Pesticide contamination and eggshell characteristics for Mountain Bluebirds in Colorado

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Introduction

I have established the Cherokee Park Bluebird Trail (140 nestboxes), located in the northern Colorado Rocky Mountain region (latilong: 405-1053), in 1980 in response to declining nesting habitat for Mountain Bluebirds *(Sialia currucoides)* in this area (Den 1984). The primary objective for establishig this trail was to stabilize and increase the population of this secondary cavity-nesting species. Another goal of this study is to determine the wintering area of this breeding population. Though I have banded 608 Mountain Bluebirds (L-522, AHY F-84, AHY M-2) in my study area, none has been encountered or reported during the winter months. As dedicated bird banders and accruers of scientific knowledge, we should consider our responsibilities extending beyond the banding of birds and our hopeful expectations of band encounters. We should constantly be on the alert for environmental variables, in addition to band encounters, which may help identify bird movements.

On 15 May 1982, I observed a Mountain Bluebird (AHY F) incubating a single-egg clutch which lacked an eggshell-the contents being encased only by the outer membrane. Like most other songbirds, Mountain Bluebirds usually do not start incubating until the last egg of the clutch is laid (Zeleny 1976 and pers. obs.). Incubating an egg without an eggshell might suggest this female was exposed to persistent pesticides (mainly DDT and metabolites) during its wintering movements south, including the southern United States, Mexico or points further south. DDT contamination, including DDE which is the primary form of DDT found in birds, is thought to be high in parts of west Texas, southeast New Mexico and Mexico (Clark and Krynitsky 1983). The purpose of this study was to determine if there is persistent pesticide contamination in the breeding population of Mountain Bluebirds in my study area.

Methods and materials

In the spring of 1983, I collected one egg from each of fifteen Mountain Bluebird clutches for organochlorine pesticide analysis. Mountain Bluebirds are indeterminant layers. Therefore, sample collections probably had minimal affect on subsequent clutch size, but I did not measure this. All sampled nestboxes were located in scattered Ponderosa Pine *(Pinus ponderosa)*, shortgrass habitat between 1,540 m and 2,400 m in elevation. Caution was taken to avoid contamination of eggs from hand or finger exposure to any form of plastics (e.g., steering wheel). The egg samples were placed in paper-based egg cartons with cotton packing to cushion them during transportation. Samples were sealed to prevent moisture loss and refrigerated overnight prior to the processing of the eggs and their contents for chemical analysis.

For each egg, I recorded whole-egg measurements: eggshell length and breadth (Helios® dial calipers to nearest 0.01 cm), egg weight (Mettler® P1200 to nearest 0.01 g), egg volume (by water displacement), and shell thickness index (g/cm²) Table 1). The contents of the 15 eggs were placed into a single chemically-cleaned glass jar and this composited sample was shipped to Hazelton Raltech, Inc., Madison, Wisconsin for chlorinated insecticide and PCB analysis. This sample was analyzed by electron capture-gas chromatography procedures similar to those described by Cain and Bunck (1983). Limit of detection was 0.05 ppm for chlorinated insecticides and 0.10 ppm for PCB's and toxaphene.

Table 1. Summary of preliminary analysis of 15 mountain bluebird eggs in northcentral Colorado.

Sample[1]	Egg size (cm) Length	Breadth	Whole egg weight (g)	Volume (ml)	Contents weight (g)	Shell index[2] (g/cm²)
1	2.18	1.65	3.26	3.2	2.79	0.190
2	2.02	1.72	3.33	3.0	2.73	0.206
3	2.11	1.55	2.83	2.0	2.39	0.175
4	2.10	1.64	3.08	2.7	2.59	0.186
5	2.16	1.61	3.14	3.1	2.45	0.190
6	2.05	1.65	3.06	2.0	2.52	0.183
7	2.21	1.64	3.25	3.2	2.78	0.188
8	2.19	1.68	3.34	3.0	2.87	0.190
9	2.19	1.63	3.17	3.2	2.65	0.188
10	2.22	1.69	3.45	3.4	2.97	0.199
11	2.12	1.70	3.34	3.5	2.74	0.200
12	2.17	1.70	3.39	3.3	2.88	0.187
13	2.16	1.70	3.31	3.0	2.68	0.198
14	2.12	1.55	2.66	2.6	2.30	0.174
15	2.16	1.55	2.67	2.4	2.26	0.174

