BIOL 410 Population and Community Ecology

Movement, migration, dispersal

Movement?

$$N_{t+1} = N_t + B - D + I - E$$

What does movement influence?

(population, community perspective)

Many population studies

Main drivers

$$N_{t+1} = N_t + B - D + I - E$$

Minor contribution
I == E functionally

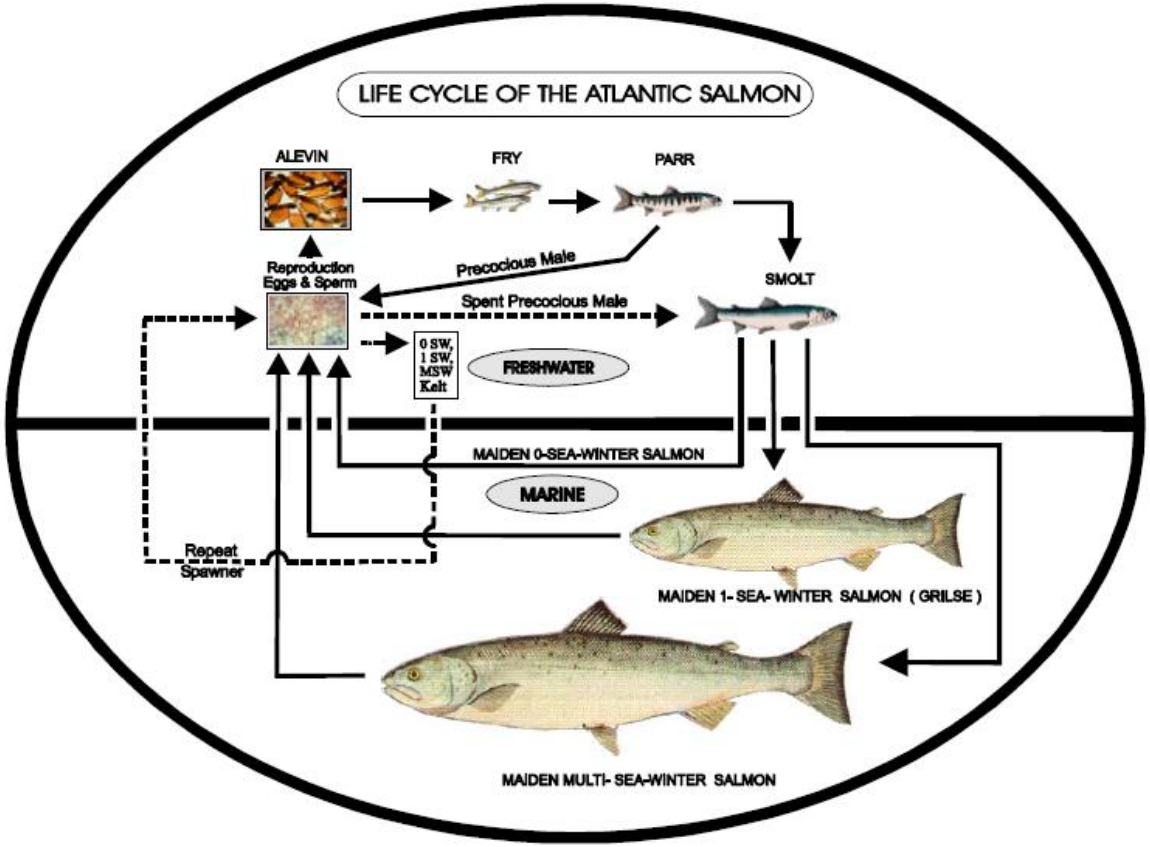
- Metapopulation models
- Source-sink models
- Island biogeography

Why do organisms move?

- Why move from a good spot?
  - Crowding at spot
  - Degradation of spot
  - Environmental degradation of spot
- Movement is risky
  - Mortality during movement
  - Not finding a better spot
- Evolution of dispersal (movement)
  - Chance of occupying a site more favorable than the one you are currently in
  - Dispersal as ESS (kin competition)

Migration and movement patterns

What needs to be known to adequately represent the population dynamics?



