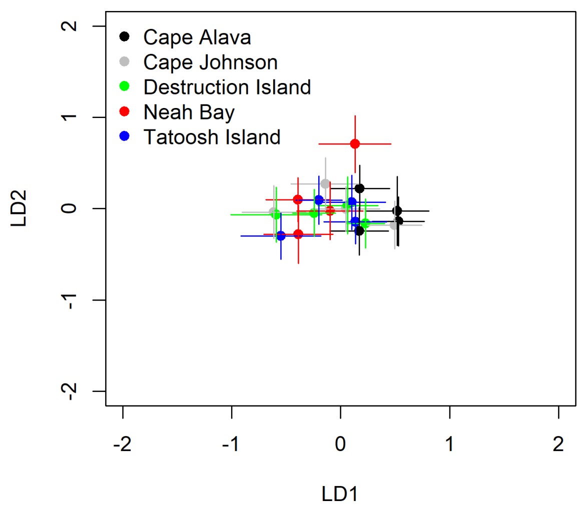


Figure 6: Means from CAP with year, site, depth.