

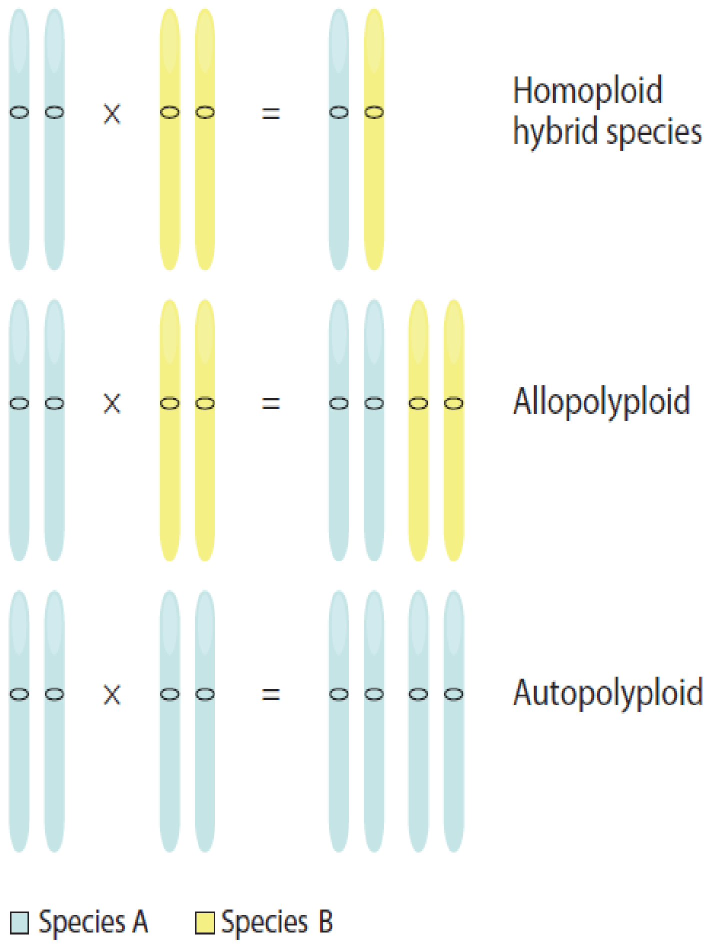


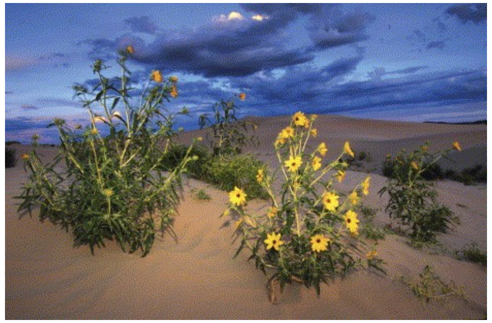
Hybrid speciation

Homoploid and Polyploid



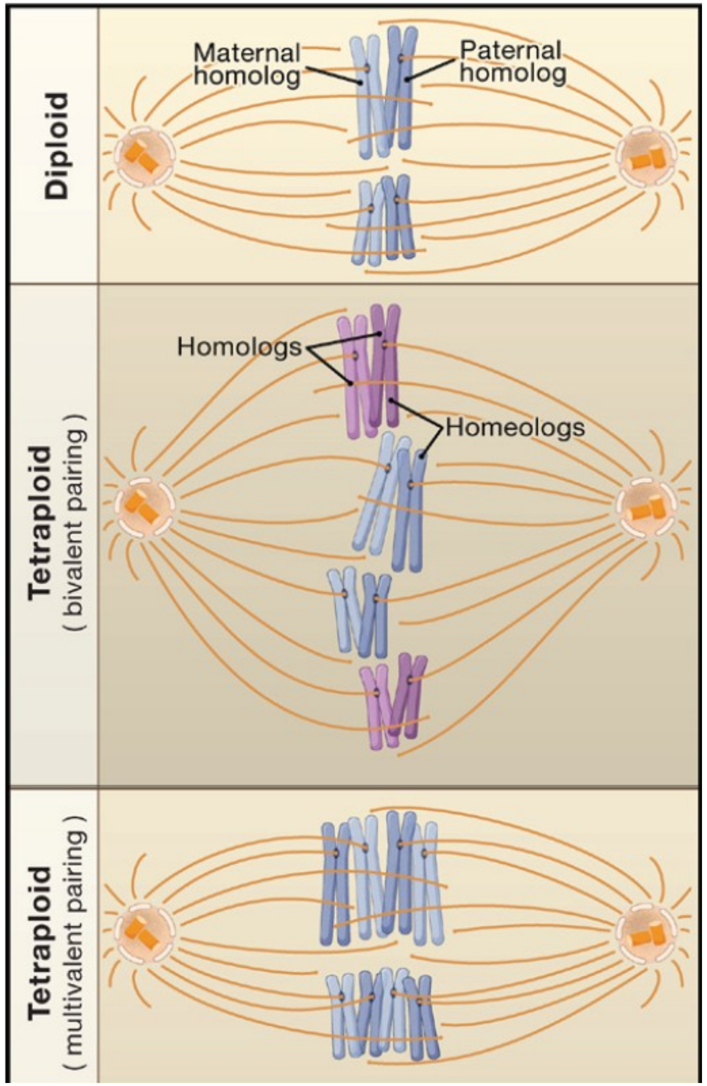
Homoploid vs Polyploid hybrid speciation




Helianthus anomalus (Asteraceae)


Triticum aestivum (Poaceae)

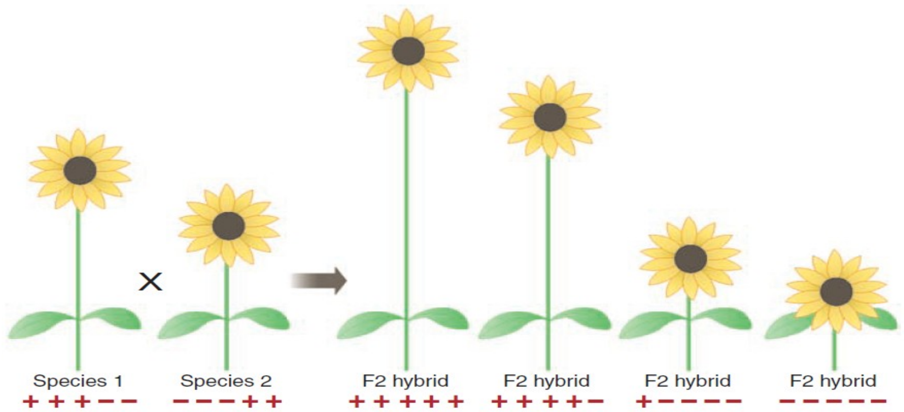

Galax ucreolata (Diapensiaceae)

