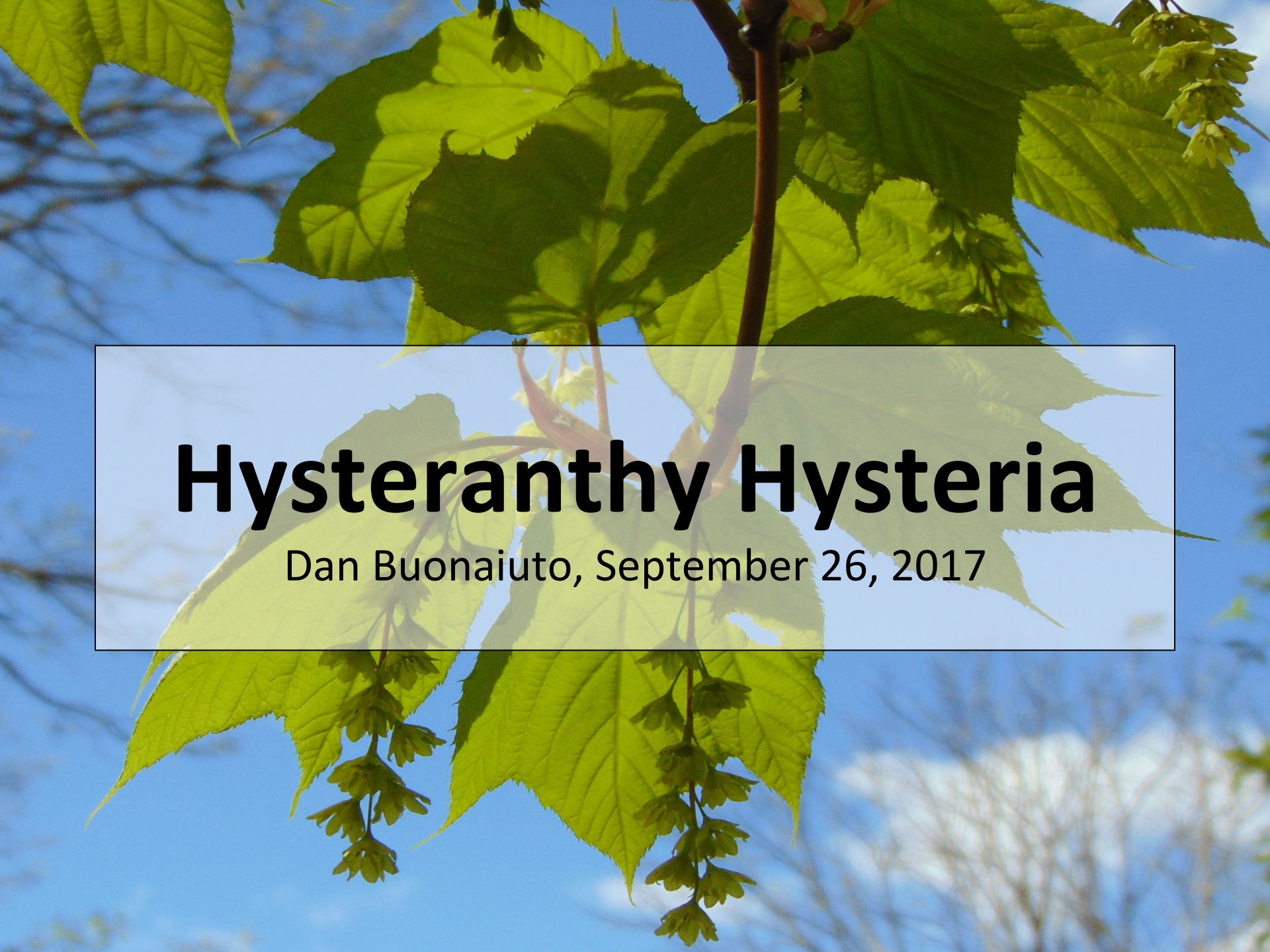


Hysteranthy Hysteria

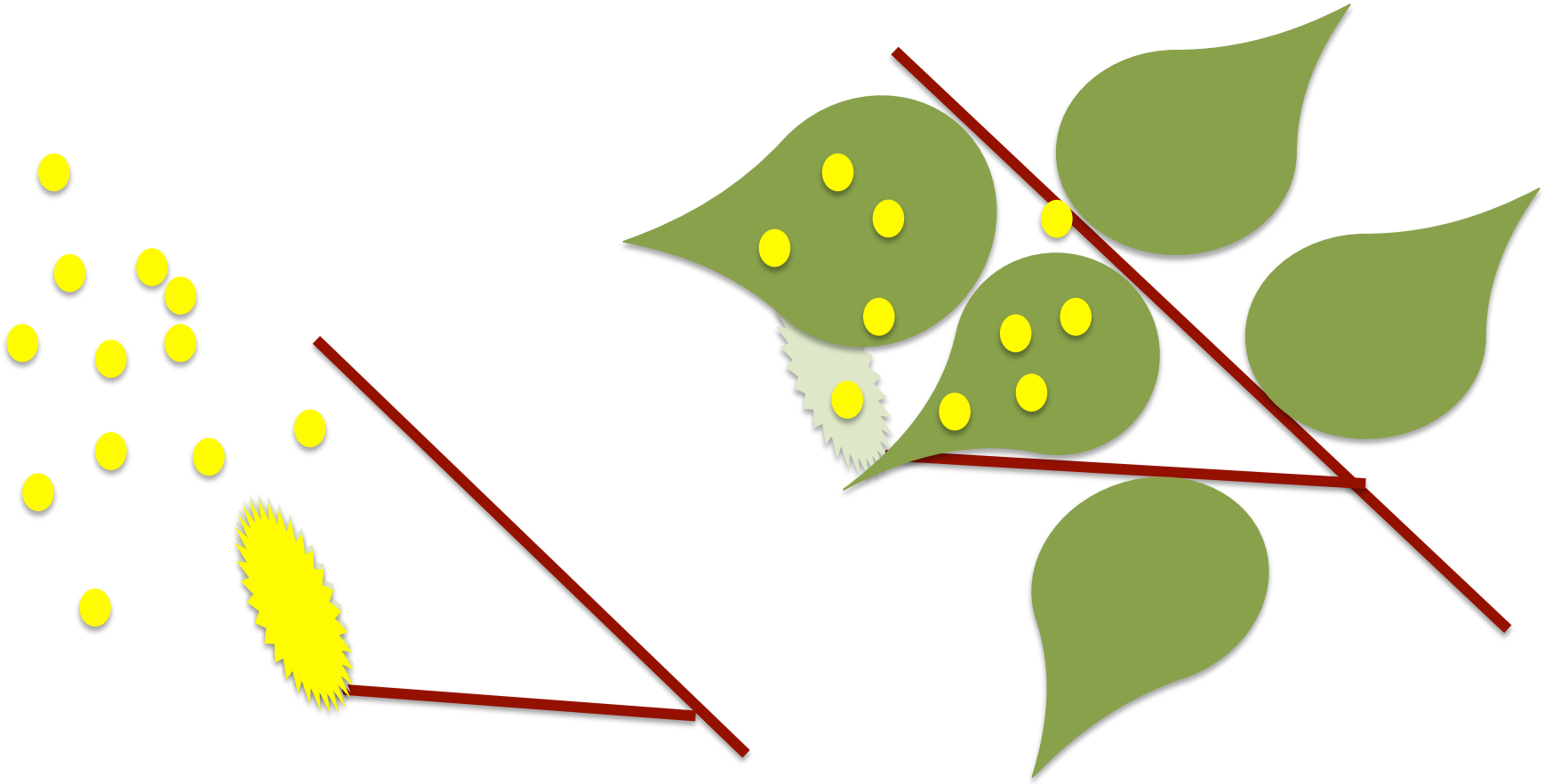
Dan Buonaiuto, September 26, 2017

Why do some species flower before leafout, while others leafout before flowering?

