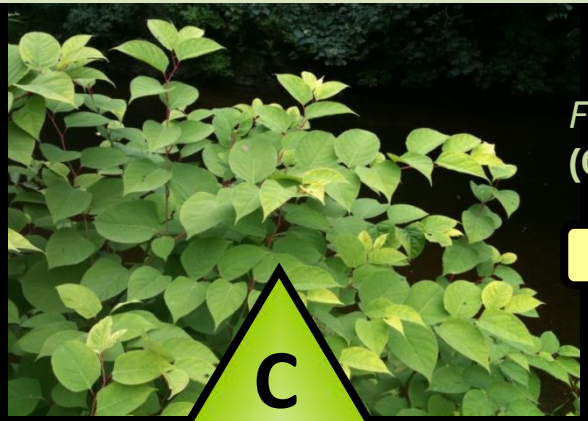
A global method for calculating plant CSR ecological strategies applied across biomes

Simon Pierce[1], Daniel Negreiros[2], Bruno E.L. Cerabolini[3], The TRY consortium[4]

[1]Department of Agricultural and Environmental Sciences (DiSAA), University of Milan, Italy
[2]Ecologia Evolutiva e Biodiversidade, Universidade Federal de Minas Gerais, Belo Horizonte, MG, Brazil
[3]Department of Theoretical and Applied Sciences, University of Insubria, Varese, Italy
[4] www.try-db.org

simon.pierce@unimi.it

CSR theory



Fallopia japonica
(Competitor)

Control of resource capture

C

Kalmia procumbens
(Stress-tolerator)

R

S

Arabidopsis thaliana
(Ruderal)

Regenerative ability (rapid life cycle, survival as seeds)

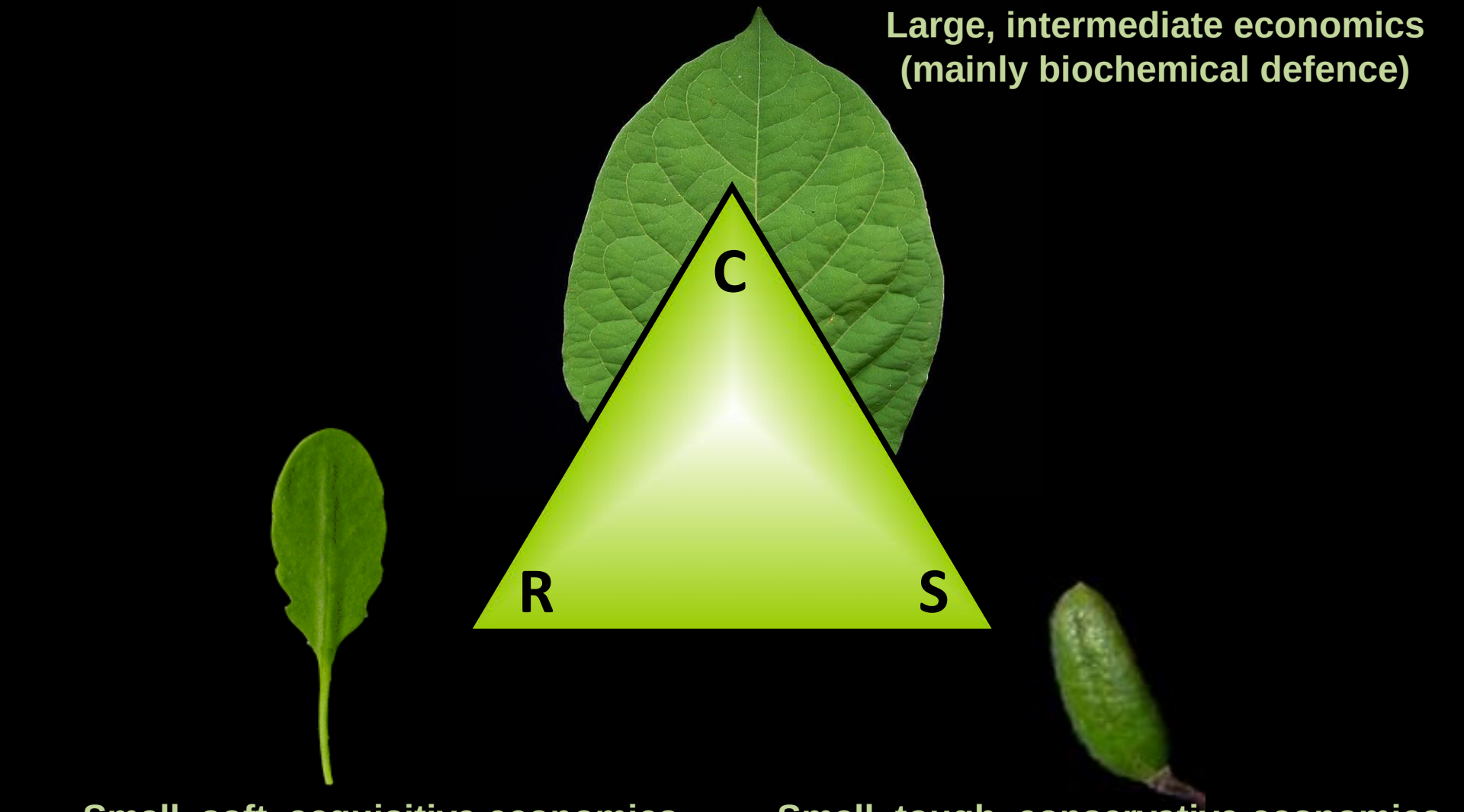
(disturbance = biomass destruction, affected tissues cannot recover)

Resistance of sub-optimal periods for metabolic function

(stress = sub-optimal function, affected tissues can recover)

