Chapter 6 – Welfare Effects

Questions & Answers

1. Describe major injury types caused by phytotoxic pollutants.

   Phytotoxic pollutants can cause acute injury with characteristic leaf symptoms, chronic symptoms characterized primarily by chlorophyll loss, and growth effects. In the last case, these may include reduced growth, abnormal flower development, etc.

2. Indicate pollutants that cause the following symptoms in plants: (a) interveinal necrosis, (b) stipple/chlorotic mottle, (c) undersurface glazing.

   Interveinal necrosis is caused by acute exposures to SO₂, stipple/chlorotic mottle by O₃, and undersurface glazing by PAN.

3. What are the distinguishing characteristics of forest declines?

   Forest declines are characterized by progressive development of chlorotic needles/leaves, casting of needles/leaves, reduced height and width growth, and ultimate death of affected trees. The phenomenon is commonly observed in coniferous species.

4. What are the likely causes of the following forest declines: (a) ponderosa pine in California, (b) red spruce in Vermont, (c) forest tree species in Germany?

   The primary cause of the decline of ponderosa pine is exposure to ambient O₃; red spruce in Vermont, a combination of factors including exposure to O₃, acidic deposition, or nitrate deposition; forest trees in Germany, ambient O₃ and acidic deposition.

5. How does acidic deposition affect forest trees?

   Acid deposition can, in theory, cause direct injury to leaves. It can leach nutrients from leaves and bark. It can also affect trees indirectly by changing soil chemistry and interfering with development of tree/fungus symbiotic relationships.

6. In many developing countries lead is smelted in facilities without any emission controls. What welfare concern(s) does this pose?

   The primary welfare concern is the potential poisoning of livestock.
7. Describe adverse effects of lake acidification as pH progressively decreases from pH = 6.5 to pH = 5.0.

As pH decreases, organisms at all food chain levels are affected. Acid-intolerant species disappear, with acid-tolerant species becoming abundant. At pH 6.0, fish populations start to decline, with complete extinction at pH 5.0.

8. Acidic deposition has adverse effects on aquatic organisms as a result of the mobilization of metals. Describe how this occurs.

Because of the high chemical reactivity of H⁺, metals are leached from mineral materials and go into solution in their ionic form.

9. What are the potential adverse effects of nitrogen deposition on forest ecosystems?

Major changes in species composition can occur, as nitrogen-loving (nitrophilous) species have a competitive advantage over less nitrophilous species.

10. Why is nitrate deposition in estuaries an important environmental concern?

Nitrogen is a limiting factor for plant growth in estuaries. As such, nitrate deposition is a major source of nitrogen that can alter species composition in such ecosystems.

11. What is biomagnification and what is its significance relative to mercury and PCB contamination of the environment?

Biomagnification is the increase in concentrations of persistent chemicals as they move up through food chains. As a consequence, organisms at the top of food chains, e.g., fish and predator birds, can be exposed to very high concentrations.

12. What is the environmental significance of dioxin emissions from incinerators?

Dioxin is a highly toxic carcinogenic and teratogenic substance. It has a relatively long environmental lifetime and is passed up through food chains.

13. What are some of the potential ecological effects associated with stratospheric O₃ depletion?

Stratospheric O₃ depletion can result in increased levels of UV-B reaching the ground. UV light is a plant growth regulator and can interfere with cell elongation. UV-B can also interfere with the reproduction of amphibians.
14. Describe potential or existing effects of global warming on Arctic ecosystems/wildlife.

   **Global warming has apparently decreased the period of time that Hudson Bay is ice-covered.** As a consequence, polar bears have a shorter hunting season with a resultant loss in average weight.

15. What effect would global warming have on the distribution of forest trees in North America?

   **Many species of both deciduous and coniferous forest trees can be expected to advance northward.**

16. Describe pollutant effects on metals and building stones.

   **Acidic pollutants, e.g., SO₂ and H₂SO₄, can corrode metals and erode carbonate building stones.** Other effects include soiling.

17. Describe pollutant effects on paper, leather, and rubber.

   **Acidic gases can react with paper making it brittle, and with leather causing it to disintegrate.** Ozone can crack rubber products.

18. Describe malodors as an air quality problem.

   **Malodors are objectionable and, in many neighborhoods, decrease property values.**

19. Considering the various welfare effects discussed in this chapter, what pollutant or pollutants have the potential to cause the most environmental harm?

   **Ozone poses the most potential harm to plants.** Considering plant effects, acidic deposition and material damage, **acid gases such as SO₂ are particularly harmful to the environment.**

20. In 2001, USEPA began the process of developing limits on mercury emissions from coal-fired power plants. **Why?**

   **This is because mercury levels are increasing in fish species in the Great Lakes ecosystem and emissions from coal-fired power plants are apparently the primary source of the mercury.**