Migration vs. dispersal

- Migration
  - Movement of large numbers of a species from one place to another, usually leaving no individuals behind
    - E.g. bird migration, locust swarms
- Dispersal
  - Spreading of individuals away from others, often parents or siblings, which remain in the original area
    - E.g. dispersal of plant seeds, movement of mammals away from their social group.
- Both movements away from unfavorable location to a potentially more favorable location

Migration and movement patterns

1. Multiple returns
    1. Diurnal migration
    2. Seasonal migration
    3. Annual migration
2. One return only
    1. Breeding sites (semelparous)
    2. Larval and adult habitat
3. One way only
    1. Multigenerational migration

Migration: Diurnal

- Diel vertical migration in zooplankton
  - Predator avoidance
  - Metabolic advantages
  - Dispersal and transport
  - Avoid UV damage

Functional Ecology 1989, 3, 21-27

ESSAY REVIEW

The adaptive significance of diel vertical migration of zooplankton

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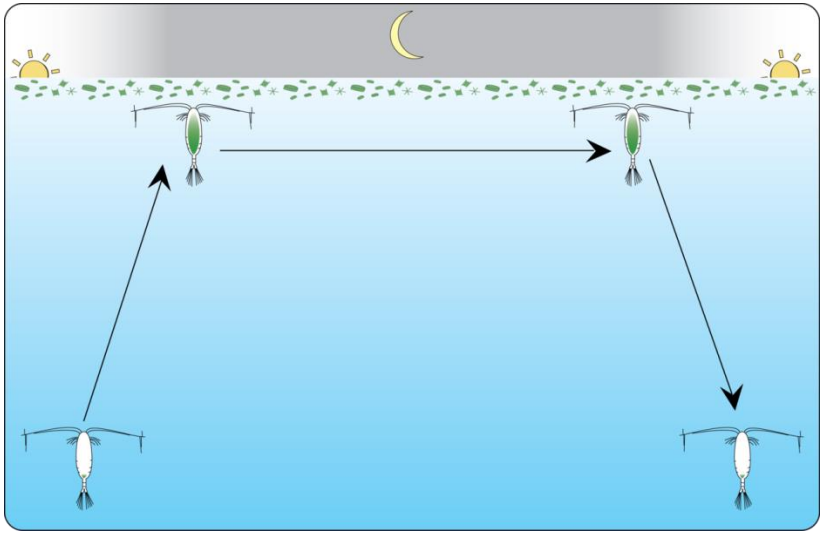
downwards. The movement
reflects only the net effect. The
the mean depths of a populatio
equals the distance travelled by