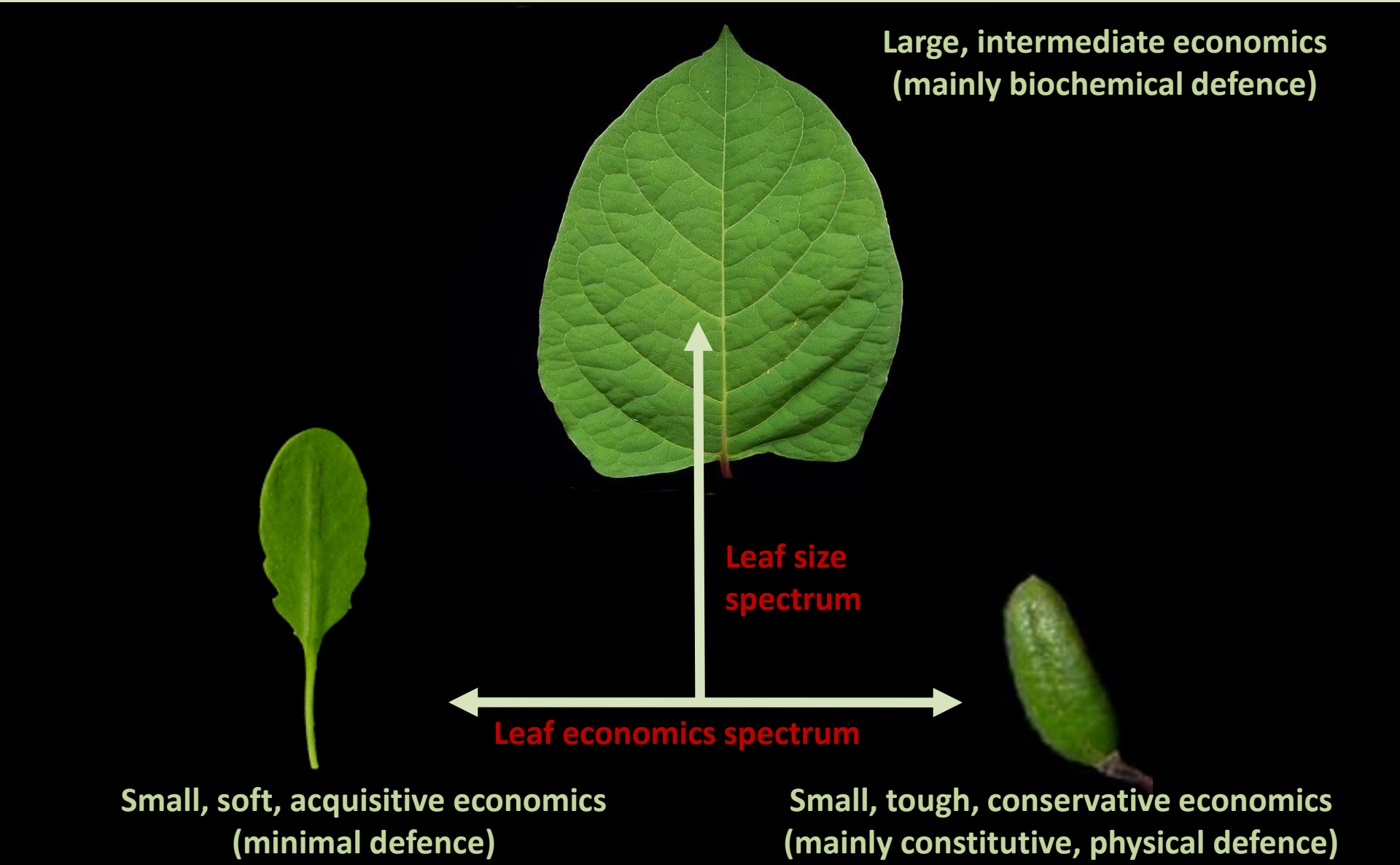
Grime JP. 2001. *Plant Strategies, Vegetation Processes and Ecosystem Properties*. Second Edition. Wiley, Chichester, UK.

The principal axes of leaf functional variability

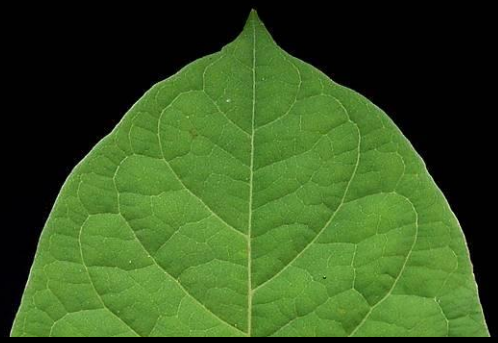


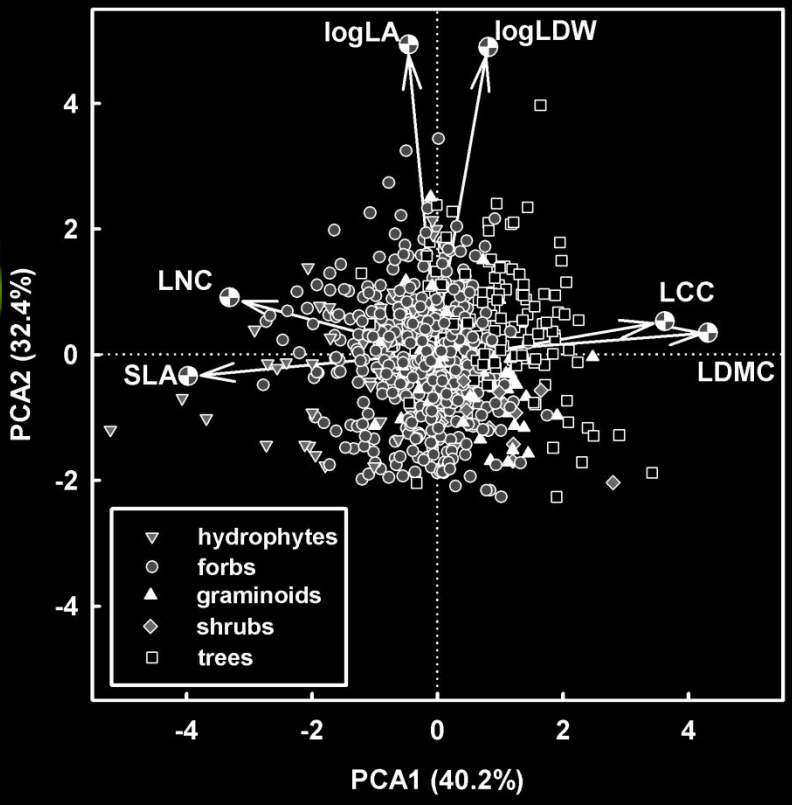
Grime JP. 2001. *Plant Strategies, Vegetation Processes and Ecosystem Properties*. Second Edition. Wiley, Chichester, UK.