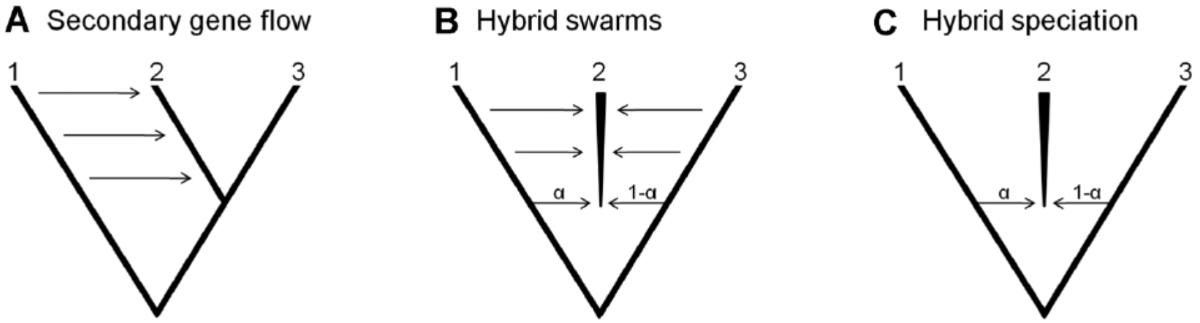


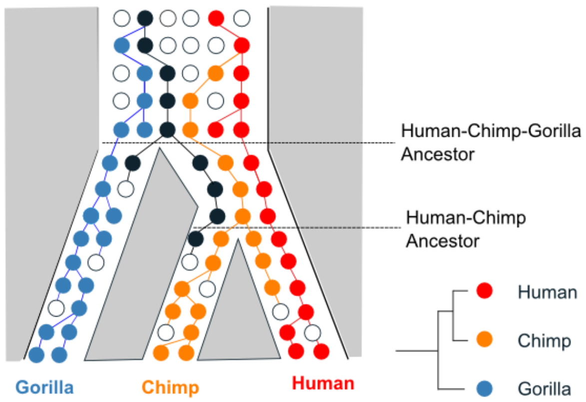
Soltis & Soltis (2009) The Role of Hybridization in Plant Speciation. *Ann Rev* **60**: 561-588.
Otto (2007) The Evolutionary Consequences of Polyploidy. *Cell* **131**: 452-462.

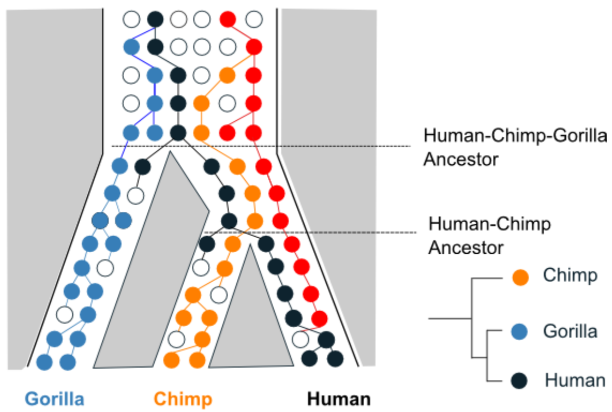
Senecio squalidus = S. chrysanthemifolius x *S. aethnensis*

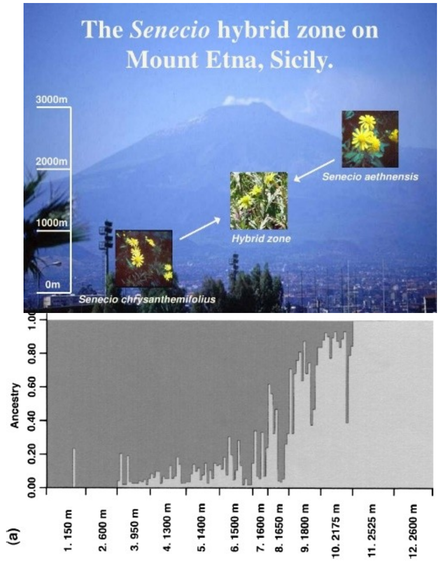
Homoploid hybrid speciation – how do we recognize a homoploid hybrid species?

