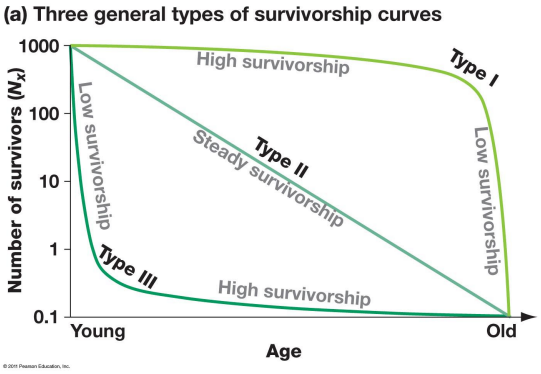
BioSci 0160 – Week 12 Recitation Activity **Survivorship and Population Growth in Primates**

Note: This recitation is adapted from the Dryad Data Teaching Module - Survivorship in the Natural World Susan C. Alberts, Dan Ward, Hilmar Lapp, December 2011: http://datadryad.org/resource/doi:10.5061/dryad.qc524/1



In class we discussed idealized models of survivorship in terms of three archetypes, meant to broadly capture the life histories of different groups of species. The curves for each type represent the mortality patterns as the proportion of individuals still alive as a function of time, in terms of the number of individuals in a cohort that are alive after *x* years.

In this activity, we will examine the survivorship curves generated from real data collected for a number of primates (See Table 1 for information on each study below). The data will allow us to investigate whether survivorship in the natural world conforms to the idealized models of the textbook.

Accessing the dataset:

1. The dataset for the activity can be found at http://bit.ly/primate_survivorship
2. Sign into your Google account. Go to the "file" menu and make a copy of the spreadsheet.

The dataset contains two sheets. The first, entitled *Survivorship Summary*, contains the computed survivorship data for several primate species, broken down by sex. Although the researchers collected data for each sex in the original studies, several of the species only have survivorship data for a single sex due to large statistical error in the missing group. The error largely arises from animals of that sex disappearing during the study either due to immigration or death that the researchers could not explicitly account for.

Visualizing survivorship curves

We will begin by visualizing the survivorship data and identifying which, if any, of the classic models describe the empirical data.

Beginning with the first sheet, select (highlight) all of the data and then click the chart button. You should select the boxes for "Use row 1 as headers" and "Use column A as labels" on the *Start* tab. Under the *Charts* tab, select a line plot. Finally under the *Customize* tab, fill in information for the chart title and horizontal and vertical axes. By default Google Spreadsheet and Excel plot the data on a linear scale for the vertical axis. Does the figure (included at the beginning of this handout) from the textbook plot the survivorship curves on a linear or logarithmic scale? You should change the scale in your own plot using the checkbox under the *axis* section (selecting horizontal or vertical from the dropdown menu) to match the convention shown in the textbook figure. You may have to resize the plot to see the full labels for each curve.

Note that the survivorship data is presented as the percentage of surviving individuals, whereas the figure from the textbook shows the number of surviving individuals from the original cohort. We could convert the latter into the former by dividing each value along the curve by 1000.

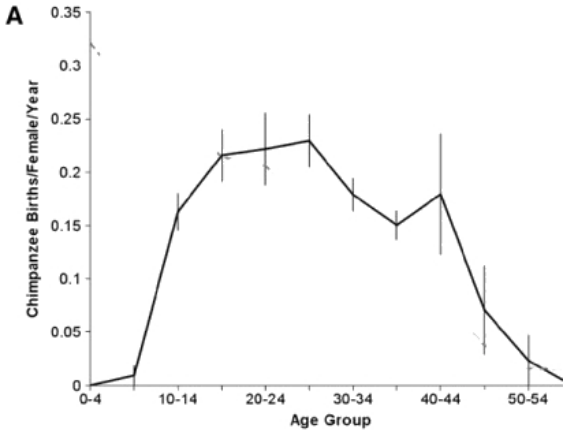
Answer the following questions:

1. For each species and sex, which model survivorship type do they most resemble?
2. Which species has the longest lifespan?
3. Describe any differences you observe between the real data and the model survivorship curves? What do those differences mean in terms of the life history of the animal?
4. Which species has the highest mortality (lowest survivorship) rates during the first 10 years of life? Which has the lowest? You might find it helpful to switch the vertical axis scale back to linear to answer this question.
5. For the species with data given for both sexes, are there observable gender differences? In a couple of sentences, describe any of the differences and suggest possible explanations for the differences.

Population Growth

We will now use the survivorship and age-specific fecundity[1] data to calculate the net reproductive rate for chimpanzees, and investigate models of population growth. This work will be done in the sheet entitled *Population Growth*. We will investigate two models (1) Geometric growth, and (2) Logistic growth.

1. Using the data in the figure on the right, approximate the age specific fecundity for each age group and put those values in the blank column labeled *age-specific fecundity*. Although the figure shows data for ranges of ages, you should enter data for each age-group (one per year) in the spreadsheet. Once you have done this, the sheet should automatically calculate the net reproductive rate, generation time, and the per-capita growth rate, *r*. These cells are colored yellow.
2. Enter the calculated value for *r* into the cell corresponding to *r (model)*. The adjustable parameters for the two growth models are specified in the orange cells. **Answer question 1 below.**
3. Experiment with different carrying capacities, initial population sizes and age-specific fecundities and note how the plots change. Can you create situations in which the population is growing? Shrinking? Can you make the logistic curve look like the geometric curve?



Answer the following questions:

1. For the value of *r* calculated from the survivorship and fecundity data, is the population growing or shrinking?
2. Does the carrying capacity affect the geometric growth curve?
3. Describe what happens to population growth for the logistic model as it approaches carrying capacity.
4. Simulate a dramatic change in the habitat that reduces the carrying capacity by 50%. How is this model different from observed phenomena of population overshoot and crash?

Table 1. Information on the studies (Adapted from the Dryad data set)

Species common name	Taxonomic Group	Country	Research Project	Related web links	When did research project begin?
Baboon	Old World Monkey	Kenya	Amboseli Baboon Research Project	http://www.princeton.edu/~baboon/	1971
Blue monkey	Old World Monkey	Kenya	Kakamega Forest, Blue Monkey Research Project	http://www.columbia.edu/~mc51/	1979
Common chimpanzee	Great ape	Tanzania	The Gombe Chimpanzee Project/Jane Goodall Institute	http://www.discoverchimpanzees.org/researchers/center.php or http://www.janegoodall.org/chimpanzees/researching-wild-chimpanzees	1963
Mountain gorilla	Great ape	Rwanda	Karisoke Research Center/Dian Fossey Gorilla Fund	http://gorillafund.org/karisoke.html	1967
Verreaux's Sifaka	Prosimian	Madagas-car	Beza Mahafaly Sifaka Research	http://www.propithecus-verreauxi.com/	1984

[1] Thompson, et al (2007) *Current Biology* 17, 2150-2156.