Final Report

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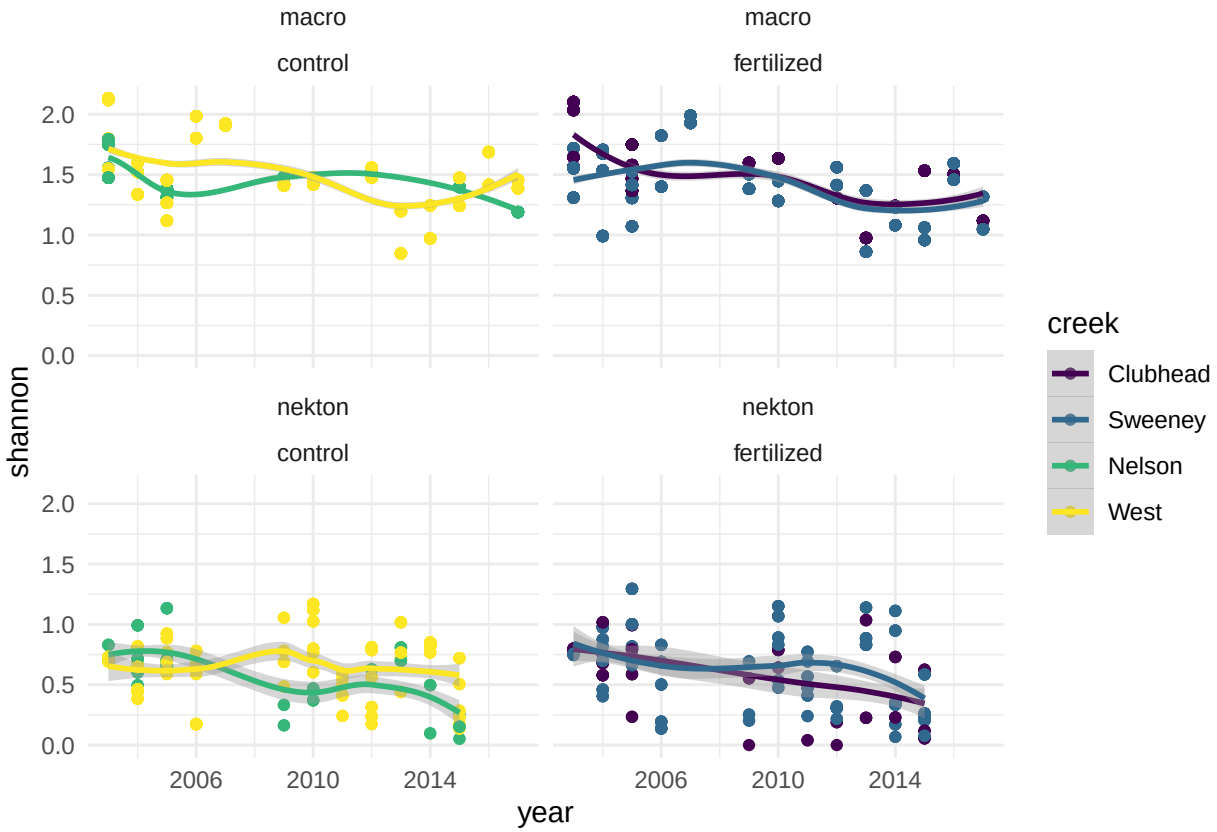
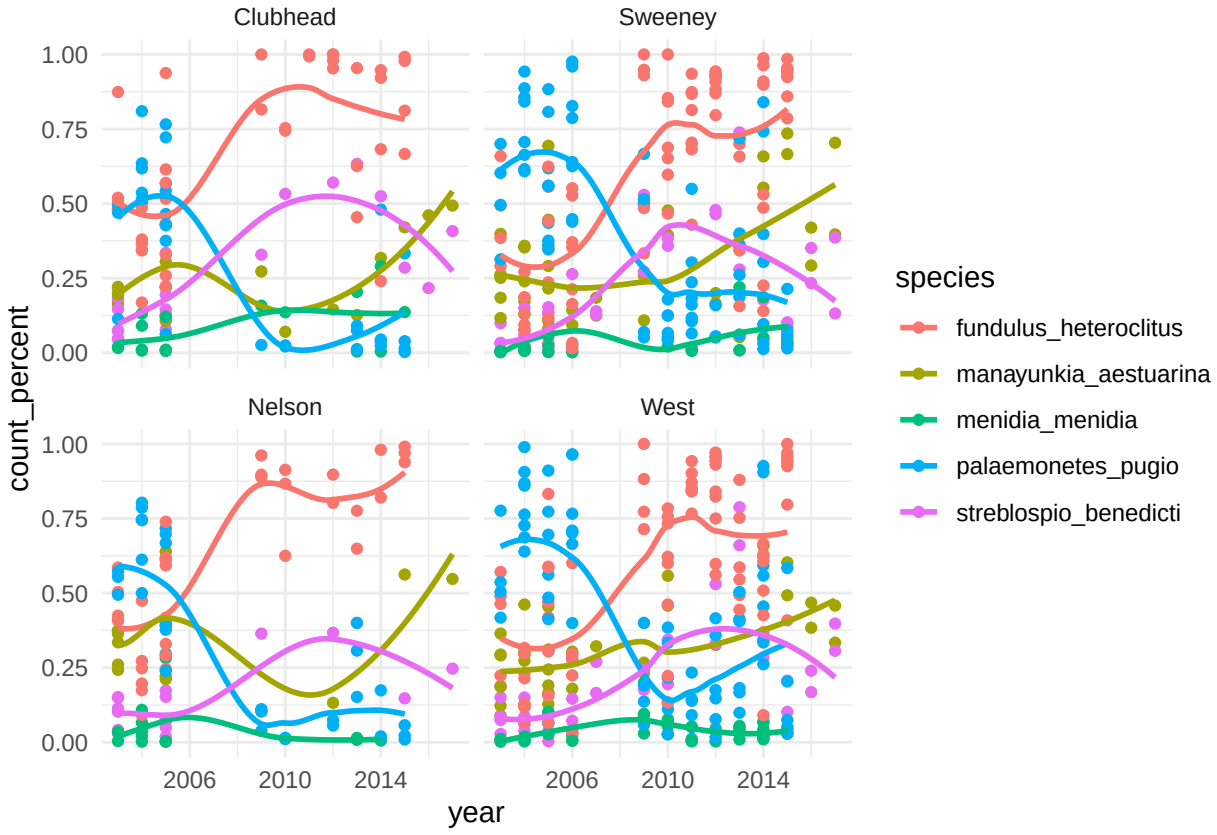
In order to understand the PIE LTER, you have to think like the Marsh Man or think like the green guy in the swamp, in tune with the environment and knees deep in the action as an ecologist should be. My first thoughts when approaching the ideas surrounding the TIDE project and understanding the impact of agricultural runoff were about ecological recovery from within the Plum Island ecosystem. If there were effects on the population or the geomorphology that would be adverse to those populations, would competitions and top-down or bottom-up effects end up reaching some sort of new stability, or would the ecosystem ultimately crash? Presumably a Pavlovian carrot throw into the mix of a delicate ecosystem won't end over very well (EPA facts on poor fertilizer control). With this consideration in mind I joined data detailing information concerning Nekton and Macroinfaunal populations. For more context, the PIE LTER is the Plum Island Estuary long term ecology research group, a collaboration involving many professors and universities. The summary of the following merged dataset is created from these datasets created and uploaded by PI Linda Deegan et. al; Macroinfaunal & Nekton.

```
