Plants are Like Other Animals
Except Arthropods and Vertebrates

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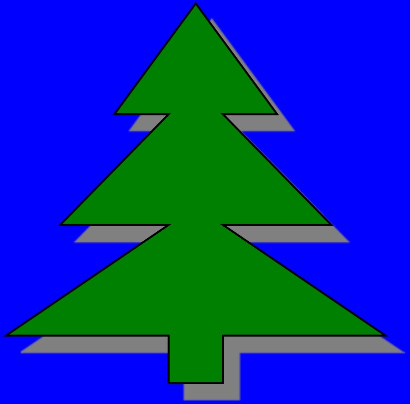

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Some Generalities about How Plants are "Different" and How Those "Differences" Might Affect Conservation Genetic Monitoring and Management

Plants vs. other organisms

	Plants	Protists	Animals	Arthropods + Vertebrates
1. Bisexuality permitting selfing	+++	+++	++	0
2. Reproduction w/out sex	+++	+++	++	+
3. Spontaneous hybridization	+++	?	?	+
4. Genomic lability	+++	?	?	+
5. Developmental flexibility	++++	++	+++	+
6. Lepto-skewed dispersal of tiny diaspores	+++	++++	+++	++?
7. Alternation of generations	++++	+++	0	0

1. Bisexuality w/ Selfing Most Common Plant Breeding System – But Obligate Outcrossing is Common, Too

Selfing - Considerations for Monitoring and Management …

- High levels of selfing are usually associated with low levels of gene flow, leading to
  - Typically, low variation w/in populations; strong differences between populations.
  - Easier local adaptation
- Possible threats/problems:
  - Figuring out whether selfing predominates
  - Gene flow from outcrossing relatives
  - Cryptic species
  - Poorly planned “genetic rescue”

2. Reproduction without sex: facultative and obligate

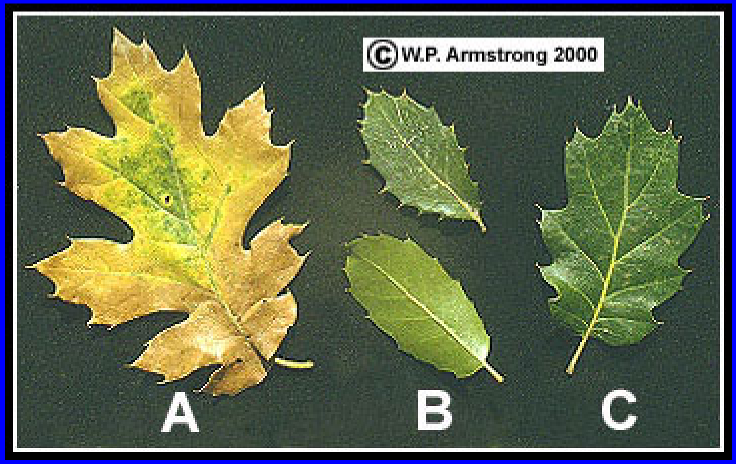
- Vegetative reproduction is particularly common
  - By joints, stolons, bulbils, rhizomes, etc.
  - Typically, in perennials
- Asexual seed (agamospermy)
  - Many *Taraxacum*, *Citrus*, *Rubus* species

Asexuality - Considerations for Monitoring and Management …

- High levels of asexuality usually lead to
  - A few clones (low variation) w/in populations; strong differences between populations.
  - Easier local adaptation
- Possible threats/problems
  - What is an individual?
  - Figuring out whether asexuality predominates
  - Clonal “Species” concept sometimes goofy
  - Poorly planned “genetic rescue”

3. Spontaneous hybridization

- Plenty of cross-compatibility within genera
  - Especially for perennials
- And within certain families
  - Cactaceae, Orchidaceae, and parts of Poaceae

