

CADDIS Volume 1

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The Case of DDT: Revisiting the Impairment

Background

The fact that DDT (or dichloro-diphenyl-trichloroethane) played a role in the decline of bald eagle and other bird-of-prey populations (e.g., ospreys, brown pelicans) is now commonly appreciated among most biologists. However, the link between DDT and the eggshell thinning that caused reproductive failure in these birds was not initially recognized. Ultimately, the connection was made by re-examining the description of the impairment.

The first link between DDT and diminishing bald eagle and other birds of prey populations was the consistent observation of high body burdens of DDT metabolites. In other words, there was co-occurrence of the declining bird populations and the candidate cause, DDT. There was also evidence of a complete exposure pathway to birds based on body burden of DDT.



However, extensive toxicity testing of DDT on adult bird mortality revealed no relationship. This suggested that the proposed mechanism, toxicity, was implausible. However, lethality was not the impairment; decline of birds-of-prey was the impairment. A new conceptual model was required that considered other mechanisms that could result in declines in bird populations. In a reexamination of the overall analysis, it became apparent that the species chosen for testing had been relatively tolerant of DDT exposure compared to those that were affected in the wild, and that the endpoint observed in these tests (lethality) would not reflect reproductive success or failure resulting from DDT exposure.

Field observations eventually revealed a potential plausible mechanism of reproductive failure due to eggshell thinning among bald eagles and other birds of prey. Laboratory experiments showed that DDE could cause eggshell thinning. Field studies showed that field exposures to DDE, a metabolite of DDT, were sufficient to cause effects in many species of birds based on the stressor-response relationship. Together these findings provided lines of evidence by which DDT might cause eggshell thinning and reduce reproductive success, a more specific impairment than declines in bird population.

Outcome

In 1972, DDT was banned from most uses in the United States. In the years following the ban, bald eagle and other bird-of-prey populations slowly recovered. The recovery of bird populations after the use of DDT was banned, is an example of mitigation of the effect following manipulation of the cause, and is very strong evidence that the use of DDT was, in fact, the true cause of bald eagle and other bird-of-prey population declines.

References

- Grier JW (1982) Ban of DDT and subsequent recovery of reproduction in bald eagles. Science 218:1232-1234.

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