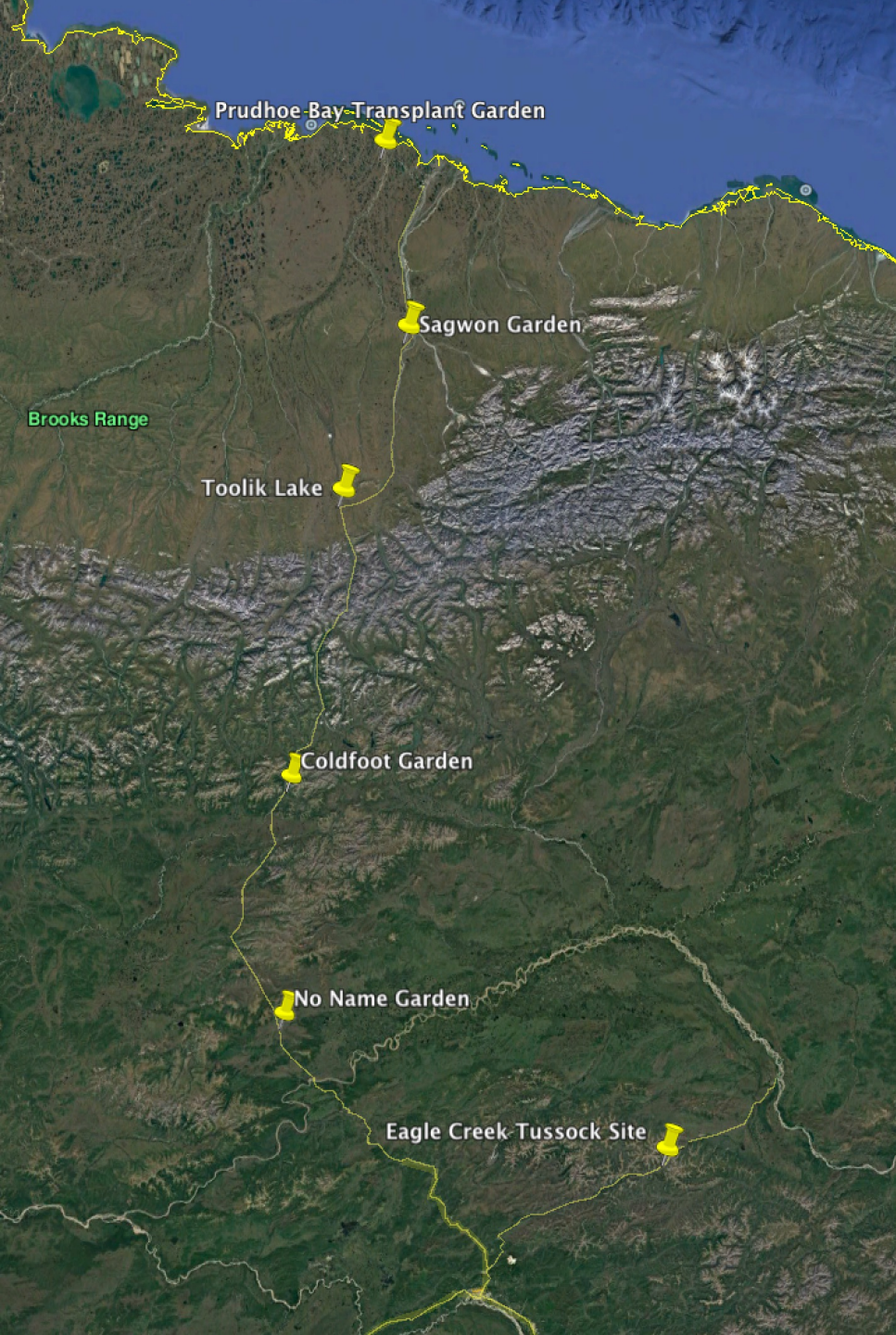


Plant response to temperature gradients in the tundra and the tropics



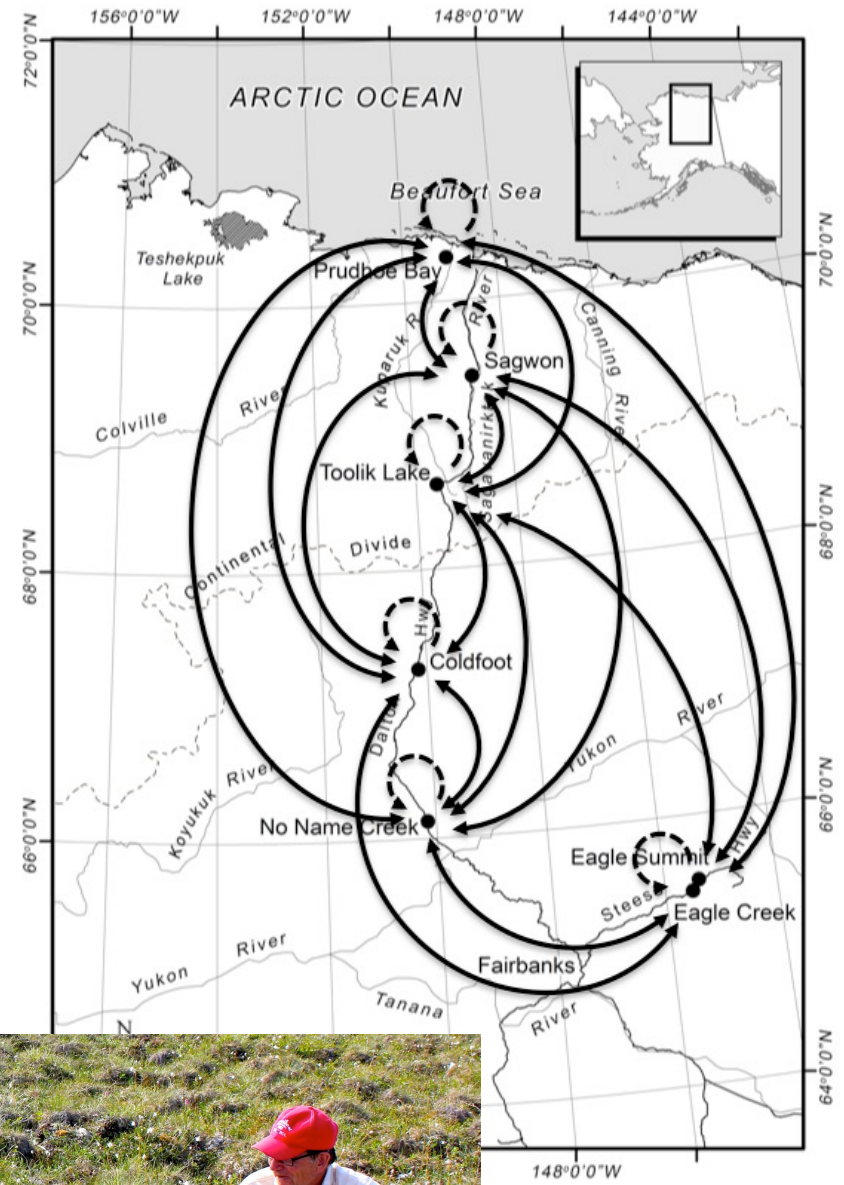


Thaw degree days

