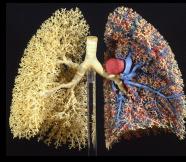


Why do fractals appear in nature?

In organisms

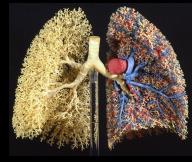
- A simple set of rules (DNA)
- Fractal structures are heritable
(Bailey et al. 2004)
- Need to maximize surface area but minimize volume
- Efficiency of transportation



Why do fractals appear in nature?

In geography

- Same processes at multiple scales



In landscape ecology

In animal behavior

Chaos

Wait for the next lecture



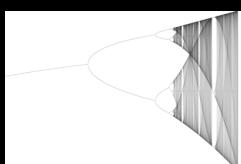
Animal behavior



Population structure



Chaos



Finance



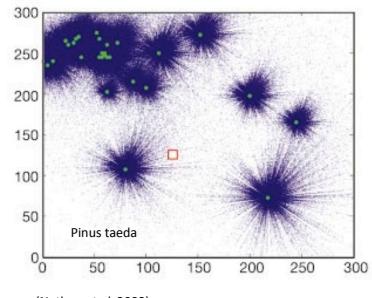
Fractals in finance



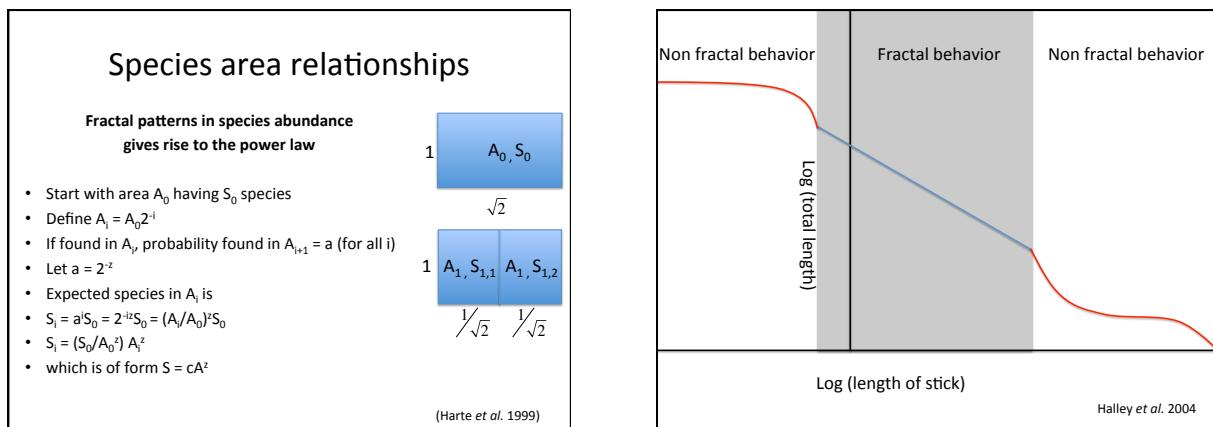
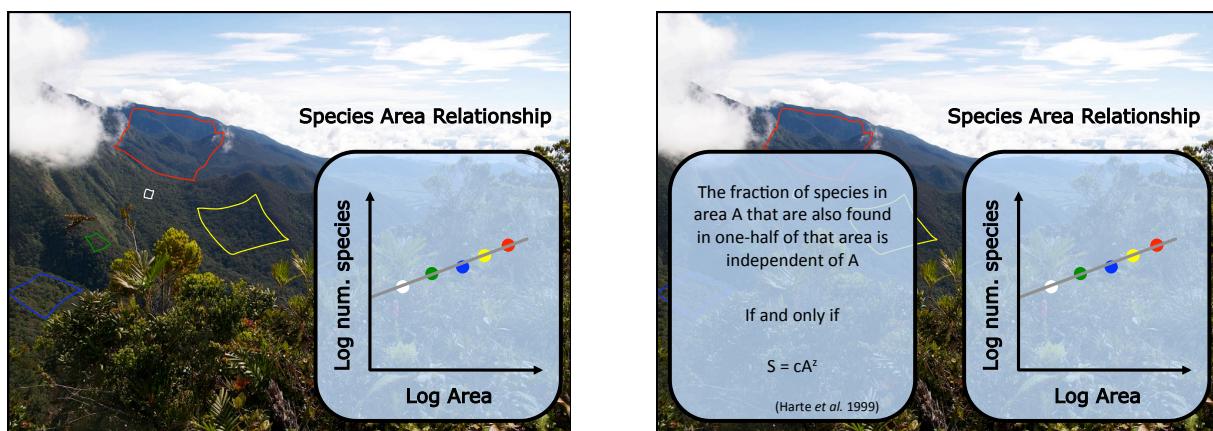
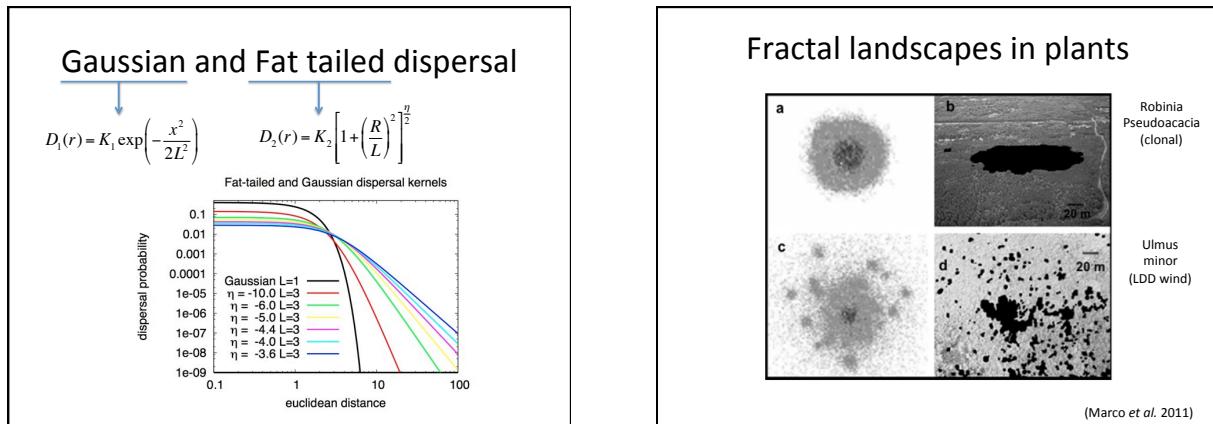
Price changes in financial markets believed normally distributed
Sudden and unexpected changes: "acts of god"
Mandelbrot – Heavy tailed distributions much better