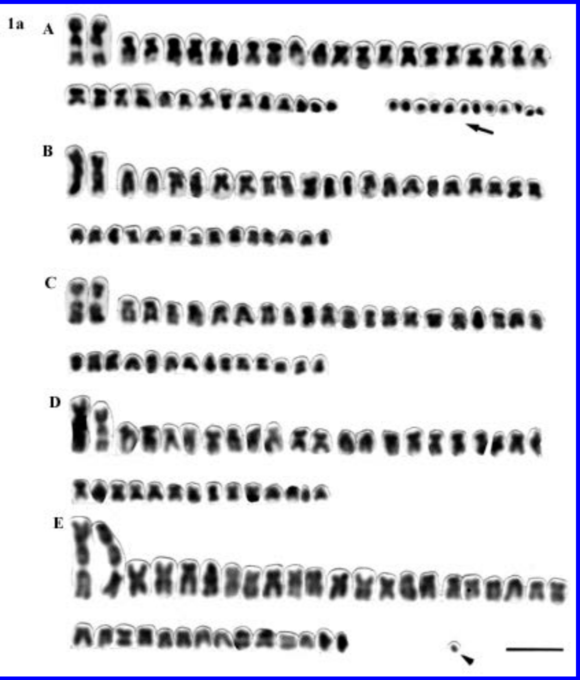


3. Hybridization - Considerations for Monitoring and Management …

- Intertaxon hybridization can sometimes lead to fertile hybrids and subsequent introgression, flow of alleles from one taxon to another
- Possible threats/problems:
  - Outbreeding depression
  - Genetic assimilation
  - What is a species?

4. Genomic lability

- chromosomal variation within species and populations is not rare – polyploidy, aneuploidy, translocations



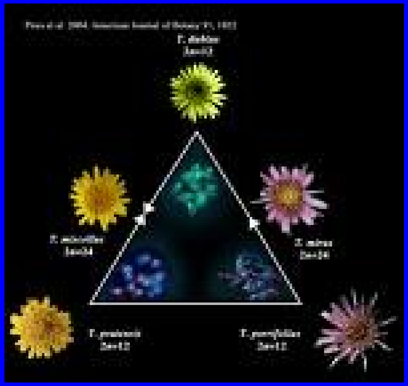
← *Mikania micrantha*

Most angiosperms and ferns have polyploid genomes

Lots of mobile elements

4. Genomic lability - Considerations for Monitoring and Management …

- Possible threats/problems
  - Variation between populations may suggest cryptic species
  - Within population chromosomal variation, how do know if we even care?
  - plant chromosomal studies are almost a “lost art”
- *Note – allopolyploidy is so common that most plant species are (> 90%) descended from an allopolyploid ancestor* – more info on request

