AB plant respones to HF

Cari D. Ficken

2019-04-29

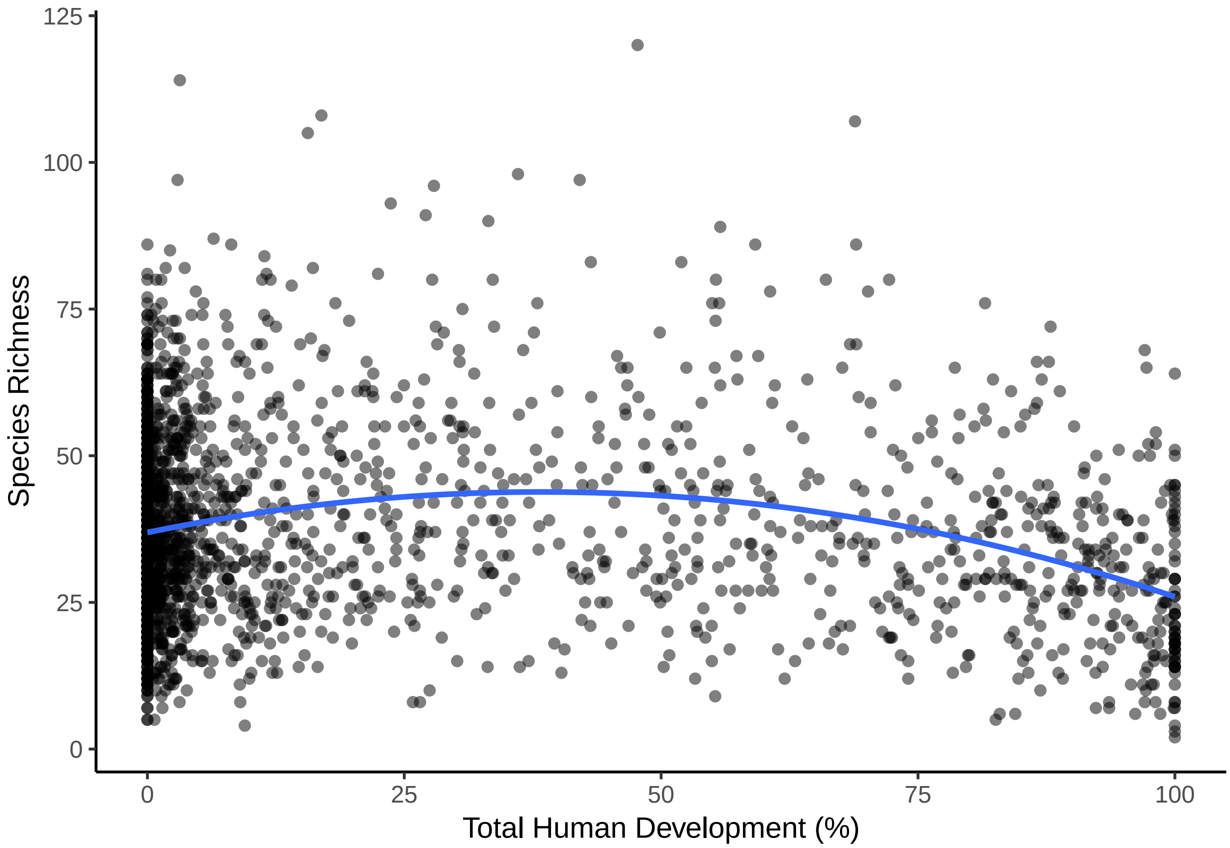
The goal of this project is to examine how wetland plant communities repond to disturbance.

1. Load data; calculate CSI

Loading vegetation data (presence/absence) and HF data (% total human development in each plot). Calculating a species specialization index and community specialization index based on the variability in species cumulative occurrences across the the binned HF gradient.

2. How does sp richness vary across disturbance gradient?

Species richrichess peaks at intermediate disturbance levels. Note that Protocol (i.e. wetland vs terrestrial) is a significant predictor of species richness; we need to do something about this.



