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THIS REPORT IS A SHORT HISTORY OF THE AVIAN BIOLOGICAL STUDIES DONE AND ON-GOING AT RMA. POISONING OF BIRDS BY RMA CHEMICALS WAS FIRST REPORTED IN 1951. BETWEEN 1952 AND 1975 SEVERAL STUDIES WERE DONE IN THE LAKES AND AT BASIN F. THE HAZARD OF EATING CONTAMINATED FOWL WAS EMPHASIZED BY CDH IN 1981. SEVERAL STUDIES HAVE BEEN INITIATED IN THE LAST FIVE YEARS:  
1. KESTREL STUDY TO DETERMINE CHEMICAL EFFECTS ON REPRODUCTION  
2. 1984 WATERFOWL STUDY AT THE LAKES  
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U.S. Fish and Wildlife Service Investigations of Chemical Contaminants in Animals  
and Habitats of the Rocky Mountain Arsenal, Denver, Colorado

Wildlife mortality from chemical poisoning at the Rocky Mountain Arsenal (RMA) was reported by the U.S. Fish and Wildlife Service (USFWS) as early as 1951 (Finley 1959). The first confirmed diagnosis of lethal dieldrin exposure in migratory waterfowl at the RMA was made by Dr. Wayland J. Jayes, Jr. (then with the Communicable Disease Center, Savannah, Georgia) (Jensen 1955). At first, disease was suspected as the cause of periodic waterfowl dieoffs at the RMA but examinations of carcasses by animal disease specialists and pathologists did not indicate involvement of any known diseases (Jensen 1955). In an investigation of the deaths of an estimated 1,200 ducks in spring 1952, duck losses were attributed to a toxic agent or agents from the RMA chemical plant (Finley 1959).

The Denver Wildlife Research Center (Denver WRC) of the USFWS conducted several investigations of chemical contamination of RMA lakes between 1952 and 1975. In addition to the earlier studies, various other studies were done each year from 1959 to 1966 and again in 1975. Cumulative losses of ducks were conservatively estimated at 20,000 birds for a 10-year period through 1959 (Finley 1959; USFWS, Denver WRC 1961). Lethal dieldrin concentrations were found in several species of waterfowl in 1961 and 1962 (DeWitt et al. 1962 and Crabtree 1963). Many other species of wildlife including other birds, mammals, and amphibians were found dead (USFWS, Denver WRC 1961). A major attempt was

*28 ppm in the brain*

**FILE COPY**

**Rocky Mountain Arsenal  
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Commerce City, Colorado**

made by the Department of the Army to clean up 3 of the RMA lakes in 1964 when they were drained and sediments removed at a cost of \$265,000. The decontamination effort and an extensive sampling scheme to measure organochlorine concentrations was done according to plans drawn by the Denver WRC (Sheldon and Crabtree 1965). Waterfowl mortality was reduced, but not eliminated, perhaps because sediment removal was not complete or the lakes became recontaminated (USFWS, Denver WRC 1967, p. 24).

Since 1954, a toxic waste disposal pond (Basin "F", separate from the other lakes) has been the source of much wildlife poisoning at the RMA. In 1975, USFWS Region 6 Law Enforcement reported that 291 carcasses of several species of birds were removed from the shoreline of Basin "F" in just 2 days (May 1 and 2). The Department of the Army has made a consistent effort to deter and repel birds from Basin "F" with various frightening devices, but they are not 100% effective. In 1980, USFWS and Colorado Division of Wildlife Law Enforcement officials were made ill by vapors from Basin "F" and from handling dead birds they were collecting from the edges of the pond. They counted 370 waterfowl carcasses at Basin "F" on one day. In 1982, USFWS Region 6 and the Department of the Army signed a Memorandum of Agreement that the Army would evaporate the liquid in Basin "F" to dryness and then dispose of the bottom sediments in an environmentally safe manner. This permanent clean-up project is in progress, but it will take several years to complete.