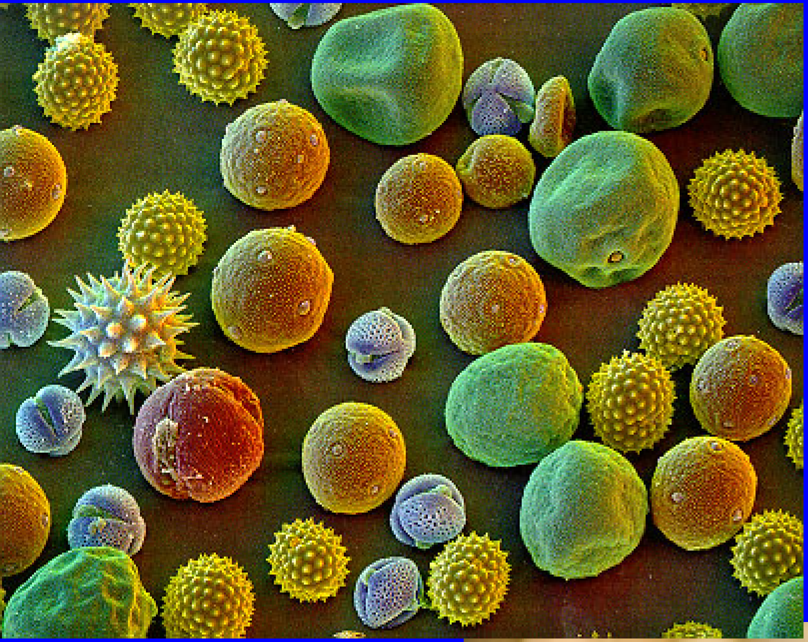


5. Developmental Flexibility

4. Developmental flexibility- Considerations for Monitoring and Management …

- A difference but is it important?
  - Input from audience

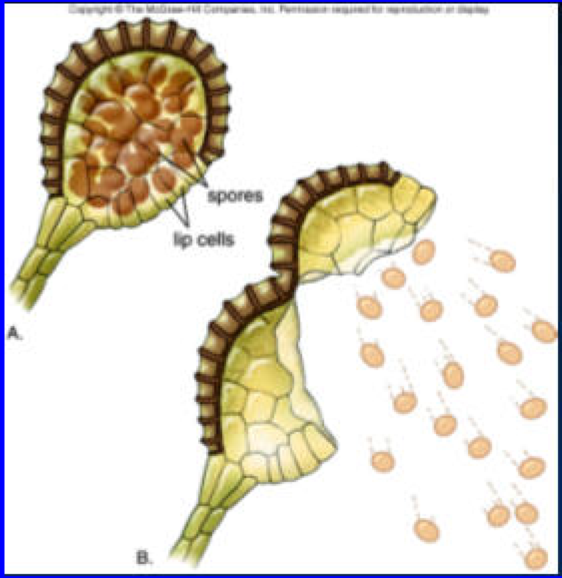
6. Skewed + leptokurtic dispersal of tiny diaspores

