Implementing GIS tools to analyse geospatial distribution factors to the reproductive success of sexual deceptive orchids: *Ophrys balearica* P. Delforge as an example

Joshua Borràs & Joana Cursach
Deceptive pollination

- Generalized food deception
- Batesian floral mimicry
- Brood-site imitation
- Shelter imitation
- Pseudoantagonism
- Rendezvous attraction
- **Sexual response**
Deceptive pollination

**Sexual response**

- Mimic female insect mating signals
  - Visual and tactile cues
  - Pheromones

- **Highly specific** (Paulus & Gack, 1990; Schiestl et al., 2004)

- Unique mechanisms of orchids

- Pseudocopulation
Current analysis of factors that affect reproductive success

In orchid, few studies have assessed male fitness as a factor

Geospatial analysis by nearest neighbour distance (NND), measured manually

Analysis of ecological services
  • Mapping and modeling floral distribution
  • In-field variability detection
**Material & Methods**

**Ophrys balearica** P. Delforge

- Balearic orchids: 14 genus and 40 species (Jonasson, 2015)
- Single endemic orchid from the Balearic islands
- Sexual deception → Highly specific
Study Zone

- 4 Locations
  - 7 populations
  - From 5 to 335 flowering individuals

- Spring of 2017 and 2018
Reproductive success factors

Fruit set (or female fitness)

Pollinia removal (or male fitness)
Population structure study

GPS position of each flowering individual

- Differential GPS *Leica™ System RTK RX 1200*
- Total station *Leica™ TPS800*
Population structure analysis
Natural pollination

- Global Lineal Model (GLM) with Binomial structure
  - Year $\rightarrow$ p-value < 0.001
  - Population $\rightarrow$ p-v < 0.001
  - Year:Population $\rightarrow$ p-v < 0.001

- Tukey’s post-hoc

- Letters indicate differences between populations

- Asterisks indicate differences between years

**Results**

Fruit Set

<table>
<thead>
<tr>
<th>Pollinia removal</th>
<th>Bellver</th>
<th>Burguesa1</th>
<th>Burguesa2</th>
<th>Burguesa3</th>
<th>Capdepera</th>
<th>Mondrago1</th>
<th>Mondrago2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>!</td>
<td>!</td>
<td>!</td>
<td>!</td>
<td>a*</td>
<td>!</td>
<td>!</td>
</tr>
<tr>
<td>2018</td>
<td>!</td>
<td>!</td>
<td>!</td>
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<td>!</td>
</tr>
</tbody>
</table>

- Letters indicate differences between populations
- Asterisks indicate differences between years
Density of plants

- Global Lineal Model (GLM) with Binomial structure for Fruit Set
  - Density 2x2 m → p-v < 0.001

- Tukey’s post-hoc

- Letters indicate differences between density squares

- Number of plants in density squares
Density of plants

• Global Lineal Model (GLM) with Binomial structure for Fruit Set
  • Density 7x7 m → p-v < 0,001

• Tukey’s post-hoc

• Letters indicate differences between density squares

• Number of plants in density squares
Position of plants

- Global Lineal Model (GLM) with Binomial structure for Pollinia Removal
  - Tertiles → p-v = 0.019
  - Population:Tertiles → p-v < 0.001
- Tukey’s post-hoc
- Letters indicate differences between relative position
- Number of plants in relative position
Conclusions

1. Reproductive success is highly variable between years and places due, likewise to changes in the density of pollinators.

2. Dilution effect of the pollinator in high density areas. As reported in Courchamp et al. (1999).

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