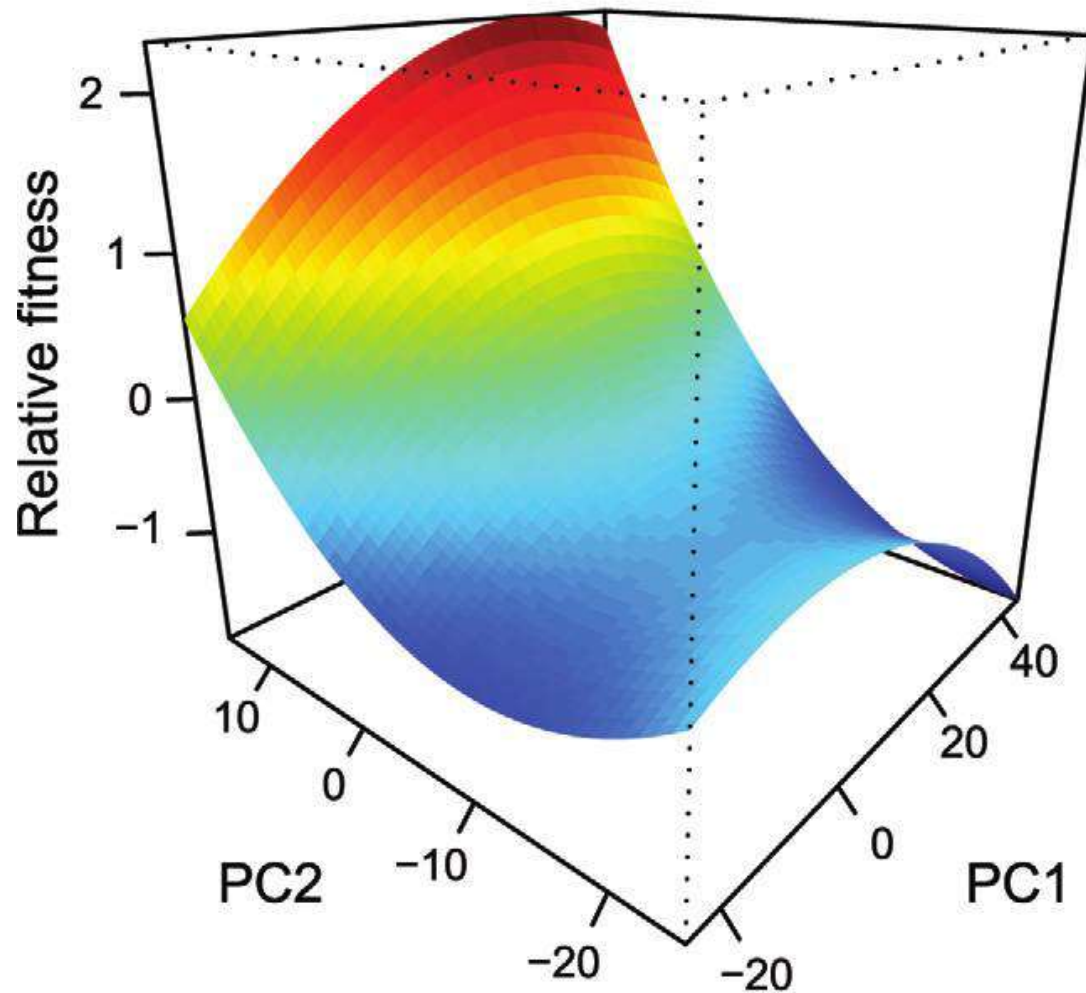


R graphics examples



Plot of fitness (z axis) for two principal component traits (PC1 and PC2)



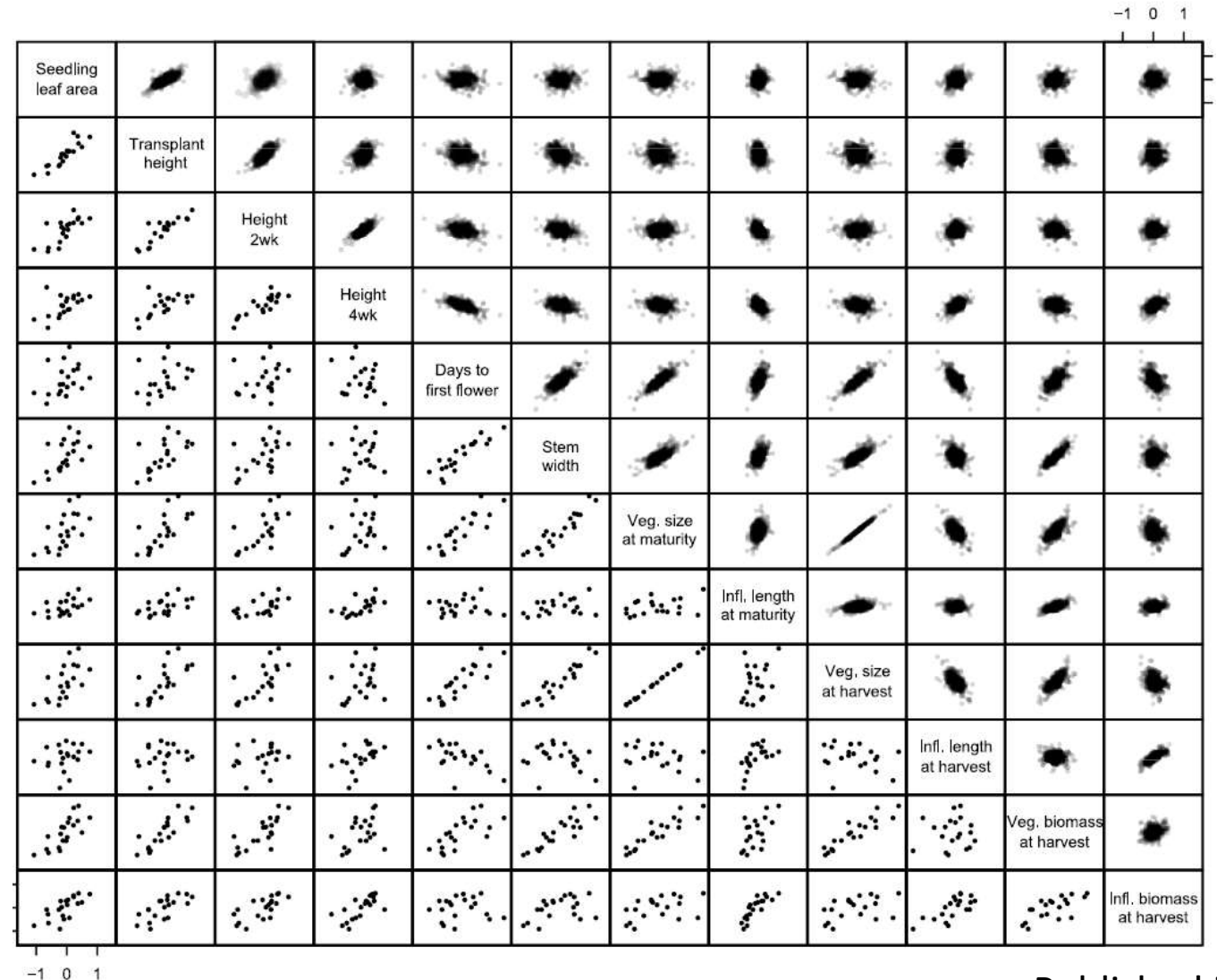
persp() function (base R)

Published in
[IJPS \(2010\)](#)