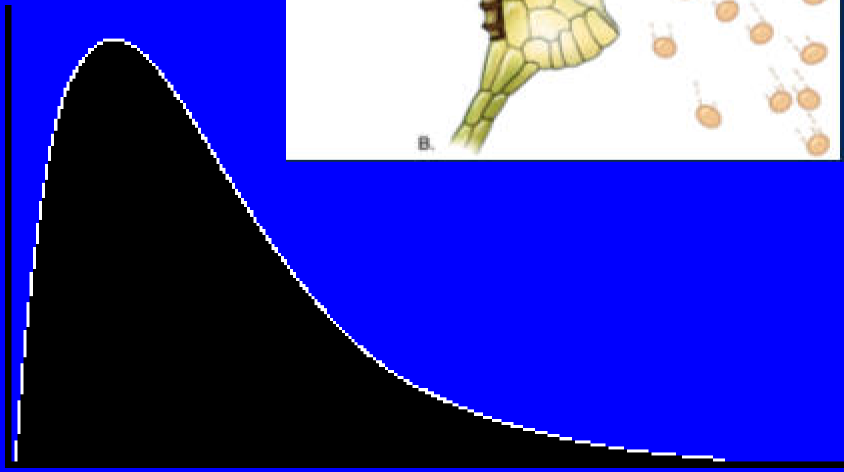


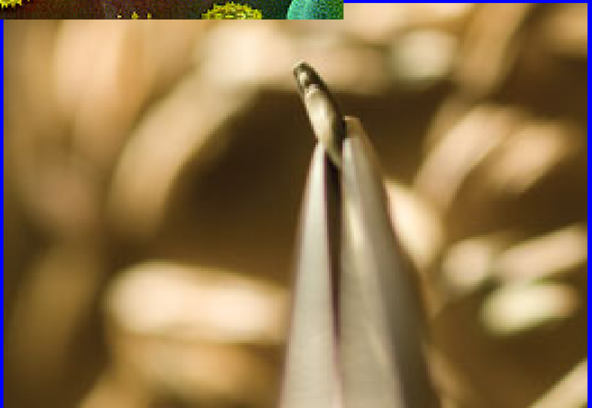
Pollen

Seed

Spores



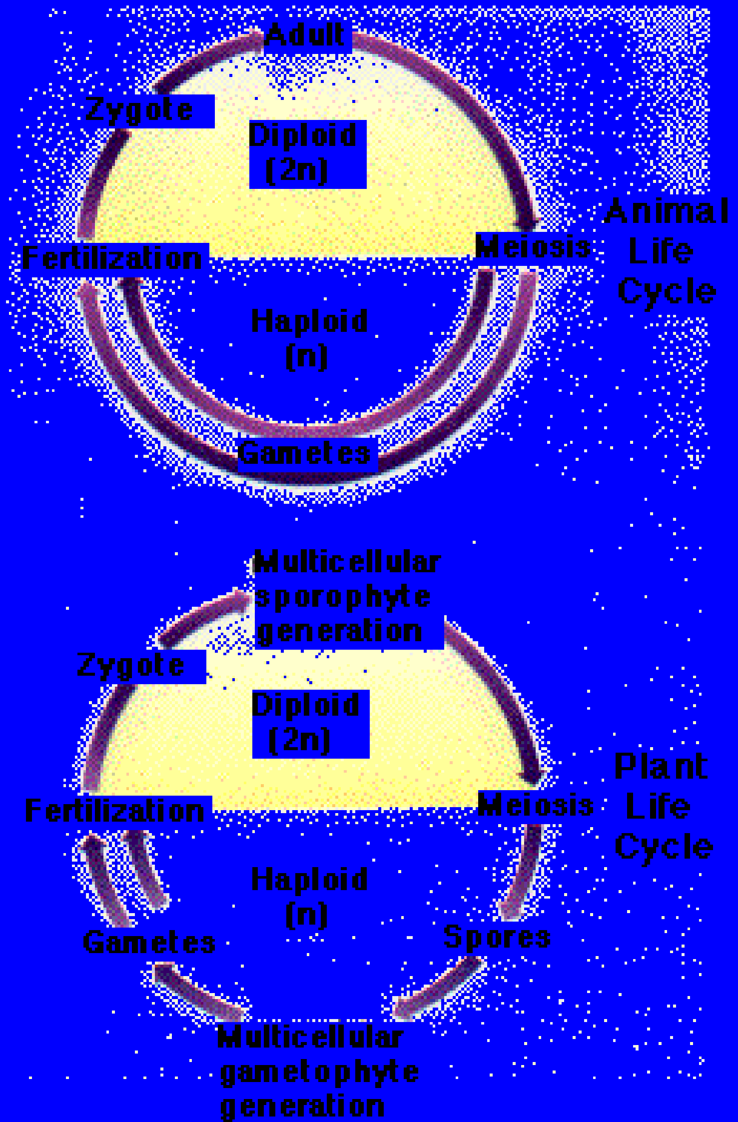


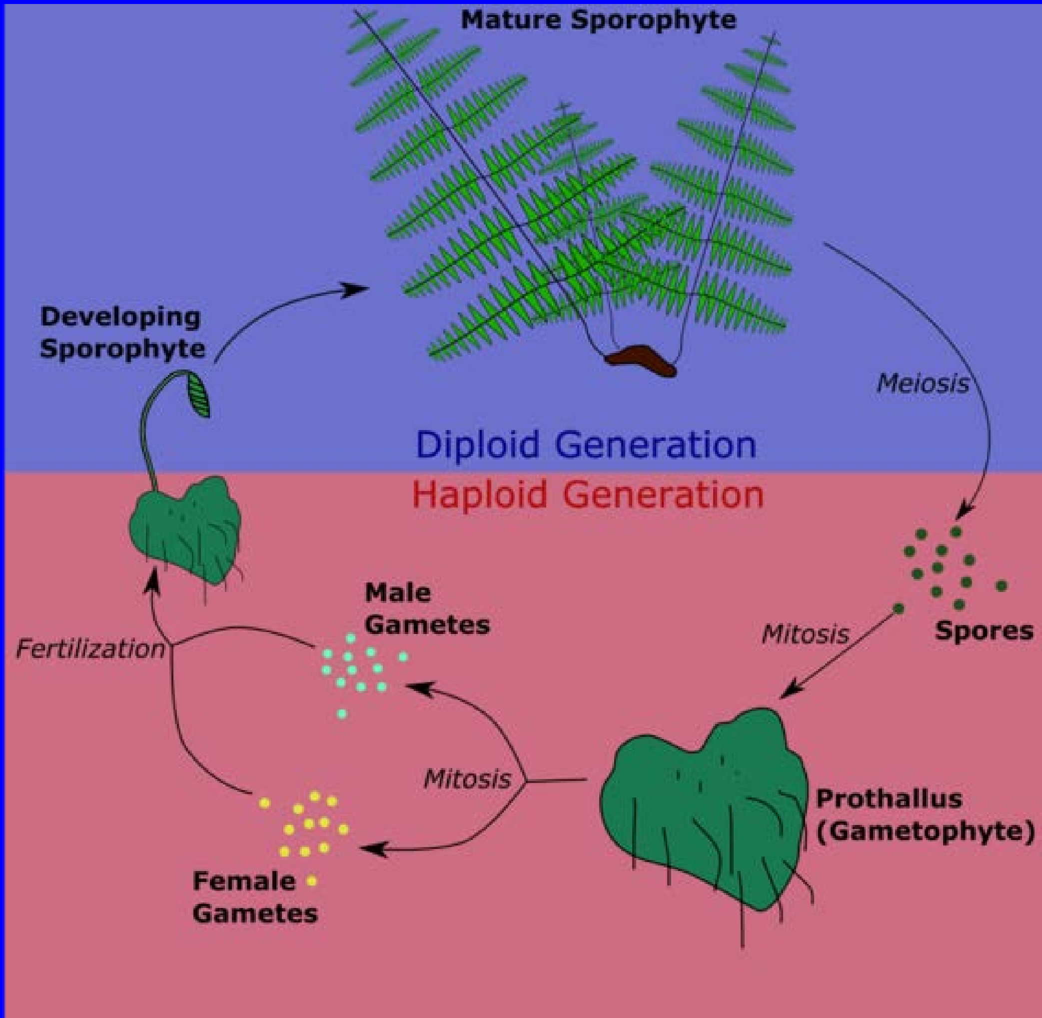


Tiny, Numerous Diaspores - Considerations for Monitoring and Management …

- Small outcrossing plant populations generally receive evolutionarily significant gene flow (>1%) from cross-compatible populations at distances of 100s to 1000s of meters
- Diaspores – seed and spores may survive a long time
- Possible threats/problems
  - Gene flow change in status quo
    - Specific risk depends on increase ↑ or decrease ↓
  - Seed/spore bank: What is an individual/population?

7. Alternation of Generations
The Big Lie = Pollen are not "gametes"





7. Alternation of Generations - Considerations for Monitoring and Management …

- A difference but is it important?
  - Input from audience

Appendix 1 – Genetically Engineered Plants? more info on request

At the moment, a GE plants are a LOT more common than GE animals, but worldwide most of the plants (>>95%) intentionally grown belong to 4 species: Canola, Corn, Cotton, Soy (in California, add Alfalfa and Sugarbeet)

Occasionally an issue for conservation scientists:

Environmental risks?

Salvation for rare species?

Appendix 2 – why plants are superior research organisms

- **“Plants stand still and wait to be counted.” – J. Harper**

- **“Plants don’t defecate in your hand”**
- **“Plants don’t bite you.”**
- **“Plants don’t bleed.”**
  - **D. A. Levin**

- **“Quantitative Genetics” studies feasible for short-lived plants that produce enough seeds/vegetative propagules**

Quantitative Genetic Study of the "Genetics of Fitness"

Worried about

- Restoration?
- Translocation?
- Genetic rescue?
- Assisted migration?
- Local adaptation?
- Local maladaptation?
- Inbreeding depression?
- Outbreeding depression?

… Lab-based studies might be helpful, but won't be very helpful

Quantitative Genetic Study of the "Genetics of Fitness"

Field-based studies can be cheap and helpful

- Common garden experiments
  - Inc. planting beyond range edge
- Reciprocal transplants
- Inter-breeding and field performance of progeny

BUT not necessarily easy

- Sample sizes must be large enough to be statistically meaningful
- Parental (male/female) and grand-parental effects?
- Replicates over time usually necessary

Summary

Plants present challenges and opportunities for conservation monitoring and management (different from vertebrates and arthropods)

Thanks!

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The Village a.k.a. “Team Ellstrand”