

**STATUS OF  
NUTTALL'S COTTONTAIL  
IN BRITISH COLUMBIA**

by  
D. Carter, A. Harestad  
and F. L. Bunnell

Wildlife Branch  
Ministry of Environment, Lands and Parks

Wildlife Working Report No. WR-56

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**ABSTRACT**

Nuttall's Cottontails (*Sylvilagus nuttallii*) have expanded their range into British Columbia within the last 60 years. They were first reported in British Columbia in 1939 (Cowan and Hatter 1940). Since that time, Nuttall's Cottontails have been considered year-long residents in the south Okanagan. Their distribution in British Columbia is the northern extent of their range west of the Rocky Mountains. Nuttall's Cottontails have never been abundant in the south Okanagan and their range is restricted to the Similkameen and Okanagan Valleys. Their scarcity and limited distribution has prompted the British Columbia Ministry of Environment, Lands, and Parks to place them on the Blue List because of an inadequate understanding of their status. The low abundance of Nuttall's Cottontails in British Columbia is likely due to habitat loss as well as low recruitment because the species is at the northern extreme of its range. During field work conducted 27 September - 13 December 1990, Nuttall's Cottontails were distributed throughout the south Okanagan. Numbers of Nuttall's Cottontails are reported to be variable, but their distribution has expanded in the last 20 years, suggesting that a stable population exists in British Columbia.



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## GENERAL BIOLOGY

### Description

Nuttall's Cottontail (*Sylvilagus nuttallii*) is medium to large in size for its genus (length 338-390 mm; weight 678-1032 g). Colouration is pale greyish-brown above and white below. The upper shoulders and nape of the neck are often bright buff. The tail is large (30-54 mm) with a grizzled top and white bottom and is usually carried so as to expose the white underside. The ears are short (54-65 mm) with rounded black tips and dense white fur inside. The hind legs are long and the hind feet are almost white in colour.

### Reproductive Capability

Nuttall's Cottontails (*Sylvilagus nuttallii*), like other members of the genus *Sylvilagus*, are capable of high levels of reproduction (Powers and Verts 1971). Nuttall's Cottontails are an induced ovulator, with ovulation occurring after copulation (Chapman *et al.* 1982). They exhibit a polygamous breeding system with a synchronized breeding season and well-defined periods of conception (Powers and Verts 1971). Conception usually occurs almost immediately after parturition of the previous litter (*ibid.*). Nuttall's Cottontails have a relatively short gestation period (29 days) and the altricial young are weaned after approximately 15 days (Chapman *et al.* 1982).

*Breeding age* — Male Nuttall's Cottontails do not become sexually active during the breeding season of the year of their birth in central Oregon (Powers and Verts 1971). There is no evidence of spermatogenesis in juvenile males until the following spring. Females can breed when less than one year old. However, only 6.7% of juvenile females collected had bred during the year of their birth (*ibid.*). Higher rates of juvenile female reproduction occur for other species of cottontails

(Chapman *et al.* 1982). Juvenile reproduction is not very important when considering the reproductive output of a Nuttall's Cottontail population; litters from juvenile females, being born late in the season, tend to have poor survival (McKay and Verts 1978a). Powers and Verts (1971) suggested that the lack of juvenile reproduction by Nuttall's Cottontails in Oregon occurs because few juvenile females reach sexual maturity prior to the termination of the relatively short breeding season. If this is the case, juvenile reproduction is unlikely in British Columbia because Nuttall's Cottontails are at the northern limit of their range. Sullivan *et al.* (1989) reported breeding seasons at Summerland, British Columbia, that were approximately 30 days shorter than those reported for Oregon (Table 1).

*Breeding frequency* — There is variation in the published estimates of annual number of litters produced by Nuttall's Cottontails (Table 1). The annual number of litters depends on the length of the breeding season (Powers and Verts 1971). Cowan and Guiguet (1966) reported that 2-3 litters were born per year in British Columbia. Given that the gestation period for Nuttall's Cottontails is 28-30 days (Cowan and Guiguet 1966), this number of litters is consistent with the March to July (approximately 120-130 day) breeding season estimated by Sullivan *et al.* (1989). The onset and termination of breeding by cottontails is strongly influenced by environmental and climatic conditions and can be quite variable between populations and years (Chapman *et al.* 1982). Sullivan *et al.* (1989) reported annual differences in reproduction at Summerland between the 1984, 1985 and 1986 breeding seasons. Recruitment during the 1984 breeding season was approximately twice that of the 1986 season. They suggested that this decline in recruitment may have been related to a reduction of herbaceous vegetation caused by unusually dry summer conditions during 1985 and 1986.