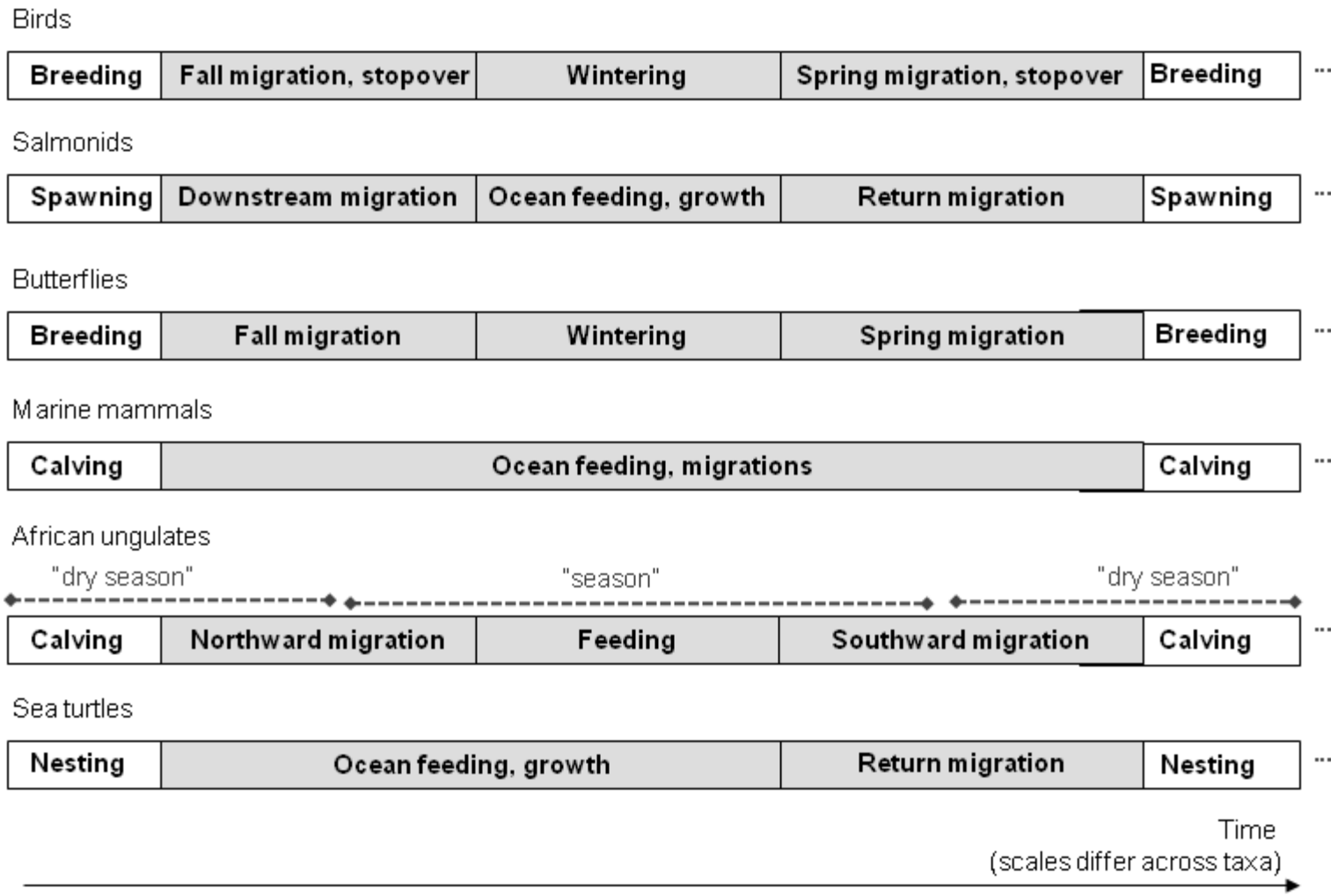
Epipelagic

Mesopelagic

Migration: Diurnal

- Bat foraging
  - Roost: cover, predator avoidance
  - Migrate to foraging grounds
- Importance for population biology?

Annual migration



http://www.ace-eco.org/vol4/iss2/art5/

Migration: seasonal, annual

Alpine animals moving from low to high elevation foraging site between winter and summer

