112701

10/29/81

1. CHEMICAL: Brodifacoum

2. FORMULATION: Formulated (0.005% A.I) Pellet bait

3. CITATION: Marsh, Rex E. and Howard, Walter E. (1978). Secondary toxicity Hazards Tests of Brodifacoum to Raptors (preliminary Report not for distribution.) Submitted by ICI Americas Inc., EPA Acc. #245704. Submitted July 22, 1981.

4. REVIEWED BY: Russel Farringer
Wildlife Biologist
EEB/HED

5. DATE REVIEWED: 10/29/81

6. TEST TYPE: Secondary Toxicity

A. TEST SPECIES: Golden Eagle (Aquita chryseatos), Red-tailed hawks (buteo borealius colurus), red-shouldered hawks (Buteo lineatus)

7. REPORT RESULTS:

All four eagles tested survived, although what appears to be anticoagulant-related syptoms occurred in three out of four birds. All four Red-tailed and one of two Red-shouldered hawks died during the course of the test.

8. REVIEWER'S CONCLUSIONS: While this study had some short comings the data could still be of value in a hazard assessment. Because of the nature of this study and the study design parts of the report will be exert for future reference. Since this is a preliminary report and the researcher raise some important points on its validatity, we will use the information contained in it as indicative and not absolute.

Materials and Methods

Test Procedure
(Excerted from text of Report)

In order to be able to replicate these tests in our own laboratory, and so the same could be done in other research centers, we established a set of rather definite parameters for preparing the rodenticide-treated rodents and how they were fed to the raptors. These procedures follow.

1. Use only wild rodents, as opposed to laboratory strains, in the secondary-hazard feeding tests.

2. Have the treated baits to be offered to the test rodents contain concentrations of rodenticide which are consistent to expected use practices.

3. Cage the test rodents individually and offer them the bait treated with the anticoagulant (brodifacoum) for 3 consecutive days in a no-choice situation, i.e, with no other food avialable.

4. Record daily the amount of bait consumed in the 3-day test and calculate the total mg of rodenticide consumed by each rodent (multiply the amount of bait consumed by the concentration of the toxicant in the bait).

5. Following this 3-day feeding period, put the rodents on normal laboratory diet and observe them daily (for 7 days with rats and 9 days with mice) and record day of death.

6. Only those rats which succum (to the rodenticide) during days 4 through 10 (days 4 through 12 for house mice) following the first day of the 3-day feeidng are to be used in the secondary hazards study. The reason for only using test rodents that died during these prescribed number of days is to facilitate determining the amount of brodifacoum they have taken in, and those living longer before dying may lose too much of the rodenticide before dying.

7. All rodents which are atypical in the amount of bait consumed or die outside the established time parameters are to be discarded.

8. Observe all test rodents several times daily; when death occurs place the animals and a record of all pertinent data concerning that animal in a plastic bag which is sealed and then frozen at 24°C (-14°F) until needed for the secondary hazards study.

9. About 16 hours before the rodenticide-laden rodents are to be fed to the raptors, remove them from the freezer and place themon trays to thaw at room temperture, generally overnight, so that partly frozen carcasses, which would influence "normal" feeding behavior, are never offered to the raptors.

10. For pre- and posttreatment feeding of raptors, wild rodents of the same species are euthanized with CO_2 and stored frozen until needed.

11. A detailed record of all data is prepared about each rodent and a copy is retained with each carcass.

Results & Discussion

(A) "It is recognized that the rodents described in the above no-choice feeding test procedures have probably 1) ingested what might be considered the maximum amount of rodenticide possible over a 3-day period; (2) that this amount is many times the quantity of brodifacoum needed to be lethal to the rodents; and 3) it is many times in excess of what might be consumed under natural field baiting operations." pg 3 of Report.

> Report no: CTL/P?462 Brodifacoum: Absorption, Excretion and Tissue Retention in the Rat by H. Bratt, & Pamela Audson (1979) ICI. Lab.
>
> 'Their results showed that absorption may be a saturable process with fecal excretion increasing rapidly after saturation.'

In realtionship to the above enumerated statements, we can agree with one and two. Statement three is unsubstantiate. If the bait was the easiest and most readily available to the rodent then one would assume that the rodent could consume large amounts of the bait.

(B) "Prior to going on to the test, each bird was maintained on fresh-frozen and then thawed carcasses of day-old chicks obtained from a hatchery by the Raptor Center." (pg 3)

"Prior to testing, the raptors were being fed as many day-old baby chicks as they would consume. How much vitamin K this provided the birds is of particular concern to this study." (pg 5)

"At [another] raptor center, it was concluded that the birds were deficient in vitamin K; and upon supplementing their diet with vitamin K, much greater resistance to anticoagulents resulted in subsequent testing." (pg 5)

Since the Raptor were fed entire baby chicks they could have received large doses of vitamin K than they would normally recieve in the wild. No testing was done that would of determined if this baised the results of this test.

The attached tables give mortality data and dose level.

Table 1. Days to death, and amount of .005% brodafacoum (PP581) treated EPA rodent diet consumed by the wild Norway rats (Rattus norvegicus) fed to the golden eagles (Aquila chrysaetos) in Table 5.