**Table 1. Reproductive characteristics of Nuttall's Cottontails.**

	Locale	Young per litter		Number of litters	Breeding season
		Mean	Range		
1)	Not specified	6.1	(4-8)	—	—
2)	Nevada	5.0	(4-6)	—	March-July
3)	Washington	—	(1-4)	—	April-June
4)	Idaho	6.0	—	—	April-June
5)	Oregon	—	(4-6)	1	April-July
6)	California/Nevada	6.1	(4-8)	2	April-July
7)	Washington/Oregon	4.7	(4-5)	3	—
8)	Utah	6.6	(5-8)	—	February-August
9)	Oregon	4.3	(1-6)	4	February-July
10)	Oregon	4.3	—	4	February-July
11)	British Columbia	2.0	—	2-3	April-June
12)	British Columbia	—	—	—	March-July

Sources: 1) Hall and Kelson(1951), 2) Hall (1946), 3) Dalquest (1948), 4) Davis (1939), 5) Bailey (1936), 6) Orr (1940), 7) Dice (1926), 8) Jansen (1946), 9) Powers and Verts (1971), 10) McKay and Verts (1978a), 11) Cowan and Guiguet (1966), 12) Sullivan et al. (1989).

*Number of young* — The litter size of Nuttall's Cottontails ranges between one and eight (Table 1). Cowan and Guiguet (1966) report an average litter size of two in British Columbia. In studies of reproduction south of British Columbia, average litters are estimated to be between four and six (Table 1). In central Oregon, females have four or five litters per season and produce between 17 and 22 young per female per breeding season (Powers and Verts 1971). Numbers of young per female in British Columbia are likely fewer.

Sullivan *et al.* (1989) reported that the number of Nuttall's Cottontails on a 19.7 ha grid of sagebrush habitat at Summerland rose from five females at the beginning of the breeding season to a total of 15 rabbits at the end of the 1984 breeding season. This increase reflects a pulse of juvenile recruitment during July and August. Assuming no immigration, emigration or mortality, this reported increase in population density suggests that at least two young are produced per female in British Columbia. If a conservative estimate of 50%

juvenile survival (McKay and Verts 1978a) is used, four young per female per year is suggested for Nuttall's Cottontails in British Columbia.

*Age structure* — The reproductive output of cottontail rabbits tends to vary between areas and seasons (Chapman *et al.* 1982). Seasonal rates of natality and juvenile mortality are usually variable and depend on habitat and climatic conditions (McKay and Verts 1978a). This variation results in populations exhibiting variable age structures both temporally and spatially as conditions change. McKay and Verts (1978a) reported a Nuttall's Cottontail population with 78% juveniles at the end of a productive breeding season in Oregon. The following year, the same Oregon population produced 73% fewer young and density declined from a high of 254/100 ha to 6.6/100 ha.

The population of Nuttall's Cottontails at Summerland showed variable abundance and survival between 1984 and 1986 (Sullivan *et al.* 1989). There was a 53% reduction in abundance (42.2 rabbits/100 ha to 22.5 rabbits/100 ha) be-

tween August 1984 and August 1986. Examination of these results suggests that the reduced densities were due to reduced natality and survival during 1985 and 1986. The age ratio of the population reflected the productivity of the 1984 breeding season with juveniles comprising 70% of the population at the end of the summer. The age structure of Nuttall's Cottontail populations in British Columbia is variable and probably depends on both climatic and habitat conditions.

*Sex ratio* — In Oregon, the fetal sex ratio was 1 male to 1.05 females; the adult sex ratio was 1 male to 1.18 females (Powers and Verts 1971). Neither ratio is significantly different from 1:1. Cottontail populations generally tend to have equal numbers of males and females (Chapman *et al.* 1982).

Selective mortality against males has been suggested for some cottontail populations (Chapman *et al.* 1982). Survival rates differ for male and female Nuttall's Cottontails in British Columbia (Sullivan *et al.* 1989). When mortality and emigration are combined and treated as population losses, females survive significantly better than males. The population at Summerland declined between 1984 and 1986. The proportion of males declined from 0.57 (n=84) in 1984 to 0.44 (n=45) in 1985 to 0.16 (n=32) in 1986. It is not known why females survived better than males nor is it known whether reduced numbers of males influence the reproductive potential of the population.

