

When will females evolve ornaments to attract males for mating?

Studying coevolution of female ornaments with nuptial gifting behaviour

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INTRODUCTION

While theoretical studies have looked at female ornamentation, it is unclear under which ecological circumstances we should expect such ornaments to evolve.

AIM: To find the **ecological parameters largely controlling the evolution of female ornamentation** (like ones seen in the long-tailed dancefly *R. longicauda*) in a species with **nuptial gifting behaviour**.

We study the effects of the following parameters on the evolutionary dynamics:-

1. Efficiency of female ornaments in exaggerating female size
2. Impact of nuptial gifts on fecundity
3. The base mortality of males and females

METHODS

I designed **agent-based computer simulation** using a modified Gillespie algorithm to test the importance of relevant ecological parameters for the evolution of female ornaments. It is **coded in R**.

4 heritable, autosomal traits are subjected to evolution by selection, mutation, and drift--

1. Female ornament (p)

$$B_{app.} = B_{true}(1 + \beta p)$$

$B_{app.}$: Apparent female size

B_{true} : True female size

β : Ornament efficiency at exaggeration

2. Male gift-search investment (τ)

$$G = \epsilon \cdot \exp(-1/\tau)$$

ϵ : Environment's effect on nuptial gift

3.1. Male's threshold female size ($B_{app.}^*$)

$$\text{Prob(accepting female of size } B_{app.}^* \text{)} = 0.5$$

3.2. Female's threshold gift size (G^*)

$$\text{Prob(accepting male with gift } g^* \text{)} = 0.5$$

3.3 Probability of a successful mating

$$\gamma / (1 + \exp(B_{app.}^* - B_{app,i})) \cdot (1 + \exp(G^* - G_j))$$

γ : Mate encounter rate

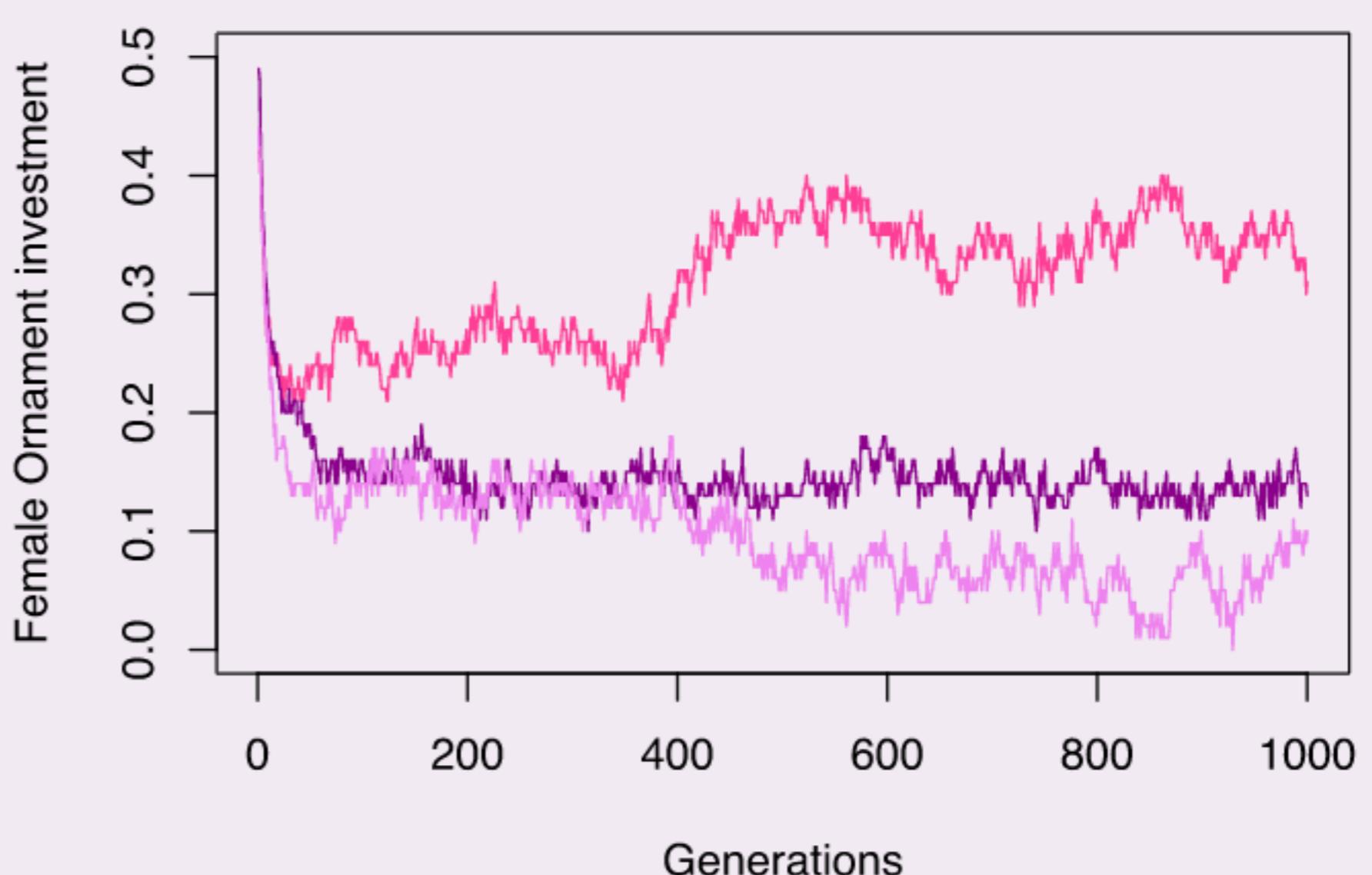
4. Fitness of a successful pair (i,j)