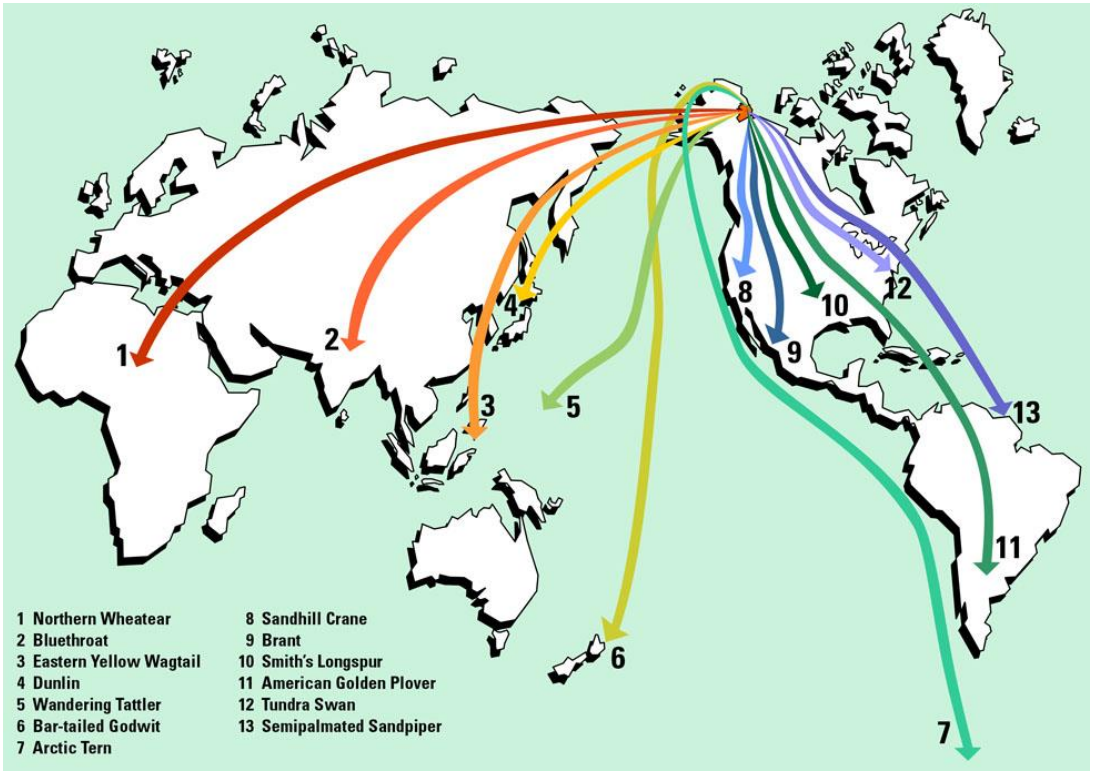
e.g. mule deer, elk

Rocky Mountain goat

- Some populations move between summer winter feeding grounds
- Short distance
- Large difference in weather and forage

Migration: seasonal, annual

Bird migration



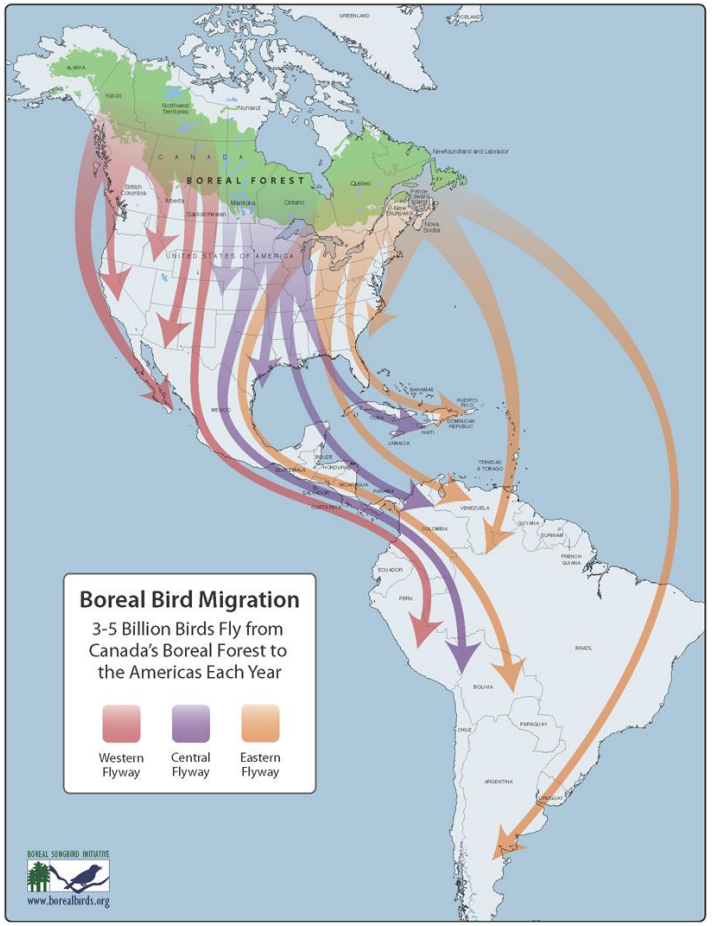


Table 1. Estimates of x (proportion of body mass used for fuel consumption, see Box 1) for different species of migratory birds and a marine migrant (the eel, Anguilla anguilla).

