

Data Exploration in the Ecology Classroom: The Science-Pipes Approach

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What education reformers think we do



What reformers want us to do



What students want to do



What we want our students to do



Science education is becoming more student-centered

- Recommendations of national panels
 - Less emphasis on lecturing
 - More on student active data gathering, analysis, reporting, critical thinking
- Goal to have students master competencies, rather than rote knowledge

Student-active learning involves data collecting and analysis

- Students behave as scientists to construct knowledge
- Feasible when examining phenomena of limited spatial and temporal scale
 - Cell / Molecular biology
 - Physiology
- Less feasible for phenomena of longer temporal scale or broader spatial scale
 - Ecology
 - Evolution

Still, want to teach ecological / evolutionary principles with data

- Use data from individual studies
 - Limited in terms of extent
- Use data multiple studies (data mining)
 - Access, compatibility an issue
- Statistics / data visualization software often challenging for students

Challenge: Facilitating access to, and visualization of, ecological data

[LTER Home](#) | [Intranet](#) | [LNO](#)

[LTER Site Home Pages](#)



The US Long Term Ecological Research Network

A founding member of the International Long Term Ecological Research network

Welcome to the LTER Data Portal

Data are one of the most valuable products of the Long-Term Ecological Research (LTER) Network program. The LTER Network seeks to inform the broader scientific community by providing open access to well designed and well documented databases via a network-wide information system. Currently, the LTER Data Portal contains over 6000 metadata entries for ecological datasets contributed by 27 past and present LTER sites. Please review the [LTER Data Policy](#) before downloading any data product.



To search for LTER data, please enter a search term in the form field below:

[Advanced Search](#)

Select to include non-LTER data

For additional LTER data, try one of these value-added data sets:

- [EcoTrends](#)
- [LTER/LTER's Climate / Hydrology Data](#)
- [Remote Sensing Data](#)


Please log on to access EcoTrends content

The EcoTrends Project

Welcome to EcoTrends. We are currently verifying the data on this website with the contributing researchers; please read the disclaimer below.

The Earth's environment is changing at local, regional, and global scales. Dramatic changes have occurred over the past century in climate, land cover, and habitat availability with important consequences for plant, animal, microbial, and human populations. Long-term data provide the only means to assess the rate and direction of change, to distinguish directional trends from short-term variability, and to forecast environmental conditions in the future.

The EcoTrends Project is designed to promote and enable the use and synthesis of long-term data to examine these trends in the Earth's



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 By Site
 By Keyword
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[Participating Sites](#)
[Publications using](#)

tive effort among state and federal agencies and institutions, at a long-term ecological data easy to access, analyze, and use website is a portal to:
 standardized long-term ecological datasets and their metadata
[data graphing and synthesis tools](#)
[search sites](#) and their parent agencies




Ecological Society of America Data Registry

[ESA Registry](#) | [Register Data](#) | [Search for Data](#) | [My Submissions](#) | [Logout](#)

Welcome to the ESA Data Registry. This is a publicly accessible registry describing **scientific data sets on ecology and the environment**. The data sets registered here are associated with articles published in the Journals of the Ecological Society of America. They are registered here in order to facilitate communication and data sharing by scientists. See individual registry entries for citation information as well as usage rights.

Registry Tools

- [Search for Data Sets](#)

Search only within the ESA Data Registry
 Search entire Knowledge Network for Biocomplexity

Search Title, Abstract, Keywords, Personnel (Quicker)
 Search all fields (Slower)

This tool allows you to search the registry for data sets of interest. When you type text in the box and click on the "Search" button, the search will only be conducted within the title, author, abstract, and keyword fields. Checking the "Search All Fields" box will search on these and all other existing fields (this search will take more time). Checking the "Search Knowledge Network for Biocomplexity" box will allow you to search the Knowledge Network for Biocomplexity (KNB) in addition to the ESA Data Registry. The KNB is an international data repository dedicated to facilitating ecological and environmental research. Click [here](#) for more information on the KNB.

You can use the '*' character as a wildcard in your searches (e.g., '*biodiversity*' would locate any phrase with the word biodiversity embedded within it).

- [Browse data sets](#)

Browse all existing data sets by title. This operation can be slow as the number of entries in the registry grows.

One Solution: Science Pipes

- Workflow system developed by Cornell Lab of Ornithology
- Allows students to analyze and visualize complex datasets.
- Uses an object-oriented interface.
- Found at <http://www.sciencepipes.org>

Science Pipes workflow system:

Select dataset

Filter data

Apply analysis

Visualize outcomes

Science Pipes workflow system:

Select dataset

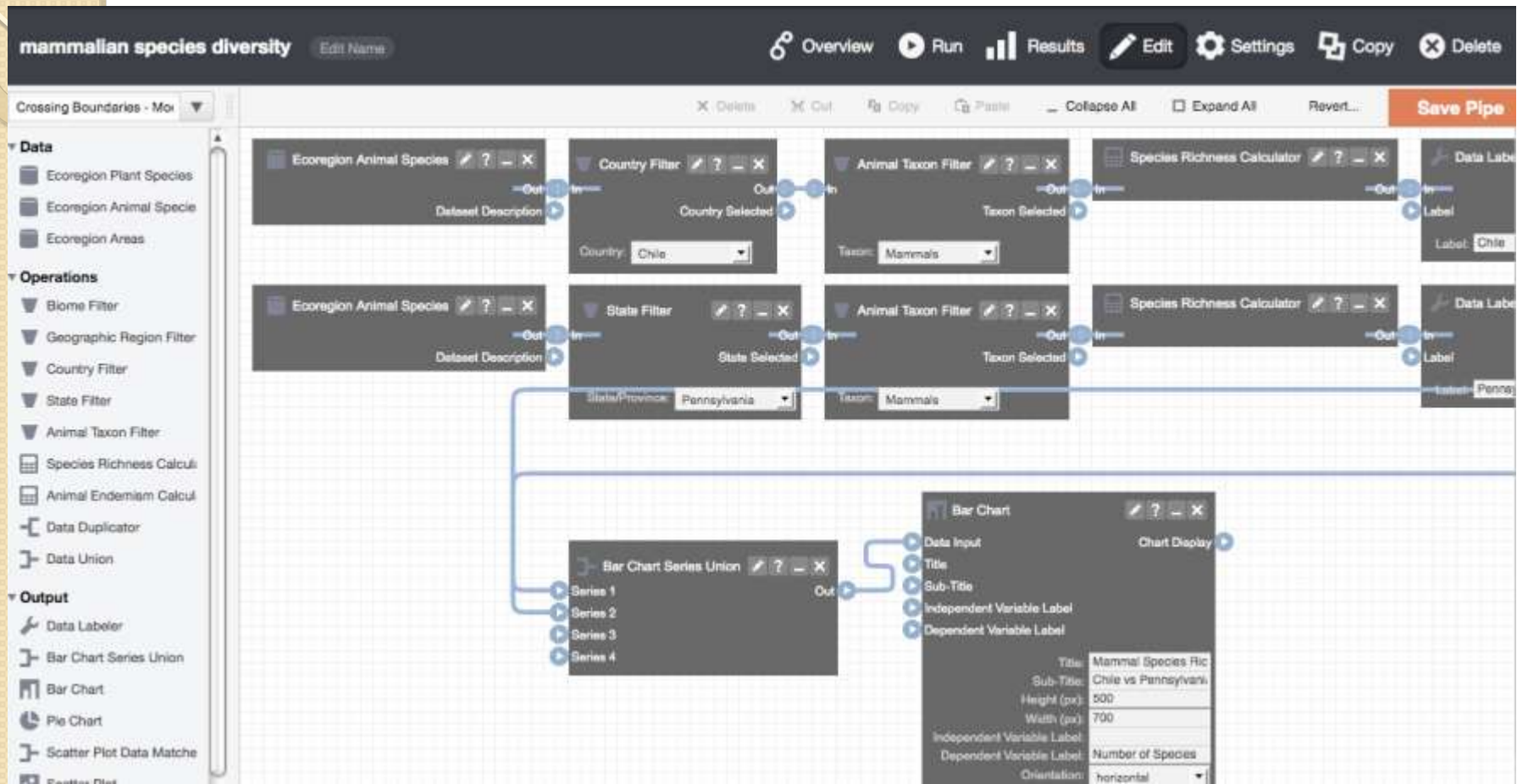
```
graph TD; A[Select dataset] --> B[Filter data]; B --> C[Apply analysis]; C --> D[Visualize outcomes];
```