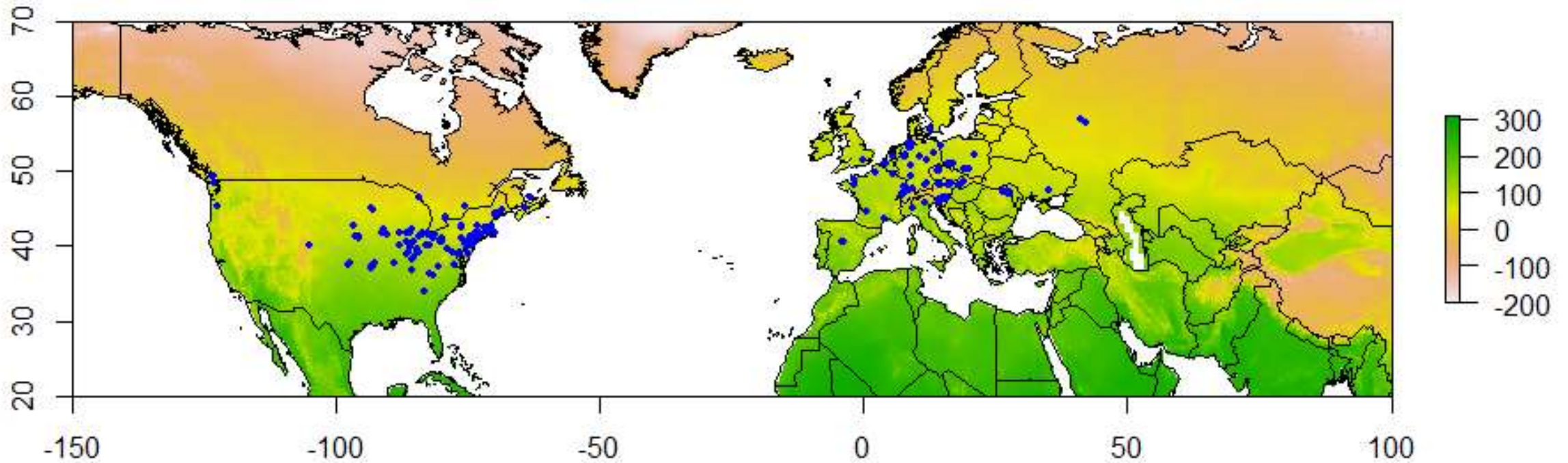
Multiple plots

Pairwise regressions

lattice package

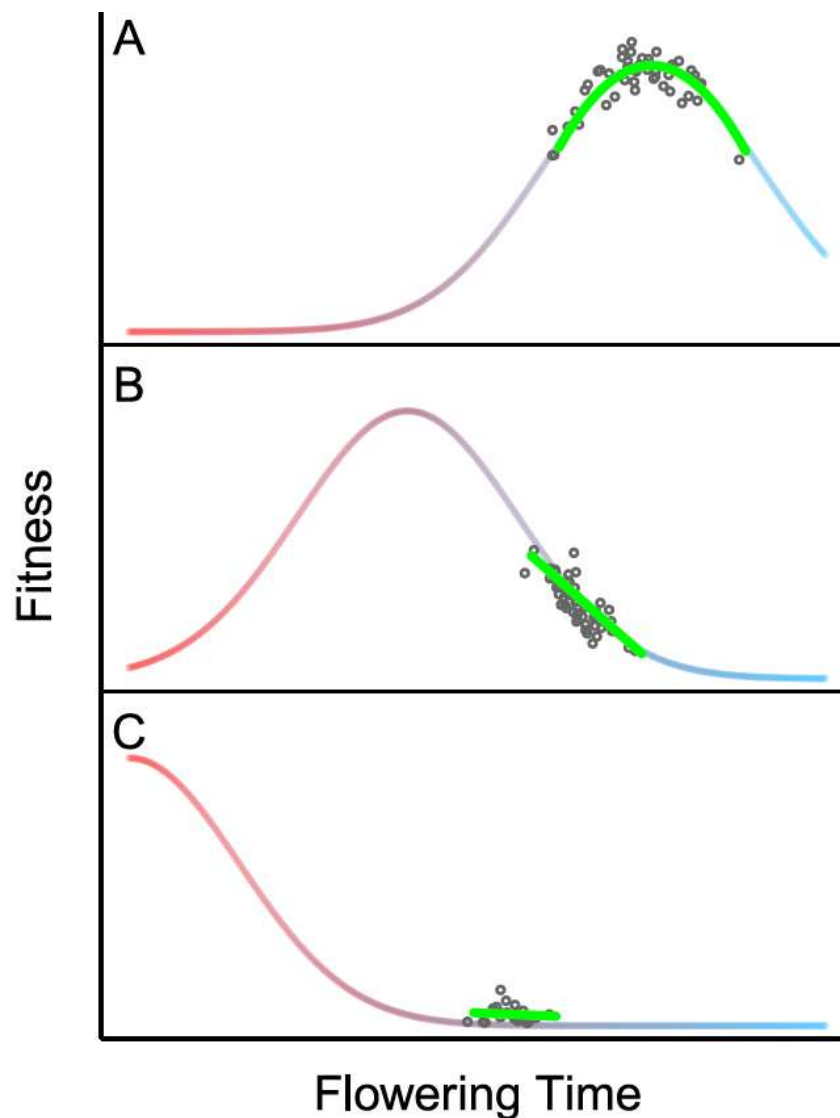


World climate data (white, orange green) and sample sites (blue dots)
from garlicmustard.org



dismo, raster, rgdal, maptools, leap packages

Multi-panel simulation model

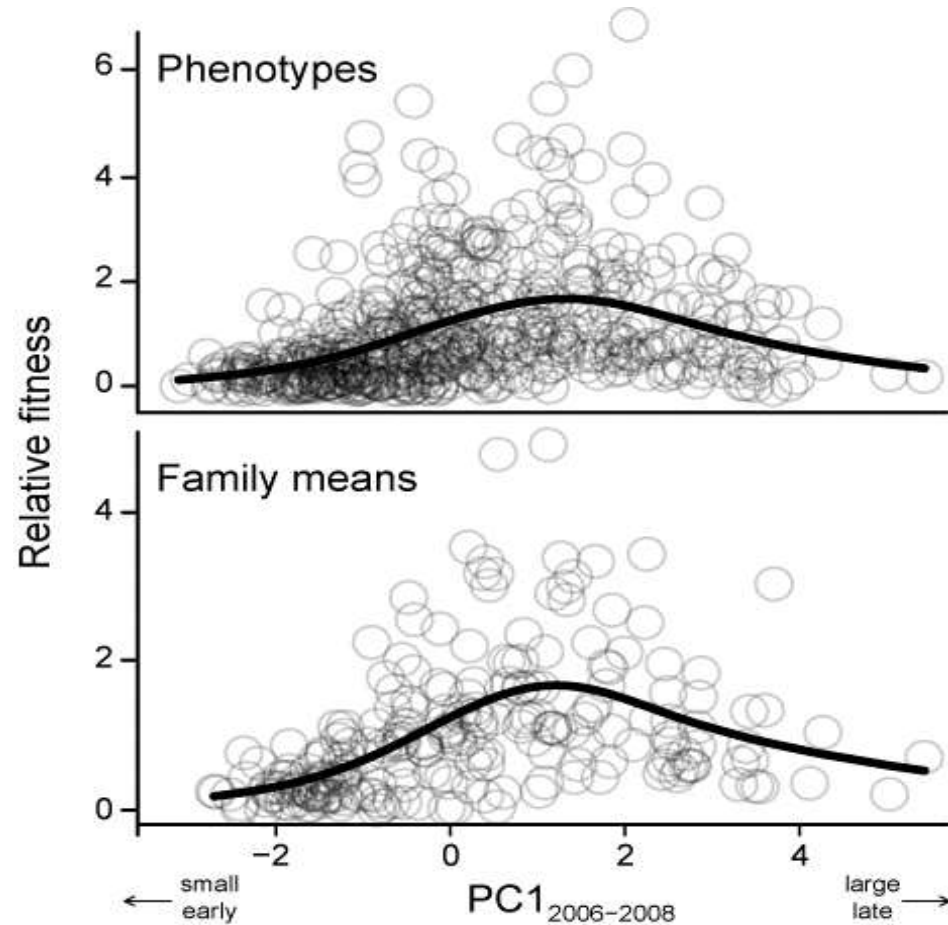


Fitness surfaces (smooth curves) with simulated genotypes (dots) and Lande-Arnold selection gradients (green curve)

ggplot2 package

Published in
[PRSB \(2010\)](#)

