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Introduction to R

Dr. Robert I. Colautti

Biology Dept.

Feb 19, 2016

> ColauttiLab

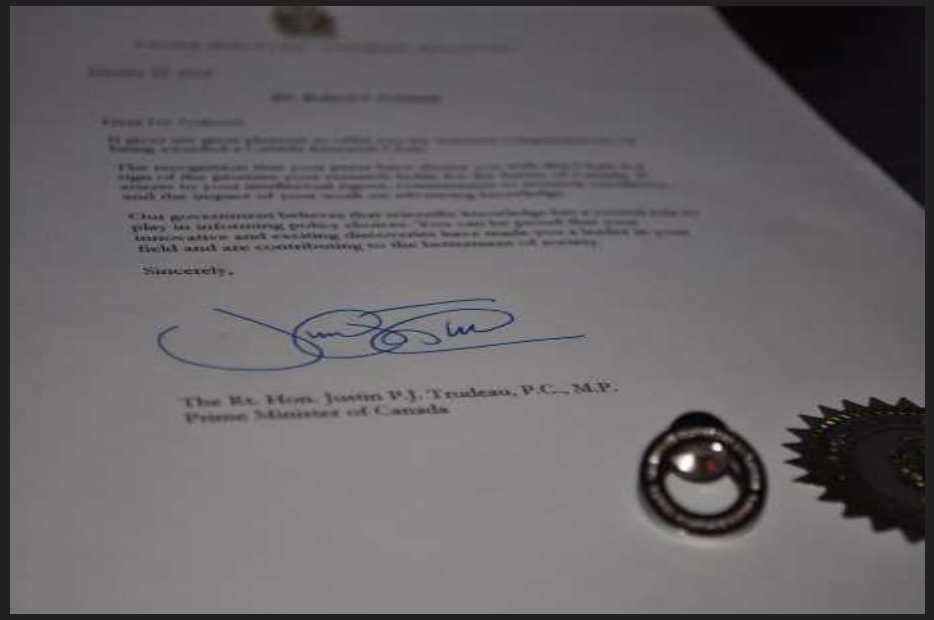
Colautti Lab

Major Research Projects

Opportunities in Computational Biology

2015 Canadian Research Chair

(Tier II) in **Rapid Evolution**



Colautti Lab

Major Research Projects

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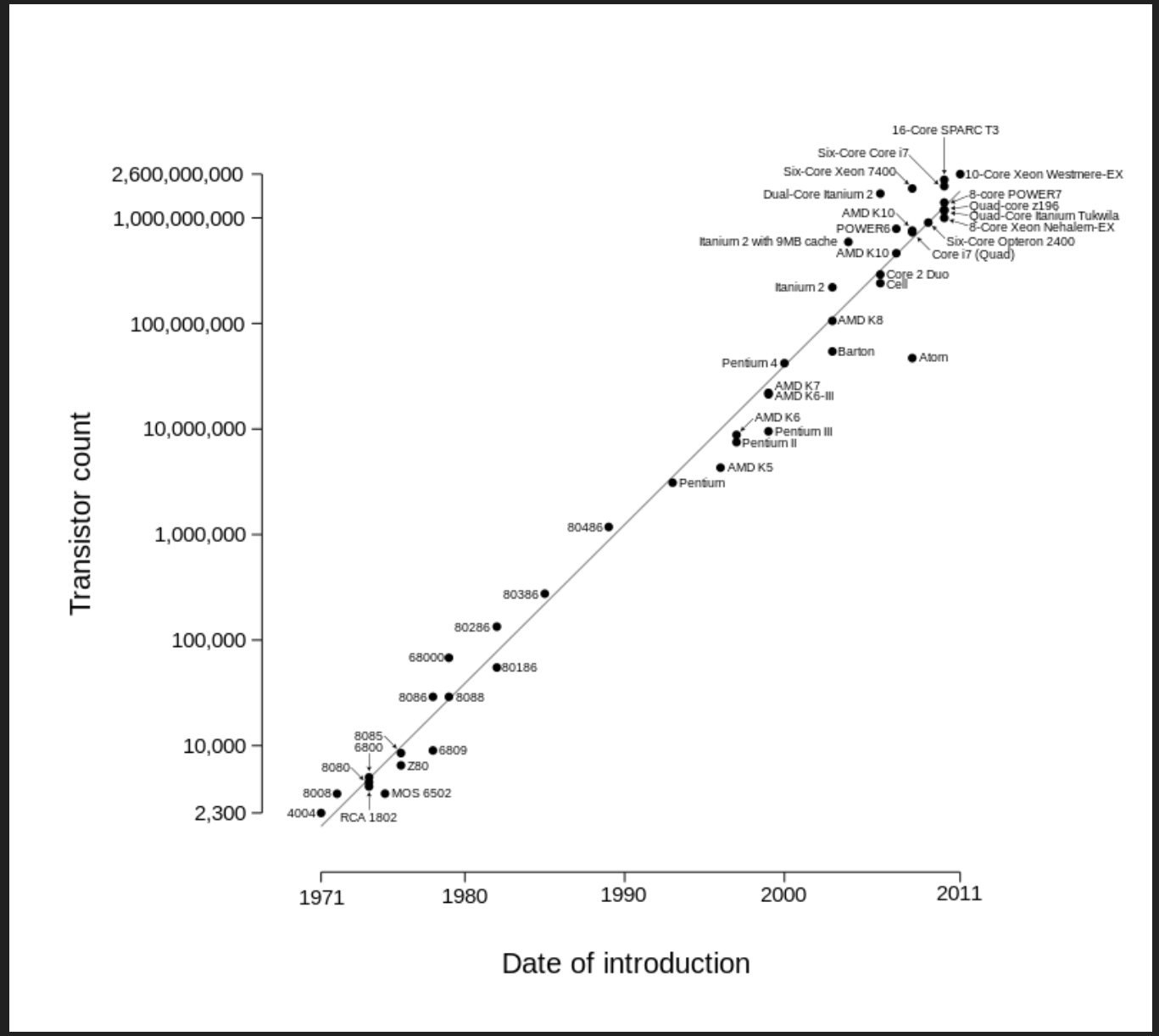
Moore's Law