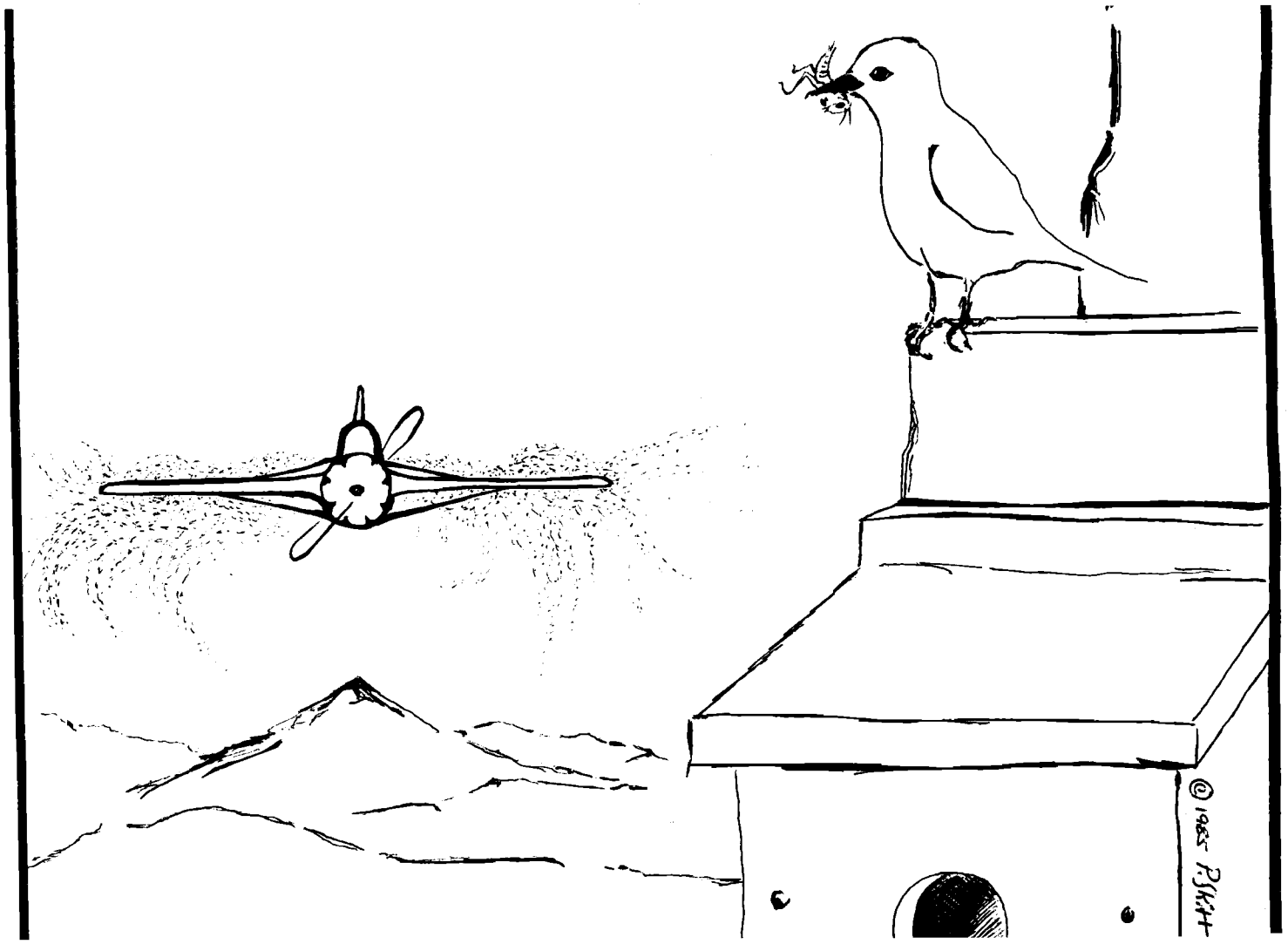
[1]All samples had fresh embryo development but 14 (5 days) and 15 (4 days).
[2]After Ratcliffe 1967 (weight/(length × breadth).

