

Why plants lose their inhibitions in the Arctic: functional traits, phylogenetics and respiration in the light

Nicholas Mirotnick
University of Toronto

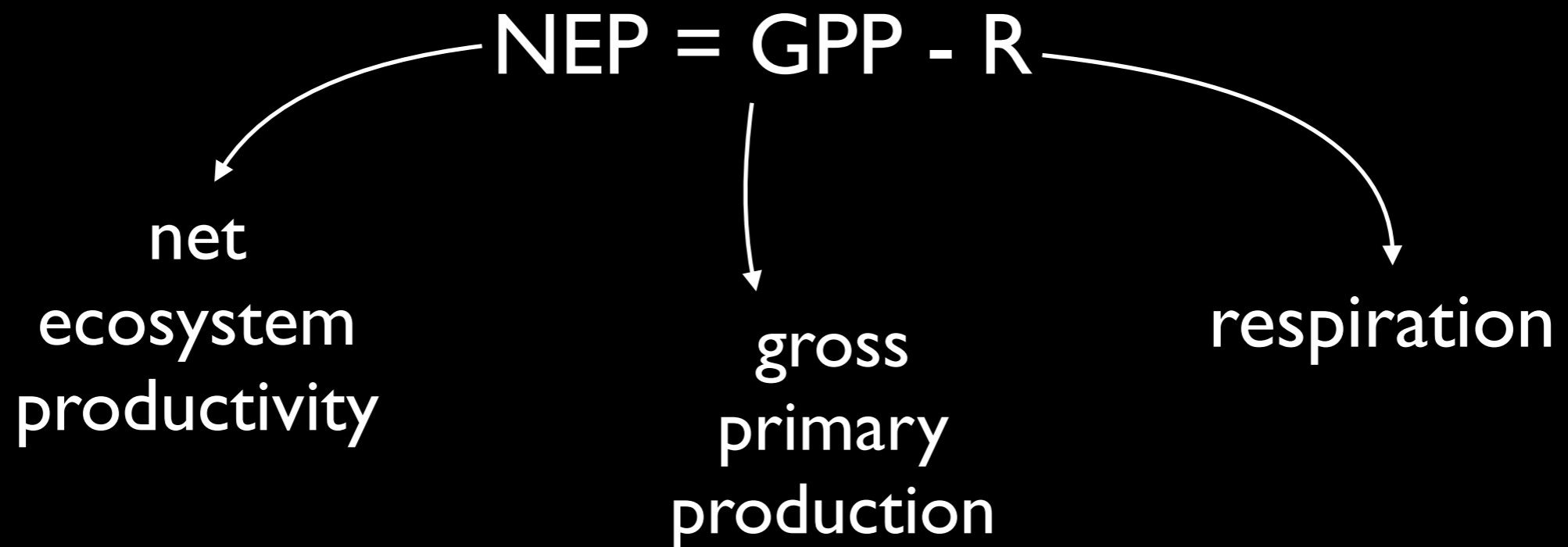
Owen Atkin
The Australian National University

