USGS

Central Columbia Plateau NAWQA Study -- Publications

USGS Fact Sheet FS-170-96
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Organochlorine Pesticides and PCBs in Aquatic Ecosystems of the Central Columbia Plateau

Organochlorine pesticides and PCBs were detected in streambed sediment and fish from streams in the Central Columbia Plateau of ***central Washington and northern Idaho****, one of 60 study units in the U.S. Geological Survey's National Water Quality Assessment (NAWQA) Program. Concentrations of some compounds were at levels that may pose a threat to fish and wildlife of the region.*

What Are Organochlorine Pesticides and PCBs?

Organochlorine pesticides are man-made organic chemicals that have been used to control everything from fungus to grasshoppers. DDT was the first that was used on a large scale in the U.S.; it was heavily applied in agricultural regions. Most organochlorine pesticides are no longer sold for use in the U.S. PCBs are not pesticides but do have many of the same properties. They are by-products and constituents of a variety of industrial products, such as electrical transformers.

Where Do We Find Organochlorines?

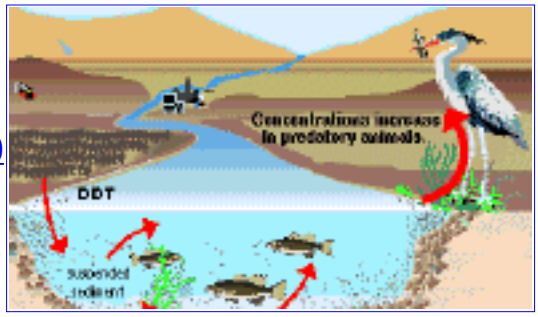
Many organochlorine pesticides are extremely persistent in the environment. Although most are no longer used in the U.S., many are manufactured here for use elsewhere, especially in developing countries. Although concentrations of these compounds are usually greatest where they are used the most (such as in agricultural areas), low levels of some compounds, such as DDT, have been found all over the world.

How Do Organochlorines Affect Wildlife?

Scientists have known since the early 1970s that DDT causes eggshell thinning in the bald eagle and other birds. Since that time, many organochlorine pesticides and PCBs have been linked to hormone

disruption and reproductive problems in aquatic invertebrates, fish, birds, and mammals (see review by Colborn and others, 1993). These effects combined with a slow rate of breakdown make many organochlorines a long-term environmental concern.

Organochlorines in the Food Chain (GIF, 21970 bytes)



Highlights

- Organochlorine pesticides and PCBs **persist in aquatic ecosystems** of the study unit, even though most are no longer used.
- ***p,p'*-DDE**, a common breakdown product of DDT, was the most frequently detected compound.
- **Land use practices**, such as irrigated farming, dryland farming and urbanization, greatly influence the distribution of organochlorines.
- **Erosion** transports organochlorines to aquatic ecosystems.
- **Wildlife in the area may be at risk** because concentrations of several compounds in both streambed sediment and fish exceeded guidelines for the protection of wildlife.

The Study Unit

The Central Columbia Plateau Study Unit covers approximately 13,000 mi^2 in east-central Washington and northwestern Idaho. It is bounded by the Palouse Mountains in the east, the Columbia River to the north and west, and the Snake River to the south.

Field Collection

Samples of streambed sediment and fish tissue were analyzed for 33 organochlorine pesticides and total PCBs at 23 sites: 16 for sediment and fish and seven for sediment only. Five to 10 samples of streambed sediment were collected at each site and composited for analysis. We collected six species of fish: carp, bridgelip sucker, largescale sucker, rainbow trout, largemouth bass, and sculpin. Bottom-feeding fish

(carp and suckers) were taken at most sites. Composite samples of four to eight whole fish of the same species were analyzed.

Land Use in the Quincy-Pasco Basins

The Quincy-Pasco Basins contain one of the most productive agricultural regions in the country. **Irrigated farming** is the dominant land use, made possible by a large system of canals and wasteways.

Detections

Several pesticides were detected in both streambed sediment and fish. **The sites with the largest number of pesticides and the highest concentrations were found in the irrigated farming areas.**

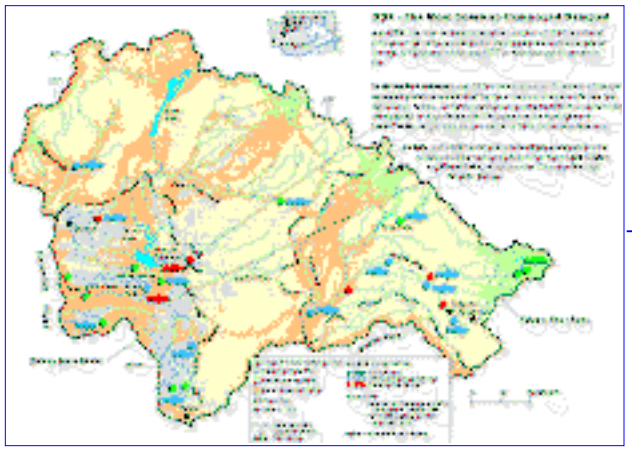
Land Use in the Palouse River Basin

The major land use in the Palouse River Basin is **dryland farming**, but **urban areas** such as Pullman, Washington, and Moscow, Idaho, impact surface waters through urban runoff and sewage treatment plant effluent.