Results and discussion

The only organochlorine chemical detected above the 0.05 ppm limit was DDE (dichlorodiphenyldichloroethylene) which is the major environmental form of the insecticide DDT. Its concentration was only 0.06 ppm. HCB (hexachlorobenzene) and HCH (hexachlorocyclohexane) were detected in minute but unquantifiable amounts. HCH is also an insecticide while HCB is a fungicidal seed protectant. Though individual egg residues remain unknown when egg samples are pooled, the maximum contamination in any one egg can be calculated by dividing micrograms of contaminant (0.06 g of DDE) by the mean egg content weight of the pooled sample (2.64 g). This computes to a maximum of 0.23 ppm that could occur in only one of the 15 pooled eggs. Levels approaching 10 ppm in passerine eggs are probably required to correlate with significant affects on reproduction, but this may vary with species. We do not know for sure if this low level of DDE present could be a problem for Mountain Bluebirds, but it appears not to be biologically important.

A pooled sample of breeding Mountain Bluebirds collected (whole body) during 1980 in the Black Hills of South Dakota had 0.18 ppm DDE and no other residues. A similar pool of Mountain Bluebirds collected in northeast Oregon three years after treatment with DDT had 7.83 ppm DDE and no other organochlorine residues (L. R. DeWeese, pers. comm.). One year following the DDT treatment in Oregon, Mountain Bluebird eggs averaged 5.29 ppm total DDT residues (parent DDT and metabolites) and 16 to 50 miles from the sprayed area they averaged 1.67 ppm total DDT residues (parent DDT and metabolites) (Henny, et al. 1977).

The Mountain Bluebird eggs I had analyzed in my study area apparently reflect a population that is relatively free of significant exposure to DDT and other persistent organochlorine pesticides. Definitive statements certainly cannot be made from this study in regard to identifying wintering grounds of Mountain Bluebirds breeding in northcentral Colorado. This study does suggest that this breeding population of Mountain Bluebirds in Cherokee Park is not migrating through or wintering in regions where significant DDT or DDE exposure occurs.



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Analysis of a Sample of Tennessee Warblers Window-killed During Spring Migration in Manitoba

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Large numbers of passerine birds killed in collision with lighted structures during night migration flights, particularly in the fall, have yielded important information on the timing of migration of individuals of different ages and gender, route selection and geographic origins of migrants, and molt (e.g., Tordoff and Mengel 1956, Payne 1961, Kemper *et al.* 1966, Crawford 1978, Raveling and Warner 1978). Large, single samples of birds killed in this manner during the spring migration have been less frequenty reported (but see Hatler and Campbell 1975), although weather-caused mortality in spring occurs frequently (e.g., Green 1962, Whitmore *et al.* 1977, Zumeta and Holmes 1978).

Prolonged below-normal temperatures in late April through May, 1974, and stormy weather in mid-May, caused mortality of many spring migrant birds, particularly passerines, in southern Manitoba (Serie and Jones 1976, McNicholl and Goossen 1980). During mid-day on 22 May 1974, about 150 passerines, most of them wood warblers (Parulinae), struck the glass wall of an arboretum that joins two apartment buildings in Winnipeg, Manitoba. Seventy-one of the birds killed were Tennesse Warblers (*Vermivora peregrina*). These specimens are examined in the present paper, and the span of the migratory movement of Tennessee Warblers in spring in southern Manitoba is determined from mist netting of individuals at a stopover site along the southern shore of Lake Manitoba.

Methods

Each salvaged bird was sexed on the basis of plumage characteristics and weighed to the nearest 0.1 g on a triple-beam balance before being frozen. Later, the exposed culmen, flattened wing, and longest rectrix were measured to the nearest 0.1 mm. Each individual's sex was determined by dissection and the amount of subcutaneous fat in the interclavicular fossa (often called the furculum or furcular cavity) was estimated using a qualitative scale of 0-4, where 0 = no fat, 1 = solid sheet of fat decurved down into the fossa, 2 = fat filling fossa, 3 = fat bulging out of fossa but not meeting layer of fat from abdomen, and 4 = fat bulging out of fossa and meeting layer of fat from the abdomen.

The spring migratory period of Tennessee Warblers in southern Manitoba was determined by mist netting individuals at a stopover site, the dune-ridge forest along the southern shore of Lake Manitoba (see MacKenzie 1982), about 120 km NW of Winnipeg, Manitoba. Mist netting was conducted daily, as weather permitted, during the spring migration periods in 1976, 1977, and 1984 and all Tennessee Warblers captured in the approximately 2-m high nets set at ground level, were sexed on the basis of plumage characteristics, banded, and released.

Results

Sex ratio. - Seventy of 71 individuals in this sample were sexed correctly based on plumage characteristics; one male was mistakenly called a female. There were significantly more males than females (51 males:20 females; $x^2 = 13.53$, $p < .001$).