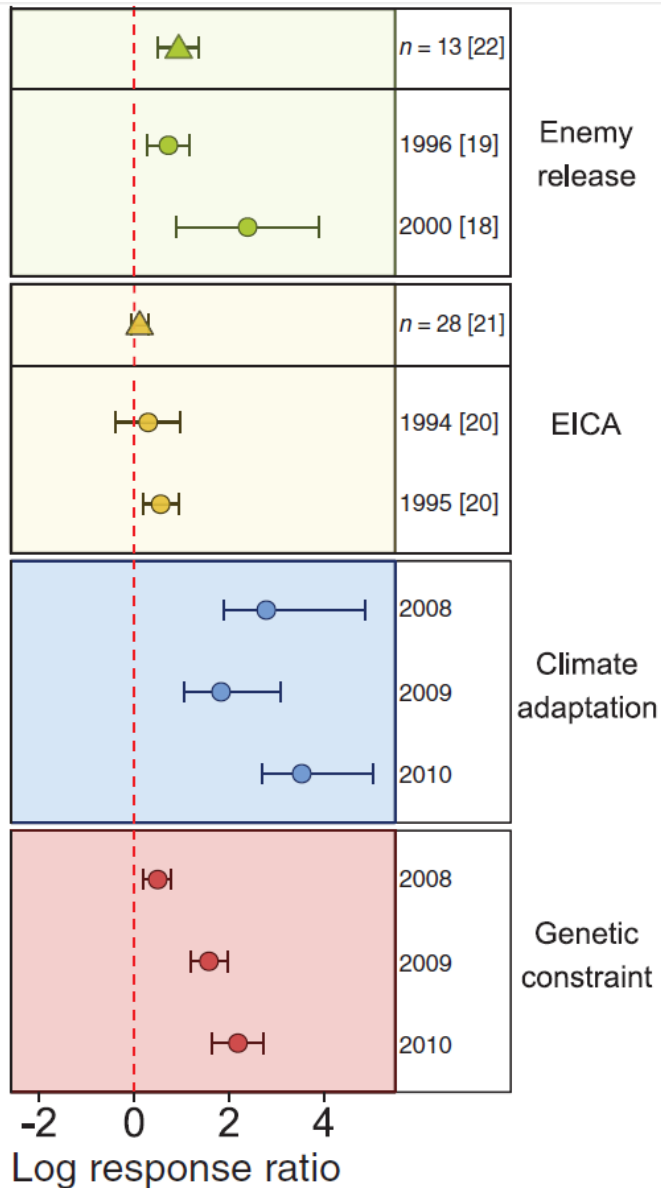
Standard bivariate plot with `gam()` fit



ggplot2 package

Published in
[IJPS \(2010\)](#)

Multi-panel plots of means + 95% C.I.



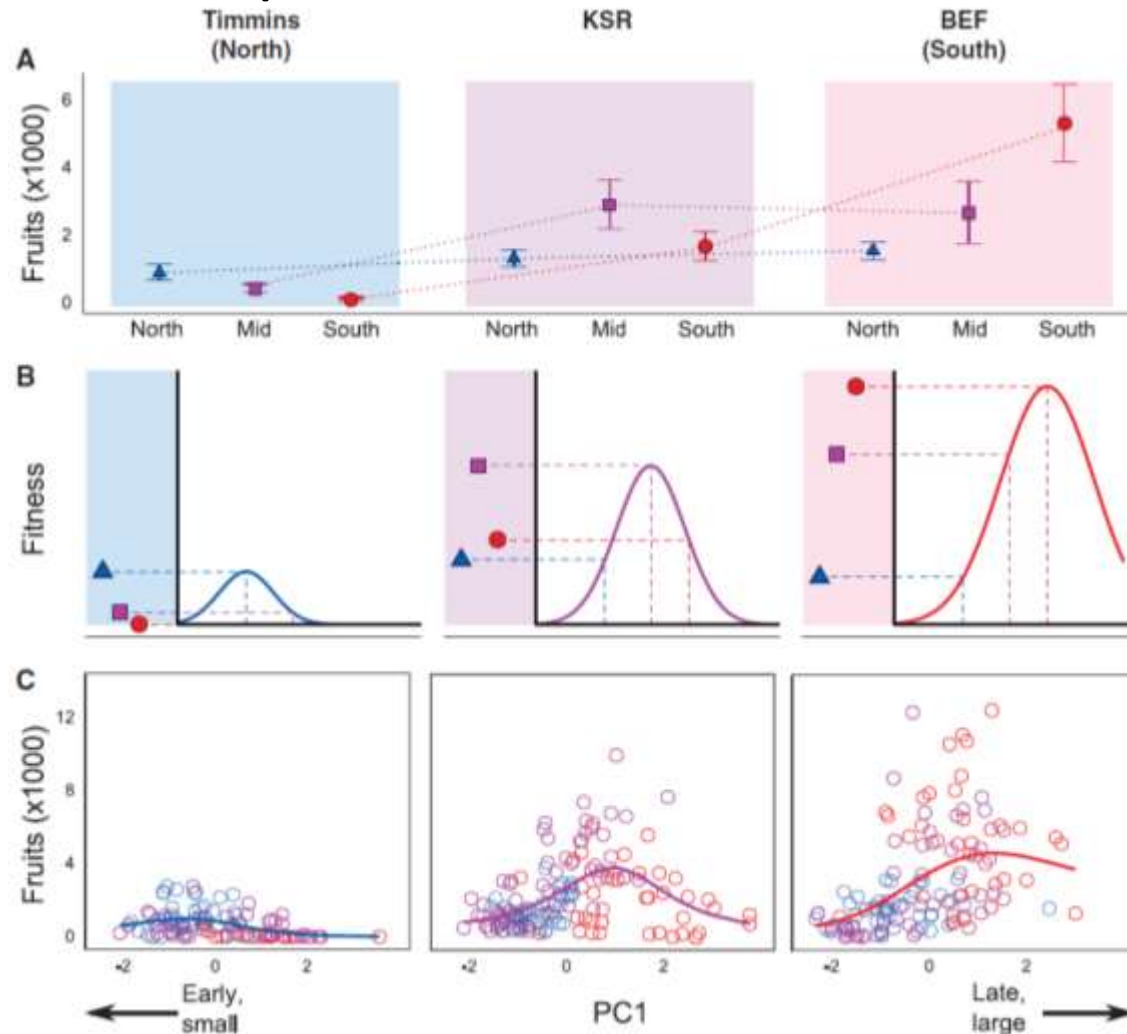
Standardized effect sizes testing different hypotheses for individual species (circles) or meta-analyses of many species (triangles). Lines show 95% C.I.

ggplot2 package

Published in
[Science \(2013\)](#)