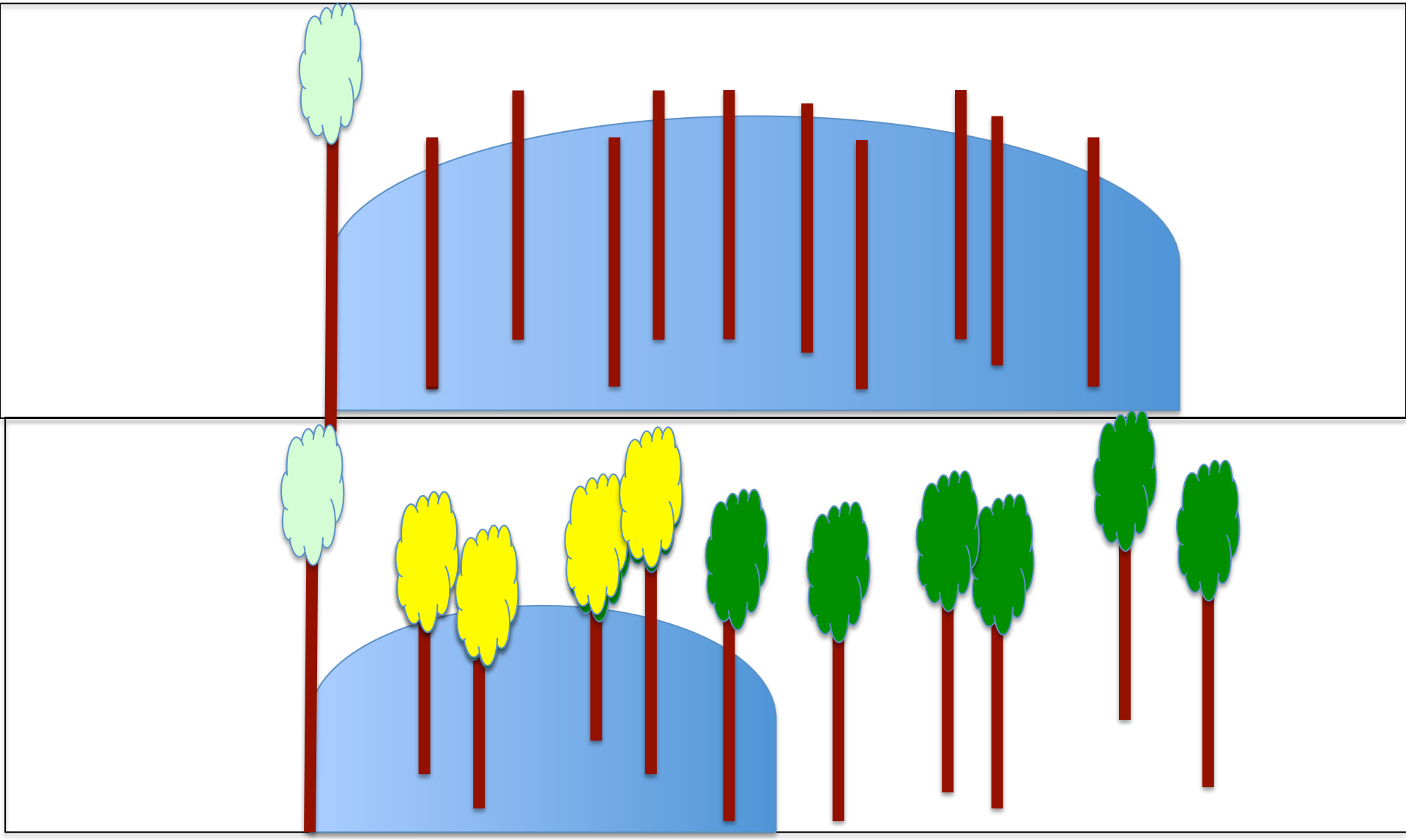
To what degree are these patterns stable, especially in a changing climate space?

If patterns are flexible, **what are the implications** for tree reproduction and demography?

