Rejecta Cast from Heron Nests as an Indicator of Food Chain Contamination

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The Hanford Reservation, in south-central Washington near Richland, is a 1,476-km^2 site of mostly undeveloped shrub-steppe that contains a major nuclear energy facility and also provides habitat for wildlife. The Great Blue Heron (*Ardea herodias*) is a year-round resident in the reservation, and a colony of about 40 pairs nests in a small, isolated grove of deciduous trees established on the west bank of the Columbia River in the northeast portion of the reservation (Fig. 1).

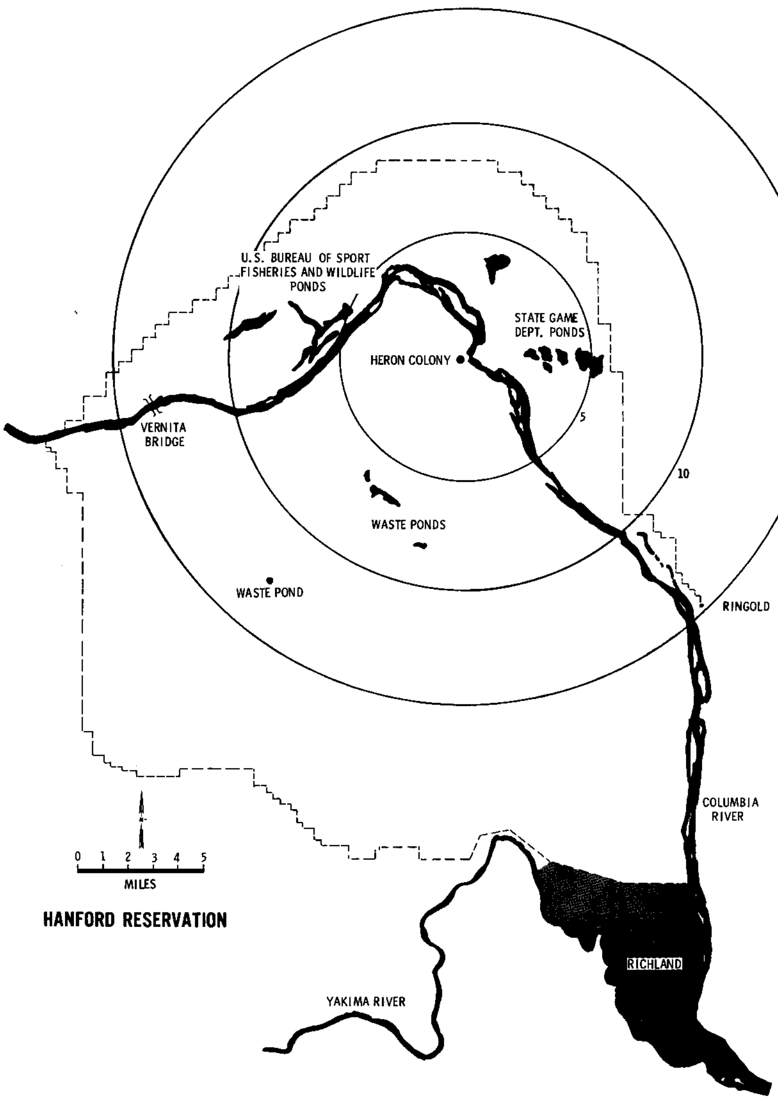

Fig. 1. Location of the heron colony on the ERDA Hanford Reservation, in relation to the Columbia River and ponds used by herons for foraging. The concentric circles are at 8-km intervals from the heron colony.

