



USGS Data Exploration Unit: Lesson 2 Activity Food Webs and Bioaccumulation (KEY)

Introduction

In this activity you are going to analyze a food web to determine which organisms in the food chain accumulate the greatest concentration of chemicals in their tissues and consider which organisms in a food web might be most affected by the introduction of a toxic chemical to their habitat. You will need to refer to your class notes to complete this activity.

When an animal consumes food having DDT residue, the DDT accumulates in the tissue of the animal by a process called **bioaccumulation**. The higher an animal is on the food chain (e.g. tertiary consumer such as seals), the greater the concentration of DDT in their body as a result of a process called **biomagnification**. In this activity you will identify the way in which DDT might move through a food chain.

Based on the food chain relationships denoted by the arrows in the food web diagram, label each plant/animal with one of the following labels: primary producer, primary consumer, secondary consumer or tertiary consumer. Next rank the relative concentration of DDE in each plant/animal using the following scale: 1 = lowest concentration - 10 = highest concentration. Finally, answer the five questions following the food web diagram.

Questions

- 1) What is the difference between bioaccumulation and biomagnification?

Bioaccumulation refers to the accumulation of a toxic chemical in the tissue of a particular organism. Biomagnification refers to the increased concentration of a toxic chemical the higher an animal is on the food chain.

- 2) Plants/animals from which of the following groups are most susceptible to problems from DDE: primary producer, primary consumer, secondary consumer or tertiary consumer. Why?

Tertiary consumers – Tertiary consumers are more susceptible to problems from DDE because of biomagnification.

- 3) What are some differences between the food chain of ospreys and the food chain of northern harriers? How might these differences in the diet of osprey and northern harriers result in exposure to different amounts of DDE?

Ospreys primarily feed on fish and are the top predators/tertiary consumers of an aquatic food chain. DDT tends to run off land into water ecosystems. Thus water ecosystems tend to be more contaminated than land ecosystems. Fish easily take up DDT and store DDE in their bodies. Ospreys eat these fish and are exposed to high levels of DDE. Northern harriers are top predators of a shorter, terrestrial

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food chain. Terrestrial organisms can and do suffer from DDT contamination. However, DDT does not remain on land the way it collects in water ecosystems. Thus land organisms tend to be exposed to less DDT over time and concentrate less DDE in their tissues. Therefore the food sources of the northern harrier probably have less DDE than the food sources of the osprey. Accordingly, northern harriers are likely to bioaccumulate less DDE than ospreys.

4)

a) Suppose an osprey eats 300 g of fish per day. The fish tissue consumed by the osprey has an average DDE concentration of 0.1µg/g. How much DDE is the osprey consuming in one day?

$$(300\text{g fish/day})(0.1 \mu\text{g DDE/g fish}) = 30 \mu\text{g DDE/day}$$

b) Now suppose a bald eagle also eats 300 g of food per day. But, the bald eagle eats seal carcasses that have washed up on the beach. The seal had eaten fish-eating fish with 1.0 µg/g DDE in their tissue. Much of the seal's body is made of blubber (a fatty substance) and the DDE bioaccumulates in the seal. So, the seal has 2.0 µg/g DDE in its tissue. If the bald eagle eats 300 g of seal, how much DDE does the bald eagle consume in one day?

$$(300\text{g seal/day})(2.0 \mu\text{g DDE/g seal}) = 600 \mu\text{g DDE/day}$$

5) Taking all factors into account, rank the following for likelihood of bioaccumulation: bald eagles, osprey, seals, and northern harriers.

1 – seals

2 - bald eagles (not only eat fish but scavenge on dead mammals and birds)

3 – osprey

4 – northern harriers