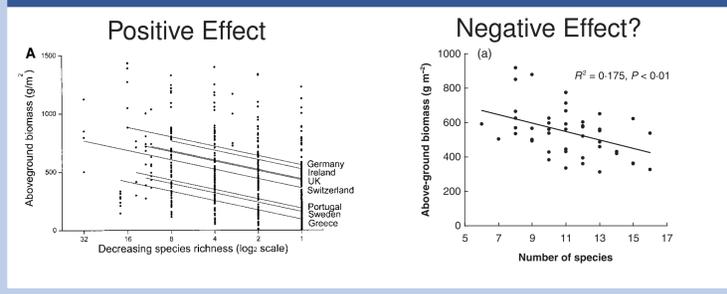


## Introduction

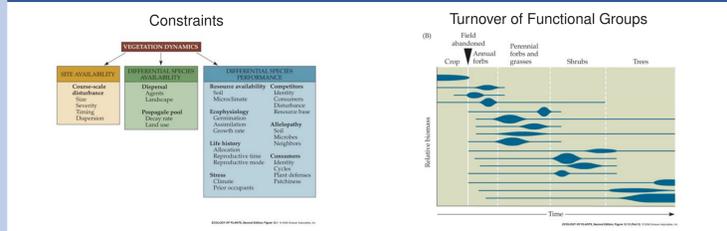
### Effects of Diversity on Productivity Are Mixed



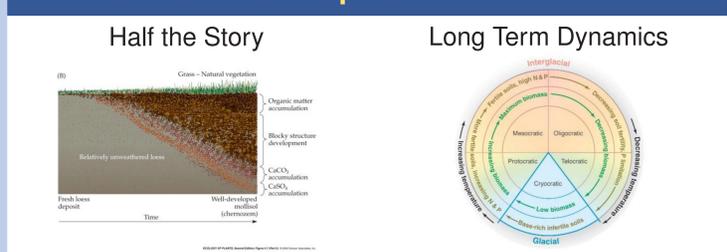
### Observations and a Question

Observation 1: Experiments often show positive effects of biodiversity on ecosystem functioning.  
 Observation 2: Natural communities often show negative effects of biodiversity on ecosystem functioning.  
 Question: *How Does Successional Status Help Explain Variation?*

### Views of Plant Succession



### Views of Soil Development



### Perhaps Simple General Theory Can Help

$$\dot{N}_1 = r_1 N_1 (1 - \alpha_{11} N_1 - \alpha_{12} N_2)$$

$$\dot{N}_2 = r_2 N_2 (1 - \alpha_{21} N_1 - \alpha_{22} N_2)$$

Lotka-Volterra Parameters  
 $\alpha_{ij}$  Effect of sp.  $i$  on sp.  $j$ .  
 $1/\alpha_{ij}$  Productivity of sp.  $i$  in the presence of itself ( $1/\alpha_{ii} = K_i$ ).  
 $1/\alpha_{ji}$  Productivity of sp.  $i$  in the presence of sp.  $j$ .

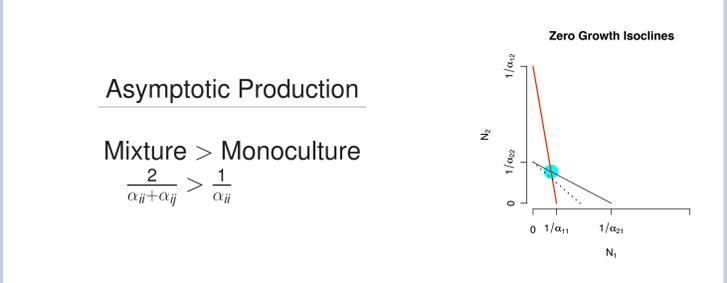
## Classic Coexistence

### Preliminaries

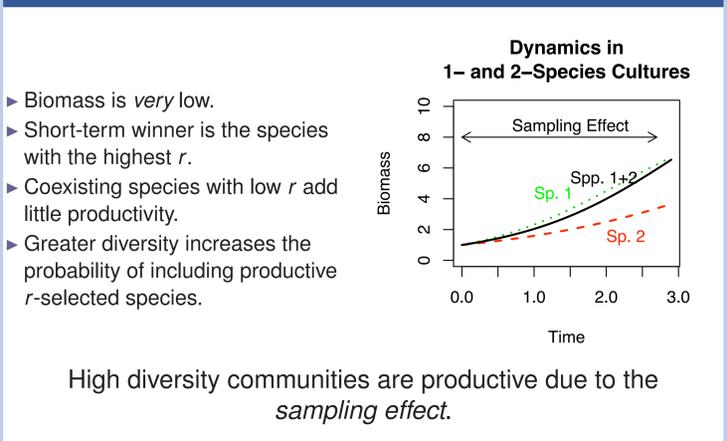
Invasion Criteria  
 $\alpha_{22} > \alpha_{12}$  ,  $\alpha_{11} > \alpha_{21}$

