Lecture III.5b Answers to HW

1. (2 pts). *Tiktaalik* bridges the gap between fish and tetrapods by virtue of possessing which of the following?
   a. Humerus.
   b. Radius.
   c. Ulna.
   d. **Wrist bones**.

2. (2 pts) Morphologically, lungfish appear to be further from the ancestry of tetrapods than crossopterygians because they lack **differentiated fin bones homologous to the radius and ulna**.

3. (8 pts) Salmon spend one or more years ("parr" stage) in the river before going to sea. After additional time in the ocean, mature fish return to the river to spawn. **a.** From the viewpoint of natural selection, what are the advantages and disadvantages of such a life cycle? **b.** In some species, parr mature sexually and reproduce before going to sea. Generally, it is the males that do so and not the females. Why might selection have favored precocious reproduction in males and not females? (Requires outside reading)
a. **Advantage:** Marine environments are more productive than freshwater environments, with the result that growth rates at sea are far greater than in the river. In females, large size translates into more eggs; in males, into enhanced ability to compete for females and territories.

**Disadvantages:** 1) Increased pre-spawning mortality. In the ocean, salmon, especially when they are small, can be eaten by other fish. Additionally, the up-stream migration is often, but not always, arduous, and many fish fail to reach the spawning grounds. 2) Increased generation time. Fitness depends both on the number of and the rate at which offspring are produced.

b. **Sperm is energetically inexpensive.** Small males are sometimes able to sneak past a territorial male and fertilize some of the female’s eggs. One imagines, but, so far as I am
aware, there is no evidence, that fecundity in females increases more sharply with size than in males.

Consistent with this conjecture is the fact that Atlantic salmon males on average spend fewer years at sea than females before returning to spawn.

4. (2 pts) Regarding the evolution of the mammalian jaw and middle ear: a. The articular bone in reptiles is to the quadrate as the dentary in mammals is to the squamosal. b. The reptile articular bone became the malleus in mammals; the quadrate, the incus.

5. (4 pts) On several occasions this semester, it has been observed that “reptiles” as traditionally defined (snakes, lizards, turtles, crocodiles) is a paraphyletic group. Yet in Figure 34-12 (page 654) of your text (4th edition), Reptilia is represented as a clade
with “scales with hard keratin” given as the synapomorphy. What gives?

In the figure birds included in Reptilia.

6. (4 pts) Synapsid lungs are expansive; avian lungs, not. Explain.

Respiration in synapsids is tidal with expansive lungs allowing for greater inspiratory volume. In contrast, avian respiration is flow-through. No need for lungs to expand as air is continuously pumped through them.

7. (6 pts) What was the Piltdown forgery? Who was responsible? (Requires outside reading. Be sure to cite sources)

Piltdown man was a hoax in which an orangutan jaw bone and parts of a modern human skull, all stained to make them appear old, were represented as the remains of a pre-human hominid. The remains were “discovered” by Charles Dawson, an Englishman, in 1912, and, despite some objections, were generally considered genuine for forty years. As such, they were con-
sistent with the late 19th / early 20th century view that large brains were an early hominid innovation. Accumulating evidence for small-brained, bipedal australopithecines set the stage for Dawson’s find’s being discredited in 1953. The identity of the perpetrator(s) remains uncertain, although Dawson is generally considered a prime suspect. For further discussion, including a list of possible perpetrators, see http://www.talkorigins.org/faqs/piltdown.html and http://www.clarku.edu/~piltdown/map_gen_hist_surveys/piltman_oaklywiener.html.
8. (6 pts) The Triassic witnessed the evolution of dinosaurs and mammals, the latter having descended from much larger, “mammal-like” reptiles that were the dominant tetrapods during the Permian. In short, species belonging to the lineage leading to mammals got smaller while archosaurs got larger. Discuss in terms of changing levels of atmospheric oxygen during the late Permian and early to mid-Triassic. (Requires outside reading. Be sure to cite sources)

During the late Permian and early Triassic, atmospheric oxygen levels are believed to have plummeted. One can speculate that selection would have favored small body size in tetrapods with tidal respiration (line leading to mammals), but not in species with flow-through respiration. If archosaurs had already evolved a bird-like system of air sacs, diverging body size in the two lineages could thereby be explained.

![Estimated Phanerozoic atmospheric oxygen levels (light line) based on carbon cycle modeling. Fbp/Fbg is the ratio of rates of carbon removal from and input to the atmosphere. From Berner (2002). Permian mass extinction indicated by red arrow.](image)
9. (6 pts) Modern hunter gatherers hunt large mammals by pursu- ing (running / jogging / walking) their much faster prey until the latter collapse. Discuss in terms of temperature regulation by ungulates and man.

“Persistence hunting” works because humans lack body hair. This allows them to thermoregulate more efficiently than large ungulates that pant and must slow down in order to do so. The difference allows human hunters to pursue their prey, sometimes for days, until the latter collapse, at which point they are easily dispatched.

An oryx can outrun a man, but only for a while. If forced to continue running, the animal eventually overheats and collapses. This allows the human hunter to literally walk up to the animal and kill it.