Marc Cadotte
University of Toronto

Matthew Turnbull
University of Canterbury

Kevin Griffin
Columbia University

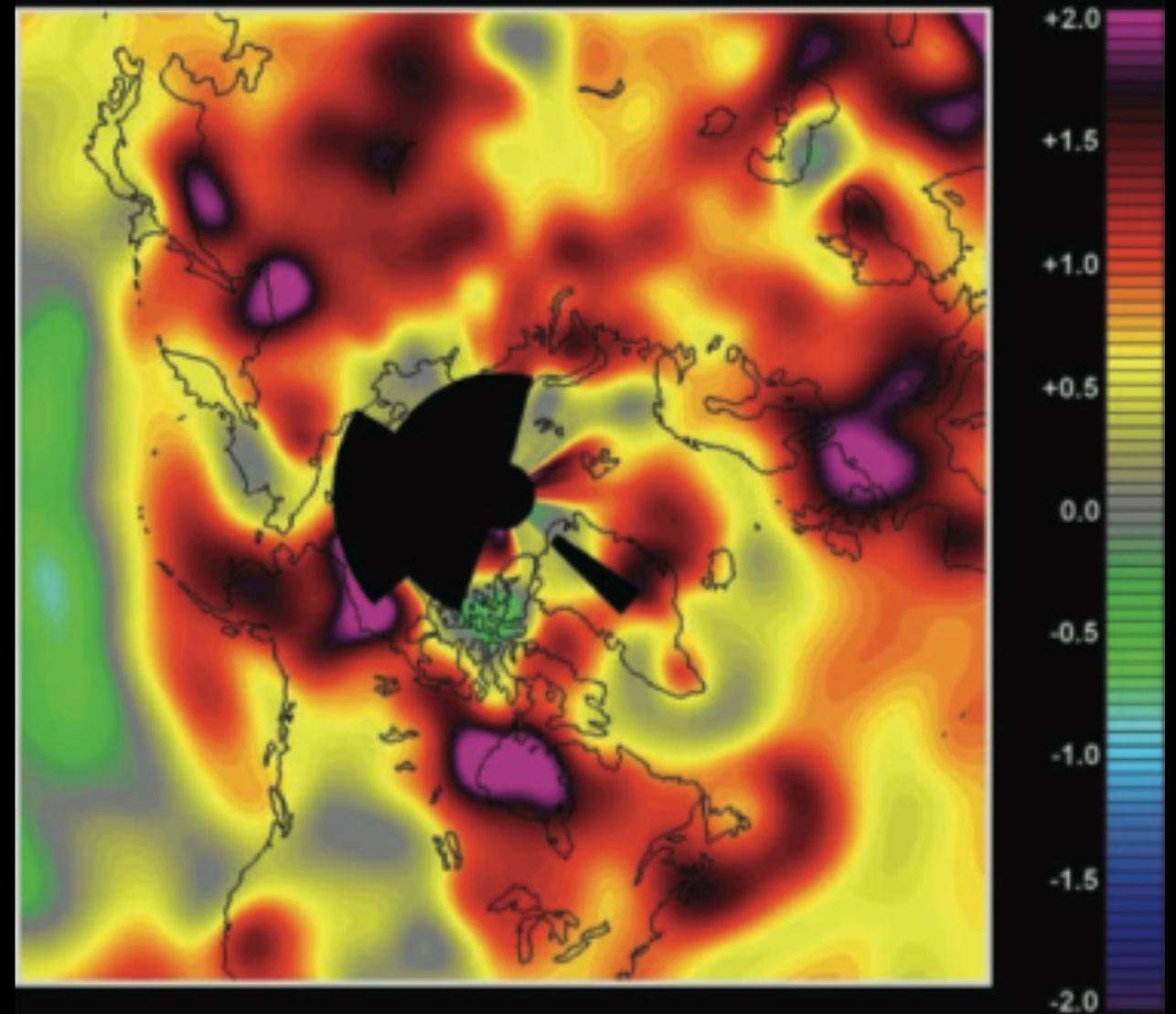
autotrophic respiration



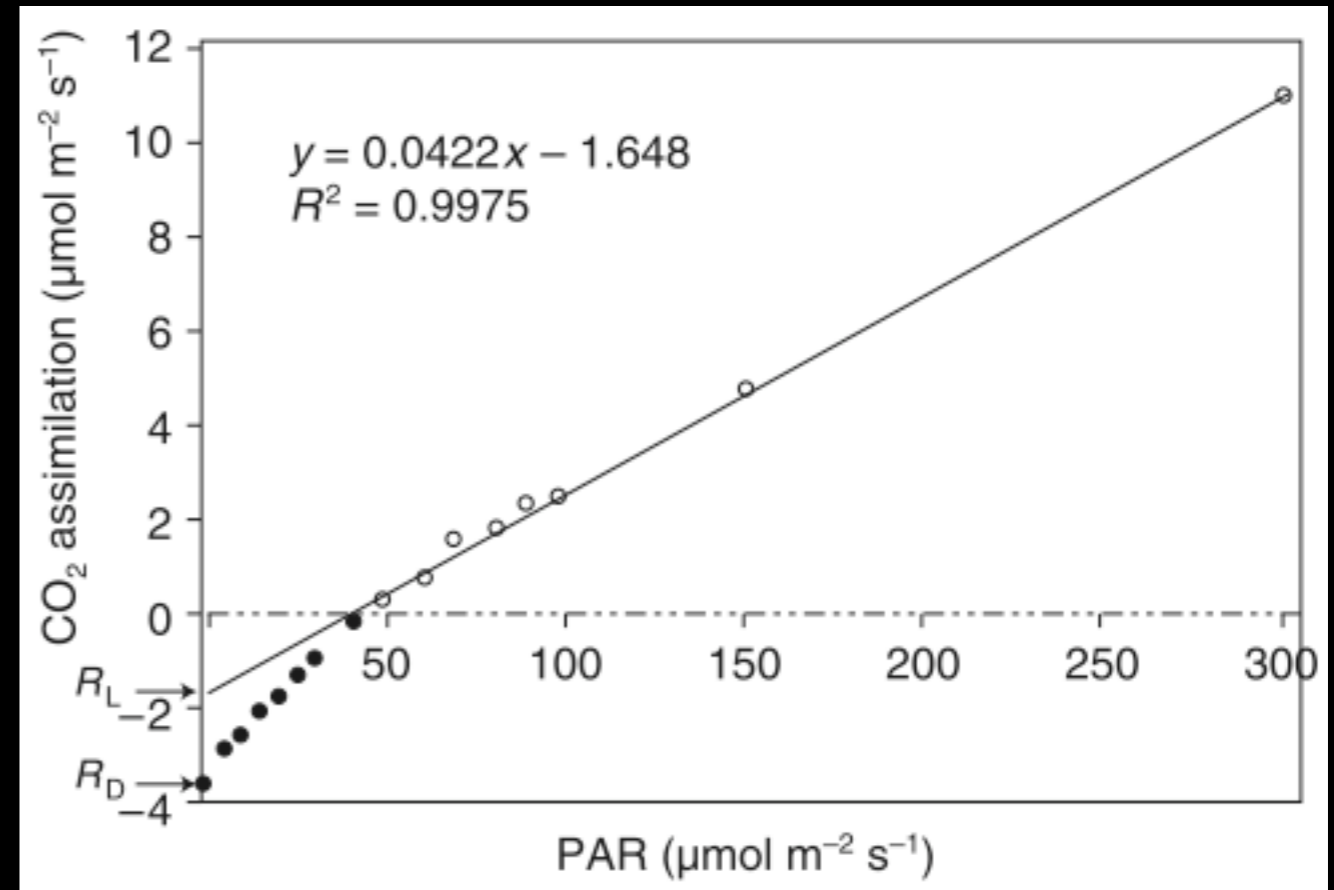
the Arctic



Surface air temperature change : 1961 - 2004
summer (JJA) - °C



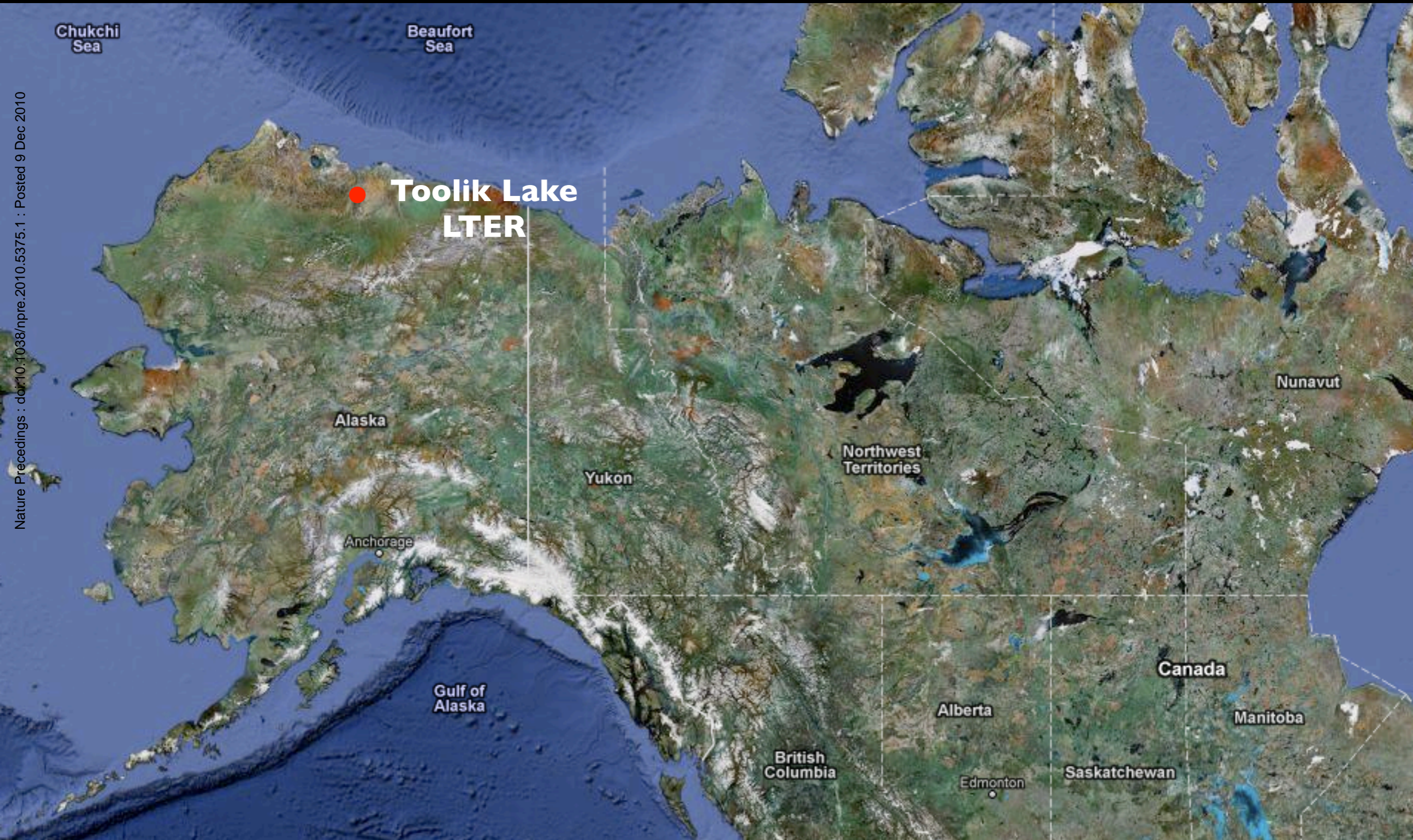
the Kok effect



traits

- specific leaf area (SLA)
- total non-structural carbohydrates (TNC):
 - fructose
 - glucose
 - sucrose
 - starch
- photosynthetic capacity (A_{\max})
- **response variable: R_L/R_D (inhibition)**

Toolik Lake, AK



6 wks in AK + 4.0×10^3 mosquito bites =

- 40 species
- 6-10 indivs./sp.

