9.20 MIT

E.O. Wilson, “Sociobiology” (1975, 1980)

Ch 1. The morality of the gene

- Concentrate on pages 3-4 from Wilson, Edward O. *Sociobiology*. Harvard University Press, 1980.

Ch. 2. Elementary concepts of sociobiology

- Keywords (definitions are on page 8)
  - **Population**
    - Compare this definition with “society.”
  - **Deme**
  - **Species**
  - **Society**

Ch. 2. Elementary concepts of sociobiology, continued

- "Social homeostasis": regulation of colony populations, caste proportions, *etc*.
- The **multiplier effect**, p.9.
  - Occurs when a small evolutionary change in individual behavior results in major effects on social behavior patterns.
  - Example: baboons, hamadryas *vs*. olive: Hamadryas males "possess" particular females long-term, whereas Olive males do so only during estrus periods of females. Result: great differences in social structure.
- The "evolutionary pacemaker":
  - Evolutionary changes in **behavior** generally occur before changes in body structures involved in the behavior. Wolfgang Wicker has found good evidence of this in fishes & birds (p 10).
  - Example: the puffer fishes
    - What starts as adaptive anti-predator behavior has evolved into structural properties of some species within the same group of fishes.

Ch. 2. Elementary concepts of sociobiology, continued

- "Adaptive demography": relative proportions of individuals of different ages and sizes can be influenced by selection in favor of groups *vs* the individual (p. 11). (See later: "Life Tables")
- **Behavioral scaling** (p. 14): With no difference in genetics, behaviors can change as a function of conditions. *E.g.*, increases in population density can drastically alter aggression and territoriality.
- Evolution leads to compromises in social evolution, as adaptations at one level may not be adaptations at another level (*e.g.*, individual, family, population levels).
- **Ultimate *vs.* proximate causation**.

Ch 3: The prime movers of social evolution

- **Phylogenetic inertia**: factors that slow evolutionary changes in social behavior: *e.g.*,
  - Reduced genetic variation
  - **Genetic swamping**: one subgroup begins to change because of altered environmental conditions, but occasional inter-breeding with another subgroup prevents the less adaptive genes from disappearing.
- Food type and distribution influences social behavior, *e.g.*:
  - Distributed, predictable food sources make territorial behavior more adaptive. However, if food sources change, a group may not change its habits because of genetic swamping.
  - Large prey makes cooperative hunting more adaptive for carnivores.
  - Chronic food shortages make solitary, anti-social behavior more likely.
- Ecological pressure: Specific ecological conditions result in the evolution of specific patterns of social behavior. Wilson summarizes various examples. *(Next slides)*

E.O. Wilson's "Sociobiology" (1975, 1980)

Ch 3: The prime movers of social evolution

- **Ecological pressure**: specific ecological conditions result in the evolution of specific patterns of social behavior.

1) Examples related to anti-predator behavior

  - "When spider webs unite, they can halt a lion" (Ethiopian proverb). Colonies are much harder for predators to approach undetected, and attacks have reduced probability of harming any individual.
    - Organized colonies are most effective but an unorganized herd instinct is also effective: cattle, fish, squid, bird flocks, locust swarms (the "selfish herd")
    - Synchronized breeding: colonial birds; social ungulates
    - Group defense strategies: owlfly larvae confronted by insect predators; guard bees; [guard meerkats]; musk oxen—perimeter defense against wolves; mobbing by certain birds and primates.

Ch 3: The prime movers of social evolution

- **Ecological pressure**: specific ecological conditions result in the evolution of specific patterns of social behavior.

  2) Examples related to foraging:

  - Groups/coalitions & cliques can increase competitive ability in feeding
  - Increased feeding efficiency by social behavior:
    - Territories form when food is evenly distributed.
    - *Cooperative foraging*:
      - Feeding flocks form when food is in unpredictable patches.
      - *Cf* pack-hunting mammals, ant cooperation, honeybee communication.
      - Large prey makes cooperative hunting more adaptive for carnivores.
  - Chronic food shortages make solitary, anti-social behavior more likely (e.g., the moose)

Ch 4: The relevant principles of population biology (selected)

- Calculaton of the inbreeding coefficient, which is the same as the coefficient of kinship: use of **"path analysis"** **(Illustrations can be found on the web: search for path analysis of inbreeding coefficients.)**
  - Represents the probability that both alleles at one locus are identical because of common descent.
- **Inbreeding taboos**? (p. 38-39). Intro. by "effective population number" (p.37), and Wright's island model.
- Note the opposed selection tendencies re sociality (p.39)
- Assortative mating (homogamy)