The principal axes of leaf functional variability



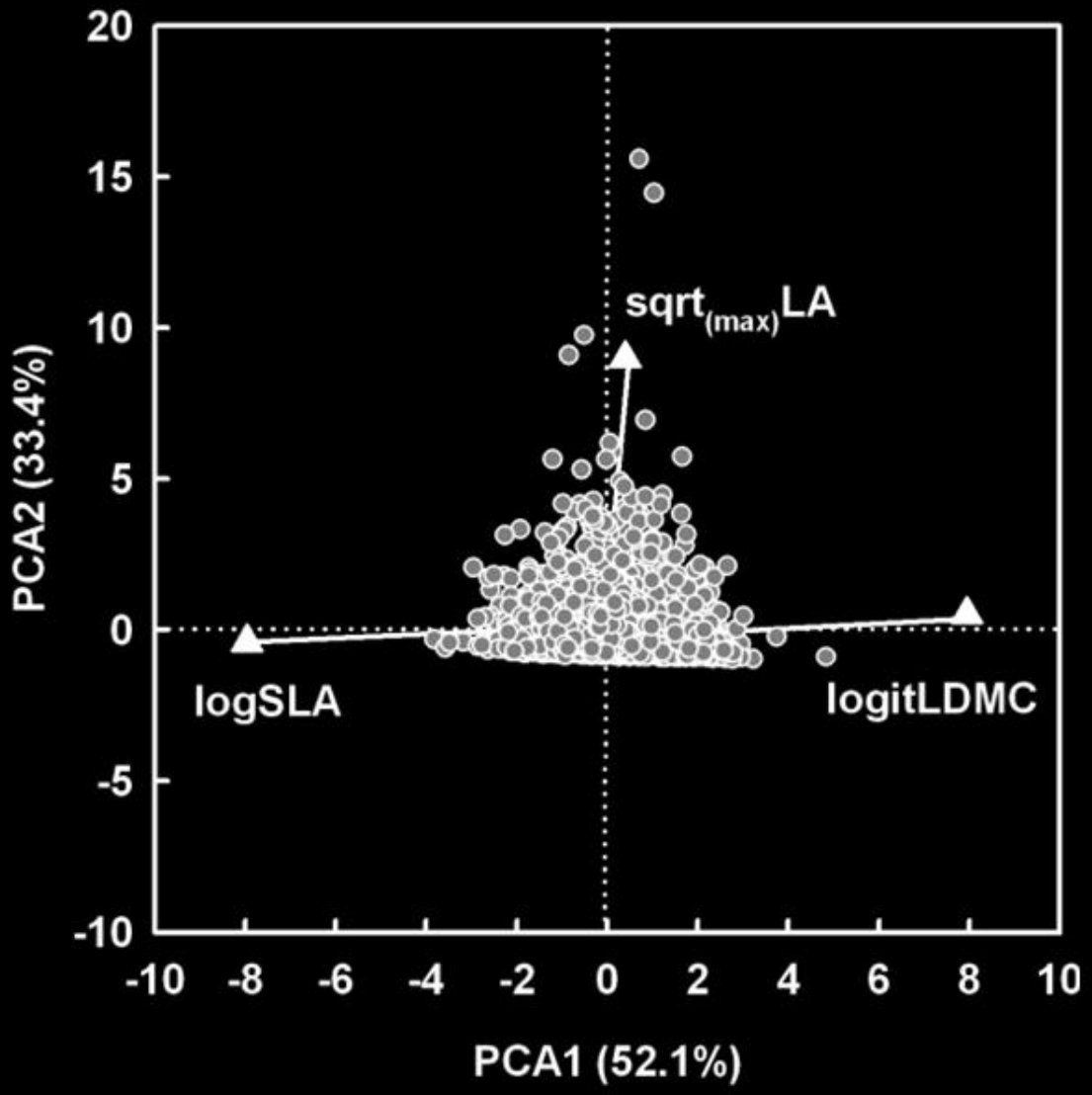
A new CSR classification method





Pierce S, Brusa G, Vagge I & Cerabolini B. 2013. *Functional Ecology* 27(4): 1002-1010

A global calibration using the TRY database



- 116979 plant functional trait records
- 3068 tracheophytes representing 198 families, six continents and 14 biomes
- number of replicate values for each trait of each species was typically between 10 to 15