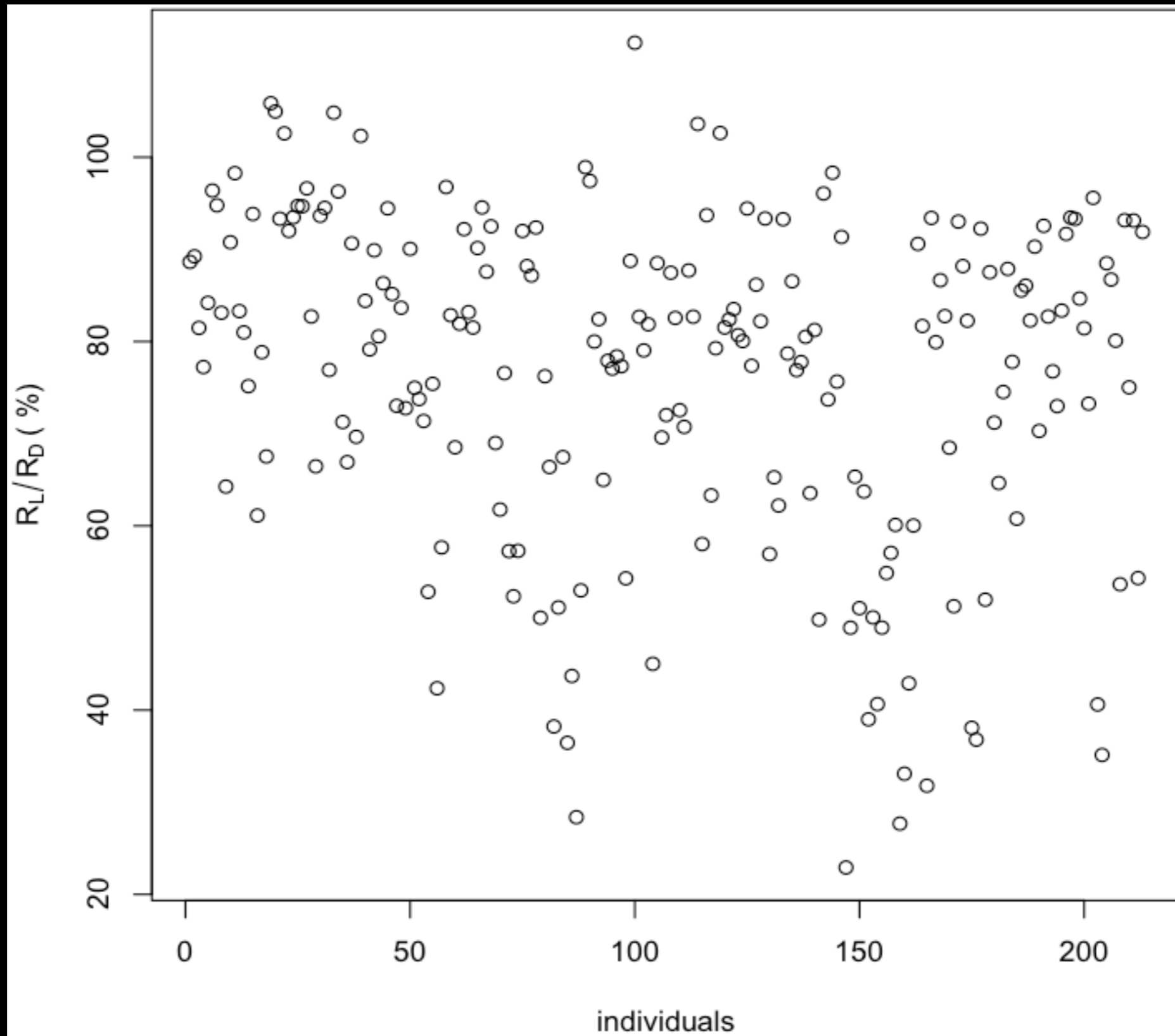
Aconitum delphinifolium
Anemone parviflora
Arctostaphylos alpina
Artemisia alaskana
Astragalus umbellatus
Calamagrostis canadensis
Carex aquatilis
Carex bigelowii
Carex saxatilis
Dryas integrifolia
Dryas Octopetala
Elymus trachycaulus
Epilobium latifolium
Equisetum arvense

Eriophorum angustifolium
Eriophorum vaginatum
Festuca rubra
Gentiana glauca
Geum glaciale
Hedysarum alpinum
Kobresia myosuroides
Kobresia Sibirica
Ledum palustre
Oxytropis deflexa
Oxytropis maydelliana
Oxytropis nigrescens
Petasites frigidus
Polygonum bistorta