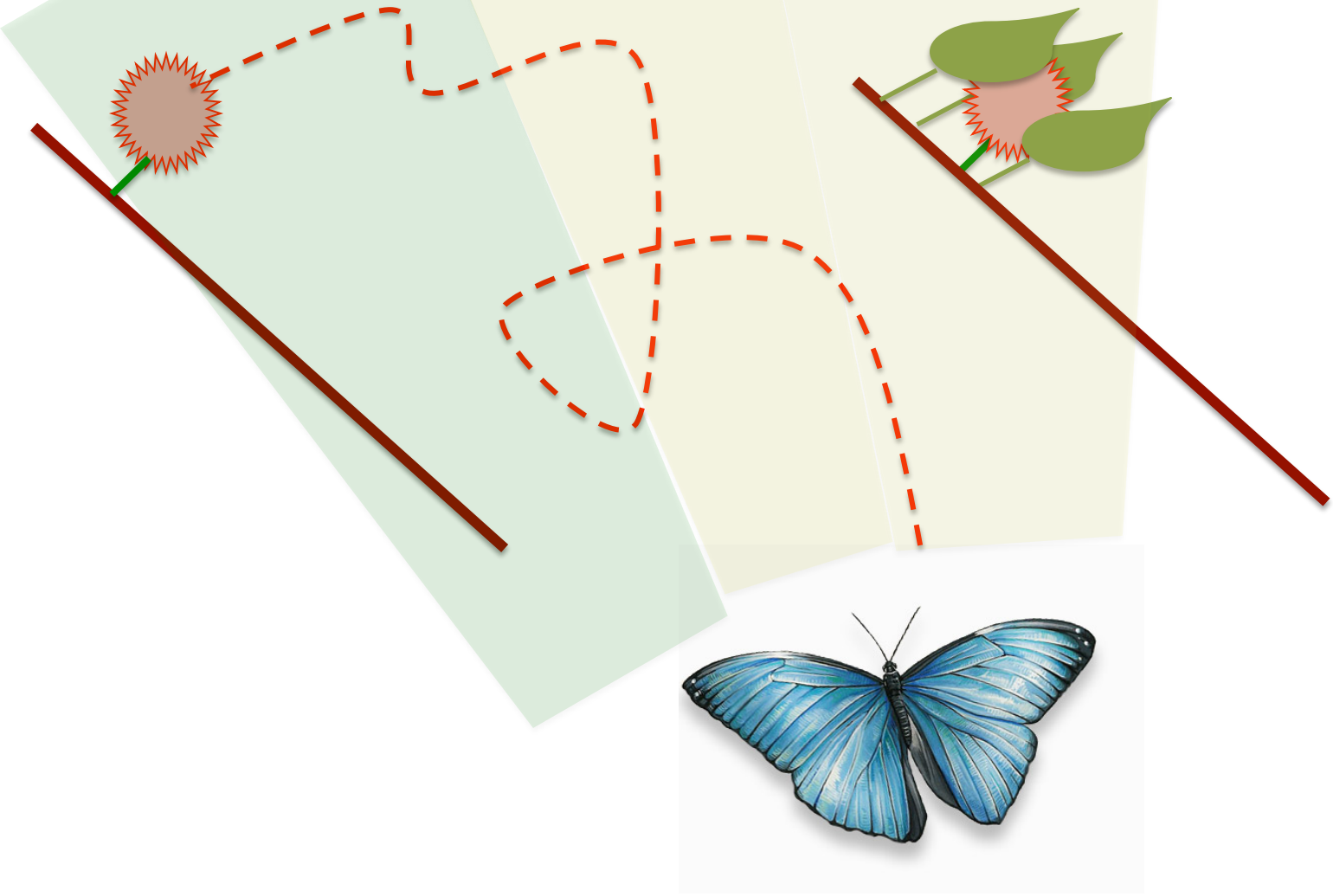
Wind pollination efficiency



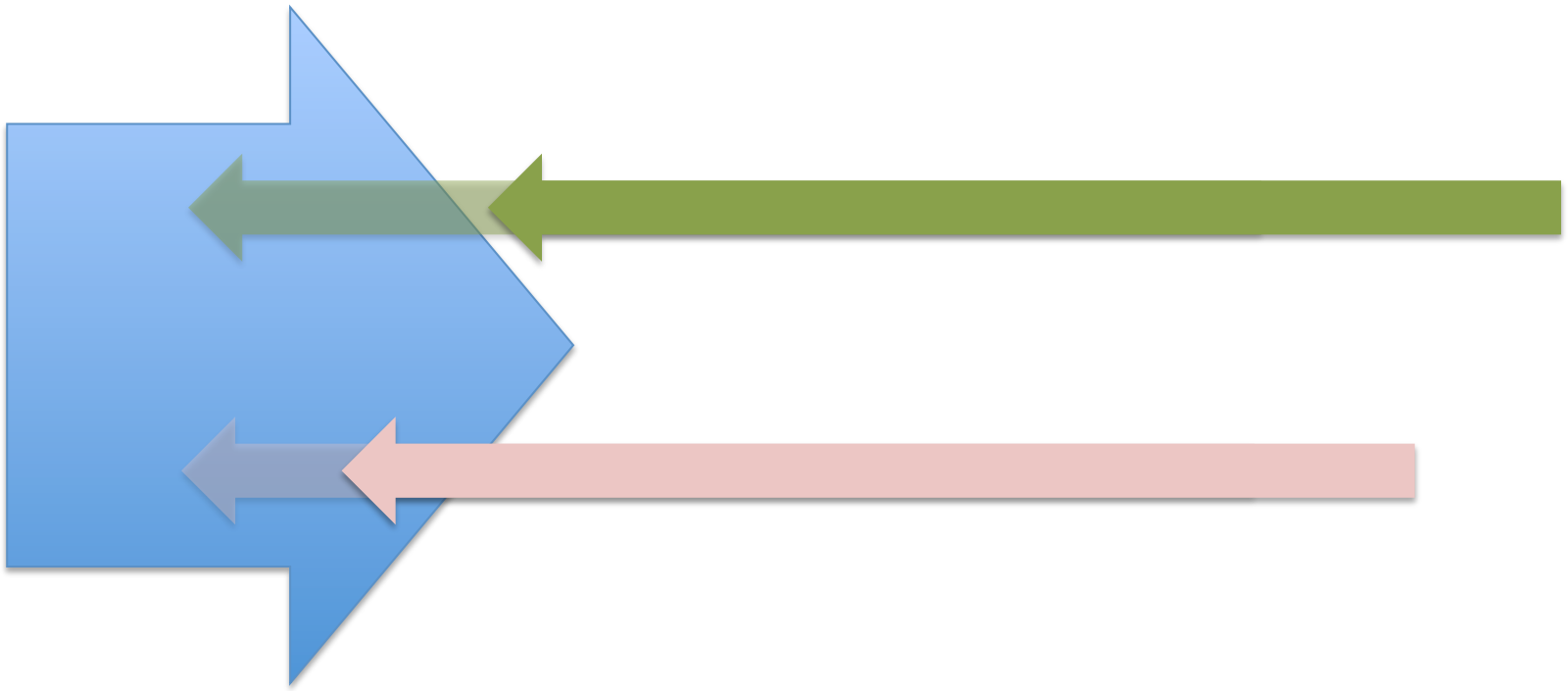
Wind pollination efficiency II