3. Do communities at low and high HF differ?

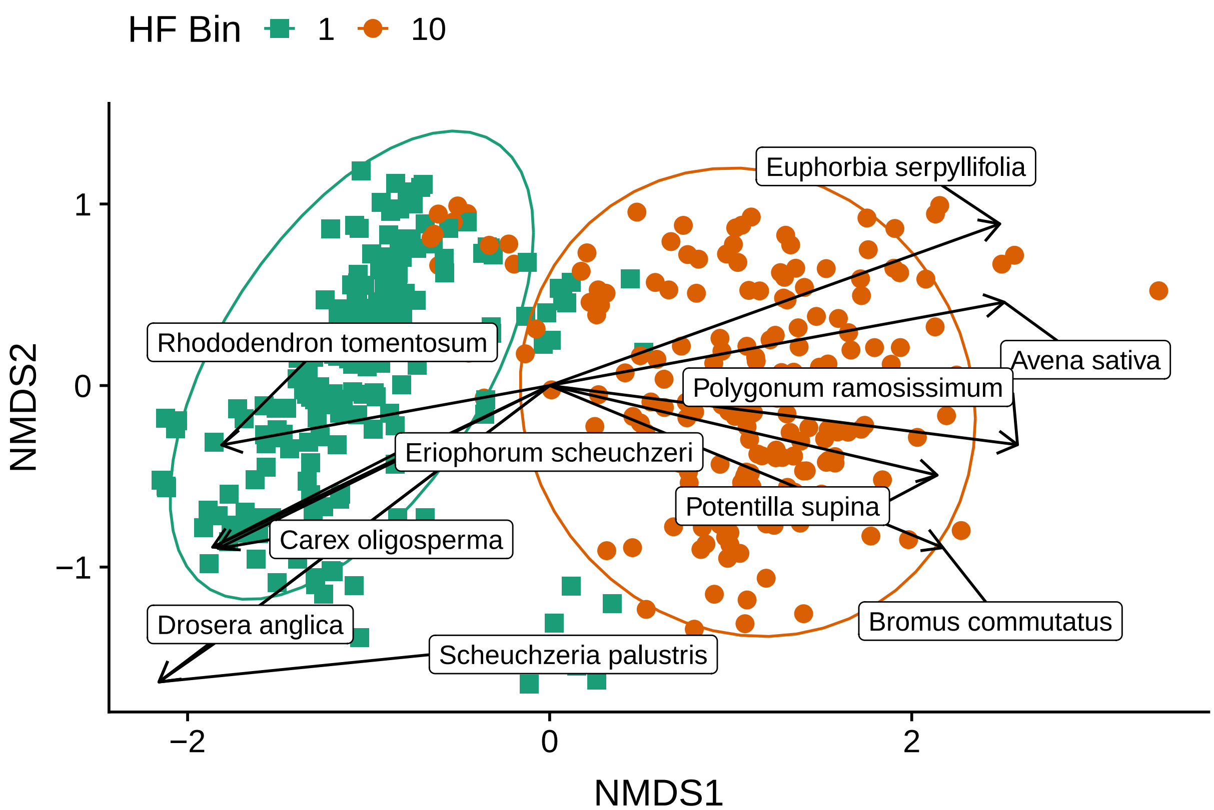
Communities at low and high end of HF gradient show similar plant diversity (richness), but are these communities compositionally different? Yes, MRPP test shows significant difference between these groups and the ordination visualizes this.

Species most strongly associated with sites in the low HF bin (bin 1):

- *Rhodondendron tomentosum*: marsh labrador tea
- *Eriophorum scheuchzeri*: white cotton grass
- *Carex oligosperma*: fewseed sedge
- *Drosera anglica*: English sundew
- _Scheuchzeria palustris: Rannoch-rush

Species most strongly associated with sites in the highest HF bin (bin 10):

- *Euphorbia serpyllifolia*: thymeleaf sandmat
- *Avena sativa*: common oat
- *Polygonum ramosissimum*: bushy knotweed
- *Potentilla supina*: bushy cinquefoil
- *Bromus commutatus*: meadow brome or hairy chess



