Lecture 1 outline: Some critical issues in the field of animal behavior

(Much of this will be review for some of you.)

1. Why study behavior?

- Emergent properties are common in biology: the whole is often greater than the sum of its parts. Behavior is one of the most inclusive levels at which you can study biology.
- As the interplay between evolution (history) and ecology (immediate concerns of survival and reproduction), it offers insights into both fields.

2. What kinds of questions do behaviorists (=ethologists) ask?

Broadly speaking, there are two types of explanations for behavioral patterns that we can observe: ultimate (*Why*? questions that seek evolutionary explanations) and proximate (*How*? questions that seek physiological or other mechanistic explanations). (Tinbergen split ultimate/proximate into four categories; K&D chap 1.)

If you observe a hummingbird returning to the same bright flower over several days, there are many questions you might ask about what you have seen. One proximate level question might be: How does the hummingbird map the forest to find the same flower every day? One ultimate level question might be: Why are hummingbirds attracted to bright flowers?

3. The naturalistic fallacy: Do not make this mistake.

The fallacy is the assumption that that which is natural is necessarily good. Traits, including behaviors, may be understood to be natural (having arisen either through genetic or cultural evolution), without any moral assessment of their value. In this class, we'll be talking about many natural things that are ugly—infanticide, forced copulation, competition between organisms that ends in maiming or death. These behaviors can be understood scientifically, but by doing so we are not taking a moral stand on whether they are good or bad. In fact, by understanding behaviors that most humans would consider immoral or inappropriate in civil society, we might better be able to reduce their occurrence.

"Natural" tendencies are also neither necessarily hard-wired (genetic), nor immutable.

4. Nature vs. nurture: Why dichotomous choices are often misleading.

Genes ("nature") evolve. Genes code for proteins that comprise many aspects of phenotype, including behaviors. Culture (nature or nurture?) also evolves. Culture (across many species) comprises suites of individual and population-level behaviors and expectations about future behavior. The environment ("nurture") of an individual includes other conspecifics (offspring, potential mates, neighbors, which have also evolved—nature or nurture?), heterospecifics (predators, competitors, symbionts, diet, diseases—nature or nurture?), and abiotic conditions (climate, geography—nature or nurture?). Furthermore, the "environment" of a single gene includes neighboring genes, which directly affect the expression of the first; if even gene expression is affected by environment, in what context can we expect the question "Nature or nurture?" to ever make sense?

5. Micro-evolution: Four mechanisms, plus phylogenetic constraint

Simply put, organic evolution is ***descent with modification***. (Abiotic things like rock formations are sometimes said to evolve—this use of the term refers only to change over time.)

Briefly:

- **Mutation:** the only force that introduces new genetic variants into a species. Most mutations are deleterious, and disappear.
- **Gene flow:** changes the make-up of populations by the movement of individuals into (immigration) and out of (emigration) those populations. Alters gene frequencies in populations, but its power is limited to moving around the variation that already exists.
- **Genetic drift:** the random element in evolution. Has no ability to "build" on structures that are borderline functional, so while important, usually not very powerful.
- **Selection:** the process by which variation, introduced by mutation, gene flow, or genetic drift, is refined. Individuals with phenotypes that are not appropriate for their environment (e.g. that preclude them from hunting well, or from obtaining mates) will not pass their genes on to the next generation. Selection produces adaptations, which are the most important force in (micro)evolution. If a trait is complex, variable in extent, and persistent, that trait is likely an adaptation.
- **Phylogenetic (aka historical) constraint:** The long evolutionary history of species often creates a form that is not immediately (or possibly ever) transferable into a different form. There may be a better way to do something, but no way for selection to act on it to get it there. Examples: inversion of the vertebrate eye; vestigial wings on flightless birds.

6. Group selection: Another fallacy

- *Individuals* (bears, algae, dragonflies, salamanders, cedars…) are selected to reproduce their genetic makeup as much as possible over their lifetime. That animal that is the most fit in the current environment will pass on the most copies of his genes, and thus be the fittest.
- Those genes that are passed on to the next generation in the greatest numbers are, by definition, the most successful. Individuals who do not reproduce are not (genetically) represented in the next generation. Evolutionarily, these individuals are dead-ends.
- To the extent that an individual's kin (siblings, cousins, etc.) share some of the genes as she does, she has a shared interest in them also being (reproductively) successful.
- But most individuals in a population are not closely related to one another. Thus, animals do not behave so as to benefit the species. In fact, in a landscape with limiting resources, more unrelated individuals seeking the same thing (food, mates, territories) puts *more* burden on each individual, not less.

  QUESTION: Do individuals benefit (genetically) when unrelated individuals reproduce?