Tuesday Lecture

2024-09-24

**Sources and Sinks vs. Ecological Traps II**

Quiz:

What needs to happen for a site to become a source? *A net surplus of individuals (that can emigrate from this site).*

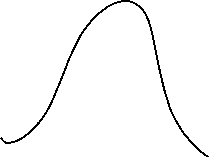
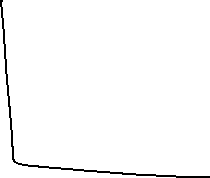
What makes a site an ecological trap? *All the cues to indicate high-quality habitat are present, but there is either some novel feature that increases mortality and/or decreases reproduction or some appropriate resource is now lacking. E.g. Open meadow-nesting birds nesting in hay fields before the first hay cutting or amphibians laying eggs in anthropogenic wetlands with insufficient hydroperiods.*

**Which are more common, sinks or ecological traps?**

* Sink, assuming sub-optimal habitat that individuals have to go to because they have nowhere else to go.
* Traps, a cue is causing individuals to want to settle there.
* Battin: “An ecological trap is a habitat “low in quality for reproduction and survival [that] cannot sustain a population, yet . . . is preferred over other available, high-quality habitats” (Donovan & Thompson 2001). Thus, a trap is simply a sink habitat that is preferred rather than avoided (Fig. 1), or an “attractive sink” (Delibes et al. 2001).”
* Something in the environment has changed, maybe not the sign stimuli, so individual does not leave. Evolution has not caught up to this sudden change and the animal stays there, despite lack of fitness.

Javan’s thoughts: Ecological traps more common - humans have so greatly changed the landscape, but in ways that may not have changed the sign stimuli. Habitat fragmentation changing sign stimuli for forest dwelling songbirds.

* **Extreme fitness consequences of habitat selection so natural selection works strongly on settling response**, so difficult for sinks to persist long-term in a landscape that is not being modified. Does it make sense for an animal to settle in an environment where it knows it will incur no fitness? No, natural selection should weed out those individuals that would select habitat that the sign stimuli indicates to them as non-habitat. Natural selection will hone in the tendency for species to select low quality habitat.



Selection

Frequency

How would we go out and actually determine which is more common?

* Looking at lambda over short period of time, we have too much variability to know. So need to look at expected lambda.
* Very difficult to determine survival, reproduction, immigration, and emigration.
* When people look into source-sink and traps, often people report incomplete measures. Battin sources often used just reproduction and survival.

**Natural selection will act quickly on individuals with settling response to sign stimuli that indicate non-habitat, but difficult to act on individuals settling in ecological traps.**

Something about the trap still looks good to the individual.

**Mannan et al. (2008) - Coopers Hawks**

Tucson has good nesting habitat for coopers hawks, but also evidence for less optimal breeding habitat due to nestling parasite due to pigeons and doves.

* High nest density, high prey delivery rates, high adult survival, small breeding season home range
* 85% nestling parasite infestation in urban areas, 40% of nestlings killed annually by diseases from parasite
* Sound like an ecological trap? **What does lambda say??**
* Lambda = 1.11 (P = 0.0073 that lambda < 1)
* Ecological trap? They argue no.
  + High post-fledgling juvenile survival, which contrasts to patterns in non-urban raptors where high 1st winter survival is common.

**LAB: Imperfect Detection – Get more notes from slides posted on D2L**

Measure where an animal is present or using features, as well as where the animal is absent or not using features.

* Collecting binary data, 1 = present, 0 = absent
* Modelling probability, our y axis is constrained to 0 to 1. Our slope lines are all curved because of the logit link function that allows us to observe our probabilities as continuous.

Review of GLMs: 3 components

1. Deterministic function (the linear predictor) aka y = β0 + β0 \* X1
   1. Deterministic function gives us our expected value (y)
   2. β0: slope
   3. β1: intercept, effect size. How much y changes per one unit change in x
2. Stochastic distribution (the error distribution)
   1. Variation of data around expected values (can think of expected value as mean)
   2. When we assume residuals have gaussian (normal) distribution, we assume deviations remain constant magnitude across x
      1. You can’t observe negative individuals, need an error distribution that can only be positive and can change its spread as expected value changes.
      2. For binomial models, we will always use binomial error distributions
3. Link function
   1. In a binomial GLM, the link function maps the linear predictor to a probability bounded between zero and one
   2. *logit(pi)* = *β0 +* *β1* \* X1,*i*
   3. Parameter estimates that you’re seeing on your model is going to correspond on the logit scale. When you observe then on the probability scale (using plogis()), they will be remapped using that plogis() transformation.
   4. See Javan’s slides about this for graph images that relate linear predictor to original scale

Binomial GLM or Logistic Regression : *yi* ~ Binomial*(β0 + β1* \* X1,*i)*

* *y*: your 0s and 1s
* *n*: trial size (always 1 with binary response) so *y* ~ Binomial(*p*)
* *p*: probability of being a 1

ACCOUNTING FOR IMPERFECT DETECTION MATTERS IN YOUR ANALYSES!!!!!

The solution for imperfect detection? Hierarchical Occupancy Models!

* Probability that Chiricahua leopard frogs are present at a site during the study period
  + If all we have is one site visit, we cannot determine detection rate
* *y:* what we observe, *z*: true state of the site, whether or not it is truly occupied
  + *Two binomial GLMs estimated simultaneously*
  + If *z* = 0, *y* = 0
  + If *z* = 1, *y* = 0 or 1
* State model (occupancy): probability of site being occupied
* Observation model (detection): probability of species being detected

How do we get this information to determine detection and occupancy?

* Multiple site visits, we will get some 0s and some 1s for same site depending on visit. Can determine true state of site.
* *ψi* = probability of occupancy (# sites with detection at any visit/total sites)
* *pi* = probability of detection (detections/site visits)

Design of occupancy models, assumptions

* see slides