*Reproductive rate* — Cowan and Guiguet (1966) reported a reproductive rate for Nuttall's Cottontails in British Columbia of approximately four to six young per female each breeding season (two to three litters/season with two young/litter). Recruitment of Nuttall's Cottontails at Summerland reported by Sullivan *et al.* (1989) support this estimate but rates of reproduction have not been directly measured in British Columbia.

Using the above indirect estimates, reproduction in British Columbia is below the 17-22 young per female per year reported for populations in Oregon (Powers and Verts 1971). A reduced rate of reproduction is expected in British Columbia populations because of their more northern location. The Okanagan Valley is the northern fringe of Nuttall's Cottontail distribution west of the Rocky Mountains. This suggests that climatic and environmental conditions in British Columbia may be near or at the species limit of tolerance and high rates of reproduction should not be expected.

*Recruitment and mortality* — Little information exists regarding long term rates of recruitment and mortality in British Columbia. Most of the evidence which exists comes from the live trapping study conducted by Sullivan *et al.* (1989). As stated previously, the reproduction and survival of cottontail rabbits is strongly influenced by climatic and environmental conditions and is variable among areas and years.

Sullivan *et al.* (1989) reported variable rates of recruitment and survival for a Nuttall's Cottontail population in sagebrush habitat at Summerland. The population exhibited an annual cycle of abundance with numbers declining during fall and winter and increasing as juveniles were recruited during the breeding season. This live trapping study was conducted over only two winters but during this time recruitment replaced mortality. Density of Nuttall's Cottontails on the 19.7 ha grid varied from a high of 15 (76 rabbits/100 ha) in August 1984 to a low of two (10 rabbits/100 ha) in April 1985. The number of Nuttall's Cottontails on the grid in May at the beginning of each breeding season was fairly stable between years at four or five (20-25 rabbits/100 ha).

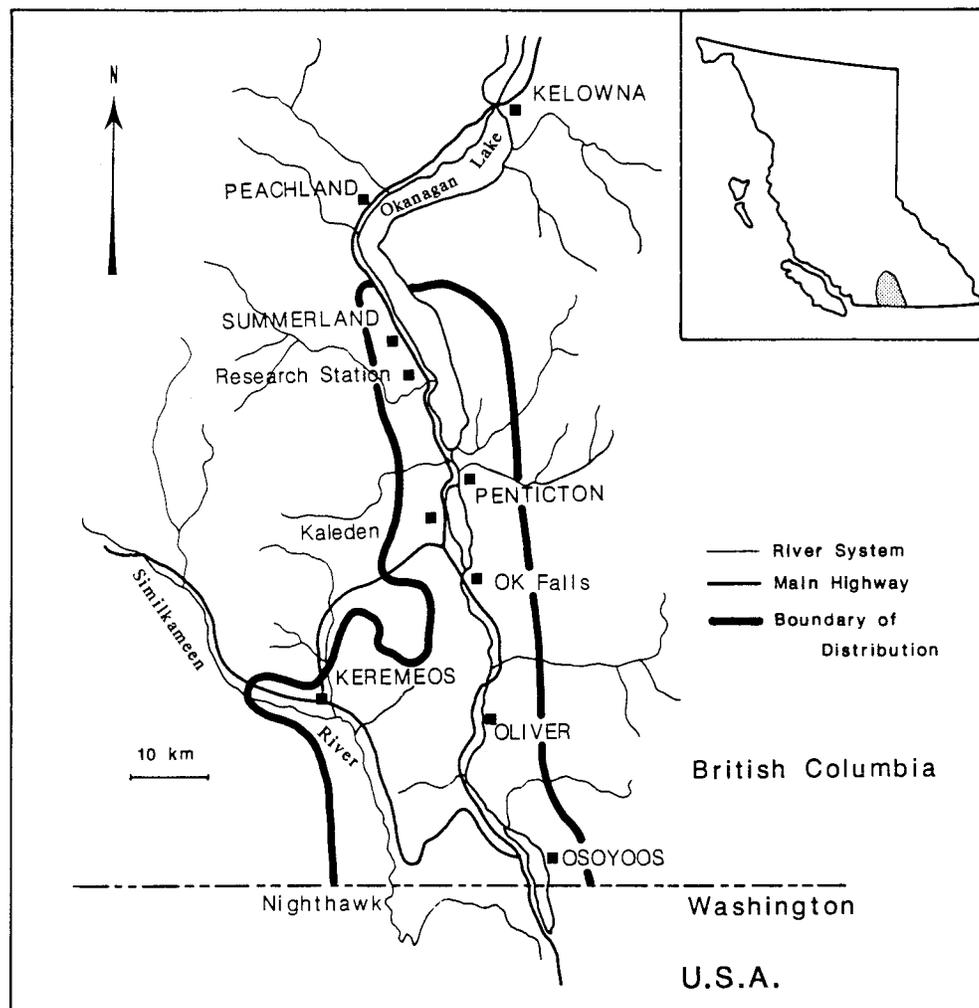
The number of Nuttall's Cottontails resident (present for three weeks) on the live trapping grid of Sullivan *et al.* (1989) declined to one during the winter of 1985-1986. This indicates immigration

