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7. Abstract

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SMALL MAMMALS AND HARVESTER ANTS IN THE 300-FF-1 OPERABLE UNIT

SUMMARY

A survey of burrowing rodents and harvester ants was conducted in the vicinity of the 300-FF-1 Operable Unit during late summer 1991. The predominant rodent in the survey area was the Great Basin pocket mouse (*Perognathus parvus).* Deer mice (*Peromyscus maniculatus*) were more abundant near the riparian vegetation zone. Harvester ants were abundant in all surveyed areas.

Pocket mice and deer mice may contribute to offsite migration of contaminants via consumption of contaminated soils or vegetation, by excavation of buried contaminated soils, or through predation by coyotes and raptors. Harvester ants may contribute to offsite migration primarily through excavation of buried contaminated soils.

1.0 INTRODUCTION

The U.S. Department of Energy's (DOE) Hanford Site in southeastern Washington State (Figure 1) has been placed on the National Priorities List for hazardous waste cleanup. The Site has been divided into "operable units," each of which is being characterized to determine possible routes of exposure to humans and methods for cleanup.

Westinghouse Hanford Company (WHC), as the operations and engineering contractor for the Site, requested that the Pacific Northwest Laboratory (PNL)[1] conduct surveys of biota at one of the designated operable units--the 300-FF-1 Operable Unit in the 300 Area of the Hanford Site (see Figure 1). The objectives for these surveys were set by the *Remedial Investigation/Feasibility Study Work Plan for the 300-FF-1 Operable Unit* (DOE 1990) under Task 5a-2--Species Survey, viz.

> ...to determine what species - which are endangered, threatened, economically important, or constitute significant components of the human food chain - inhabit 300-FF-1. In addition, the use of the operable unit habitat of each such species

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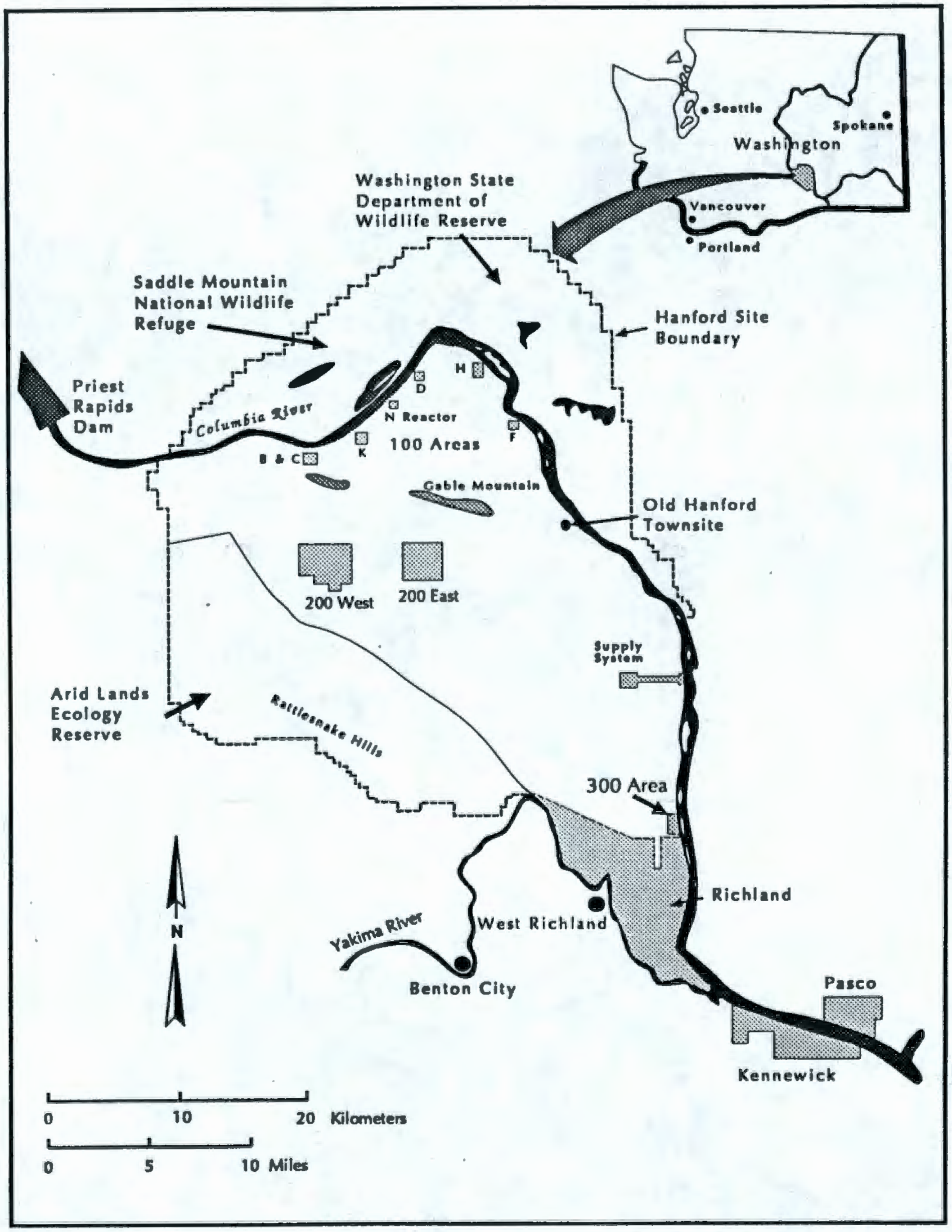
[1]The Pacific Northwest Laboratory is operated for the U.S. Department of Energy by Battelle Memorial Institute under Contract DE-AC06-76RL0 1830. Funding for this program was provided by the WHC Environmental Restoration Program.