Prudhoe Bay	672
Sagwon	912
Toolik Lake	1227
Eagle Creek	1451
Coldfoot	1615
No Name Creek	1890

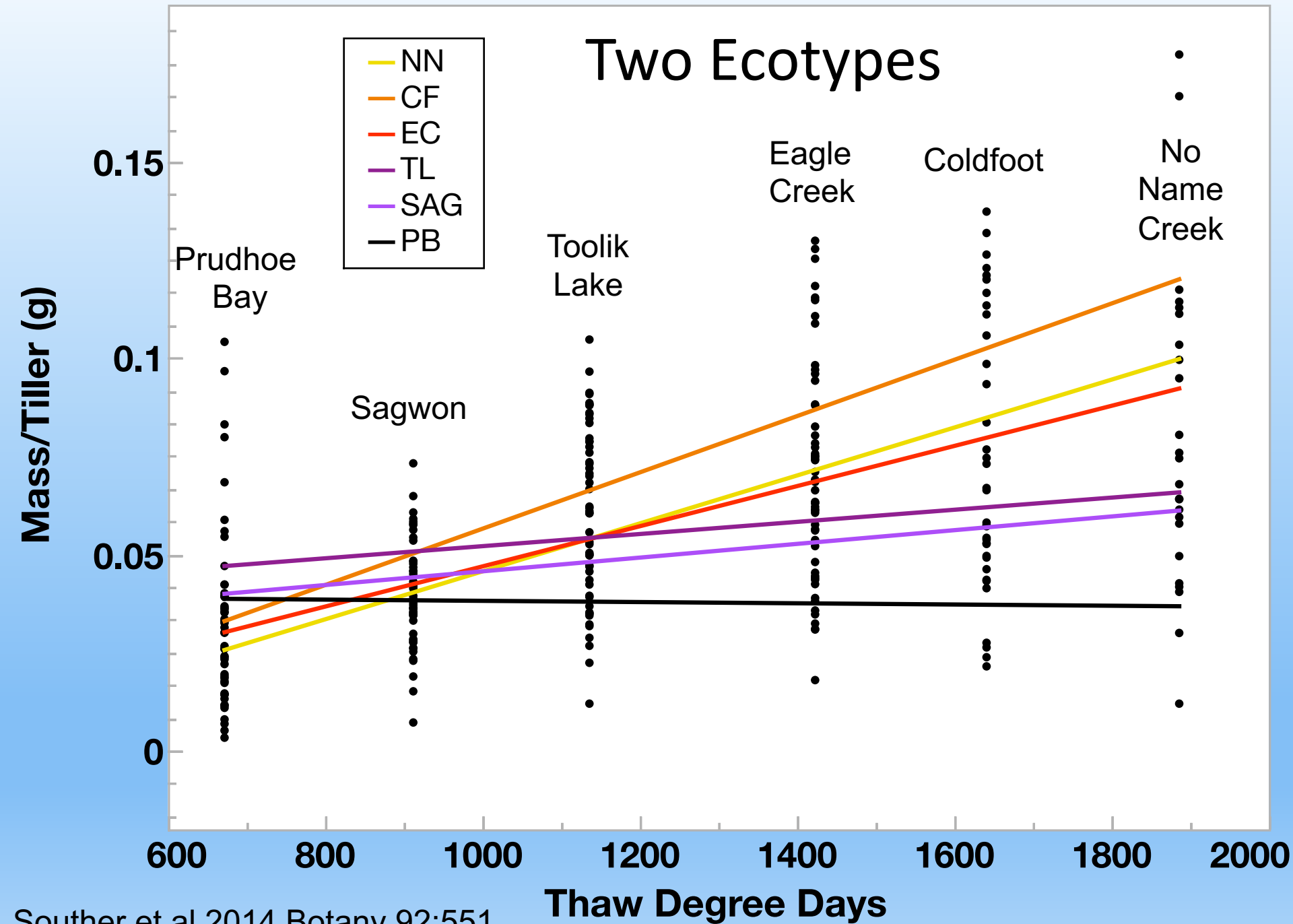


Are there
ecotypes in
Eriophorum
vaginatum?