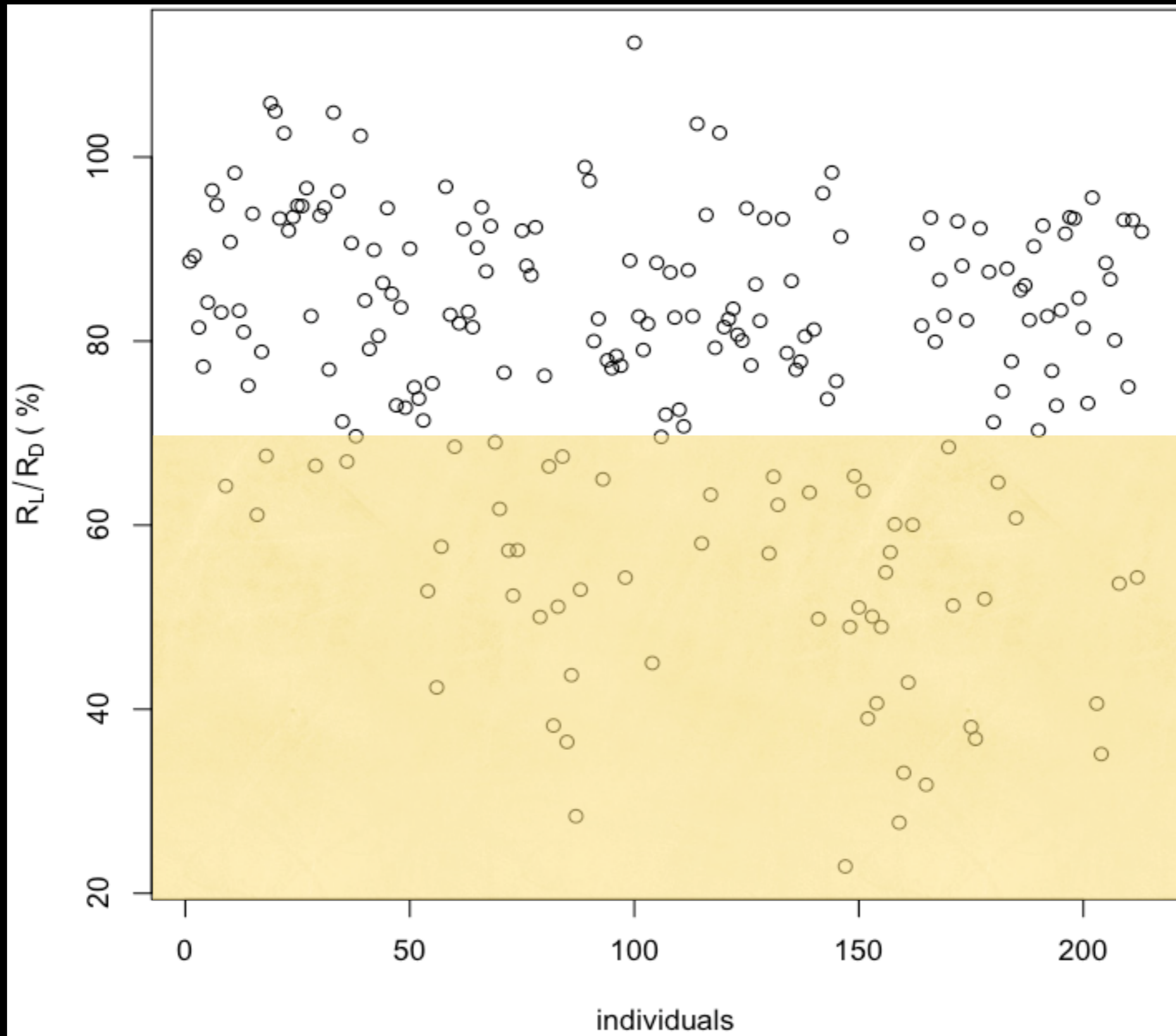
Potentilla fruticosa
Potentilla nivea
Potentilla palustris
Rhododendron lapponicum
Salix glauca
Salix pulchra
Salix reticulata
Saussurea angustifolia
Spiraea beauverdiana
Vaccinium uliginosum
Vaccinium vitis-idaea