Menagerie of graphics in R

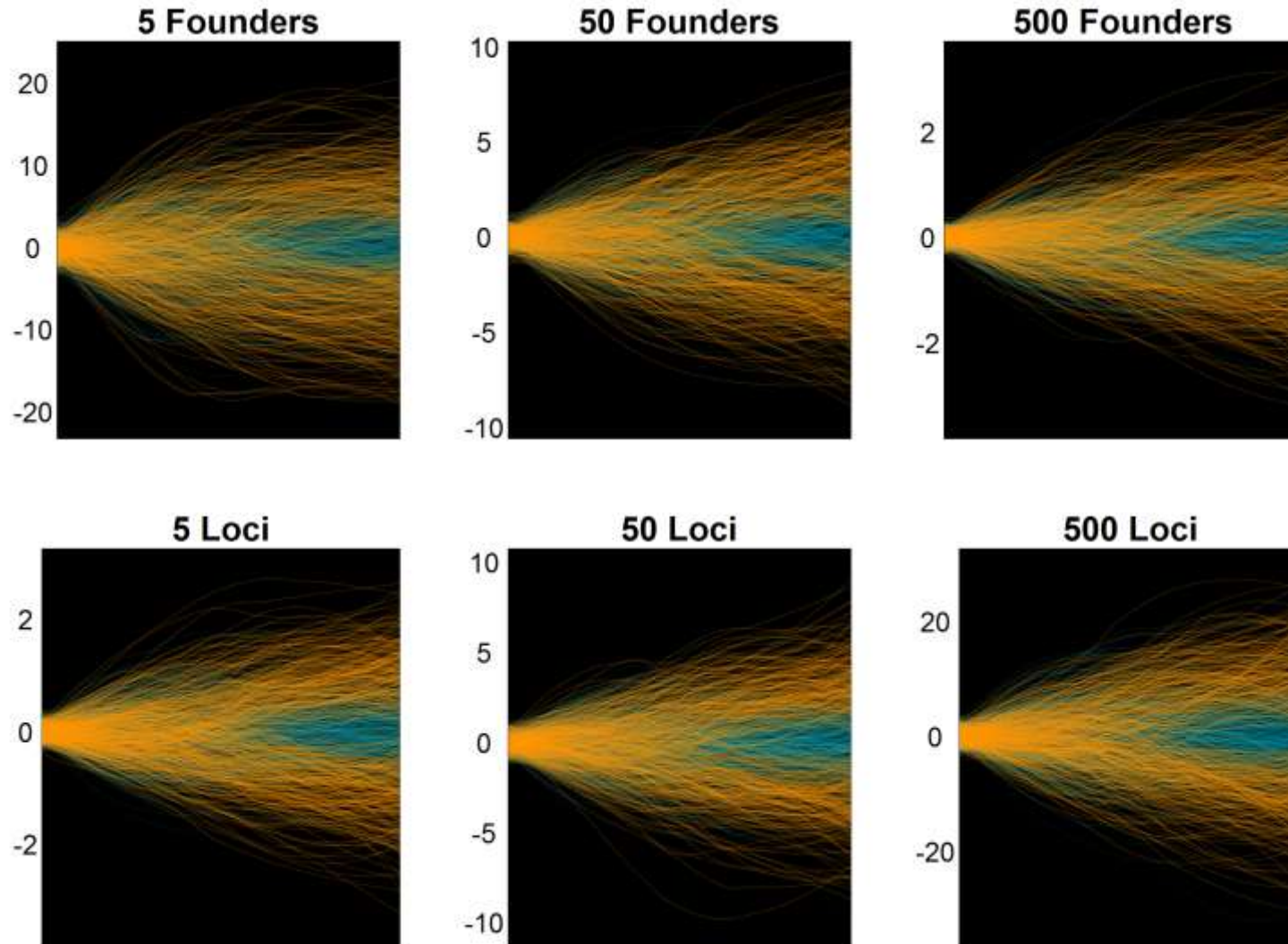
Potpourri of graphs: (A) test of local adaptation; (B) fitness model; (C) selection splines



ggplot2 package

Published in
[Science \(2013\)](#)

Stepwise colonization simulation model



ggplot2 package

Published in
[Invasion Genetics Book \(2016\)](#)

<http://www.davidmccandless.com/>

<http://coolours.co/>

<https://color.adobe.com/>

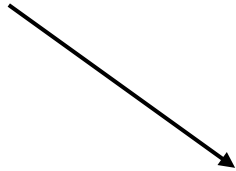
<http://idl.cs.washington.edu/>

R Graphics Concepts



Vector vs. Raster Formats

Vector



Formats:

SVG

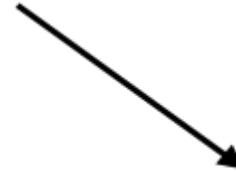
PDF

EPS

AI

PS

Raster



Formats:

JPEG

PNG

TIFF

BMP

Vector vs. Raster Formats

Vector

Formats:

SVG

PDF

EPS

AI

PS

Raster

Formats:

JPEG

PNG

TIFF

BMP

Easy, no loss of information



Vector

Raster



Hard – which pixels to keep?

Pixel Dimension = Physical size x Resolution

Large size, low resolution



Small size, high resolution

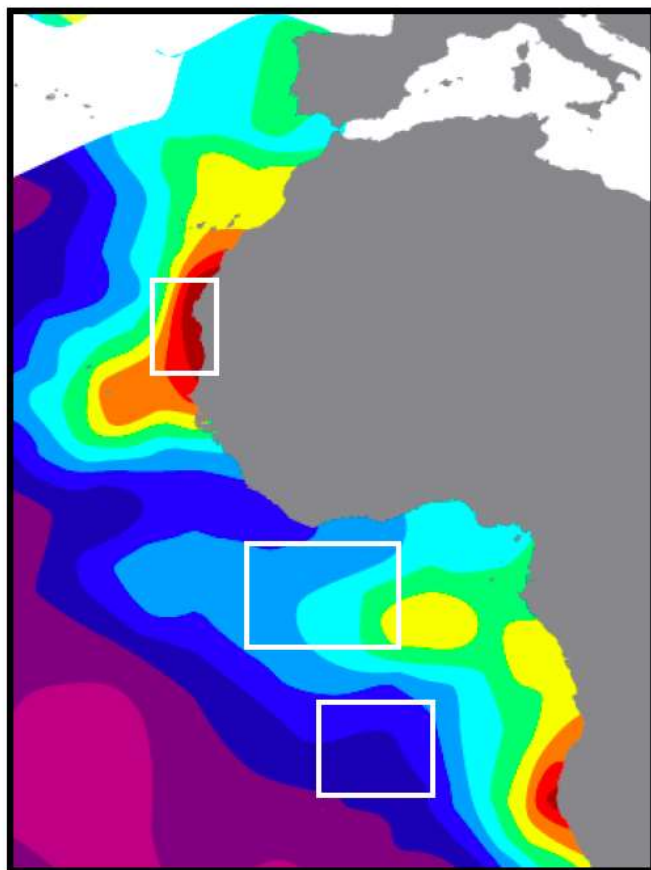


Same pixel dimension

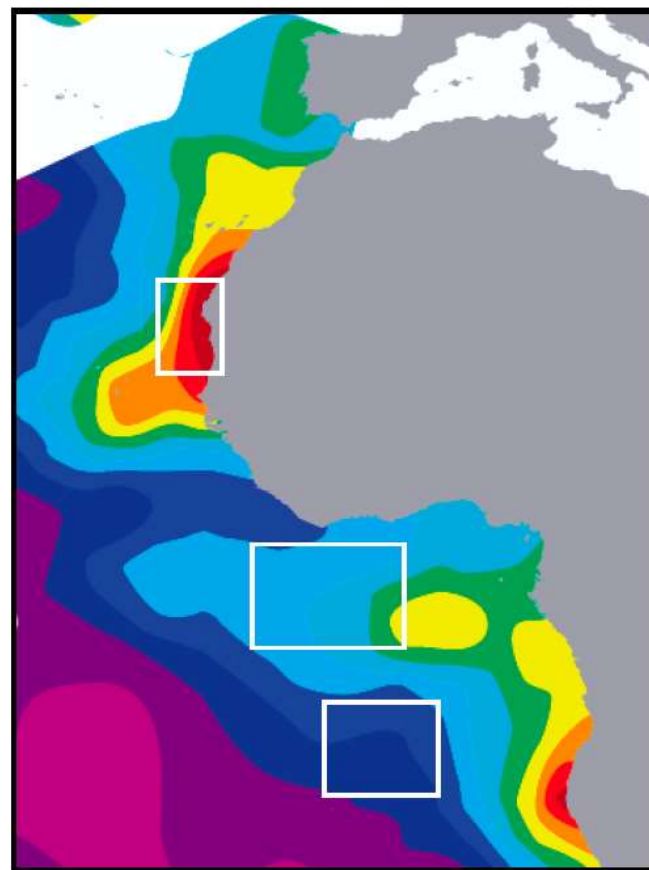
RGB (screen) vs CMYK (print)