Detections

About the same number of compounds were detected in the Palouse River Basin as in the Quincy-Pasco area. However, for some compounds, the effects of historical land use practices were apparent. For instance, **PCBs** were found only in fish and sediment at the urban sites near the towns of Pullman and Moscow. **Hexachlorobenzene**, which was used primarily with wheat seed, was found much more frequently in dryland sites than in irrigated sites.

DDE - The Most Common Compound Detected



Map of land use and p,p'-DDE concentrations (GIF, 54488 bytes)

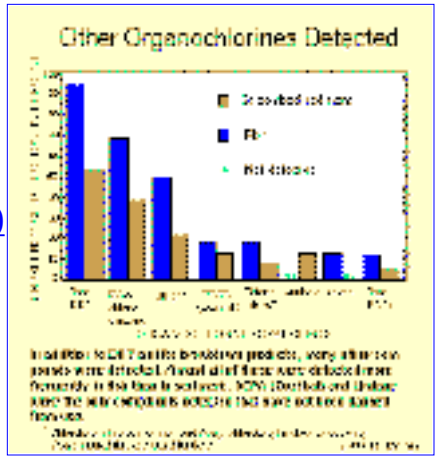
***p,p'*-DDE**, the most persistent breakdown product of DDT, was found throughout the study unit except for the forested site and comprised an average of 80 percent of the total DDT in sediment and 91 percent

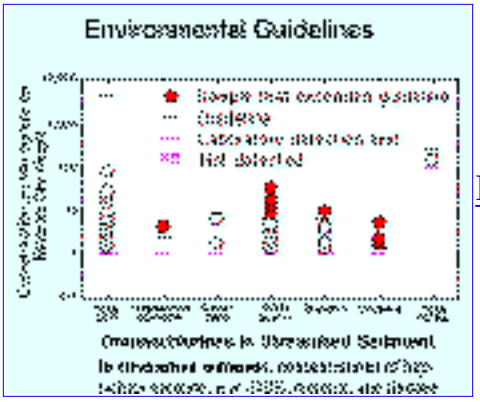
in fish.

In streambed sediment, *p,p'*-DDE concentrations at 22 percent of the sites exceeded guidelines established for the protection of aquatic life. At these concentrations, adverse effects on aquatic life are expected to occur frequently. The concentration was highest at **Lind Coulee**, which may act as a source of DDE to Potholes Reservoir.

In fish, *p,p'*-DDE concentrations exceeded guidelines for the protection of fish-eating wildlife at two sites: Lind Coulee and Royal Lake, which is in the Columbia National Wildlife Refuge. In fish, *p,p'*-DDE concentrations exceeded guidelines for the protection of fish-eating wildlife at two sites: **Lind Coulee** and **Royal Lake**, which is in the Columbia National Wildlife Refuge.

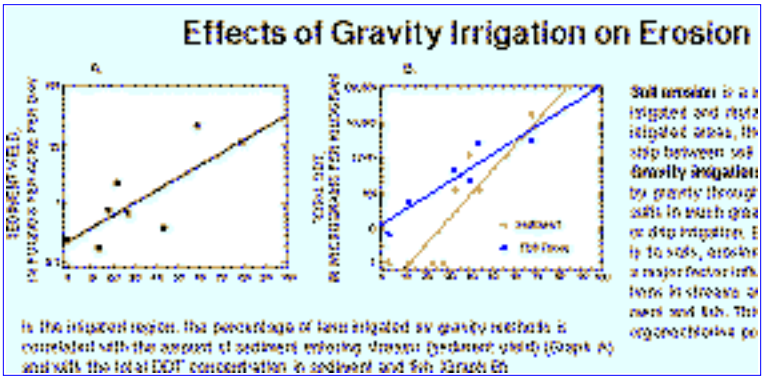
Other Organochlorines Detected (GIF, 9045 bytes)





Environmental Guidelines for Organochlorines (GIF, 10118 bytes)

Effects of Gravity Irrigation on Erosion (GIF, 11594 bytes)



Implications

Effects of Organochlorines

Concentrations of several organochlorines exceeded guidelines for the protection of wildlife. Wildlife in two areas may be particularly vulnerable: Royal Lake in the Columbia National Wildlife Refuge, home to thousands of migratory and resident birds; and Lind Coulee, which drains into Potholes Reservoir, a major recreational fishing area. *p,p'*-DDE concentrations in fish at these sites are among the highest in the country (Schmitt and others, 1990). Assessing the impacts of organochlorines on fish and wildlife is becoming increasingly important because of recent evidence suggesting that some organochlorines, even at low concentrations, disrupt the endocrine system, which is responsible for proper hormone balance. Further studies are needed to assess the impacts of organochlorines on animals, especially in agricultural areas where these compounds are most prevalent.

Keeping Organochlorines out of Streams

With the exception of a few compounds still in use, such as DCPA (Dacthal) and Lindane, most organochlorines found in the study area were applied to agricultural fields in the past. Agricultural soils thus act as reservoirs of these contaminants. The strong correlations between the percentage of irrigated land with gravity irrigation, the amount of sediment in streams, and the concentration of DDT in streambed sediment and fish suggest that the most effective way to prevent the entry of organochlorine pesticides into streams is to control erosion of agricultural soils.

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References

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