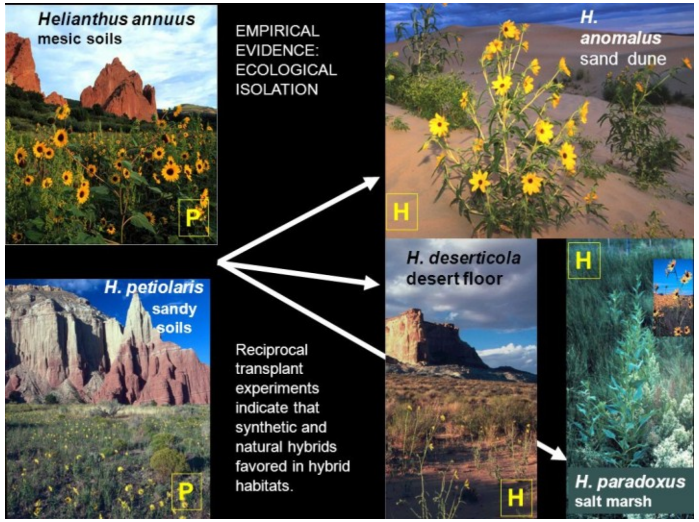






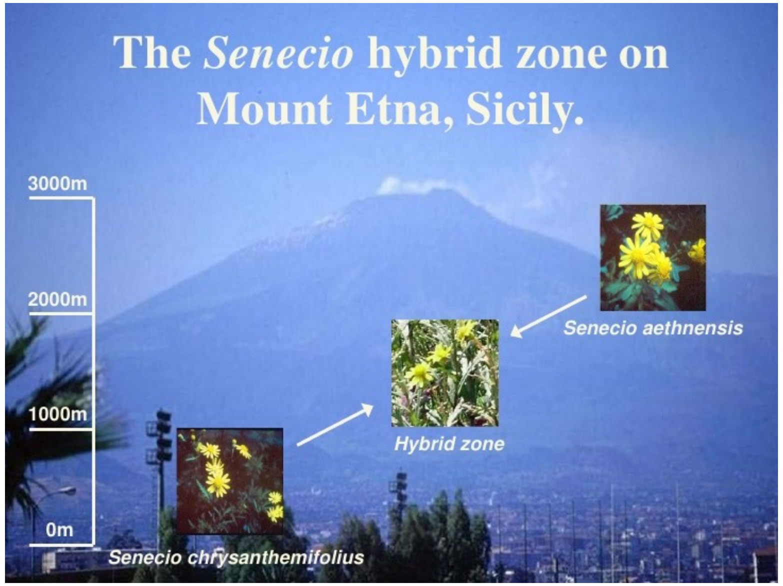


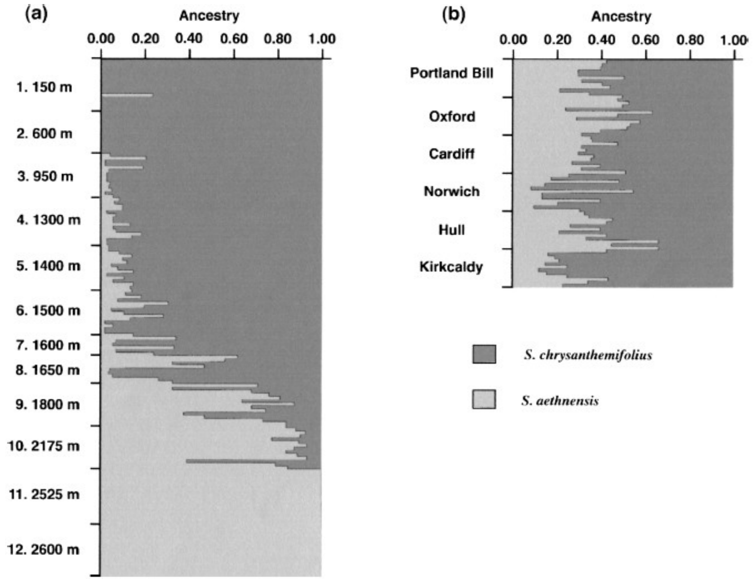


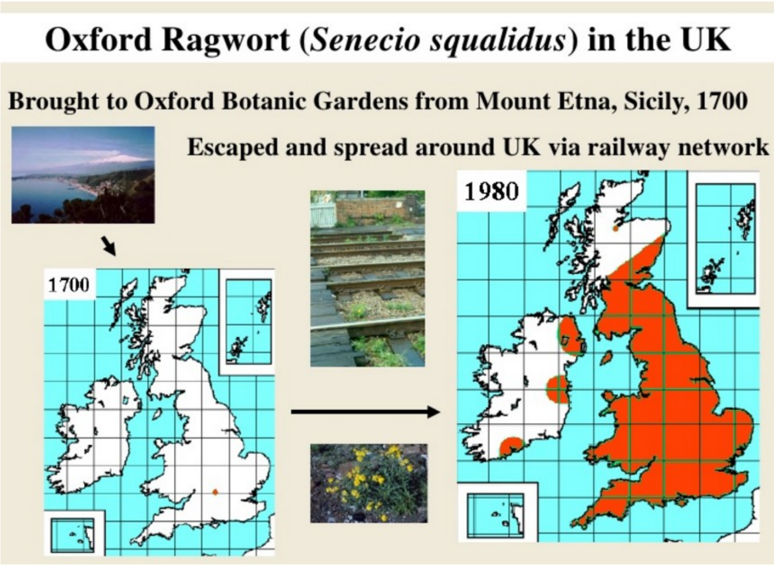


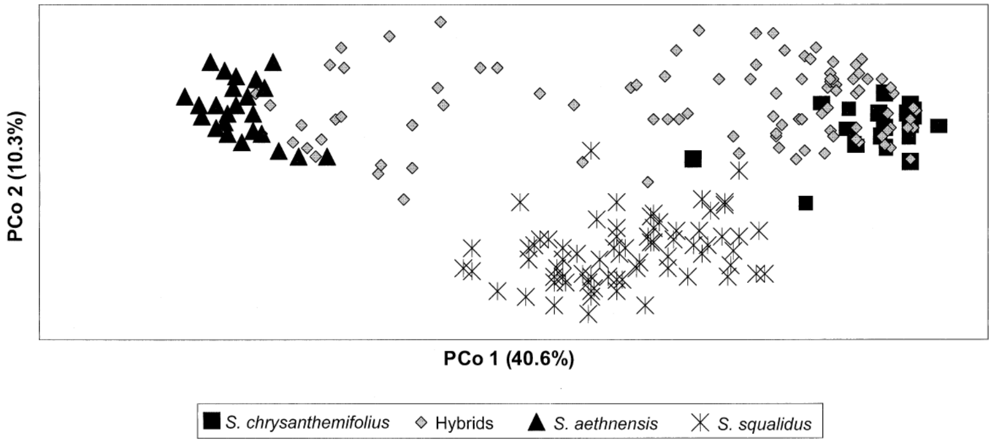
Schumer et al. (2014) How common is homoploid hybrid speciation. *Evolution* **68**: 1553–1560.
Gross and Riesberg (2005) The Ecological Genetics of Homoploid Hybrid Speciation. *J Hered* **96**: 241–252.

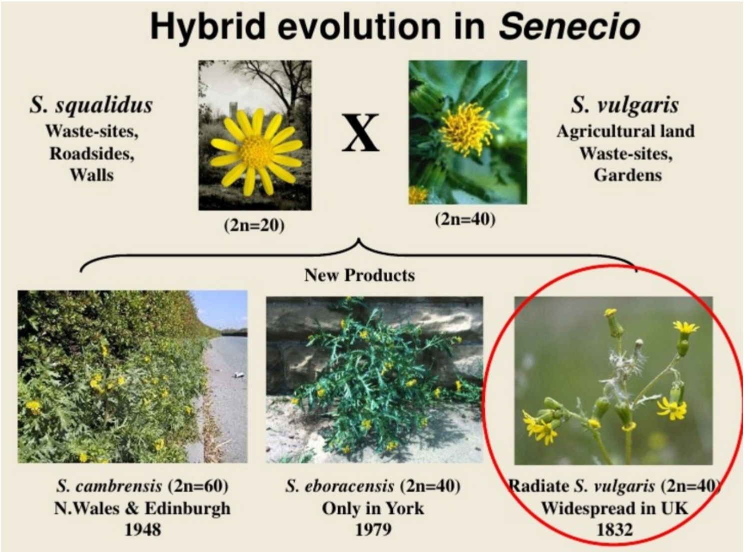
Homoploid hybrid speciation in allopatry – *Senecio squalidus*