onto the grid played a role in increasing numbers prior to the 1986 breeding season. Dispersal onto the grid suggests that individuals emigrated from less desirable habitats or that declines may have been a local event.

Local people in the south Okanagan report Nuttall's Cottontails have moved into areas not previously inhabited by the species (R. Allen, pers. comm.), and the range in the province has been expanding. In 1940, Cowan and Hatter (1940) reported the distribution of Nuttall's Cottontails was limited to the Osoyoos area. By 1966, Nuttall's occurred as far north as Penticton (Cowan and Guiguet 1966). According to the results of field work conducted

September-December 1990, Nuttall's Cottontails have extended their range north of Summerland (Fig. 1).

*Population growth potential*—The growth potential of Nuttall's Cottontail populations in British Columbia seems to be positive. Dispersal and range expansion appear to be occurring, indicating an increasing population. However, many factors are likely involved in determining the abundance of Nuttall's Cottontails and these factors are not well understood. The importance of natality, mortality, immigration and emigration are poorly understood with respect to their roles in regulation of cottontail populations. In addition,



**Figure 1. Distribution of Nuttall's Cottontails in British Columbia estimated in 1990 from museum records, sightings and pellet transects.**

climatic factors such as severe winters and drought are thought to strongly influence cottontail numbers (Chapman *et al.* 1982) and are beyond a manager's control. Densities of Nuttall's Cottontail in British Columbia are not as high as those reported in the United States (McKay and Verts 1978a). This suggests that environmental conditions in British Columbia may not be ideal for Nuttall's Cottontails, and that a severe winter or dry summer may have a greater influence on populations in British Columbia than those in southern areas.

### **Movement and Dispersal**

*Migration* — Minor seasonal shifts in habitat use have been reported for some species of cottontails (Chapman *et al.* 1982), particularly in areas where herbaceous plants provide adequate escape cover only during the growing season. There is no evidence to suggest that distinct summer and winter ranges exist for Nuttall's Cottontails.

In general, cottontails do not maintain territories. Their relatively small (one to four ha) home ranges overlap, particularly during the fall and winter when individuals tend to concentrate in areas offering the best food and escape cover (Chapman *et al.* 1982). Home range sizes of some cottontail species change seasonally, with home ranges being smallest during the growing season and largest during winter (*ibid.*). During winter, home ranges increase in size but retain areas of escape cover used during the summer (Dixon and Chapman 1980). There is no published information regarding the home range size of Nuttall's Cottontails but home range size likely varies depending on season and habitat type.

*Concentrations and dispersal* — Nuttall's Cottontails appear to be more solitary than other members of the genus *Sylvilagus* (Orr 1940). Like other cottontail species (Chapman 1975), Nuttall's

Cottontails may concentrate in localized areas where patches of forage plants or other desirable habitats are found.

Dispersal allows colonization of new habitats as well as genetic exchange with existing populations. This important aspect of cottontail population biology is not well documented or understood. Cottontails tend to occupy successional or disturbed environments (Chapman *et al.* 1982), dispersal is important in colonizing these areas. There is no published information available regarding dispersal of Nuttall's Cottontails.

*Protection of concentration areas* — The areas in which Nuttall's Cottontails may concentrate are likely small and contained within larger areas of general cottontail habitat. If concentrations do occur they are likely due to shifts within home ranges rather than long seasonal movements.