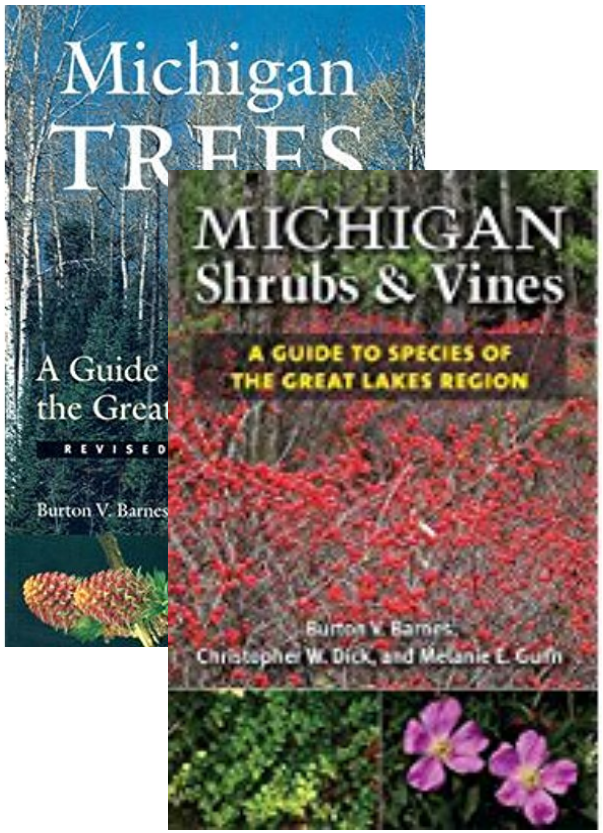
Insect visibility



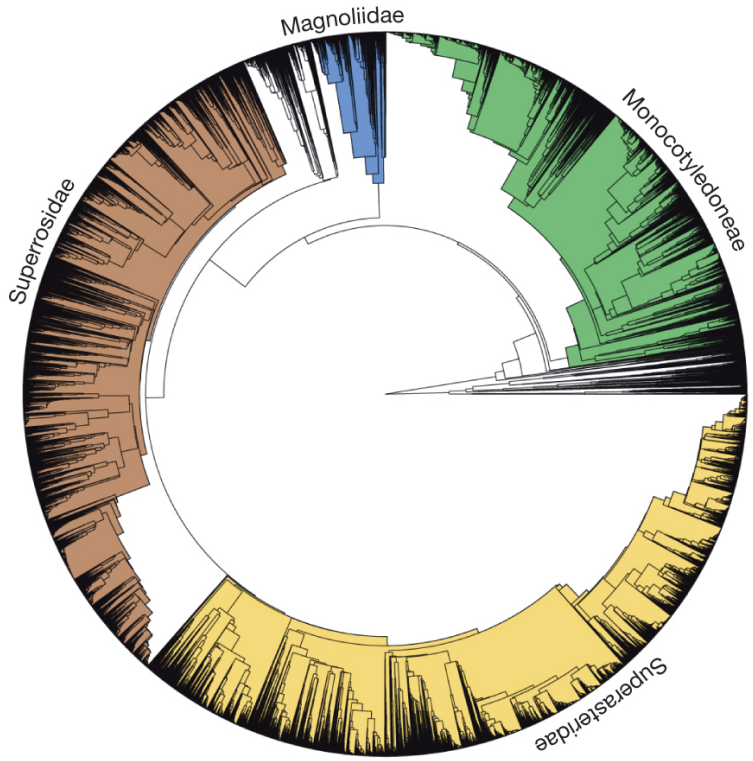
Differential selection



Data:

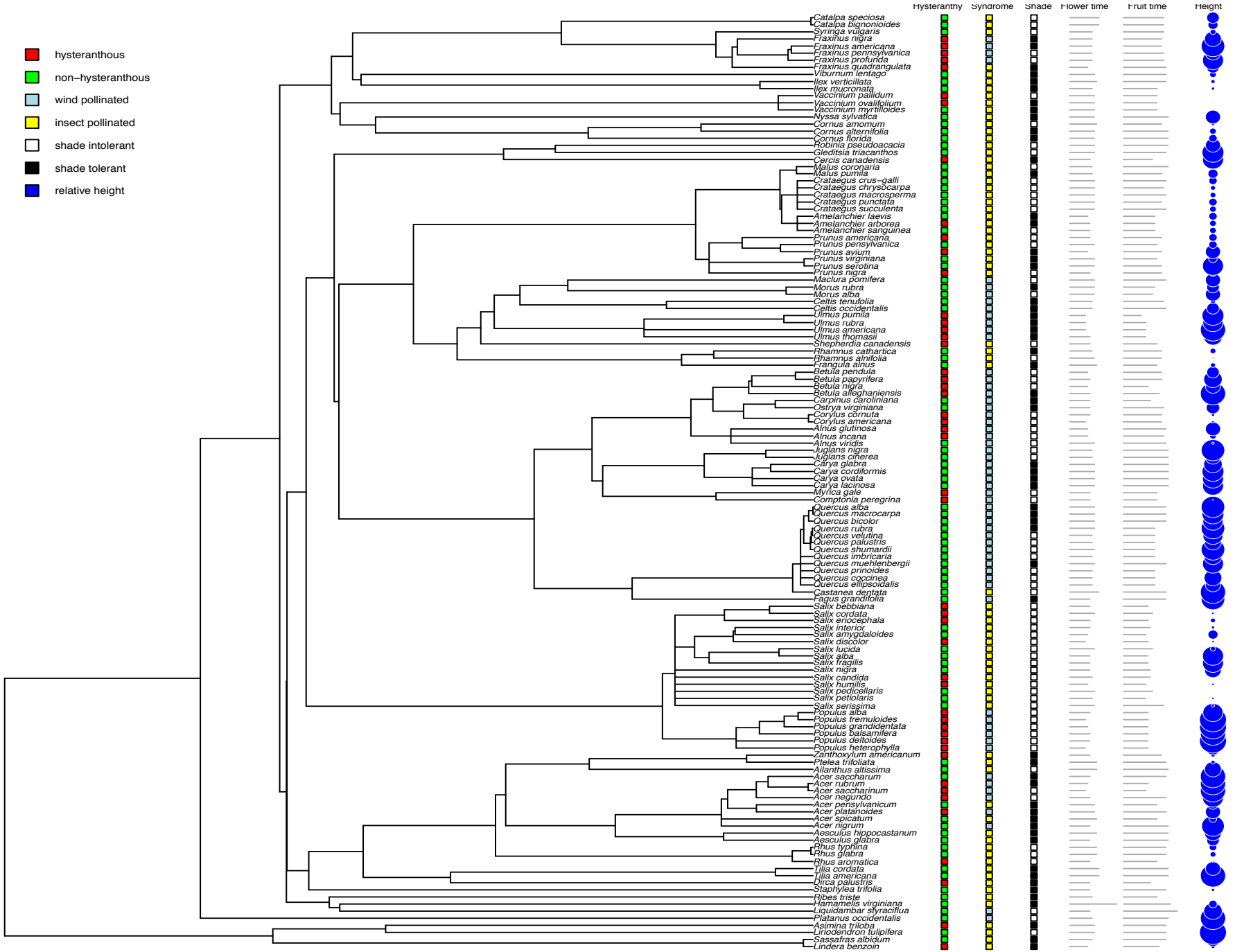


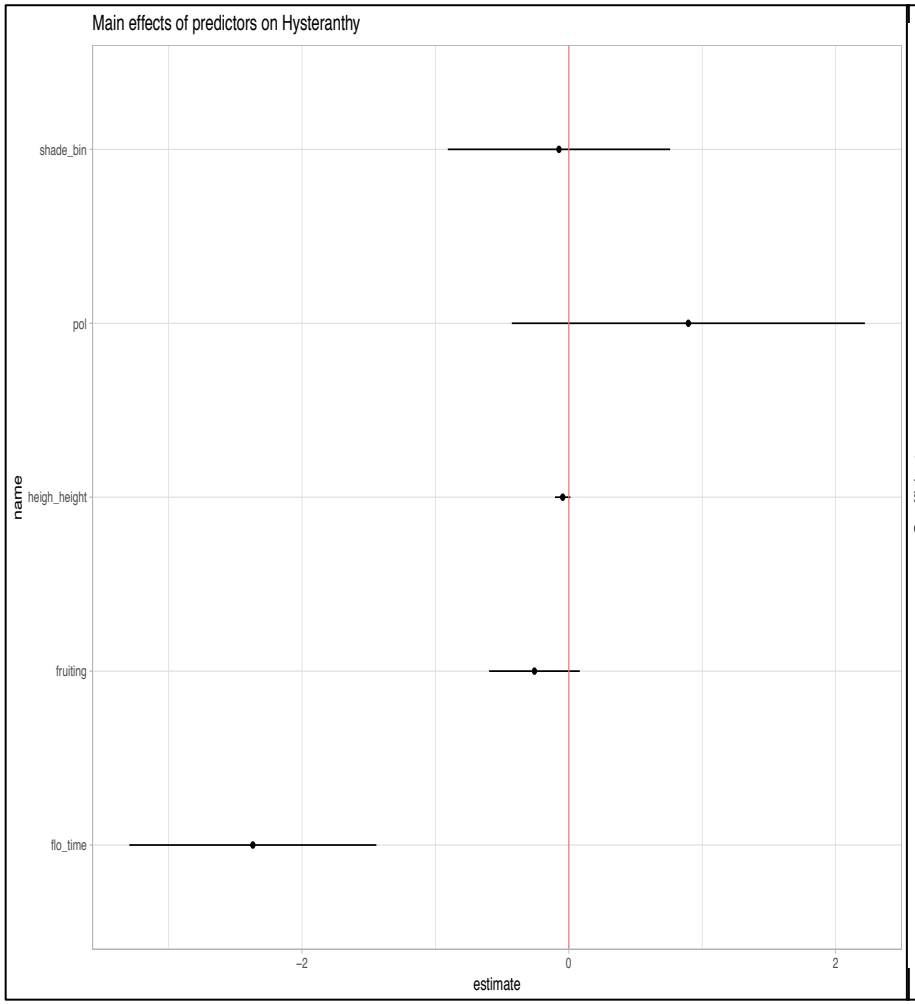
Phylogenetic Tree:

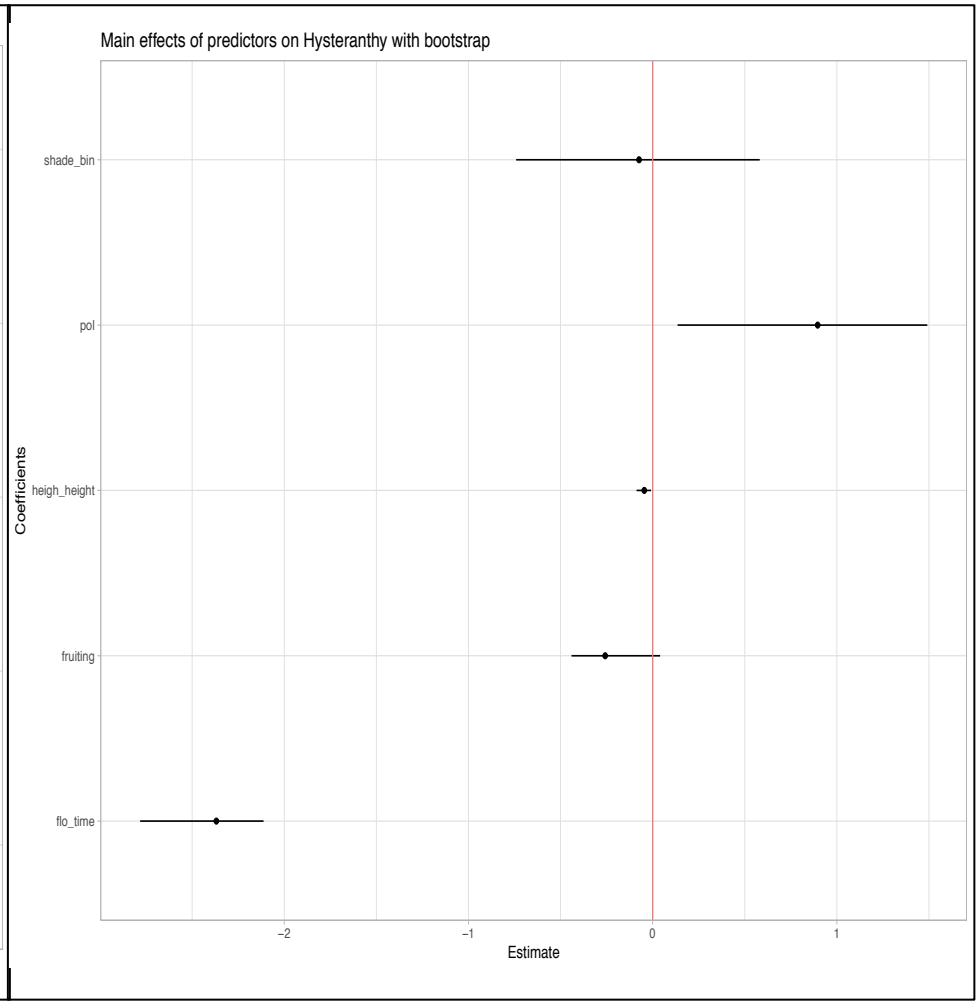


From: AE Zanne *et al. Nature* **000**, 1-4 (2013) doi:10.1038/nature12872

Model: $Pr(Hyst(0,1))\sim\beta_1 x_1+\beta_2 x_2\ldots+\varepsilon$


hysteranthous
non−hysteranthous
wind pollinated
insect pollinated
shade intolerant
shade tolerant
relative height
Hysteranthy
Syndrome
Shade
Flower time
Fruit time
Height
Catalpa speciosa
Catalpa bignonioides
Syringa vulgaris
Fraxinus nigra
Fraxinus americana
Fraxinus pennsylvanica
Fraxinus profunda
Fraxinus quadrangulata
Viburnum lentago
Ilex verticillata
Ilex mucronata
Vaccinium pallidum
Vaccinium ovalifolium
Vaccinium myrtilloides
Nyssa sylvatica
Cornus amomum
Cornus alternifolia
Cornus florida
Robinia pseudoacacia
Gleditsia triacanthos
Cercis canadensis
Malus coronaria
Malus pumila
Crataegus crus−galli
Crataegus chrysocarpa
Crataegus macrosperma
Crataegus punctata
Crataegus succulenta
Amelanchier laevis
Amelanchier arborea
Amelanchier sanguinea
Prunus americana
Prunus pensylvanica
Prunus avium
Prunus virginiana
Prunus serotina
Prunus nigra
Maclura pomifera
Morus rubra
Morus alba
Celtis tenuifolia
Celtis occidentalis
Ulmus pumila
Ulmus rubra
Ulmus americana
Ulmus thomasii
Shepherdia canadensis
Rhamnus cathartica
Rhamnus alnifolia
Frangula alnus
Betula pendula
Betula papyrifera
Betula nigra
Betula alleghaniensis
Carpinus caroliniana
Ostrya virginiana
Corylus cornuta
Corylus americana
Alnus glutinosa
Alnus incana
Alnus viridis
Juglans nigra
Juglans cinerea
Carya glabra
Carya cordiformis
Carya ovata
Carya laciniosa
Myrica gale
Comptonia peregrina
Quercus alba
Quercus macrocarpa
Quercus bicolor
Quercus rubra
Quercus velutina
Quercus palustris
Quercus shumardii
Quercus imbricaria
Quercus muehlenbergii
Quercus prinoides
Quercus coccinea
Quercus ellipsoidalis
Castanea dentata
Fagus grandifolia
Salix bebbiana
Salix cordata
Salix eriocephala
Salix interior
Salix amygdaloides
Salix discolor
Salix lucida
Salix alba
Salix fragilis
Salix nigra
Salix candida
Salix humilis
Salix pedicellaris
Salix petiolaris
Salix serissima
Populus alba
Populus tremuloides
Populus grandidentata
Populus balsamifera
Populus deltoides
Populus heterophylla
Zanthoxylum americanum
Ptelea trifoliata
Ailanthus altissima
Acer saccharum
Acer rubrum
Acer saccharinum
Acer negundo
Acer pensylvanicum
Acer platanoides
Acer spicatum
Acer nigrum
Aesculus hippocastanum
Aesculus glabra
Rhus typhina
Rhus glabra
Rhus aromatica
Tilia cordata
Tilia americana
Dirca palustris
Staphylea trifolia
Ribes triste
Hamamelis virginiana
Liquidambar styraciflua
Platanus occidentalis
Asimina triloba
Liriodendron tulipifera
Sassafras albidum
Lindera benzoin

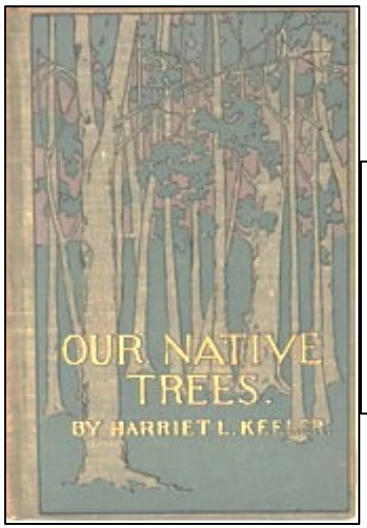

Main effects of predictors on Hysteranthy
shade_bin
pol
heigh_height
fruiting
flo_time
name
−2
0
2
estimate


Main effects of predictors on Hysteranthy with bootstrap
shade_bin
pol
heigh_height
fruiting
flo_time
Coefficients
−2
−1
0
1
Estimate

