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Sodium Monofluoroacetate (1080): A Study of Residues in Arctic Fox Muscle Tissue

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Starting about 1836 and continuing into the 1930's fur traders and fox farmers introduced arctic fox (Alopex lagopus) to several islands in the Aleutian Chain--islands that were previously free of terrestrial mammalian predators (Jones and Byrd 1979). By 1937, this exotic furbearer was successfully introduced on almost all of the Aleutian Islands. Their effect on native avifauna was immediate and acute since they depended on natural foods, including indigenous birds for sustenance and it soon became a pest of significant importance in the Aleutian Islands. Aleutian Canada geese (Branta canadensis leucopareia) were a major prey species, and by 1967 were listed as endangered. Recovery plans for the Aleutian Canada goose specified the sequential eradication of arctic fox throughout the Aleutian Islands including Kiska Island, a large land mass (28,200 ha) and historic breeding site of this species in the western Aleutians.

The investigations of the efficacy of the pesticide sodium fluoroacetate (1080) against arctic fox and the potential hazards of such use began on Kiska Island in March 1986 and the initial phases were completed by April 1987. 1080, the sodium salt of fluoroacetate, was selected for this attempt at eradication of arctic fox because of its toxicological profile. It is considerably more toxic to carnivores and rodents than any other species (Atzert 1971) and is known to be an effective predacide and rodenticide (Crabtree 1962). 1080 is classified very highly toxic (FR Doc. 1985) by the Environmental Protection Agency (EPA) with an average acute oral LD_{50} of 1.4 mg/kg for a variety of indicator and pest mammals (Atzert 1971).

Our study, covered by an EPA Experimental Use Permit (Stubbs 1982) had 3 objectives that addressed efficacy of 1080 against arctic fox, impacts of treatment on nontarget raptors and scavengers, and posttreatment recovery of specific prey species. The subject study of in situ 1080 (fluoroacetate) in arctic fox muscle

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tissue, part of objectives 1 and 2, provided data on postmortem 1080 burdens and a means for assessing potentials for adverse effects on nontarget species.

MATERIALS AND METHODS

Between March 30 and April 4, 1986, field personnel of the U.S. Departments of Interior and Agriculture aerially applied (by helicopter) 1080-treated single dose baits (SDBs) for control of arctic fox on Kiska Island. The formulation consisted of a 4.3 g cone-shaped beef tallow (90%) and white beeswax (10%) matrix with a 4.0 mg spot of 1080 applied in the center, surrounded by the matrix.

Of the 186 dead arctic fox observed during posttreatment surveys, 132 were recovered between March 31 and April 4, 1986. The right hindquarter was excised from 66 of the 132, and forwarded to the Denver Wildlife Research Center. Hindquarters were frozen upon collection in the field and remained so until they were prepared for analysis, a period of about 80 days. Data on 1080 residues were determined for 61 arctic fox (33 females and 28 males).

About 1.0 g of muscle tissue from each hindquarter was prepared for analysis according to the method of Okuno et al. (1982, 1984). Samples were extracted with an acetone-water mixture in an ultrasonic cleaner. The acetone was evaporated and the aqueous solution containing fluoroacetic acid was acidified and extracted with ethyl acetate. The ethyl acetate was evaporated after adding triethanolamine to convert the fluoroacetic acid to triethanol-ammonium fluoroacetate salt. The dry residue was reconstituted with acetone and derivatized with pentafluorobenzyl bromide. The samples were analyzed for 1080 using a Hewlett-Packard Model 5880A gas chromatograph with a SPB-5 capillary column (60 m, 0.32 mm I.D., 0.25 micron film thickness), and measured by electron capture detector. This method is adaptable for routine use in most laboratories, and is capable of detecting and quantifying to about 0.05 ppm (microgram 1080/g of sample) with satisfactory repeatability.

A t-test of unequal sample sizes was used to test for differences in residue levels in female and male foxes.

RESULTS AND DISCUSSION

Concentrations of 1080 found in muscle tissue of female and male arctic foxes are given in Table 1. Of the 61 specimens analyzed, all but 3 contained detectable/quantifiable 1080 residues ($\geq$0.05 ppm). No significant difference in concentrations of 1080 was found between females (0.81 ppm) and males (0.70 ppm). There are no published data available on residues of 1080 in muscle tissue of arctic fox fed a single lethal dose of 1080 in bait form under controlled conditions. However, recent studies conducted on 3 individually caged arctic fox (1 female, 2 males) each fed 1 SDB containing 4.0 mg 1080 yielded a mean residue in

Table 1. Compound 1080 (sodium fluoroacetate) residues in arctic fox muscle tissue from samples collected on Kiska Island, Alaska, 3/30-4/1/86.

Measured Parameter	Female	Male
Whole body wt (kg)		
mean	3.6	4.5
range	2.8-4.3	3.3-5.6
1080 Concentration (ppm)		
mean	0.81	0.70
SE	0.118	0.093
range	0.09-2.80	0.12-2.20
Combined values for 1080 concentration (ppm) both sexes		
mean	0.76	
SE	0.076	

hindquarter muscle tissue of 0.39 ppm (range 0.24-0.65 ppm). The time to death of these 3 foxes after SDB consumption ranged from approximately 2 to 3-3/4 h. The results of these limited cage trials suggest that most free-ranging arctic fox on Kiska Island consumed more than one 4.0 mg SDB (0.81 ppm, equivalent to an average of 2.1 SDBs or 8.4 mg 1080 for females and 0.70 ppm, equivalent to an average of 1.8 SDBs or 7.2 mg 1080 for males), a phenomenon consistent with their opportunistic feeding behavior. Maximal residue values for arctic foxes collected on Kiska Island were 2.8 ppm for females (equivalent to 7.2 SDBs or 28.8 mg 1080) and 2.2 ppm for males (equivalent to 5.6 SDBs or 22.4 mg 1080).

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