

Population Ecology 4 - Life Tables

(Chap. 10)

- A. Patterns of survival and reproduction
- B. Age distributions
- C. Calculating rates of population change
 - a. non-overlapping generations
 - b. overlapping generations

A. Patterns of survival and reproduction

What do we need to know about pop'n to figure out b and d so we can figure out r ?

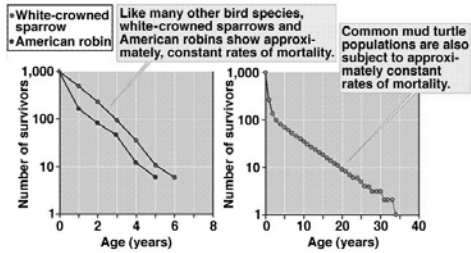
Are birth and death rates similar for all individuals in a population?

How do b and d vary with age?

1. Survivorship curves show how likelihood of death varies with age

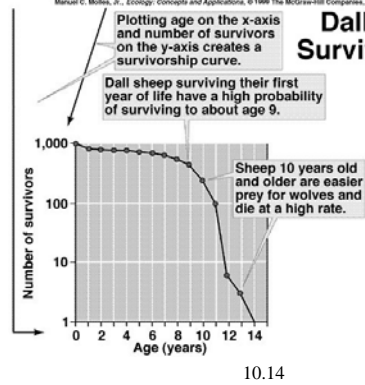
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Constant Rates of Survival



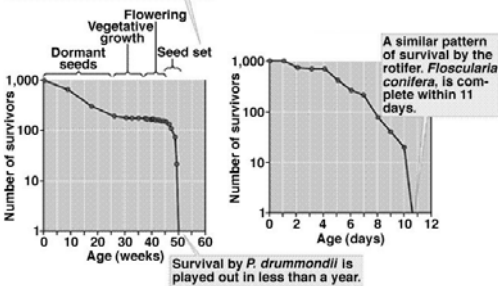
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Dall Sheep Survival, cont.



Plant and Rotifer Survival

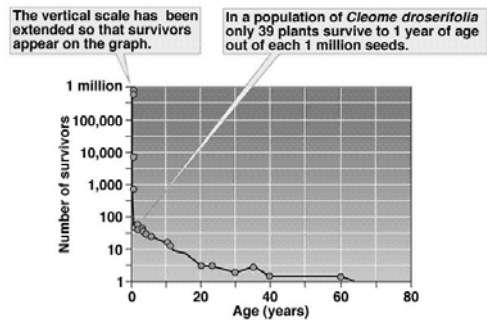
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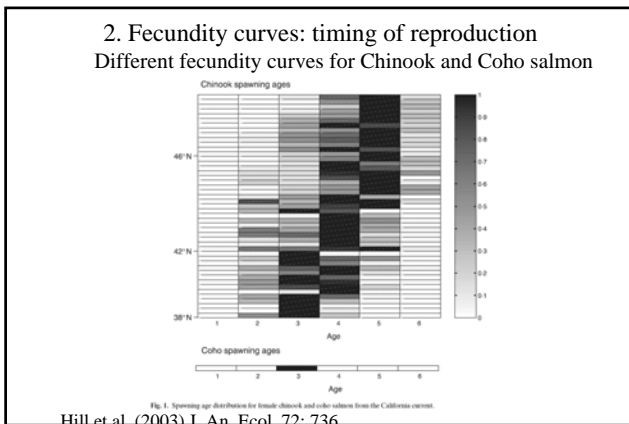
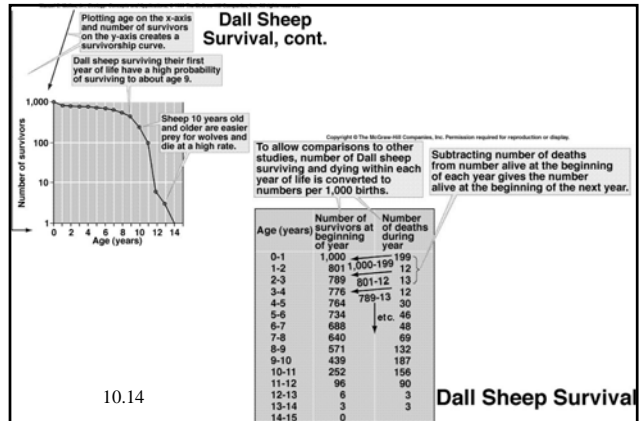
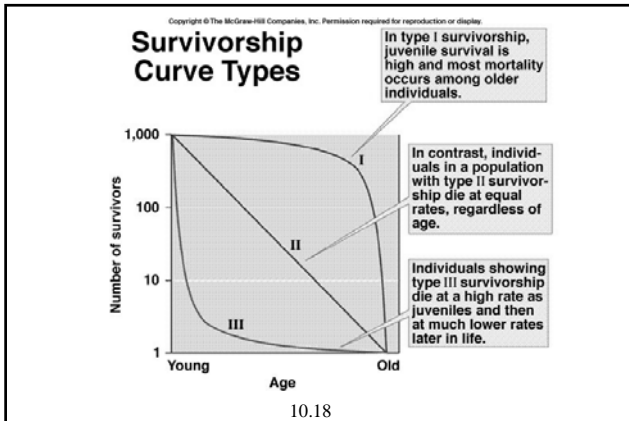


