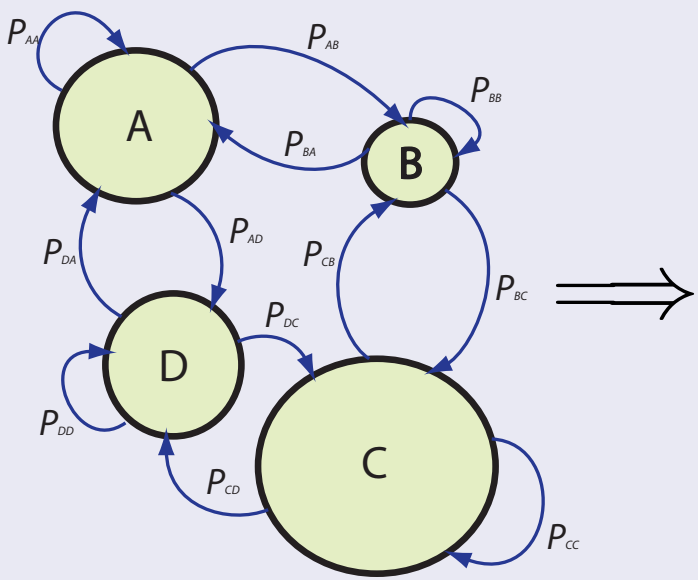
The Simulation Model

The Birth-Death Process

- Probability of speciation, birth rate $= \lambda$
- Probability of extinction, death rate $= \mu$

The Geographical Template

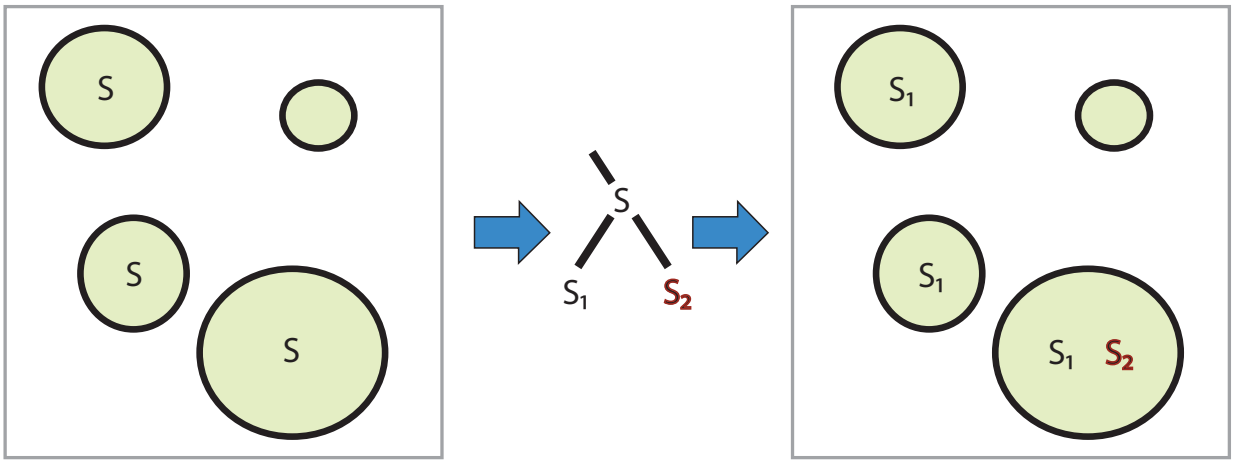


$\Longrightarrow$

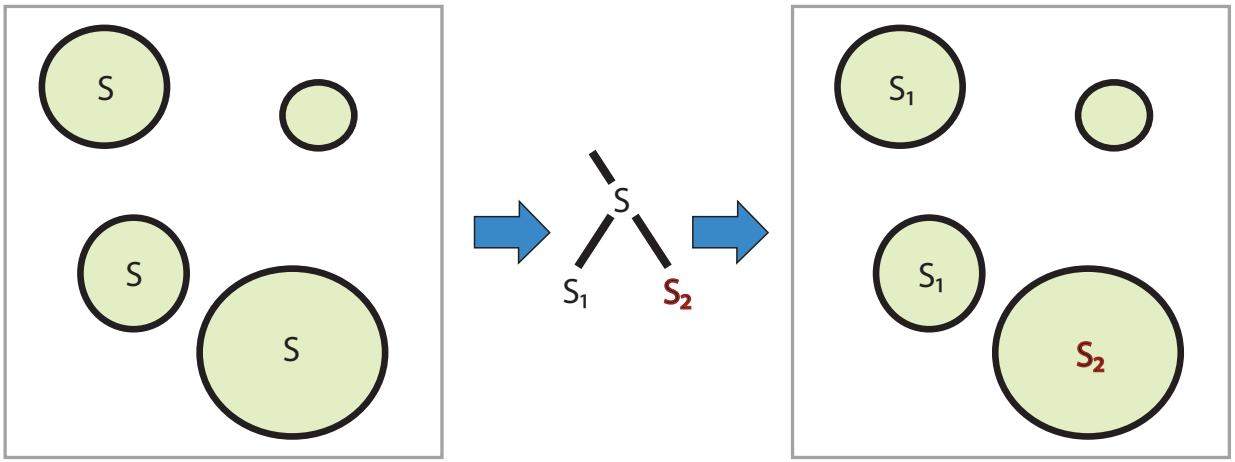
	A	B	C	D
A	P_{AA}	P_{AB}	P_{AC}	P_{AD}
B	P_{BA}	P_{BB}	P_{BC}	P_{BD}
C	P_{CA}	P_{CB}	P_{CC}	P_{CD}
D	P_{DA}	P_{DB}	P_{DC}	P_{DD}

Speciation Modes

- Sympatric



- Allopatric



Simulation Cycle

1. Initialize with λ, μ, region definitions and speciation mode.
2. "Seed" system: introduce single lineage into a region.
3. Set termination condition:
   - Target diversity $= T$: Run until T species.
   - Number of generations $= G$: Run until generation G.
4. Repeat until T species or G generations, or all species extinct:
   - Migration:
     - For each species in each region, select a destination region for dispersal (include current region, i.e., no dispersal) according to dispersal probability.
     - Add species to destination region if not already present
   - Diversification:
     - For each species in the system, draw a uniform random number, $u \sim U(0, 1)$.
     - If $u < \lambda$: split lineage.
     - If $u > \lambda$ and $u < (\lambda + \mu)$: remove lineage.