##       year          month             creek        branch
##  Min.   :2003   Min.   : 6.000   Clubhead: 684   Left :1935
##  1st Qu.:2004   1st Qu.: 7.000   Sweeney :1345   Right:2024
##  Median :2006   Median : 8.000   Nelson  : 566
##  Mean   :2008   Mean   : 7.611   West    :1364
##  3rd Qu.:2012   3rd Qu.: 8.000
##  Max.   :2017   Max.   :10.000
##    species              count             type      count_percent
##  Length:3959        Min.   :   0.00   macro :3136   Min.   :0.00000
##  Class :character   1st Qu.:   0.00   nekton: 823   1st Qu.:0.00000
##  Mode  :character   Median :   1.00                 Median :0.00165
##                     Mean   :  55.12                 Mean   :0.08765
##                     3rd Qu.:  19.00                 3rd Qu.:0.03913
##                     Max.   :1832.00                 Max.   :1.00000
##     shannon       total_count        treatment         date
##  Min.   :0.000   Min.   :   1   control   :1930   Min.   :2003-06-01
##  1st Qu.:1.046   1st Qu.: 493   fertilized:2029   1st Qu.:2004-07-01
##  Median :1.415   Median : 894                     Median :2006-06-01
##  Mean   :1.309   Mean   :1173                     Mean   :2008-08-05
##  3rd Qu.:1.597   3rd Qu.:1758                     3rd Qu.:2012-09-16
##  Max.   :2.133   Max.   :4126                     Max.   :2017-08-01
```

