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Mammal Occurrence and Exclusion at the Hanford Site

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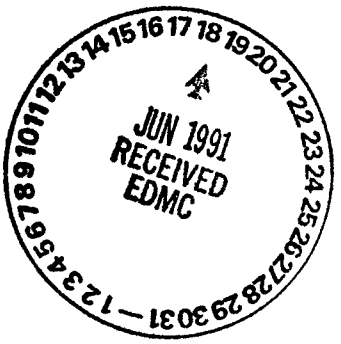

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MAMMAL OCCURRENCE AND EXCLUSION AT THE HANFORD SITE

A. R. Johnson

ABSTRACT

Effluent and operational facilities monitoring on the Hanford Site in Washington State is conducted by Westinghouse Hanford Company for the U.S. Department of Energy. This includes collecting mammals from process facilities and from nuclear waste disposal sites to quantify (1) effluent control and (2) the effectiveness of barriers to biological intrusion. This paper reports the numbers and kinds of mammals, plus measured radionuclide contamination, from 10 years of data collection in a section of the Hanford Site called the 200 East and 200 West Areas. Mammals inhabiting or occurring in these locations include 13 species ranging in size from Odocoileus hemionus (the mule deer) to Perognathus parvus (the Great Basin pocket mouse), with the latter being the most abundant mammal on the Hanford Site. The mammal most frequently associated with contamination is Mus musculus (the house mouse), which usually is found in and near facilities where biological barriers to radionuclide contaminants are not available. The low frequency of contamination in mammals found at waste disposal sites suggests that the engineered biological barriers at these locations are effective.

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1.0 INTRODUCTION

Westinghouse Hanford Company, the Operations and Engineering contractor for the U.S. Department of Energy at the Hanford Site in Washington State has, as part of its mission, the responsibility of managing the fuel reprocessing and radioactive waste management facilities in the 200 East and 200 West Areas. An effluent monitoring program to ensure operational control includes collecting and conducting radionuclide analyses of mammalian inhabitants of these reprocessing and waste management facilities. The waste management sites are intended for low maintenance; therefore, biological barriers are an integral part of the design. Because the process facilities are areas of high use, they usually cannot protect against the intrusion of small mammals. This difference in physical characteristics results in significant differences in mammal control.