Species	m_0 (kg)	Distance (km)	X (% m h^{-1})	Source
Blackpoll warbler *Dendroica striata*	0.011	1300	0.56	[36]
Thrush nightingale[a] *Luscinia luscinia*	0.025	-	1.0	[37]
Bar-tailed godwit *Limosa lapponica*	0.166	11 000	0.42	[6]
Greater knot *Calidris tenuirostris*	0.143	5 400	0.52	[38]
Red knot *Calidis canutus*	0.126	4 800	0.77	[32]
Ruddy turnstone *Arenaria interpres*	0.115	3 700	0.48	[8]
Ruby-throated hummingbird *Archilochus colubris*	0.0044	1 100	2	[3]
Eel *Anguilla anguilla*	0.734	5 500	0.0053	[34]

[a]based on wind tunnel study.
doi:10.1371/journal.pbio.1000362.t001

Bar-tailed godwit

- Non-stop flight from Alaska to New Zealand

Hedenström A (2010) Extreme Endurance Migration: What Is the Limit to Non-Stop Flight?. PLoS Biol 8(5): e1000362. doi:10.1371/journal.pbio.1000362
http://127.0.0.1:8081/plosbiology/article?id=info:doi/10.1371/journal.pbio.1000362

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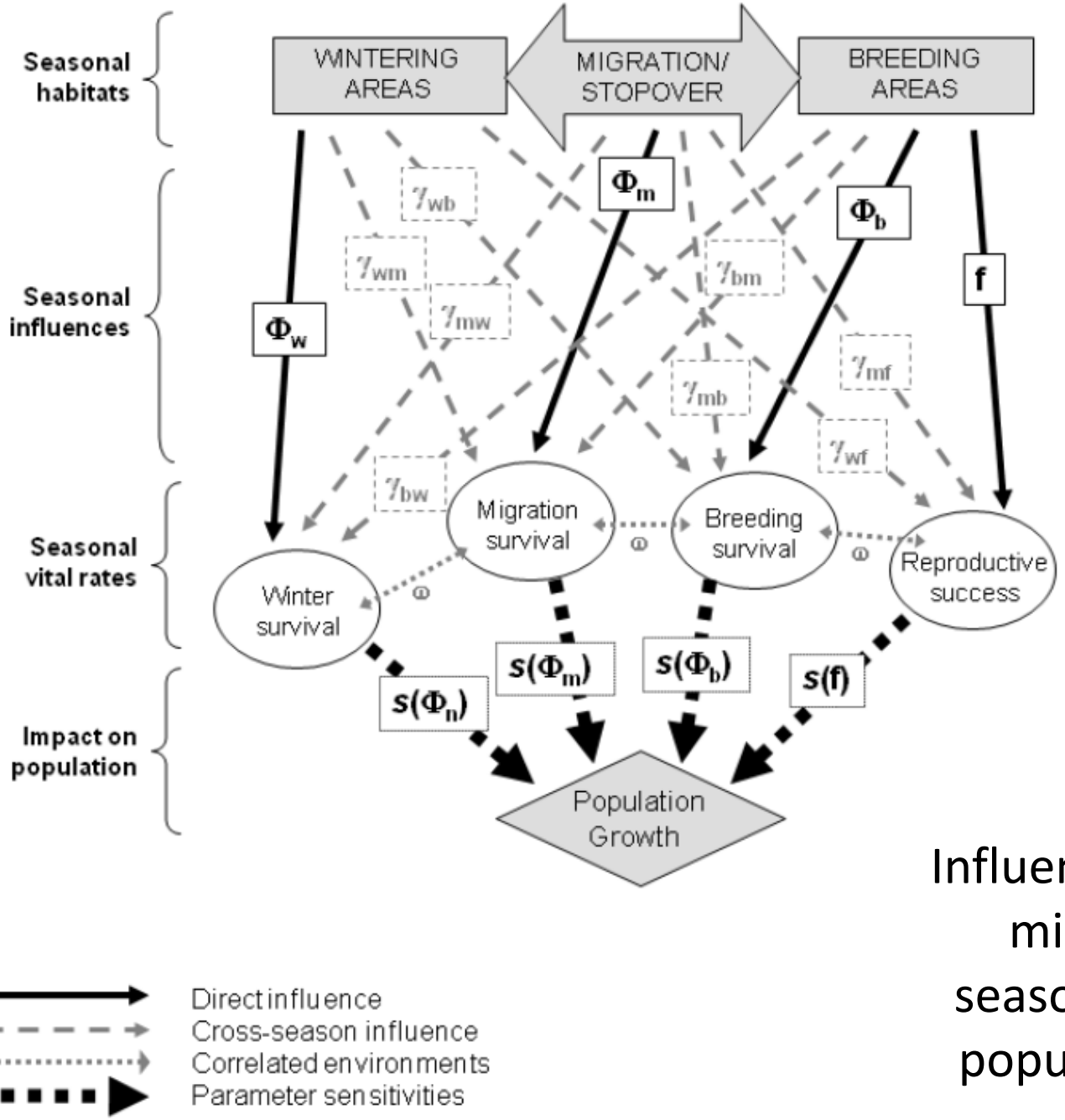
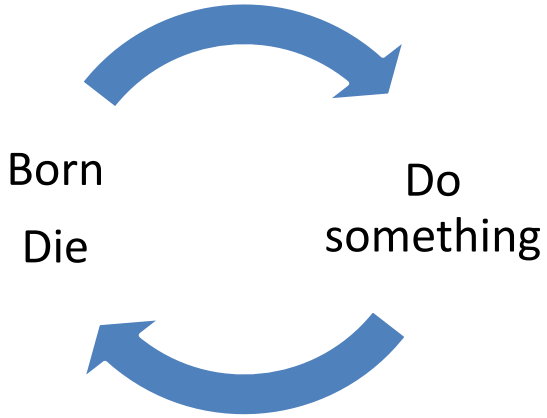