Classifying target species

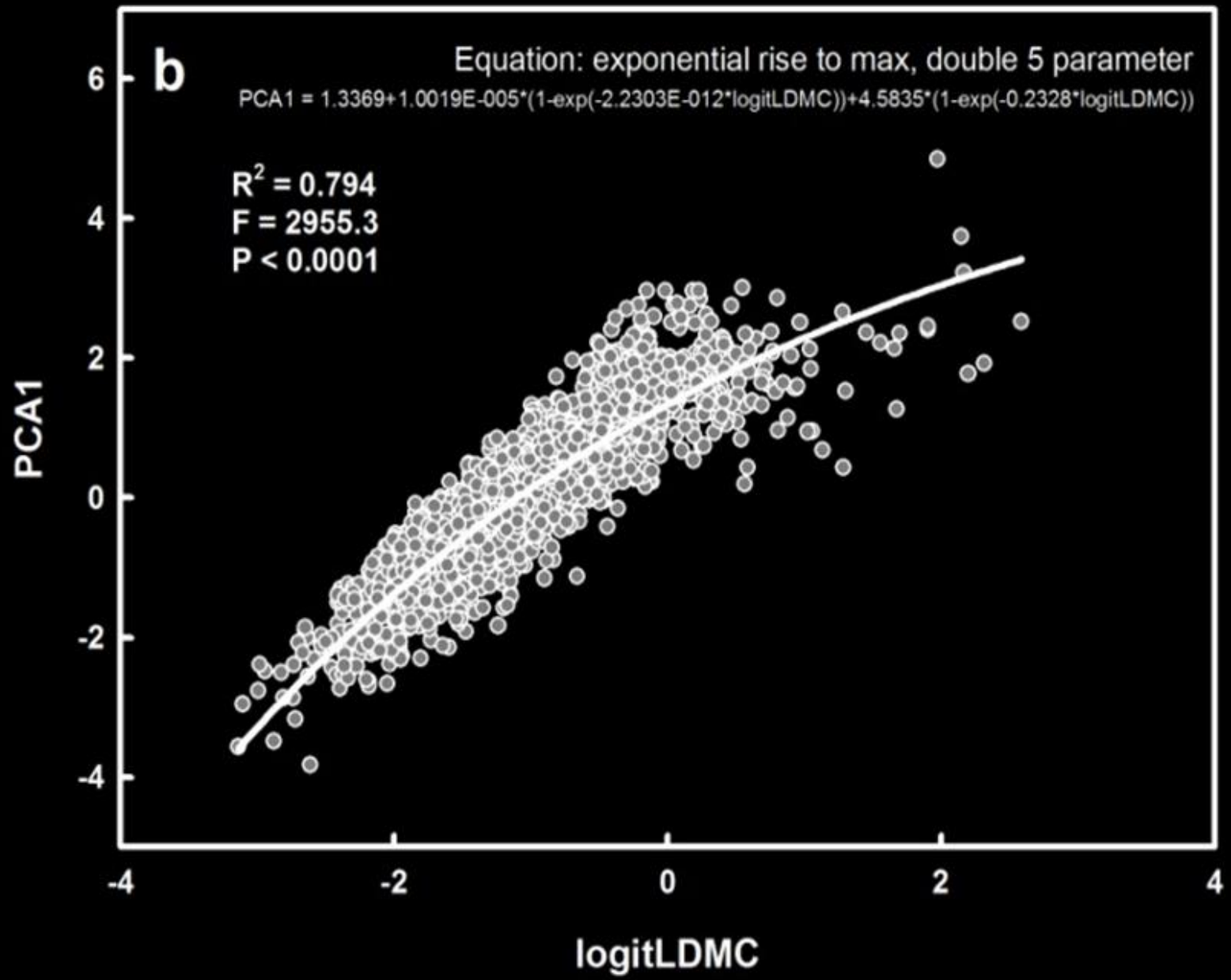


Table S2 StrateFy - Microsoft Excel

Home | Inserisci | Layout di pagina | Formule | Dati | Revisione | Visualizza | Componenti aggiuntivi

Incolla | Taglia | Copia | Copia formato | Appunti | Calibri | 10 | Carattere | Testo a capo | Unisci e centra | Allineamento | Generale | % | 000 | Numeri | Formattazione condizionale | Formatta come tabella | Stili cella | Stili | Inserisci | Elimina | Formato | Celle | Somma automatica | Riempimento | Cancella | Ordina e filtra | Trova e seleziona | Modifica

A3 | HOW TO StrateFy: Either measure leaf traits (LA, LFW and LDW) and input these into columns D - F, or cut and paste LA, LDMC and SLA data directly into columns J - L Paste or

StrateFy

/ ˈstrætefaɪ / *verb* (-ies, -ied) (esp. as **stratefied** *adjective*) to arrange in ecological strategies.

HOW TO StrateFy: Either measure leaf traits (LA, LFW and LDW) and input these into columns D - F, or cut and paste LA, LDMC and SLA data directly into columns J - L

Paste or input your species names and info in these columns (A, B, C)

data input

Paste or input your trait measurements here (D, E, F)

calculated traits

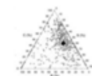
traits for CSR analysis

Cut and paste data directly into these columns if you prefer, but please note that if you do the automatic formulae referring to columns D - F will be overwritten