2.0 SITE DESCRIPTION

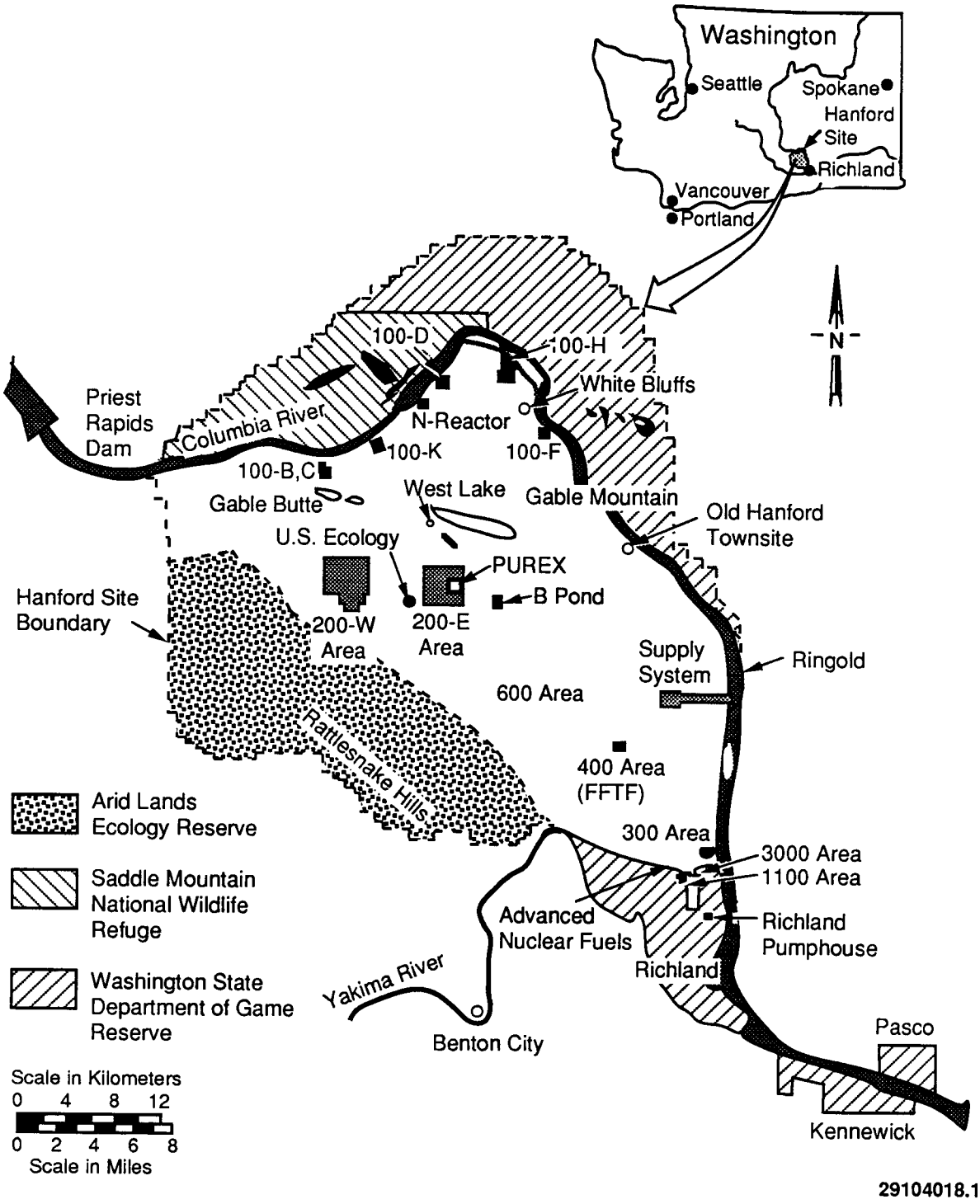
The Hanford Site, consisting of approximately 1,450 km^2 (570 mi^2) is located within the Pasco Basin in southcentral Washington State (Figure 1). The Site lies approximately 270 km (170 mi) southeast of Seattle, Washington; 325 km (200 mi) northeast of Portland, Oregon; and 200 km (120 mi) southwest of Spokane, Washington. The 200 Area, consisting of approximately 40 km^2 (15 mi^2), contains nuclear fuel reprocessing facilities and waste management units, which are centrally located within the Hanford Site approximately 11 km (7 mi) south of the Columbia River (Figure 1).

The Hanford Site was acquired by the Federal Government in 1943 for the construction and operation of facilities to produce plutonium for the atomic weapons program during World War II. For more than 20 yr, Hanford Site facilities were primarily dedicated to the production of plutonium for national defense, and management of wastes generated by chemical processing operations. In later years, programs at the Hanford Site have become increasingly diverse, involving research and development for advanced reactors, renewable energy technologies, waste disposal technologies, and cleanup of contamination from past practices.

3.0 METHODS

A scientific collection permit was granted to Westinghouse Hanford Company by the Washington Department of Wildlife to allow collection and salvage of selected animals for radionuclide contamination analyses and for testing engineered barriers. Methods of collection varied from live traps, snap (kill) traps, to salvage of dead animals (e.g., road kills) for laboratory analyses.

Figure 1. Hanford Site Map.



3.1 LABORATORY ANALYSES

Field preparations of mammals were done as outlined in routine sample-collection procedure manuals. Procedures for methods in the case of unusual samples (e.g., bobcats) not covered in a procedure manual were specified by the Environmental Protection field work coordinator. Samples that had radioactivity levels above background, as determined by field survey instruments, were sent to onsite analytical laboratories.

Samples were washed to remove external contamination before analysis, and the resulting rinse was analyzed in addition to the whole body or dissected parts. Samples of larger specimens (e.g., rabbits), after being washed, were divided into portions to separate skin and fur, gastro-intestinal organs, and muscle and bone. Small animals usually were dissolved in acid and analyzed for radionuclides.

