***Dispersal and resource allocation methods simulation outline: Individual based model with condition dependent dispersal***

**Basic outline of model**

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

*Variable cost of dispersal*

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 present. 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)

**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 parental colony. If there is a high cost to dispersal only fitter individuals should disperse(?)

(2) **Indirect and direct fitness** where both their indirect and direct fitness affect whether they will disperse. Not sure about the fitness of these individuals, potentially only fitter individuals will disperse

(3) **Forced ejection** from the colony to maintain the colony at the optimum group size. In this case lower fitness individuals will disperse as they will be the ones most likely to be expelled from the colony/population

Factorial design: *Resource allocation* vs *dispersal method* vs *cost of dispersal(?)*

**Main hypothesis 1: The degree of dynamically instability vs amount of scramble competition and dispersal mechanism**

**I will investigate this by determining:**

1. *The degree of intrinsic instability relative to degree of scramble competition and dispersal method*
2. *Number of patches (local populations) that go extinct per generation against degree of scramble competition and dispersal method*

**Condition of dispersers and condition dependent dispersal**

The different dispersal mechanism will result in individuals of differing fitness dispersing. This should affect the structure of the metapopulation

**(1) Dispersal is only controlled by direct fitness of disperser**

Depending on the cost of dispersal the disperser should be healthy. Therefore she would be more successful founding new colonies. The parental colony will be unhealthy as it will be at its stable group size when dispersal takes place and is likely to die soon after.

**(2) Dispersal is controlled by both direct and indirect fitness**

Not sure whether the disperser will be healthier, but the parental colony will be near its optimum group size so will remain healthy

**(3) Dispersers are rejected form the colony**

The dispersers will be the least fit in the colony and therefore less successful at founding new colonies. The parental colony will remain at its optimum group size and therefore remain healthy.

**I will investigate this by determining:**

1. *Dispersal success: Percentage of dispersers that survive one generation compared to dispersal mechanisms and cost of dispersal*

*b. Dispersal mechanism and cost against colony size distribution*

* How many colonies/populations are there within the metapopulation?
* What is the distribution of colony sizes within the metatpopulation? i.e. is there a unimodal distribution of colony size where there are mainly intermediate colony sizes (dispersal at optimum group size?) or is there a bimodal distribution of colony size with mainly small and large colonies (dispersal at stable group size?)
* Could compare to real data from *A. eximius*?

**Other ideas**

1. Evolution of dispersal strategies: I could include some genetics within the simulation to see what dispersal strategy evolves under which conditions

2. I could make the model spatially explicit, with the cost of dispersal increasing with the distance dispersed. This could simulate the spatial structure of *A. eximius* metapopulations and we could compare it to real data from *A. eximius*.