To survey radionuclides as an environmental contaminant without imposing mortality on the nesting colony, we radiochemically analyzed the material cast from nests during the period when young birds were in the nests and being fed by parent birds. Rejecta from heron nests were collected on 0.9 × 3.6 m cheesecloth blankets spread on the ground beneath several closely grouped nest trees. Seven sites were selected for blanket placement by judging visually where rejecta would likely accumulate on the ground beneath nest groups. Blankets were replaced at 21-day intervals between 18 April and 20 June 1975. One "control" blanket was located in the open away from the colony to collect airborne radionuclides. The blankets plus accumulated rejecta were oven-dried, ashed at 400°C to reduce the volume of material, and counted for gamma-emitting radionuclides in a well-type NaI (Tl) crystal using conventional gamma-ray spectroscopic techniques.

The accumulated dry weight of rejecta (mostly carp bones, skin, and scales, and amorphous fecal material) averaged 174 g/m^2 (Table 1). The amount of rejecta increased as the nestling birds grew and their food demands increased. Only 31 g/m^2 of rejecta were accumulated during the first 21-day period. This increased to 81 g/m^2 during the final 21-day period. Approximately 290 kg dry weight of rejecta was estimated to have been deposited over the 1,700-m^2 area under the nest trees. The amount of rejecta accumulated by different blankets varied because in certain situations several nests contributed rejecta to a single blanket while in other instances only one or two nests provided rejecta.

Six different radionuclides accumulated on the control blanket as contributions from airborne detritus (Table 2). These are man-made radionuclides except for the naturally occurring ^{40}K. However, eight different radionuclides were measured on the blankets containing heron rejecta. When expressed in terms of picocuries per gram dry weight (pCi/g), the control blankets had higher concentrations of ^{144}Ce, ^{106}Ru, ^{95}Zr, and ^{54}Mn than did blankets exposed to heron rejecta. When expressed as pCi per square meter of blanket area, the blankets with accumulated rejecta had more of the biologically active radionuclides (^{137}Cs, ^{40}K, ^{65}Zn, and ^{60}Co) indicating that these radionuclides were associated with the materials that parent birds had transported to the nest as food for young birds.

The ^{137}Cs content varied between blanket locations (Table 1) but locations 1 and 5 consistently had the highest concentrations, suggesting that the food materials brought to these nests contained higher amounts of radiocesium. Location 3 consistently had very low ^{137}Cs levels. On the average, blankets receiving rejecta had higher contents of radiocesium than the control blanket that was exposed only to airborne radiocesium.

Two adult Great Blue Herons were found dead on the Hanford Reservation, both apparently killed by colliding with aerial-strung wires. Samples of breast muscle were removed from the birds and radiochemically analyzed. One bird had 50 pCi^{137}Cs/g dried muscle tissue in comparison to 0.3 pCi/g for the other. The liver of the first bird also contained detectable amounts of ^{95}Zr and ^{54}Mn, while the other bird's did not. Although limited in scope, these data suggest that these two herons had accumulated different amounts of radionuclides by foraging on foods of different radionuclide content or else had experienced different turnover times after ingesting foods of similar radiocesium content.

The Columbia River probably provides the bulk of the heron colony foods. Data are not available for all species of Columbia River fish, but whitefish (Blumer et al. 1976, BNWL-1980, Battelle, Pacific Northwest Laboratories, Richland, WA) had very low ^{137}Cs levels, averaging only 0.43 pCi/g fresh weight.

TABLE 1. Dry weight (g/m^2) of heron rejecta and its ^{137}Cs content (pCi/g dry wt) at three different times during the nesting season of 1975

Blanket location	18 April–9 May		10 May–30 May		31 May–20 June		Wt (Total)	^{137}Cs ($\bar{X}$)
	Wt	^{137}Cs	Wt	^{137}Cs	Wt	^{137}Cs		
1	57	36.1	110	47.2	101	25.5	268	36.3
2	38	5.45	55	8.99	79	4.70	172	6.38
3	24	3.90	43	2.86	36	2.89	103	3.22
4	26	13.5	34	14.9	46	11.4	106	13.3
5	22	17.7	47	70.0	69	30.1	138	39.3
6	24	23.4	88	15.5	142	10.7	254	16.5
7	25	11.5	54	12.9	93	5.73	172	10.0
Average	31	15.5	62	24.6	81	13.0	174	17.9
SE	± 5	±4.4	±10	±9.3	±14	±4.0	±25	±3.6
Control blanket	1.0	7.28	0.9	19.9	2.3	3.56	4.2	10.2 ±4.9