Looking into the data a bit and using the package vegan to assign Shannon Diversity Index values, an understanding of ecology eveness and abundance can be visualized.

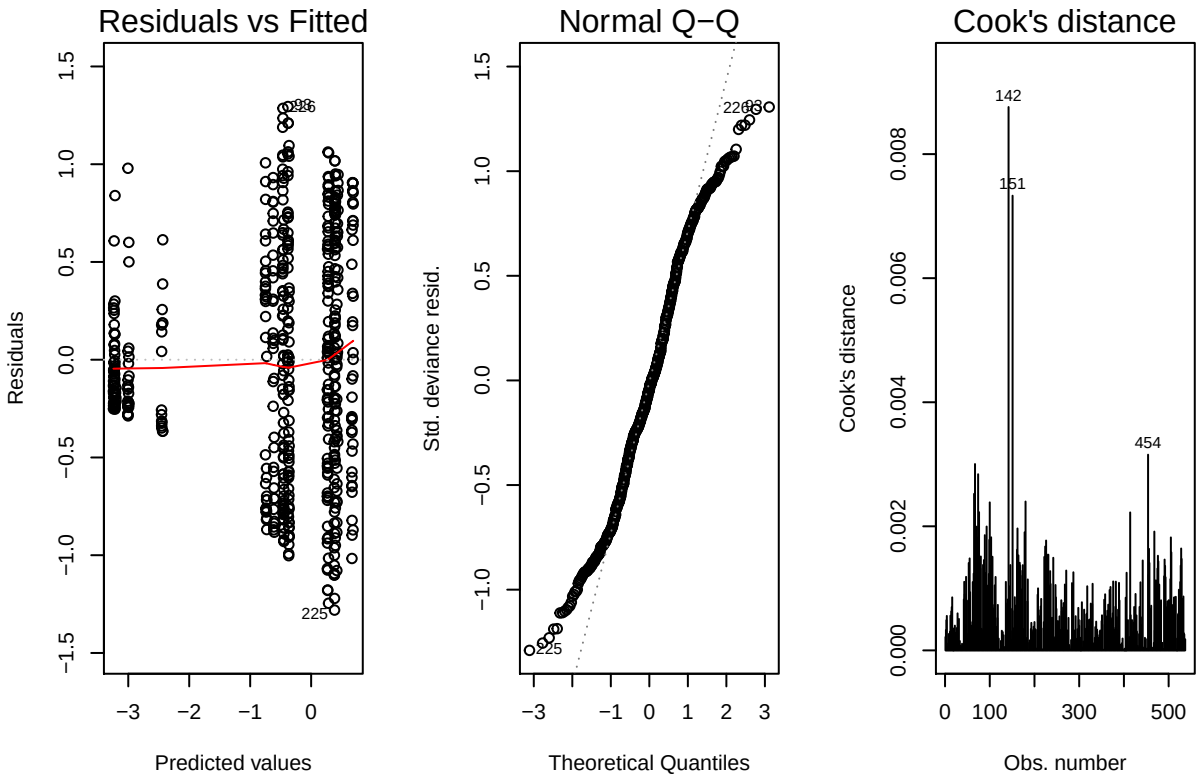


Macro Control appears to have normal oscillations of Shannon Diversity eveness, indicative of a pattern of population equilibrium and likely a Lotka-Volterra zero growth predator/prey & competition interaction. Interestingly enough nekton control seems to lose it's normal oscillation of diversity eveness, with both creeks tapering off and losing eveness and likely their nekton equilibria. Fertilized macro and nekton diversity curves appear to be tapering off with normal oscillation, indicative of a linear diversity or equilibria loss. A prelminary look at change in percent representation of species of interest by creek is not very revealing especially with some macro and nekton species being in the same model. As it appears above it seems as though nekton and macro overall are not linked.




```
##  contrast                                estimate    SE  df z.ratio p.value
##  Clubhead fundulus_heteroclitus effect    1.703 0.359 Inf  4.741  <.0001
##  Sweeney fundulus_heteroclitus effect     1.413 0.280 Inf  5.044  <.0001
##  Nelson fundulus_heteroclitus effect      1.455 0.369 Inf  3.943  0.0002
##  West fundulus_heteroclitus effect        1.301 0.278 Inf  4.686  <.0001
##  Clubhead menidia_menidia effect         -1.419 0.838 Inf -1.694  0.1083
##  Sweeney menidia_menidia effect          -1.974 0.878 Inf -2.248  0.0421
##  Nelson menidia_menidia effect           -2.186 1.199 Inf -1.823  0.0911
##  West menidia_menidia effect             -2.208 0.786 Inf -2.807  0.0120
##  Clubhead palaemonetes_pugio effect       0.285 0.391 Inf  0.730  0.4656
##  Sweeney palaemonetes_pugio effect        0.567 0.287 Inf  1.974  0.0726
##  Nelson palaemonetes_pugio effect         0.409 0.380 Inf  1.076  0.3075
##  West palaemonetes_pugio effect           0.653 0.285 Inf  2.293  0.0421
##
## Results are given on the log odds ratio (not the response) scale.
## P value adjustment: fdr method for 12 tests
```

A likelihood binomial logit regression model reveals some differences between species across the creeks, but with poor significance and standard error values it is difficult to confirm the potency of the effect. The regression model in itself checks out with a tight resids vs fitted plot, a clean qq plot, and small cook's distance values generally under 0.005. Poor significance of contrast related to the shrimp and silverback species is likely due to their low abundance in observation, a sample size error.


Residuals vs Fitted
Residuals
Predicted values
225
Normal Q−Q
Std. deviance resid.
Theoretical Quantiles
225
Cook's distance
Cook's distance
Obs. number
142
151
454