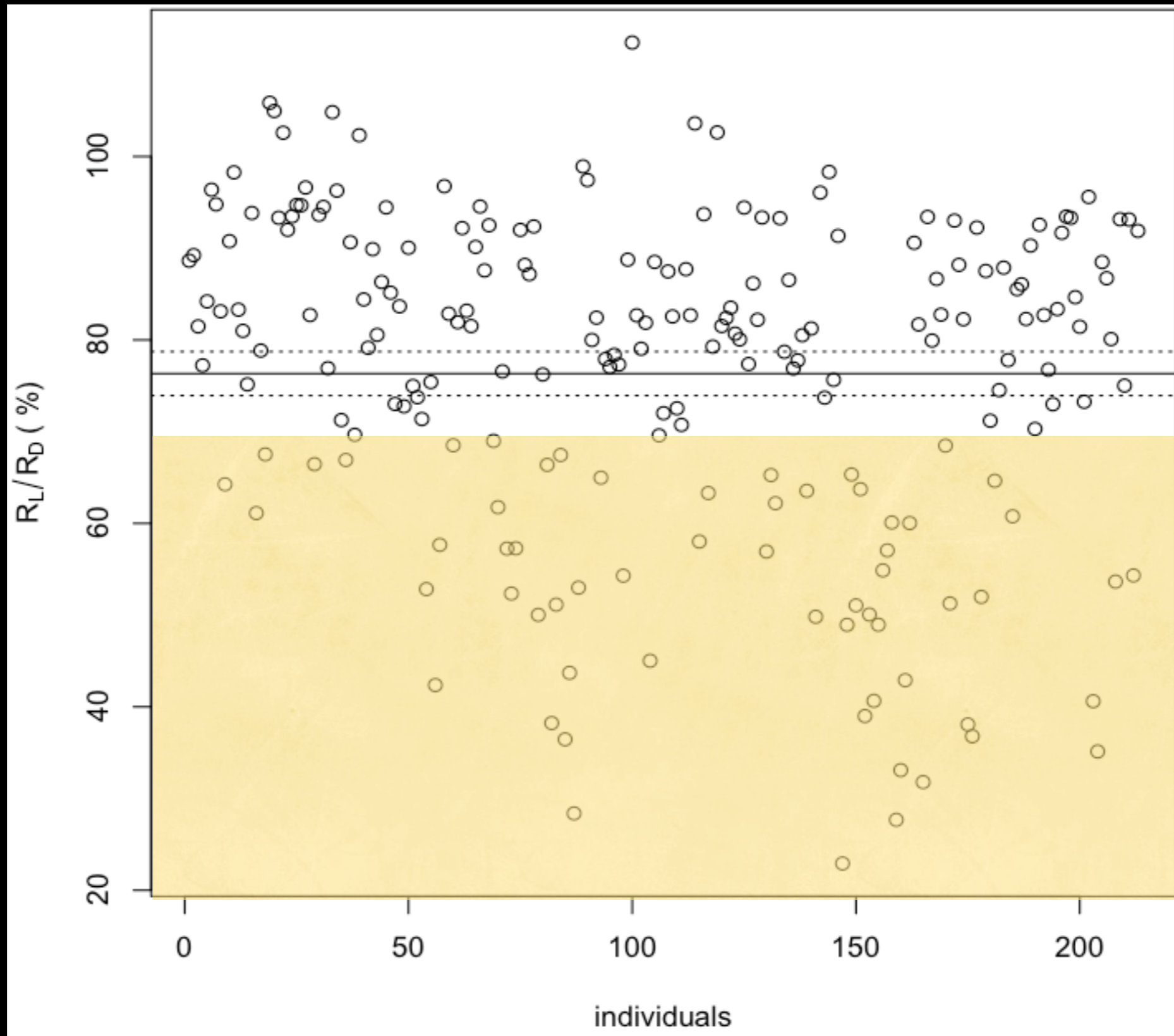
inhibition



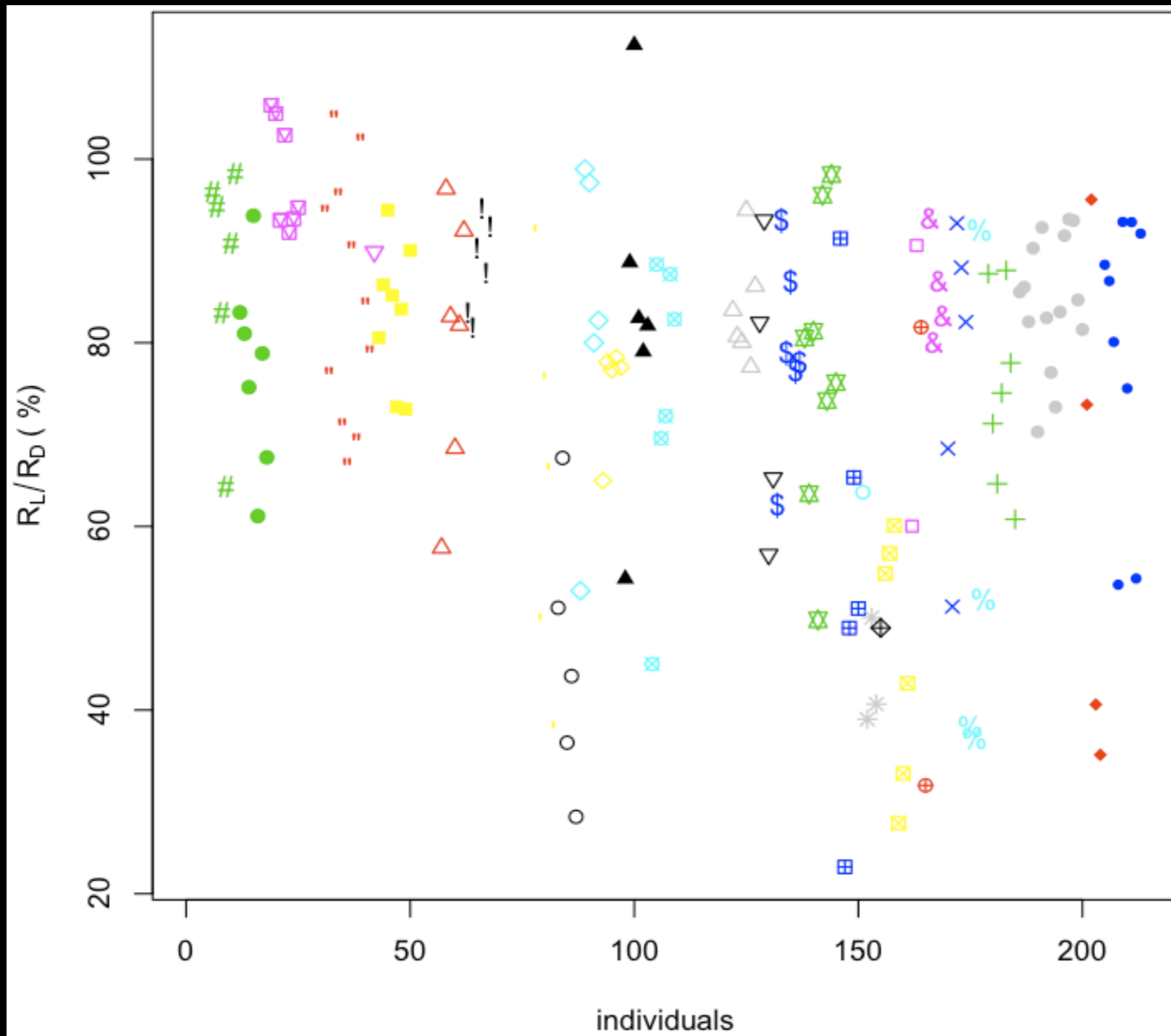
inhibition



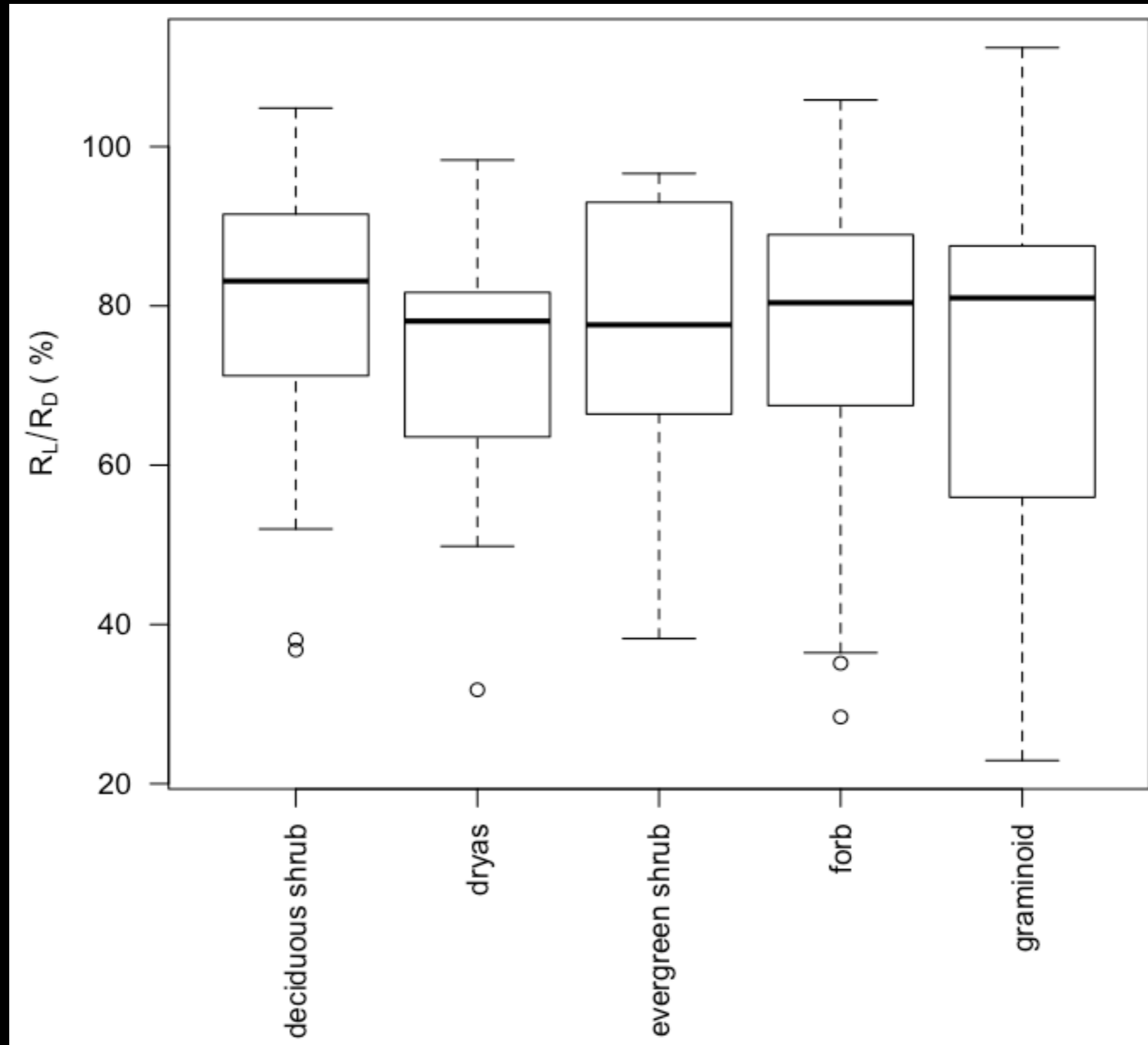
inhibition



inhibition by species



inhibition by functional group



functional traits

R_L/R_D

model	p	AIC	R ²
$A_{\max}/\text{sucrose}$	0.002	-8.73	0.26
$A_{\max}/\text{fructose}/\text{sucrose}$	0.004	-7.64	0.25
$A_{\max}/\text{fructose}/\text{glucose}/\text{SLA}/\text{sucrose}$	0.02	-4.62	0.23