Figure 1. Location of the 300 Area and Hanford Site



> identified will be characterized to allow for an assessment of potential biological impacts (DOE 1990, p. SAP/FSP-29).

The survey was required to be qualitative in nature (DOE 1990, p.WP-175) rather than quantitative. A listing of endangered and threatened species potentially associated with the 300 Area was provided in the Work Plan (DOE 1990, p.WP-51).

This report addresses the results of small-mammal and ant surveys completed in Fiscal Year 1991 under Task 5a-2. Small mammals and ants are of interest as they are potential pathways for the offsite migration of contaminants. These surveys were conducted after those reported by Rickard et al. (1990), who addressed the plant, bird, and medium-sized and large mammals inhabiting 300-FF-1.

The purpose of this small-mammal study was to evaluate the composition and relative abundance of species that occur in the vicinity of the 300-FF-1 Operable Unit. The small-mammal species occurring at the Hanford Site have been documented (Rickard et al. 1974), as has the past burrowing activity of small mammals on the 300 Area Burial Ground sites (Fitzner et al. 1979). Burrowing depths for several small mammals found at Hanford were summarized by Gano and States (1982); these depths suggest the potential for movement of contaminated soils to the surface. Cadwell et al. (1983) estimated that various small-mammal species common at arid low-level waste burial grounds have the potential of moving from 0.35 to 8.30 m^3 of soil per hectare to the surface each year. Once contaminated soils are at the surface, wind and water erosion and biotic transport factors are important considerations in determining contaminant transport from the waste site.

The purpose of this ant survey was to evaluate the relative abundance of harvester ants that occur in the vicinity of the 300-FF-1 Operable Unit. A previous study by Fitzner et al. (1979) showed that four ant species (*Solenopsis molesta*, *Formica manni*, *F. subpolita*, and *Pogonomyrmex owyheei*) occupy the 300 Area waste sites and adjacent areas. Fitzner found that the harvester ant (*Pogonomyrmex owyheei*) was abundant within the 300 Area. In comparing ant densities inside versus outside the enclosures, he found that the ants seemed to prefer to establish their colonies within disturbed areas such as the 300 Area Burial Grounds.

2.0 METHODS

2.1 SMALL-MAMMAL SURVEY METHODS

Three small-mammal trap-transects were selected outside the waste site perimeter fencing but within the 300 Area Burial Ground Exclusion Zone (300-FF-1 boundary) (Figure 2). The criteria for selection of the trap-transects were their closeness to the waste sites and their similar vegetation.

2.1.1 Small-Mammal Transect 1

Located west of the 300 Area Process Trenches, the 500-m Small-Mammal Transect 1 had a series of 50 live-traps placed 10 m apart starting at the northwest end of the fence and continuing south toward the south end of the fence. The trenches compose a narrow band of waste area; the vegetation was described by Rickard et al. (1990) as a bitterbrush-Sandberg's bluegrass community (*Purshia tridentata/Poa sandbergii*). In addition, cheatgrass (*Bromus tectorum*) and Russian thistle (*Salsola kali*) are dominant along the perimeter fence, and grey rabbitbrush (*Chysothamnus nauseosus*) and sagebrush (*Artemisia tridentata*) are dominant in areas west of the trapline. The substrate and habitat of the trench area and perimeter (gravelly substrate and piles of windblown Russian thistle) differed from the surrounding community (sandy substrate with grey rabbitbrush and Sandberg's bluegrass). Consequently, traps were located along the site perimeter fence to sample rodents representative of the trench habitat.

