**Discussion Questions**

to accompany

***Animal Behavior,* Eleventh Edition**

by Dustin Rubenstein and John Alcock

**Chapter 6**

**Avoiding Predators and Finding Food**

6.1 The ability of one species of noctuid moth to hear ultrasound is considered an antipredator adaptation because it apparently enables individuals to hear and avoid nocturnal, ultrasound-producing bats (see Chapter 4). Imagine that you wished to test this hypothesis via the comparative method. Identify the utility of each of the following lines of evidence about the hearing abilities of other insect species. Specify whether these cases involve convergent evolution, divergent evolution, or neither.

1. Almost all other species of noctuid moths also have ears that respond to ultrasound.
2. Almost all the species in the evolutionary lineage that includes the noctuid moths and several other groups also have ears that respond to ultrasound (Yack and Fullard 2000).
3. Some diurnal noctuid moths have ears but are largely or totally incapable of hearing ultrasound (Fullard et al. 2003).
4. Almost all butterflies, which belong to the same large evolutionary grouping as the noctuids, are usually active during the day, and they lack ears to detect ultrasound (Fullard 2000).
5. Six species of noctuid moths found only on the Pacific Ocean islands of Tahiti and Moorea have ears and can hear ultrasound but do not react to this stimulus with antibat responses, such as diving for cover (Fullard et al. 2004).
6. Members of one small group of nocturnal butterflies have ears on their wings and can hear ultrasound. These species respond to ultrasonic stimulation by engaging in unpredictable dives, loops, and spirals (Yack and Fullard 2000).
7. Lacewings and praying mantises fly at night and have ears that detect ultrasound and lead to antibat defensive behavior.

6.2 Some people might say that the fact that most noctuid moths have ultrasound-sensitive ears is “simply” a reflection of their shared ancestry, a holdover from the past, and therefore that ultrasound sensitivity is not an adaptation in these species (Brooks and McLennan 1991). Others disagree, arguing that it makes no sense to define adaptations in a way that limits them to just those traits that have diverged from the ancestral pattern (Reeve and Sherman 1993). Who is right?

6.3 Assassin bugs are honey bee killers that sometimes prey on bees as they are settling down for the night. Devise at least three alternative hypotheses on the possible anti-assassin bug value of these sleeping clusters, and list the predictions that follow from each hypothesis.

6.4 When Scott Creel and colleagues studied elk (*Cervus canadensis*) behavior in Montana, they found that elk tended to form larger groups when foraging in the open far away from forest cover (Creel et al. 2005, Creel and Christianson 2008). Why might this result lead us to interpret large group formation by elk as an antipredator response? Creel and company noted that the elk aggregated only on days when wolves (*Canis lupus*) were *absent*. In the presence of wolves, elk remained in smaller herds. What is the significance of these observations for the antipredator hypothesis about the tendency of elk to group together under some conditions? In scientific terms, which label should be given to these observations: hypothesis, prediction, test data, or scientific conclusion? What is the significance of this work for studies of puddling by butterflies?

6.5 Why might game theory be useful in analyzing decision making by Adélie penguins (*Pygoscelis adeliae*) as they wait to enter the water by the edge of their breeding colonies? The penguins gather in groups before diving into the ocean where a huge predator, a leopard seal (*Hydrurga leptonyx*), may be lurking. How might one individual’s decision to dive in be dependent on what other penguins are doing?

6.6 Consider the following finding: In the years since 1950, pollution controls have reduced the amount of soot deposited on tree trunks, and the melanic form of *Biston betularia* has correspondingly become increasingly scarce in Europe (Brakefield and Liebert 2000, Cook 2003) as well as in North America where the species also occurs (Grant and Wiseman 2002). Put this statement into the context of a scientific investigation into whether the typical salt-and-pepper coloration of some members of this species constitutes an adaptation. Begin with a research question and proceed through hypothesis, prediction, test, and conclusion.

6.7 Some people have suggested that the real cause of the (temporary) increase in the frequency of the melanic form of *Biston betularia* was selective predation by bats. If, however, Kettlewell was correct about the role of visual predation by birds, and if it were possible to examine how bats responded to the two forms at night, what would you predict about the mortality rates of the two forms of the moth?

6.8 If snakes do tend to avoid *Anolis* lizards that perform a series of push-ups, why don’t weaker lizards “cheat” by boosting the number of push-ups they perform upon spotting a predator?

