SUMMARIES OF POPULATION MODELS

OUTLINE OF POPULATION MODELS & CONCEPTS: Population growth models

MODEL	CONCEPT
Exponential Growth	Population growth (*dN/dt*) increases at a constant rate *r* and is not limited
Logistic Growth (Verhulst-Pearl Equation)	Population growth (*dN/dt*) is initially exponential, but becomes inhibited by environmental factors which result in zero growth at the carrying capacity (*K*) of the environment. Growth limited by environment.

OUTLINE OF POPULATION MODELS & CONCEPTS: Predator/prey models

MODEL	CONCEPT
Predator/Prey Model	Population growth of a prey species (dN_2/dt) is dependent on (Lotka-Volterra Equations) the number of predators (N_1) in the environment. Population growth (dN_1/dt) of the predator is dependent on the number of prey in the environment. Predator densities directly affect the death rate of the prey. Prey densities directly affect the birth rate of the predator. The birth rate of the prey is not affected by the predator density. The death rate of the predator is not affected by the prey density. Inefficient predators tend to make the system stable because the prey population cycles near its carrying capacity. Moderately efficient predators tend to make the system less stable, but the system still cycles. Very efficient predators drive the prey to extinction by feeding and then go to extinction themseleves. The use of a refugium stabilizes a system where a highly efficient predator is present.

OUTLINE OF POPULATION MODELS & CONCEPTS: Parasitoid/host models

MODEL	CONCEPT
Parasitoid/Host Model (Thompson's Equation)	The production of parasites from one generation to another is based upon the random search of the parasitoid for the host. Parasitoid densities are a function (result from) of the density of the hosts. The model results in extinction of the parasites and host.
Parasitoid/Host Model (Nicholson's Equations)	Considers parasitoid and host to be in the condition of "steady state" (= equilibrium). Searching for hosts by the parasitoid population is assumed to be random. The rate at which the parasites find hosts to parasitize is proportional to the host density. The area of discovery is constant. The increase or decrease in host density from one generation to the next is dependent on initial host density, the proportion of hosts parasitized, and the host's reproductive rate. Parasitoid density increase or decrease from one generation to the next is dependent upon the initial host generation and the proportion of hosts attacked in that generation multiplied by the density of parasites present. The model is unstable because it assumes that the rate of parasitoid attack continues to increase at the same initial rate as the host density increases. Does not consider density dependent factors at high host densities. System is unstable (both species go to extinction) unless density dependent components are added which affects parasitoid behavior (i.e., handling time, searching interference).
Parasitoid/Host Sub-Models	
a. **Hassel & Varley** ("interference" or"Quest Constant" model)	Effectiveness of parasitoid searching decreases as parasitoid density increases (intraspecific competition) due to "interference" of parasite's searching ability when search is interrupted by chance meeting with another parasitoid. Interference increases as parasitoid density increases. Acts as a stabilizing factor in system. As effectiveness of parasitoid searching decreases (area of discovery "a" decreases) system becomes more stable because host densities tend to be regulated more by intraspecific density dependence. As effectiveness of parasitoid searching increases ("a" increases), system becomes stable through a certain range of area of discovery values, but then becomes unstable again as value is made higher. This is because parasitoid can then search out all hosts and destroy them leading to extinction of host population.
b. **Holling "Disc" Equation Model**	Effectiveness of parasitoid searching for hosts is a result of several parameters of which handling time, total searching time, and rate of parasitoid attack are important. Increases in host density increase the total amount of handling time required for all hosts and reduces the total amount of time spent searching for hosts. Handling time acts as a stabilizing factor.