Bird No.	Rodent No.	Rodent wt. (kg)*	Toxic bait consumed (g) Day 1	Day 2	Day 3	Amount consumed Bait (g)	PP581 (mg)	Time to death (days)
GE-4	D-18	.335	30.1	27.1	15.2	72.4	3.62	6
	D-1	.353	20.4	22.7	27.6	70.7	3.54	7
	D-10	.265	1.4	30.7	35.1	67.2	3.36	8
	F-1	.428	38.5	36.7	33.1	108.3	5.42	7
GE-5	D-9	.250	23.3	20.6	30.9	74.8	3.74	8
	D-14	.256	23.1	21.9	26.1	71.1	3.56	6
	D-7	.306	12.9	24.9	30.0	67.8	3.39	7
	D-5	.474	23.7	26.0	33.2	82.9	4.15	7
GE-7	D-8	.271	20.0	22.3	32.1	74.1	3.71	7
	D-19	.371	3.7	32.7	33.8	70.2	3.51	7
	D-6	.297	17.3	23.6	25.9	66.8	3.34	6
	D-17	.366	36.8	31.7	39.3	107.8	5.39	8
GE-8	F-5	.269	30.1	22.0	24.7	76.8	3.84	8
	D-2	.353	17.6	22.4	31.7	71.7	3.59	6
	F-8	.253	22.2	21.8	24.8	68.8	3.44	9
	F-7	.386	24.0	26.4	26.5	76.9	3.85	8

*Rodents are listed in the order they were fed to the golden eagles.

Table 2. Days to death, and amount of .005% brodafacoum (PP581) treated EPA rodent diet consumed by the wild Norway rats (Rattus norvegicus) fed to the western red-tailed hawks (Buteo borealis colurus) in Table 6.

Bird No.	Rodent No.	Rodent wt. (kg)*	Toxic bait consumed (g) Day 1	Day 2	Day 3	Amount consumed Bait (g)	PP581 (mg)	Time to death (days)
RT 58	D-11	.228	15.9	18.9	14.7	60.1	3.01	7
	D-12	.237	9.3	17.5	26.8	53.6	2.68	9
	D-15	.315	0.3	17.7	32.3	50.3	2.52	8
	F-13	.300	22.6	22.7	20.5	41.4	2.07	10
RT 70	D-13	.265	11.7	19.5	28.9	60.1	3.01	8
	D-20	.204	16.0	17.0	21.4	54.4	2.72	8
	F-12	.170	17.4	16.8	15.6	49.8	2.49	8
	F-4	.157	5.5	17.6	17.7	40.8	2.04	7
RT 107	D-3	.284	15.8	20.9	24.0	60.7	3.04	8
	D-16	.290	4.9	21.8	32.9	59.6	2.98	7
	F-3	.198	18.8	14.1	11.9	44.8	2.24	9
	F-11	.180	7.7	16.0	16.0	39.7	1.99	10
RT 116	F-9	.184	22.5	21.0	18.6	62.1	3.11	6
	F-6	.161	17.8	18.5	19.2	55.5	2.78	6
	F-15	.156	19.7	17.0	14.6	51.3	2.57	6
	F-14	.150	15.3	11.2	7.6	34.1	1.71	7

*Rodents are listed in the order they were fed to the western red-tailed hawks.

Table 3. Days to death, and amount of .005% brodafacoum (PP581) treated EPA rodent diet consumed by the wild house mice (Mus musculus) fed to the red-shouldered hawks (Buteo lineatus) in Table 7.

Bird No.	Rodent No.	Rodent wt. (kg)*	Toxic bait consumed (g) Day 1	Day 2	Day 3	Amount consumed Bait (g)	PP581 (mg)	Time to death (days)
RS 6	H-6	.0179	3.5	3.6	4.1	11.2	.56	10
	H-11	.026	3.3	3.8	4.3	11.4	.57	12
	H-13	.0222	3.2	4.2	3.7	11.1	.56	10
	H-14	.0237	1.8	3.4	4.6	9.8	.49	5
	H-19	.0188	2.2	2.9	4.2	9.3	.47	10
	H-33	.0156	3.4	3.7	3.5	10.6	.53	11
	H-12	.0146	3.6	3.3	2.5	9.4	.47	6
	H-21	.0168	1.5	2.3	3.7	7.5	.37	5
	H-22	.0158	1.4	2.7	3.3	7.4	.37	9
	H-4	.0206	4.8	4.3	4.1	13.2	.66	7
	H-26	.0151	1.4	2.1	3.0	6.5	.33	7
	H-29	.0169	1.7	2.2	3.0	6.9	.35	9
RS 10	H-31	.0158	3.7	4.0	3.4	11.1	.56	12
	H-35	.0154	3.8	4.2	3.5	11.5	.58	10
	H-38	.0184	4.0	3.6	3.5	11.1	.56	7
	H-18	.0237	3.1	2.9	3.8	9.8	.49	6
	H-32	.0199	3.5	3.8	3.2	10.5	.53	10
	H-39	.0149	2.9	3.5	3.0	9.4	.47	9
	H-16	.0163	2.0	3.6	3.6	9.2	.46	9
	H-24	.0154	1.7	2.5	3.1	7.3	.37	7
	H-25	.0145	1.9	2.7	3.1	7.7	.39	8
	H-7	.0192	4.6	5.0	3.9	13.5	.68	9
	H-23	.0153	0.5	2.6	3.4	6.5	.33	9
	H-30	.0152	1.8	2.5	2.5	6.8	.34	12

*Rodents are listed in the order they were fed to the red-shouldered hawks.