Filter data

Apply analysis

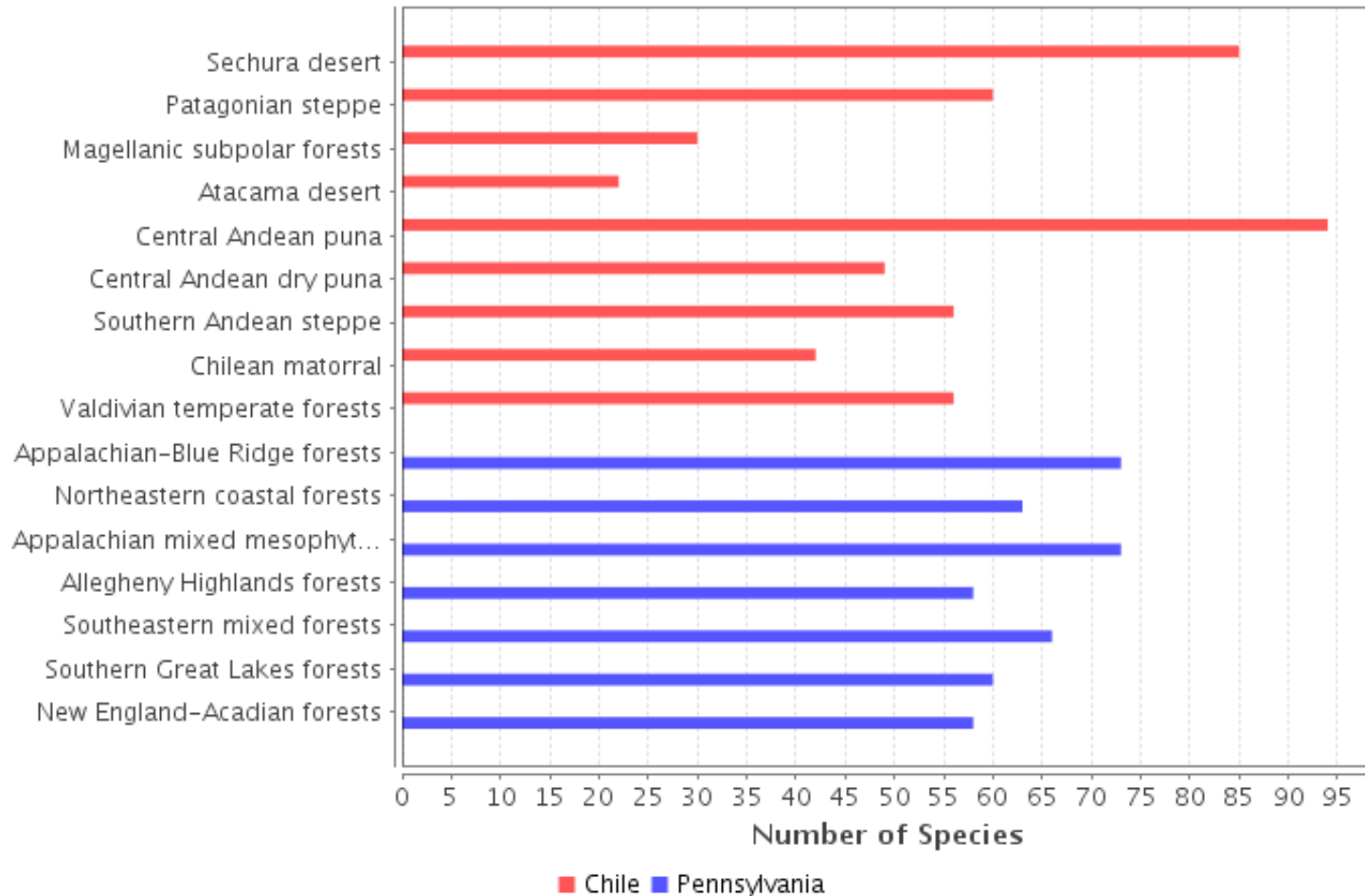
Visualize outcomes

Example of Science Pipe



Output of Pipe

Mammal Species Richness Chile vs Pennsylvania



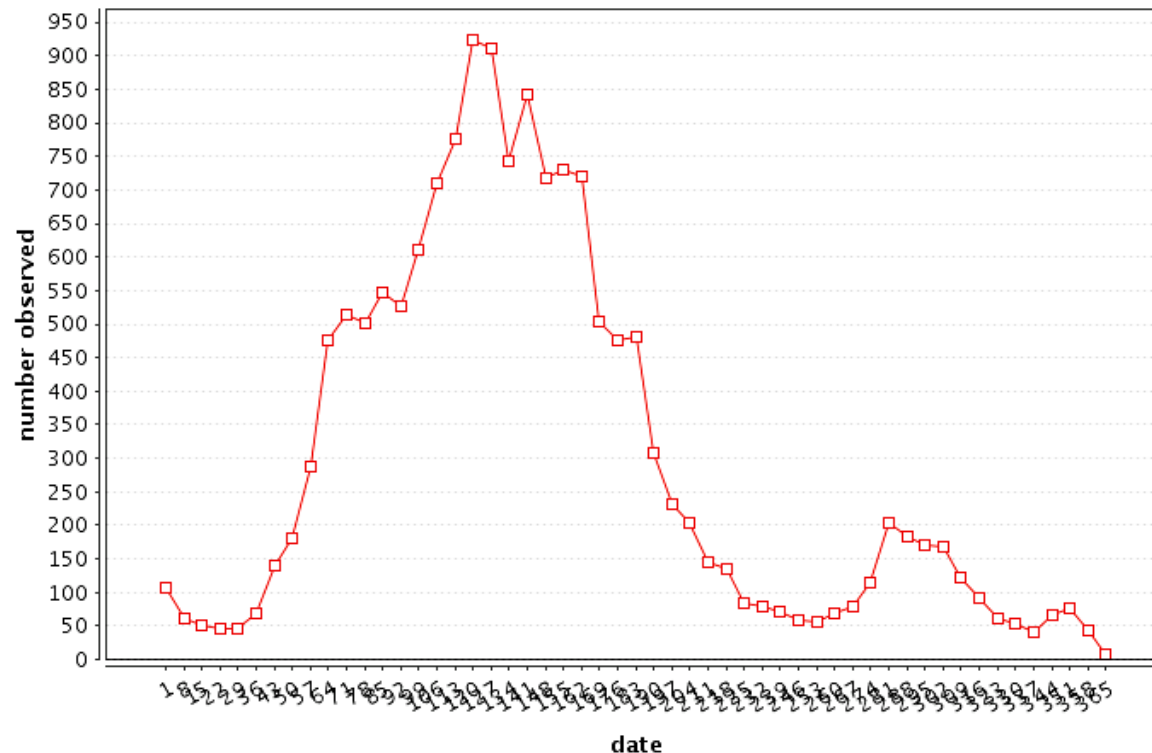
Datasets in Science Pipes

- From Cornell Lab of Ornithology
 - Avian Knowledge Network (eBird, Project Feeder Watch)
 - WWF WildFinder (Crossing Boundaries)
- From Ecological Society of America
 - Cemetery Demography
 - Adaptive radiation
 - Pollen data
 - Forest Inventory & Analysis

Avian Knowledge Network (eBird, Project Feeder Watch)

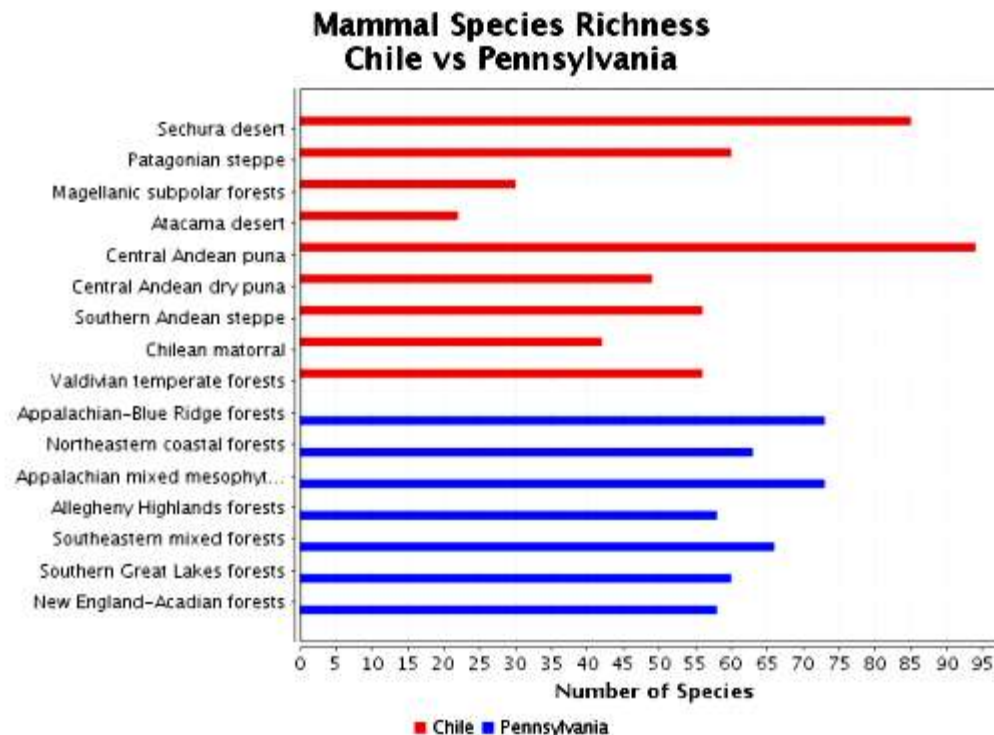
- Massive dataset from researchers and citizen science volunteers
- Analyze populations and communities over time and space