CSR analysis output

CSR ternary coordinates

CSR coordinates united into triplets: copy-and-paste values into documents



Tertiary CSR strategy classification

for plotting paste value

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
4	species binomial	family	notes	LA leaf area (mm^2) [single-sided leaf area with petiole]	LFW leaf fresh weight (mg) [saturated, turgid fresh weight]	LDW leaf dry weight (mg) [after oven drying to constant weight]	LSI leaf succulence index (g water dm^{-2})	LWC leaf water content (% of fresh weight)	LMA leaf mass per area (g m^{-2})	LA leaf area (mm^2)	LDMC leaf dry matter content (%)	SLA specific leaf area (mm^2 mg^{-1})	C (%)	S (%)	R (%)	C : S : R =	Strategy class	S (%)	C (%)
5	*Molopospermum peloponnesiacum (L.) W. D. J. Ko*	Apiaceae	Mean trait values:	369615.7	84009.6	21187.8	1.7	74.8	57.3	369615.7	25.2	17.4	83.6	9.9	6.5	84 : 10 : 7 %	C	9.9	83.6
6	*Kalmia procumbens (L.) Gift, Kron, & Stevens ex Ga*	Ericaceae	Mean trait values:	11.8	4.5	1.8	2.3	60.3	151.8	11.8	39.7	6.6	0.0	100.0	0.0	0 : 100 : 0 %	S	100.0	0.0
7	*Arabidopsis thaliana (L.) Heynh.*	Brassicaceae	Mean trait values:	55.7	12.3	1.6	1.9	86.7	29.4	55.7	13.3	34.1	4.3	0.0	95.7	4 : 0 : 96 %	R	0.0	4.3
8	*Pteridium aquilinum (L.) Kuhn aquilinum*	Dennstaedtiaceae	Replicate 1 values:	36061.2	6988.0	2480.0	1.3	64.5	68.8	36061.2	35.5	14.5	67.6	25.9	6.5	68 : 26 : 6 %	C/CS	25.9	67.6
9	*Pteridium aquilinum (L.) Kuhn aquilinum*	Dennstaedtiaceae	Replicate 2 values:	22391.8	8292.0	2756.0	2.5	66.8	123.1	22391.8	33.2	8.1	69.1	30.9	0.0	69 : 31 : 0 %	C/CS	30.9	69.1
10	*Pteridium aquilinum (L.) Kuhn aquilinum*	Dennstaedtiaceae	Replicate 3 values:	30068.1	6868.0	2476.0	1.5	63.9	82.3	30068.1	36.1	12.1	67.2	28.9	3.9	67 : 29 : 4 %	C/CS	28.9	67.2
11	*Pteridium aquilinum (L.) Kuhn aquilinum*	Dennstaedtiaceae	Replicate 4 values:	31059.5	9356.0	3292.0	2.0	64.8	106.0	31059.5	35.2	9.4	71.0	29.0	0.0	71 : 29 : 0 %	C/CS	29.0	71.0
12	*Pteridium aquilinum (L.) Kuhn aquilinum*	Dennstaedtiaceae	Calculation of mean:	29895.1	7876.0	2751.0	1.7	65.1	92.0	29895.1	34.9	10.9	69.3	28.7	2.0	69 : 29 : 2 %	C/CS	28.7	69.3
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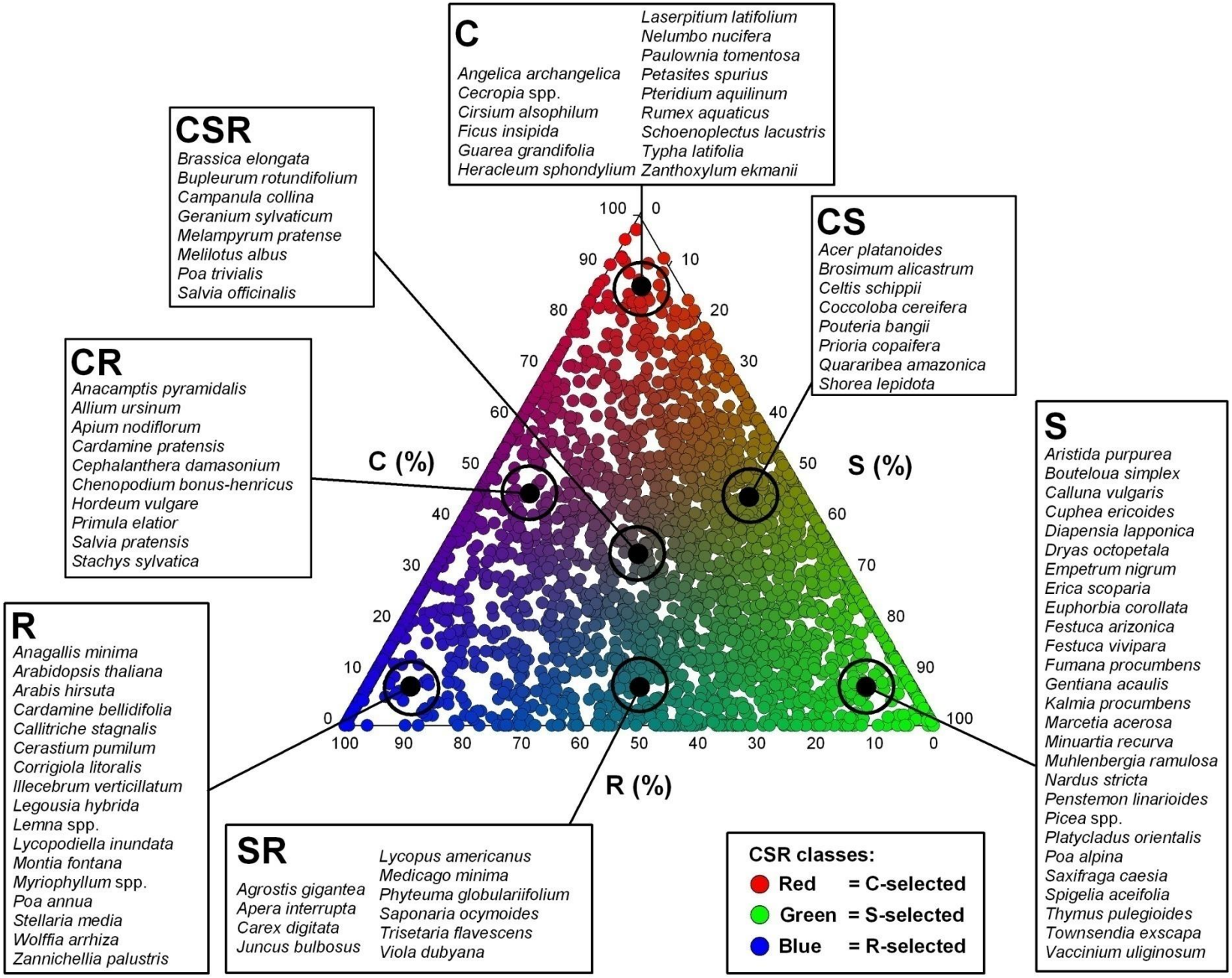
StrateFy (CSR GVP v1.0)

Pronto | 85%

Start | Alessio Brivio | Functional Ecology | MATERIALI E METODI (2... | Microsoft PowerPoint - [... | Microsoft Excel - Tabl... | 09:04