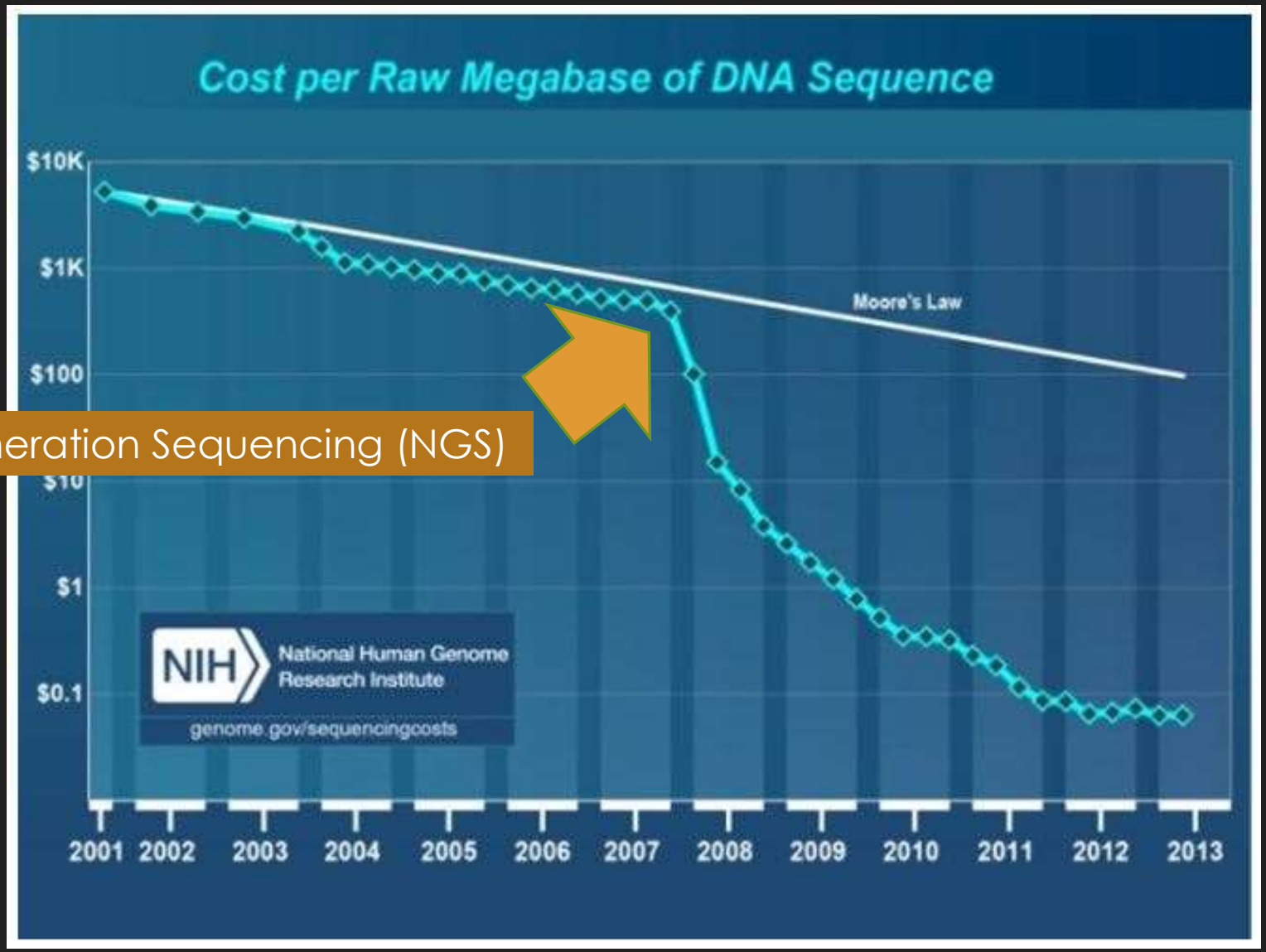


"the number of transistors in a dense integrated circuit doubles approximately every two years"

-- Wikipedia (Feb 2, 2016)

Moore's Law vs DNA sequencing

'Next' or 'New Generation Sequencing (NGS)



Bioinformatics and NGS at Queen's

Tomas Babak (Biology)

Rob Colautti (Biology)

Qingling Duan (Biomed/Mol Sci)

Tier 1 CRC in Bioinformatics (Path/Mol Med)

Babak

Colautti

Duan

illumina

Roche

ion torrent

Ecology and Evolution in the Anthropocene