TABLE 2. Average radionuclide contents of cheesecloth blankets exposed from 18 April to 20 June 1975 to rejecta from heron nests as compared to controls

Radio-nuclides	pCi/g dry weight									pCi/m²	
	Blanket locations with rejecta										
	1	2	3	4	5	6	7	Average	Control	Rejecta	Control
^{144}Ce	3.3	4.2	5.0	4.9	4.6	2.9	3.8	4.1	131	610	410
^{106}Ru	[a]	1.3	3.4	1.1	[a]	[a]	1.1	0.99	143	110	490
^{137}Cs	36	6.4	3.2	13	39	16	10	18	9.9	3,300	34
^{95}Zr	0.74	1.0	1.3	1.4	1.4	0.90	1.2	1.1	43	170	130
^{54}Mn	0.31	1.0	0.23	0.39	0.55	0.38	0.13	0.43	2.1	98	6.0
^{65}Zn	0.35	0.42	0.17	0.73	0.60	0.28	0.21	0.39	[a]	66	[a]
^{40}K	14	14	10	13	14	13	16	13	3.2	2,400	24
^{60}Co	0.34	0.87	0.43	0.49	0.54	0.51	0.23	0.48	[a]	94	[a]

[a] Below detection limits.

Great Blue Herons sometimes forage around nuclear waste ponds that contain goldfish (Fitzner and Rickard 1975, BNWL-1885, Battelle, Pacific Northwest Laboratories, Richland, WA). These goldfish have relatively high levels of ^{137}Cs (about 84 pCi/g fresh weight; Cushing and Watson 1974, BNWL-1884). Possibly goldfish contributed to the levels of ^{137}Cs measured in heron rejecta, but we have no direct evidence of this.

Young herons remain in the nest for several weeks following hatching, during which time food scraps and fecal droppings accumulate on the ground beneath the nest trees. Systematic collection of nest rejecta and analysis for radioactivity, trace metals, and other kinds of potentially biologically transportable industrial pollutants appears to be a useful way of detecting trends in local environmental contamination of food chains in a high trophic level organism without imposing mortality upon a relatively small and isolated heron population. Collections such as these could be applied to other heron colonies to yield information on food chain contamination in regions with different and changing mixtures of land uses.

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Second Occurrence and First Successful Nesting Record of the Hook-billed Kite in the United States

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On 16 December 1975 two pairs of adult Hook-billed Kites (*Chondrohierax uncinatus*) were observed on Santa Ana National Wildlife Refuge, 11.3 km south of Alamo, Hidalgo County, Texas. These birds were seen almost daily until the end of April 1976, when one pair apparently left the area.

In early May, a Hook-billed Kite nest with two eggs was found in a Texas ebony tree (*Pithecellobium flexicaule*) located in chapparral brushland by Cruz Martinez. The nest was 6.5 m from the ground. On 6 June 1976 the newly-hatched birds were first observed. One young kite inexplicably disappeared but the other fledged. The adults were last seen and the young bird heard calling from outside the nest on 10 July 1976 by Wayne Shifflett although the fledgling was not observed at that time. These observations represent the second occurrence and first successful nesting record for this tropical species in the United States. The previous record in early May 1964 was also at Santa Ana and included three downy young that soon disappeared from a nest in another Texas ebony tree located in brushy woodlands growing on a sandy Rio Grande floodplain (Fleetwood and Hamilton, Auk 84: 598–601, 1967).

Beneath the nest there were several hundred opened land snail shells that the kites had fed on. All were identified as *Rabdotus alternatus* (Joe Ideker, Pers. Comm.)—*Received 24 February 1977, accepted 19 April 1977.*