# Free Response Questions
## 10 Mar 2017
## Population Ecology & Conservation of Biodiversity

1. The California Department of Fish and Game is developing a plan to connect mountain "habitat islands" that are separated by open areas of flat, arid land in the deserts of southeastern California. These mountain areas are habitats for desert bighorn sheep (*Ovis canadensis*), which move extensively among the islands through habitat corridors. The habitat corridors provide opportunities for recolonization, seasonal migration, and maintenance of genetic variation among the metapopulation of bighorn sheep.

    **i.** Explain what is meant by a metapopulation and how it relates to the bighorn sheep. (1)

    **ii.** Identify and explain *two* density-dependent factors and *one* density-independent factor that could affect the populations of desert bighorn sheep. (3)

    **iii.** Explain the consequences to the desert bighorn sheep population if the plan to connect the mountain habitat islands is not implemented. (2)

    **iv.** Explain how the theory of island biogeography applies to the mountainous areas of southeastern California. (2)

    **v.** Given what we know about the main drivers of extinction, discuss how **cores, corridors** and **carnivores** are each important to preserving biodiversity, both richness and relative abundance.
        a. How is each individually vital to richness and relative abundance? (2)
        b. How do these three "C's" work ***together*** towards preserving richness and abundance? (2)
        c. Compare the three "C's" concept as they relate to the stages of land conversion discussed in Quammen's essay *The Planet of Weeds*. Of what value to CCC is each to the four levels? (2)

    **vi.** The CA Dept of Fish and Game is given a federal grant to purchase more acreage for habitat for the desert bighorn sheep and mountain lion that occupy the same habitat. Fish and Game is considering two options. One is a single, larger tract of reasonable, but not ideal habitat. The second option is made up of three separate sections, but each contains much better, smaller patches of pristine habitat. Both options contain the same total acreage. You are a consultant being asked to advise Fish and Game. Describe the benefits and drawbacks of each. What considerations should be taken into account when making the final decision? (6)

2.  A remote county in Arizona, which includes portions of two national forests, is the proposed site of reintroduction of a small pack of red wolves (*Canis rufus*).  This project will be jointly overseen by the Arizona Department of Fish and Game along with the U.S. Fish and Wildlife Service (which manages populations protected by the Endangered Species Act).  The assumed main prey animal for these wolves would be the mule deer (*Odocoileus hemionus*) that also occupy the same forests and canyons.  There is some concern being voiced by hunters who feel that the wolves will negatively impact the deer population available for hunting.  A smaller voice of opposition is being raised by some in the ranching community who have rights to graze their sheep on nearby land administered by the Bureau of Land Management.

       **i**. The current population of mule deer in the area has been determined to be approximately 15,000.  If the intrinsic growth rate ("r") of mule deer in this habitat is 8%, by how many individuals *should* the population be growing annually? (2)

       **ii.** As part of the management plan for the mule deer population, the Arizona Department of Fish and Game annually sells hunting tags to harvest 6% of the total population.  Yet, only half of these tags were returned last year for deer actually killed by hunters.  Therefore, how many deer from this population were (legally) killed last year? (2)

       **iii.** The small pack of red wolves that is being proposed for reintroduction numbers 7 individuals.  Wolves eat 18 prey animals per year, per individual, on average.  The expected growth rate for this pack is 2 individuals per year.  If the AZ Dept of Fish and Game and US FWS operate under these two assumptions, how many deer would this pack be expected to kill in the first four years of reintroduction? (2)

       **iv.**  For red wolves, pack size generally caps out at a maximum of 18 individuals.  At this point, the US FWS would either relocate any wolves over this number or expect them to disperse on their own to new territory to which they could migrate along habitat corridors (being proposed under a separate plan).  At the pack's maximum, still assuming a deer population of 15,000, calculate the wolves' impact on the mule deer population *as a percentage* of the number of deer that could be taken by hunters (still assuming hunting tags being issued for 6% of the population).  Based upon this answer, are hunters' concerns generally justifiable? (3)

       **v.**  For more than the past decade the mule deer population in this remote corner of Arizona has maintained a steady population of approximately 15000.  What factors, both density-dependent and density-independent could be reasons for this stasis despite a natural "r" of 8%?  Explain.  (3)