Influence of seasonal migration and seasonal events on population growth

Migration: one return only

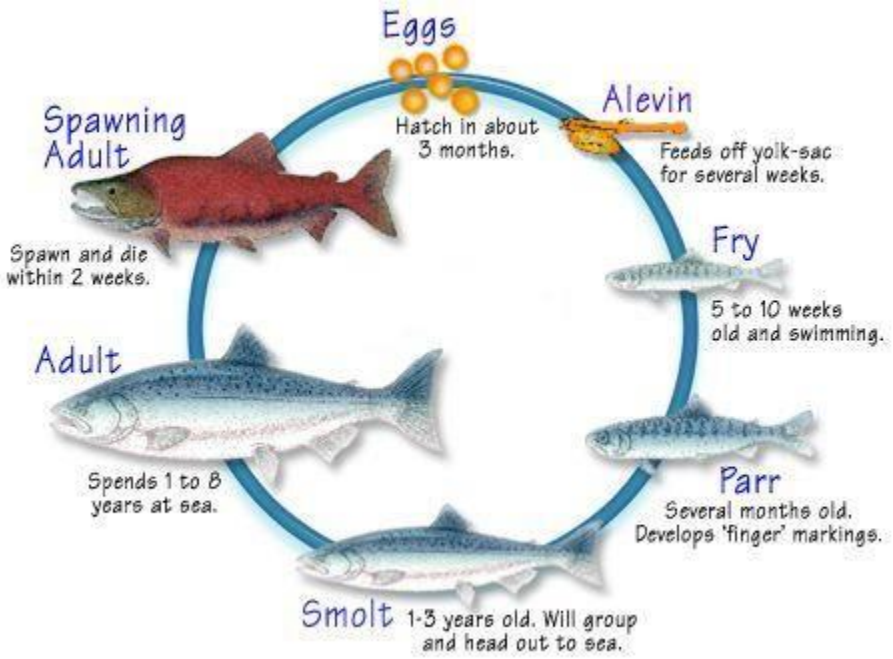
- Salmon
- Eels
- Butterflies



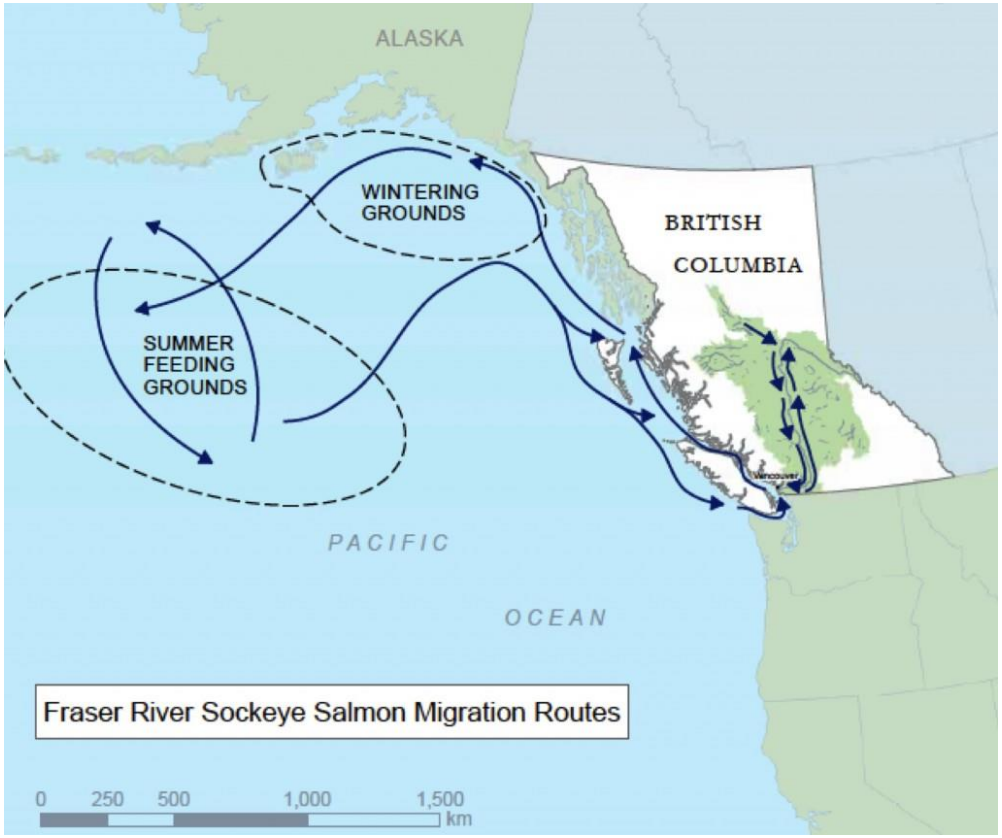
- Migration often synchronized during year
