

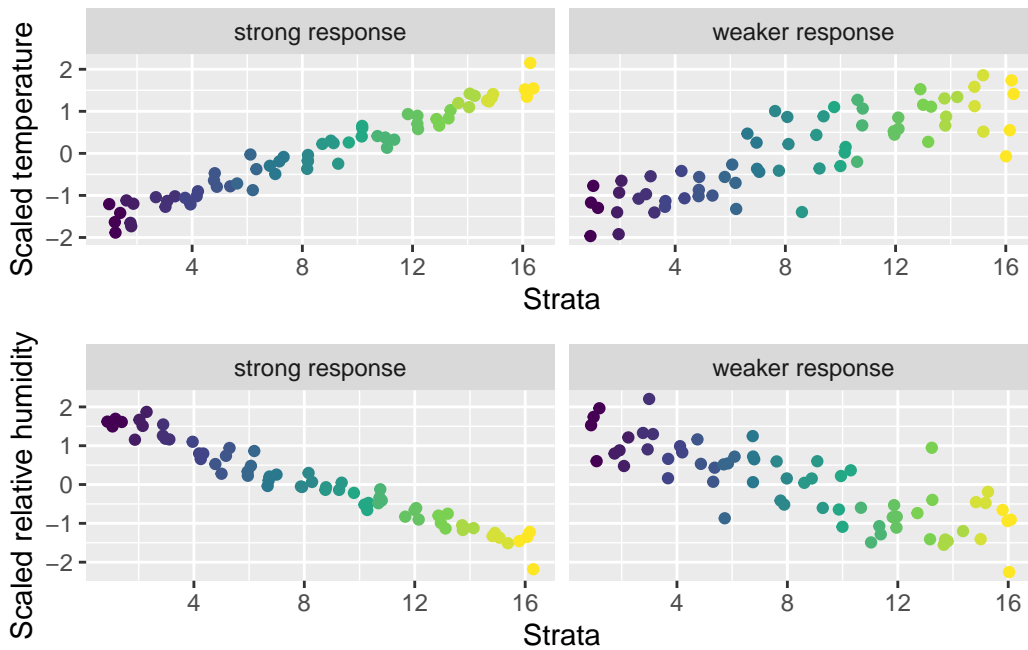
Katahdin power analysis

Relationship between strata and climate variables

We will consider two climate variables: temperature (`tmp`) and relative humidity (`rh`). There are 16 strata and we will investigate two different scenarios:

1. `tmp` and `rh` have strong linear responses to strata
2. `tmp` and `rh` have weaker linear responses to strata

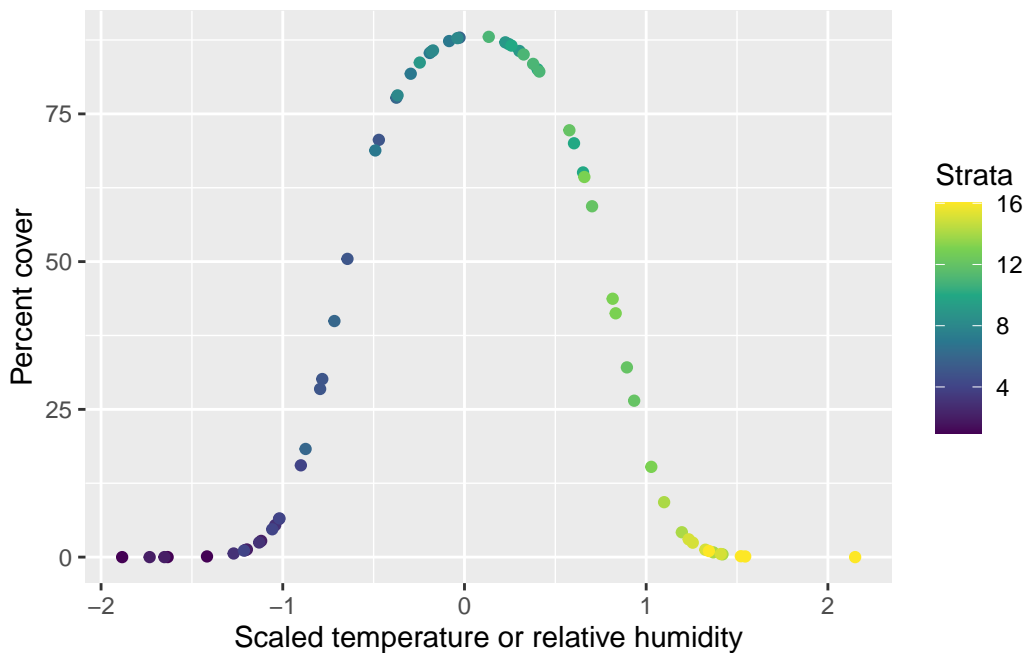
The scenario of no linear response is unlikely given that strata were chosen to represent meaningful climatic variation.