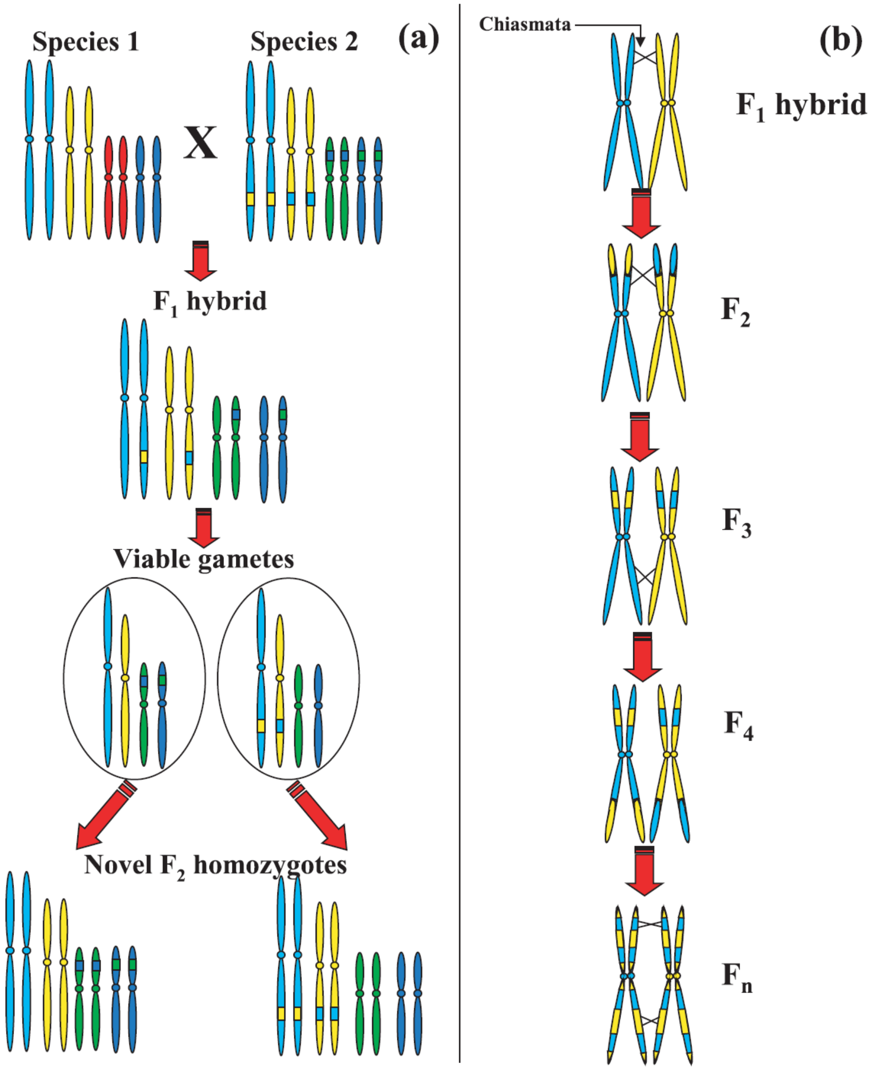


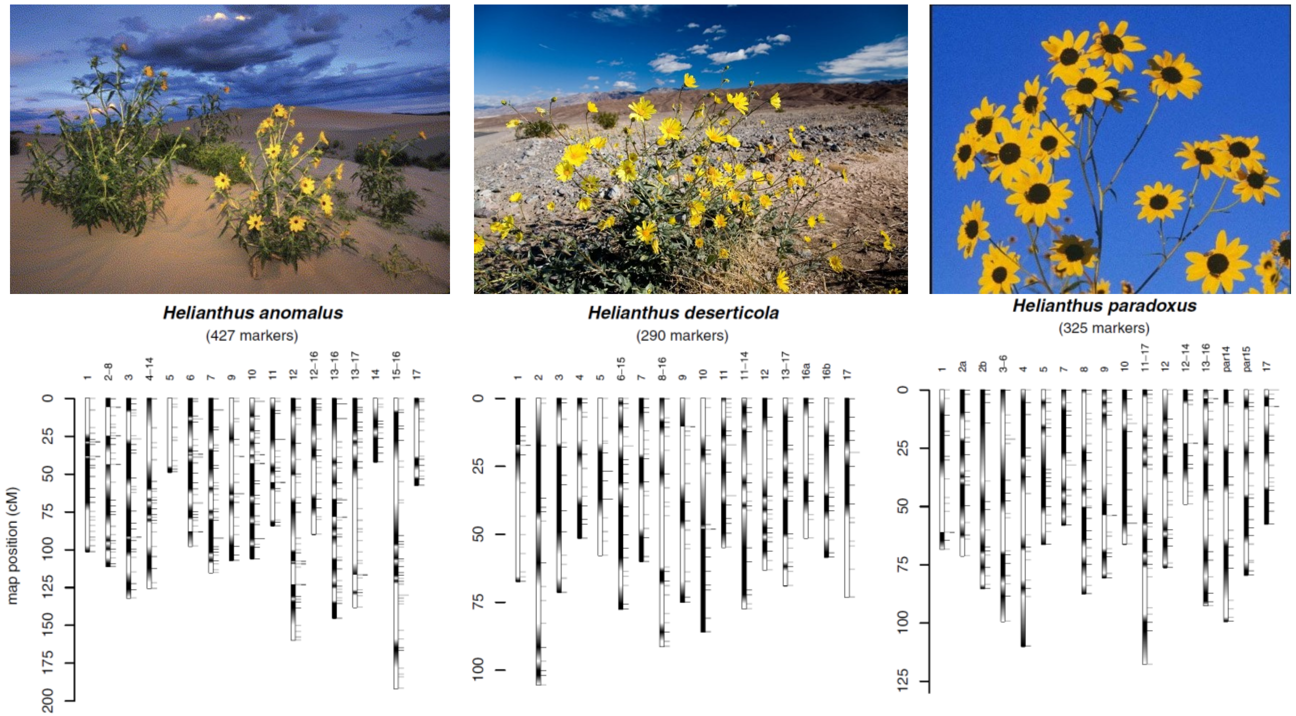


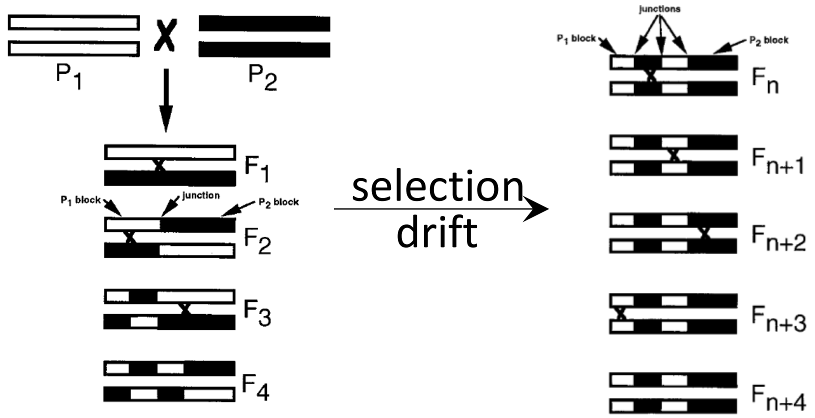


Abbott et al. (2010) Homoploid hybrid speciation in action. *Taxon* **59**: 1375–1386.

Homoploid hybrid speciation – recombinational (chromosomal) model







Species	Min.	Low CL	Point estimate	High CL	Max.
(A) Number of generations					
H. anomalus	436	686	795	904	1753
H. deserticola	311	448	558	667	1054
H. paradoxus	486	798	907	1016	—
(B) Effective population size					
H. anomalus	39	60	68	76	147
H. deserticola	29	40	48	56	88
H. paradoxus	44	70	78	85	—

Hegarty & Hiscock (2005) Hybrid speciation in plants: new insights from molecular studies. *New Phytol* **165**: 411–423.
Buerkle & Riesberg (2008) The rate of genome stabilization in homoploid hybrid species. *Evolution* **62**: 266–275.