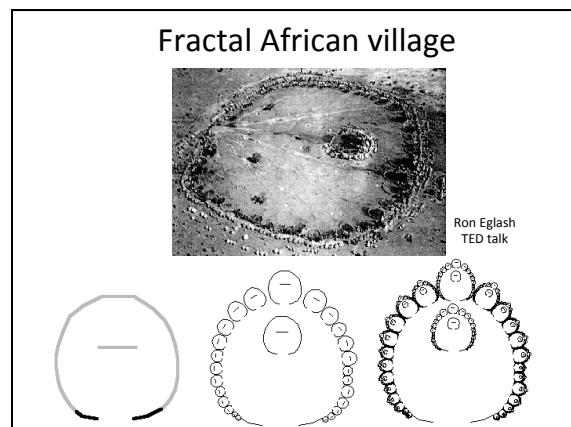
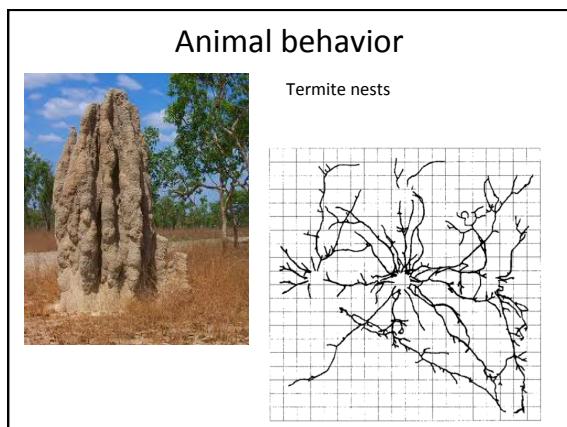
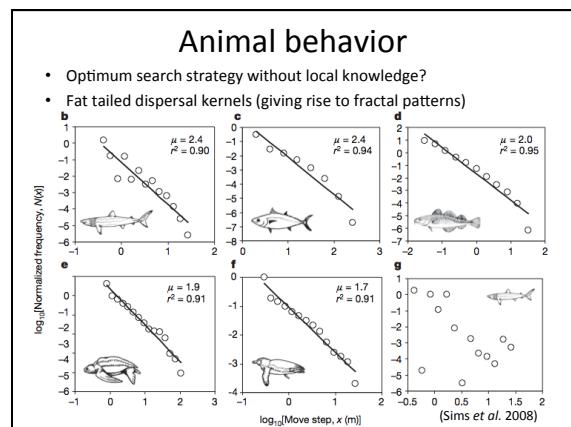
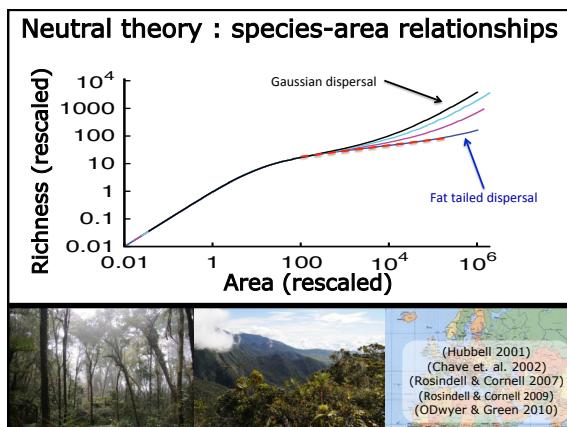
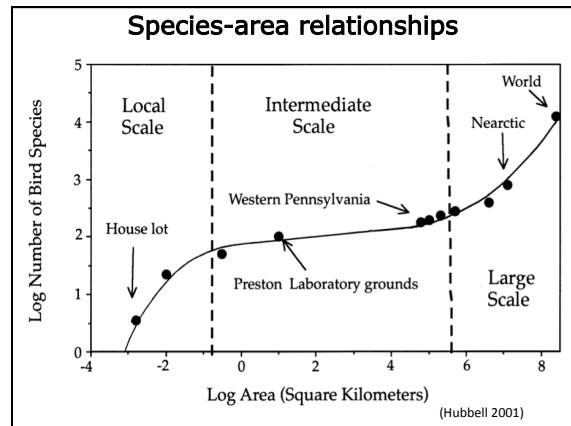
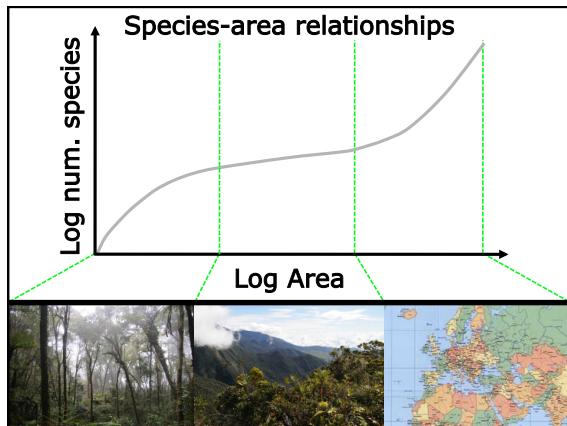