2.1.2 Small-Mammal Transect 2

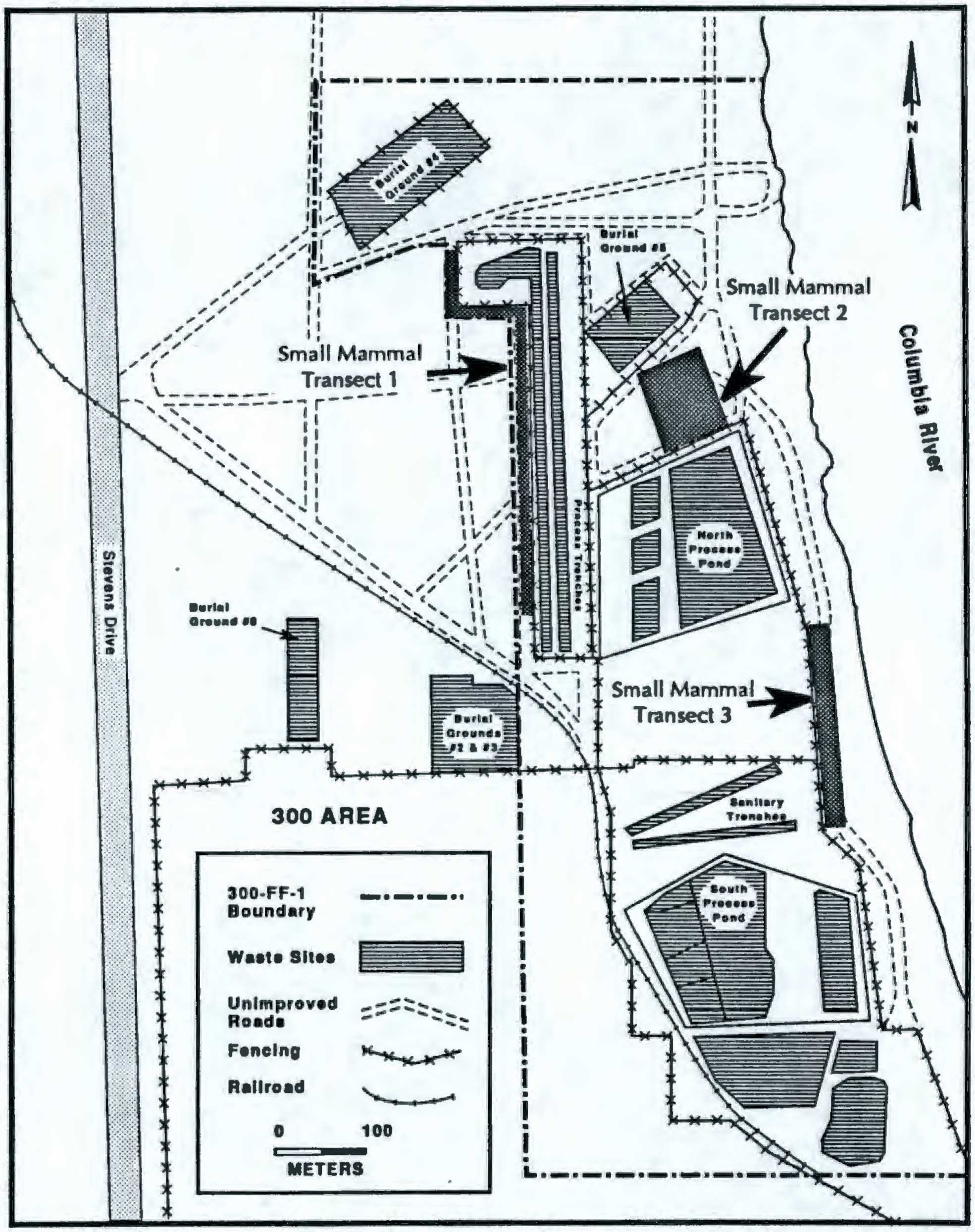
Small-Mammal Transect 2 contained 100 live-traps spaced at 10-m intervals in a 10 x 10 grid pattern covering a hectare area with fenced-in waste areas on three sides. The vegetation on this trapping grid was listed by Rickard et al. (1990) as a grey rabbitbrush-cheatgrass community. The soil at this site is sandy. The study site is surrounded by Burial Ground #5 on the north, the process trenches on the west, and the north process pond on the south.

