

Preview Material Exam 4 – Fall 2002

In 1859, 24 rabbits were introduced into Victoria, a state of Australia. There were previously no rabbits in Australia. At that time, excessive food was available to the rabbits, and there were very few competitors, predators, or parasites. Thirty years after their release, the rabbit population size was constant. In the 1920s, biologists introduced a deadly virus, myxovirus, into the population of rabbits to reduce their population size. An estimated 98% of the rabbits were killed in the first year. Two percent of the rabbit population survived the initial exposure to the deadly virus. Today, most of the rabbits are immune to the virus. The virus is still spread among rabbits, but its effects are mild (like a cold). Note that $r = b - d$, and $G = r \cdot N$ OR $G = r \cdot N \cdot ((K - N) / K)$, where r is the exponential growth rate, b and d are the birth and death rates, N is the population size, G is the growth increment, and K is the carrying capacity.

Carp, prized as food, were abundant in Eastern Europe in the 19th century. When Eastern Europeans came to the U.S. near the end of the 19th century, they brought a small number of carp to use as breeding stock in the U.S. The founding U.S. carp population prospered in ponds in Minnesota where they were introduced. The fish isolated in these ponds were not permitted to be moved to lakes or rivers in Minnesota. When the carp populations increased and fish growers thought they would not become extinct, groups of young adult carp regularly were shipped in railroad cars filled with water (called live cars) to New York City. There, wealthy people paid high prices to eat the fish in expensive restaurants. Two rich old brothers ate at one of these restaurants frequently. The food was so good that, over the decades, they ate a great deal of it. One of them remained thin and the other became obese, even though they ate the same amount of food. One day, the train hauling carp to New York in a live car derailed, and the water spilled out into a ditch. The carp swam away into the small creeks that flow into the Mississippi River. Carp became established in the entire Mississippi River drainage (streams and lakes). Because carp are highly effective herbivores, they outcompeted many species that were native to the U.S.

Members of the Conidae family (Cone snails) have been collected for centuries for their beautiful and intricately designed shells. Cone snails are marine mollusks (includes clam, snail, octopus, and squid) and they are found in reef environments throughout the world. Most species are found in the Indo-Pacific region in temperate or tropical waters (22° - 29° C), but others live along the southern Australian coast where the water temperature is only 5° - 12° C. They feed upon other marine organisms (mollusks, fish, worms) that they capture by immobilizing them with venom that contains some of the most potent neurotoxins known. The venom is injected by way of a hollow spear-like tooth and it has an immediate effect. *Conus purpurascens*, a fish-eating snail, can paralyze its prey in about two seconds. This is advantageous for an organism such as the snail that has limited mobility.

Cone snail venoms are variable mixtures of 10 to 30 amino acid-long polypeptides (proteins). Each species' venom may contain 2 to 3 different types of neurotoxins. The venoms are very prey-specific and although Cone snails do not feed on humans they will sting if disturbed and this can result in death without proper medical treatment.

In the past few years, homeowners have become fascinated with water gardens, and the number of homes with these small ponds has dramatically increased. Many cities including Stillwater host annual water garden tours. The gardens contain various types of plants and fish. **Floating plants** float freely on the surface of the water and can be placed in all areas of the pond. **Surface plants** have their roots in the soil and leaves on long stems that float on the water's surface. Floating and surface plants shade the underlying water. The leaves of **submerged plants** remain underwater. They may root in the soil or float freely. Some people use large goldfish in their gardens, however, the most popular fish are Koi. Koi reach a maximum length of 1 meter and are white with colored (red, black, yellow, orange) blotches. Koi can produce thousands of eggs in a single breeding. The eggs hatch in 3-7 days, and the young must be separated from the adults to prevent them from eating their offspring.

To maintain water quality, some water garden experts recommend using many submerged plants in your water garden. Experts also suggest that you monitor the temperature of your water garden and feed Koi according the following guidelines.