Red-winged Blackbird (*Agelaius phoeniceus*)
Pennsylvania



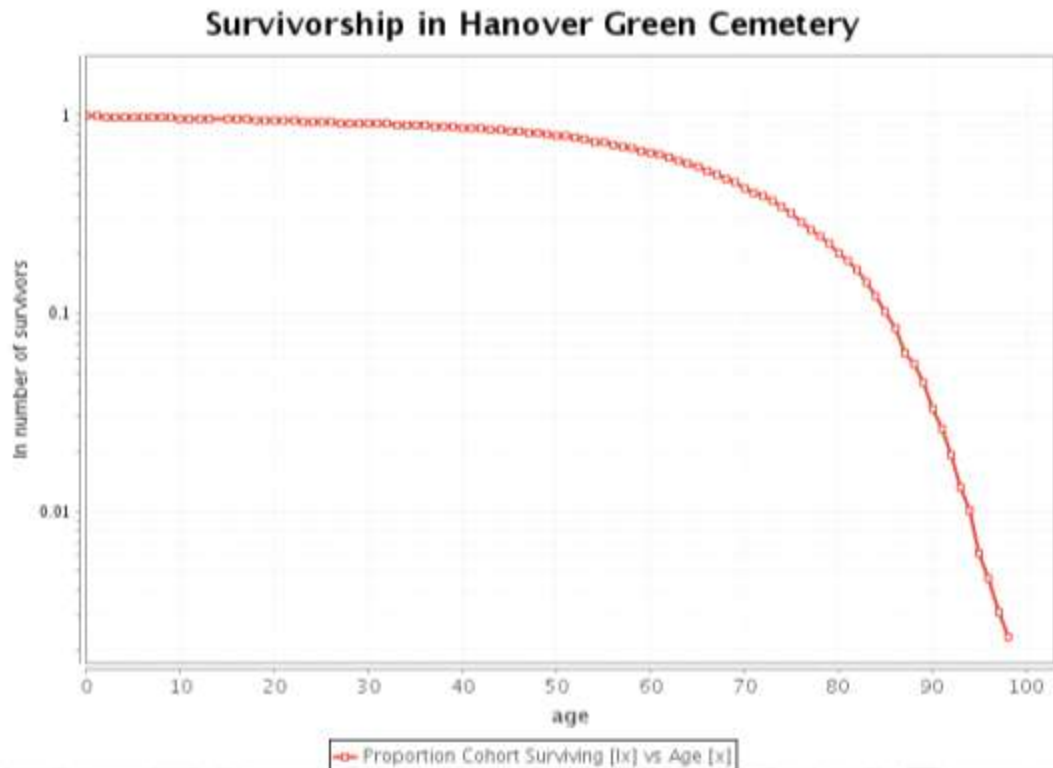
WWF WildFinder (Crossing Boundaries)

- Species diversity in different ecoregions
- Compare countries and states



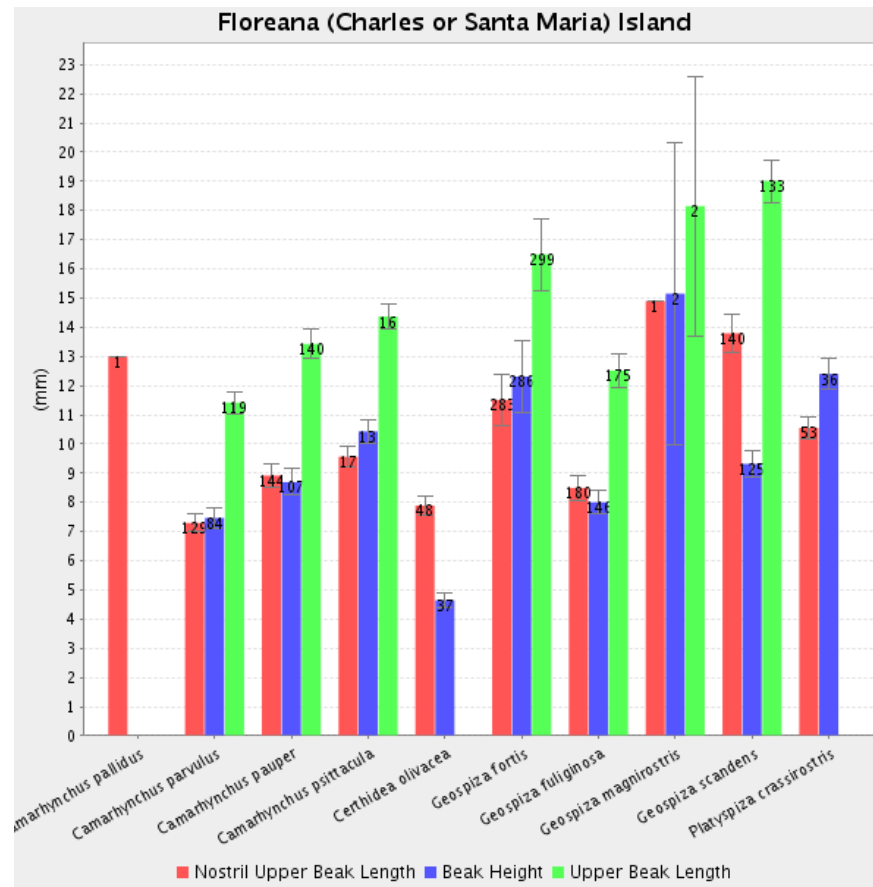
Cemetery demography

- Allows students to construct
 - life tables
 - age distributions
 - survivorship curves



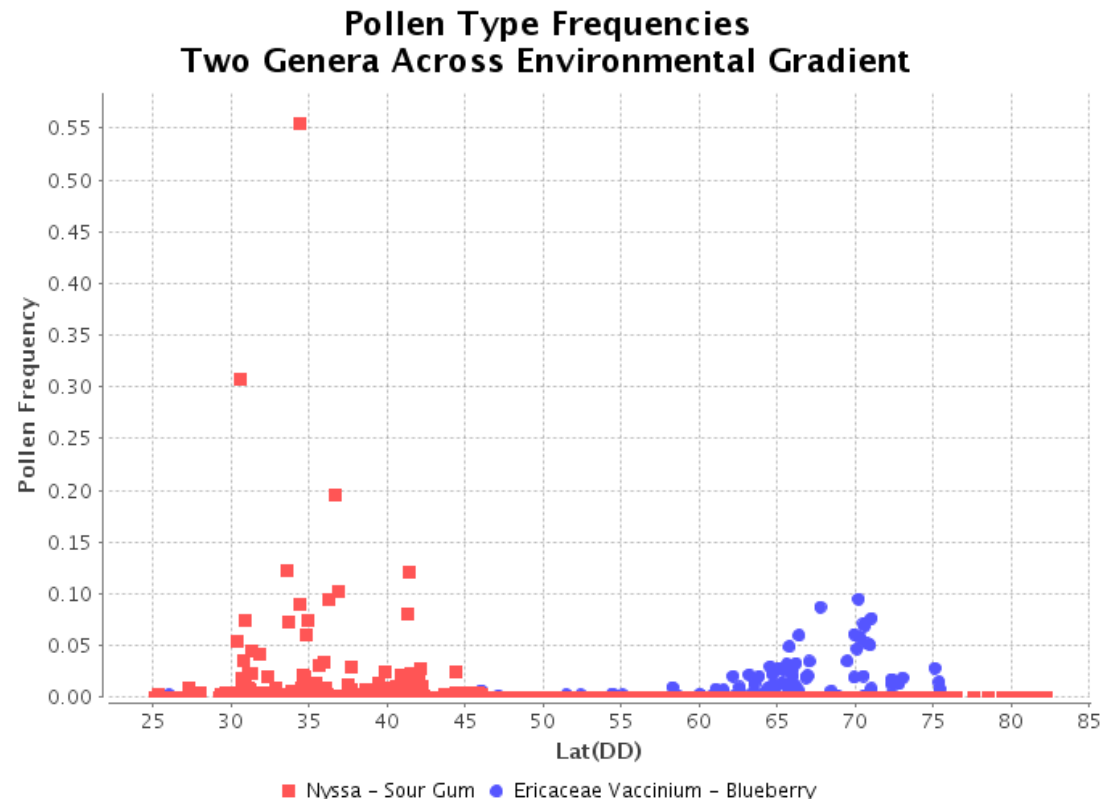
Datasets in Science Pipes

- Adaptive radiation
 - Based on Darwin's finch morphometric data
 - Compare species by island