2.1.3 Small-Mammal Transect 3

Small-Mammal Transect 3 was 250 m long with two parallel rows of live-traps, 10 m between trap-rows, and 10 m between traps within rows. This site is between the Columbia River on the east and the east fence of the 300 Area Burial Grounds on the west and may represent populations of small mammals that have access to waste areas along the river. The plant community for this site was characterized by Rickard et al. (1990) as a grey rabbitbrush-cheatgrass community. The first row of traps was placed in a disturbed area between the fence and access road; vegetation there contained a large amount of Russian thistle. The second row of traps was east of the access road in vegetation typical of a rabbitbrush-cheatgrass community.

Sherman live-traps were used in each transect and were baited daily with an oatmeal-peanut butter mix. Each trap was placed inside a sheet metal can slightly larger than the trap and covered with a sheet metal tent to help protect against overheating while the animals were confined. Two trapping sessions were started by an initial baiting on June 6, 1991, and again on July 16, 1991. Each trapping session

Figure 2. Location of Transects Used in Small-Mammal Surveys



comprised five consecutive days. When an animal was first captured, it was given an individual identification mark using a permanent felt-marker to facilitate the identification of recaptured mice.

2.2 ANT SURVEY METHODS

Three ant survey areas were established close to the small-mammal trap areas (Figure 3). Areas sampled for ant activity were at least 1 hectare in size and were surveyed for harvester ant colonies on September 30, 1991. The colonies were counted by personnel walking transects across the study area and marking the ant colonies to prevent duplicate counts as all colonies were identified.

2.2.1 Ant Survey Area 1

Ant Survey Area 1 was located south and west of the process trenches and east of an access road. The dimensions of the survey area were 143 m from north to south and 70 m from east to west (see Figure 3). The trenches compose a narrow band of waste area, and the vegetation was described by Rickard et al. (1990) as a bitterbrush-Sandberg's bluegrass community. The survey area is in contrast to the nearby waste area and also includes a sagebrush-grey rabbitbrush-cheatgrass community. The soil at the study site resembles a stabilized sand dune type.