4. Do communities along HF gradient differ in their specialization?

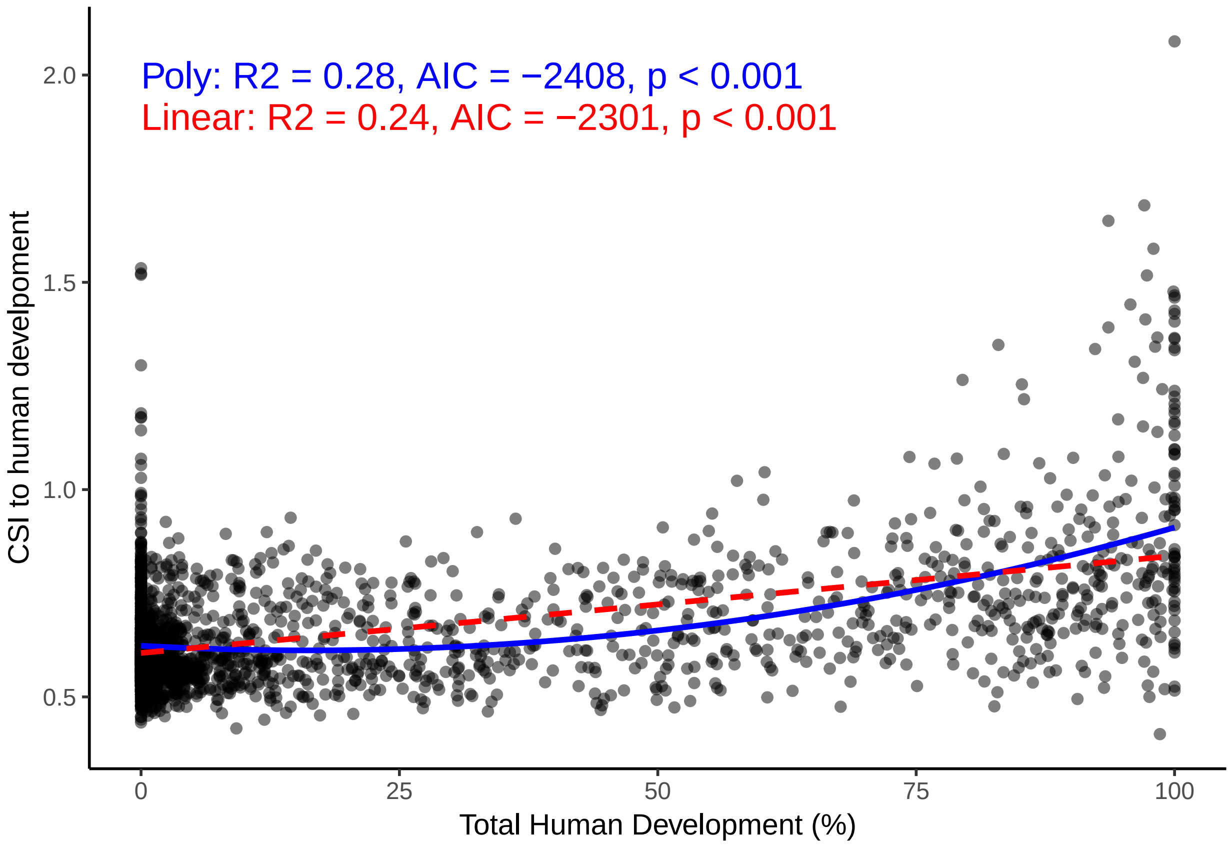
Community specialization index (CSI) is a measure of the mean niche breadth of species within a community. Species which occur with high frequency under a narrow HF are highly specialized and have a narrow niche bread; conversely, species which occur across a range of HF levels are less specialized and have a broader niche breadth.

Models with random effects (linear, 2nd order polynomial, 3rd order polynomial) show no effect of including a Protocol x Site unique ID random effect. Linear models find that the quadratic model describes CSI better than the linear model.

Plant communities show a U-shaped relationship between CSI and HF, indicating that communities at high and low develoment intensities are composed of more specialized species than communities at intermediate develoment intensities. We speculate that communities at intermediate development intensities encompass the edges of two, different "preferred" habitats - either higher or lower development intensities.

Communities at high and low develoment intensities both are composed of species with high specialization to that respective habitat. Species at low development intensities may be so-called "competitive" species, with a high capacity to catpure limiting soil nutrients (or they could also be stress-tolerant species, if climate is the stronger limiting factor). In contrast, species at high development intesnities may be so-called "ruderal" species, which are r-selected species with high dispersal capacity.