Screen

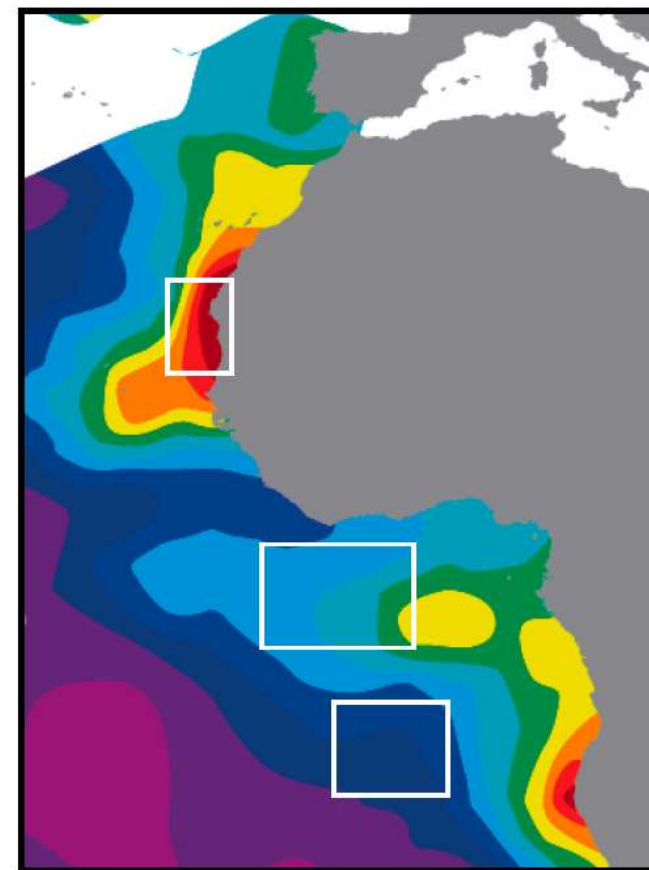
Print



RGB



CMYK
Coated paper



CMYK
Uncoated paper

DON'T USE POWERPOINT FOR PUBLICATION

Paid software:

- Adobe Photoshop (pixels)
- Adobe Illustrator (vectors)

FREE Software:

- GIMP (pixels) <http://www.gimp.org/>
- Inkscape (vectors) <https://inkscape.org/en/>

Bioconductor: bioinformatics tools in R

<http://www.bioconductor.org/packages/release/bioc/html/EBImage.html>

EBImage – R-based image processing

<http://www.bioconductor.org/packages/release/bioc/html/EBImage.html>

Quick EBImage intro tutorial:

<http://www.bioconductor.org/packages/release/bioc/vignettes/EBImage/inst/doc/EBImage-introduction.pdf>

Full documentation:

<http://www.bioconductor.org/packages/release/bioc/manuals/EBImage/man/EBImage.pdf>

ggplot

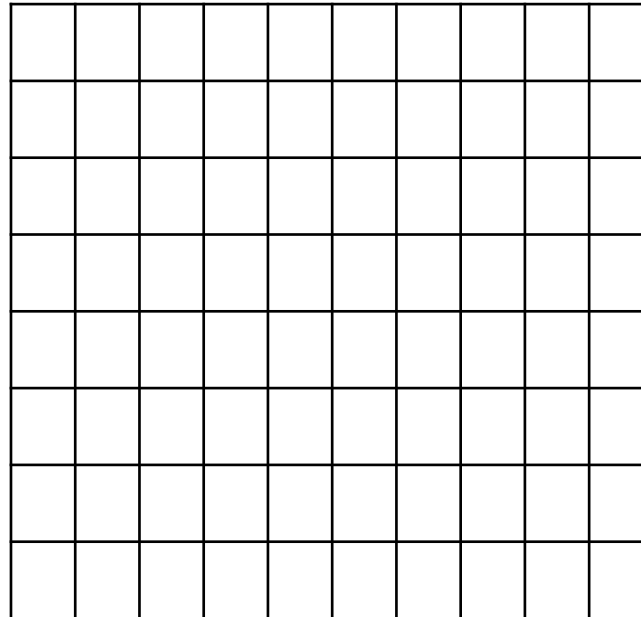
And the grammar of graphics

Grammar of graphics

data

	A	B	C	D	E	F	G
1	PotNum	Scenario	Nutrients	Taxon	Symphytum	Silene	Urtica
2	1	low	low	japon	9.81	36.36	16.0
3	2	low	low	japon	8.64	29.65	5.9
4	3	low	low	japon	2.65	36.03	17.0
5	5	low	low	japon	1.44	21.43	12.3
6	6	low	low	japon	9.15	23.9	5.1
7	7	low	low	japon	6.31	24.4	
8	8	low	low	japon	19.53	29.93	
9	9	low	low	japon	6.08	18.25	8.4
10	10	low	low	japon	5.69	35.23	4.8
11	11	low	low	japon	15.58	20.81	2.8
12	12	low	low	japon	11.38	28.67	9.7
13	14	low	low	japon	2.92	27.11	6.2
14	16	low	low	bohem	12.99	18.02	9.9
15	17	low	low	bohem	4.9	29.52	1.3
16	18	low	low	bohem	3.51	27.61	8.1
17	19	low	low	bohem	7.49	32.14	5
18	20	low	low	bohem	11.16	25.58	1
19	22	low	low	bohem	0.76	22.66	9.8
20	23	low	low	bohem	7.53	33.14	9.4
21	24	low	low	bohem	5.74	28.12	14.6

coord



geom

(e.g. point, histogram, boxplot)

x =

y =

colour =

size =

...

data

- any information you want to plot

geoms

- geometric objects (lines, points, polygons)

coord

- coordinate system of the graph (e.g. Cartesian, polar, lat/long)

stats

- statistical transformations applied to the data (e.g. binning for histograms)

scale

- scales of conversion from data to visual space (e.g. legend, range and scale of axes)

facet

- break up data into separate graphs

aes

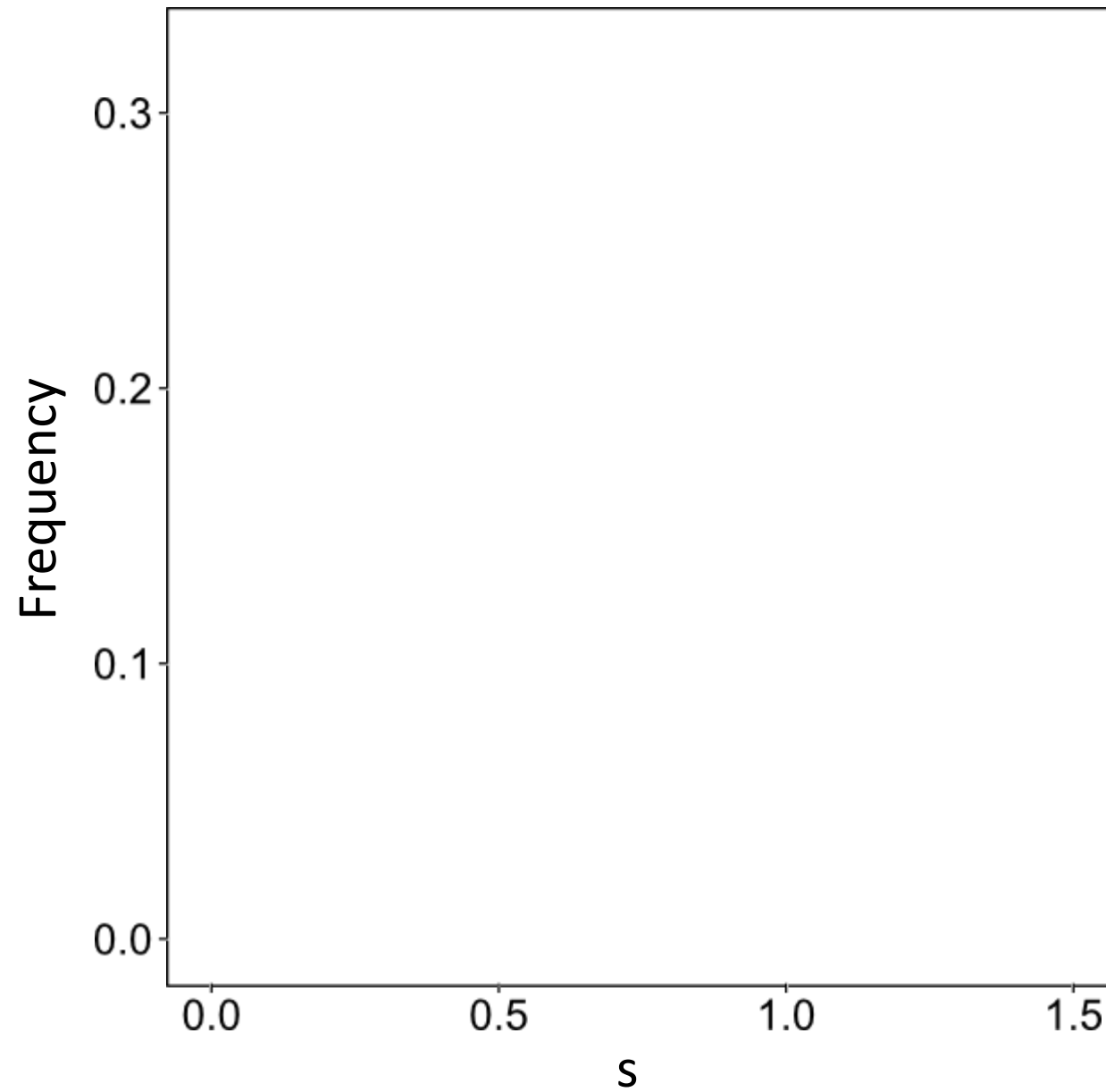
- aesthetic mapping describes how data is mapped (e.g. x, y, colour)