Environment --> Natural Selection --> Genome Evolution

Photos by Ed Burtynsky (mostly)

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Invasions: grand, unplanned ecological experiments

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Subsistence farming in a changing climate

Amaranthus

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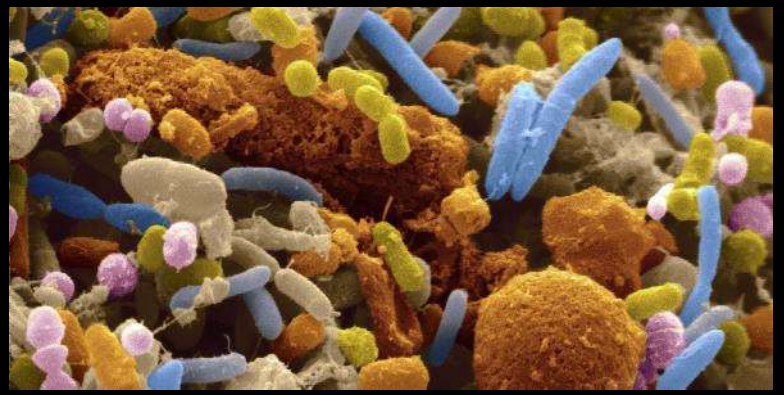
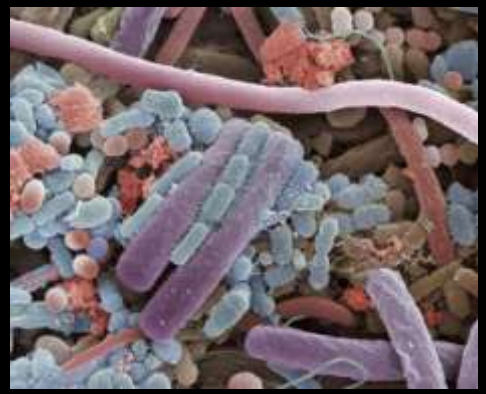
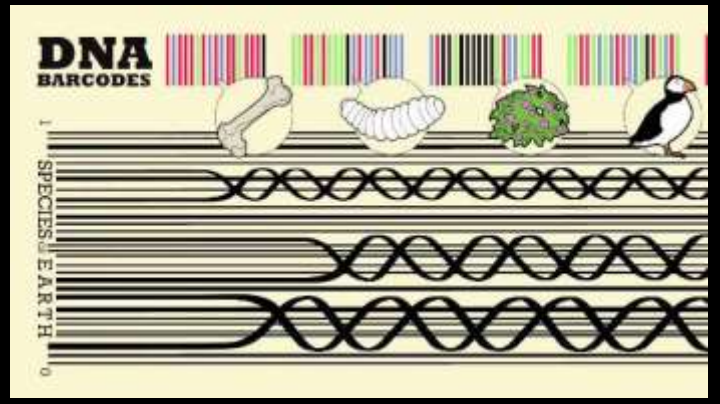
eDNA and DNA barcodes for environmental monitoring