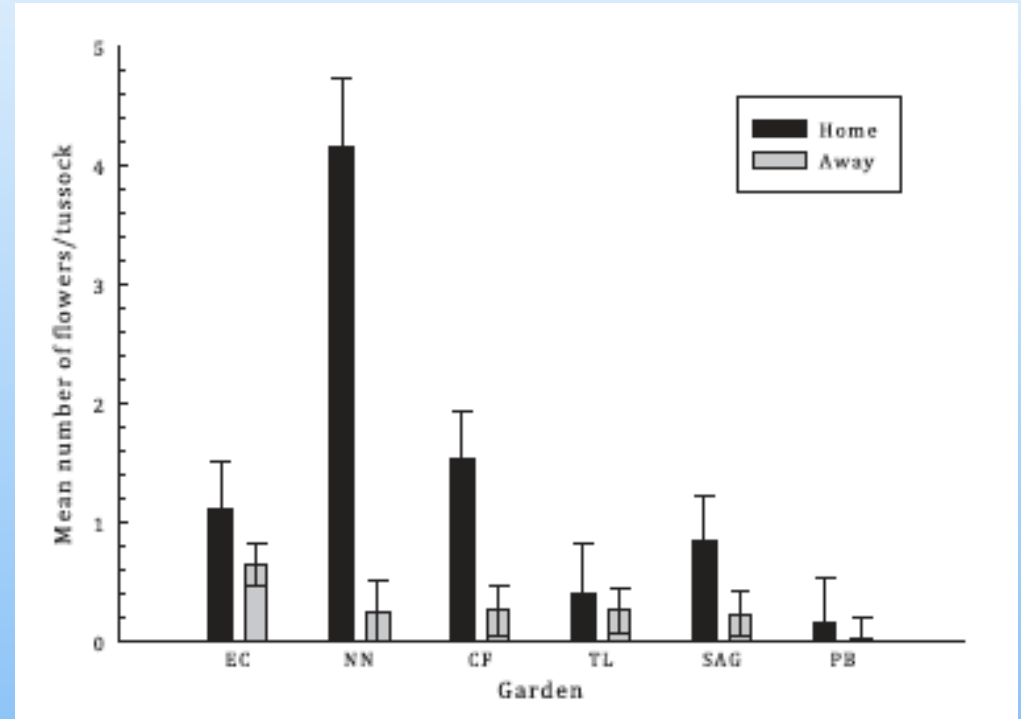




Two Ecotypes



Home-Team Advantage



Tussocks transplanted back into home sites tend to do better

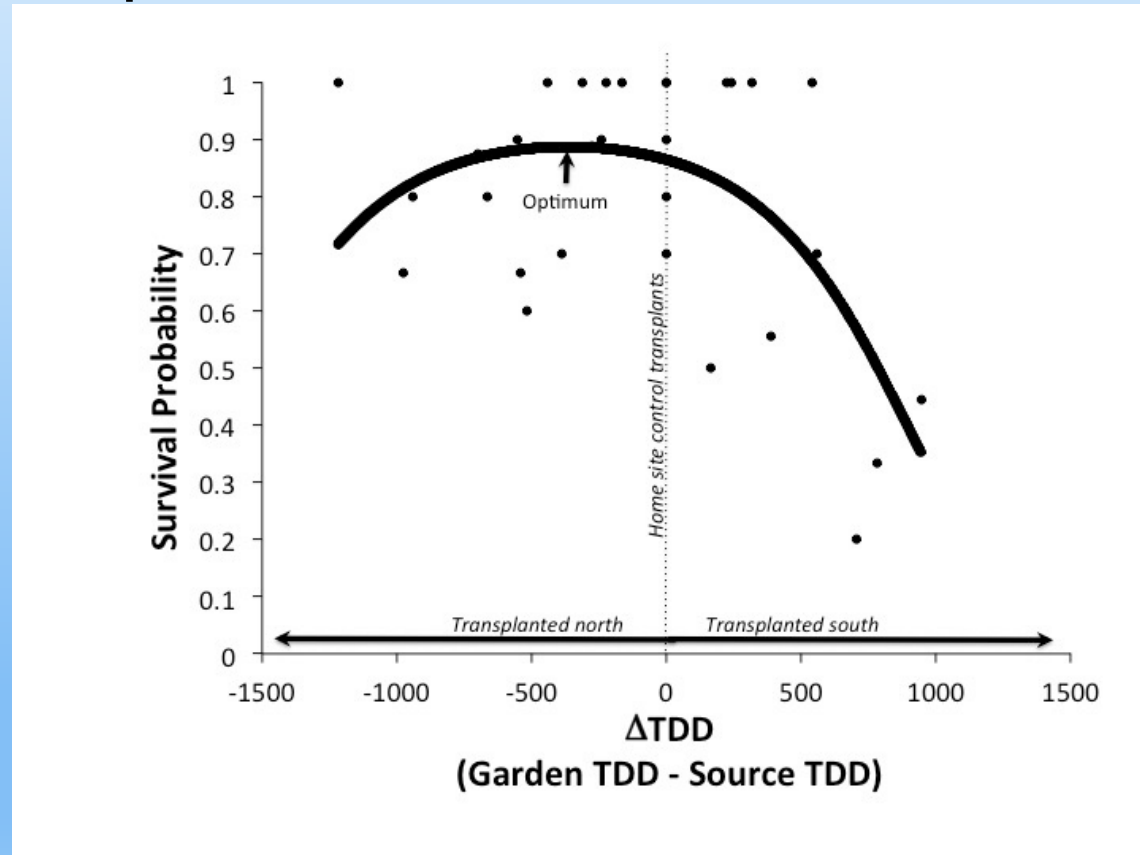
The *problem* of genetic specialization

If populations are generally genetically specialized to their local environments, what happens when the climate warms?