For convenience, assume  
 $(\alpha_{11} = \alpha_{22}) > (\alpha_{12} = \alpha_{21})$

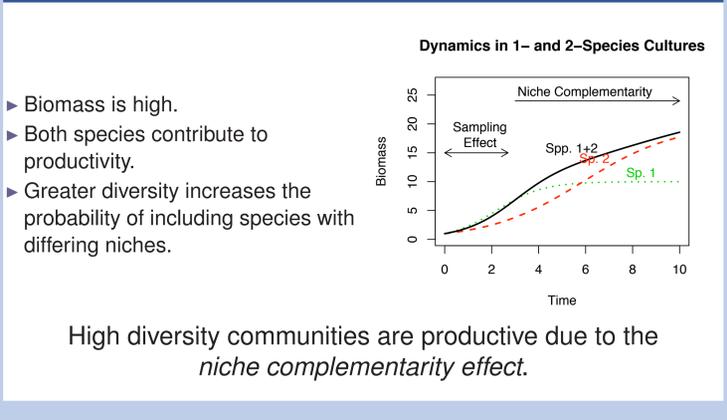
### Asymptotic Equilibrium



### Early Succession



### Continued Succession → Over-Yielding

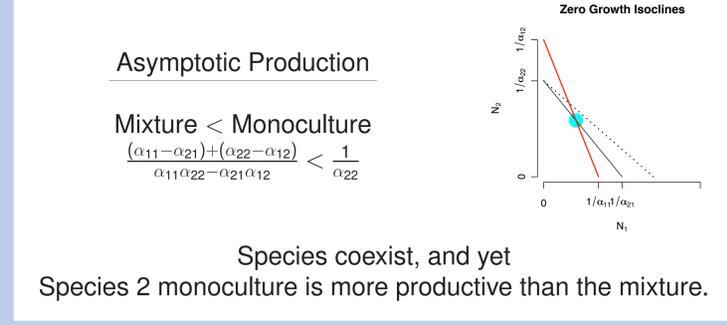


## Coexistence with Interference

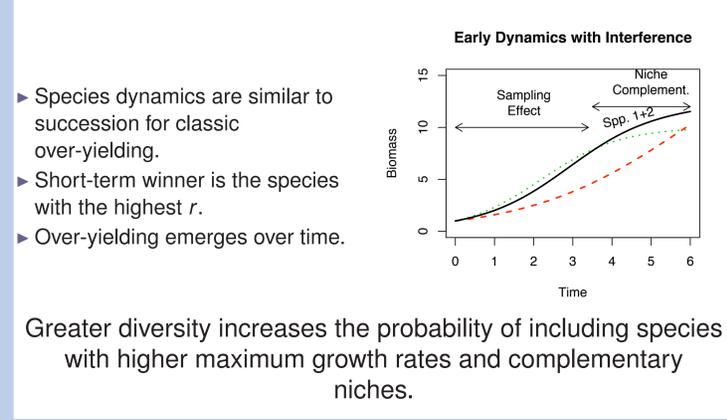
### Preliminaries

What if...?  
 ▶ Species 2 is more productive ( $1/\alpha_{22} > 1/\alpha_{11}$ ),  
 ▶ Species 1 and 2 coexist ( $\alpha_{11}\alpha_{22} > \alpha_{21}\alpha_{12}$ )  
 ▶ Species 1 suppresses species 2 ( $\alpha_{21} > \alpha_{22}$ ).  
 ▶ Competitive Effects:  $\alpha_{11} > \alpha_{21} > \alpha_{22} > \alpha_{12}$

