Lect 19 - Populations - Chapter 23

- Different Levels of Ecological Organization
  - Individuals
  - Populations
  - Assemblage
  - Community
  - Ecosystem

Populations

Populations - all individuals of a particular species in a given area - but need to recognize genetic structure - “a gene pool that has continuity through time because of reproductive activities of the individuals in the population”. Populations grow and shrink and that effects genes.

- Four major factors effect populations: Birth, death, immigration, emigration.

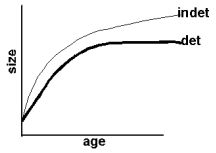
Populations

- Four major factors effect populations: Birth, death, immigration, emigration.

Populations

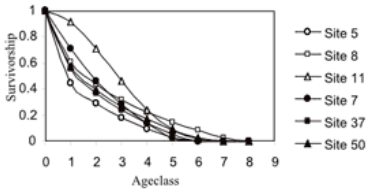
Life Tables - birth and death rates (age-specific reproduction and survivorship) used to calculate population change -

- Death rates = survivorship = Lx
- Reproductive Output per female = Mx
- Reproductive rate of population = LxMx
- Net Reproductive Rate = summation LxMx
- Migration - immigration vs emigration



GROWTH

Survivorship curves
Survival probabilities lx plotted against age x. Called "survivorship curves". Show, at what age death rates are high and low



Survivorship curve (illustrated above) can be combined with age-specific fertility to estimate population turnover using a life table approach

a. Site 7

Age	*Age Class*	*b(x)*	*l(x)*	*g(x)*	*l(x)b(x)*	*l(x)b(x)x*	*Estimate $e^{-rx}l(x)b(x)$*	*Corrected $e^{-rx}l(x)b(x)$*
0-29	0	0	1	0.710	0	0	0	0
30-59	1	1.039	0.710	0.644	0.738	0.738	0.521	0.506
60-89	2	1.464	0.457	0.607	0.669	1.339	0.333	0.315
90-119	3	1.662	0.278	0.499	0.462	1.385	0.162	0.149
120-149	4	1	0.139	0.179	0.139	0.554	0.034	0.031
150-179	5	0	0.025	0	0	0	0	0
180-209	6	0	0		0	0	0	0
G=	2.000	age classes (30 days)			$=R_o=$	=	=	=
r(est)=	0.348	ind/(ind*30 days)			2.008	4.016	1.051	1.000
Corr=	0.029							
r(Euler)=	0.378	ind/(ind*30 days)						

Populations

- Recruitment - addition to a population through reproduction; eg larval fish settle
- In fisheries, recruitment refers to Stock = potentially catchable individuals
- Colonization - addition of established individuals - nursery habitat to adult habitat
- Year class or cohort - strength very important e.g. if have dense old fish but no young fish the population can collapse very quickly

Populations

- Populations often size structured - not just age
- Indeterminate growth and overlapping generations create populations of very different size individuals;
- Size can effect where individuals feed - Ontogenetic niches and shifts - many examples.

Populations

- Death - eggs and larvae most dangerous time for a fish; up to 99.9%; many predators including own species - Cannibalism - very common in fish;

Populations

- Production –
  - How much biomass is a fish population producing?
  - How much is available to predators (including humans) without crashing population?
  - Can production be predicted from certain life history parameters?

Populations

- Production = growth rate of individual over time x biomass of age class corrected for mortality;
- Varies from 0.1 g/m2/yr for sockeye salmon in Oregon Lake to 155 g/m2/yr for Desert Pupfish
- Most 1 to 10; Tropical and fertilized ponds greater;

Populations

- Annual turnover = production/biomass; young fish have small biomass but fast growth rate - turnover great - index of how productive populations are.

Populations

Genetic Structure of populations vs Physical Structure of population

- Gene flow - exchange of genes across boundaries and between populations; influences how we view a population;
- Demes - Distinct genetic groupings vs species such as eels - distinct physical populations but reunite to spawn
- Panmictic Spawning (entire species consists of one population - eg all individuals have equal probability of reproducing) vs genetically discrete stocks - salmon will be physically together for most of life but will have genetically distinct stocks that separate and return to their natural streams.

