

USGS Data Exploration Unit: Presentation 3

Opening Questions

Read and answer each question.

1. Why is DDT harmful? What effect of DDT (DDE) is linked to the slow decline of birds of prey in the United States during the late 1960s and early 1970s?

DDT breaks down in the body of animals to become DDE. DDE tends to stay in the body and at high concentrations can result in nervous system damage, immune system problems, thyroid problems, eggshell thinning and death. The slow decline of birds of prey in the US mostly reflects the effect of eggshell thinning caused by DDE bioaccumulation in female birds. Thin eggs tend to break before embryos can fully develop and hatch.

2. Does DDE accumulate in all species equally? Why not? What type of species is most likely to accumulate large amounts of DDE due to biomagnification?

No, DDE does not accumulate in all species evenly. Consumers that are high in the food chain such as tertiary consumers are likely to accumulate a lot of DDE due to biomagnification. In order to meet their caloric requirements, tertiary consumers eat a lot of organisms that have small concentrations of DDE in their bodies. These small doses add up to high concentrations of DDE in the bodies of tertiary consumers. In addition, since DDT gets washed off into streams, rivers and the ocean, animals that feed on water-dwelling creatures tend to accumulate more DDE than animals that feed on terrestrial animals. (Unless the terrestrial animals they feed on are consumers that largely feed on aquatic animals.)

3. When was DDT banned?

DDT was banned in 1972.

Presentation Questions

Fill in the questions based on information in the presentation.

1. From where will we get data to investigate whether the DDT ban was effective in reducing DDE concentrations in wildlife?

The Contaminants Exposure and Effects Database-Terrestrial Vertebrates or CEE-TV

2. Who created this database? Why might they be interested in contaminants?

The Biological Resources Division of the U.S. Geological Survey (USGS), a part of the Department of the Interior of the federal government. The mission of the Biological Resources Division is to support the sound management and conservation of our Nation's

USGS Data Exploration Unit: Presentation 3

biological resources. Thus their interest in contaminants probably stems from a desire to determine whether animals and plants are at risk due to pollution.

3. Where did the data in the database come from? Do you trust this source of data to be fairly non-biased? Why or why not?

CEE-TV contains data gathered by hundreds of different scientists throughout the 20th and 21st centuries that has been published in peer-reviewed journals, government reports and on government websites. In general, data from peer-reviewed journals and government sources tends to be trustworthy.

4. What type of species should we investigate? Why?

A TERTIARY CONSUMER. Due to biomagnification, tertiary consumers will accumulate the most DDE in their bodies. Small amounts of DDE in organisms lower in the food web might still accumulate to dangerous concentrations in a tertiary consumer. In order for the ban to be considered effective, the biomagnification of DDE needs to decrease significantly. That is, DDE concentrations in tertiary consumers need to decrease below a harmful concentration.

5. Do all tertiary consumers have the same likelihood of accumulating high concentrations of DDE?

No, as noted in lesson 2 and in today's opening questions, DDT runs off into the water and consumers that eat mostly water-dwelling organisms tend to accumulate higher concentrations of DDE. Thus in order to focus on the most sensitive species, we should pick a tertiary consumer that feeds mostly on water-dwelling animals.

6. Can we combine species or do we need to pick one? Why?

Species do not necessarily accumulate DDE in the same way due to differences in the type of animals they eat and physiological differences that cause DDE to be processed differently. Some species will accumulate more or less DDE than other species even if fed the exact same food. Thus an 8 ug/g ww DDE concentration in one species may not be comparable to an 8 ug/g ww concentration in another species. In order to insure we are comparing data in a non-biased manner we should pick only one species.

7. What other factor effects our choice of species since we are getting our data from an existing database?

We are not collecting data ourselves but relying on data that has been collected by others. Thus, we not only need to pick a tertiary consumer that feeds mostly on water-dwelling animals but also one for which a lot of DDE data has been collected so we can have a large sample size to minimize bias. Some species are more difficult to study than other species either because they are protected or difficult to capture or only found in very remote locations.

USGS Data Exploration Unit: Presentation 3

8. We have data on DDE concentrations in osprey eggs collected from various locations in the U.S. between 1968 and 1991. What question do we want to ask? What is our hypothesis?

DDE concentrations in osprey eggs did not decrease since DDT was banned in 1972

9. With this hypothesis, how have we specifically defined our investigation?

Species: Osprey

Matrix (body part): egg contents

Location: United States

Harmful concentration of DDE: ≥ 3 ug/g ww

Time frame: DDE concentrations < 3 ug/g ww by 1992

10. What do we expect a graph of DDE concentrations in osprey eggs collected in the U.S. by year to look like if the hypothesis is supported?

No consistent pattern, no decrease, or an increase.

11. What do we expect a graph to look like if the hypothesis is rejected?

Consistent decrease in DDE concentrations with time.

USGS Data Exploration Unit: Presentation 3

12. What steps need to be taken to transform the individual records into DDE averages that can be graphed?

The computer program, Excel, is used to sort the individual data records into groups by year. We then use Excel to calculate an average DDE egg content concentration for each group.

13. How is the average DDE concentration for a group calculated?

*The average DDE egg content concentration for each group is calculated by dividing the sum of the DDE concentrations for **all** individuals by the number total number of individuals.*

14. What did the graph of the osprey data look like? What was the highest average concentration of DDE found in osprey eggs and during what time period was this high found?

*Consistent decrease of DDE to < 3 ug/g ww by 1992
8.4 ug/g ww DDE in 1970-1972*

15. Do we reject our hypothesis? What is our conclusion?

YES. Our conclusion is that DDE concentrations in osprey eggs in the United States consistently decreased below a harmful concentration (< 3 ug/g ww) in two decades following the DDT ban in 1972.

16. How long did it take for DDE to decrease below a harmful concentration (< 3 ug/g ww)?

Around 9 years

17. Was the DDT ban effective in decreasing DDE concentrations in wildlife in the United States?

We cannot answer this question. Our results are limited to our hypothesis that concerns DDE concentrations in osprey eggs. Moreover, if we wanted to be truly accurate we would not say in the U.S. but along coast and estuaries in the U.S. since the data

USGS Data Exploration Unit: Presentation 3

contained in CEE-TV are limited to these regions. Now lets explore the effectiveness of the DDT ban further by looking at another data set, DDE in bald eagle eggs.