**Simulation outline**

**Main hypothesis 1: As the degree of scramble competition increases the degree of dynamically instability will increase.**

**I will investigate this by determining:**

1. ***The degree of intrinsic instability relative to degree of scramble competition***

**HA:** The higher the degree of scramble competition the more intrinsically unstable the local population dynamics.

I will test this by plotting the slope of the growth function as it crosses the identity line against degree of scramble competition. If the slope increases as the degree of scramble competition increases this hypothesis would be supported.

**H0:** Resource allocation method does not affect intrinsic instability.

1. ***Number of patches (local populations) that go extinct per generation against degree of scramble competition***

**HA**: As scramble competition increases so does the fraction of local populations that go extinct every generation.

**H0**: Resource partitioning does not have an effect on the number of local populations that go extinct.

**Section 2: Dispersal and population/metapopulation stability interaction with resource allocation?**

Dispersal will be modelled by three different mechanisms (1) Direct fitness only where individual only disperse once their lifetime reproductive success would be lower if they stayed in the nest (2) Indirect and direct fitness where both their indirect and direct fitness affect whether they will disperse (3) forced ejection from the colony to maintain the colony at the optimum group size.

**OR/AND Metapopulation structure and dispersal type?**

higher the cost of dispersal due to the higher search costs to locate suitable sites.

**Hypothesis 1: Dispersal at the optimum group size**

If dispersal takes place at the optimum group size then dispersal should have a stabilizing effect on the colony so parental colonies should remain healthy (Łomnicki 1988). Additionally whether individuals are being ejected from the colony or whether they are leaving to increase their indirect fitness, dispersers would have a lower fitness than philopatric individuals. This implies that single female nests would have a low success rate, producing a metapopulation with most individuals in colonies around the optimum group size.

**Hypothesis 2: Dispersal at the stable group size**

However if dispersal takes place at the stable group size then it is possible that the parental colony is unhealthy and will die soon after. If the only consideration an individual makes as to whether to disperse is related to direct fitness, then fitter individuals will disperse resulting in a higher success rate for single female nests compared to dispersers at optimum group size. This would leave the less fit individuals in the parental colony. This would result in a wide range of colony sizes.

**Null hypothesis**

Dispersal mechanisms do not affect the metapopulation structure.

**I will investigate this by determining:**

1. ***Percentage of single female nests compared to the number of dispersers that survive one generation compared to dispersal mechanisms***

|  |  |
| --- | --- |
| **Hypothesis** | **Percentage of surviving single female nests** |
| 1: Optimum group size | Few single female nests survive as dispersers have a lower fitness than philopatric individuals |
| 2: Stable group size | A larger number of nests survive as dispersers have a higher fitness than average |
| Null | No difference between percentage of single female nests surviving and dispersal mechanism |

***b. Dispersal mechanism against colony size distribution averaged over time***

|  |  |  |
| --- | --- | --- |
| **Hypothesis** | **Colony size distribution** | **Number of colonies** |
| 1: Optimum group size | Unimodal peaking at the optimum group size | Few colonies, most at or around the optimum group size |
| 2: Stable group size | Bimodal peaking at small colony sizes and stable size | Lots of smaller colonies and a few at the stable group size |
| Null | Dispersal mechanism does not affect distribution of colony sizes | Dispersal mechanism does not affect number of colonies in the metapopulation |

**OR I could include some genetic basis for when to disperse and see the evolution in the system? Direct/indirect or ejection?**

**Methods: Basic outline of model**

I am proposing the rough outline of my individual based model to follow the flow chart in figure 5.

START

Female(s) die after x time

Adult females become inseminated

Single inseminated female nest

Juveniles reach adulthood

Proportion of females die depending on female size and stochastic element

Juveniles grow, getting access to resources by either scramble or contest competition (see figure 6)

Female(s) lays egg- number of offspring proportional to size of females and stochastic element

Juvenile does not reach adulthood

Dispersal: when this takes place depends on ‘rules’ for dispersal (see below)

**Figure 5**: Flow chart demonstrating the proposed outline of my model. I am assuming the female size is directly related to female fitness. Each solid arrow represents one time tick.

**Figure 6:** Outline of mechanism of contest or scramble competition. Again each solid arrow represents one time tick. To progress to the next instar the spider has to reach a specific, predefined size.

\* s can be negative: indicating that the individual did not get enough food and decreases in size

Individual of size *s***\***

The amount of food an individual gets*, a* , proportional to *s* is dependent of the ratio of scramble to contest competition

Grows depending of **a**, gaining new size, **s**

Dies if s is death!

The amount of food obtained by a nest will be proportional to the number of each instar. For example each adult contributes x amount of food, each subadult contributes x/2 amount of food. This will be scaled by a unimodal group size function so individuals at intermediate group sizes get most food per capita as we assume that prey capture efficiency and size of insects captured increases as group size increases, but amount of web surface area to individual decreases as nest size increases, resulting in less prey landing in the web (Yip et al. 2008)