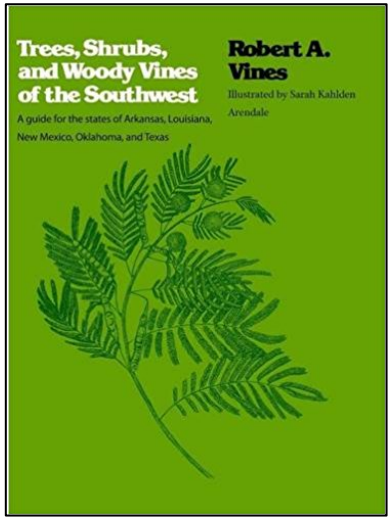
Model validation, inference space

USFS Silvics Manual:
- Non-parallel data
- Missing predictors
- N~50, few df

In progress:
- Non-parallel data
- Missing predictors
- N~100+ , model convergence more likely

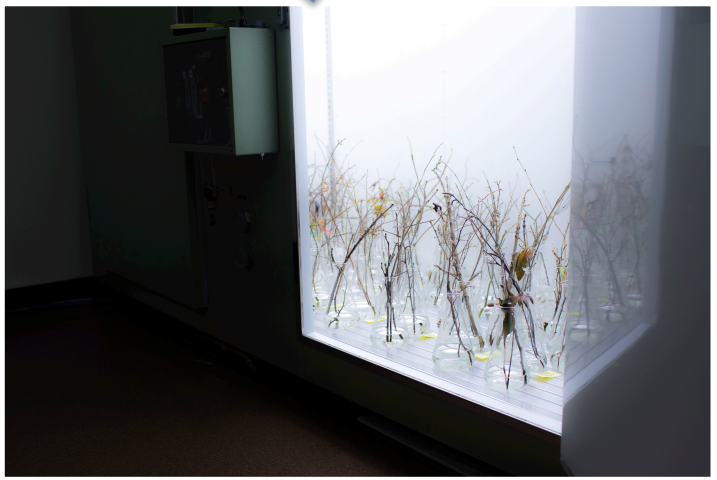


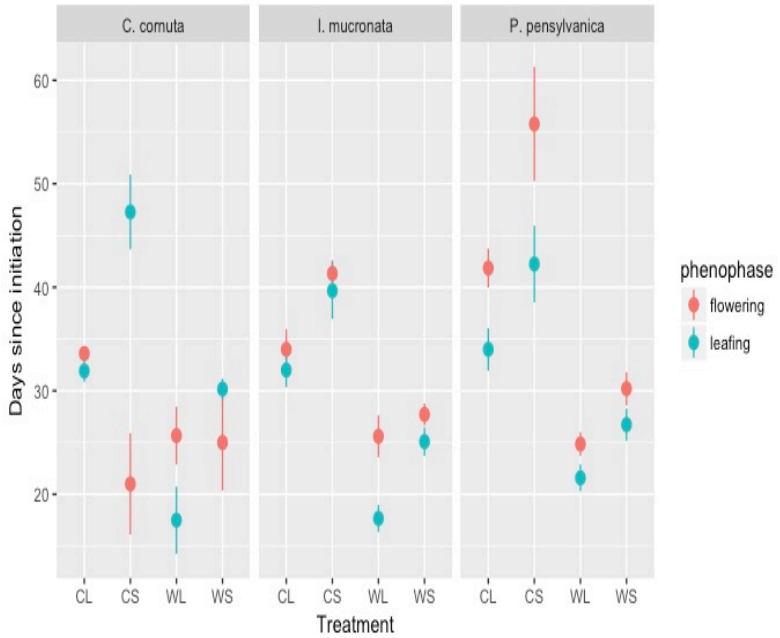
Published 1900!
- Non-parallel data
- Missing predictors
- N~50, few df



	mod2	mod3	mod3a	mod4	mod4a	mod5	mich4cent	mod5cent
Pol	0.238	0.86	0.16	0.851	0.91	0.89	1	0.86
Flo_time	−2.57	−2.653	−2.32	−2.71	−2.39	−2.37	−12.52	−11.3
height	X	−0.052	X	−0.049	−0.046	−0.045	−1.76	−0.66
shade	X	X	X	−0.18	X	−0.07	X	−1.2
fruiting	X	X	−0.23	X	−0.25	−0.25	−0.76	−0.05
	Silv1	Silv3	Silv4cent					
Pol	1.48	0.98	0.26					
flo_time	−3.17	−3.26	−10					
av_fruit_time	X	0.08	X					
fruiting	X		−3.69					
height_cent	X	X	−0.51					
	Keeler2	Keeler3(cent						
Pol	1.16	1.89						
flo_time	−4.16	−21.5						
height		−0.67						

Part II: To what degree are these patterns stable, especially in a changing climate space?