If turnover of individuals and migration are slow, will mean fitness decline as the climate warms?

Adaptive Lag

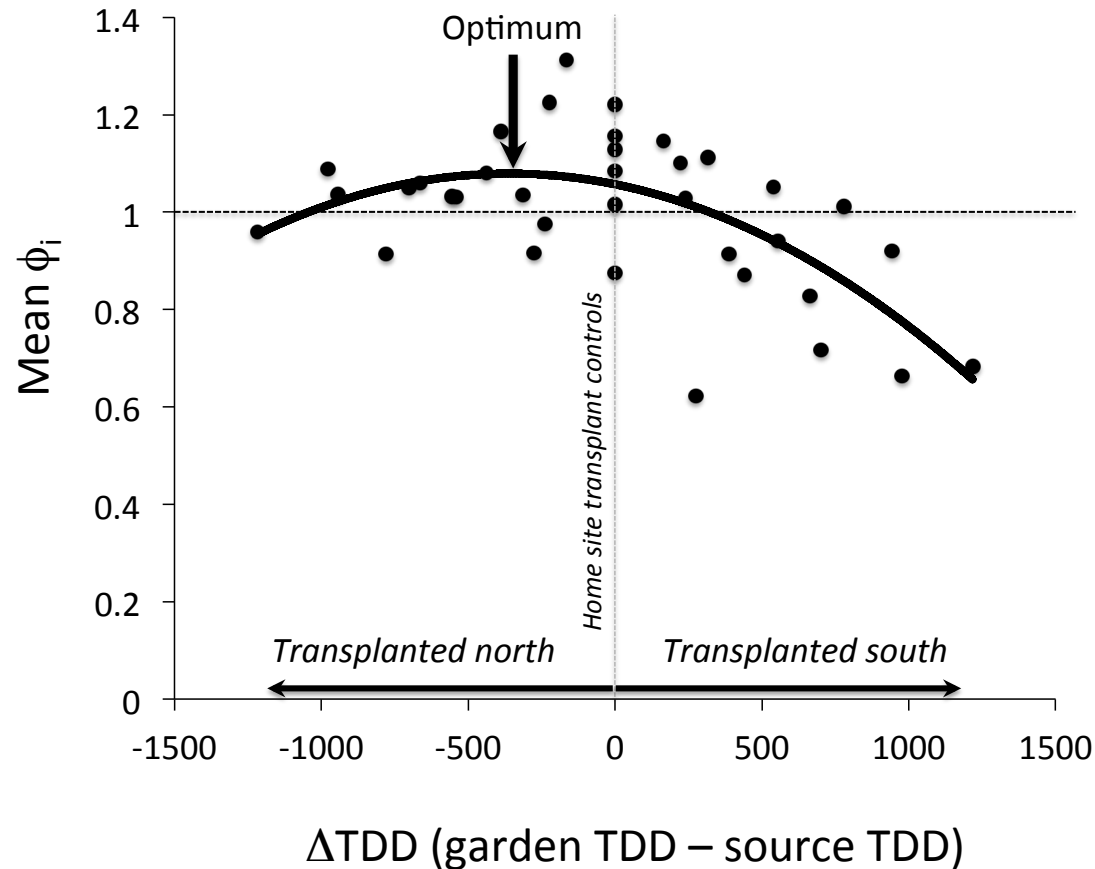
Optimum for tussock survival was shifted to the north suggesting that survival might be greater away from present location