Populations

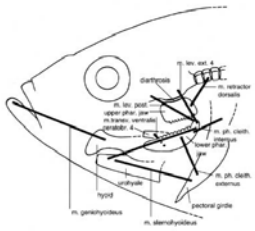
Genetic vs ecophenotypic differentiation

- Arctic char - distinct genetic populations within a lake; four distinct morphs that are genetically and ecologically distinct; feeding; inshore v offshore; coloration etc.

Populations

Genetic vs ecophenotypic differentiation

- differences are genetic not ecophenotypic - like cichlid pharyngeal jaws can be.



Populations

Understanding genetic makeup has become increasingly important - as species decline and are over-exploited; Degree of genetic variation in population is key.

Herring

Metapopulation

Populations

Another important factor that influences genetic structure of fish populations is Hybridization

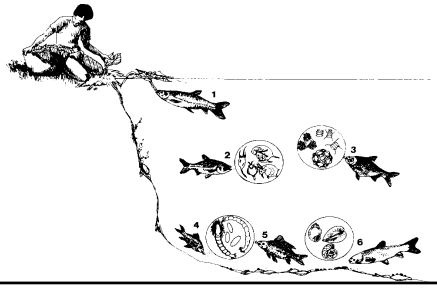
- Heterosis vs. Species isolating mechanisms

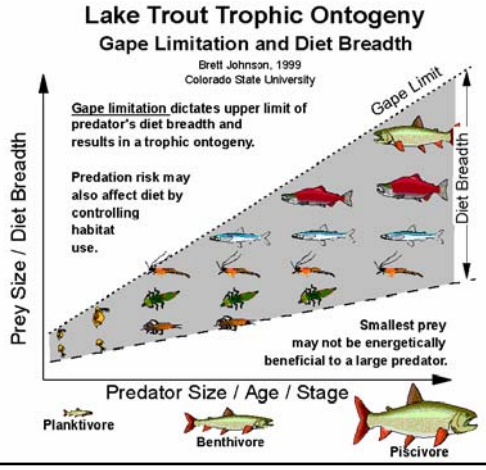
Populations

- Assemblages - various species populations of a larger taxon (e.g. fish) in defined areas - look at competitive and predator interactions

Populations

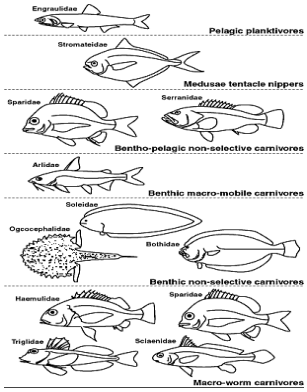
- Niches - ecological function of fish; what fish does for living; nth dimensional hyper-volume; what fish eats, what eats it, temperature etc.





Populations

- Guilds - ecological rather than taxonomic similarities; habitat preferences in streams; feeding preferences;



Populations

Fish often classified by habitat preferences
Habitat Use and Choice

- Fish have specific habitat use - many examples of convergence - between systems and lakes etc; can change with season; ontogeny; Deeper bigger; Predation influence - cannibalism can also influence - cottids and bluegills.

Populations

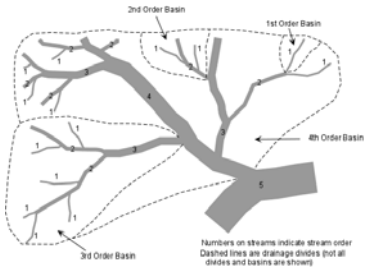
Fish often classified by habitat preferences -

- Habitat Choice and Spatial Structure in Fish Assemblages - Zonation - compare fish assemblages across environmental gradients; water velocity, temperature, width, depth etc.

Populations

Zonation - Stream order

- Longitudinal zones - upstream - more dependence on allochthonous inputs vs autochthonous (production of stream itself) inputs



Populations

Competition - intra- vs. interspecific - resource partioning in sympatric species

- Predation
  - Direct effects v indirect effects
  - Density dependent - Direct density dependence = **compensatory** - predation increases to compensate for increases in prey population size.
- Inverse density dependence = depensatory - relative predation risk and impact decrease as prey numbers increase - fixed number of predators become swamped - salmon smolt, spawning runs.
- Predation effects major - both population/ genetic structure - primarily in young - exponentially declining mortality

TROPHIC CASCADES & TOP-DOWN vs BOTTOM-UP