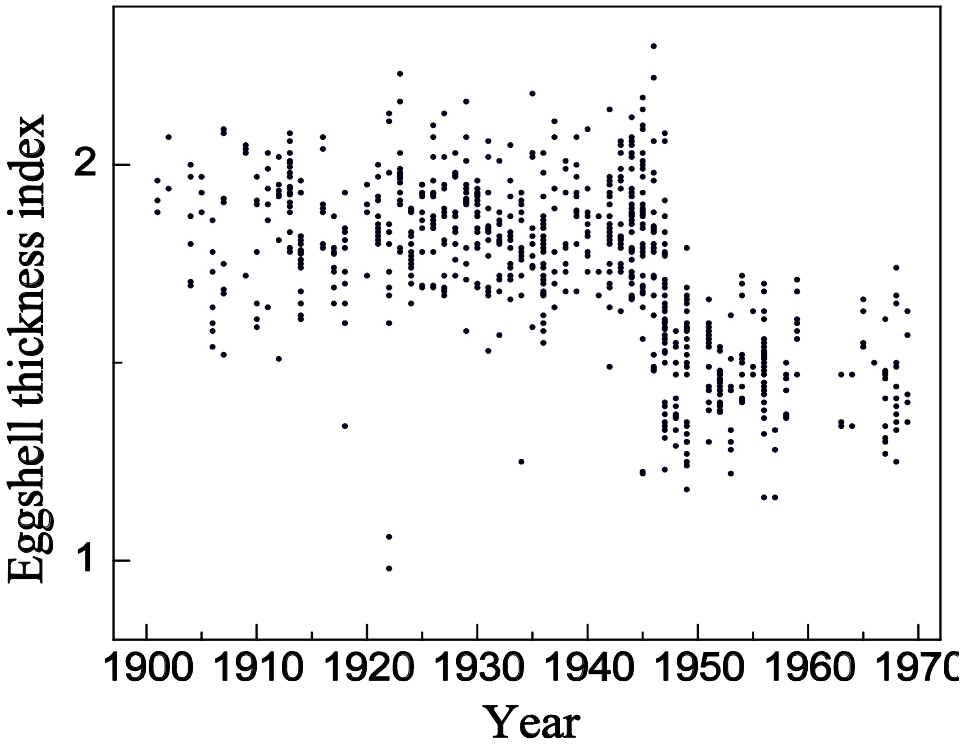
Patuxent Research Notes

DDE and birds of prey

The year was 1967 and Derek Ratcliffe, a British biologist, was plotting data points on his graph. He was investigating why there were fewer peregrine falcons in Britain than in the past. His best clue came from his visits to peregrine nests, where he found that falcon eggs sometimes broke before they hatched. Now he was plotting data showing the thickness of peregrine eggshells from eggs he collected or borrowed from museums. Ratcliffe arranged the data points in order, from about 1900 to 1970, as shown to the right. The graph showed that eggshells were variable, some thinner than most, and others thicker. This variability was expected, just as animals have different weights and heights. However, the graph showed a startling and unexpected pattern. Most of the points from 1900 to 1945 were scattered about the index value of 2. Then there was a drop in the values, and the points were scattered about an index value of 1.5.



Eggshell thicknesses of peregrine falcon eggs collected from the British Isles, excluding Scotland. The figure is redrawn from Derek Ratcliffe's article in the journal Nature.

Ratcliffe had just made a significant discovery, that after 1945 eggshells became thinner and more likely to break. He and other scientists could only guess at the reason for the thinning. One suggested cause was the insecticides used to control mosquitos or to control insects attacking crops. But before we can evaluate this hypothesis, we need to know a little about the biology of the peregrine falcon and its relatives, the raptors.

Raptors are an awesome group, known for their hooked bills and powerful talons (claws), designed for ripping flesh from carcasses. They are also known as birds of prey. Raptors have excellent eyesight for locating prey from a distance. Some raptors, such as eagles, have huge wings to carry them long distances. Eagles "soar," which means they stay aloft on rising hot air currents, barely moving their wings. Other raptors, such as peregrines, can streamline their bodies as they fall from the sky, reaching fearsome speeds of up to 200 mph as they strike their prey. Because falcons are so skillful and can be taught to return to their masters, falconry became a sport popular with kings. Owls, another group of raptors, are

nocturnal and have excellent night vision. Vultures are definitely the ne'er-do-wells of the group. They have shaved heads, a serious attitude problem, and the worst breath in the animal kingdom. They wander the hood, looking for carcasses, reciting their motto, "seize the prey." But enough said of these rank under-achievers. Let's get back to insecticides, but remember that raptors are either predators or scavengers. This is a clue to why they would be susceptible to poisoning.

When DDT or another insecticide is sprayed on insects, some of the residue is eaten by the predators of those animals. Those predators are in turn eaten by larger predators. This sequence is called a **food chain**. Animals at the top of the food chain, such as raptors, are exposed to the most DDT. At each step the amount of DDT eaten is increased, and so we call the process **biomagnification**. ("Magnify" means to make bigger and "bio" means life or living organisms.) Of the many animals exposed to DDT, the raptors or other predators at the top of a food chain are the animals most likely to be affected.

The suggestion that DDT was causing the decline of bird populations made sense to some biologists. However, scientists do not accept a hypothesis just because it sounds reasonable. Scientists want evidence from a controlled study. After all, it was possible that the use of insecticides and the decline of falcon

Exhibit A - the cracked eggshell.

populations was a coincidence, and that some other environmental factor was the real culprit. Conclusive studies were done on ducks and kestrels at the Patuxent Wildlife Research Center. In both experiments, the birds were divided into two groups, the "control" and "treated." The two groups were handled the same, except that a small amount of DDT was added to the diet of the treated group. Once the two groups had laid enough eggs for comparison, biologists measured the thicknesses of the eggshells and calculated an average for the treated birds and an average for the controls. The biologists found that birds treated with DDT laid eggs having thinner shells.

These two controlled experiments proved that DDT could thin eggshells. The last step was to prove that DDT had thinned eggshells of peregrine falcons or other wild birds. A different kind of data was required to tell us about wild birds. Biologists returned to the nests of wild birds, collected eggs, measured eggshell thickness, and analyzed the eggs for DDT. From the controlled studies mentioned, biologists knew how much DDT would cause eggshells to become thin. Biologists found even higher concentrations in eggs of wild birds. They also found that the eggs with the thinnest eggshells were those with the most DDT. Finally, when the results of all of the studies were combined, Derek Ratcliffe's graph was explained. We now have firm scientific evidence that DDT thinned eggshells and decreased populations of peregrines as well as some other species of raptors.

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