6.9 In some places, American crows (*Corvus brachyrhynchos*) open walnuts by dropping them on hard surfaces (Cristol and Switzer 1999). Unlike northwestern crows (*Corvus caurinus*) opening whelks, American crows reduce the height from which they drop walnuts from about 3 meters on the first drop to about 1.5 meters on the fifth drop. If this tendency is adaptive, what prediction follows about a difference between whelks and walnuts in the likelihood of breaking on successive drops? In addition, American crows tend to drop walnuts from lower heights when other crows are present. If this trait is an adaptation, what do you predict about the likelihood of breakage over a series of drops?

6.10 The Cape gannet (*Morus capensis*), a seabird, normally feeds on oceanic fishes such as sardines, but during the nonbreeding season, the birds consume large quantities of fishery waste discarded by fishing vessels that process catch at sea (Grémillet et al. 2008). Despite the fact that the adult birds do fine on a mixed diet of discards and sardines, when there are young chicks to feed, gannets try to provide their young with whole fish caught at sea rather than giving them the easily retrieved odds and ends thrown out of fishing boats. What prediction can you make about the development of gannet chicks fed fish guts and the like versus whole fish?

6.11 Imagine a population of 1000 fruit fly larvae in which there are two hereditarily distinct foraging phenotypes, rover and sitter. Imagine that there are 195 rovers and 805 sitters. Let’s say that both types survive to adulthood equally well and both types have 1.2 surviving offspring on average. What were the frequencies of the two behavioral types in the parental generation? What will the frequencies be in the generation composed of their offspring? What would happen if rovers had 1.1 surviving offspring on average, whereas sitters had 0.9? What’s the point of this question?

6.12 When the frequency of sitters is 0.75 (see Figure 6.22), the fitness of rovers is much higher than that of the sitters. So why don’t rovers quickly and completely eliminate the sitters in this population?

6.13 Here are two examples of curious behaviors that might help individuals either avoid predators or capture food: (1) some burrowing owls (*Athene cunicularia*) place mammalian dung near their burrows, and (2) some orb-weaving spiders add thick silk to their webs, creating conspicuous white lines or crosses on the webs. Why are these traits Darwinian puzzles? Use selection theory to produce alternative explanations for these behaviors, and then generate predictions from your hypotheses that would enable you to test your ideas.

References

Brakefield, P. M., and Liebert, T. G. 2000. Evolutionary dynamics of declining melanism in the peppered moth in The Netherlands. *Proceedings of the Royal Society of London B* 267: 1953–1957.

Brooks, D. R., and McLennan, D. A. 1991. *Phylogeny, Ecology, and Behavior*. Chicago: University of Chicago Press

Cook, L. M. 2003. The rise and fall of the *Carbonaria* form of the peppered moth. *Quarterly Review of Biology* 78: 399–417.

Creel, S., and Christianson, D. 2008. Relationships between direct predation and risk effects. *Trends in Ecology and Evolution* 23: 194–201.

Creel, S., Winnie Jr., J., Maxwell, B., Hamlin, K., and Creel, M. 2005. Elk alter habitat selection as an antipredator response to wolves. *Ecology* 86: 3387–3397.

Cristol, D. A., and Switzer, P. V. 1999. Avian prey-dropping behavior. II. American crows and walnuts. *Behavioral Ecology* 10: 220–226.

Fullard, J. H. 2000. Day-flying butterflies remain day-flying in a Polynesian, bat-free habitat. *Proceedings of the Royal Society of London B* 267: 2295–2300.

Fullard, J. H., Dawson, J. W., and Jacobs, D. S. 2003. Auditory encoding during the last moment of a moth's life. *Journal of Experimental Biology* 206: 281–294.

Fullard, J. H., Ratcliffe, J. M., and Soutar, A. R. 2004. Extinction of the acoustic startle response in moths endemic to a bat-free habitat. *Journal of Evolutionary Biology* 17: 856–861.

Grant, B. S., and Wiseman, L. L. 2002. Recent history of melanism in American peppered moths. *Journal of Heredity* 93: 86–90.

Grémillet, D., Pichegru, L., Kuntz, G., Woakes, A. G., Wilkinson, S., et al. 2008. A junk-food hypothesis for gannets feeding on fishery waste. *Proceedings of the Royal Society B* 275: 1149–1156.

Majerus, M. E. N. 2008. Non-morph specific predation of peppered moths (*Biston betularia*) by bats. *Ecological Entomology* 33: 679–683.

Reeve, H. K., and Sherman, P. W. 1993. Adaptation and the goals of evolutionary research. *Quarterly Review of Biology* 68: 1–32.

Yack, J. E., and Fullard, J. H. 2000. Ultrasonic hearing in nocturnal butterflies. *Nature* 403: 265–266.