Datasets in Science Pipes

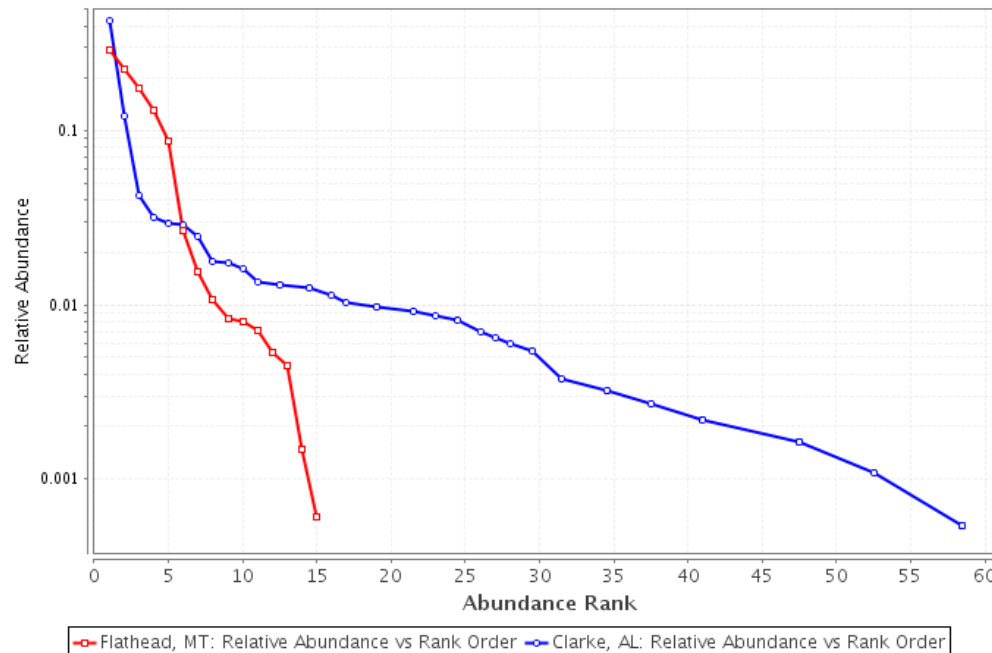
- Pollen data
 - From North America Pollen Database
 - Compare pollen frequencies by species and site



Datasets in Science Pipes

- USDA Forest Inventory Analysis
 - Focus on population and community structure
 - Use to calculate rank abundance, species richness, species diversity, diameters

Rank Abundance Curves
2004 - 2005





Create Pipe



Browse Pipes



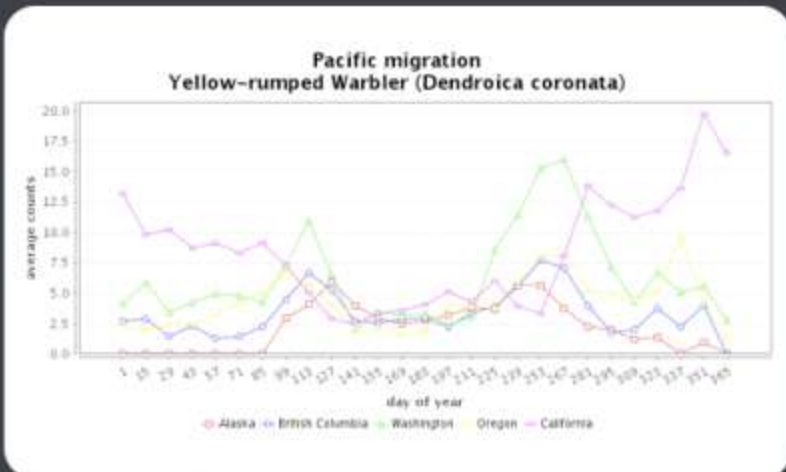
My Pipes



Get Help

Find a Pipe...

SEARCH



Pacific Coast Migration by Wim van Dam

NEXT →

Analyze + visualize data. Share results.

Science Pipes is a free service that lets you:

- Connect to real biodiversity data
- Use simple tools to create visualizations and feeds
- Embed results on your own web site or blog

[More Info](#) | [Video Demos](#) | [Tutorials](#) | [Latest News](#)

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Featured Pipes



DP1-demo-Histogram

Derik Barsaghian — Mar 20, 2012 at 1:06 PM

No ratings yet



DP1-demo-Dual Bar Chart

Derik Barsaghian — Mar 12, 2012 at 7:33 PM

No ratings yet

[Create a Pipe](#)

Search for a pipe...

Find by tag...

Please Sign In

Username:

Password:

Remember me

Sign In

[Help! I forgot my password or username](#)

No account?

Creating a profile lets you...

- Run pipes
- Create new pipes
- Copy existing pipes
- Comment and interact with other Science Pipes users

Sign Up

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The Cornell Lab of Ornithology



Supported by NSF DUE-0734857

Create a New Pipe

Pipe Name:

Hanover Green Cemetery

Description:

Use data sets from:

- WildFinder (Crossing Boundaries) [more info](#)
- AKN (eBird & PFW) [more info](#)
- Survivorship (ESA EcoEd Digital Library) [more info](#)
- Adaptive Radiation [more info](#)

Create Pipe

Cancel

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TheCornellLab of Ornithology



