Parental care buffers against inbreeding depression in burying beetles

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Introduction

Background and Rationale
- Inbreeding results from matings between relatives and can cause a reduction in offspring fitness inbreeding depression
- There is substantial variation in the severity of inbreeding depression both within and among species (Keller & Waller 2002, TREE 17:230-241)
- Inbreeding depression is exacerbated by environmental stresses, such as starvation, parasitism, and competition (Fox & Reed 2011, Evolution 65:246-258)
- Parental care may buffer against inbreeding depression in the offspring by alleviating these environmental stresses

Question
- Can parental care moderate the severity of inbreeding depression in the offspring?

Study Species
- Burying beetles (Nicrophorus vespilloides) breed on carcasses of small vertebrates and have facultative parental care
- Parents bury a carcass and lay eggs around it
- After hatching, larvae crawl to the carcass and start feeding
- Larvae can self-feed, but parents also provision larvae with predigested carrion, as pictured below (photo credit: Per Smiseth)

Methodology

Experimental design
- 2 × 2 factorial design
  - Presence or absence of maternal care
  - Inbred or outbred offspring
- We measured 5 fitness-related offspring traits at different life stages
  - Before independence: time to dispersal, survival to dispersal, larval mass at dispersal
  - After independence: survival to eclosion, post-eclosion lifespan

Statistical analysis
- Main effects: parental care (maternal presence or absence), offspring inbreeding status (inbred or outbred)
- Interaction between parental care and offspring inbreeding status
- Covariates: carcass size, female age

Results & Discussion

- Significant effect of the interaction between parental care and offspring inbreeding status on two offspring fitness-related traits: survival to dispersal and post-eclosion lifespan
  - Maternal presence led to a higher increase in larval survival in inbred than in outbred broods (ZAP regression: \( P<0.001 \))
  - Maternal presence at the larval stage also increased the lifespan of inbred but not outbred adults (gaussian GLM: \( P<0.0001 \))

- This interaction means that maternal care improves the performance of inbred offspring more than that of outbred offspring → buffering effect of care against inbreeding depression (Fig. 1)
  - This buffering effect persists long after offspring have become independent, as seen in the results for post-eclosion lifespan

Conclusions

- It is generally accepted that parental care evolves as a mechanism for neutralizing the effects of environmental stresses, such as starvation, parasitism, and competition, on offspring fitness (Tallamy & Wood 1986, Ann Rev Entomol 31:369-390)
  - Once parental care has evolved, it may inadvertently moderate the severity of inbreeding depression because it alleviates many of the same stresses predicted to exacerbate inbreeding depression
  - We therefore expect similar buffering effects to be widespread across species with parental care, regardless of whether they have a history of inbreeding

- Lastly, we expect selection for inbreeding avoidance to be relaxed when parental care can moderate the deleterious effects of inbreeding in the offspring
- Under these conditions, the buffering effects of parental care may favour inbreeding tolerance or even inbreeding preference

Fig. 1 Inbreeding depression (δ) in offspring, calculated as the proportional change in mean fitness of outbred (\( w_o \)) and inbred offspring (\( w_i \)): \( δ = (w_i - w_o)/w_o \)

See the full paper for more details: