GEOGRAPHIC DISTRIBUTION AND HABITAT PREFERENCES OF WASHINGTON GROUND SQUIRRELS (*SPERMOPHILUS WASHINGTONI*)

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ABSTRACT—Possible locations (189) of Washington ground squirrel colonies in Washington and Oregon were identified from the literature, state databases, museum collections, and converstions with local researchers and residents. In all, 80 confirmed and 7 probable colonies were found at 179 examined sites. Most colonies were small; the largest were on protected public lands. Squirrels were gone from 68 previously reported sites, and 25 additional sites were rated as highly vulnerable to extinction. Cultivation seems most responsible for range reduction. At 13 locations, 23 habitat variables were measured at 2 randomly chosen sites within a colony and also in a paired non-colony area. Although absolute values for some variables varied greatly between the 13 paired locations, Wilcoxon tests on the differences in the variables at each area showed that squirrels inhabited sites that had significantly greater grass and forb cover, deeper soil, weaker soil, and soil with less clay. These results suggest that food availability and soil characteristics are most important in determining where squirrel colonies are located within the habitats currently available to them.

The Washington ground squirrel (*Spermophilus washingtoni*) is a little known rodent inhabiting the steppe grasslands of the Columbia Basin Province (Franklin and Dyrness 1988) in central Washington and northeastern Oregon. Although originally confused with the similar but unspotted Townsend's ground squirrel (*Spermophilus townsendii*) (Bailey 1936), its identification was clarified by Howell (1938) who described two subspecies on the basis of size. However, Dalquest (1948) found no size difference in specimens he collected and concluded that the subspecies were synonymous, and Hall and Kelson (1959) combined the two subspecific ranges of Howell (1938). Although he had no specimens from the more northern subspecies proposed by Howell (1938), Hill (1978), using numerical taxonomic and karyotypic methods, found no subspecific differences in populations separated by the Snake River. Other than general descriptions of its habitat, we know little of the natural history of *S. washingtoni*. Scheffer (1941) included comments on its food habits in a paper devoted mostly to *S. townsendii* and Dalquest (1948) claimed that burrows, nests, habits, and food of *S. washingtoni* are nearly identical to those of *S. townsendii*, as is hibernation as described by Svihla (1939).

The current geographic range and population status of Washington ground squirrels also are not well known. Howell (1938) listed museum records delimiting the range of *S. washingtoni*, but there are no recent published accounts of changes in this range except for a note by Olterman and Verts (1972) that a 1971 search in the northern Oregon part of the range, including Howell's (1938) sites, located no Washington ground squirrel colonies. In 1979 a group of students from Lewis and Clark College in Portland, Oregon located 44 *S. washingtoni* colonies in Oregon and Washington, but their records are in an unpublished report to the National Science Foundation (Carlson et al. 1980). Finally, 26 records of Washington ground squirrel colonies were part of the Washington Department of Wildlife Nongame Database, but some of these were questionable and had not been verified in the field.

Our lack of knowledge about Washington ground squirrels is reflected in attempts to classify their status. Olterman and Verts (1972) classified it as "undetermined." In Washington, this species is legally "unclassified wildlife" and thus is given no protection;

however, within the Nongame Program it is included on a "species of special concern" list in the category of "monitor" (K. McAllister, pers. comm.). In Oregon, the Nongame Wildlife Management Plan (Marshall 1986) includes the Washington ground squirrel in its six-year operational plan at priority 2, which calls for "actions needed to secure or restore nonendemic endangered, sensitive, or otherwise vulnerable Oregon populations" (p. VI-2) and specifically lists the goal to "reassess previous study and delineate secure habitat" of *S. washingtoni* (p. VII S-3). This species is also listed on the Oregon Natural Heritage Plan "special animal species" list at priority 3, which denotes species that are disjunct and could become extinct in Oregon and which calls for including a viable population of *S. washingtoni* in a conservation area (Marshall 1986). Finally, the Washington ground squirrel is included on a draft sensitive wildlife species list recently distributed for comment by the Oregon Department of Fish and Wildlife in response to a recently adopted Administrative Rule by the Oregon Fish and Wildlife Commission.

Much of the concern about the status of Washington ground squirrels stems from recent changes in its habitat. The native vegetation in this area is dominated by bunchgrasses and xerophytic shrubs (Poulton 1955; Daubenmire 1970) which immigrated from the north in the Pliocene as the Columbia Basin became more xeric in the rain shadow of the recently elevated Cascade Mountains (Axelrod 1948; Daubenmire 1975). Shrubs such as big sagebrush (*Artemisia tridentata* Nutt.), bitterbrush (*Purshia tridentata* [Pursh] DC), and snowberry (*Symphoricarpos albus* [L.] Blake) and perennial grasses such as bluebunch wheatgrass (*Pseudoroegneria spicata* [Pursh] Löve), Sandberg bluegrass (*Poa sandbergii* Vasey), Idaho fescue (*Festuca idahoensis* [Elmer]), needle-and-thread (*Stipa comata* Trin. & Rupr.), and Great Basin wildrye (*Leymus cinereus* [Scribn. & Merr.] Löve) prospered until recent times in the absence of significant fire and grazing pressure (Daubenmire 1942, 1970, 1975; Poulton 1955; Vale 1975; Winward 1980; Tisdale and Hironaka 1981; Mack and Thompson 1982). The first cattle were introduced into the area in 1836, and grazing by cattle and sheep peaked between 1890 and 1910 (Tisdale 1961; Galbraith and Anderson 1971). Heavy grazing of the caespitose native grasses and the trampling of the intervening cryptogam layer led to the invasion of the shrubs gray rabbitbrush (*Chrysothamnus nauseosus* [Pall.] Britt.) and green rabbitbrush (*C. viscidiflorus* [Hook] Nutt.) and of alien annual grasses, especially cheatgrass (*Bromus tectorum* [L.]), Kentucky bluegrass (*Poa pratensis* [L.]), and medusahead (*Taeniatherum caput medusae* [L.] Nevski) (Hanson and Stoddart 1940; Daubenmire 1940, 1970; Poulton 1955; Tisdale 1961; Harris 1967; Rickard et al. 1975; Mack 1981; Mack and Thompson 1982). In the past century, especially with the advent of circle irrigation (Muckleston and Highsmith 1978), the most productive portions of the Columbia Basin have been subject to cultivation (Tisdale 1961). Fire has been used in recent years to eliminate big sagebrush (Daubenmire 1942) and, along with occasional wildfires, has sometimes led to invasion by cheatgrass (Pickford 1932; Wright and Klemmedson 1965; Rickard and Sauer 1982). Livestock grazing, cultivation, and fire (both planned and wild) have reduced the native vegetation to small, isolated remnant patches (Daubenmire 1970).

Probably the largest remaining tract of native vegetation within the historic range of the Washington ground squirrel is in the 10,595 ha United State Naval Weapons Systems Test Facility (Bombing Range) south of Boardman, Oregon, and particularly in the 2095 ha Research Natural Area located on the bombing range. The RNA, established in 1978 to preserve high quality steppe communities, has not been grazed by livestock since 1943 although some areas have burned at various times (Mayfield and Kjelmyr 1984). *Spermophilus washingtoni* has been reported as doing well on the Bombing Range (Carlson et al. 1980; Mayfield and Kjelmyr 1984).

Although it currently has refuge on the Bombing Range, the overall geographic range of the Washington ground squirrel has apparently decreased in both Oregon and Washington (Carlson et al. 1980). An understanding of its habitat preferences will be important for its future management and survival. The purposes of this study were to determine habitat preferences by comparing vegetation and soil characteristics in squirrel colonies with those in adjacent unoccupied sites, and to determine the current geographic distribution of this species.

METHODS

Location of Colony Sites

The search for colony sites was conducted in March, April and May of 1987–1989. I identified possible colony locations from published and unpublished reports (Howell 1938; Scheffer 1941; Hill 1978; Carlson et al. 1980); museum records of Oregon State University, Washington State University and University of Idaho; records in the Washington Department of Wildlife Nongame Database; and conversations with local researchers and residents. In addition to checking each of these sites, I searched along roads and in promising sites identified from maps.

I searched each possible site on foot and usually confirmed squirrel presence by either sight or sound. At a few sites, I assumed Washington ground squirrels were present if I found evidence of squirrels (burrow entrances with fresh digging or fecal material) and if I could eliminate the possibility that they were a different species. I only made such assumptions if the site was well inside the range of *S. washingtoni*, if it was not near the range of another species, and usually when I also had a reliable description from local residents. Squirrel presence was designated as probable if I was convinced that information from local residents was valid but I could not confirm squirrel presence by sight, sound, or burrow evidence. I made a rough estimate of population size based on number of squirrels seen or heard and on number of burrow entrances.

Habitat Preferences

Data on habitat preferences were collected from 15 April–5 May, 1988. I found 13 locations where there was a patch of similar but unoccupied habitat adjacent to a colony site. In both the colony and unoccupied areas of each location, I located two sample plots using randomly chosen compass directions and distances from a central point in each area. I centered two perpendicular 5 m transects on each sample plot, and measured the following soil and vegetation variables:

Percent cover.—I used a 1 m point intercept frame (Mueller-Dombois and Ellenberg 1974) with pins spaced 10 cm apart to sample percent cover of bareground, cryptogams, forbs, perennial grasses, and annual grasses. Percent cover of sagebrush (*Artemisia* spp.) and other shrubs was also measured, but kept separate in the analysis because they represent a different vegetational stratum. I measured sagebrush separately because it is a typical component in the native vegetation of the area whereas the other shrubs, almost entirely rabbitbrushes (*Chrysothamnus* spp.), are more typical of disturbed areas (Daubenmire 1970).

Shrub density and volume.—I counted all sagebrush and other shrubs greater than 25 cm high within a 20 m^2 circular area centered on the plot. Each shrub's longest and shortest diameter and height were measured and converted to average radius; shrub volume was estimated using the formula for a sphere.

Soil depth.—I pushed a standard 1.0 m metal probe into the ground as far as possible at the end of each transect and at the center of the sample plot and measured the distance of penetration; the average of the five measurements was recorded.

Soil strength.—At the center of each plot I dug a hole approximately 50 cm long, 30 cm wide and 60 cm deep. I measured soil strength at depths of 10 cm and 50 cm with a pocket penetrometer (Davidson 1965), averaging readings taken on each of the four walls of the hole at each depth.

Soil moisture.—Approximately 200 g of soil were collected from each hole at depths of 10 cm and 50 cm and placed in self-sealing plastic bags. About 25% of each soil sample came from each wall of the hole. In the lab, I dried 80 g samples to constant weight at 104°C, and calculated percent moisture as the difference in wet and dry weights divided by the dry weight.

Soil texture.—I used standard hydrometer settling-time techniques (Day 1965) to determine the proportion of sand, clay, and silt in 50 g of the dried soil samples.

The measurements from the two sample plots in each area were averaged and the difference in means between the colony and adjacent unoccupied areas was calculated for each variable. I used Wilcoxon tests to determine the probability that these differed significantly ($p \leq 0.05$) from zero.

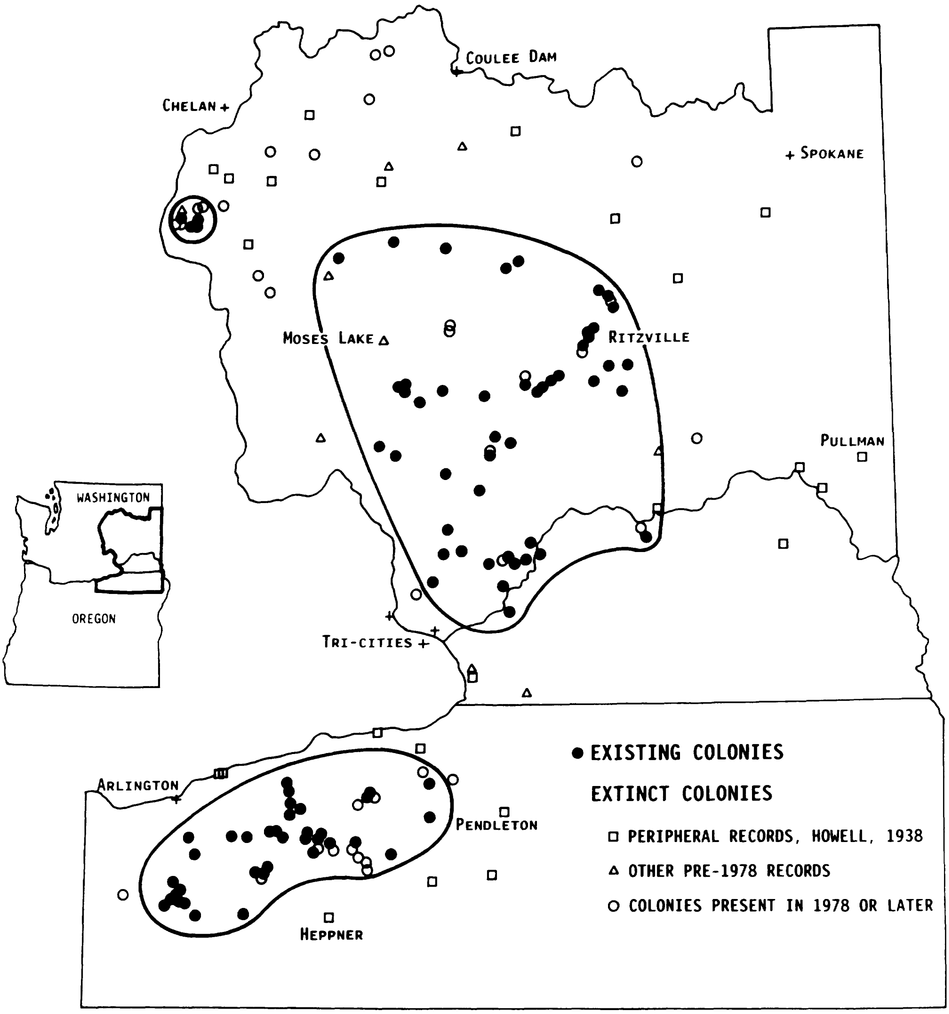

FIGURE 1. Geographic locations of existing and extinct Washington ground squirrel colonies, 1987–1989.

Results

Location of Colony Sites

I found 45 confirmed and 6 probable colonies in Washington (Fig. 1, Appendix). Undoubtedly these are not the only existing colonies in Washington. Although most identified sites were checked, I was not able to get to 10 previously recorded sites. I searched extensively near the periphery of the range and in areas outside the range where squirrels had been recorded previously, but spent less time searching all likely sites within the center of the range. Most of the colonies are within a central area in the Columbia Basin. The largest populations and concentrations of populations are located in Adams and Franklin Counties (Appendix). This central cluster includes only three colonies south of the Snake River in Washington. There also is a small group of colonies south of Chelan on Badger Mountain in southwestern Douglas County (Fig. 1, Appendix).

The current geographic range in Washington is considerably smaller than that reported by Howell (1938), with squirrels inhabiting only the west-central portion of the historic range (Fig. 1). Squirrels were gone from 48 previously recorded sites, including 31 outside the current Washington range; 23 colonies have disappeared since 1978 and 11 (48%) of these are outside the current range. Of particular note is the loss of most colonies in the northern part of the Columbia Basin.

I found 35 confirmed colonies and 1 probable colony in Oregon (Fig. 1, Appendix). As with the Washington range, the current Oregon range is considerably less than the historical range (Howell 1938), at least along the northern, eastern, and southern boundaries. I found several colonies further west (Fig. 1) than reported by Howell (1938), but whether this represents a range extension or inadequate former records is not known. Squirrels were gone from 20 previously reported sites, including 10 outside the current Oregon range.

All of the colonies were subjectively evaluated as to their vulnerability to extinction on the basis of colony size, isolation from other colonies, land ownership, and threat from human activity. Colonies of highest vulnerability were small, isolated, on private land, and subject to poisoning, shooting, or additional cultivation. All small, isolated colonies were rated as high vulnerability regardless of the other factors. Colonies on private land were rated as low vulnerability only if they were at least moderate-sized and not isolated from other colonies by large patches of inappropriate habitat.

Of the 51 Washington colonies, 18, 13, and 20 are rated as high, medium, and low vulnerability, respectively (Appendix). All of the colonies on Badger Mountain and 2 of the 3 colonies south of the Snake River are rated as high vulnerability. Within the central Washington part of the range, there are several large, unthreatened colonies on public land. In Oregon, 7, 14, and 15 colonies are rated as high, medium, and low vulnerability, respectively (Appendix). One group of low vulnerability colonies is on the Bombing Range and just south of it at a site owned by The Nature Conservancy. But all 6 of these colonies are small and are rated as low vulnerability only because the land is protected and the colonies are near each other. A second group of low vulnerability colonies is west of Howell's (1938) original range map in the area of Mikalo and Clem south of Arlington in Gilliam County (Fig. 1). Much of the land in this area is grazed rather than cultivated; the land owners I talked to tolerate the squirrels' presence, although some occasionally shoot them.

Habitat Preferences

In comparison to adjacent unoccupied areas, colony areas have significantly greater cover of annual grasses, all grasses combined, and grasses and forbs combined (Table 1). The soil in colony areas also is deeper, weaker at both 10 cm and 50 cm depths, and contains a lower percentage of clay at both 10 cm and 50 cm depths than the soil at adjacent unoccupied areas (Table 1).

DISCUSSION

One must be cautious in drawing conclusions on habitat "requirements" or "preferences" from the type of comparative data I have provided here. First, there is always the possibility that an important variable has not been measured. One must rely heavily on his/her biological knowledge and intuition to select variables that are important to the species in question and are reasonably few in number; having many variables does not automatically provide better data (Johnson 1981a). Johnson (1981b) also suggests using a broad exploratory study to identify important variables, followed by a confirmatory study focusing on those variables. In a preliminary study on the Bombing Range, I also measured slope, aspect, effective vegetation height (Wiens 1969), and distance to closest bluebunch wheatgrass (a point-quarter technique; Noon 1981) in addition to most of the variables included in this study. However, vegetative cover, sagebrush density and size, and soil characteristics were the important variables identified by this exploratory study and were the ones I focused on in this confirmatory study.

TABLE 1. Comparison of vegetation and soil variables measured at 13 Washington ground squirrel colonies and paired, adjacent unoccupied sites.

Habitat variable	Colony site ($\bar{x} \pm$ SE)	Unoccupied site ($\bar{x} \pm$ SE)	p*
Bareground cover (%)	5.7 ± 1.1	5.0 ± 1.1	NS
Litter cover (%)	27.0 ± 2.3	33.7 ± 3.1	NS
Cryptogam cover (%)	5.2 ± 1.4	12.7 ± 3.5	NS
Forb cover (%)	12.5 ± 3.8	10.8 ± 3.3	NS
Perennial grass cover (%)	19.8 ± 5.6	17.6 ± 4.7	NS
Annual grass cover (%)	29.3 ± 5.3	20.2 ± 4.5	0.033
Total grass cover (%)	49.2 ± 3.3	37.8 ± 2.1	0.013
Forb and grass cover (%)	61.6 ± 2.7	48.6 ± 2.1	0.005
Sage cover (%)	0.0 ± 0.0	2.4 ± 1.6	NS
Other shrub cover (%)	5.8 ± 1.6	4.6 ± 1.6	NS
Sage number (#/20 m^2)	0.04 ± 0.04	2.1 ± 1.3	NS
Other shrub number (#/20 m^2)	6.0 ± 2.1	5.3 ± 1.6	NS
Sage volume (m^3/20 m^2)	0.001 ± 0.018	0.35 ± 0.22	NS
Other shrub volume (m^3/20 m^2)	0.32 ± 0.10	0.43 ± 0.15	NS
Depth (cm)	91.2 ± 5.7	71.7 ± 7.5	0.007
Strength (kg/cm^2)			
10 cm deep	2.91 ± 0.25	3.32 ± 0.27	0.036
50 cm deep	2.18 ± 0.20	2.80 ± 0.29	0.028
Moisture (% dry weight)			
10 cm deep	9.0 ± 0.8	8.8 ± 0.6	NS
50 cm deep	9.1 ± 0.6	9.5 ± 0.8	NS
Surface texture (10 cm)			
Sand (%)	34.0 ± 4.3	35.4 ± 4.4	NS
Silt (%)	54.5 ± 3.8	51.7 ± 4.0	NS
Clay (%)	11.4 ± 0.9	12.9 ± 0.8	0.045
Subsurface texture (50 cm)			
Sand (%)	36.2 ± 4.0	36.0 ± 5.3	NS
Silt (%)	57.1 ± 3.8	53.8 ± 4.9	NS
Clay (%)	6.8 ± 0.6	10.2 ± 1.0	0.002

* Wilcoxon matched pairs test.

A second reason for being cautious is that comparing paired sites only indicates what individuals prefer out of the range of variables available on those sites. It does not indicate what the individuals would prefer if other options were available to them. Washington ground squirrels, whose native habitat has been mostly altered or destroyed, may be existing in suboptimal habitat in many sites.

A third reason for being cautious involves the use of statistics. One must keep in mind that statistical significance does not prove biological significance (Cavallaro et al. 1981) and correlation does not prove causation (Johnson 1981b). Each of the variables identified as being important needs to be discussed as to its biological significance.

Fortunately, in this study the variables differing significantly between squirrel colonies and their paired unoccupied sites make sense biologically. Grasses and forbs are important foods (Scheffer 1941) and squirrels would be expected to select sites where they are most abundant. Percent cover of annual grasses, perennial grasses, and forbs were each higher in colony areas than in unoccupied areas, but the difference was significant only for annual grasses (Table 1). However, percent cover of all grasses (perennial grasses combined with annual grasses) and percent cover of all foods (forbs combined with all grasses) were also significantly greater in colony areas. These results suggest that the squirrels are choosing areas where total food is most abundant, although one cannot rule out the possibility that they are specifically favoring areas with greater annual grass cover.

Because of the apparent importance of shrubs on the Bombing Range in the exploratory study, it was surprising that sagebrush and rabbitbrushes were so infrequent in the sites where I found squirrels. Shrub cover and height are significant variables in determining the presence of pygmy rabbits (*Sylvilagus idahoensis*) (Green and Flinders 1980; Weiss and Verts 1984). Shrubs could provide thermal cover, aerial predator protection (Craighead and Craighead 1956; Southern and Lowe 1968; Wakeley 1978; Bechard 1982), and soil stability for burrowing. It may be that sites with shrubs would be preferred by squirrels if given a choice, which was not the case in most of the 13 paired sites studied here. However, experimental removal of shrubs had no effect on population size, sex ratios, or age structure of Uinta ground squirrels (*Spermophilus armatus*) in a shrub-steppe community in southwestern Wyoming (Parmenter and MacMahon 1983).

Washington ground squirrels preferred areas with deeper and weaker soils. Similar results were obtained in southeastern Oregon for pygmy rabbits (Weiss and Verts 1984) and for Great Basin pocket mice (*Perognathus parvus*) (Feldhammer 1979). Both studies attributed this preference to the need for burrow excavation. This is probably also true for *S. washingtoni*. The statistically significant but only slightly greater percentage of clay in the soils of unoccupied sites probably exerts its biological significance as a contributor to soil strength and burrowing difficulty.

The decrease in the geographic range of Washington ground squirrels is a matter of concern and seems mostly attributable to loss and isolation of habitat because of cultivation. Especially disconcerting is the disappearance of 23 Washington and 12 Oregon colonies in the last 10 years and the high vulnerability rating given to an additional 25 (29%) of the 87 colonies I found. The small size of many of the colonies makes them vulnerable to extirpation from natural causes such as predators and epizootics. Badgers are a particularly effective predator (Lindzey 1982); one colony containing several squirrels in 1987 showed no activity in 1988 and many of the burrows showed signs of badger digging. Several ground squirrel species are hosts to plague and *S. townsendii* populations in Washington decreased dramatically starting in 1936, apparently because of sylvatic plague (Tomich 1982). Although the isolation of many *S. washingtoni* colonies may hinder the spread of epizootics, it also makes it unlikely colonies would be repopulated if they did become extinct. Weiss and Verts (1984) noted a marked decline in evidence of pygmy rabbit activity within a one-year period and discussed the need for maintaining habitat corridors between islands of appropriate habitat to allow for recolonization. Some of the landowners I talked with were not adamantly opposed to the presence of the squirrels and perhaps can be persuaded to provide protection for the colonies on their land.

Although *S. washingtoni* has strongholds in both states, I believe it has a better future in Washington than in Oregon. Several of the large, low vulnerability colonies in Washington are on public land where they receive little threat from human activity. However, the Gilliam County group of low vulnerability colonies in Oregon is on private land where a change in land use or owner attitude could increase the threat to their existence. Abandonment of the Bombing Range by the Navy, which is occasionally discussed, could result in a change in land use outside the RNA from grazing to cultivation; this would eliminate some of the low vulnerability colonies on the Bombing Range and isolate the others.

I expect the future extinction of smaller, isolated colonies on the periphery of this species' range in both states. Particularly vulnerable are the colonies on Badger Mountain and those south of the Snake River in Washington and those along the eastern edge of the range in Oregon. Populations need to be monitored in both states and private landowners should be encouraged to provide them protection. Preventing further total isolation of colonies, by persuading land owners to leave corridors of natural habitat between islands created by any new cultivation, seems particularly important.

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APPENDIX. Locations and vulnerability ratings for 87 Washington ground squirrel colonies located from 1987–1989.

		Vulnerability				
County	Legal location	Rating	Colony size	Colony isolation	Land ownership	Attitude toward squirrels
Washington						
Adams	20N, 36E, S9	Moderate	Small	No	Private	Unknown
Adams	20N, 36E, S22	Low	Large	No	Private	Unknown
Adams	19N, 35E, S13, 14	Moderate	Moderate	No	Private	Unknown
Adams	19N, 35E, S14	High	Small	No	Private	Negative
Adams	18N, 36E, S21	Low	Large	No	Private	Unknown
Adams	18N, 37E, S19	Low	Large	No	Private	Unknown
Adams	17N, 32E, S19, 20	Low	Moderate	No	Unknown	Unknown
Adams	17N, 33E, S13	Low	Large	No	Unknown	Unknown
Adams	17N, 34E, S7, 18	Moderate	Large	No	Private	Negative
Adams	17N, 35E, S11, 12	Low	Large	No	Unknown	Unknown
Adams	17N, 36E, S13, 24	Low	Large	No	Unknown	Unknown
Adams	15N, 28E, S16	Low	Large	No	Government	Unknown
Adams	15N, 28E, S24	Low	Moderate	No	Government	Unknown
Adams	15N, 32E, S4	High	Moderate	Yes	Private	Unknown
Adams	15N, 32E, S12	Moderate	Moderate	Yes	Government	Positive
Douglas	23N, 21E, S9	High	Small	Yes	Private	Negative
Douglas	23N, 21E, S11, 12, 13	High	Small	Yes	Private	Negative
Douglas	23N, 21E, S23, 24	High	Small	Yes	Private	Negative
Douglas	23N, 21E, S24	High	Small	Yes	Private	Negative
Franklin	14N, 30E, S11, 14	Low	Large	No	Government	Negative
Franklin	14N, 31E, S36	Low	Large	No	Private	Unknown
Franklin	12N, 30E, S11	Low	Large	No	Government	Unknown
Franklin	12N, 33E, 22, 23	Low	Large	No	Unknown	Unknown
Franklin	11N, 30E, S3	High	Small	Yes	Private	Unknown
Franklin	11N, 31E, S4.5	Low	Large	No	Unknown	Unknown
Franklin	11N, 32E, S2, 11, 12	High	Small	Yes	Unknown	Negative
Franklin	11N, 33E, S15	Moderate	Small	No	Unknown	Unknown

APPENDIX. Continued.

County	Legal location	Vulnerability: Rating	Colony size	Colony isolation	Land ownership	Attitude toward squirrels
Franklin	11N, 33E, S17	High	Moderate	Yes	Unknown	Unknown
Franklin	10N, 30E, S5	Low	Small	No	Government	Unknown
Franklin	10N, 32E, S3, 11	High	Small	Yes	Private	Unknown
Grant	22N, 26E, S25	Moderate	Large	No	Private	Negative
Grant	22N, 28E, S1	Moderate	Large	Yes	Private	Positive
Grant	22N, 30E, S11	High	Small	Yes	Unknown	Unknown
Grant	17N, 29E, S5	Low	Large	No	Government	Unknown
Grant	17N, 29E, S7	Low	Large	No	Government	Unknown
Grant	17N, 29E, S8, 17	Low	Large	No	Government	Unknown
Grant	17N, 29E, S23, 26	Moderate	Small	No	Private	Negative
Grant	17N, 30E, S9, 14	High	Small	No	Private	Unknown
Lincoln	22N, 33E, S32	High	Small	Yes	Private	Unknown
Lincoln	21N, 32E, S1, 2	Moderate	Small	No	Unknown	Unknown
Lincoln	21N, 36E, S31	Low	Large	No	Private	Unknown
Walla Walla	12N, 37E, S23, 24	High	Small	Yes	Private	Negative
Walla Walla	11N, 33E, S1, 12	High	Small	Yes	Unknown	Unknown
Walla Walla	09N, 32E, S11, 13, 23	Low	Large	No	Private	Unknown
Oregon						
Gilliam	01N, 21E, S3	Moderate	Large	Yes	Private	Positive
Gilliam	01N, 21E, S23, 24	Low	Moderate	No	Private	Negative
Gilliam	01S, 21E, S19	Low	Moderate	No	Private	Unknown
Gilliam	01S, 21E, S33	Low	Moderate	No	Private	Unknown
Gilliam	02S, 20E, S13	Low	Large	No	Private	Unknown
Gilliam	02S, 21E, S5	Low	Large	No	Private	Unknown
Gilliam	02S, 21E, S6	Low	Large	No	Private	Unknown
Gilliam	02S, 21E, S8, 16, 21	Low	Large	No	Private	Unknown
Gilliam	02S, 21E, S15	Low	Moderate	No	Private	Unknown
Gilliam	02S, 21E, S25	Moderate	Moderate	No	Unknown	Unknown
Morrow	03N, 25E, S6, 7	Low	Small	No	Government	Positive
Morrow	03N, 25E, S17, 18, 29	Low	Small	No	Government	Positive
Morrow	03N, 25E, S32	Low	Small	No	Government	Positive
Morrow	02N, 23E, S32	High	Small	Yes	Private	Unknown
Morrow	02N, 24E, S26	Moderate	Small	No	Private	Unknown
Morrow	02N, 24E, S27	Moderate	Small	No	Private	Unknown
Morrow	02N, 25E, S3	Low	Small	No	Government	Positive
Morrow	02N, 25E, S8	Low	Small	No	Government	Positive
Morrow	02N, 25E, S35	Moderate	Small	No	Unknown	Unknown
Morrow	02N, 26E, S32	Moderate	Small	No	Private	Positive
Morrow	01N, 23E, S2	Moderate	Small	No	Private	Unknown
Morrow	01N, 24E, S1	High	Small	No	Private	Negative
Morrow	01N, 25E, S2	Low	Small	No	Private	Positive
Morrow	01N, 26E, S5	Moderate	Small	No	Private	Positive
Morrow	01N, 26E, S10	High	Small	Yes	Private	Negative
Morrow	01N, 26E, S19	High	Small	Yes	Private	Unknown
Morrow	01N, 27E, S3, 10	Moderate	Moderate	Yes	Unknown	Unknown
Morrow	01N, 28E, S26	High	Small	Yes	Unknown	Unknown
Morrow	01S, 24E, S3	Moderate	Small	No	Unknown	Unknown
Morrow	01S, 24E, S9	High	Small	Yes	Private	Unknown
Morrow	01S, 24E, S11	Low	Large	No	Private	Negative
Morrow	02S, 23E, S27	Moderate	Small	No	Private	Unknown
Umatilla	03N, 27E, S23, 24	Moderate	Small	No	Private	Positive
Umatilla	03N, 28E, S18	Moderate	Small	No	Private	Positive
Umatilla	03N, 30E, S7	Moderate	Moderate	Yes	Unknown	Unknown
Umatilla	02N, 30E, S8, 17	High	Small	Yes	Unknown	Negative