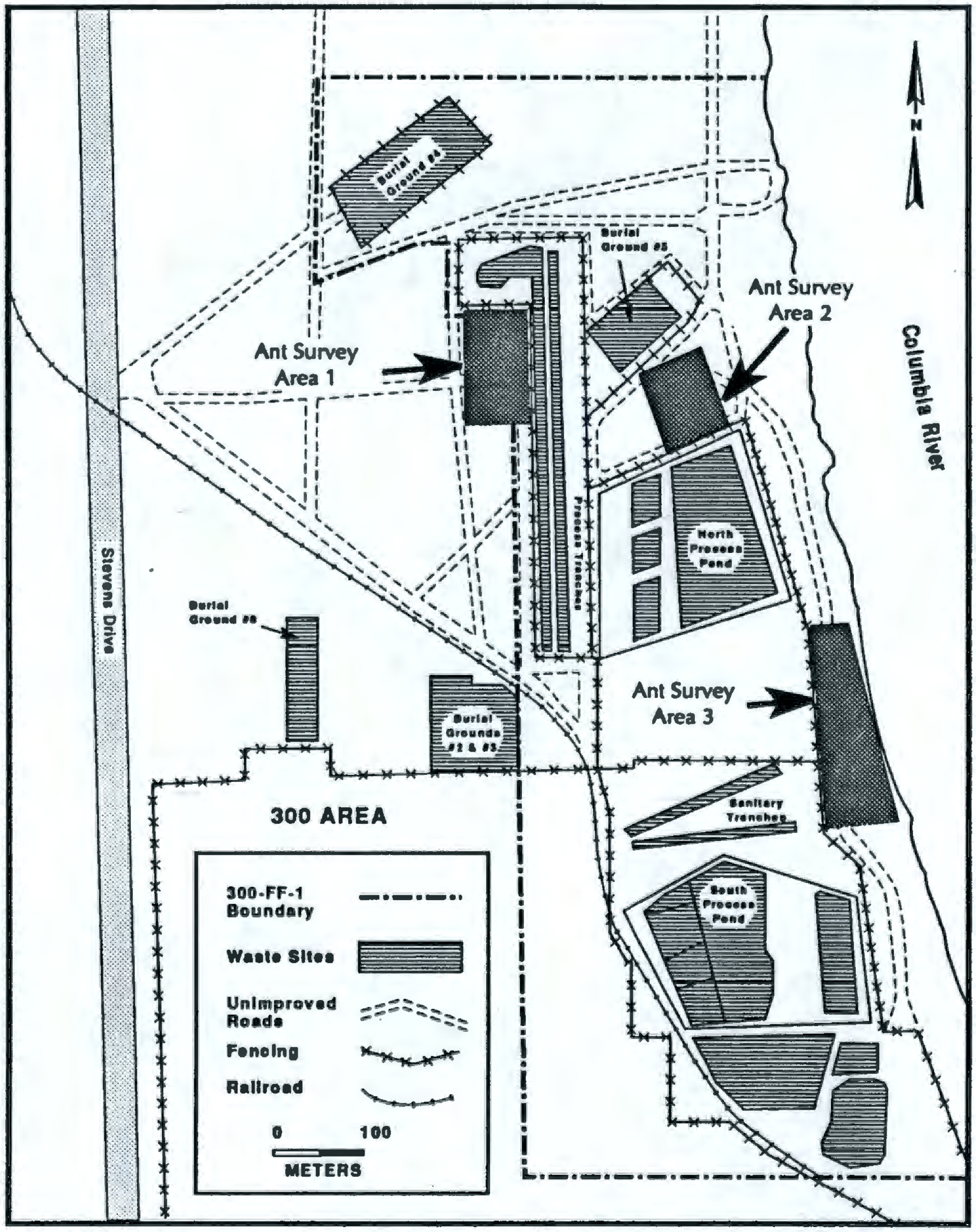
2.2.2 Ant Survey Area 2

Ant Survey Area 2 was a hectare area (100 x 100 m) also identified as Small-Mammal Transect 2. The study site is surrounded by Burial Ground #5 on the north, the process trenches on the west, and the north process pond on the south.

2.2.3 Ant Survey Area 3

Ant Survey Area 3 was the complete area east of the small-mammal trapline between the east perimeter fence and the river (not including the riverbank). The area is southeast of the north process pond and northeast of the south process pond (see Figure 3). Rickard et al. (1990) characterized the vegetation as a grey rabbitbrush-cheatgrass community. Because of the geographic confinement between the fence and the river, the dimensions of the 1.4-hectare study area were trapezoidal, with the narrowest edge (40 m) toward the north and the widest edge (65 m) toward the south. The study area was from 250 m from north to south and included the area within and east of Small-Mammal Transect 3.

Figure 3. Location of Harvester Ant Survey Areas



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3.0 RESULTS

3.1 SMALL MAMMALS

Two species of mice were consistently trapped on the three transects: the Great Basin pocket mouse (*Perognathus parvus*) and the deer mouse (*Peromyscus maniculatus*). The other burrowing species captured were Townsend's ground squirrel (*Spermophilus townsendii*) and western harvest mouse (*Reithrodontomys megalotis*) (Table 1). The remaining captures consisted of two young cottontail rabbits (*Sylvilagus nuttalli*).

Table 1. Small-Mammal Species Captured on the Three Transects.

Species	Number of captures		
	Transect 1	Transect 2	Transect 3
Pocket mouse	15	22	7
Deer mouse	4	2	5
Harvest mouse	0	3	0
Ground squirrel	0	1	0

3.2 HARVESTER ANTS

The density of harvester ant colonies at the three study areas ranged from 11 to 53 colonies per hectare (30 colonies/hectare average) (Table 2).

Table 2. Harvester Ant Colonies Near the 300 Area Burial Grounds.

Survey area	Size (ha)	Number of colonies	Density (colonies/ha)
1	1.0	11	11
2	1.0	53	53
3	1.4	37	26

4.0 DISCUSSION

The pocket mouse was the most abundant mammal trapped at 300 Area waste sites (see Table 1); this fact conforms to earlier trapping results (Fitzner et al. 1979). We found that Transects 1 and 2 produced a higher ratio of pocket mouse to deer mouse catches than did Transect 3 along the river. This difference may be attributed to the habitat characteristics of Transects 1 and 2, because they were near or within dry areas containing deep sandy soil and open bunchgrass-cheatgrass areas typical of pocket mouse habitat. Pocket mice do not need a water supply and prefer sandy soil for burrows. Pocket mice tend to stay in their territories, but their estimated home range (O'Farrell et al. 1975) of 503 to 4,005 m^2 would suggest that the rodent could move across the boundaries of a waste site. The diet of pocket mice consists primarily of dry seeds, which generally concentrate less radionuclides than does the aboveground green vegetation. Pocket mice, however, may ingest large amounts of soil when preening and dust bathing, and thereby would ingest soil-adherent. The relatively high density of pocket mice on the site may be a significant factor in resuspension and offsite migration of soil-borne contamination. Therefore, pocket mice should be considered as a potential vector for transport of soil-borne contamination.