- May be multiyear cycle
- May include multiple cohorts

Migration: one return only

Sockeye Salmon



Migration: one return only



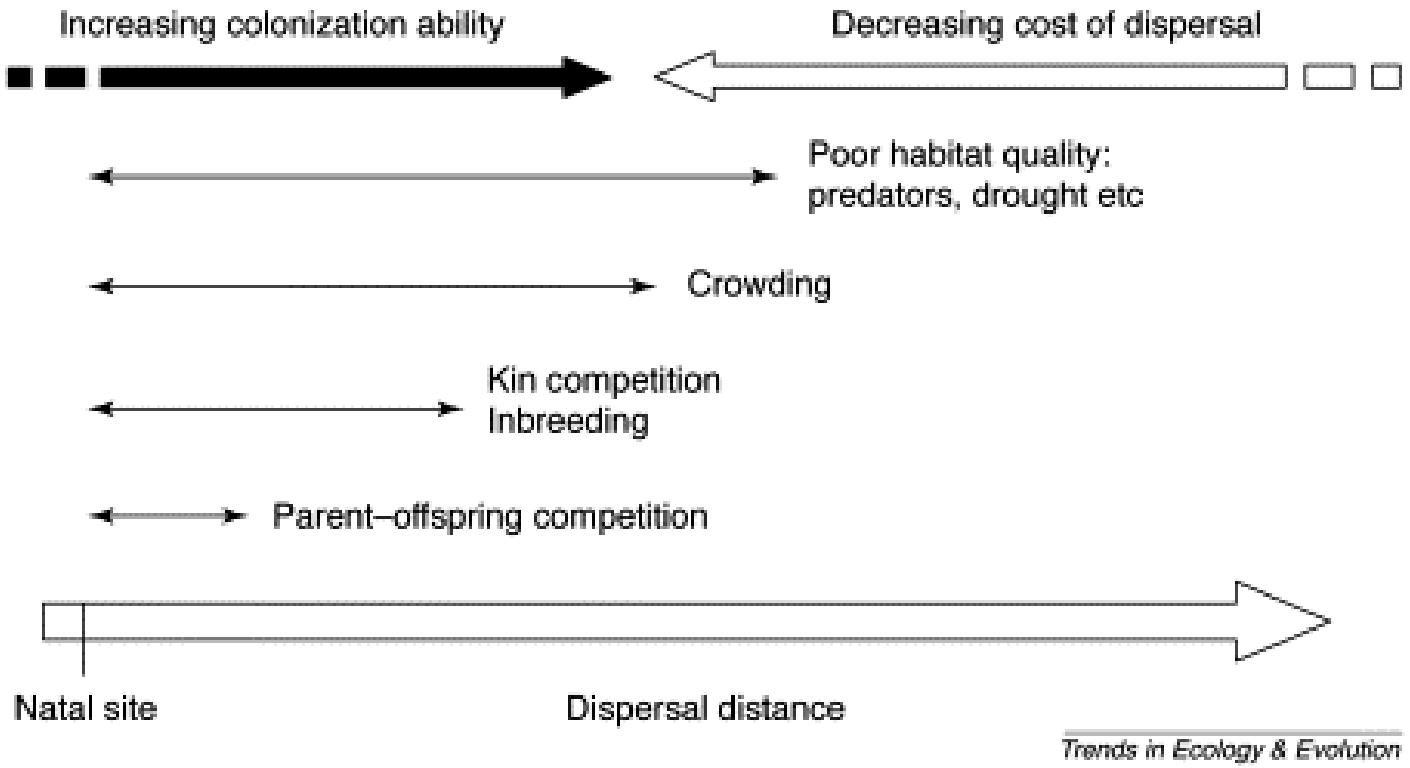
- Duration of time spent in each habitat (stage)