4.0 RESULTS

4.1 MAMMAL COLLECTION AND SALVAGE

Mammals captured or salvaged on and near reprocessing facilities or waste management sites included 16 species. These included Sylvilagus nuttallii (Nuttall's cottontail), Lepus californicus (the black-tailed jackrabbit), Spermophilus townsendii (Townsend's ground squirrel), Thomomys talpoides (the northern pocket gopher), Perognathus parvus (the Great Basin pocket mouse), Reithrodontomys megalotis (the western harvest mouse), Peromyscus maniculatus (the deer mouse), Onychomys leucogaster (the northern grasshopper mouse), Neotoma cinerea (the bushy-tailed wood rat), Lagurus curtatus (the sagebrush vole), Mus musculus (the house mouse), Canis latrans (the coyote), Taxidea taxus (the badger), Lynx rufus (the bobcat), and Odocoileus hemionus (the mule deer).

4.2 RADIONUCLIDE CONTAMINATION

Six of these 16 species have been documented to be implicated with radionuclide contamination in the 200 East and 200 West Areas during the past 10 years. They include nine Nuttall's cottontails, four black-tailed jackrabbits, eight deer mice, 25 house mice, two coyotes, and one badger (Table 1). Radionuclide analyses results have been conducted for five of these species (Table 2). All examples of contamination were found within or near facilities or structures without biological intrusion barriers, with the exception of the badger, which burrowed through a physical barrier of four feet of soil. Not all of these cases have been analyzed in a laboratory, but results are reported in Table 1 for those species that have been analyzed for radionuclide contamination. The contamination level, as determined by a field survey instrument (a Geiger-Mueller counter), is recorded in counts per minute, and the laboratory analyses results are recorded in picoCuries per gram.

Table 1. Radionuclide Contamination in Six Mammal Species (1981-1990).

Species	Barrier sites Contaminated/ noncontaminated	Nonbarrier sites Contaminated/ noncontaminated
Nuttall's cottontail (Sylvilagus nuttallii)	0/23	9/17
Black-tailed jackrabbit (Lepus californicus)	0/2	4/6
Deer mouse (Peromyscus maniculatus)	0/52	8/23
House mouse (Mus musculus)	0/0	17/25
Coyote (Canis latrans)	1/8	1/3
Badger burrow (Taxidea taxus)	1/3	0/0

Table 2. Radionuclide Contamination in Mammals at the Hanford Site (1981-1990).

Mammal	Geiger-Mueller Level (cpm[a])	Radionuclide Concentration (pCi/g[b])
Nuttall's cottontail (Sylvilagus nuttallii)	23,000	^{90}Sr 4.6 E4 ^{137}Cs 2.8 E5 ^{239}Pu 1.5 E3
Black-tailed jackrabbit (Lepus californicus)	700	^{90}Sr 3.2 E3 ^{137}Cs 6.1 E1 ^{239}Pu 1.2 E0
Deer mouse (Peromyscus maniculatus)	13,000	^{90}Sr 7.6 E7 ^{137}Cs 1.7 E4 ^{239}Pu 2.6 E2
House mouse (Mus musculus)	NR	^{90}Sr 6.3 E4 ^{137}Cs 1.9 E5 ^{239}Pu 7.5 E2
Coyote (Canis latrans)	NR	^{90}Sr 2.3 E3 ^{137}Cs 3.6 E2 ^{239}Pu 7.5 E0
Badger (burrow soil) (Taxidea taxus)	20,000	NR

[a]cpm = counts per minute
[b]pCi/g = picoCuries per gram dry weight
NR = Not reported.

5.0 CONCLUSIONS

The absence of radionuclide contamination in the Hanford Site's most abundant mammal, the Great Basin pocket mouse, and the higher frequency in the less abundant house mouse, is indicative of the ecological differences between the two species, and also indicates that barriers to mammal intrusion at waste sites can be effective. It is important that the type of barrier be fitted to the type of mammal present as evidenced by the intrusion of the deep-burrowing badger.

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