Deer mice prefer green vegetation and arthropods, and tend to occupy areas in shrub cover near a water source, as evidenced by the higher percentage of deer mice captured near the river. Deep-rooted plants growing on a burial ground could, if demonstrated to uptake contaminants, provide a pathway for radionuclides and other hazardous material to reach deer mice. Ground squirrels may also be an important link in the potential transport of hazardous materials from the waste site because their diet is dependent on plant material. A study by Fitzner et al. (1979) found no ground squirrels present on the burial grounds. However, we captured one ground squirrel and observed burrowing activity. The number of ground squirrels actually may be greater than observed because they usually are hibernating below ground during the late-summer period when our survey was conducted. If plant uptake of contaminants on waste sites is confirmed, the role of larger, mobile rodents (e.g., ground squirrels) in the food chain pathway would require evaluation.

Predators of small mammals that are known to occur on the 300-FF-1 Operable Unit include coyote (*Canis latrans*), American kestrel (*Falco sparverius*), burrowing owl (*Athene cunicularia*), Swainson's hawk (*Buteo swainsoni*), and prairie falcon (*Falco mexicanus*) (Fitzner et al. 1979; Rickard et al. 1990). If future investigations document the uptake of contaminants by small mammals, the role of predators in the transfer pathway would require evaluation.

Unlike those from small mammals, food chain transfers from ants may lead to humans if ants are found to be contaminated. The potential exposure pathway for game birds on the 300-FF-1 Operable Unit, as described by Rickard et al. (1990), shows that contaminated insects (which include ants) could be eaten by game birds. Another route of exposure or movement of contaminants off the site that may be initiated by harvester ants is resuspension of excavated contaminated soils. The exposed soils then would be exposed to wind and water erosion. Ants may excavate deeply buried wastes and mobilize a large amount of material. Several colonies dug at the Hanford Site averaged a tunnel depth of 2.3 m (Fitzner et al. 1979). Harvester ant colonies in eastern Colorado were estimated to excavate 3.8 kg soil over the average 10-year life of a colony (Rogers 1972).

REFERENCES

Cadwell, L. L., W. E. Kennedy, and D. H. McKenzie, 1983, "Evaluating Biological Transport of Radionuclides at Commercial Low-Level Waste Burial Sites," *Proceedings of the Fifth Annual Participants' Information Meeting DOE Low-Level Waste Management Program*, CONF-8308106.

DOE, 1990, *Remedial Investigation/Feasibility Study Work Plan for the 300-FF-1 Operable Unit, Hanford Site, Richland, Washington*, DOE/RL 88-31, U.S. Department of Energy, Richland, Washington.

Fitzner, R. E., K. A. Gano, W. H. Rickard, and L. E. Rogers, 1979, *Characterization of the Hanford 300 Area Burial Grounds. Task IV-Biological Transport*, PNL-2774, Pacific Northwest Laboratory, Richland, Washington.

Gano, K. A., and J. B. States, 1982, *Habitat Requirements and Burrowing Depths of Rodents In Relation to Shallow Waste Burial Sites*, PNL-4140, Pacific Northwest Laboratory, Richland, Washington.

O'Farrell, T. P., R. J. Olson, R. O. Gilbert, and J. D. Hedlund, 1975, "A Population of Great Basin Pocket Mice, *Perognathus parvus*, in the Shrub-Steppe of South-Central Washington," *Ecol. Mono.*, Vol. 45, No. 1, pp.1-28.

Rickard, W. H., J. D. Hedlund, and R. G. Schreckhise, 1974, *Mammals of the Hanford Reservation in Relation to Management of Radioactive Waste*, BNWL-1877, Pacific Northwest Laboratory, Richland, Washington.

Rickard, W. H., R. E. Fitzner, and C. A. Brandt, 1990, *Biota of the 300-FF-1 Operable Unit*, EMO-1016/AD-902, Environmental Management Operations, Richland, Washington.

Rogers, L. E., 1972, *The Ecological Effects of the Western Harvester Ant (Pogonomyrmex occidentalis) in the Shortgrass Plains Ecosystem*, IBP Tech, Report 206, Grasslands Biome, Fort Collins, Colorado.