$$W = B_{true} + b \cdot G_j$$

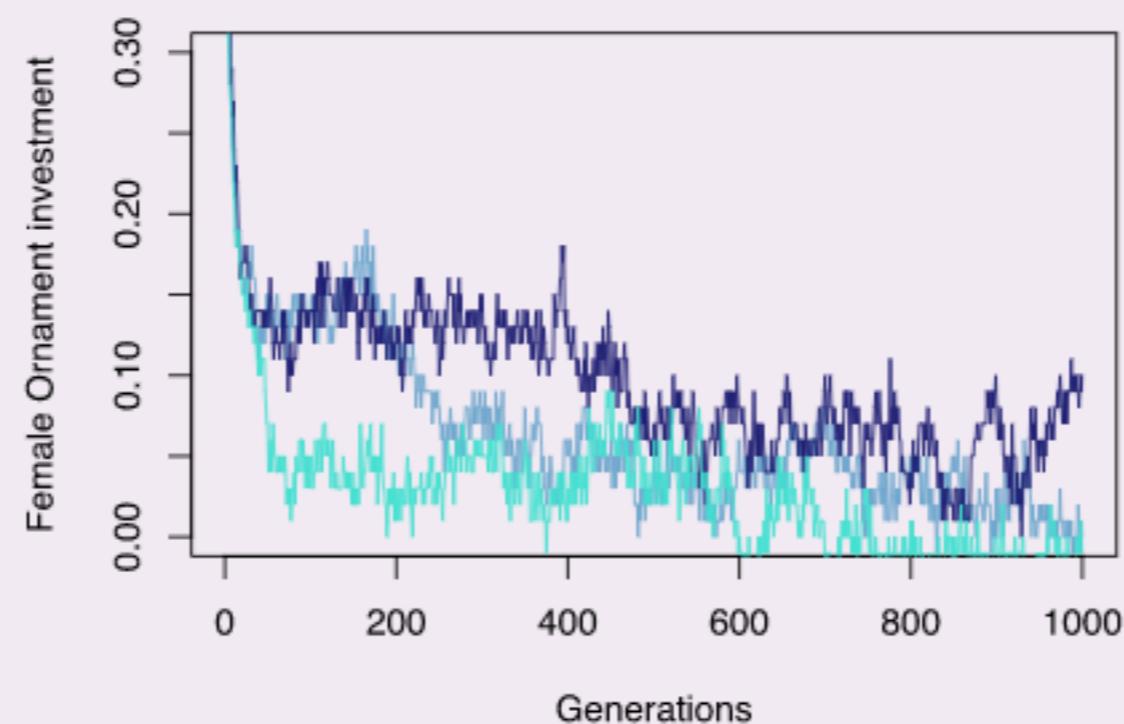
b : Fraction of gift invested in reproduction