### **Behaviour and Adaptability**

*Tolerance of human disturbance* — There has been little investigation of the influence of human activities on the abundance of Nuttall's Cottontails. The degree of impact is probably dependent on the nature of the disturbance. Any human activities which reduce the availability of escape cover or herbaceous vegetation will likely reduce the number of cottontails. Those which increase cover or increase succulent forage (e.g. irrigation) may enhance cottontail numbers.

Early methods of agriculture may have enhanced habitat for Nuttall's Cottontails in the Okanagan Valley. Irrigation would have extended the growing season providing cottontails with succulent forage. Early agricultural methods, which were less intensive than present methods, likely provided the cottontails with an abundance of cover and forage. Brushy fence rows and patches of uncultivated land interspersed with crops may approach ideal habitat for cottontails. The en-

hancement of habitat by early agriculture is suggested by reports that Nuttall's Cottontails were at one time sufficiently abundant to be considered a pest and were controlled with poison baits from 1955 to about 1965 (Sullivan *et al.* 1989).

Other human activities likely affect the distribution and abundance of Nuttall's Cottontails in British Columbia. Predator control during past decades may have reduced natural mortality of Nuttall's Cottontails and contributed to the increased abundances observed during the 1950s and 1960s. It is not known how the reduction of predator control during the last twenty years will influence Nuttall's Cottontail numbers and distribution but trapper returns indicate that the abundance of Coyotes (*Canis latrans*) has increased in the South Okanagan and four Coyotes were observed during this study in areas where Nuttall's Cottontails were also observed. Use of pesticides and herbicides in agricultural areas may have affected the distribution and abundance of Nuttall's Cottontails.

Modern land use practices have likely negatively affected Nuttall's Cottontails. Not only is the proportion of land used for agriculture greater than that in the 1950s and 1960s, but intensive methods of agriculture currently practiced in the Okanagan Valley have eliminated much of the

interspersed cover that cottontails require. Greater areas of land committed to agriculture and more intense use have likely reduced the amount and quality of habitat available for Nuttall's Cottontails. Sullivan *et al.* (1989) reported that Nuttall's Cottontails avoid using orchard habitat. Under modern orchard management, little or no cover is available in or between orchards.

In southeastern Idaho, MacCracken and Hansen (1982) found that the abundance of Nuttall's Cottontails was lower in areas of sagebrush habitat that were grazed by cattle when compared to ungrazed areas. Much of the south Okanagan's available sagebrush habitat is presently used for grazing cattle. Pellet count transects conducted this fall near Vaseux Lake indicate that Nuttall's Cottontails tend to use ungrazed sagebrush habitat (3.55 pellets/m<sup>2</sup>, SE=1.02, n=40) more than adjacent grazed sagebrush habitat (0.20 pellets/m<sup>2</sup>, SE=0.11, n=40) Details of the field work are described in Appendix 2.

*Specialization in food* — Like many other leporids, Nuttall's Cottontails exhibit a seasonal dietary shift from grasses and forbs during spring and summer to woody shrubs during fall and winter (Table 2). In California, Orr (1940) reported that grasses are selected over all other potential food plants during spring and summer

**Table 2. Seasonal diets of Nuttall's cottontails in Idaho.**

Season	% Grasses	% Forbs	% Shrubs
Spring-summer	78	11	11
Fall-winter	22	16	62

Most important plants in each group:

Grasses: wheatgrass (*Agropyron* sp.), needle and thread grass (*Stipa comata*)

Forbs: milkvetch (*Astragalus* sp.), bluebells (*Mertensia* sp.), pussytoes (*Antennaria* sp.)

Shrubs: winterfat (*Eurotia lanta*), sagebrush (*Artemisia tridentata*), saltbush (*Atriplex* sp.)

Source: MacCracken and Hansen (1984)

while sagebrush (*Artemisia* spp.) is the most important plant during winter. In British Columbia, during field work in October 1990, a Nuttall's Cottontail was observed browsing on sagebrush (*Artemisia tridentata*) near Vaseux Lake.

Nuttall's Cottontails do not have a specialized diet. They consume most of the plants available in their habitat at some time during the year (MacCracken and Hansen 1984). However, they do exhibit species and seasonal preferences, likely related to forage quality. The availability of succulent forage influences the survival of Nuttall's Cottontails in arid regions of Oregon (Verts *et al.* 1984).

Coprophagy has been reported for most species of *Sylvilagus*. Two types of pellets are excreted: hard, brown fecal pellets and soft, green food pellets. The food pellets are consumed directly from the anus and are reported to be an important source of vitamin B (Chapman *et al.* 1982).

*Specialization in habitat* — In Oregon, Nuttall's Cottontails occupy ridges and slopes vegetated with sagebrush (*Artemisia tridentata*), bitterbrush (*Purshia tridentata*) and rabbitbrush (*Chrysothamnus* sp.) (McKay and Verts 1978b). In Washington, they occupy rocky ravines on sagebrush-covered hills, as well as sagebrush-dominated valley bottoms near abandoned structures, but not throughout the general sagebrush (Dice 1926). In California, rocky sagebrush-covered hills are preferred habitat for Nuttall's Cottontails (Orr 1940). In Nevada, Nuttall's Cottontails occupy rocky sagebrush habitats while Audubon's Cottontails (*S. audubonii*) occupy the desert valleys (*ibid.*).

In British Columbia, Sullivan *et al.* (1989) reported that sagebrush habitats with at least 30% vegetative cover are preferred by Nuttall's Cottontails over other available habitats. This

habitat preference is consistent with observations of Orr (1940) who reported that Nuttall's Cottontails in California do not use plains areas without thick brush or rocky outcrops.

The results of 25 days of field work conducted September - December 1990 support Sullivan *et al.*'s (1989) conclusions about habitat use. During spotlight counts from a vehicle (1546 km of transects sampled) and on foot (60 km of transects sampled), 26 cottontails were seen, 21 in sagebrush-dominated habitats. The average estimated percent vegetative cover at all sagebrush locations where cottontails were sighted was 31.2% (SE=2.16, n=21). These results should only be considered in terms of habitat use within sagebrush habitat types and should not be considered indicative of habitat type preferences. Because transects were conducted simultaneously looking for White-tailed Jackrabbits and Nuttall's Cottontails, sagebrush type habitats were sampled to a greater extent than other habitat types. Details of methods and results are in Appendix 1.

Pellet count transects conducted between September and December 1990 (Table 3) as well as those done by Sullivan *et al.* (1989) indicate that Nuttall's Cottontails prefer sagebrush-dominated habitats and use other habitats only minimally. Numbers of pellets were quite variable among different areas of dense sagebrush habitat (Table 4), suggesting that percent cover of vegetation (mainly sagebrush) is not the only important factor influencing Nuttall's Cottontail abundance in an area.

In Idaho, McKay and Verts (1978b) sampled areas with abundant and fairly uniform sagebrush cover. The abundance of Nuttall's Cottontails was greater in sites where there were both a high biomass of forbs and the presence of small rocky outcrops, and was positively correlated to the biomass of herbaceous vegetation. McKay and

**Table 3. Number of Nuttall's Cottontail pellets/m<sup>2</sup> in natural and cultivated habitats between Osoyoos and Oliver. See Appendix 1.**

Habitat	% Vegetative cover	Mean pellets/m <sup>2</sup>
Sagebrush/antelope-brush	23 (SE=7.5)	16.2 (SE=7.4, n=40)
Grassland	9 (SE=2.1)	0.0 (SE=0.0, n=40)
Riparian	37 (SE=10.4)	1.2 (SE=0.9, n=40)
Ponderosa pine	12 (SE=3.2)	1.9 (SE=0.8, n=40)
Douglas fir/Ponderosa pine	5 (SE=1.3)	0.0 (SE=0.0, n=40)
Meadow/hayfield	16 (SE=3.5)	0.1 (SE=0.1, n=40)
Cultivated field	0 (SE=0.0)	0.0 (SE=0.0, n=40)
Orchard	0.5 (SE=0.5)	0.0 (SE=0.0, n=40)

Verts (1978b) suggested that Nuttall's Cottontails prefer areas with rocky outcrops because of the abundant crevices available for use as daytime refuges.

Pellet count transects were done during October 1990 near Osoyoos Lake in uniform sagebrush habitat near a rocky bluff. The number of pellets/m<sup>2</sup> declined with increasing distance from the rocky bluff (Table 5), indicating that the presence of refuges may be an important factor determining habitat use by Nuttall's Cottontails.

Nuttall's Cottontails require escape cover such as thick brush, rocky areas or burrows of other animals (Stevens and Lofts 1988); they do not dig their own burrows (Chapman *et al.* 1982). Residents in the Okanagan Valley have reported Nuttall's Cottontails using sites under farm buildings as daytime refuges (R. Allen, pers. comm.).

During field work, the building was examined and rabbit pellets were abundant near and beneath the structure.

*Specialization in breeding sites* — Nuttall's Cottontails use abandoned burrows of other species, natural crevices or cup-shaped forms in thick brush as nest sites (Chapman *et al.* 1982). Perhaps the abundance of protected nest sites plays a role in determining the abundance of Nuttall's Cottontails in British Columbia.

*Specialization in feeding sites* — Nuttall's Cottontails feed primarily in sagebrush steppe habitats, but may also feed in agricultural habitats (Stevens and Lofts 1988). Nuttall's Cottontails usually feed in the shelter of brush or in clearings a few metres from cover (Orr 1940), and use narrow foraging trails in open areas, meadows, gullies or riparian areas close to suitable cover

**Table 4. Percent vegetative cover and mean number of Nuttall's Cottontail pellets in various areas of sagebrush habitat in the south Okanagan.**

Location	% Vegetative cover	Mean pellets/m <sup>2</sup>
Summerland	29.5 (SE=5.1)	26.9 (SE=10.9, n=40)
Vaseux Lake	30.5 (SE=7.3)	3.5 (SE=4.5, n=40)
Osoyoos Lake	23.0 (SE=7.5)	16.2 (SE=7.4, n=40)
Cawston	22.5 (SE=8.3)	10.6 (SE=4.6, n=40)
White Lake	20.1 (SE=6.2)	2.3 (SE=1.2, n=40)
Naramata	29.0 (SE=6.4)	14.0 (SE=5.6, n=40)
Blue Lake	27.5 (SE=7.8)	1.3 (SE=1.1, n=40)

**Table 5. Number of Nuttall's Cottontail pellets in relation to a rock bluff near Osoyoos Lake, B.C.**

Distance from rock bluff	% Vegetative cover	Mean pellets/m <sup>2</sup>
25 m	32.4 (SE=7.2, n=10)	37.4 (SE=8.2, n=20)
50 m	27.3 (SE=6.3, n=10)	11.1 (SE=5.3, n=20)
100 m	24.7 (SE=8.1, n=10)	2.1 (SE=1.4, n=20)
150 m	30.3 (SE=6.4, n=10)	0.0 (SE=0.0, n=20)

(Stevens and Lofts 1988). Summer diet consists mostly of succulent grasses and forbs while winter diet is mostly shrubs (Table 2). Stevens and Lofts (1988) report the use of bark and buds of trees and shrubs during winter. MacCracken and Hansen (1982) report that herbaceous vegetation may be more important than shrub cover in determining the abundance of Nuttall's Cottontails in an area.

*Susceptibility to special conditions* — In general, cottontails are not well adapted to adverse climatic conditions (Chapman *et al.* 1982). In California, heavy rain and wind apparently reduced activity and feeding (Orr 1940). In central Oregon, reduced seasonal precipitation caused major reductions in natality and juvenile survival of Nuttall's Cottontails (McKay and Verts 1978a). In central Oregon, most females had four litters between April and July 1972 of which 10, 22, 68 and 80 percent, respectively, survived until the end of August. However, during 1973, when 64% less rain fell, only three litters were produced between April and June of which 25, 21 and 11 percent, respectively, survived until the end of August. McKay and Verts (1978a) suggest that if forage moisture content drops below 55% during the breeding season, juvenile survival is adversely affected.

Mortality of Nuttall's Cottontails during autumn and early winter is associated with periods of low ambient temperatures. Losses of cottontails are high following the first few nights of below-freezing temperatures during fall (McKay and Verts 1978a). Of the Nuttall's Cottontails alive

during November 1974, 80% were lost during December when minimum temperatures fell to -32° C and snow cover remained for 17 days.

## HABITAT

### Description

*Life requisites* — Nuttall's Cottontails use sagebrush dominated habitats more intensively than other habitat types in British Columbia. Sullivan *et al.* (1989) reported that use of other habitats in the Okanagan of British Columbia is low or non-existent and concluded that sagebrush habitat with at least 30% vegetative cover was good habitat for cottontails. Their conclusion is supported by the results of 25 days of field work conducted between September 27 and December 13, 1990 (Table 4).

*Seasonality* — There is no evidence to suggest that Nuttall's Cottontails use different habitats seasonally. They have been reported to increase the size of their home ranges during winter but this is likely due to reduced food abundance, forcing them to forage further from their day refuges (McKay and Verts 1978b).