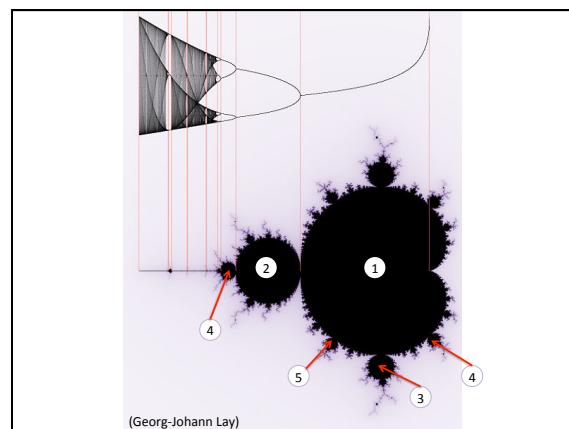
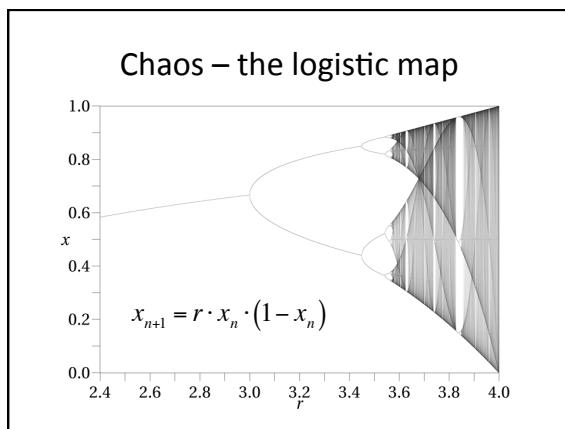
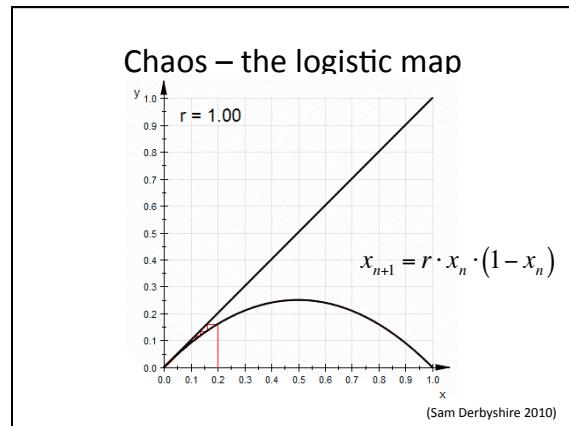
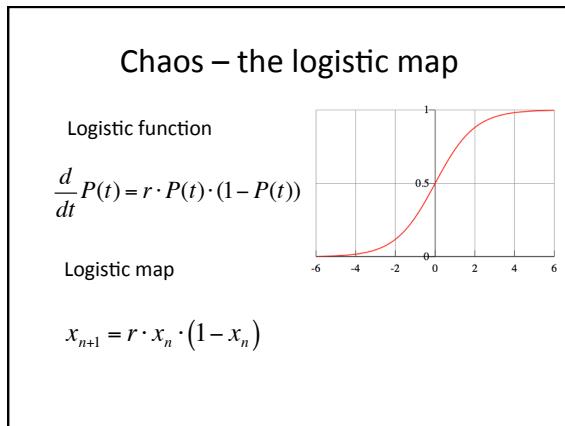
Seed dispersal



(Nathan et al. 2002)







- ### Summary
- Fractals have a dimension that isn't a whole number
 - Fractals display self similarity
 - Fractals occur in nature because of
 - Similar processes at different scales
 - Need to build complex structures from simple rules
 - Need to fit a large surface area into a small volume
 - As a result of fat tailed dispersal patterns
 - Fractal dimension gives us a way to measure objects (fractals) for which the normal laws of geometry do not apply
 - Deterministic chaos is present in systems where a small change in the initial conditions dramatically changes the outcome