RESULTS

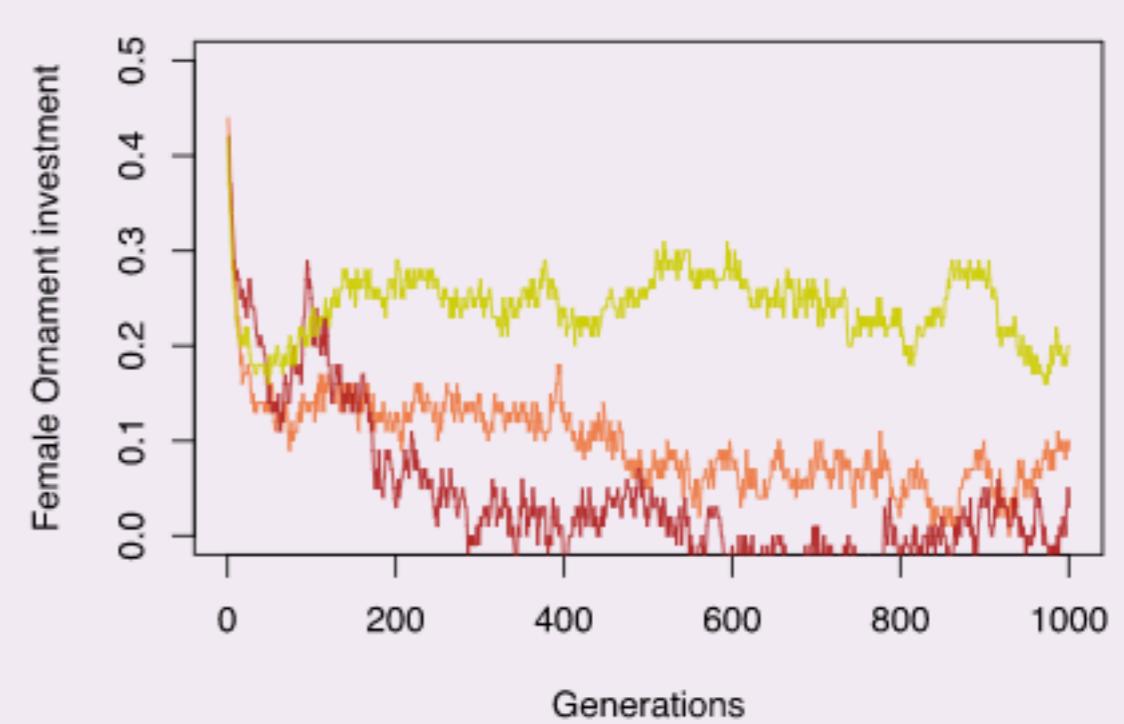
A. Evolution of female ornaments when ornaments do not / moderately / strongly exaggerate female's apparent size (as males perceive it)



B. Evolution of female ornaments when environmental effects do not / moderately / strongly increase the nuptial gift size



C. Evolution of female ornaments when male mortality is higher / equal to / lower than female's base mortality



CONCLUSION

Simulation results show female ornamentation is a rare trait to evolve as most of the parametric space did not select for its evolution. Female ornaments, in a system with nuptial gifting behaviour by the males, can evolve when--

1. Large direct benefit from mating for females (Plot B is nonzero for only abundant environment with large gifts, Plot C is highest for high female mortality)
2. Ornaments only moderately exaggerate female fecundity signal (see Plot A)

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References

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