theme

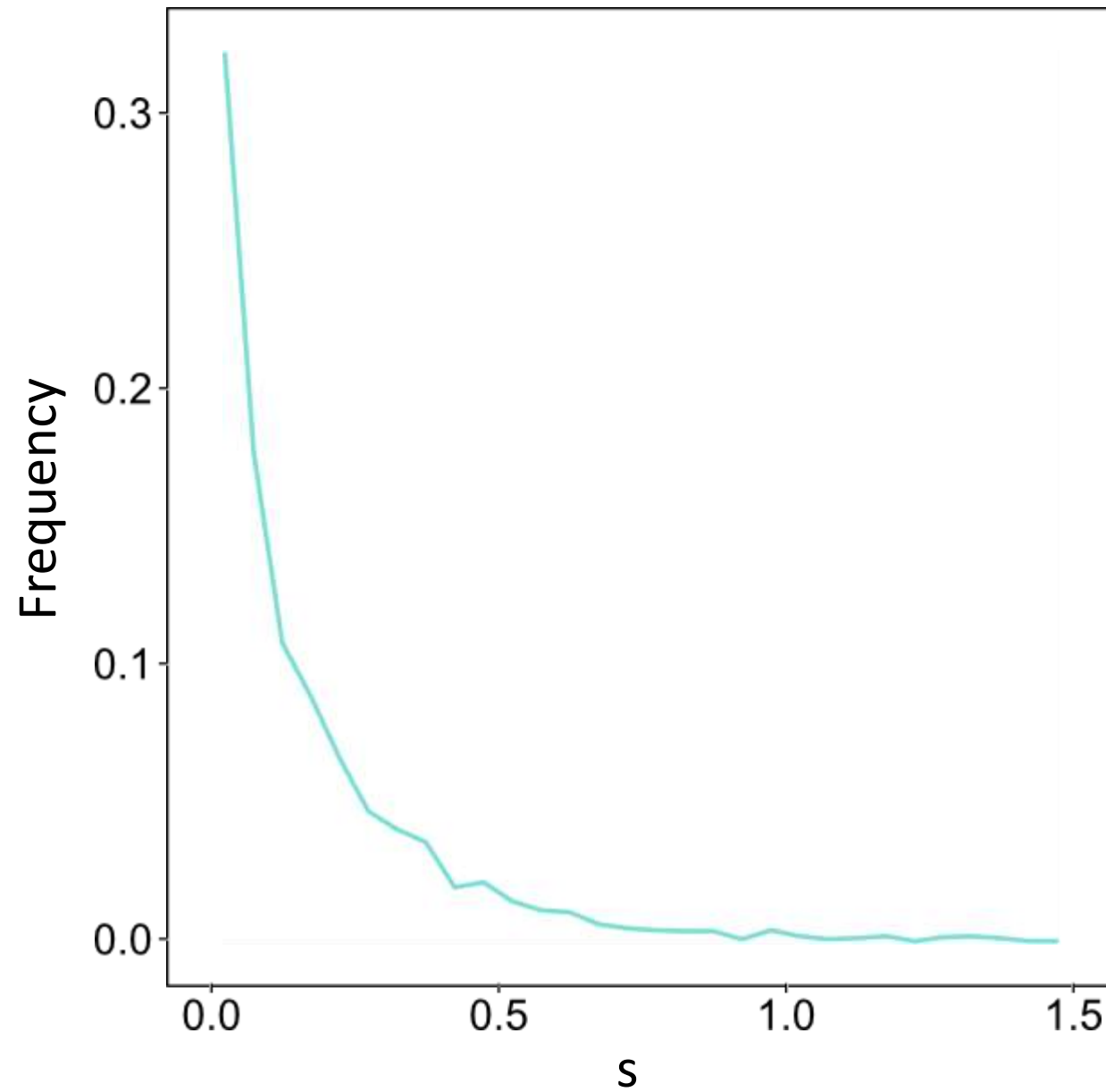
- fine-tune appearance (e.g. background colour, gridlines)

Think of R graphics as 'layers'...