Humans too!

Perennial Plant Mortality

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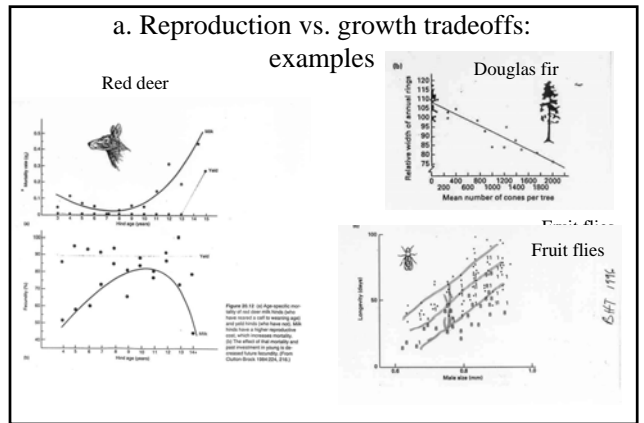


Fecundity for humans and oak trees

3. Relationship to life history traits

Reproductive allocation vs. growth/survival

- limited resources
- reproduction is energetically expensive
- different reproductive strategies
 - frequent disturbances
 - stable environments



b. r- vs K-selection

r-selection K-selection

A. Disturbance	Common, irregular	Rarer, more regular
B. Mortality	Variable, unpredictable	Constant, predictable
C. Competition	Low or variable	High, constant
D. Pop. size	Variable, below K	Rel. constant, near K
E. Consequence	High r	Good competitors



Small size
Rapid growth
Early reproduction
Many, small offspring
Little parental care



Large size
Slow growth
Late reproduction
Few, large offspring
More parental care

FIGURE 12.19 Mouse and elephant: r selection versus K selection.

K vs. r selection: extremes in parental care



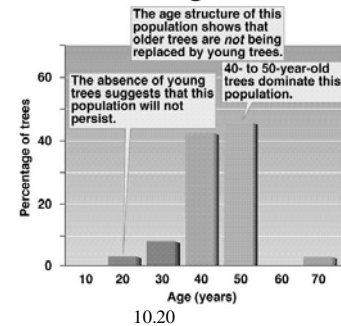
Sea urchins



Humpback whales

B. Age distributions help tell if population is growing or shrinking.

Cottonwood Age Distribution

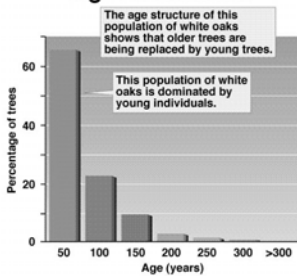


10.20

Is this population growing or shrinking?

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Age Distribution



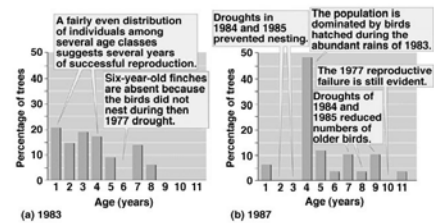
10.19

Can't tell for sure: depends if age distribution is stable or not

Are age distributions typically stable?