C
Laserpitium latifolium
Nelumbo nucifera
Paulownia tomentosa
Angelica archangelica
Petasites spurius
Cecropia spp.
Pteridium aquilinum
Cirsium alsophilum
Rumex aquaticus
Ficus insipida
Schoenoplectus lacustris
Guarea grandifolia
Typha latifolia
Heracleum sphondylium
Zanthoxylum ekmanii
CSR
Brassica elongata
Bupleurum rotundifolium
Campanula collina
Geranium sylvaticum
Melampyrum pratense
Melilotus albus
Poa trivialis
Salvia officinalis
CS
Acer platanoides
Brosimum alicastrum
Celtis schippii
Coccoloba cereifera
Pouteria bangii
Prioria copaifera
Quararibea amazonica
Shorea lepidota
CR
Anacamptis pyramidalis
Allium ursinum
Apium nodiflorum
Cardamine pratensis
Cephalanthera damasonium
Chenopodium bonus-henricus
Hordeum vulgare
Primula elatior
Salvia pratensis
Stachys sylvatica
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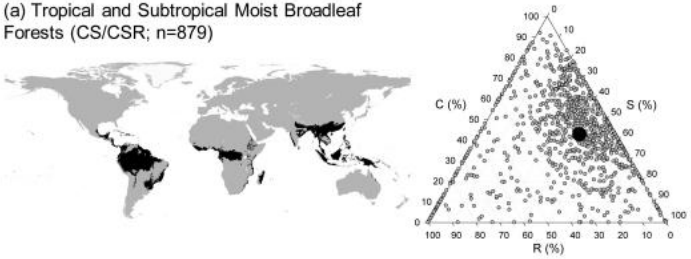
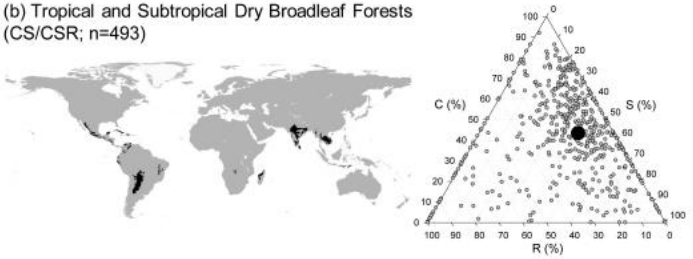
Aristida purpurea
Bouteloua simplex
Calluna vulgaris
Cuphea ericoides
Diapensia lapponica
Dryas octopetala
Empetrum nigrum
Erica scoparia
Euphorbia corollata
Festuca arizonica
Festuca vivipara
Fumana procumbens
Gentiana acaulis
Kalmia procumbens
Marcetia acerosa
Minuartia recurva
Muhlenbergia ramulosa
Nardus stricta
Penstemon linarioides
Picea spp.
Platycladus orientalis
Poa alpina
Saxifraga caesia
Spigelia aceifolia
Thymus pulegioides
Townsendia exscapa
Vaccinium uliginosum
R
Anagallis minima
Arabidopsis thaliana
Arabis hirsuta
Cardamine bellidifolia
Callitriche stagnalis
Cerastium pumilum
Corrigiola litoralis
Illecebrum verticillatum
Legousia hybrida
Lemna spp.
Lycopodiella inundata
Montia fontana
Myriophyllum spp.
Poa annua
Stellaria media
Wolffia arrhiza
Zannichellia palustris
SR
Agrostis gigantea
Apera interrupta
Carex digitata
Juncus bulbosus
Lycopus americanus
Medicago minima
Phyteuma globulariifolium
Saponaria ocymoides
Trisetaria flavescens
Viola dubyana
CSR classes:
Red = C-selected
Green = S-selected
Blue = R-selected
C (%)
S (%)
R (%)
100
90
80
70
60
50
40
30
20
10
0

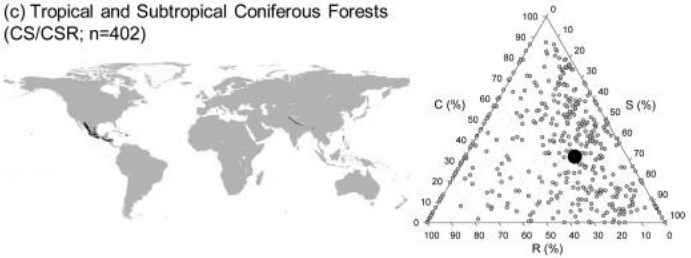
(a) Tropical and Subtropical Moist Broadleaf Forests (CS/CSR; n=879)



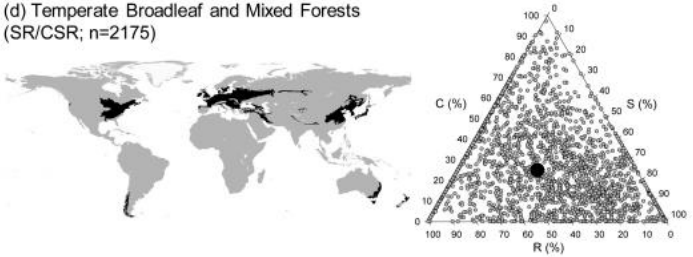
(b) Tropical and Subtropical Dry Broadleaf Forests (CS/CSR; n=493)



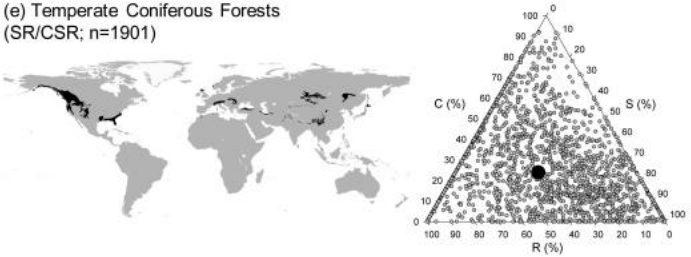
(c) Tropical and Subtropical Coniferous Forests (CS/CSR; n=402)



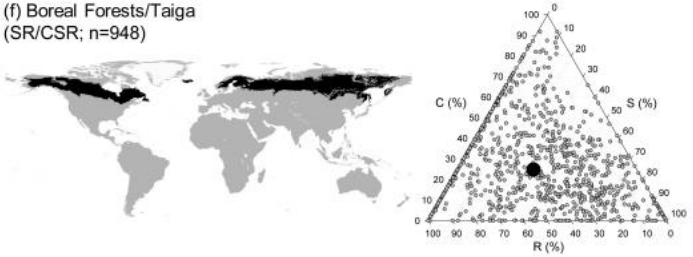
(d) Temperate Broadleaf and Mixed Forests (SR/CSR; n=2175)



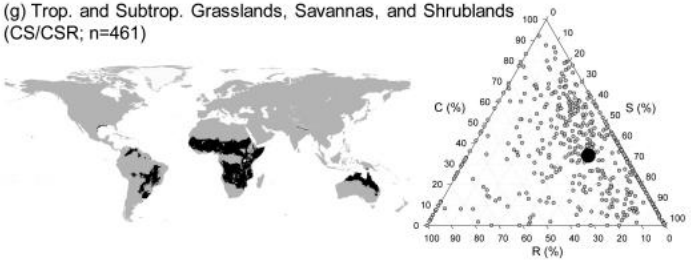
(e) Temperate Coniferous Forests (SR/CSR; n=1901)