Homoploid hybrid speciation – ecological divergence

Iris brevicaulis

X

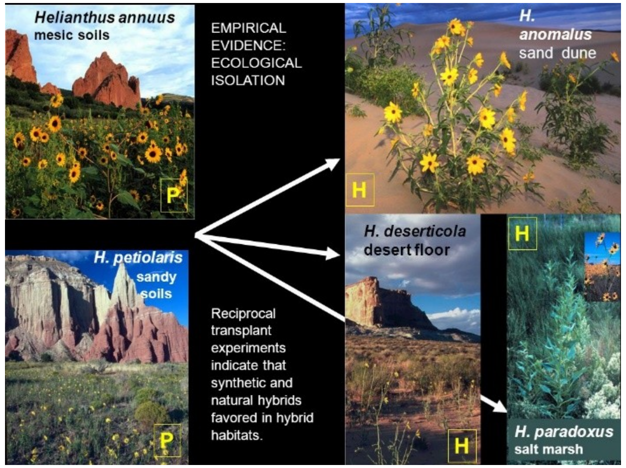
Iris fulva

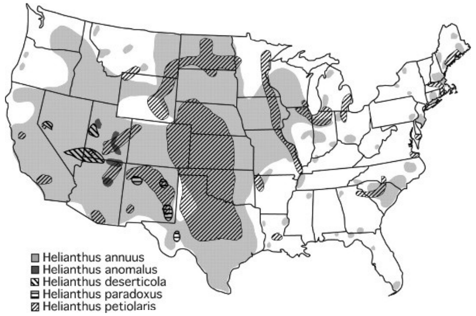
X

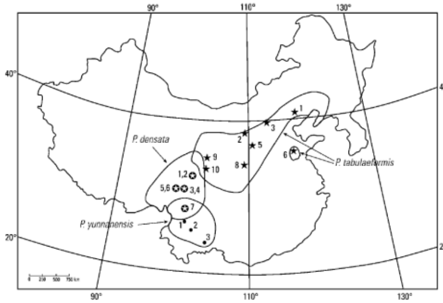
Iris hexagona

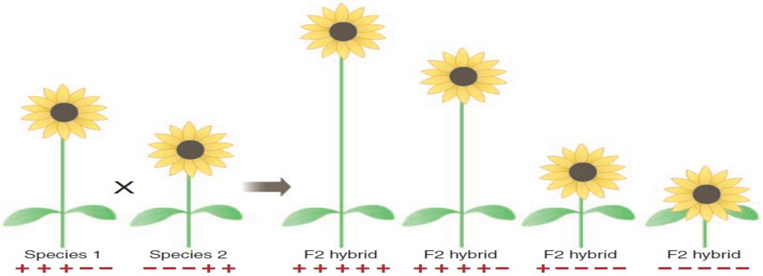
=

Iris nelsonii





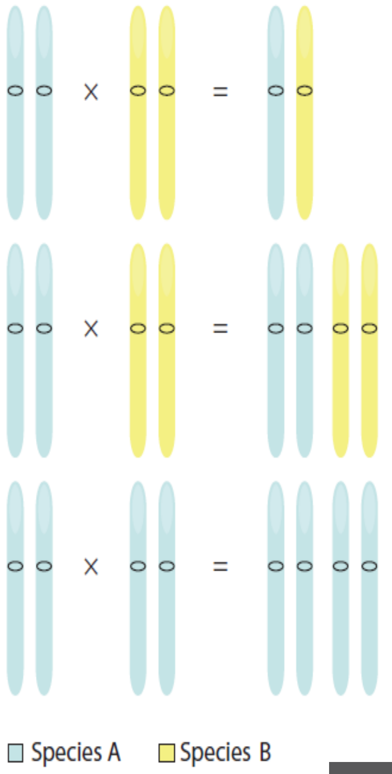


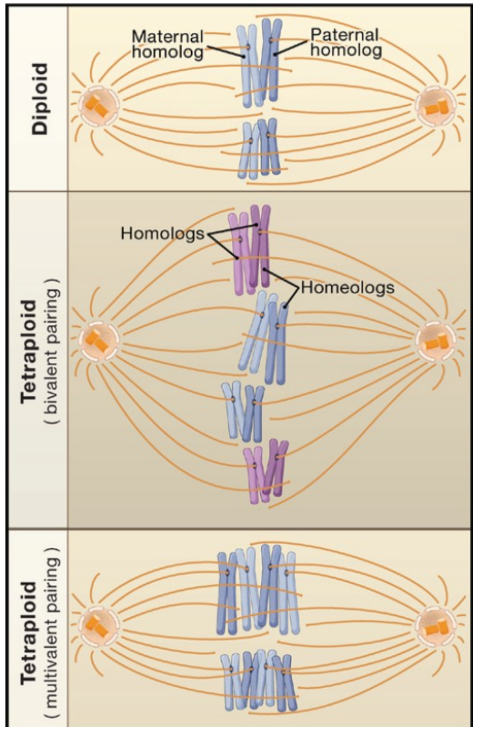


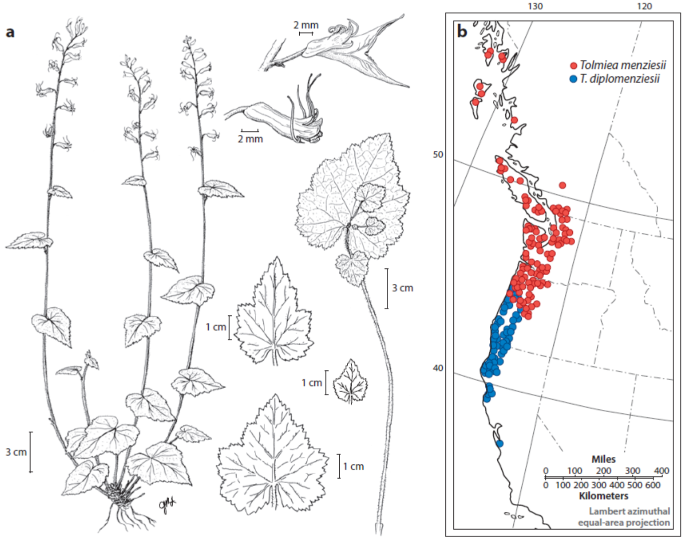
Pinus densata

Gross & Riesberg (2005) The Ecological Genetics of Homoploid Hybrid Speciation. *J Hered* **96**: 241–252.
Nolte & Tautz (2009) Understanding the onset of hybrid speciation. *Trends in Genetics* **26**: 54–58.

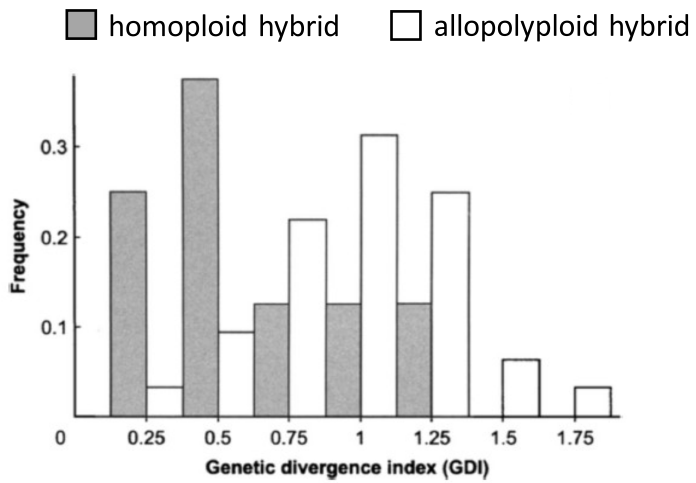
Polyploid hybrid speciation

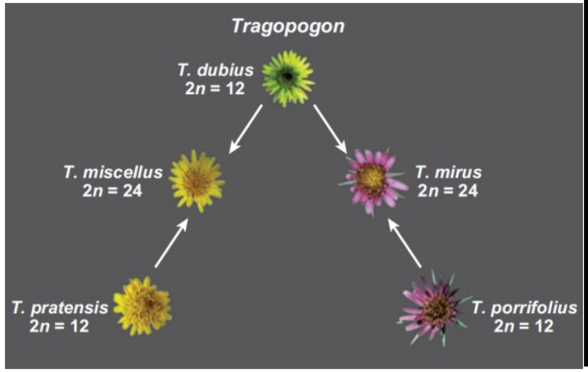


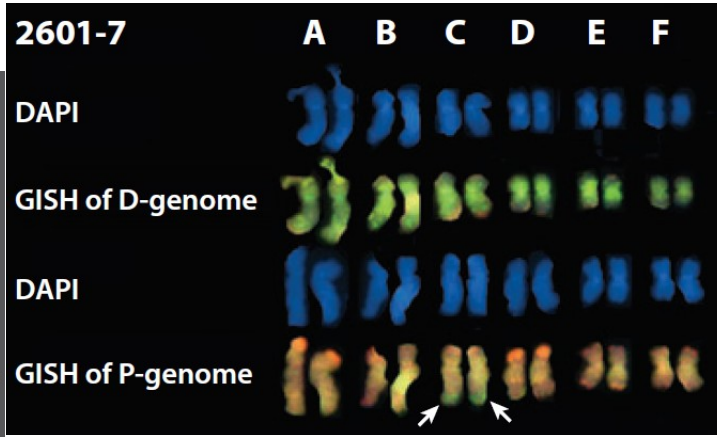


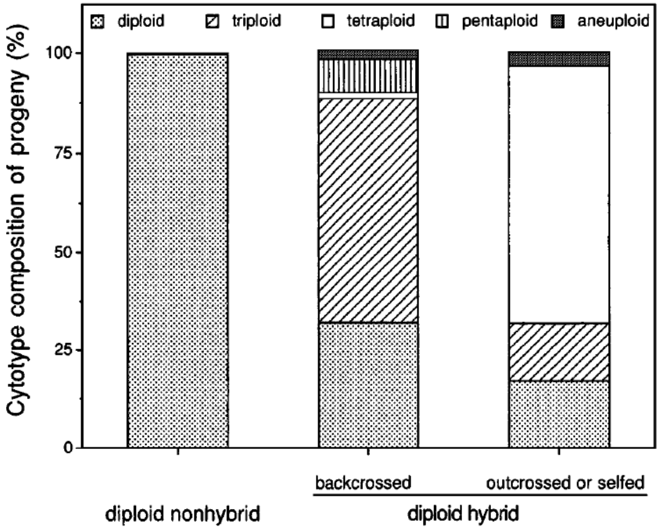


Tolmiea diplomenziesii (2n=14), *T. menziesii* (2n=28)