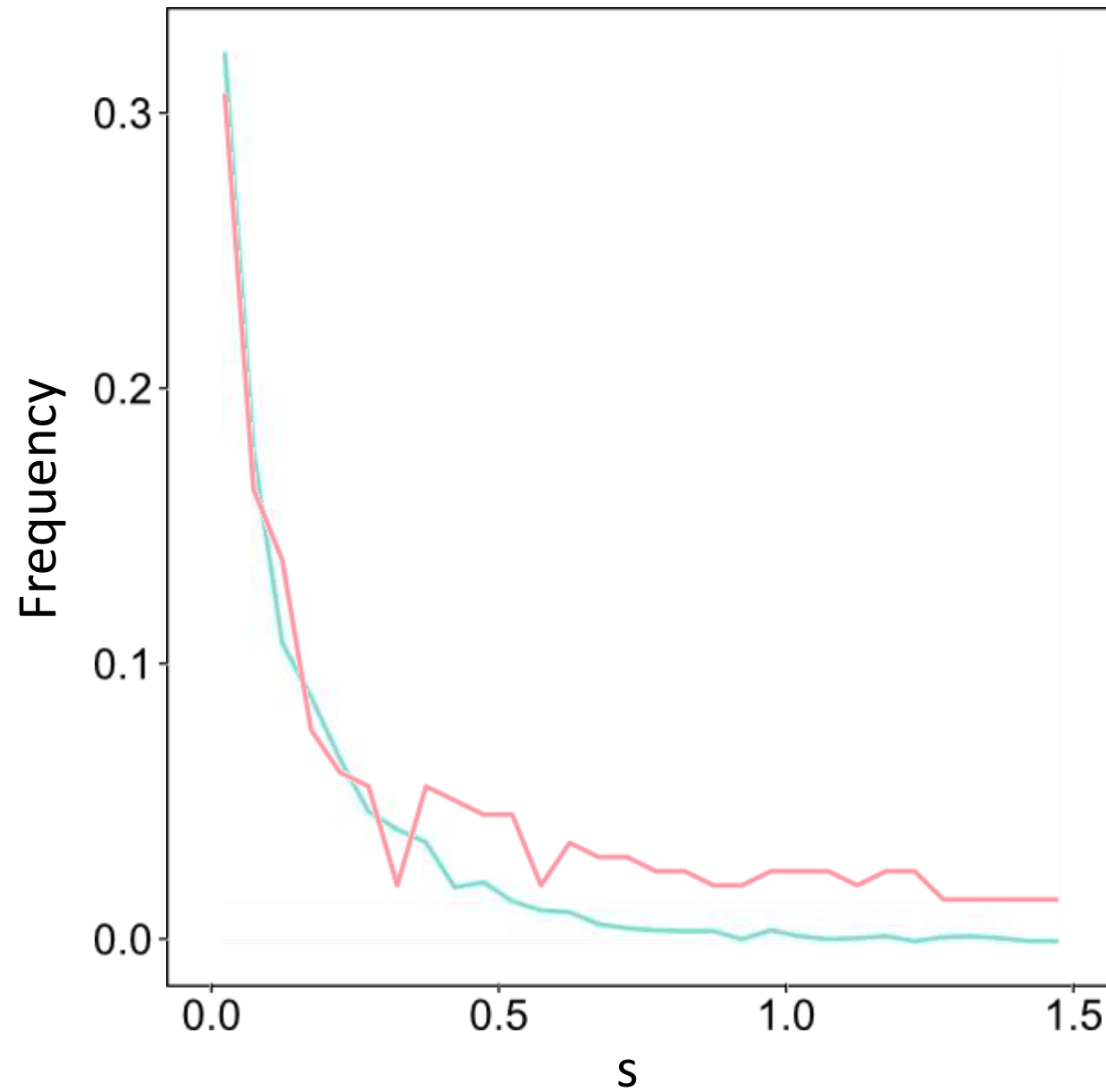
Layer 1



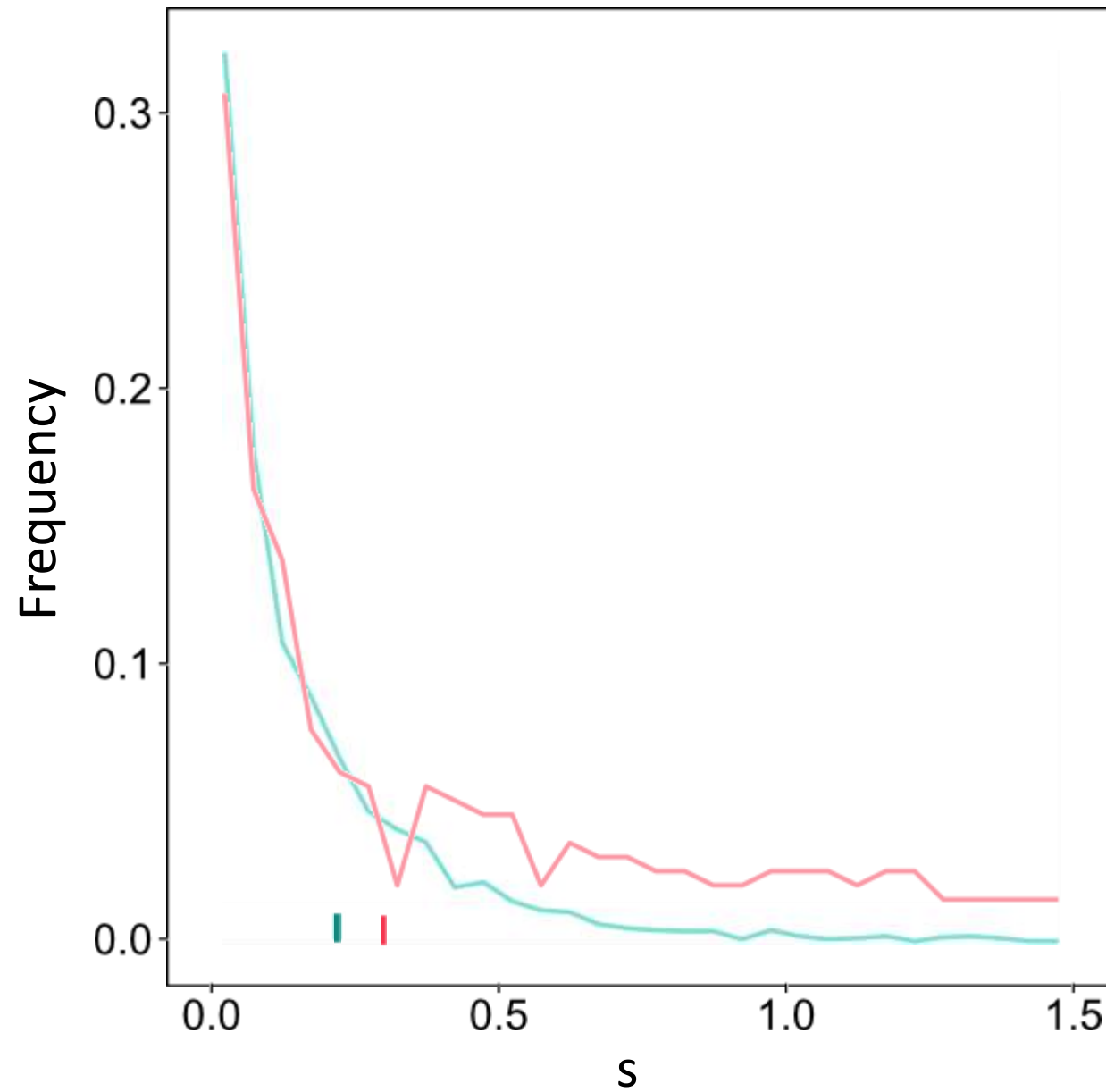
Layer 2



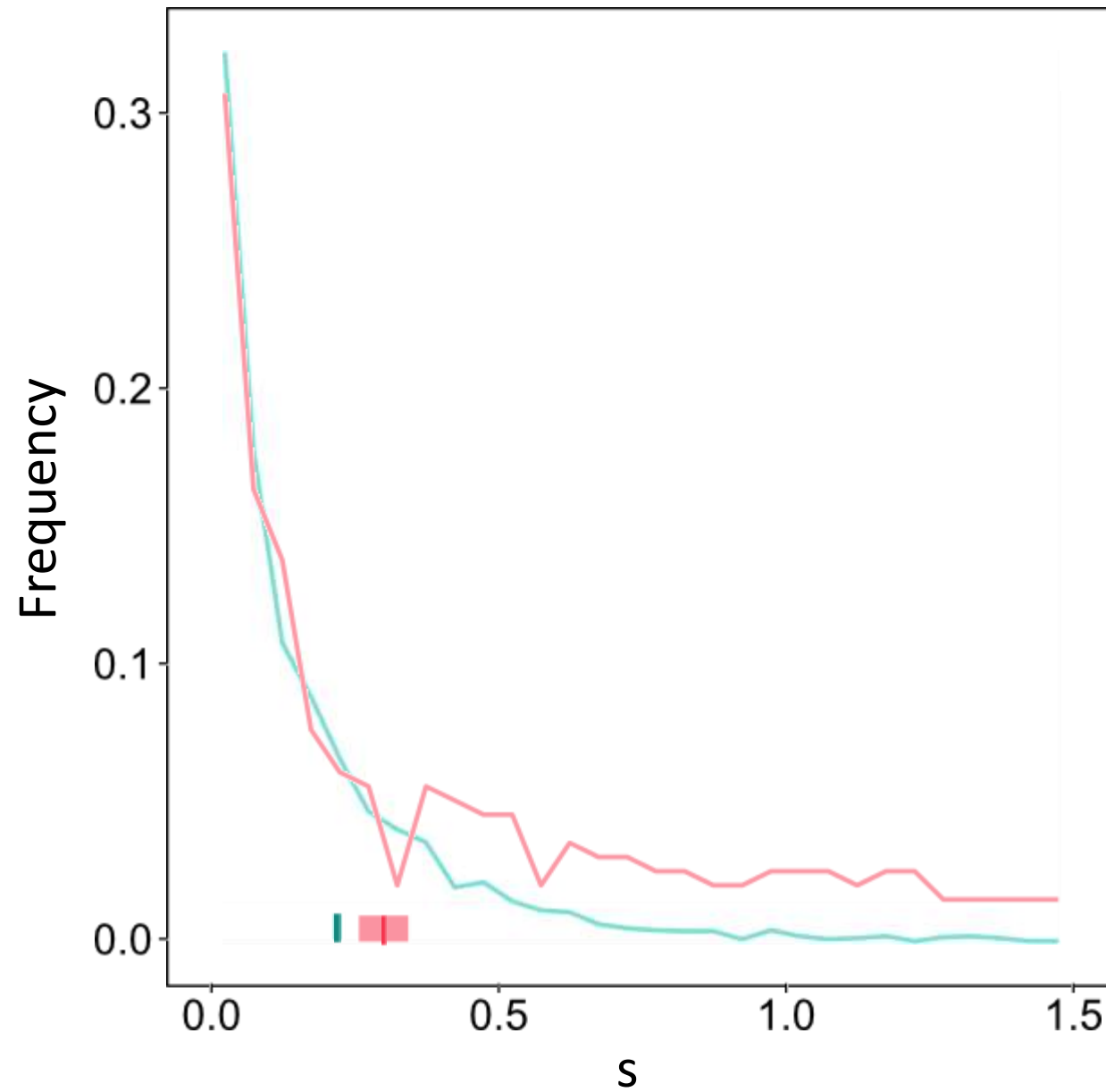
Layer 3



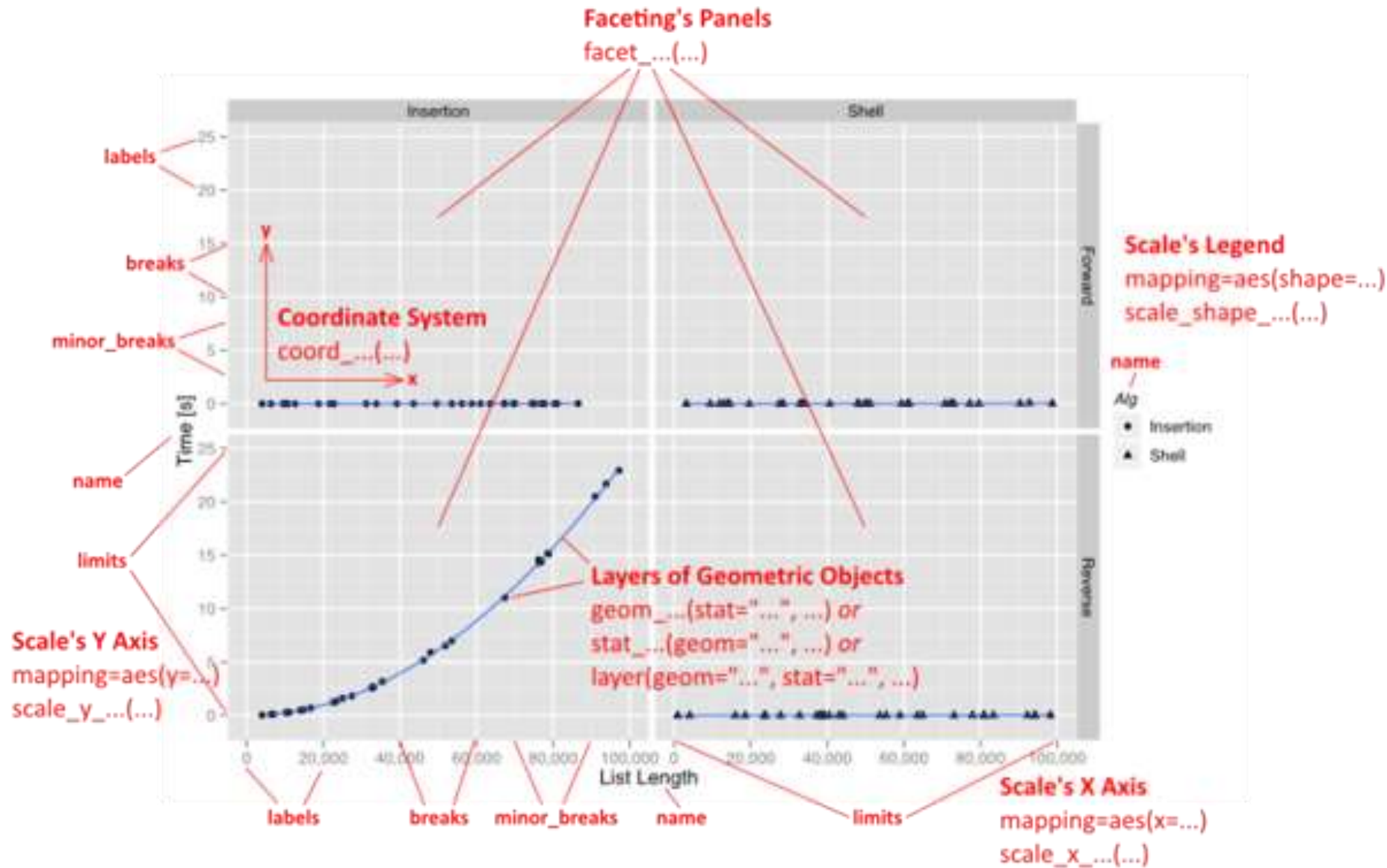
Layer 4



Layer 5



Anatomy of a ggplot() plot



Geom list

Name	Description
abline	Line, specified by slope and intercept
area	Area plots
bar	Bars, rectangles with bases on y-axis
blank	Blank, draws nothing
boxplot	Box and whiskers plot
contour	Display contours of a 3d surface in 2d
crossbar	Hollow bar with middle indicated by horizontal line
density	Display a smooth density estimate
density_2d	Contours from a 2d density estimate
errorbar	Error bars
histogram	Histogram
hline	Line, horizontal
interval	Base for all interval (range) geoms
jitter	Points, jittered to reduce overplotting
line	Connect observations, in ordered by x value
linrange	An interval represented by a vertical line
path	Connect observations, in original order
point	Points, as for a scatterplot
pointrange	An interval represented by a vertical line, with a point in the middle
polygon	Polygon, a filled path
quantile	Add quantile lines from a quantile regression
ribbon	Ribbons, y range with continuous x values
rug	Marginal rug plots
segment	Single line segments
smooth	Add a smoothed condition mean.
step	Connect observations by stairs
text	Textual annotations
tile	Tile plot as densely as possible, assuming that every tile is the same size.
vlane	Line, vertical

Table 4.2.: Geoms in `ggplot2`

Name	Default stat	Aesthetics
abline	abline	colour, linetype, size
area	identity	colour, fill, linetype, size, x , y
bar	bin	colour, fill, linetype, size, weight, x
