Oikos

o19487
Meier, C. M., Starrfelt, J. and Kokko, H. 2011. Mate limitation causes sexes to coevolve towards more similar dispersal kernels. – Oikos 120: 1459–1468.

Appendix 1

Sex-specific dispersal distance and the distribution in space

In model 2 we expect a specific dispersal kernel for a particular sex would distribute the individuals of that sex in a certain way along the mortality gradient from the core to the edge of the population. The emerging distribution of this one sex can then be a seen as a "resource distribution" for the opposite sex, for which it will adapt its own dispersal distance.

If our proposed mechanism works as expected, we should see a relationship between the difference in the means of the sex-specific dispersal kernels and the ability of one sex to match the spatial distribution of the opposite, which would then result in a high rate of finding a mate. We looked at this relationship after settling time and at the end of evolution.

We summarize the differences in dispersal kernels as the difference in the trait values $D_F–D_M$. To look at the distribution of mate-location failures over space we created the measures L_F and L_M (L stands for edge loneliness). These measures are derived in the following way:

First we discriminate between individuals that did or did not succeed in mate-location. We defined mate-location to be successful if there was at least one potential mate (individual of the opposite sex) n_{mate} within the distances d_{mate}, and to be unsuccessful if $n_{mate} = 0$. This yielded four distributions: individuals successful (Φ_{S_M}, Φ_{S_F}) and unsuccessful (Φ_{U_M}, Φ_{U_F}) in mate-location, and we scored the median distance from the origin for each of these distributions. The difference between the distribution of unsuccessful and successful individuals gave an indication of how strongly the distance from the origin predicts mate-location failures.

$$L_F = \text{med}(\Phi_{U_F}) – \text{med}(\Phi_{S_F}), \text{ and } L_M = \text{med}(\Phi_{U_M}) – \text{med}(\Phi_{S_M})$$

High value of edge loneliness means that unsuccessful individuals were located further from the origin than successful ones.

The dispersive sex fails more often to locate a mate

Edge loneliness was almost always positive, meaning that individuals that were unsuccessful in mate-locating were found further from the origin than successful individuals (Fig. A2–A3). For females the edge loneliness was positive in 96.36%, 95.88% and 96.58% of all replicates (scenarios I, II and III respectively), and for males the corresponding proportions were 98.06, 97.58 and 97.32% after settling time. After evolution edge loneliness values were positive in about the same proportion of all simulations.
After settling time but before evolution has taken place, there was, as expected, a clear relationship between the sexual difference in dispersal kernel and the risk of failing to locate a mate for individuals at the edge (significant Pearson correlation test in Fig. A2A–A2C). When dispersal was negatively biased, i.e. males on average dispersed further than females, males suffered more and females less from edge loneliness. Conversely, when dispersal was biased such that females dispersed further, females also became the sex to be more affected by edge loneliness.

After evolution the relationship between sex bias in dispersal and edge loneliness remained qualitatively unchanged for the sex that could not evolve (Fig. A3A–A3C). However, when males evolved the relationship for males was still positive but weaker (Fig. A3A), when females evolved the relationship changed from positive to negative (Fig. A3B) and when both sexes evolved the relationship between sex bias in dispersal and edge loneliness disappeared in both sexes (Fig. A3C).