functional traits

R_L

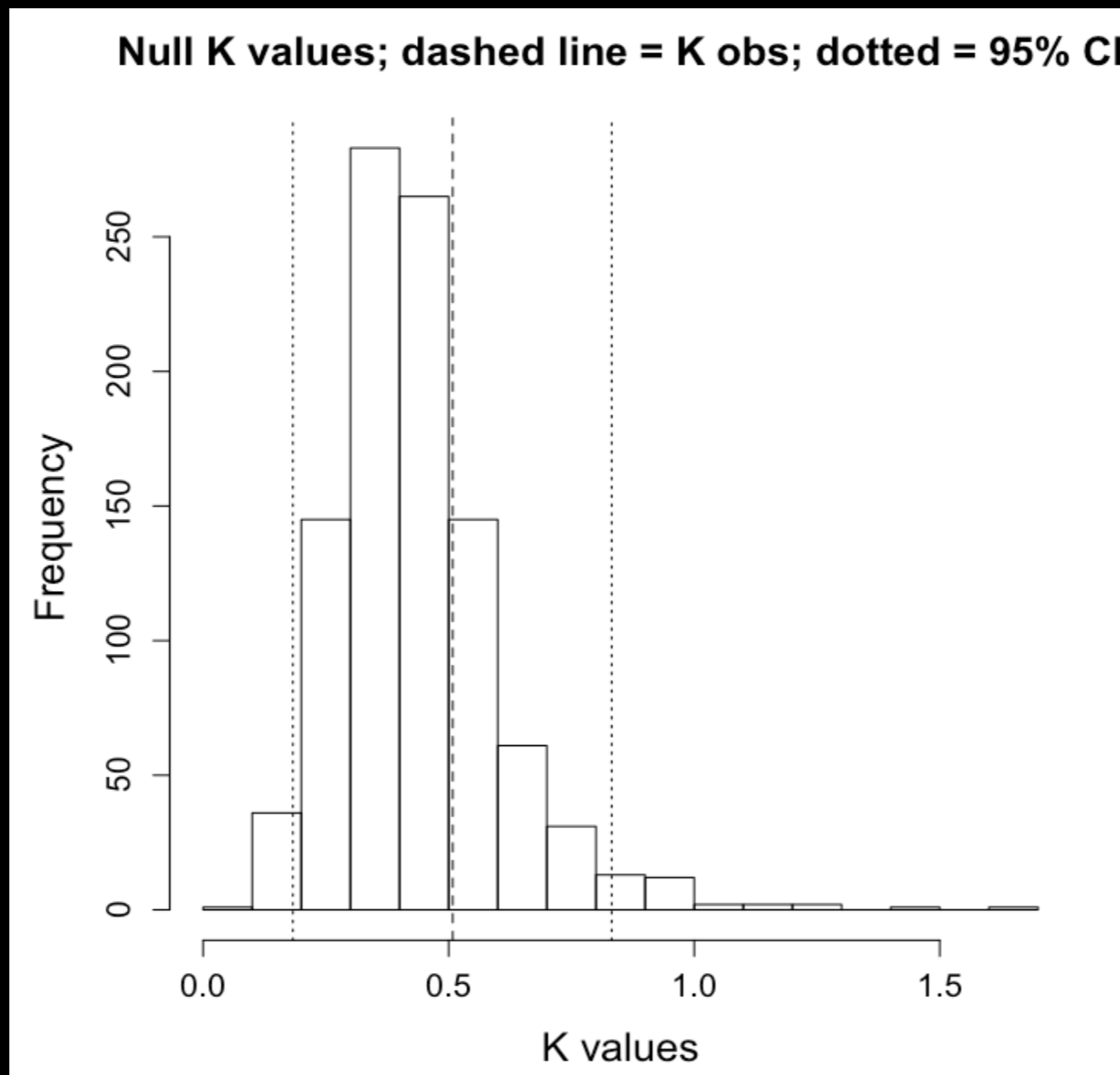
model	p	AIC	R ²
$A_{\max}/SLA/sucrose$	<0.001	-20.61	0.47
$A_{\max}/SLA/fructose/sucrose$	<0.001	-18.62	0.45
$A_{\max}/fructose/glucose/SLA/sucrose$	<0.001	-16.62	0.43

phylogenetic signal

- Blomberg's K
- measures phylogenetic signal in traits
- standardized, can be compared among traits, trees

phylogenetic signal

A_{\max}



phylogenetic signal

Trait	K_{obs}	K_{null}	Significant
TNC	0.34	0.43	no
Soluble	0.41	0.42	no
Glucose	0.53	0.42	no
Sucrose	0.52	0.43	no
Starch	0.31	0.42	no
SLA	0.76	0.43	no
A_{max}	0.51	0.43	no
R_L/R_D	0.97	0.44	yes
R_L	1.03	0.52	yes

conclusions

- arctic R_L is 76% of R_D
- inhibition does not depend on species or functional groups
- inhibition depends on sucrose, SLA, A_{max}
- inhibition shows strong phylogenetic signal

implications

- there is less carbon in the arctic than we think
- compositional shifts could alter carbon stocks over time
- functional groups are less informative than traits and evolutionary history

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