BIOS 3010: Ecology
Lecture 4: Distribution and Movement

• Lecture summary:
  – Patterns of dispersion.
  – Dispersal, Range expansion and Migration.

2. Patterns of dispersion:

• Dispersion is the distribution pattern produced as a result of movement: either dispersal or migration.
• There are three basic patterns of dispersion:
  – Random - equal probability of occupying any point in space
  – Regular - (regular, even or overdispersed) evenly spaced because individuals tend to avoid each other
  – Aggregated - (contagious, clumped or underdispersed) individuals are closer together than expected by chance because of a tendency to be attracted
  • see Fig. 5.1 - at different scales the same observation (e.g. aphids on a leaf) can appear aggregated at large scales (landscape or woodland ecosystem), random at intermediate scales (leaves of a host tree), or regular (single leaf).

3. Dispersal:

• Dispersal is the movement of individuals from the homesite or,
• the spreading of individuals away from each other e.g. of offspring from their parents and from regions of high density to regions of lower density (Begon et al. glossary).
  – Basically it is the movement of organisms in response to resource distribution and habitat conditions (both abiotic - temperature etc., and biotic - competitors, predators etc.)
  – Patterns of dispersal are commonly shown by a negatively asymptotic curve with most dispersing units falling near their origin (Figs. 5.1 & 5.10)
4. Dispersal can be increased in 2 ways:

- 1) More dispersing units
- 2) Greater vagility:
  - increased dispersal ability by increased adaptations for dispersal on wind, water etc., or better adapted movement behaviors.

- Reasons for dispersal include:
  - 1) avoiding crowding:
    - proximate: ultimate = avoidance of resource depletion.
  - 2) avoiding competition with relatives.
  - 3) avoiding inbreeding and negative genetic consequences.

5. Dispersal in time or space (passive & active):

- Periodical cicadas (Fig. 6.3) are essentially dispersing in time to avoid predation by synchronous emergence every 13 or 17 years (like plant dormancy).
- Other species disperse actively in space in ways that facilitate their immigration to islands of habitat (real islands or habitat patches) as in Fig. 5.3 for birds, or Fig. 6.13 for the Colorado potato beetle:
  - most individuals disperse away from the birth site!
- Or, dispersal polymorphisms (bet-hedging) as in Fig. 5.10
- Passive dispersal of animals in water - marine versus freshwater organisms (Fig. 5.8); or passive dispersal of seeds (Fig. 5.9).

6. Range Expansion:

- "Range Expansion is the product of successful dispersal into an area not formerly occupied by the species"

- Range expansion usually follows events such as:
  - 1) removal of an ecological, physiological or behavioral barrier.
  - 2) formerly unsuitable habitat becomes suitable.
  - 3) an evolutionary shift (could be components of 1 and 2).
  - (see Figs 2-19, 2-20 & 2-21 from Brewer, 1994)
7. Migration and life cycles:

- Begon et al define migration as:
  - "The movement of individuals, and commonly whole populations, from one region to another."
  - "the mass directional movements of large numbers of a species from one location to another."

- Baker (1978) uses:
  - "the act of moving from one spatial unit to another*"
  - Baker uses this definition so that life histories of variable temporal and spatial scale are included (Figs. 4.1, 5.1) - multiple journeys (Fig. 5.1), single return journeys & one-way journeys. Or a response to environmental stochasticity causing outbreaks (Fig. 5.1).

- I like the following definition (my own) best of all:
  - "predictable and directional movement of populations (or individuals & their genes) between spatially separated resources"

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**Figure 5.1**

- (a) Patterns of dispersion
- (b) spatial changes with time in the grass *Festuca ovina*
- See Fig 6.3 (4th ed.).

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**Figure 5.5** (3rd ed.)

- (a, b) Eucalyptus seed shadow
- (c) 2-D seed shadow of tropical *Lonchocarpus*
- (d) Seed density and dispersal distance
**Figure 5.12 (3rd ed.)**
- Dispersal distance from birth site in great tits to site of first breeding

**Figure 6.5**
- Density changes in 13-year periodical cicadas & % predation

**Figure 5.3 (see fig 21.19, 4th ed.)**
- Fraction of islands occupied ($J$) against number of bird species on an island ($S$) for (a) “supertramp” pigeon (colonist) and (b) high-$S$ cuckoo (competitor) in Bismark archipelago.
**Figure 6.13**

- Spread of the Colorado potato beetle in Europe

**Figure 5.10**

- Dispersal polymorphisms in insects and plants

**Figure 5.9**

- Dispersal stages in marine and freshwater habitats
Figure 2.19: Brewer (1994)

- Geographical range and dispersal

Figure 2.20: Brewer (1994)

- Range expansion of the opossum

Figure 2.21: Brewer (1994)

- Zebra mussel distribution in the Great Lakes region, 1991
Figure 5.14 (3rd ed.)

- Migration patterns in relation to life cycles

Figure 6.7: Global migration of knots (Calidris spp.)

Figure 5.16 (a, b, c) (3rd ed.)

- Development, migration and subsidence of a desert locust (Schistocerca gregaria) outbreak in Africa
Figure 5.16 (d, e, f)

- Locust migration … continued