Barcode of Life Project
www.boldsystems.org







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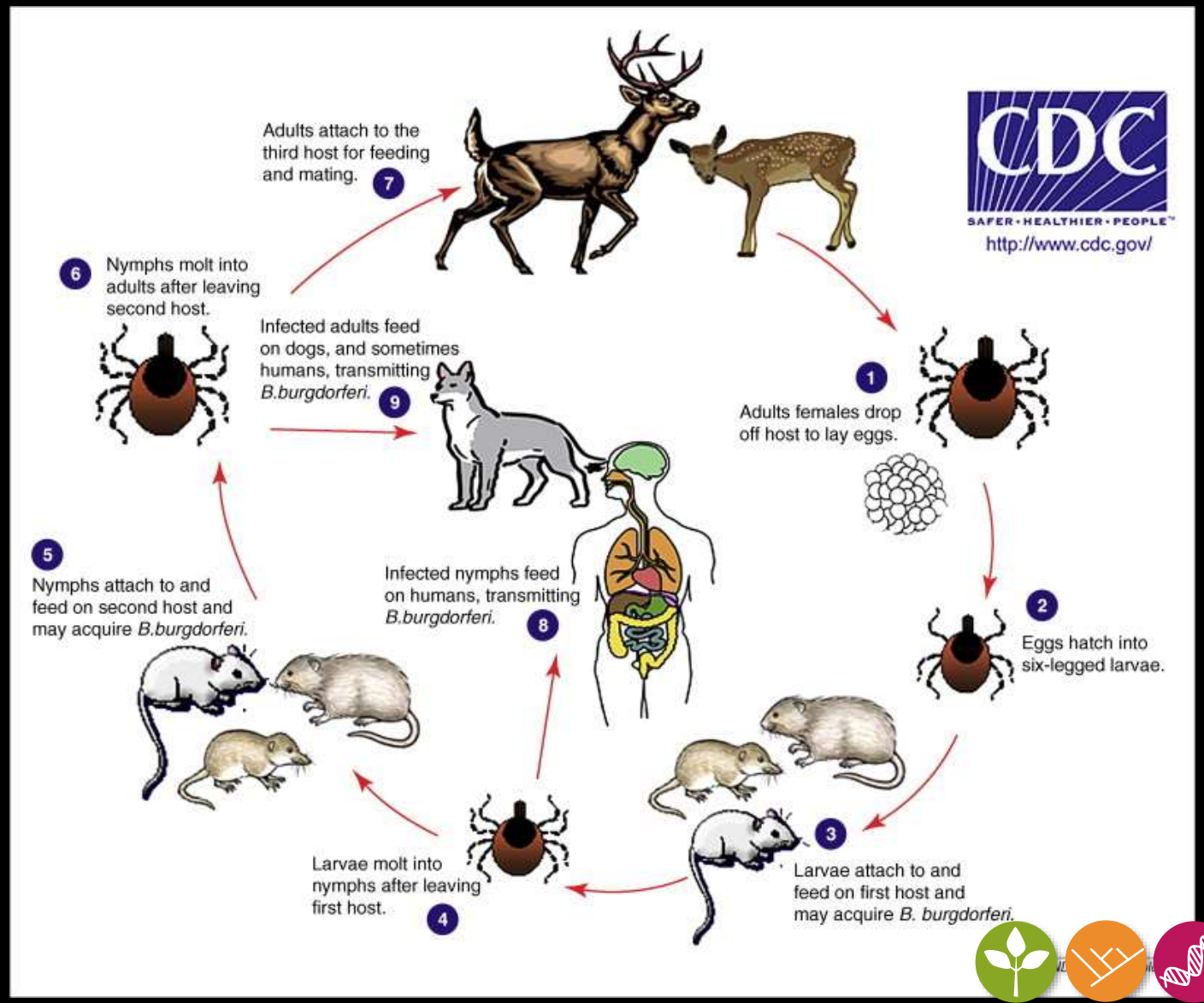
Climate change and disease ecology

Lyme disease in Canada (cbc.ca)

Ixodes scapularis (black-legged tick)



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Computational methods

Imaging

- 3D imaging in the field
- remote sensing
- climate models

Genomics

- *de novo* assembly
- population genomics
- genome-wide association
- comparative genomics
- transcriptome mapping

Analysis

- Generalized linear models
- Multivariate statistics
- Simulations and differential equation models
- Custom analysis pipelines
- Figures!