Dispersal

- Movement away from breeding site
  - Natal dispersal
    - Movement of individuals from their site of birth to their breeding site
  - Breeding dispersal
    - Movement from one breeding site to another
- Three stages (leaving, travelling, settling)

Dispersal

- Means of escape (competition (kin), environmental conditions)



(Ferriere et al. 2000)

Who disperses?

- Stage dependent?
- Sex dependent?
- Genetic dependent?
- Phenotype dependent (dispersal polymorphism)

Who disperses?

- Stage dependent
  - Egg, seed
  - Juvenile
  - Adult

    - Investment
    - Costs
    - Competition

- Disperser size and number
  - Mortality during dispersal
  - Energetic cost
  - Competitive ability following dispersal

Who disperses?

- Sex dependent
  - In birds, females are predominantly the dispersing sex
  - In mammals, males are more likely to disperse
  - Dispersal may be more costly for female mammals.
  - Contrast with birds?

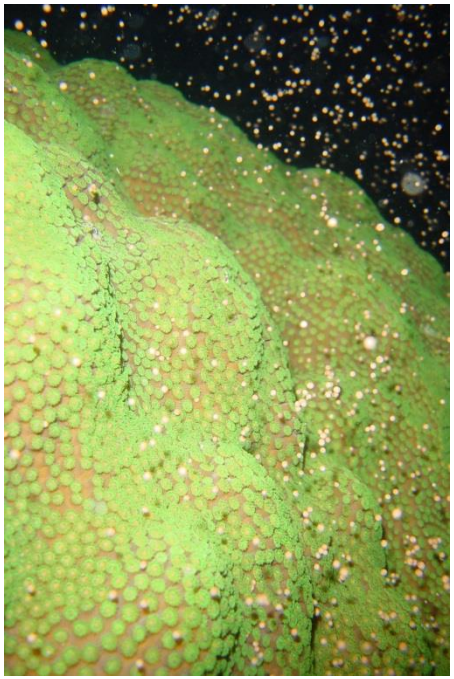
Who disperses?

- Genetic dependent
  - Propensity to disperse genetically dependent

- Phenotype dependent (dispersal polymorphism)

Is dispersal passive or active

- Passive dispersal
  - Dispersal distance random (somewhat)
  - Habitat selection minimum



Who disperses?

- Active dispersal
  - Influence dispersal distance
  - Habitat selection
    - Best of “n”
    - State or experience dependent

When dispersal occurs

- Density independent?

- Density dependent?
  - Resource dependent?
  - Competition dependent?