

The term "population" is interpreted differently in various sciences:

- In human demography a population is a set of humans in a given area.
- In genetics and ecology, a population is a group of interbreeding individuals of the same species, which is isolated from other groups.

Passenger Pigeon

- Once abundant in early 1800's
- May have been the most abundant bird that ever existed
- Audubon observed flock that took 3 days to pass
- Great flocks with 300,000,000 birds per hour, that could be heard 6 miles away
- One flock contained 2 billion birds
- Nested in long narrow colonies, 90 nests/tree, 40 miles long and 3 miles wide.
- They fed on acorns and beechnuts of great eastern forests, as well as other fruits
- But only laid 1 egg at a time

Passenger Pigeon and Humans

- They were easy targets for human food
- Early settlers could simply walk through nesting grounds and pick up injured adults or squabs knocked out of nests
- Railroads opened paths for market hunters to transport pigeons to centers like New York. Telegraph allowed the birds to be tracked.
- Methods used
 - Suffocation, by burning grass or sulfur below their roosts
 - Fed alcohol soaked grains then picked up drunk
 - Knocked out of trees with broom handles
 - Shotguns
 - Nets
 - Felling trees
 - Stool pigeon tied to perch with eyes sewn shut
- Live birds were used as targets in shooting galleries
- In 1878, a market hunter in MI shipped 3 million birds, where their last stronghold was held
- Last wild bird seen on 1900
- Martha died in 1914 in Cincinnati zoo
- First time we knew the exact moment of a species extinction

Population Ecology

- Population ecology is the branch of ecology that studies the structure and dynamics of populations
- Studies factors that affect populations, such as competition, predation, disease, weather, catastrophes...
- Life tables - demographics
 - static life table: observer infers past population from current members or evidence from dead members of the population
 - cohort life table: following a group of similarly aged individuals from birth to death
- Is useful information to have in order to (1) reduce population size of pests [integrated pest management] (2) increase population size of endangered species [conservation biology]

Life tables - demographics

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<i>x</i>	<i>n</i>	<i>d</i>	<i>l</i>	<i>q</i>	<i>L</i>	<i>T</i>	<i>e</i>	<i>m</i>	<i>l x m</i>
age class	# alive beginning	# deaths during	proportion alive beginning	death rate during	average # alive	sum of ave. living age classes	life expectancy $l(x)$	fecundity	
0-1	10000	1000	1	0.1	9500	30100	3.01	0	0
1-2	9000	1000	0.9	0.11111111	8500	20600	2.289	0	0
2-3	8000	0	0.8	0	8000	12100	1.513	0.5	0.4
3-4	8000	7900	0.8	0.9875	4050	4100	0.5125	0.6	0.48
4-5	100	100	0.01	1	50	50	0.5	0.1	0.001
									R= 0.881

Major components of a population system

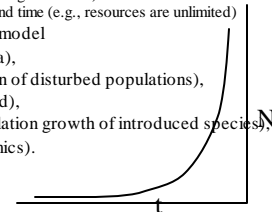
- Population itself. Organisms in the population can be subdivided into groups according to their age, stage, sex, and other characteristics.
- Resources: food, shelters, nesting places, space, etc.
- Enemies: predators, parasites, pathogens, etc.
- Environment: air (water, soil) temperature, composition; variability of these characteristics in time and space.

Why do population sizes change?

- Increases
 - births (B)
 - immigration (I)
- Decreases
 - deaths (D)
 - emigrations (E)
- $N_t = N_0 + B - D + I - E$
 - I and E are often ignored in population models, esp. when considering world human population sizes

Exponential Model

- growth by constant rate 2, 4, 8, 16, 32, 64
- $N_t = N_0 e^{rt}$
- e^r = number of female offspring per individual
- t = time, expressed as number of generations
- $dN/dt = rN$
- Assumptions of Exponential Model:
 - Continuous reproduction (e.g., no seasonality)
 - All organisms are identical (e.g., no age structure)
 - Environment is constant in space and time (e.g., resources are unlimited)
- Applications of the exponential model
 - microbiology (growth of bacteria),
 - conservation biology (restoration of disturbed populations),
 - insect rearing (prediction of yield),
 - plant or insect quarantine (population growth of introduced species),
 - fishery (prediction of fish dynamics).



Biotic potential

$N_t = N_0 e^{rt}$

A female fruit flies lays 100 eggs that will mature in 12 days. After 1 year...

$e^r = 50$; $t = 365/12 = 30.4$; $N_0 = 1$, what is N_t ?

$N_t = 1 \times 50^{30.4} = 4.5 \times 10^{51}$ = # females after 1 year

Total number of flies (males + females) = 9×10^{51} (1:1 sex ratio)

Each fly weighs 0.5 mg; total mass of last generation would be $4.5 \times 10^{51} \text{ kg} \sim 4.5 \times 10^{33} \text{ km}^3$

Earth weighs $6 \times 10^{24} \text{ kg}$

Flies would weigh 750,000,000,000,000,000,000,000 times more than Earth

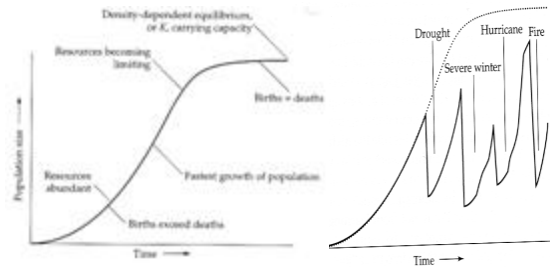
Earth's surface area = $510,000,000 \text{ km}^2$; distance to moon is 385,000 km

After 1 year, flies would fill a box with the area of Earth to $8.8 \times 10^{24} \text{ km}$ high, or 23,000,000,000,000,000,000,000 times past the moon

Does this help you appreciate the importance of decomposers?

Logistic Model

- $dN_1/dt = r_1 N_1 (1 - N_1/K_1)$ (intraspecific competition)
- $dN_1/dt = rN_1 (1 - N_1/K_1 - P_{12}N_2/K_1)$ (interspecific competition)
- density dependent vs. density independent factor



Marine Fisheries

- For the first time in this century, world marine fish catches are declining.
- The downward trend in marine productivity stands in stark contrast to the remarkable growth in world catches during most of this century -- from about 3 million tons in 1900 to a high of 86 million tons in 1989, when harvests peaked.
- To fisheries experts, recent declines are a warning that current levels of exploitation have exceeded the productive limits of many of the world's marine ecosystems.
- A 1990 U.N. survey of world fisheries confirmed that view, classifying nearly every commercial species it surveyed as fully exploited, over-exploited, or depleted.

Solutions

- MSY
- Stop the subsidy
- Marine sanctuaries
- Protest (it worked with tuna)
- Buying habits
- Fishing methods
 - drift lines
 - CN
 - TNT
 - TEDs