Supported by NSF DUE-0734857

Hanover Green Survivorship

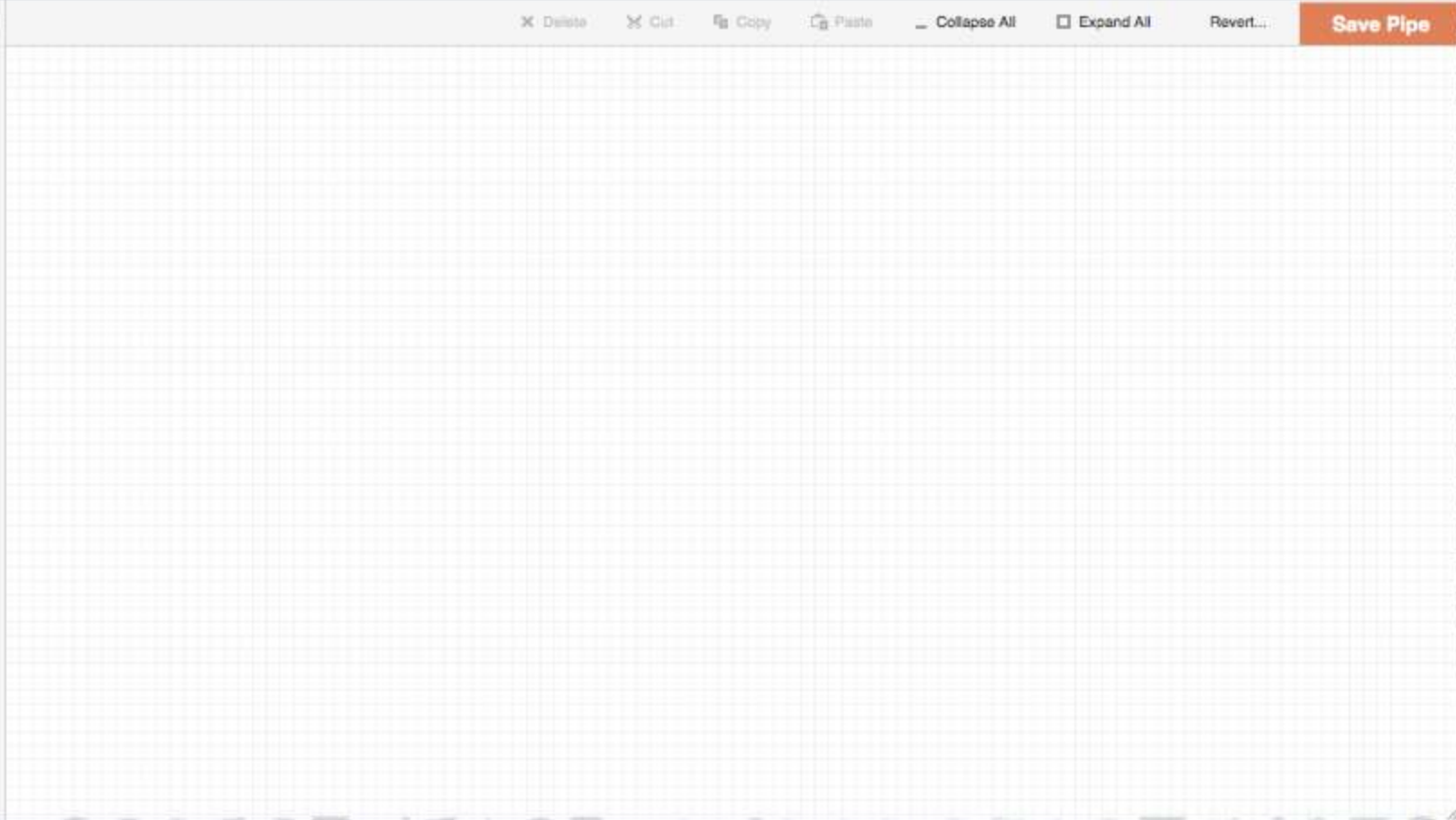
Edit Name

Overview
 Run
 Results
 Edit
 Settings
 Copy
 Delete

Survivorship (ESA EcoEd)

Delete
 Cut
 Copy
 Paste
 Collapse All
 Expand All
 Revert...
 Save Pipe

- ▼ **Data**
 - Survivorship Data
- ▼ **Operations**
 - ▼ Birth Year Filter
 - ▼ Death Year Filter
 - ▼ Age Filter
 - ▼ Sex Splitter
 - Survivorship Data Grouper
 - Data Duplicator
 - Survivorship Calculation
- ▼ **Output**
 - Line Chart
 - Large Line Chart
 - Histogram
 - Dual Bar Chart
 - Data Viewer



Hanover Green Survivorship

Edit Name

- Overview
- Run
- Results
- Edit**
- Settings
- Copy
- Delete

Survivorship (ESA EcoEd)

- Delete
- Cut
- Copy
- Paste
- Collapse All
- Expand All
- Revert...
- Save Pipe**

- Data**
 - Survivorship Data
- Operations**
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 - Data Viewer

Survivorship Data

Out

Cemetry Name

Cemetry: Hanover Green C

Hanover Green Survivorship

Edit Name

Overview Run Results Edit Settings Copy Delete

Survivorship (ESA EcoEd)

Delete Cut Copy Paste Collapse All Expand All Revert... Save Pipe

- Data
 - Survivorship Data
- Operations
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 - Death Year Filter
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Survivorship Data

Out Cemetery Name

Cemetery: Hanover Green C

Survivorship Calculation

Data Input Life Table

Age (x)

Number surviving (sx)

Number of deaths (d_{year})

Proportion surviving (lx)

Proportion dying during each year (dx)

Mortality Rate (qx)

Hanover Green Survivorship

Edit Name

Overview Run Results Edit Settings Copy Delete

Survivorship (ESA EcoEd)

Delete Cut Copy Paste Collapse All Expand All Revert... Save Pipe

- Data
 - Survivorship Data
- Operations
 - Birth Year Filter
 - Death Year Filter
 - Age Filter
 - Sex Splitter
 - Survivorship Data Grouper
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 - Dual Bar Chart
 - Data Viewer

Survivorship Data

Out Cemetery Name

Cemetery: Hanover Green C

Survivorship Calculation

Data Input

Life Table

- Age (x)
- Number surviving (ex)
- Number of deaths (deaths)
- Proportion surviving (lx)
- Proportion dying during each year (dx)
- Mortality Rate (qx)



Hanover Green Survivorship

Edit Name

Overview Run Results Edit Settings Copy Delete

Survivorship (ESA EcoEd |

Delete Cut Copy Paste Collapse All Expand All Revert... Save Pipe

Data

Survivorship Data

Operations

- Birth Year Filter
- Death Year Filter
- Age Filter
- Sex Splitter
- Survivorship Data Grouper
- Data Duplicator
- Survivorship Calculation

Output

- Line Chart
- Large Line Chart
- Histogram
- Dual Bar Chart
- Data Viewer

Survivorship Data

Out

Cemetery Name

Cemetery: Hanover Green C

Survivorship Calculation

Data Input

Life Table

Age (x)

Number surviving (sx)

Number of deaths (deaths)

Proportion surviving (lx)

Proportion dying during each year (dx)

Mortality Rate (qx)

Line Chart

x1 Values

y1 Values

Series 1 Label

x2 Values

y2 Values

Series 2 Label

Title

Sub-Title

Title:

Sub-Title:

Height (px): 500

Width (px): 700

X-Axis Label:

Y-Axis Label:

Series 1 Label:

Series 2 Label:

Y-Axis Scale: Linear

Hanover Green Survivorship

Edit Name

Overview

Run

Results

Edit

Settings

Copy

Delete

Survivorship (ESA EcoEd)

Delete Cut Copy Paste Collapse All Expand All Revert... Save Pipe

- ▼ Data
 - Survivorship Data
- ▼ Operations
 - Birth Year Filter
 - Death Year Filter
 - Age Filter
 - Sex Splitter
 - Survivorship Data Grouper
 - Data Duplicator
 - Survivorship Calculation
- ▼ Output
 - Line Chart
 - Large Line Chart
 - Histogram
 - Dual Bar Chart
 - Data Viewer

Survivorship Data

Out

Cemetery Name

Cemetery: Hanover Green C

Survivorship Calculation

Data Input

Life Table

Age (x)

Number surviving (nx)

Number of deaths (dtx)

Proportion surviving (lx)

Proportion dying during each year (dx)

Mortality Rate (qx)

Line Chart

x1 Values

y1 Values

Series 1 Label

x2 Values

y2 Values

Series 2 Label

Title

Sub-Title

Title:

Sub-Title:

Height (px):

Width (px):

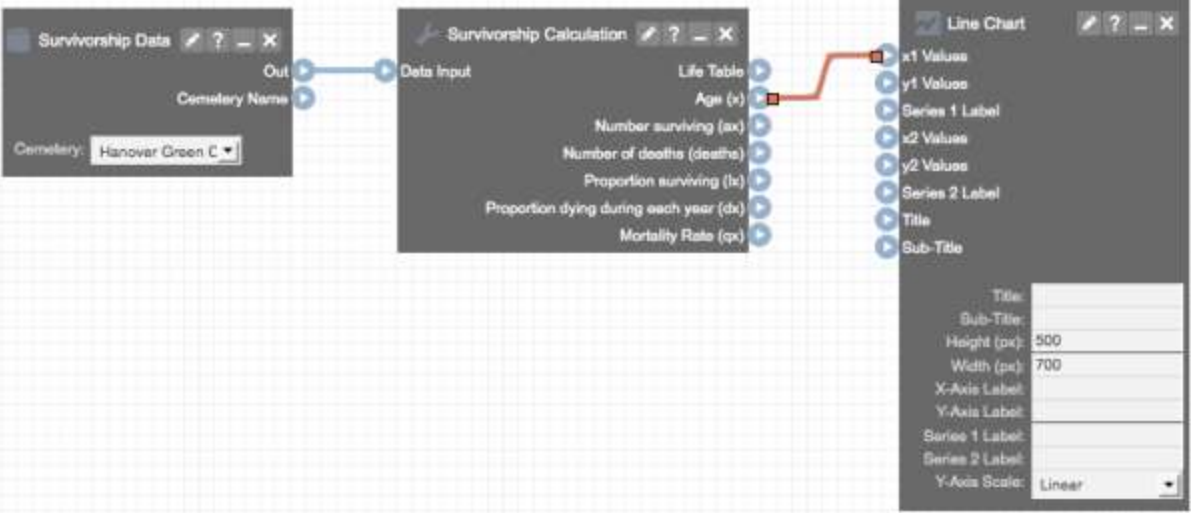
X-Axis Label:

Y-Axis Label:

Series 1 Label:

Series 2 Label:

Y-Axis Scale:



Hanover Green Survivorship

Edit Name

Overview Run Results Edit Settings Copy Delete

Survivorship (ESA EcoEd)

Delete Cut Copy Paste Collapse All Expand All Revert... Save Pipe

Data

- Survivorship Data

Operations

- Birth Year Filter
- Death Year Filter
- Age Filter
- Sex Splitter
- Survivorship Data Grouper
- Data Duplicator
- Survivorship Calculation

Output

- Line Chart
- Large Line Chart
- Histogram
- Dual Bar Chart
- Data Viewer

Survivorship Data

Cometary Name: Hanover Green C

Out

Survivorship Calculation

Data Input

Life Table

Age (x)

Number surviving (sx)

Number of deaths (deaths)

Proportion surviving (lx)

Proportion dying during each year (dx)

Mortality Rate (qx)

Line Chart

x1 Values

y1 Values

Series 1 Label

x2 Values

y2 Values

Series 2 Label

Title

Sub-Title

Title:

Sub-Title:

Height (px): 500

Width (px): 700

X-Axis Label:

Y-Axis Label:

Series 1 Label:

Series 2 Label:

Y-Axis Scale: Linear

Run pipe...