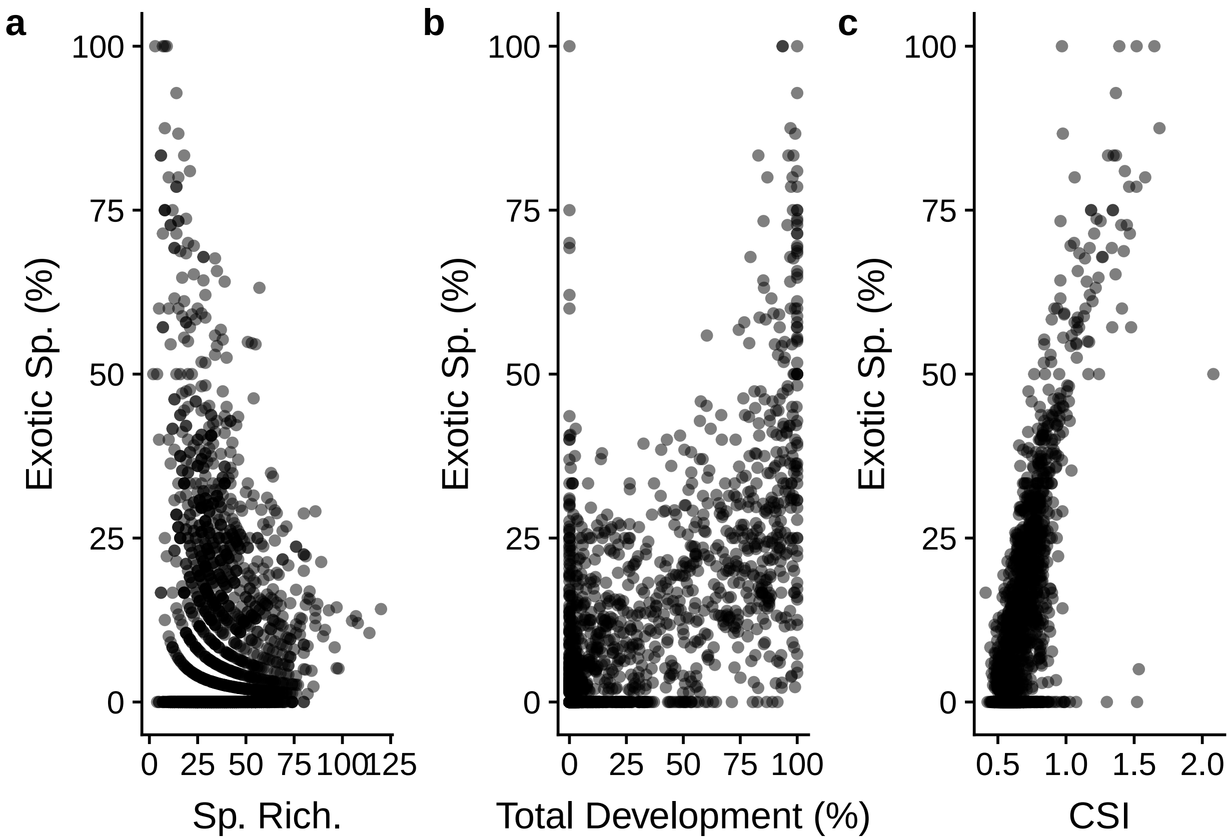
```
## 
## Call:
## lm(formula = CSI ~ poly(totdist_percent, 2), data = veg_CSI_HF)
## 
## Residuals:
##      Min       1Q   Median       3Q      Max 
## -0.48842 -0.07470 -0.02654  0.05223  1.17252 
## 
## Coefficients:
##                           Estimate Std. Error t value Pr(>|t|)    
## (Intercept)               0.662260   0.002967  223.19   <2e-16 ***
## poly(totdist_percent, 2)1 3.560279   0.134477   26.48   <2e-16 ***
## poly(totdist_percent, 2)2 1.419899   0.134477   10.56   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 0.1345 on 2051 degrees of freedom
## Multiple R-squared:  0.2837, Adjusted R-squared:  0.283 
## F-statistic: 406.2 on 2 and 2051 DF,  p-value: < 2.2e-16
```



5. How does the proportion of exotic species contribute to these patterns?

The prorportion of exotic species generally decreases with species richness (a), indicating that communities composed of few species are more likely to be composed of exotic species; perhaps in these communities exotic species are displacing native species.