Ch 4: The relevant principles of population biology (selected)

- Formula for **rate of change in population size:**

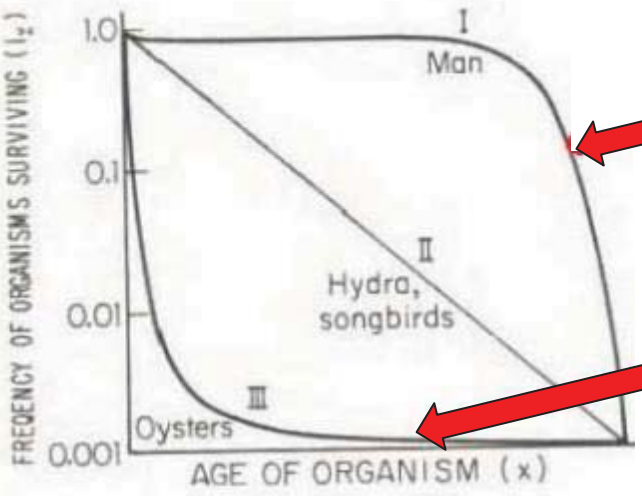
$$dN/dt = rN\left[(K-N)/K\right]$$

Note the variable "K", the carrying capacity of the environment. If N becomes greater than K, the population's rate of change becomes negative; if it is below K, the population grows at a rate described by the formula.

- **r selection**: found in a species capable of very rapid growth in numbers by a high birth rate. This allows opportunistic proliferation during short periods of favorable conditions. Usually in such species there is poor survival beyond the earliest periods of life.
- **K selection**: found in species with more stable numbers, often close to the carrying capacity of the environment. There is slower growth of a population because of few births per female and a more prolonged period of development.

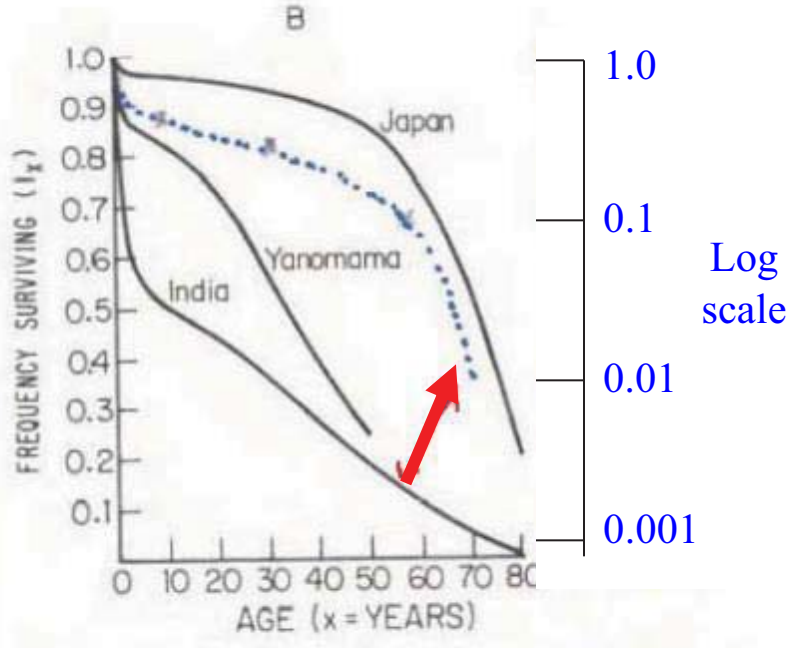
Ch 4: The relevant principles of population biology (selected)

- Density dependent behavior (p.41f), and population cycles (true cycles *vs*. "intercompensation“, when population density shifts from one equilibrium number to another with a change in the environment)



K selection

r selection



In this figure, Wilson seems to be showing that some human groups—e.g. in India—are closer to r selection than to K selection. Plotting the data properly destroys this implication.

Ch. 5. Group selection and altruism:

See chapter 5 of Wilson, Edward O. *Sociobiology*. Harvard University Press, 1980.

-- Look at Figure 5.4 depicting the evolution of altruism, selfishness and spite.

E.O. Wilson, “Sociobiology” remainder of book

- Chapters 6-26: for topics covered, see Outline posted (class 26-27)

9.20 Animal Behavior
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