Email me when finished

[Run Pipe](#) [Reset Form](#)

PIPES RUNNING
Nothing running...

PIPES WAITING
Nothing waiting...

RECENTLY FINISHED

- [all cemeteries](#)
Ken Klemow
- [all cemeteries](#)
Ken Klemow
- [Dual bar chart](#)
Ken Klemow
- [Dual bar chart](#)
Ken Klemow
- [Dual bar chart](#)
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- [Dual bar chart](#)
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- [Dual bar chart](#)
Ken Klemow
- [Dual bar chart](#)
Ken Klemow

Hanover Green Survivorship

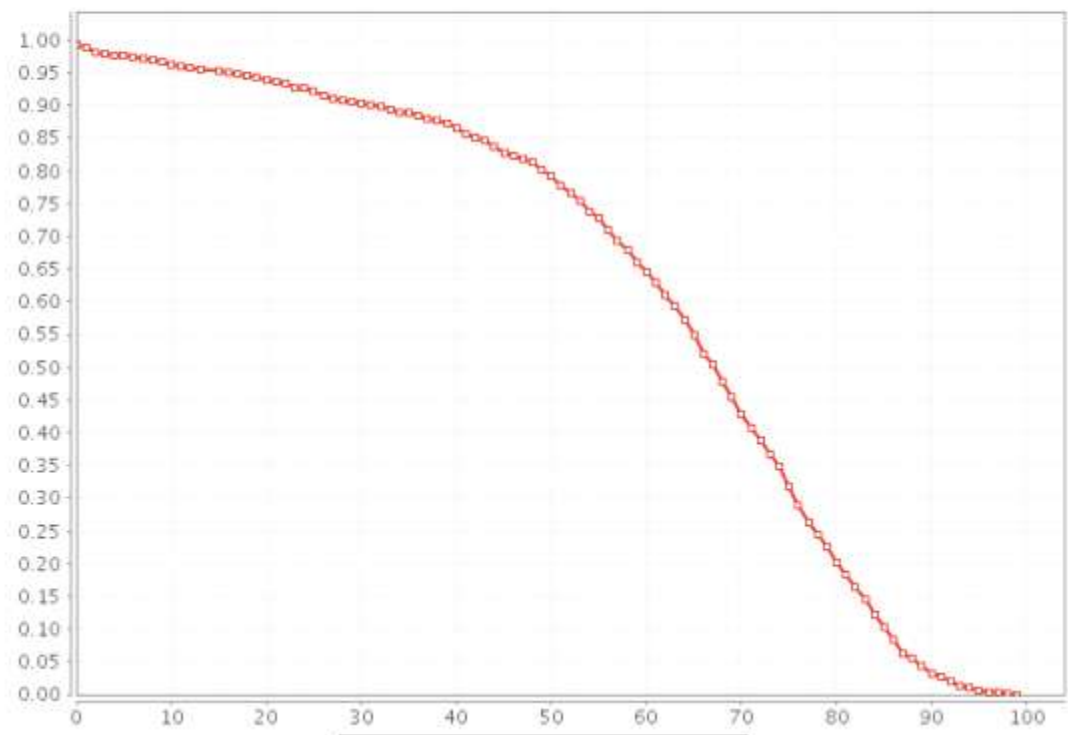
Edit Name

- Overview
- Run
- Results**
- Edit
- Settings
- Copy
- Delete

Results > Mar 28, 2012 11:01 PM (1 second and 351 milliseconds) > View Settings

LINE CHART

FIT FRAME ACTUAL SIZE NEW WINDOW HIDE



Proportion Cohort Surviving [lx] vs Age [x]

Owner: Ken Klemow
Mar 28, 2012 11:00 PM

Add description

Average: ★★★★★
No ratings yet

You: ★★★★★
Click stars to rate

Make this a favorite

YOUR TAGS

Add tags

Pipe Properties

Hanover Green Survivorship

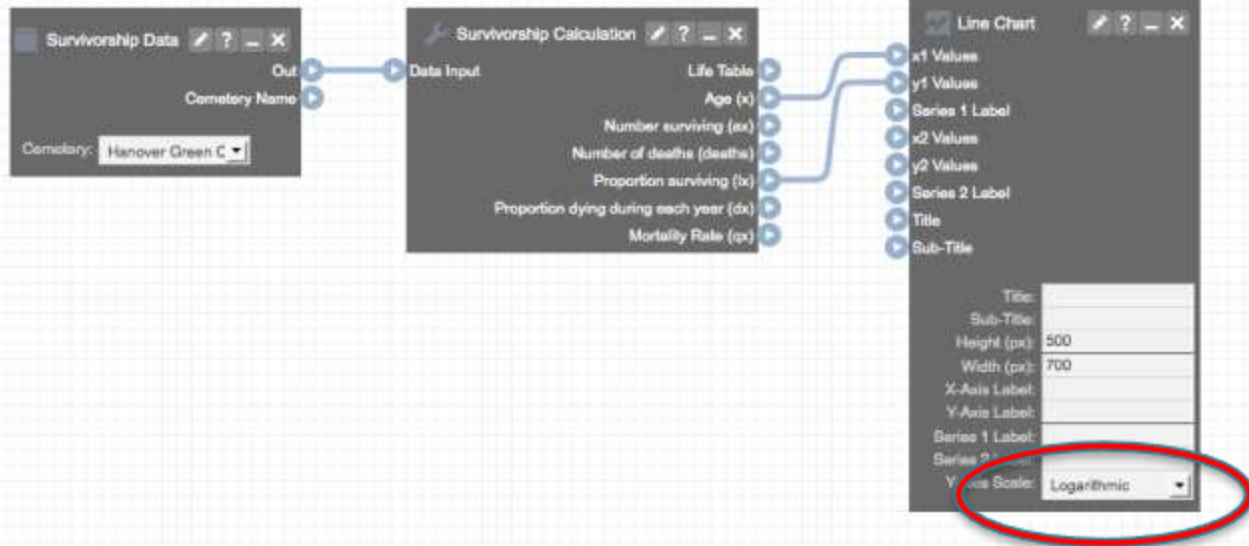
Edit Name

Overview Run Results Edit Settings Copy Delete

Delete Cut Copy Paste Collapse All Expand All Revert... Save Pipe

Survivorship (ESA EcoEd | ▾)

- Data
 - Survivorship Data
- Operations
 - Birth Year Filter
 - Death Year Filter
 - Age Filter
 - Sex Splitter
 - Survivorship Data Grouper
 - Data Duplicator
 - Survivorship Calculation
- Output
 - Line Chart
 - Large Line Chart
 - Histogram
 - Dual Bar Chart
 - Data Viewer



Hanover Green Survivorship

Edit Name

Overview Run Results Edit Settings Copy Delete

Survivorship (ESA EcoEd)

Delete Cut Copy Paste Collapse All Expand All Revert... Save Pipe

- Data
 - Survivorship Data
- Operations
 - Birth Year Filter
 - Death Year Filter
 - Age Filter
 - Sex Splitter
 - Survivorship Data Grouper
 - Data Duplicator
 - Survivorship Calculation
- Output
 - Line Chart
 - Large Line Chart
 - Histogram
 - Dual Bar Chart
 - Data Viewer

Survivorship Data

Out Cemetery Name

Cemetery: Hanover Green C

Survivorship Calculation

Data Input

Life Table

Age (x)

Number surviving (sx)

Number of deaths (d_x)

Proportion surviving (lx)

Proportion dying during each year (d_x)