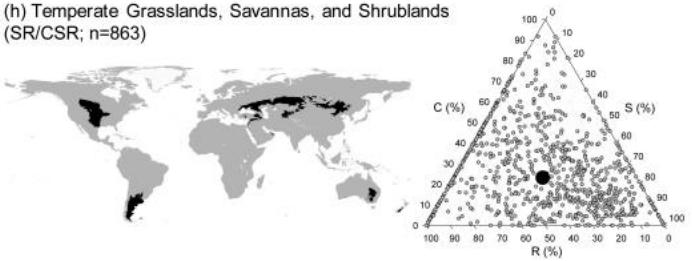
(f) Boreal Forests/Taiga (SR/CSR; n=948)



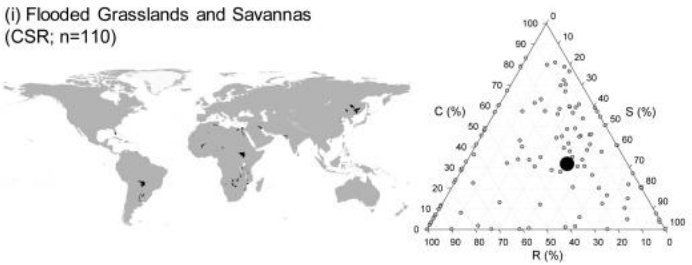
(g) Trop. and Subtrop. Grasslands, Savannas, and Shrublands (CS/CSR; n=461)



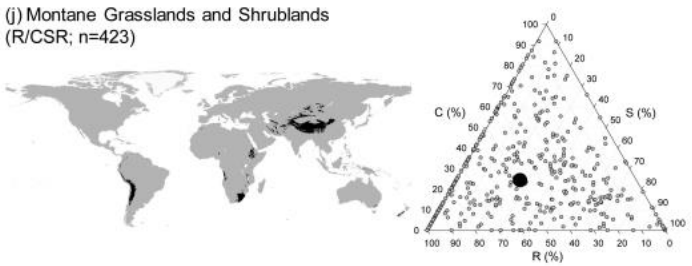
(h) Temperate Grasslands, Savannas, and Shrublands (SR/CSR; n=863)



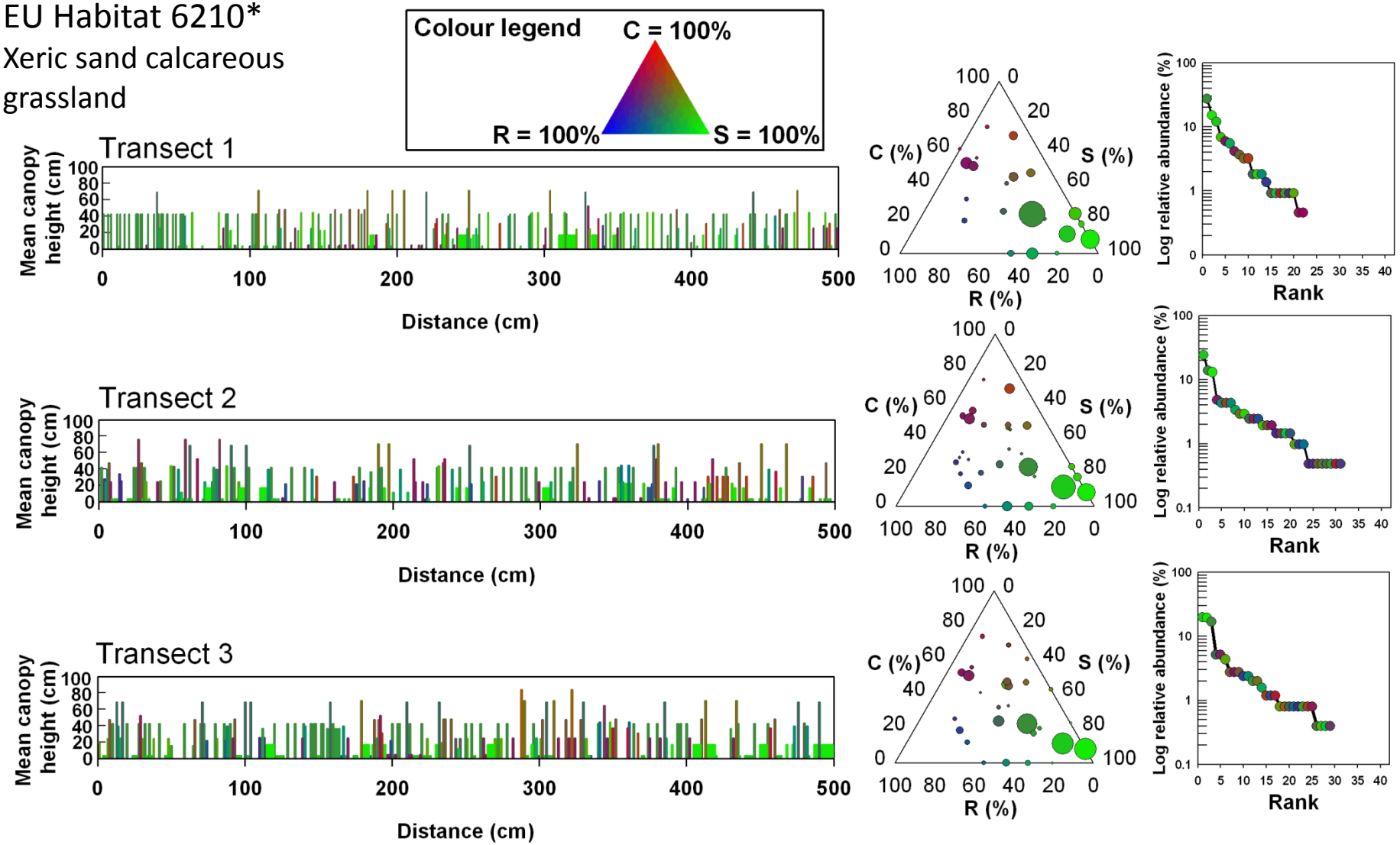
(i) Flooded Grasslands and Savannas (CSR; n=110)