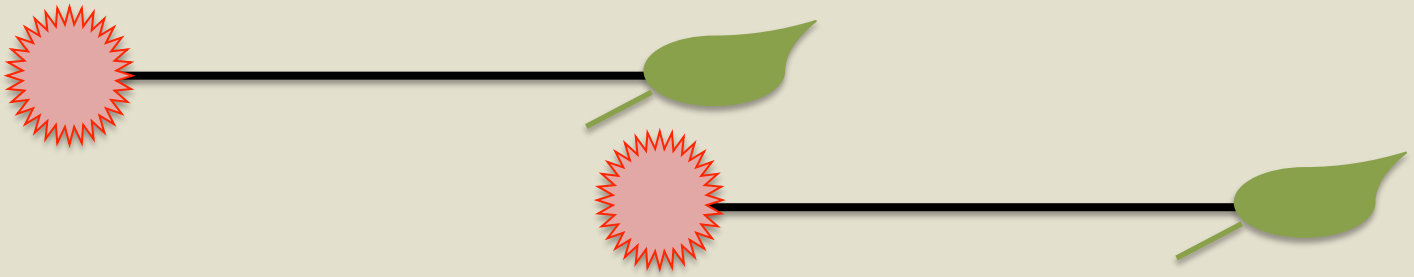




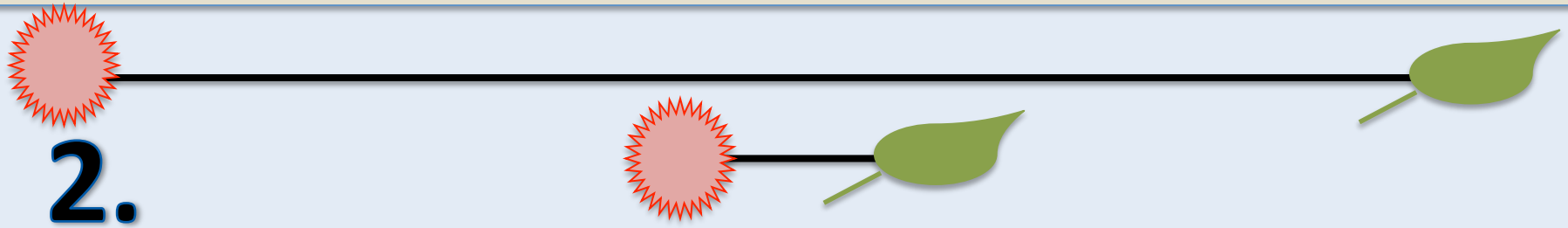
Possible patterns

Null

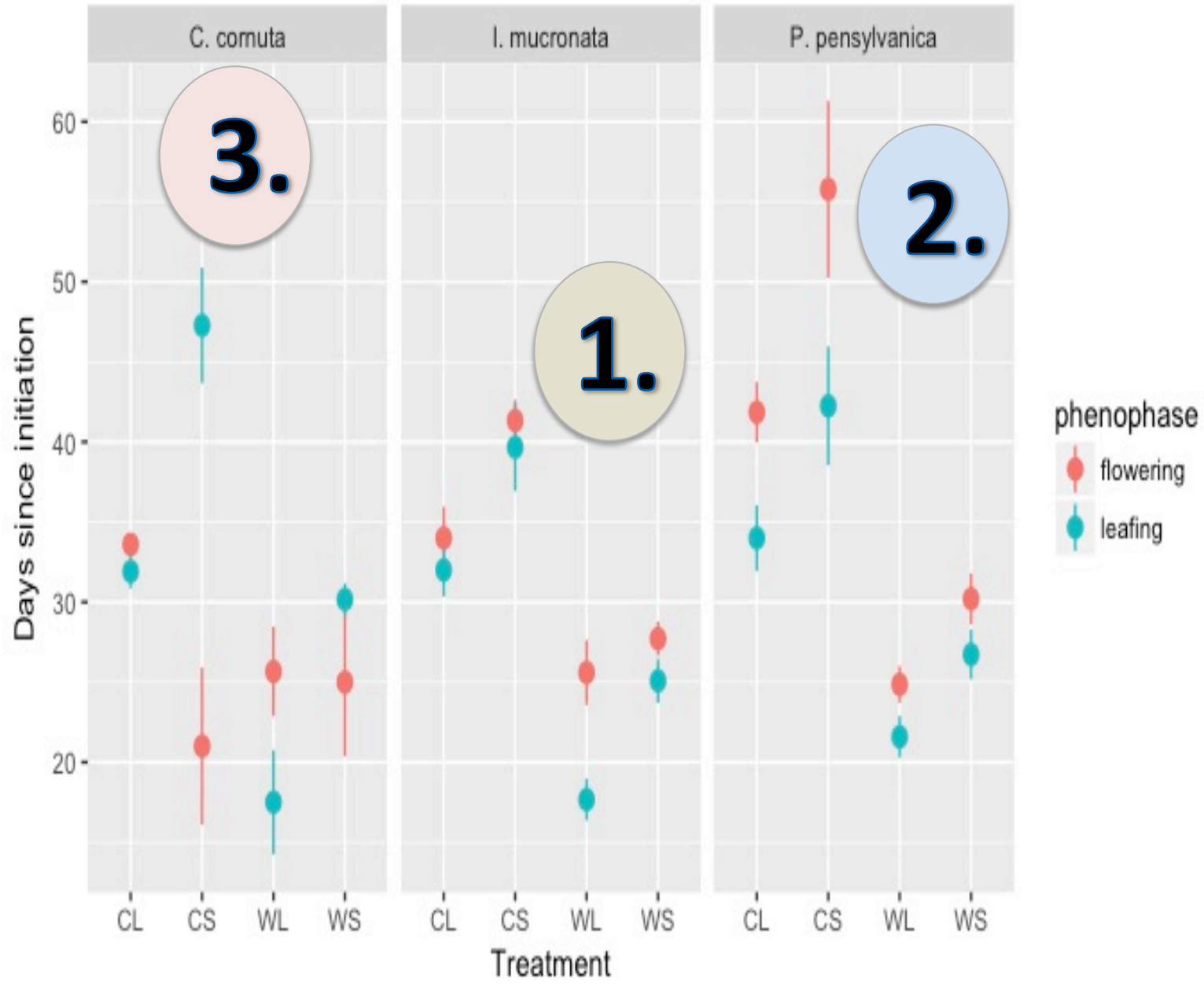
1.



2.



3.


C. cornuta
I. mucronata
P. pensylvanica
3.
1.
2.
Days since initiation
60
50
40
30
20
CL
CS
WL
WS
Treatment
phenophase
flowering
leafing

- 8 treatments combinations
  - Temperature (10, 20)
  - Photoperiod (8,12)
  - Chiling(0, 6 weeks)

12(13) species

- *Corylus cornuta (H)*
- *Betula allegheniensis (H)*
- *Acer saccharum (H)*
- *Acer rubrum (H)*
- *Acer pensylvanicum (N)*
- *Fagus grandifolia (N)*
- *Ilex mucronata (N)*
- *Ilex verticillata (N)*
- *Prunus pensylvanica (N)*
- *Prunus virginiana (N)*
- *Comptonia perigrina (H)*
- *Vaccinium corymbosum (N)*
- *Viburnum acerifolium (N)*

Sunday **October:**	**Monday**	**Tuesday**	**Wed**	**Thur**	**Fri**	**Sat**
22	23 Cut (HF)	24	25	26 Place (WH)	27	28
29	30	31	1 NOV	2	3	4
5	6 Alt Cut (HF)	7	8	9 Alt Place (WH)	10	11

Questions, Comments, Discussion