← Transplanted North

Transplanted South →

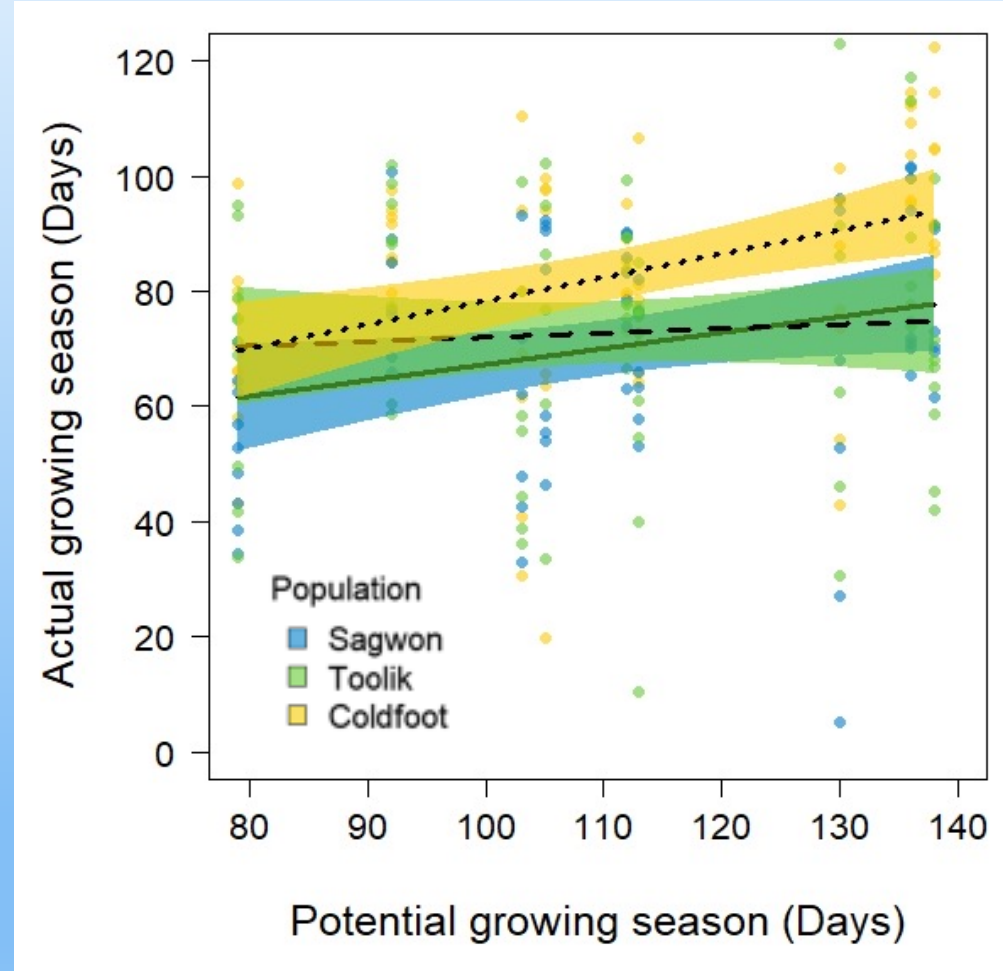
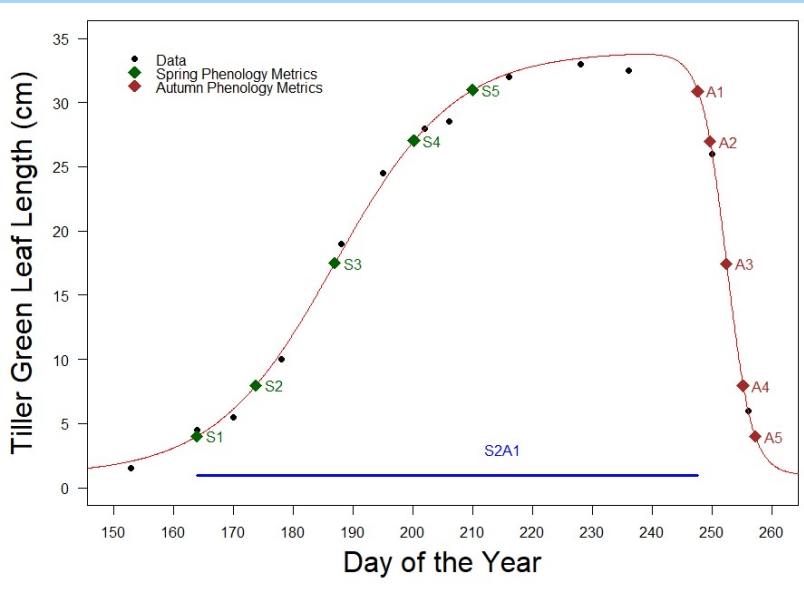
Optimum for tiller population growth rate also shifted to the north





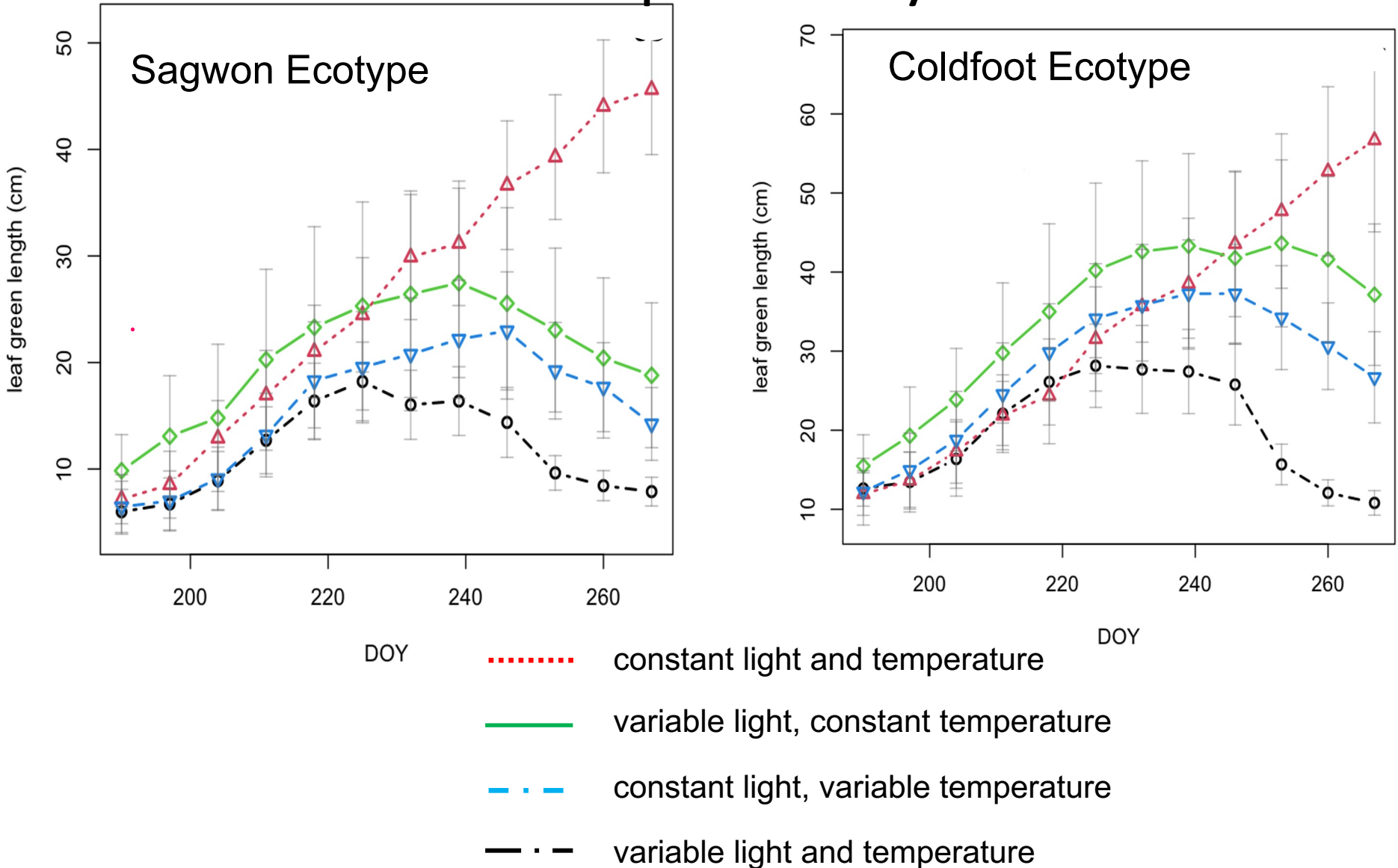
Toolik tussock at
Eagle Creek in
mid-August,
1983