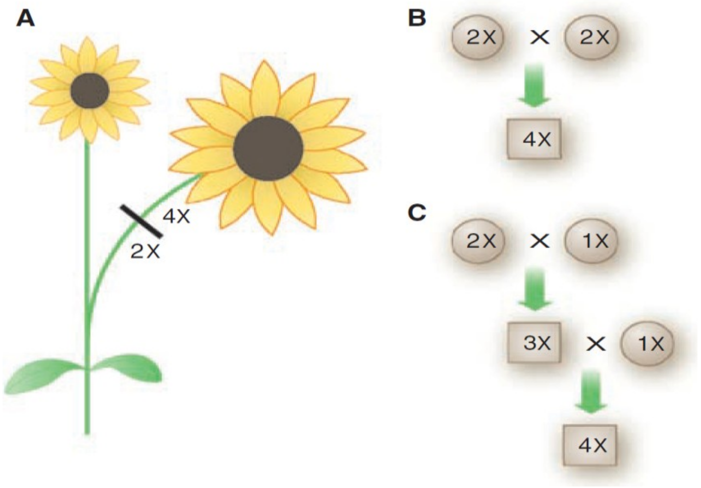


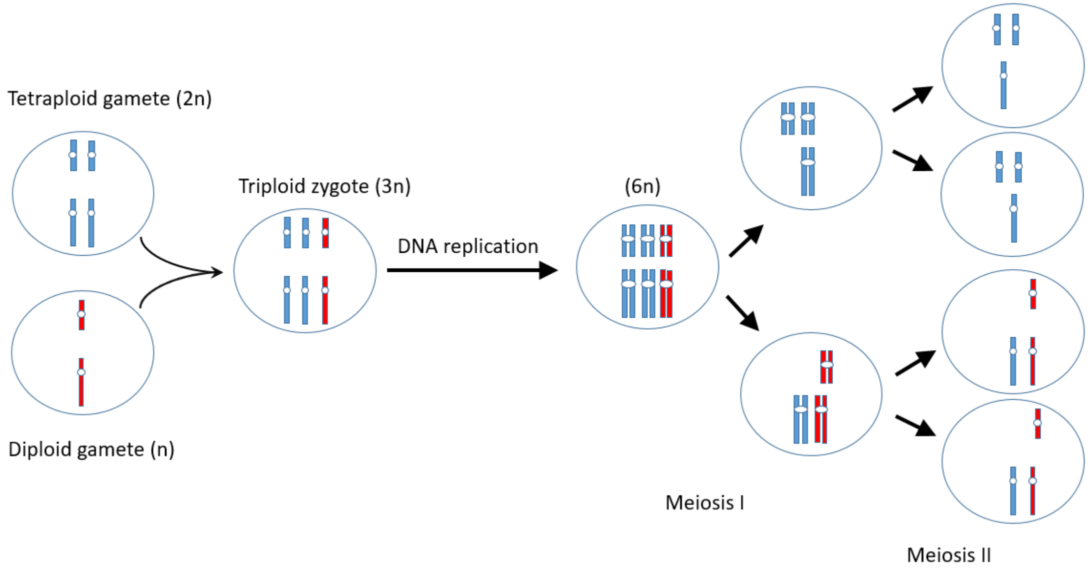


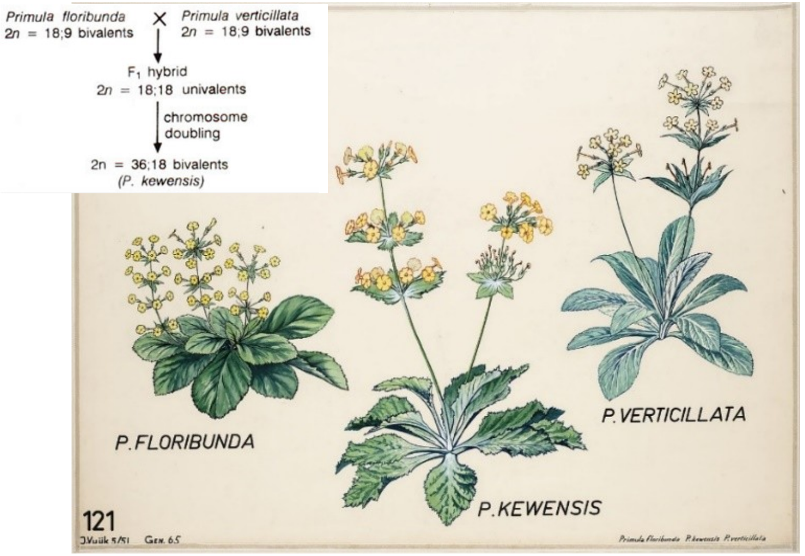


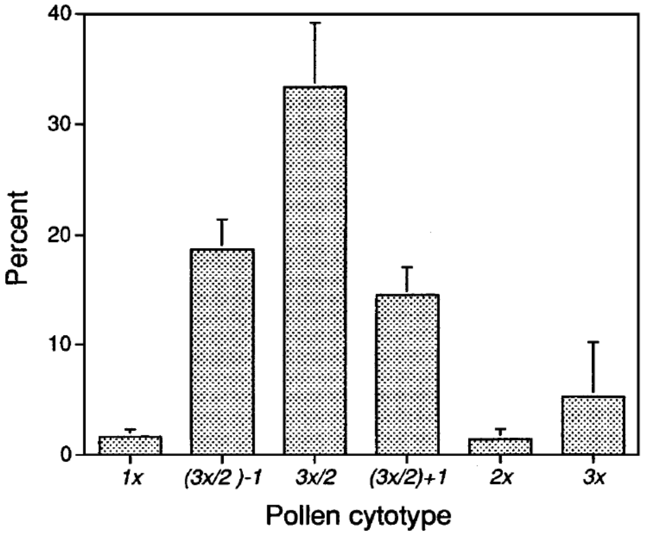
Soltis & Soltis (2009) The Role of Hybridization in Plant Speciation. *Ann Rev* **60**: 561-588.
Paun et al. (2009) Hybrid speciation in angiosperms: Parental divergence drives ploidy. *New Phytol* **182**: 507-518.
Otto (2007) The Evolutionary Consequences of Polyploidy. *Cell* **131**: 452-462.
Ramsey & Schemske (1998) Pathways, mechanisms and rates of polyploid formation in flowering plants. *Ann Rev* **29**: 467-501

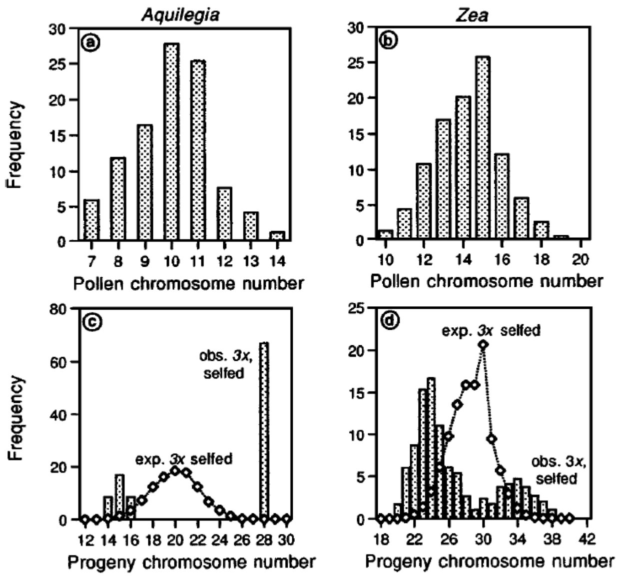
Polyploid hybrid speciation - origin, reproductive isolation





