Outline: Source Sink Dynamics in Neotropical Migratory Songbirds

- Review of Metapopulation Ecology and Source-Sink Dynamics
- Examples of Sources and Sinks
- Current Limitations of Source-Sink Models
- Future Directions
Metapopulations: Population of Populations (Levin 1969)

...Recall Chapter 5?

Derived to describe spatially-structured populations

Local populations inhabit discrete habitat patches. Eg. Fragments

These local populations are connected through migration between patches
Metapopulations: Sources and Sinks  
(Pulliam 1988)

Source: net exporter of individuals  \( \lambda_1 = P_A + P_J \beta_1 > 1 \)

Sink: net receptor of individuals  \( \lambda_2 = P_A + P_J \beta_2 < 1 \).

Source-sink dynamics arise when surplus reproduction from a source maintains a positive population in a sink.
Source-sink Dynamics as a Management Tool

Analyzing declines in Neotropical Migratory Songbirds

![Graph showing bird numbers per route over time. The x-axis represents years from 1970 to 2020, and the y-axis represents numbers of birds per route. The graph displays a downward trend in bird numbers over time.]

Source: Analyzing declines in Neotropical Migratory Songbirds

- sink Dynamics as a Management Tool

**Source**

- Analyzing declines in Neotropical Migratory Songbirds

**Year**

- 1970 to 2020

**Birds per route**

- 0 to 8

**Legend**

- Green dots for one route
- Red dots for another route
- Black dots for a third route
Identifying Sources and Sinks

- Burke and Nol (2000) identified if fragments of different size served as sources or sinks.
- Monitored nesting success of 5 species of interior forest songbirds in southern Ontario.
Identifying Sources and Sinks

Local:
Wood Thrush demographics in Northern Indiana fragments

Continental:
Use of predictive models to detect relationship between fragmentation and population growth

Fauth 2000

Lloyd et al. 2005
Limitation to Pulliam’s Model

• Actual measures of source-sink dynamics largely lacking

• Difficulty estimating parameters

• Assumes equilibrium \(\rightarrow\) Ignores dispersal

Solutions:

Runge et al 2005 suggests use of a different metric to define sources and sinks

• \(C^r = \text{per capita contribution of a member of the focal subpopulation to the metapopulation}\)

\[
C^r = \phi^r_\alpha + \sum_{s \neq r} \phi^r_s + \beta^r \left( \phi^r_j + \sum_{s \neq r} \phi^r_j \right). \tag{6}
\]
Source-Sink Dynamics: Wood Thrush

Titler et al. (2006) assessed sources and sinks using measures of asynchronous dispersal

Fig. 2. Populations included in the analyses at the 60–70 and 70–80 km distance classes, with those found to be putative sources or sinks represented by solid circles and all others represented by open circles. Note a lack of putative source/sink populations in the Midwest, despite the inclusion of several populations in this area in the analyses.


Identifying Sources and Sinks

**Local:**
Wood Thrush demographics in Northern Indiana fragments

**Regional:**
Habitat-specific fecundity in fragments across the Mid-West, 8 species

Fauth 2000

Robinson et al 1995
Identifying Continental Sources and Sinks

Use of predictive models to detect relationship between fragmentation and population growth
What about the non-breeding season?

Runge and Marra 2005