Phenology



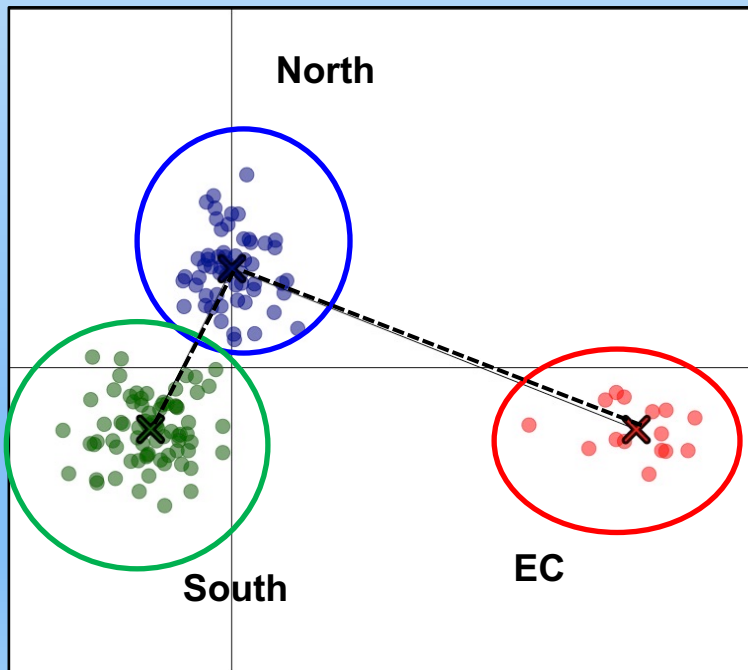
Potential growing season =
DOY of snowmelt –
DOY of return of cold temperatures