<10 °C	No food at all
11 to 15 °C	Feed once a week
16 to 18 °C	Feed every 3 to 4 days
19° to 23°C	Feed every day

24 to 26°C	Feed 2 - 3 times per day
27° to 30 °C	Feed 2-3 times per day and increase amount to no more than fish can eat in 5 minutes
>30 °C	Decrease amount of food to prevent oxygen depletion

Northern Florida has over 300 freshwater springs, which provide recreational sites and drinking water. Rainfall seeps through the subsoil to replace the groundwater that feeds these springs. Rainwater carries any surface pollutants, unfiltered by the grass and soil above, into the groundwater. The watersheds include many residential lawns, golf courses, sewage treatment plants, and poultry and livestock operations. Each spring receives enough seepage from its own watershed to reflect local conditions above ground. As the numbers of farm animals and humans living above the springs continue to grow, the pollutant concentration in the spring water is likely to increase. In recent years, chemists have begun to detect high concentrations of nitrogen (nitrates) in springs located in certain counties in Florida.

Spiders eat insects. Thus, they are secondary consumers. Spiders produce silk streamers that allow young spiders to be carried long distances on air currents. Thus spiders are often the first animals carried to new islands. Suppose that a new island has just appeared in an extremely large lake at Hogwarts School for Wizards. The wizards name it New Island. The first spiders to become established on the island are jumping spiders with excellent eyesight. They came from a British population of the species named Brilliant Jumpers because their eyes may be bright red, purple or orange. Over the centuries, the number of different eye colors and patterns in Brilliant Jumpers on New Island becomes much greater than in the founding population. These different eye colors and patterns were first thought to be the result of too much magic in the neighborhood, but Professor Dumbledore (who is an excellent biologist) reports that he has found no influence of magic on eye color in spiders. In the last 2 years, the Brilliant Jumpers have become specialized. Spiders with red eyes eat only blind ants. Spiders with yellow eyes eat only small red-eyed spiders. The spiders with purple eyes eat only cockroaches. Professor Dumbledore reports that yellow-eyed spiders breed only with yellow-eyed spiders. Purple-eyed spiders breed only with other purple-eyed spiders. Red-eyed spiders breed only with others with red eyes. Brilliant Jumpers that are most successful as hunters tend to jump fast and far.

One striking characteristic in adult males of some damselfly species is the presence of wing pigmentation (color). In the species *Calopteryx haemorrhoidalis*, males show a series of mating displays (behaviors) during which they face females while showing their pigmented wings. Male *C. haemorrhoidalis* defend areas (territories) along a stream bank that contains suitable substrate (underwater plants) on which females can lay eggs. Males fight over these territories in flying contests in which the male with more fat in his flight muscles wins. Males mate with more than one female. After they copulate, females deposit their eggs on the substrate and fly off.

Damselflies suffer from infection with parasites called eugregarines that may live in their guts. These parasites eat the food that the damselfly has eaten. They can cause the gut to rupture if the number of parasites is large. Damselflies need the amino acid phenylalanine to make melanin. Melanin has two uses: production of wing pigment [graphs (a, b, d, e)] and trapping of parasites in the gut [graph (b)]. However, melanin cannot be used in both places at the same time.

Recently, a scientist in Northern Spain investigated the characteristics that contribute to successful reproduction in male *C. haemorrhoidalis* (see graphs). He recorded the proportion of the wing pigmented for each male [graphs (a, b, d, e)], the length of time they survived [graph (a)], whether or not they controlled a breeding territory [graph (e)], the number of females with which each mated [graphs (c, d)], and the number of parasites each had [graph (b)]. After recording some data, he experimentally added more breeding substrate (aquatic plants on which to lay eggs) to those territories that had fewer [graph (c)].

Source: Córdoba-Aguilar, A. 2002. Wing pigmentation in territorial male damselflies, *Calopteryx haemorrhoidalis*: a possible relation to sexual selection. *Animal Behaviour* 63: 759–766.