(j) Montane Grasslands and Shrublands (R/CSR; n=423)



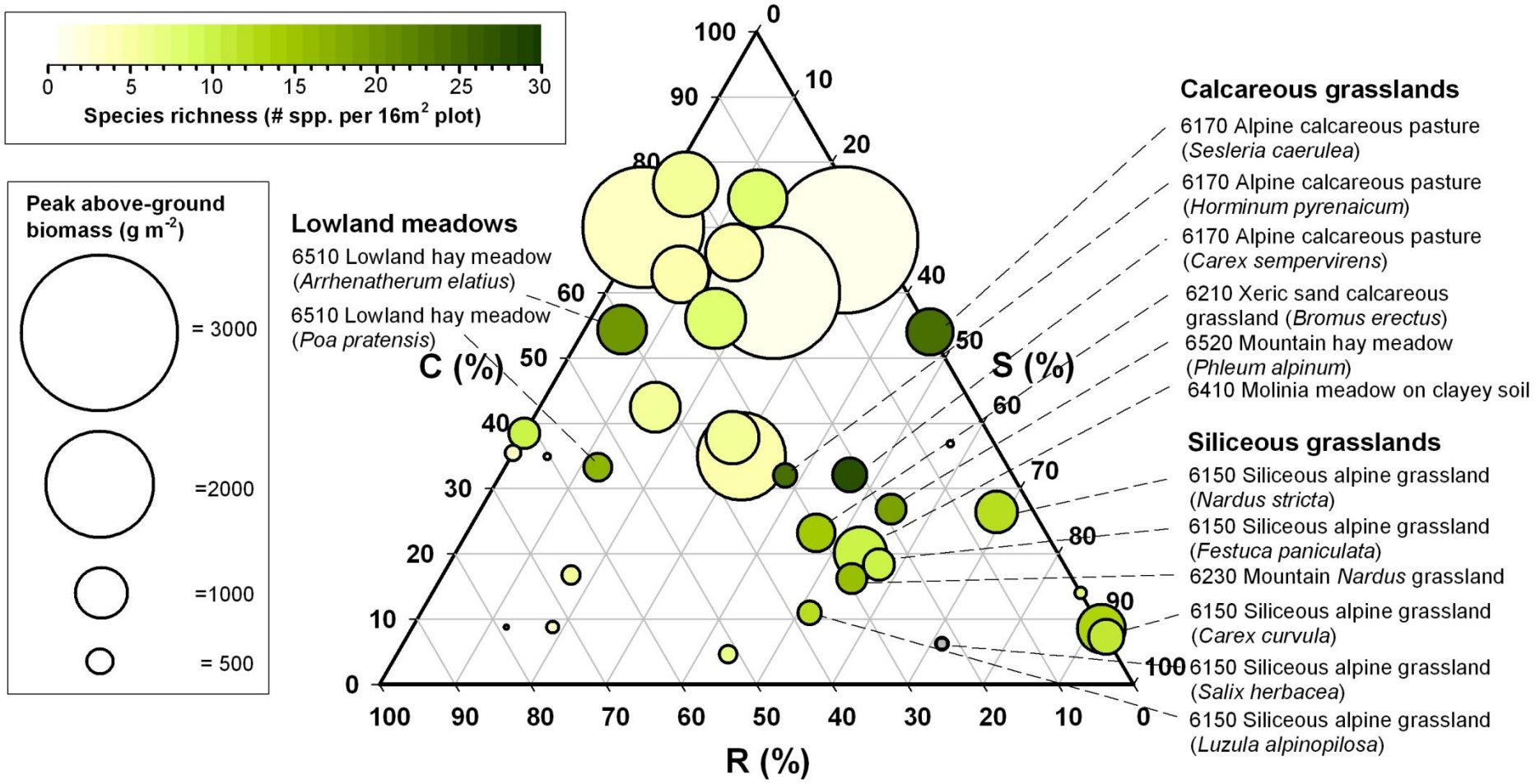
EU Habitat 6210*
Xeric sand calcareous grassland



Pierce S, Vagge I, Brusa G & Cerabolini B. 2014. *Plant Ecology* 215: 495-505

Does greater species richness correspond with particular CSR strategies?

Community weighted mean CSR strategies



Cerabolini *et al.* 2015. *Plant Biosystems* (in press)

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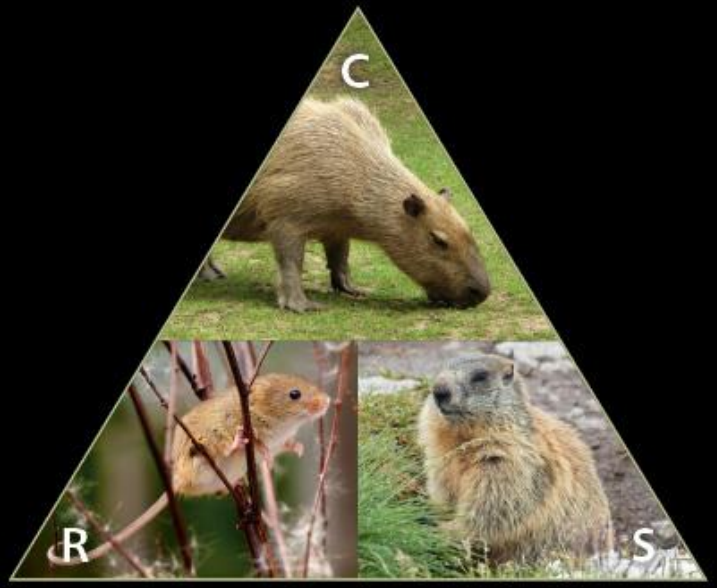
[4] www.try-db.org

simon.pierce@unimi.it



THE EVOLUTIONARY STRATEGIES THAT SHAPE ECOSYSTEMS

J. Philip Grime and Simon Pierce

WILEY-BLACKWELL