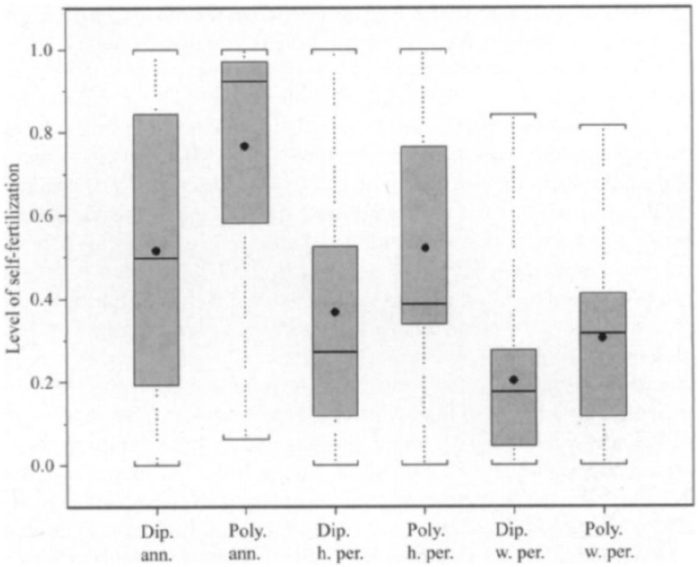


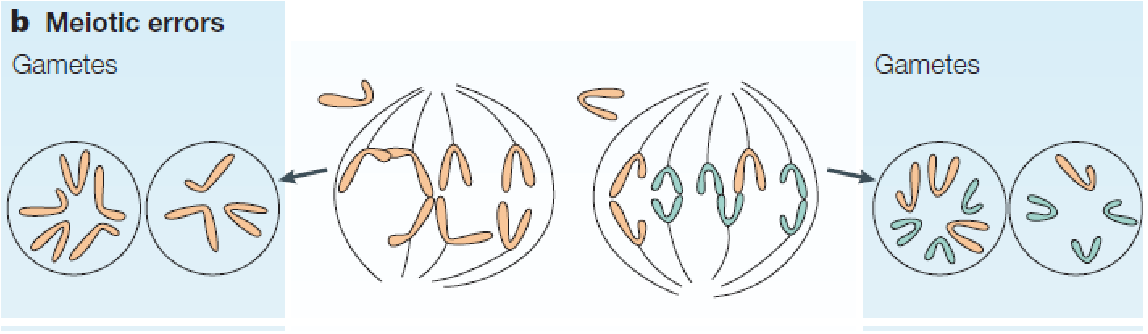


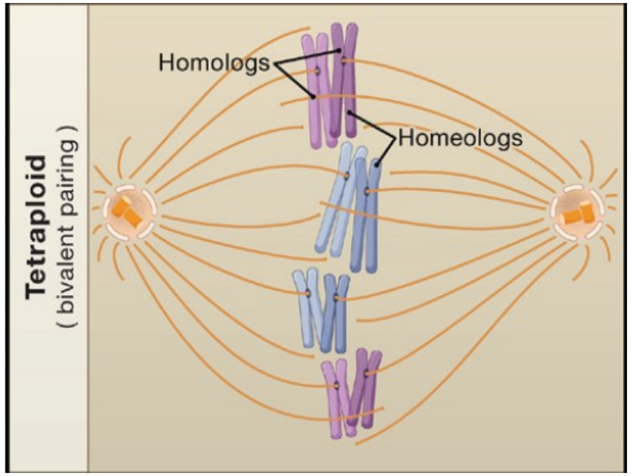


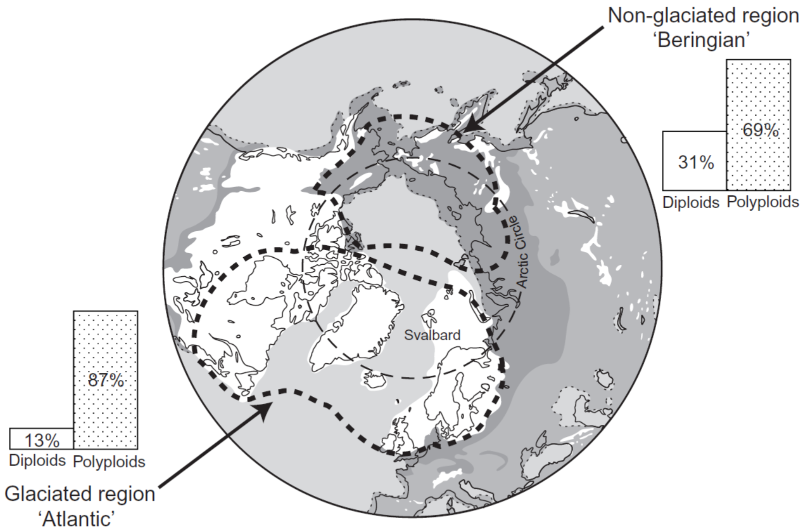
Soltis & Soltis (2009) The Role of Hybridization in Plant Speciation. *Ann Rev* **60**: 561-588.
Riesberg & Willis (2007) Plant Speciation. *Science* **317**: 910-914.
Ramsey & Schemske (1998) Pathways, mechanisms and rates of polyploid formation in flowering plants. *Ann Rev* **29**: 467-501.

Polyploid hybrid speciation – disadvantages and advantages







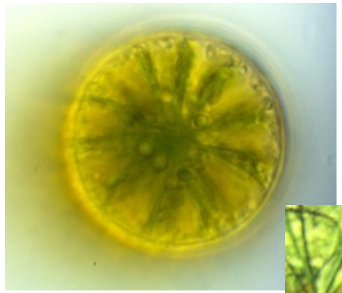


Silene acaulis

Soltis & Soltis (2009) The Role of Hybridization in Plant Speciation. *Ann Rev* **60**: 561-588.
Barringer (2007) Polyploidy nd self-fertilization in flowering plants. *Am J Bot* **94**: 1527-1533.
Comai (2005) The advantages and disadvantages of being polyploid. *Nature Reviews* **6**: 837-846.

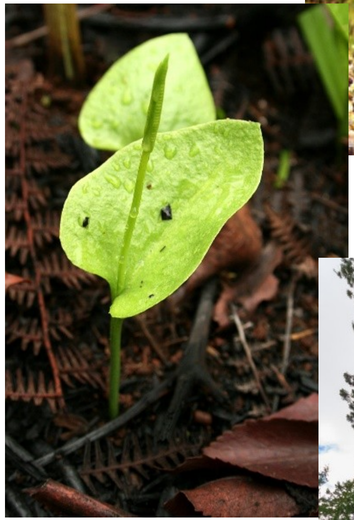
Table 16.1 Frequency of polyploidy, the highest known ploidy level and the record-holder species in different plant groups. The groups do not represent comparable phylogenetic/taxonomic categories (Data compiled from different sources)

Plant group	Number of extant species	Incidence of polyploidy	Maximum ploidy level	Record-holder
Glaucophytes (Glaucophyta)	13	Unknown	Unknown	–
Red algae (Rhodophyta)	~6,000	Frequent	Moderate (~16-ploid)	*Polyides rotundus*, n = 68–72 (Cole 1990)
Chlorophyta (Green algae s.s.)	~3,800	Frequent	Moderate (~20-ploid)	*Eraemosphaera viridis*, n = 80 (Mainx 1927)
Charophyta (Green algae, streptophyte algae)	~5,000	(Very) frequent	(Very) high	*Netrium digitus*, n = 592 (King 1960)
Liverworts (Marchantiophyta)	~5,000	Rare (~8%)	Rather low (~12-ploid)	*Riccia macrocarpa*, n = 48 (Przywara and Kuta 1995)
Mosses (Bryophyta s.s.)	~12,000	Ambiguous (c. 20–80%)	Moderate (~16-ploid)	*Leptodictyum riparium*, *Physcomitrium pyriforme*, n = 72 (Przywara and Kuta 1995)
Hornworts (Anthocerotophyta)	~150	Absent	–	*Anthoceros sampalocensis*, n = 10 (Przywara and Kuta 1995)
Lycopods (Lycopodiophyta)	~900	(Very) frequent	Very high (~50-ploid)	*Huperzia prolifera*, 2n = ~556 (Tindale and Roy 2002)
Ferns and allies (Monilophyta)	~11,000	Very frequent (up to ~95%)	Very high (~96-ploid)	*Ophioglossum reticulatum*, 2n = ~1440 (Khandelwal 1990)
Cycads (Cycadophyta)	~250	Absent	–	*Zamia paucijuga*, *Z. prasina*, 2n = 28 (Moretti and Sabato 1984)
Ginkgo (Ginkgophyta)	1	Absent	–	2n = 24
Conifers (Pinophyta)	~550	Very rare (<2%)	Low (hexaploid)	*Sequoia sempervirens*, 2n = 66 (Hirayoshi and Nakamura 1943)
Gnetophytes (Gnetophyta)	~50	Moderate (~30%)	Low (octoploid)	*Ephedra funerea*, *E. gerardiana*, 2n = 56 (Ickert-Bond 2003)
Monocots	~60,000	Very frequent (~75%)	Very high (~50-ploid)	*Voanioala gerardii*, 2n = ~596 (Johnson et al. 1989)
Dicots s.l.	~200,000	Very frequent (~75%)	Very high (~80-ploid)	*Sedum suaveolens*, 2n = ~640 (Uhl 1978)