Light and temperature affect senescence independently

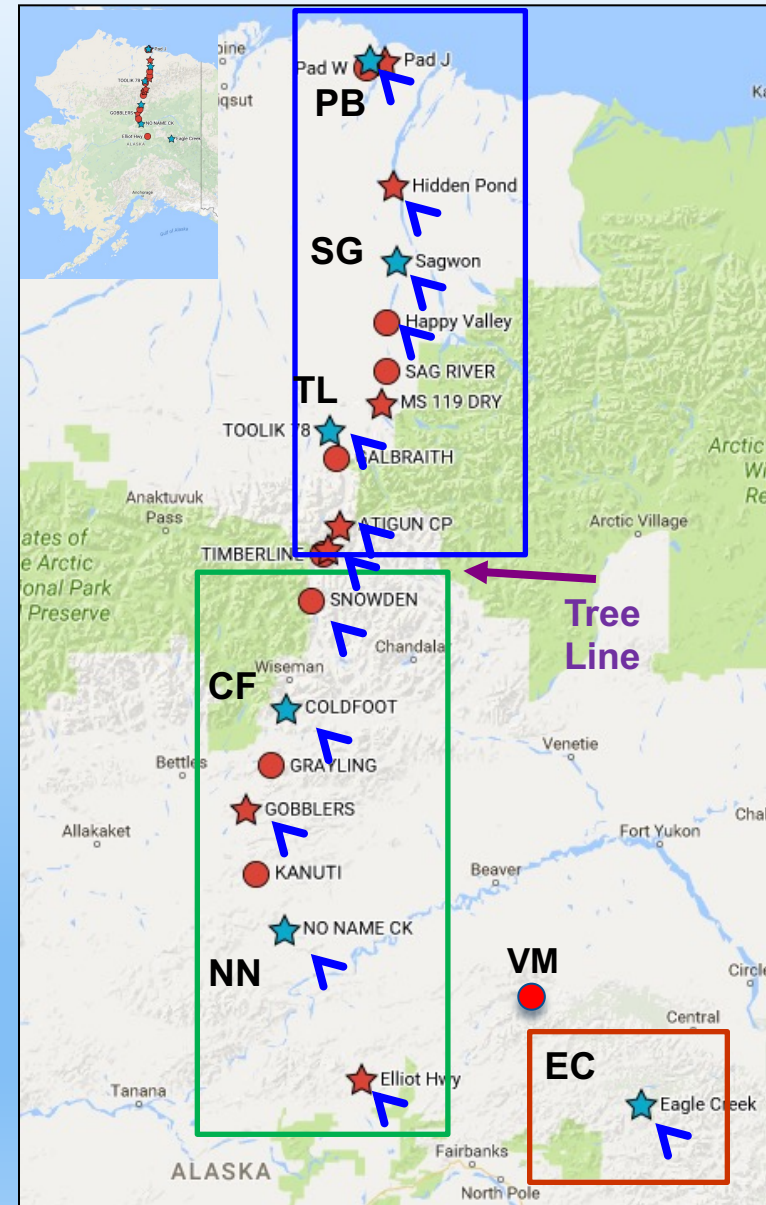


Genetic Structure

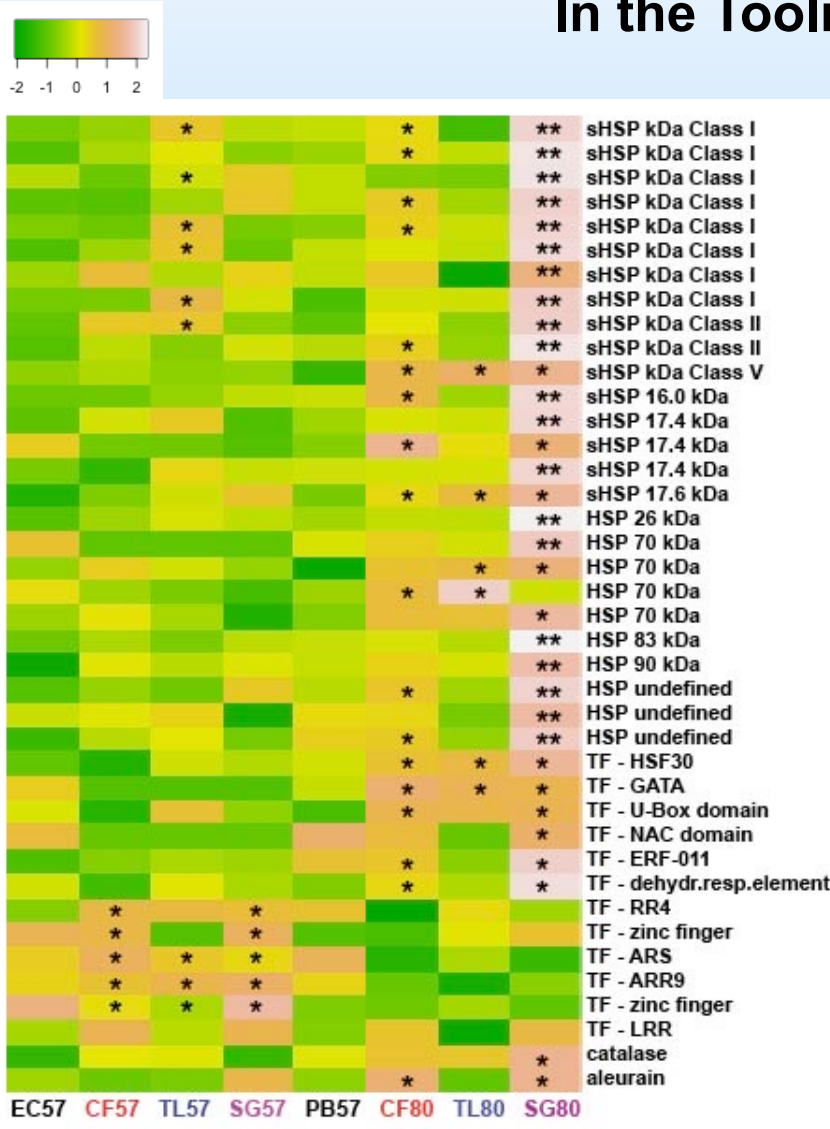
- 3 genetic clusters recognized as best result using two methods
- Genetic structure consistent with expectations from current and previous ecological results (except Eagle Creek)
- Not all populations are distinct ecotypes
- Same results with neutral vs. outlier loci



DAPC scatter plot of individuals
(adegenet v2.0.1)



Differential expression of Genes (DEGs) in Plants on 14°C & 27°C Days In the Toolik Common Garden



Gene Description	EC14	CF14	TL14	SG14	PB14	CF27	TL27	SG27
sHSP kDa class I	35	31	98	471	154	437	102	6069
sHSP kDa class II	1	8	3	10	7	20	4	519
sHSP kDa class V	3	5	3	3	1	30	45	81
sHSP 17.4 kDa	20	10	57	38	41	42	43	313
sHSP 17.6 kDa	0	7	29	103	6	58	148	805
HSP 26 kDa	133	294	506	405	302	420	408	8601
HSP 70 kDa	50	163	93	51	7	208	246	493
HSP 70 kDa	196	131	108	78	129	266	591	165
HSP 83 kDa	13	26	16	32	35	42	30	862
HSP 90 kDa	1	27	16	26	19	41	24	417
TF U-box domain	38	10	61	24	13	76	72	79
TF ERF-011	11	15	18	17	33	31	15	75
TF dehydr.resp.	92	42	99	76	60	112	78	363
TF RR4	25	61	59	56	54	11	44	29
TF zinc finger	261	193	3	308	3	2	42	118
TF ARS	127	175	132	117	170	43	85	48
TF ARR9	69	84	101	119	68	27	14	34
catalase	241	1175	1115	246	1106	1844	1746	4364

HSP = Heat shock protein

TF = Transcription factor

DEGs for all ecotypes and on 14°C (57 F) and 27°C (80 F) days;
 * >2x upregulated for ecotype, ** >5x upregulated over all

Summary

- **Phenology**

- All ecotypes start at the same time; Coldfoot senescences later
- Tiller size difference explained by length of growing period
- Coldfoot phenology more plastic than Toolik and Sagwon

- **Analysis of SNP's shows three clusters**

- Northern, southern, and Eagle Creek
- Border between northern and southern clusters at Timberline, not Continental Divide

- **Transcriptome tells a different story**

- Eagle Creek still different
- But Sagwon expressed much more heat shock protein on warm day than Toolik Lake and Coldfoot
- Northern populations may not be as similar as we thought