Mortality Rate (q_x)

Line Chart

x1 Values

y1 Values

Series 1 Label

x2 Values

y2 Values

Series 2 Label

Title

Sub-Title

Title: Over Green Cemetery

Sub-Title:

Height (px): 500

Width (px): 700

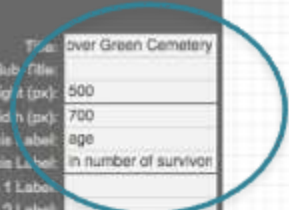
X-Axis Label: age

Y-Axis Label: ln number of survivor

Series 1 Label:

Series 2 Label:

Y-Axis Scale: Logarithmic



Results > Mar 28, 2012 11:05 PM (1 second and 339 milliseconds) > View Settings

LINE CHART

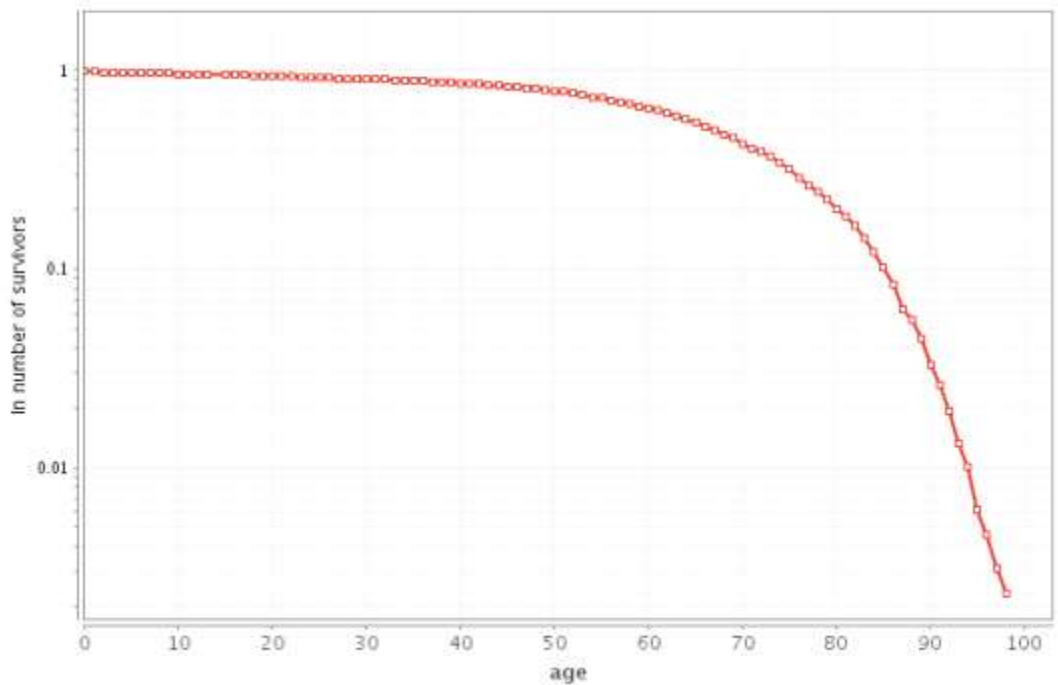
FIT FRAME

ACTUAL SIZE

NEW WINDOW

HIDE

Survivorship in Hanover Green Cemetery



Proportion Cohort Surviving [lx] vs Age [x]

Owner: Ken Klemow
Mar 28, 2012 11:05 PM

Add description

Average: ★★★★★
No ratings yet

You: ★★★★★
Click stars to rate

Make this a favorite

YOUR TAGS

Add tags

Pipe Properties

Hanover Green Survivorship

Edit Name

Overview

Run

Results

Edit

Settings

Copy

Delete

Survivorship (ESA EcoEd)

Delete

Cut

Copy

Paste

Collapse All

Expand All

Revert...

Save Pipe

Data

Survivorship Data

Operations

- Birth Year Filter
- Death Year Filter
- Age Filter
- Sex Splitter
- Survivorship Data Grouper
- Data Duplicator
- Survivorship Calculation

Output

- Line Chart
- Large Line Chart
- Histogram
- Dual Bar Chart
- Data Viewer

Survivorship Data

Out

Cemetery Name

Cemetery: Hanover Green C

Survivorship Calculation

Data Input

Life Table

Age (x)

Number surviving (ax)

Number of deaths (deaths)

Proportion surviving (lx)

Proportion dying during each year (dx)

Mortality Rate (qx)

Line Chart

x1 Values

y1 Values

Series 1 Label

x2 Values

y2 Values

Series 2 Label

Title

Sub-Title

Title: Survivorship in Hano

Sub-Title:

Height (px): 500

Width (px): 700

X-Axis Label: age

Y-Axis Label: ln number of survivor

Series 1 Label:

Series 2 Label:

Y-Axis Scale: Logarithmic

Hanover Green Survivorship

Edit Name

Overview Run Results Edit Settings Copy Delete

Survivorship (ESA EcoEd)

Delete Cut Copy Paste Collapse All Expand All Revert... Save Pipe

Data

Survivorship Data

Operations

- Birth Year Filter
- Death Year Filter
- Age Filter
- Sex Splitter
- Survivorship Data Grouper
- Data Duplicator
- Survivorship Calculation

Output

- Line Chart
- Large Line Chart
- Histogram
- Dual Bar Chart
- Data Viewer

Survivorship Data

Out

Cemetery Name

Cemetery: Hanover Green C

Sex Splitter

In

Male

Female

Survivorship Calculation

Data Input

Life Table

Age (x)

Number surviving (ax)

Number of deaths (deaths)

Proportion surviving (ix)

Proportion dying during each year (dx)

Mortality Rate (qx)

Line Chart

x1 Values

y1 Values

Series 1 Label

x2 Values

y2 Values

Series 2 Label

Title

Sub-Title

Title: Survivorship in Hano

Sub-Title:

Height (px): 500

Width (px): 700

X-Axis Label: age

Y-Axis Label: ln number of survivor

Series 1 Label:

Series 2 Label:

Y-Axis Scale: Logarithmic

Hanover Green Survivorship

Edit Name

Overview

Run

Results

Edit

Settings

Copy

Delete

Survivorship (ESA EcoEd)

Delete

Out

Copy

Paste

Collapse All

Expand All

Revert...

Save Pipe

Data

Survivorship Data

Operations

Birth Year Filter

Death Year Filter

Age Filter

Sex Splitter

Survivorship Data Grouper

Data Duplicator

Survivorship Calculation

Output

Line Chart

Large Line Chart

Histogram

Dual Bar Chart

Data Viewer

Survivorship Data

Out

Cemetery Name

Cemetery: Hanover Green C

Sex Splitter

In

Male

Female

Survivorship Calculation

Data Input

Life Table

Age (x)

Number surviving (ax)

Number of deaths (deaths)

Proportion surviving (lx)

Proportion dying during each year (dx)

Mortality Rate (qx)

Survivorship Calculation

Data Input

Life Table

Age (x)

Number surviving (ax)

Number of deaths (deaths)

Proportion surviving (lx)

Proportion dying during each year (dx)

Mortality Rate (qx)

Line Chart

x1 Values

y1 Values

Series 1 Label

x2 Values

y2 Values

Series 2 Label

Title

Sub-Title

Title: Survivorship in Hanov

Sub-Title:

Height (px): 500

Width (px): 700

X-Axis Label: age

Y-Axis Label: ln number of survivor

Series 1 Label: males

Series 2 Label: females

Y-Axis Scale: Logarithmic

Hanover Green Survivorship

Edit Name



Overview



Run



Results



Edit



Settings



Copy



Delete

Results > Mar 28, 2012 11:11 PM (1 second and 920 milliseconds) View Settings

LINE CHART

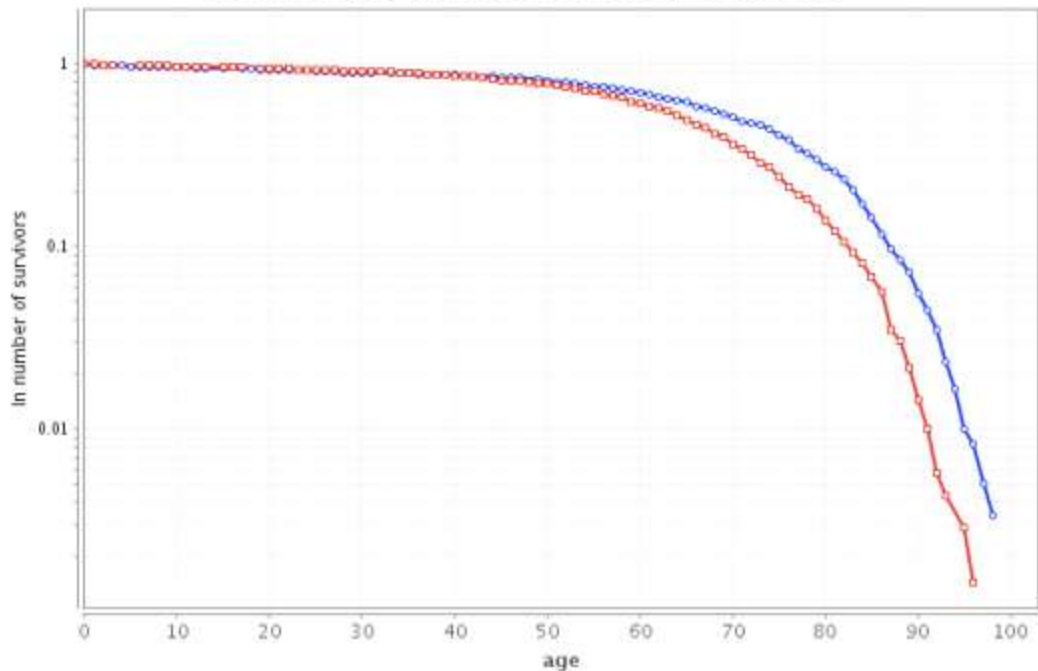
FIT FRAME

ACTUAL SIZE

NEW WINDOW

HIDE

Survivorship in Hanover Green Cemetery



males: Proportion Cohort Surviving [ix] vs Age [x] females: Proportion Cohort Surviving [ix] vs Age [x]

Owner: Ken Klemow

Mar 28, 2012 11:11 PM

Add description

Average: ★★★★★

No ratings yet

You: ★★★★★

Click stars to rate

Make this a favorite

YOUR TAGS

Add tags

Pipe Properties

Hanover Green Survivorship

Edit Name

Overview

Run

Results

Edit

Settings

Copy

Delete

Survivorship (ESA EcoEd)

Delete

Cut

Copy

Paste

Collapse All

Expand All

Revert...

Save Pipe

Data

Survivorship Data

Operations

Birth Year Filter

Death Year Filter

Age Filter

Sex Splitter

Survivorship Data Grouper

Data Duplicator

Survivorship Calculation

Output

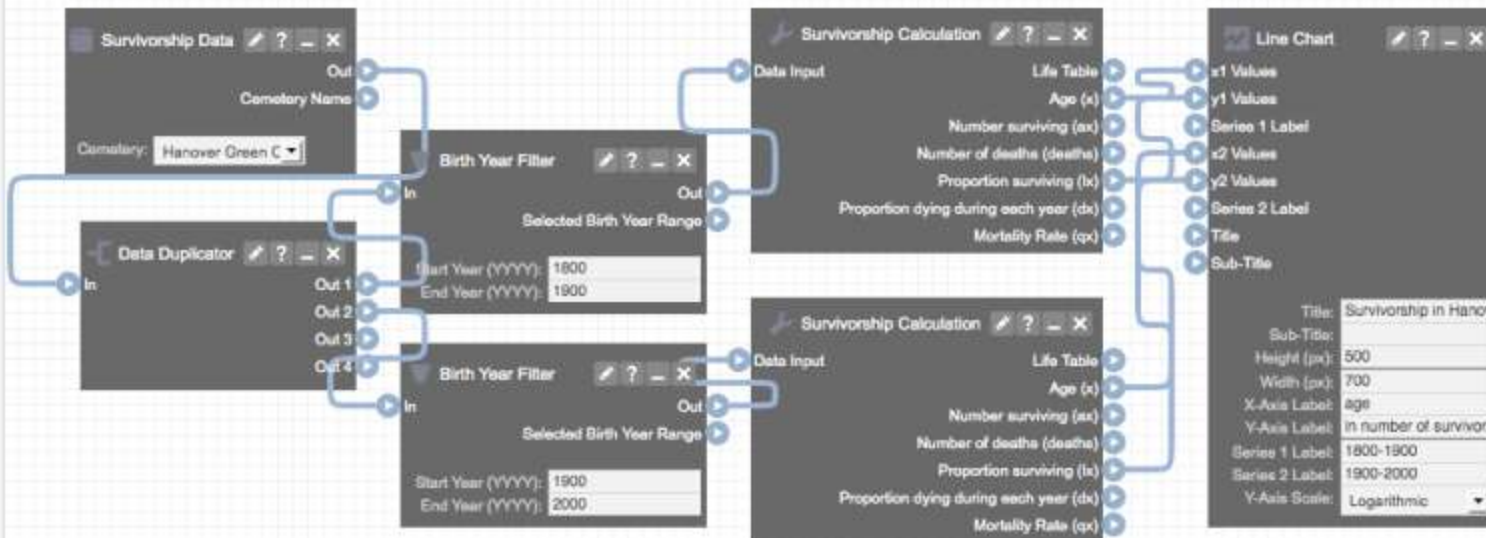
Line Chart

Large Line Chart

Histogram

Dual Bar Chart

Data Viewer

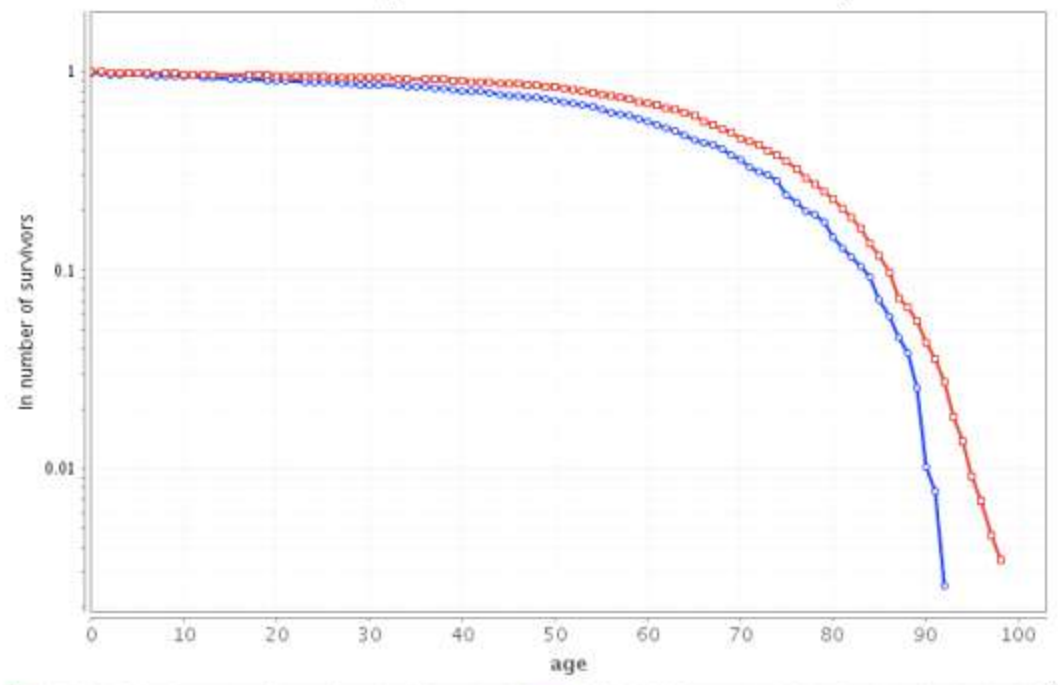


| | |
|-----------------|-----------------------|
| Title: | Survivorship in Hanov |
| Sub-Title: | |
| Height (px): | 500 |
| Width (px): | 700 |
| X-Axis Label: | Age |
| Y-Axis Label: | In number of survivor |
| Series 1 Label: | 1800-1900 |
| Series 2 Label: | 1900-2000 |
| Y-Axis Scale: | Logarithmic |

Results > Mar 28, 2012 11:19 PM (2 seconds and 11 milliseconds) > [View Settings](#)

LINE CHART [FIT FRAME](#) [ACTUAL SIZE](#) [NEW WINDOW](#) [HIDE](#)

Survivorship in Hanover Green Cemetery



—○— 1800-1900: Proportion Cohort Surviving [lx] vs Age [x] —●— 1900-2000: Proportion Cohort Surviving [lx] vs Age [x]

Owner: Ken Klemow
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Ideas for future datasets?

- <http://www.sciencepipes.org>

Kenneth M. Klemow, Ph.D.

Chair, ESA Data in Ecology Classroom (DECA) Panel

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