Setting up possible scenarios for the relationships between focal taxa and climate

We will assume there is an optimal climate for the taxon where its percent cover peaks as displayed in the below figure which shows an idealized response of percent cover to climate (i.e. without random noise).

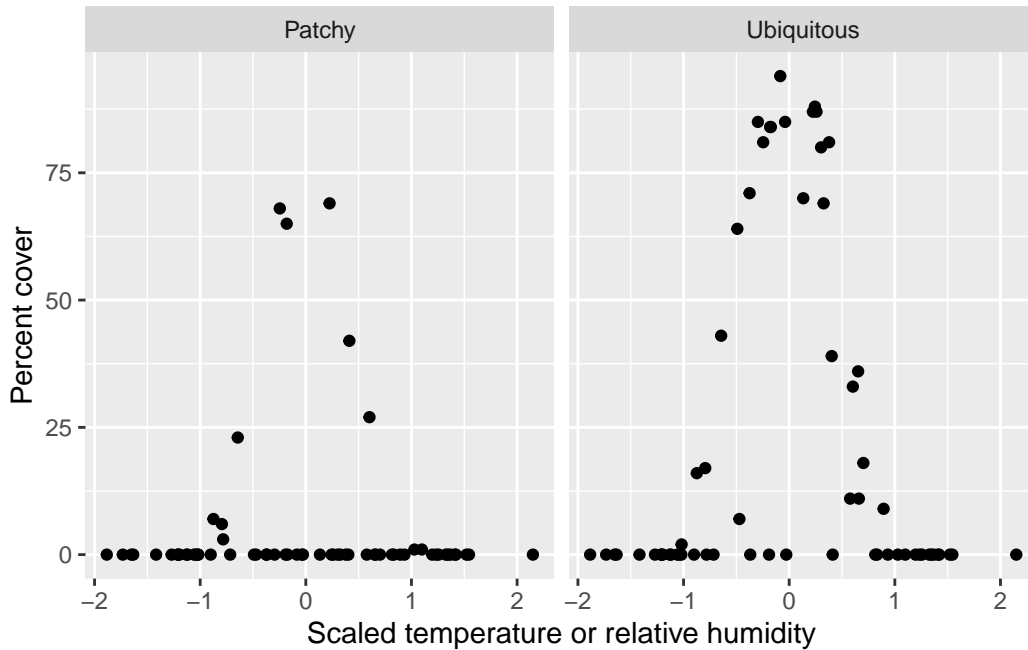
```
pfun <- function(x, b0, b1, b2) {  
  1 / (1 + exp(-(b0 + b1 * x + b2 * x^2)))  
}  
  
x <- d1$tmp  
  
ideal_response <- data.frame(s = d1$s, x = x, p = pfun(x, 2, 0.5, -4))  
  
ggplot(ideal_response, aes(x = x, y = p * 100, color = s)) +  
  geom_point() +  
  scale_color_viridis_c(name = "Strata") +  
  xlab("Scaled temperature or relative humidity") +  
  ylab("Percent cover")
```



Different taxa will have different optimal climates, different maximum percent covers, and different tolerances for climatic conditions away from their optimal climate (i.e. narrow or wider peaks in percent cover).

The goal of our power analysis is to determine what sample size is necessary to accurately capture the climatic preferences of focal taxa under different representative scenarios of patchy versus ubiquitous spatial distributions and climate niches that are narrow versus wide.

We will model the patchiness of taxa via a zero inflated binomial distribution. The below figure shows the difference between a patchy spatial distribution and a ubiquitous spatial distribution.



What we can see is that the patchy taxon still peaks at the same climate optimum, but there are more sites where it was absent due to its patchy distribution. The ubiquitous taxon has fewer sites where it is absent, but there are still some gaps because we assume all taxa have some amount of patchiness.

Power analysis for relationship between focal taxa and climate

Now we investigate our statistical power to detect a response of the percent cover of a focal taxon to local climate variation, and how that power changes with number of sampling sites. To recap, we are investigating 8 scenarios coming from all unique combinations of the following conditions:

- *Variation in climate across strata:*
 1. tmp and rh have strong linear responses to strata
 2. tmp and rh have weaker linear responses to strata
- *Climate niche:*

1. narrow
2. wide

- *Spatial distribution:*

1. patchy
2. ubiquitous