Table 5. A secondary-toxicity test with golden eagles (Aquila chrysaetos), including pre- and postfeeding periods and the number of additional days the birds were observed for symptoms, which were fed wild Norway rats (Rattus norvegicus) that had died from eating rodent bait containing .005% brodifacoum (PP581). See Table 1 for details about these rats. The actual amount of PP581 consumed by the eagles is unknown because of detoxification and other factors but the maximum potential amount that could be in the rats eaten by the eagles is shown.

Bird No.	Bird wt. (kg)	3-day pretest feeding period: Total rodents consumed	3-day pretest feeding period: Total consumed (g)	4-day pretest feeding period: Rodents offered daily	4-day pretest feeding period: Total no. consumed	4-day pretest feeding period: wt. of rodents consumed (g)	Maximum chemical consumed: mg	Maximum chemical consumed: mg/kg	3-day posttest feeding period: Total rodents consumed	3-day posttest feeding period: Total consumed (g)	Additional observation period: no. of days	Toxic symptoms observed: yes/no	Toxic symptoms observed: days to (symptoms)	Mortality yes/no
GE-4	3.459	3	430	1	4	960	15.93	4.61	3	373	27	no	-	no
GE-5	3.167	3	514	1	4	986	14.83	4.71	3	487	27	yes	13 (external blood)	no
GE-7	4.621	3	547	1	4	1052	15.95	3.45	3	606	27	yes	9 (sluggish)	no
GE-8	3.657	3	629	1	4	1149	14.71	4.02	3	527	27	yes	11 (external blood)	no

Table 6. A secondary-toxicity test with western red-tailed hawks (Buteo borealis calurus) including pre- and postfeeding periods and the number of additional days the birds were observed for symptoms, which were fed wild Norway rats (Rattus norvegicus) that had died from eating rodent bait containing .005% brodifacoum (PP501)., See Table 2 for details about these rats. The actual amount of PP501 consumed by the hawks is unknown because of detoxification and other factors but the maximum potential amount that could be in rats eaten by the hawks is shown.

Bird No.	Bird wt. (kg)	3-day pretest feeding period: Total rodents consumed	3-day pretest feeding period: Total consumed (g)	4-day pretest feeding period: Rodents offered daily	4-day pretest feeding period: Total no. consumed	4-day pretest feeding period: wt. of rodents consumed (g)	Maximum chemical consumed: mg	Maximum chemical consumed: mg/kg	3-day posttest feeding period: Total rodents consumed	3-day posttest feeding period: Total consumed (g)	Additional observation period: no. of days	Toxic symptoms observed: yes/no	Toxic symptoms observed: days to (symptoms)	Mortality: yes/no	Mortality: days
BT-56	1.616	3	292	1	4	384	10.27	6.36	3	270	11	yes	6 (external blood)	yes	
BJ-70	1.247	3	271	1	4	670	10.26	8.23	3	342	10	yes	8 (external blood)	yes	
BJ-107	1.247	3	293	1	4	472	10.24	8.21	3	323	3	yes	7 (external blood)	yes	
BT-116	1.077	3	319	1	4	390	10.15	9.42	3	376	5	yes	7 (external blood)	yes	

Table 7. A secondary-toxicity test with red-shouldered hawks (Buteo lineatus) including pre- and postfeeding periods and number of additional days the birds were observed for symptoms, which were fed wild house mice (Mus musculus) that had died from eating rodent bait containing .005% brodifacoum (PP581). See Table 5 for details about these mice. The actual amount of PP581 consumed by the hawks is unknown because of detoxification and other factors but the maximum that could be in the mice eaten by the hawks is shown.

Bird No.	Bird wt. (kg)	3-day pretest feeding period: Total rodents consumed	3-day pretest feeding period: Total consumed (g)	4-day pretest feeding period: Rodents offered daily	4-day pretest feeding period: Total no. consumed	4-day pretest feeding period: wt. of rodents consumed (g)	Maximum chemical consumed: mg	Maximum chemical consumed: mg/kg	3-day posttest feeding period: Total rodents consumed	3-day posttest feeding period: Total consumed (g)	Additional observation period: no. of days	Toxic symptoms observed: yes/no	Toxic symptoms observed: days to (symptoms)	yes
RS-6	.590	9	118	3	12	164	5.72	10.60	9	140	27	yes	8 (blood in droppings?)	no
RS-10	.680	9	134	3	12	168	5.72	8.41	9	136	11	yes	10 (external blood)	yes