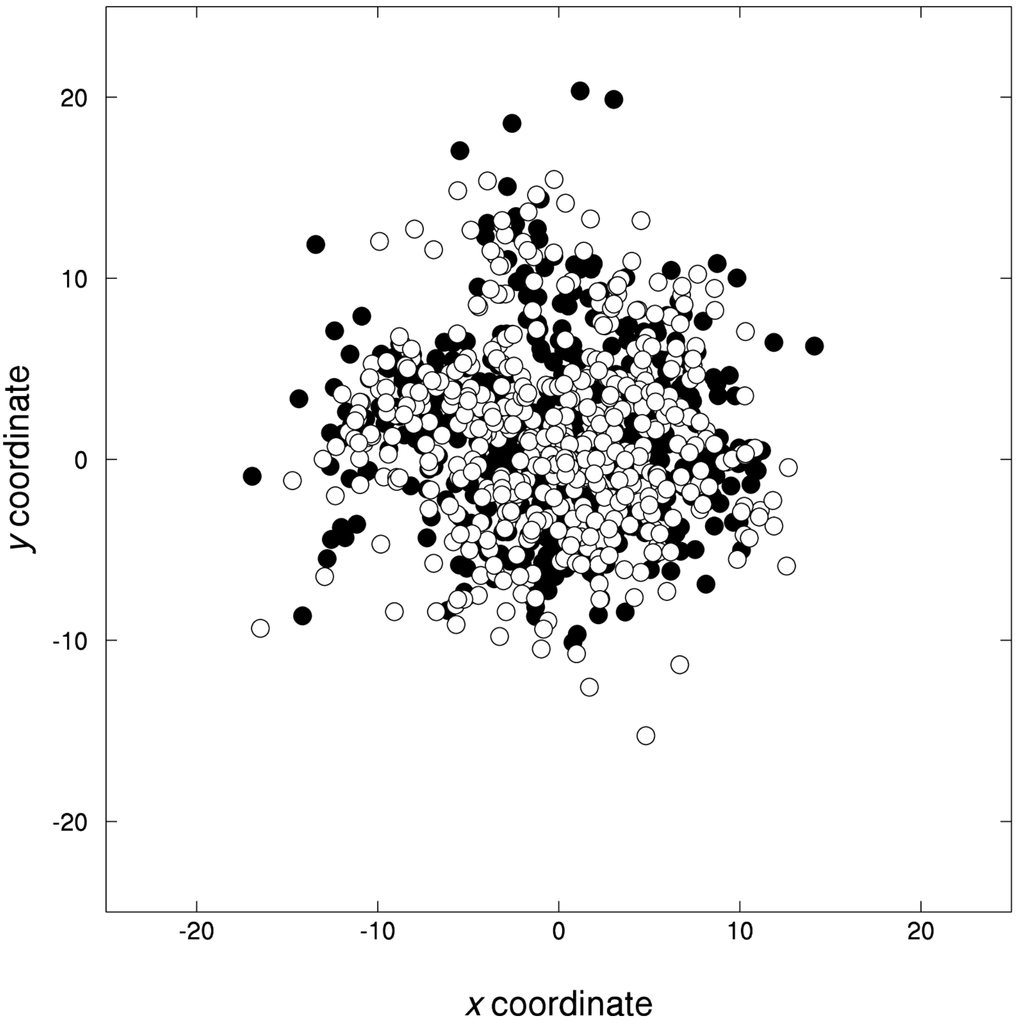

Figure A1. The spatial configuration used to initiate simulations of model II; 500 males (black) and 500 females (white) positioned around the origin (x = 0, y = 0). The coordinates were derived from a population at the end of a preliminary simulation run. Units are in principle arbitrary, in practice they can be interpreted as multiples of mating distance d_{mate} (i.e. the maximum distance between two reproducing partners), given that mating distance was set to unity in all simulations.

