Tuesday Lecture

2024-10-01

**Learning and Habitat Selection, Part II: Natal Habitat Preference Induction (NHPI)**

Quiz:

Describe the Natal Habitat Preference Induction (NHPI) hypothesis in your own words: *Individuals that settle or select habitat conditions similar to those they experienced early in life. This hypothesis may help explain why we see individual variation in habitat conditions among individuals of the same species.*

NHPI may allow individuals to better “…match preference and performance.” Would variation in individual performance be better explained as genetic variation among individuals or phenotypic plasticity (i.e., same genotype, different phenotype)? Why or why not? *If the fitness consequences of habitat selection are strong, then natural selection should remove genetic variation among individuals for the habitat selection template. Differences among individuals would therefore emerge via phenotypic plasticity rather than from differences in genotypes.*

**NHPI**

Advantages of this hypothesis:

1. Increased efficiency of habitat selection process
2. Match of performance and fitness, phenotypic plasticity – find the environments that worked well for your parents and you, therefore they should work well for you and your offspring

**Individual Variation: NHPI as an explanation for why we see variation among individuals.**

Same species, assumed same genetic pool, how do we see inter-individual variation?

* Mt. Graham red squirrel example: two squirrels raised on mt graham, but slightly different habitat conditions.



Settling Response



Tree Density Canopy Cover

Red lines are settling response thresholds for this species, blue lines are conditions in which RS1 was raised, green lines are conditions in which RS2 was raised.

Scenario in which NHPI could be detrimental?

* Changes in habitat features, decreasing quality
* Individuals trapped in a habitat, forced to raise young there, now the offspring develop an affinity for these novel conditions that aren’t optimal for fitness success

**Case Study: Cooper’s Hawks**

Test NHPI hypothesis – do hawks hatched in particular tree species and urban environments nest in similar situations when they first settle to breed?

* Tree species: Aleppo pine and eucalyptus
* Percent cover of buildings

Looking at where the individual was raised and where they settled, is that enough to evaluate NHPI? **No**, also need to measure **availability** tocompare use versus nonuse

Findings: No differences in what was available in Tucson and where they settled based on natal habitat.

Does this mean they can reject the NHPI hypothesis? **No**, they only looked at these features, but it could have been tree density or height. Could have been much more general conditions eliciting the settling response. The nest condition thresholds could have been so low, that settling response is being observed across the gradient.

**Case Study: Mt. Graham Red Squirrels**

Do dispersing juveniles select areas with similar forest structure and composition as their natal home range?

* Measured: trees species, diameter and breast height, tree alive/dead, basal area, tree species diversity, canopy cover, estimated cone production
* Multi-scale analysis of covariates, at plot (30m radius) and home range (100m radius)

Findings: evidence for NHPI, particularly for long-distance dispersers (compared to short-distance dispersers) and with regards to live basal area and canopy cover.

* Would we expect to see this NHPI more likely in individuals dispersing further from natal habitat? Two possible explainations
  + If you’re not moving that far from natal home range, harder to detect because conditions closer are going to be more similar. Spatial auto correlation, tendency for things closer in space to be more similar than things further in space.
  + If you’re moving further, fitness consequences of selecting poor habitat very high, so better to choose habitat similar to what you recognize from growing up

**LAB – Continuation of previous lab slides**

**Occupancy Modeling Study Design**

When dealing with hierarchical occupancy models we are still using a binomial GLM. There are two binomial processes: occupancy (is the site used/unused) and detection (is the species detected or not)

When we detect the species, we know the true state (presence) of the site.

Design of occupancy studies: assumptions that go into occupancy modeling

* Site closure assumption: **with respect to true occupancy state of the site**, occupied v unoccupied remains constant for duration of study. If true state is occupied, individuals can come/go, but there are always some turtles for duration of your study. If true state of site is unoccupied, there must be no turtles for duration of the study.
  + This will be true for species that have high site fidelity, but for species that move around a lot during a season, say leopard frogs during monsoon season move around a lot and true occupancy state may change for your sites during study
  + Okay if violations occur completely random
    - Camera trap studies: your site closure assumption is being violated. If we can make the assumption that the probability of a bobcat coming into the site and leaving is random, we still meet site closure assumption. *This is not true for monsoon season and highly mobile leopard frogs*
* Species correctly identified (no false positives)
  + Easy to avoid for distinct species, but becomes problematic when you are observing a species that is very similar to another species
* Independence of detection histories across locations
  + Issue if an individual moves from one study site to another, captured on one camera then another camera later on.
  + Can be avoided with study design
* No unmodeled heterogeneity in occupancy or detection
  + If there is just on individual at a site, it’s going to be much harder to detect than a site with many individuals.
  + Can be avoided with study design, e.g. don’t start surveys until start of breeding season and stop prior to end of breeding season
  + If unavoidable, can be dealt with in model (i.e. put in a quadratic relationship with detection and covariate)

**Formatting Data for *unmarked: unmarkedFrameOccu* objects**

Encounter History Site-level Covariates

Site↓

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 0 | 0 |  |  | 10% | 1400m | 250m2 |
| 0 | 1 | 1 |  |  | 75 | 1445 | 50 |
| 1 | 1 | 0 |  |  | 55 | 1450 | 850 |
| 0 | 1 | NA |  |  | 25 | 1480 | 500 |
| 0 | 0 | NA |  |  | 5 | 1500 | 750 |
| 1 | NA | NA |  |  | 85 | 1450 | 300 |

Air temp Day-of-Year

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 21 | 18 | 15 |  |  | 21 | 29 | 31 |
| 23 | 17 | 19 |  |  | 37 | 41 | 50 |
| 25 | 19 | 20 |  |  | 29 | 39 | 48 |
| 20 | 18 | NA |  |  | 20 | 29 | NA |
| 17 | 21 | NA |  |  | 2 | 12 | NA |
| 18 | NA | NA |  |  | 11 | NA | NA |

All these data frames are fed into *unmarkedFrame* to model occupancy and detection

Survey/visit ↓

Example:

* 6 sites
* 1-3 visits or surveys per site
* 2 survey-level covariates
* 3 site-level covariate

Rows = site

Column = site visit

Site-level covariates, constant through duration of study. Used for first coin flip, presence/absence of species. Is presence of species at my site influenced by

Survey level covariates, dependent on survey/visit, species presence should not vary based on these conditions, because assumption of constant occupancy.