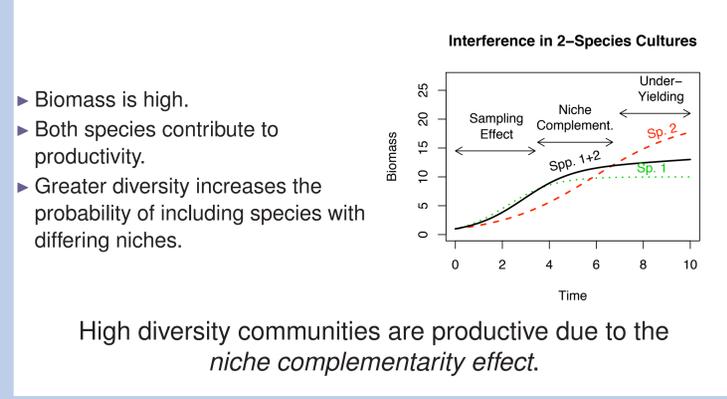
### Asymptotic Equilibrium



### Early and Mid-Succession

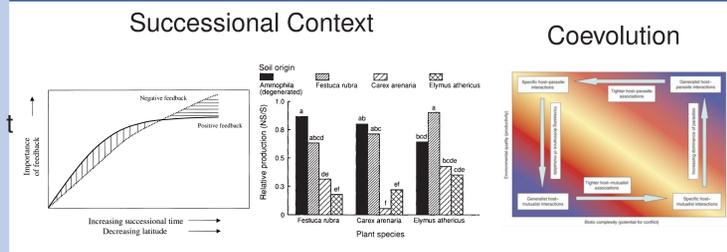


### Continued Succession → Under-Yielding

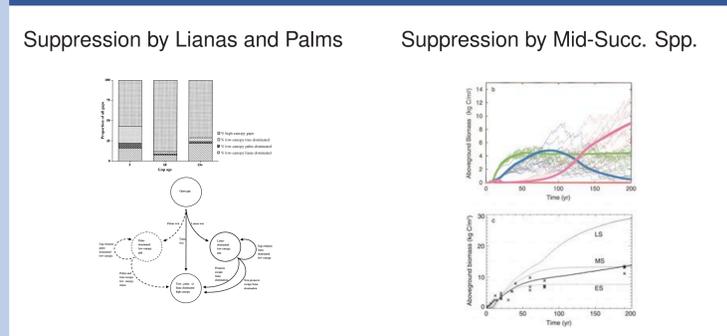


## Possible Mechanisms of Interference

### Soil Microbes



### Asymmetric competition for light in Forests



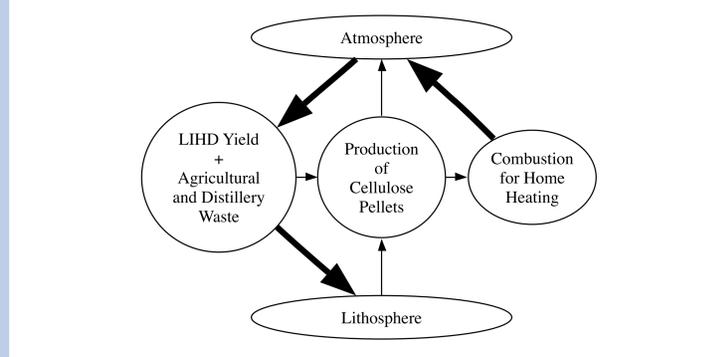
## Conclusions

### Conclusions and Questions

Simple theory predicts...  
 ▶ High biodiversity is not necessarily a good thing (for yield).  
 ▶ Yields can decline with time due to interference.  
 ▶ Specific mechanisms can suggest management strategies to increase yield in LIHD systems.  
 ▶ Can plowing or fire reset succession by altering soil pathogen communities?  
 ▶ Can species with high interference potential be suppressed (through seeding, or selective herbicides)?

### “And Now For Something Completely Different...”

### Trying to close the loop in SW Ohio, USA



References: Hector, A. et al., Science 286, 1123–1127 (1999); Thompson, K., Askew, A., Grime, J., Dunnett, N. & Willis, A. Functional Ecology 19, 355–358 (2005); Gurevitch, J., Scheiner, S. M. & Fox, G. Sinauer Associates, Inc., Sunderland, MA, USA, (2006), 2nd edn. Birks, H. & Birks, H. Science 305, 484–485 (2004); Kinzig, A. P., Pacala, S. P. & Tilman, D. Princeton University Press, Princeton, (2002); Reynolds, H. L., Packer, A., Bever, J. D. & Clay, K. Ecology 84, 2281–2291 (2003); Van der Putten, W. H., Dijk, C. V. & Peters, B. Nature 362, 53–56 (1993); Thrall, P., Hochberg, M. E., Burdon, J. J. & Bever, J. D. Trends in Ecology & Evolution 22, 120–126 (2006); Moorcroft, P. R., Hurr, G. C. & Pacala, S. W. Ecological Monographs 71, 557–585 (2001); Schnitzer, S. A., Dalling, J. W. & Carson, W. P. Journal of Ecology 88, 655–666 (2000).