Pico del Este Transplant Garden

El Verde Station

Pico del Este
Cloud Forest
1000 m
Annual Temperature 18.9

El Verde
Lower Montane Forest
300 m
Annual Temperature 22.9

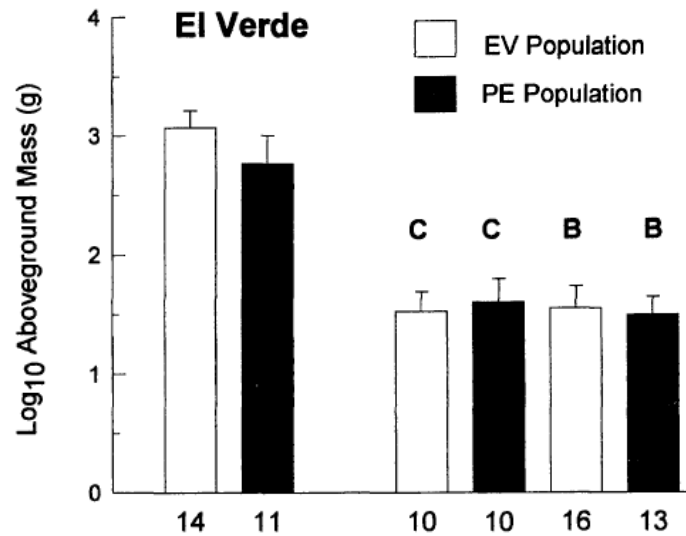


El Verde

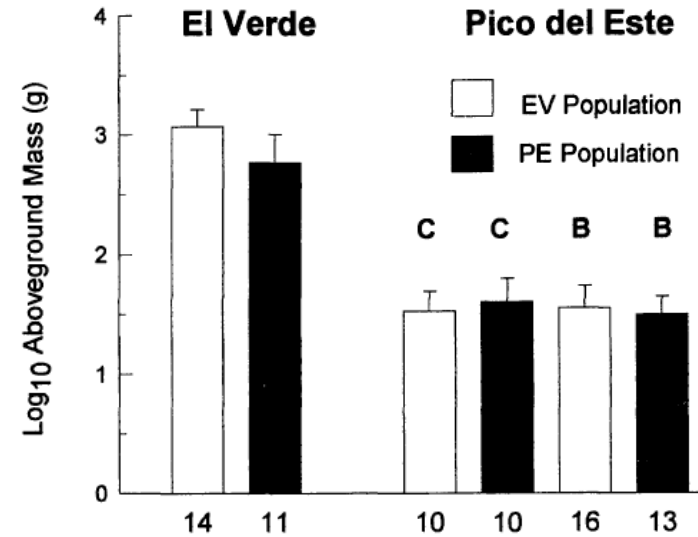




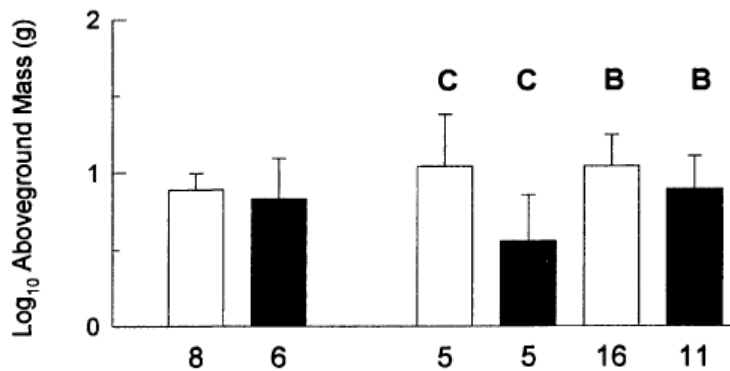
Clibadium erosum



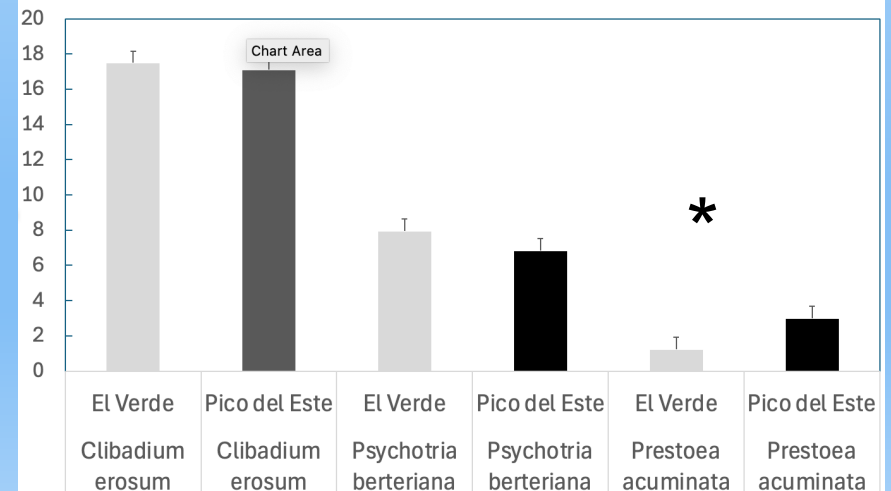
Psychotria berteriana



Prestoea acuminata



Amax



Why negative results?

- High gene flow
 - Carromero (1996) reported F_{st} of 0.103 for *Prestoea acuminata*
 - Mean number of migrants per generation = 2.18
 - Only 9 km
- *Clibadium erosum* is early successional and may have migrated to Pico del Este along the road.



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1993

Arctic LTER

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2009-2012

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Questions?