bin2d	bin2d	colour, fill, linetype, size, weight, xmax , xmin , ymax , ymin
blank	identity	
boxplot	boxplot	colour, fill, lower , middle , size, upper , weight, x , ymax , ymin
contour	contour	colour, linetype, size, weight, x , y
crossbar	identity	colour, fill, linetype, size, x , y , ymax , ymin
density	density	colour, fill, linetype, size, weight, x , y
density2d	density2d	colour, linetype, size, weight, x , y
errorbar	identity	colour, linetype, size, width, x , ymax , ymin
freqpoly	bin	colour, linetype, size
hex	binhex	colour, fill, size, x , y
histogram	bin	colour, fill, linetype, size, weight, x
hline	hline	colour, linetype, size
jitter	identity	colour, fill, shape, size, x , y
line	identity	colour, linetype, size, x , y
linrange	identity	colour, linetype, size, x , ymax , ymin
path	identity	colour, linetype, size, x , y
point	identity	colour, fill, shape, size, x , y
pointrange	identity	colour, fill, linetype, shape, size, x , y , ymax , ymin
polygon	identity	colour, fill, linetype, size, x , y
quantile	quantile	colour, linetype, size, weight, x , y
rect	identity	colour, fill, linetype, size, xmax , xmin , ymax , ymin
ribbon	identity	colour, fill, linetype, size, x , ymax , ymin
rug	identity	colour, linetype, size
segment	identity	colour, linetype, size, x , xend , y , yend
smooth	smooth	alpha, colour, fill, linetype, size, weight, x , y
step	identity	colour, linetype, size, x , y
text	identity	angle, colour, hjust, label , size, vjust, x , y
tile	identity	colour, fill, linetype, size, x , y
vlane	vlane	colour, linetype, size

Table 4.3.: Default statistics and aesthetics. Emboldened aesthetics are required.