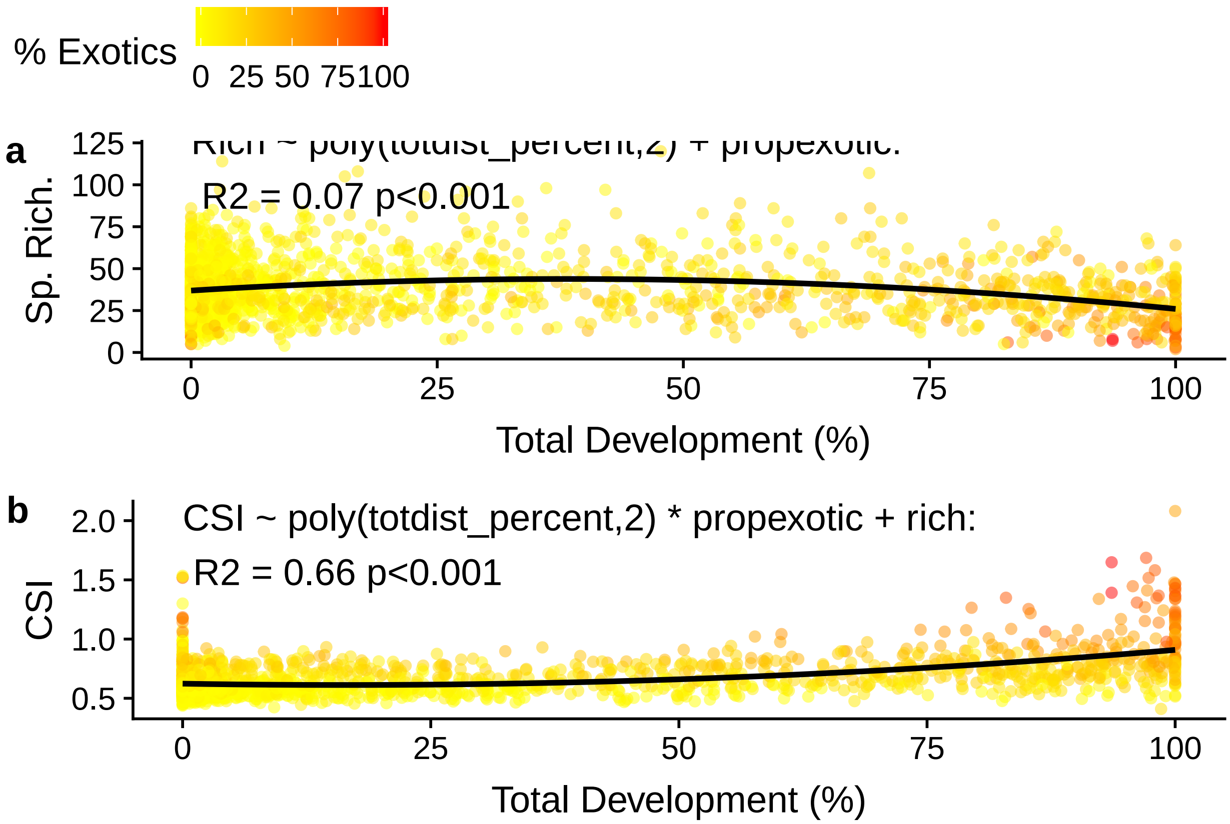
The prorportion of exotic species increases with development (b) and increases strongly with CSI (c). Figure b indicates that wetlands surrounded by more human develoment are more likely to include non-native species. Fgiure c indicates that highly specialized communities (i.e. those found at high and low disturbance intensities) are composed of a greater proportion of exotics than more generlized communities.



The figures below again indicate that communities at high devleopment intensities are composed of a greater proportion of exotic species, and that these communities are more specialized than communities at low develoment intensities. Species richness is not well predicted by development and the proportion of exotic species, although these are significant predictors. In contrast, both variables are strong predictors of CSI (development is the stronger predictor).

Together these results suggest that the responses of both species richness and CSI to total development can be explained by the proportion of exotic species in a community.

Note we need to statistically test whether we need a unique site ID random effect, and also how to handle any potentially differeces between Protocols.


% Exotics
0 25 50 75 100
a
Rich ~ poly(totdist_percent,2) + propexotic:
R2 = 0.07 p<0.001
Sp. Rich.
125
100
75
50
25
0
0 25 50 75 100
Total Development (%)
b
CSI ~ poly(totdist_percent,2) * propexotic + rich:
R2 = 0.66 p<0.001
CSI
2.0
1.5
1.0
0.5
0 25 50 75 100
Total Development (%)