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R Tutorials Overview

Further Reference:

http://haschmi.github.io/2016-02-17-queens/

http://wiki.hpcvl.org/index.php/Training:SWC:Feb2016

Morning

- Key features of R & RStudio
- Basic objects
- Working with data
- Basic statistics
- Basic graphs with qplot()

Afternoon

- Elegant graphics with ggplot()
- Flow control
- Regular expressions
- Custom functions
- Custom packages

Why use R?

- Reproducible, publication-worthy analysis and figures
- Free, open-source, flexible
- Large community of active users
- Built with a focus on manipulating and analyzing data
- Particularly useful for:
  1) Combining, cleaning-up & reorganizing data
  2) Statistical analysis, matrix algebra, modeling
  3) Graphing for data exploration or publication
  4) Basic analysis 'pipeline': input->reorganization->analysis->figure/table

Preparation checklist

- R is installed
- RStudio is installed
- Create a working directory
- Download tutorial files: *FallopiaData.csv* and *FirstScript.R*
  - *bit.ly/RCrashCourse*
- Start Excel (or OpenOffice Calc or other spreadsheet program)
  - Open *FallopiaData.csv*

cran.r-project.org
rstudio.com

Useful Print References:

1. The R Book – Michael Crawley
2. R in Action – Robert Kabacoff

FallopiaData.csv

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	PotNum	Scenario	Nutrients	Taxon	Symphytur	Silene	Urtica	Geranium	Geum	All_Native	Fallopia	Total	Pct_Fallopia	
2	1	low	low	japon	9.81	36.36	16.08	4.68	0.12	67.05	0.01	67.06	0.01	
3	2	low	low	japon	8.64	29.65	5.59	5.75	0.55	50.18	0.04	50.22	0.08	
4	3	low	low	japon	2.65	36.03	17.09	5.13	0.09	60.99	0.09	61.08	0.15	
5	5	low	low	japon	1.44	21.43	12.39	5.37	0.31	40.94	0.77	41.71	1.85	
6	6	low	low	japon	9.15	23.9	5.19	0	0.17	38.41	3.4	41.81	8.13	
7	7	low	low	japon	6.31	24.4	7	9.05	0.97	47.73	0.54	48.27	1.12	
8	8	low	low	japon	19.53	29.93	0	3.51	0.4	53.37	2.05	55.42	3.7	
9	9	low	low	japon	6.08	18.25	8.44	9.64	0.01	42.42	0.26	42.68	0.61	
10	10	low	low	japon	5.69	35.23	4.84	7.3	0.47	53.53	0	53.53	0	
11	11	low	low	japon	15.58	20.81	2.81	6.36	0.33	45.89	0	45.89	0	
12	12	low	low	japon	11.38	28.67	9.79	5.04	0.56	55.44	3.58	59.02	6.07	
13	14	low	low	japon	2.92	27.11	6.25	9.5	0.05	45.83	11.83	57.66	20.52	
14	16	low	low	bohem	12.99	18.02	9.51	7.52	0.36	48.4	0.58	48.98	1.18	
15	17	low	low	bohem	4.9	29.52	1.36	0	0.19	35.97	0	35.97	0	
16	18	low	low	bohem	3.51	27.61	8.14	3.81	0.21	43.28	0	43.28	0	
17	19	low	low	bohem	7.49	32.14	5.7	6.93	0.01	52.27	0	52.27	0	
18	20	low	low	bohem	11.16	25.58	1.8	5.1	0.07	43.71	2.21	45.92	4.81	
19	22	low	low	bohem	0.76	22.66	9.85	10.6	0.74	44.61	0	44.61	0	

FallopiaData

- OR use your own data

Fallopia experiment

Madalin Parepa

University of Tuebingen (Germany)

Oliver Bossdorf

Two species of invasive Knotweed (Fallopia)

- F. japonica
- F. bohemica

Native competitors

- Symphytum
- Silene
- Urtica
- Geranium
- Geum