The hazard to humans from eating game birds and mammals contaminated with dieldrin and other organochlorine chemicals at the RMA was recognized by the USFWS as early as 1960 (Finley 1961, DeWitt et al. 1962). This problem was brought to the forefront by the Colorado Department of Health in 1981. A series of meetings was held to decide what actions to take. Participating agencies also included USFWS Region 6, Patuxent Wildlife Research Center (Patuxent WRC), Colorado Division of Wildlife, EPA, and the Department of the Army. The Colorado Division of Wildlife warned hunters of possible

contamination of game birds and mammals that may have utilized RMA habitats. Of course, such a warning is ineffectual for migratory waterfowl and doves that fly beyond the immediate vicinity of the RMA and are bagged by unknowing hunters. A study of the rate of chemical uptake by waterfowl in relation to time spent on the RMA lakes is needed. This would provide data for (1) evaluation of toxic hazard to the waterfowl and (2) estimation of human health risk from consuming the meat in hunter-killed birds.

In response to the concern about chemical contaminants in wildlife at the RMA, Patuxent WRC initiated a 2-year study in 1982 of American kestrels ("sparrowhawks") as indicators of terrestrial contamination. This project was undertaken at the invitation of the Department of the Army. The USFWS provided most of the funding for the work.

The objectives of the kestrel study were to determine organochlorine chemical concentrations in kestrel eggs and young and to determine toxic chemical effects on kestrel reproduction. The design of the study involved placing about 45 nest boxes to attract kestrels in each of 3 areas: (1) within the confines of the RMA, (2) a near-zone outside the RMA boundaries but within 10 miles, and (3) a control set in northeastern Colorado >40 miles away. One egg was collected for chemical analysis from each active nest box in the 3 areas each year and the remaining eggs were left for observations on hatching success and production of young. A representative sample of young kestrels was also collected for chemical analysis prior to fledging (one per nest from some of the nests in each area). The results of this study are not complete at this time. Some of the samples have not yet been analyzed and a manuscript needs to be completed.

In 1984, Patuxent WRC initiated a new wildlife study at the RMA. The primary objective is to determine aldrin, dieldrin, endrin, and mercury concentrations in eggs and young of waterfowl nesting on and around the RMA lakes. The area will be searched for nests and one egg will be taken per nest found.

Mallards are of highest priority but eggs of other species (redheads, coots, and Canada geese) will be taken if not enough mallard nests are located. Later, ducklings and goslings of the same species will be collected for analysis, one per brood, before they reach full flight capability. This study is partially funded by the Army and ties in with a companion USFWS study of aquatic biota in the RMA Lower Lakes. The final report on the results should be available in early 1985 after the chemical analyses have been completed.

The USFWS Division of Fish Hatcheries and Fish Management has been involved with the RMA Lower Lakes since 1960. Earlier work included stocking warm and cold water fish species, but this was discontinued in 1977 when 50% of the fish filets tested were found to exceed the FDA action level of 0.3 ppm dieldrin concentration. Since 1977, USFWS activities at the Lower Lakes have been mainly to conduct an annual gill net survey and to collect specimens for chemical analysis by RMA chemists. In 1984 a major study of the 4 Lower Lakes was initiated under Army funding. Fish, aquatic invertebrates, and aquatic plants will be periodically collected from predetermined sampling locations. Samples will be analyzed for aldrin, dieldrin, endrin, and mercury concentrations. The general plan is for the Army to drain the lakes, excavate the contaminated sediments, and refill and restock the lakes. The USFWS will later repeat the sampling of the aquatic life to determine if the organochlorine and mercury concentrations have been reduced to below hazardous levels.

Fish and wildlife mortality and contamination from toxic chemicals have been recorded at the RMA for more than 30 years. In addition to the known direct losses of wildlife there are important unanswered questions concerning toxic effects. The RMA is attractive to migrant birds because it is a large area of relatively undisturbed upland and wetland habitat in the midst of an urbanized, developed region. What are the effects of the organochlorine chemical residues acquired by the thousands of waterfowl, wading birds,

songbirds, and raptors that utilize the RMA? Do these residues cause later mortality as fat stores are mobilized in migration and breeding? Do they lower reproductive success? Do humans suffer health effects from eating contaminated game? The current clean-up program, which includes elimination of Basin "F" and rehabilitation of the Lower Lakes, will greatly reduce the organochlorine chemical impacts on fish and wildlife when completed. More work will be needed to determine the extent and types of chemical contamination of the RMA uplands and associated wildlife/human health problems. Wildlife can serve as bioindicators of the presence and concentrations of toxic chemicals and can provide information for decisions on a decontamination action program for the RMA.

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