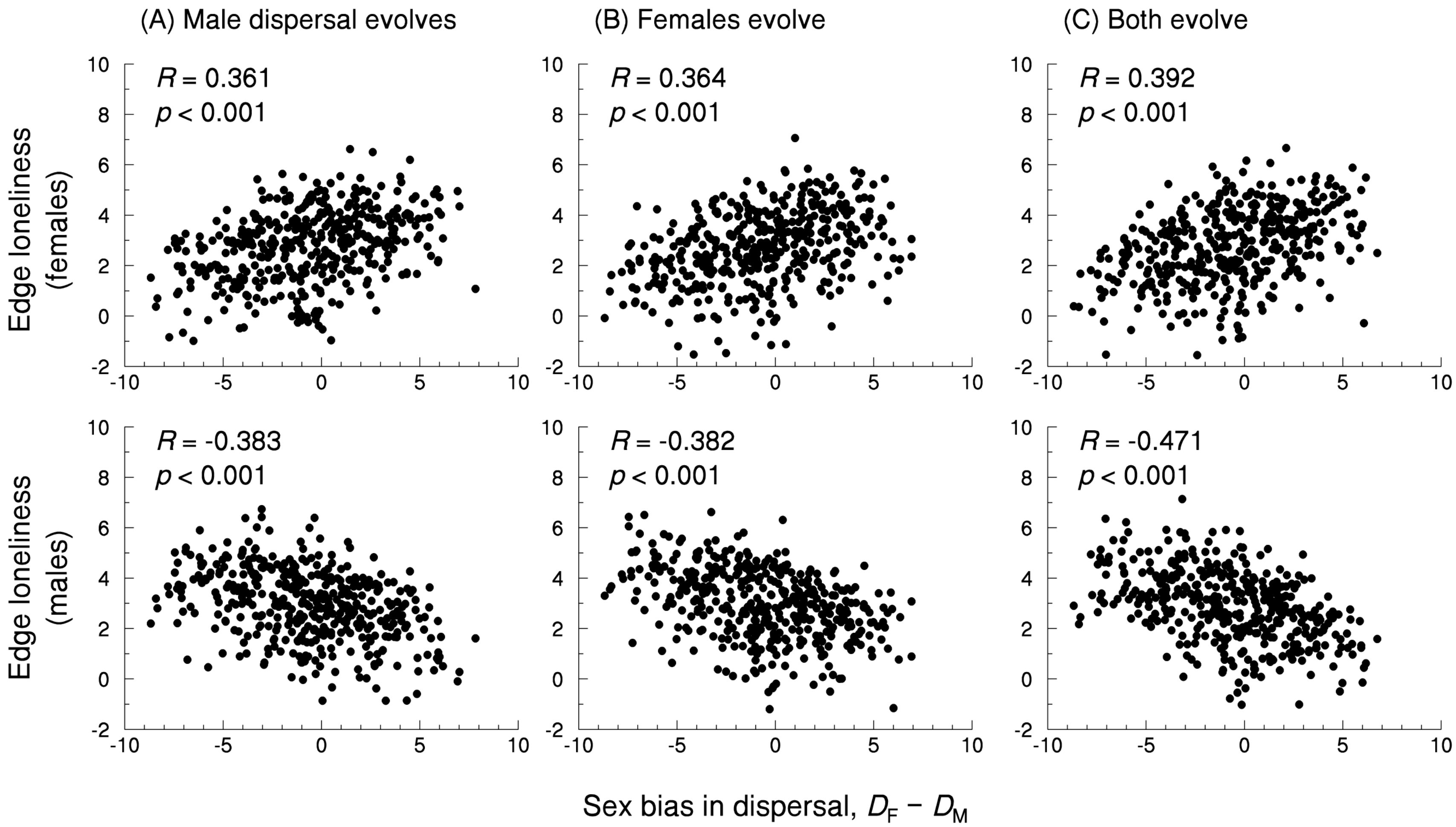

Figure A2. The relationship between the sex bias in dispersal (the sex difference in mean dispersal distance) and edge loneliness (the predictive power of the spatial location as a determinant of mate-locating failure), measured before evolution is allowed to take place.

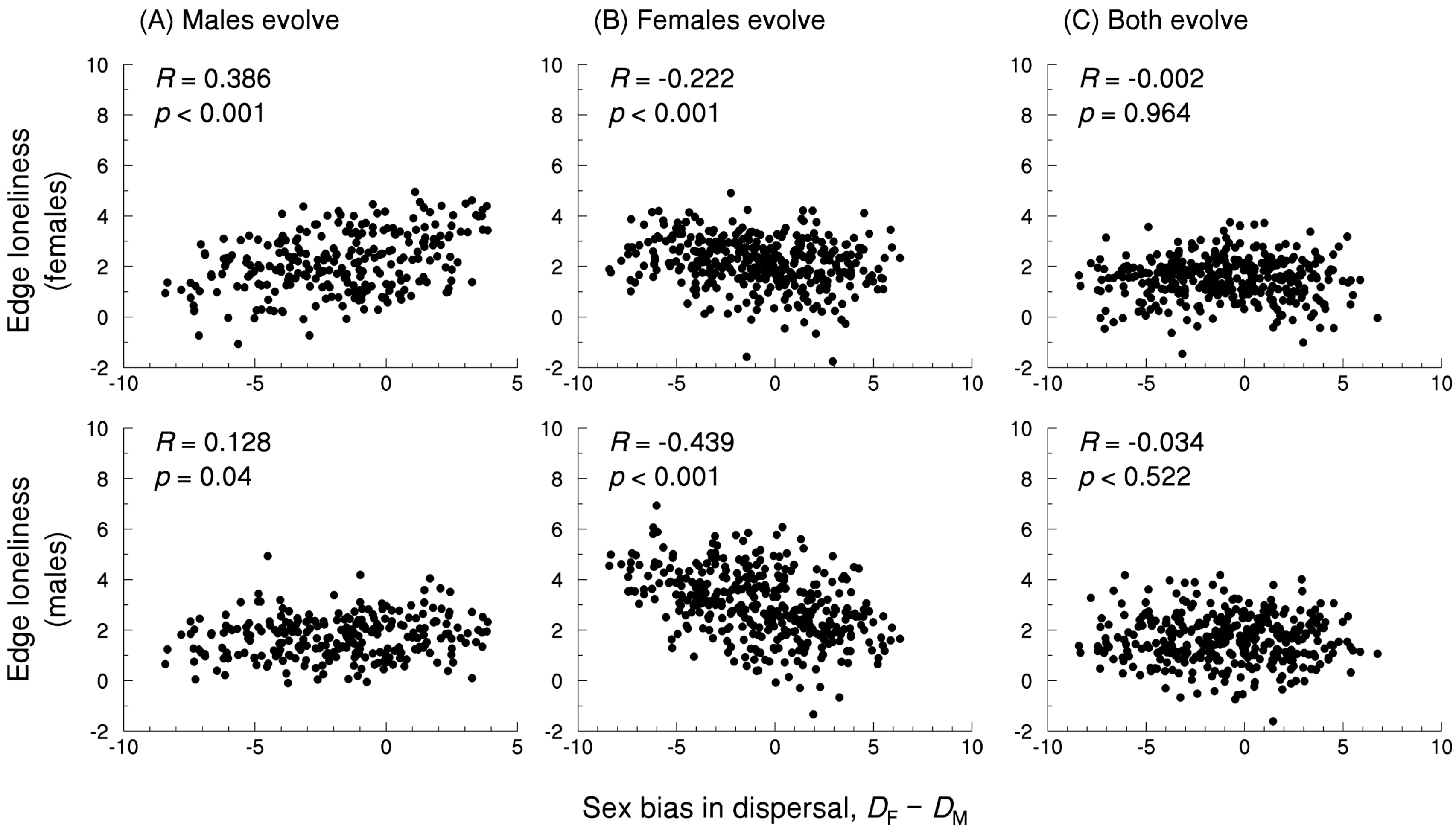

Figure A3. The relationship between the sex bias in dispersal (the sex difference in mean dispersal distance) and edge loneliness (the predictive power of the spatial location as a determinant of mate-locating failure), measured after evolution is allowed to take place.