Netrium digitans

Leptodictyum riparium



Ophioglossum reticulatum

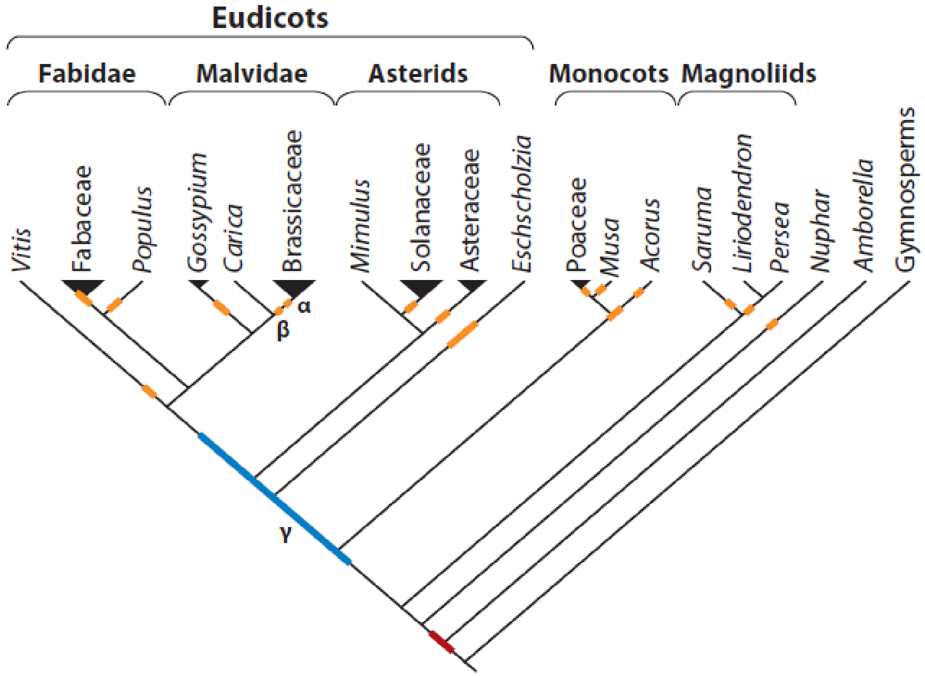
Sequia sempervirens

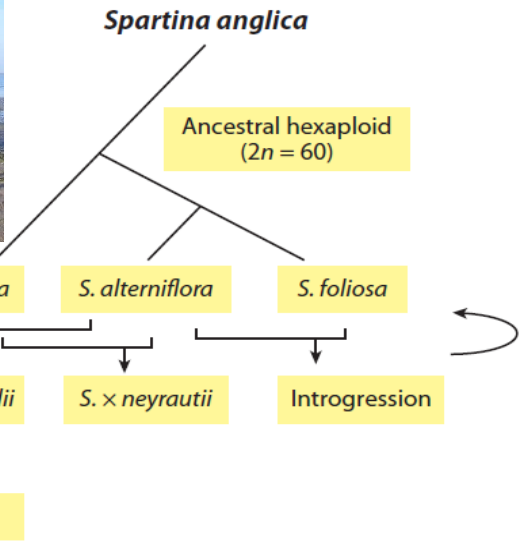
Sedum suaveolens

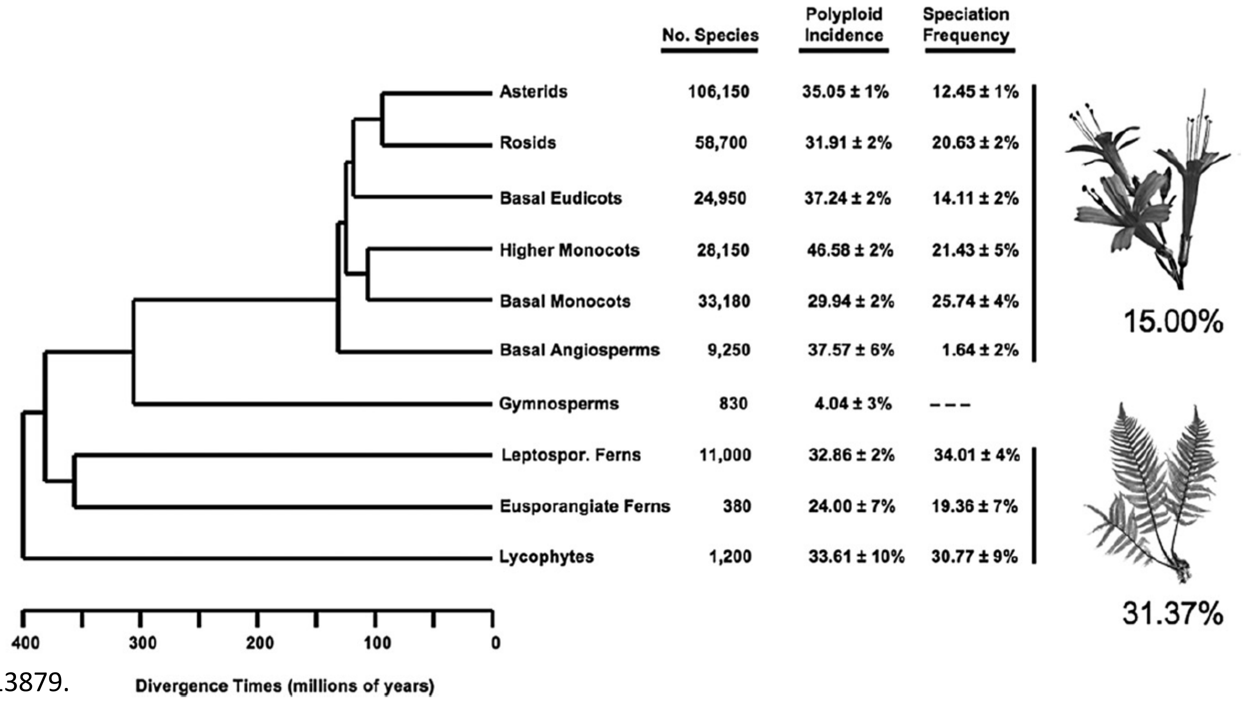
Husband et al. (2013) The Incidence of Polyploidy in Natural Plant Populations: Major Patterns and Evolutionary Processes. In: *Plant Genome Diversity Vol. 2,* Springer, pp 255-276.

Polyploid hybrid speciation – recent and ancient polyploid speciation

T. pratensis | ***T. miscellus*,** short-liguled | ***T. miscellus*,** long-liguled | ***T. dubius***







Soltis & Soltis (2009) The Role of Hybridization in Plant Speciation. *Ann Rev* **60**: 561-588.
Wood et al. (2009) The frequency of polyploid speciation in vascular plants. *PNAS* **106**: 13875-13879.