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Finch Age Distribution



(a) 1983

(b) 1987

10.21 – Age distributions of large cactus finch, *Geospiza conirostris*, on Genovesa Is., Galapagos

C. Calculating rates of population change

1. Non-overlapping generations

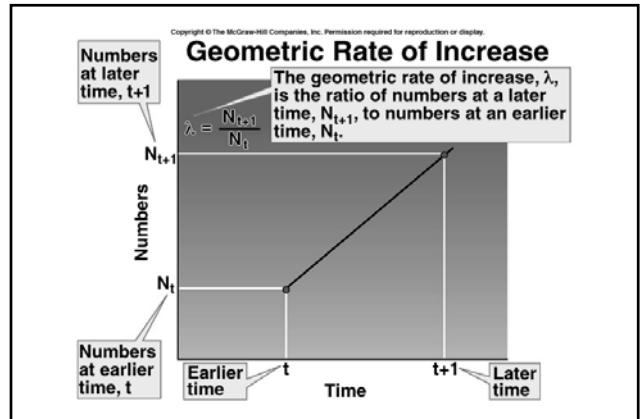


Table 10.1
Combining survivorship with seed production by *P. drummondii* to estimate net reproductive rate, R_0

Age (days)	Number surviving to day x	Proportion surviving to day x	Average number of seeds per individual during time interval	Multiplication of l_x and m_x
x	n_x	l_x	m_x	$l_x m_x$
0-299	996	1.0000	0.0000	0.0000
299-306	158	0.1586	0.3394	0.0532
306-13	154	0.1546	0.7963	0.1231
313-20	151	0.1516	2.3995	0.3638
320-27	147	0.1476	3.1904	0.4589
327-34	136	0.1365	2.5411	0.3470
334-41	105	0.1054	3.1589	0.3330
341-48	74	0.0743	8.6625	0.6436
348-55	22	0.0221	4.3072	0.0951
355-62	0	0.0000	0.0000	0.0000

Data from Levitch and Levin 1979.

Each individual leaves an average of 2.4177 offspring.

$$R_0 = \sum l_x m_x = 2.4177$$

The value of R_0 , which is greater than 1.0, indicates that this population of *P. drummondii* is growing.

Summing the final column yields R_0 , the net reproductive rate per individual.

2. Overlapping generations: life tables

(use board)

Table 10.2
Calculating net reproductive rate, R_0 , and generation time, T , for a population of the common reed, *Phragmites australis*

Age (years)	l_x	m_x	$l_x m_x$	$x l_x m_x$
0	1.0000	0	0	0
1	0.9500	0	0	0
2	0.7500	0	0	0
3	0.5000	0	0	0
4	0.3750	0.0076	0.0028	0.0114
5	0.2875	0.0090	0.0026	0.0130
6	0.2150	0.0079	0.0017	0.0102
7	0.1575	0.0088	0.0014	0.0099
8	0.1150	0.0045	0.0005	0.0040
9	0.0825	0.0036	0.0003	0.0027
10	0.0600	0.0028	0.0002	0.0018
11	0.0450	0.0022	0.0001	0.0014
12	0.0325	0.0018	0.0001	0.0010
13	0.0225	0.0014	0.0000	0.0003
14	0.0150	0.0011	0.0000	0.0002
15	0.0100	0.0008	0.0000	0.0001
16	0.0075	0.0006	0.0000	0.0001
17	0.0050	0.0004	0.0000	0.0000
18	0.0030	0.0002	0.0000	0.0000
19	0.0020	0.0001	0.0000	0.0000
20	0.0015	0.0001	0.0000	0.0000
21	0.0010	0.0000	0.0000	0.0000
22	0.0007	0.0000	0.0000	0.0000
23	0.0005	0.0000	0.0000	0.0000
24	0.0003	0.0000	0.0000	0.0000
25	0.0002	0.0000	0.0000	0.0000
26	0.0001	0.0000	0.0000	0.0000
27	0.0001	0.0000	0.0000	0.0000
28	0.0000	0.0000	0.0000	0.0000
29	0.0000	0.0000	0.0000	0.0000
30	0.0000	0.0000	0.0000	0.0000
31	0.0000	0.0000	0.0000	0.0000
32	0.0000	0.0000	0.0000	0.0000
33	0.0000	0.0000	0.0000	0.0000
34	0.0000	0.0000	0.0000	0.0000
35	0.0000	0.0000	0.0000	0.0000
36	0.0000	0.0000	0.0000	0.0000
37	0.0000	0.0000	0.0000	0.0000
38	0.0000	0.0000	0.0000	0.0000
39	0.0000	0.0000	0.0000	0.0000
40	0.0000	0.0000	0.0000	0.0000

Summing the final column yields $R_0 = 0.0011$. The generation time for this population is 10.0 years.

$$R_0 = \sum l_x m_x = 0.0011$$

$$T = \frac{\sum x l_x m_x}{R_0} = 10.0$$

End