

# BIOL 410 Tutorial 7

Incidence function model

# Meta population dynamics of a marsh plant

- *Sparganium erectum*
  - Branched bur-reed
  - Perennial marsh plant
  - Dispersal via seeds
  - 27 ponds where plant is expected



# Meta population dynamics of a marsh plant

- Dispersal (distance dependent)

$$edis = \exp(-\alpha * d)$$

- Extinction (pond area dependent)

$$E = \frac{e}{A^x}$$

- Estimated parameters



alpha	1	Dispersal kernel param.
x	0.41	Extinction param.
e	0.02	Base extinction rate
y	15.29	Colonization param.

# Incidence function model

- Load the script for the incidence function model
  - Load the system data (patch coordinates, size, occupancy)
  - Load the model parameters and functions
  - Plot the dispersal kernel, extinction probability and patch occupancy in 2010
  - Load the incidence function model
  - Run the model for 200 years (`tmax <- 200`)
    - Plot the changes in system occupancy state
    - Plot the occupancy state of patches through time
- The model is stochastic, so estimates need to be based on multiple runs
  - Run the model 10 times (for 200 years)
  - For each run record:
    - Is the metapopulation persistent?
    - What is the occupancy state after 200 years?
    - What is the mean occupancy state (red line)?
    - Has the population reached a pseudo-equilibrium state?

# Questions

1. If current conditions are maintained, is this population expected to persist?
2. If you run 2000 year simulations instead of 200 years, do your predictions changes?
  - Are these better estimates?
3. After a 2000 year simulation, plot the occupancy state of the patches through time. Based on this data consider:
  - What are the five most important plots in the system (i.e. if you are a conservation officer which ponds would you make sure to maintain)?
  - What are the 10 least important ponds (which ponds can be destroyed)?
4. If the extinction parameter ( $x$ ) is actually 0.6 (instead of 0.41):
  - What is the impact on each patches extinction rate?
  - What is the impact on metapopulation dynamics (occupancy, persistence)?
5. If connectivity between the ponds is higher (i.e. the alpha parameter is 0.8 instead of 1):
  - What is the impact on the connectivity between patches?
  - What is the impact on metapopulation dynamics?