*Critical habitats* — Areas that have sagebrush cover of 30% or greater, an abundance of naturally occurring burrows or rocky crevices, and a high biomass of forbs are likely to support thriving populations of Nuttall's Cottontails. Nuttall's Cottontails do occur in habitats other than sagebrush but only to a very small extent (Table 4).

*Distribution*—Nuttall's Cottontails inhabit the western Great Plains region from Arizona to the southern parts of the prairie provinces. West of the Rocky Mountains, their distribution follows that of the intermountain grasslands north into British Columbia. Nuttall's Cottontails are restricted to the Southern Interior Ecoprovince of British Columbia (Stevens and Lofts 1988). Within this ecoprovince, their distribution is largely restricted to the sagebrush steppe of the Bunchgrass-Ponderosa Pine Biogeoclimatic Zone (British Columbia Ministry of Forests 1988) in the south Okanagan and Similkameen Valleys (Fig. 1).

*Trend in quality and quantity of habitat* — There has been a severe reduction in the amount of natural vegetation types in the south Okanagan. Redpath (1990) reports that less than 10% of the area is in a "relatively undisturbed" state. This reduction of natural habitats is mainly due to the increased human settlement and agriculture that has occurred since the mid 1940s.

The impact of human disturbance on natural habitats is difficult to assess for Nuttall's Cottontails in British Columbia, which have likely expanded their range north into the Okanagan Valley within the last 60 years (Cowan and Hatter 1940). This range expansion corresponds with, and may have been facilitated by, patterns of human settlement. Early agricultural practices, such as increased irrigation and predator control, may have improved the conditions for Nuttall's Cottontails, allowing populations to expand northward. Nuttall's Cottontails have never been extremely abundant in the Okanagan (D. Fraser, pers. comm.), although they were abundant enough between 1955 and 1965 to warrant control of their numbers with poison baits (Sullivan *et al.* 1989).

In recent years, new and more intensive agricultural methods and livestock grazing of rangelands has likely led to a significant reduction in the amount of available habitat for Nuttall's Cottontails

in the southern Okanagan. While some species of cottontail rabbits inhabit disturbed or successional habitats in North America, agricultural practices and grazing in the south Okanagan reduced security cover and the abundance of forbs, both of which are important habitat elements for Nuttall's Cottontails.

*Rate of habitat change* — The rate of habitat change has been extremely rapid in the south Okanagan since the 1940s. Advanced capabilities in irrigation have allowed agriculture to spread quickly from the valley floor up the sides of the valley. The rate of agricultural expansion has slowed in recent years but very little undisturbed natural sagebrush habitat remains in the south Okanagan.

*Present habitat status* — There are 21 protected areas in the south Okanagan (Hlady 1990). Four of these protected areas contain sagebrush/antelope-brush habitat. These areas are the Vaseux-Bighorn National Wildlife Area (792 ha), Ecological Reserve 33 Field's Lease (4 ha), Ecological Reserve 100 Hayne's (101 ha) and the Nature Trust of British Columbia lands at Vaseux Lake (210 ha). Nuttall's Cottontails were seen in the Vaseux-Bighorn National Wildlife area in October 1990. Nuttall's Cottontails also use Ecological Reserve 100 (M. Sarell, pers. comm.), the Vaseux Lake Migratory Bird Sanctuary (282 ha) and the Osoyoos Oxbows Management Reserve (262 ha) (Hlady 1990).

The area of preferred sagebrush habitat currently protected in the south Okanagan is less than 1000 ha. Sullivan *et al.* (1989) reported abundances of between 22.5 to 42.5 Nuttall's Cottontails per 100 ha of sagebrush habitat in British Columbia. Assuming these densities are at ecological carrying capacity, the area currently protected could support between 225 and 425 animals. Nuttall's Cottontails are distributed throughout much of the south Okanagan, seem to be stable populations

and may even be dispersing into new areas. Given the above estimates, the current level of protection may be adequate to ensure continued maintenance of Nuttall's Cottontails in the south Okanagan.

*Habitat protection*—Critical areas of habitat may be improved or conserved by negotiating protection of sites and land use practices through agreements with landowners. Areas with rocky outcrops in sagebrush habitat should be considered for protection or landtrades since they may be more valuable to cottontails than areas of uniform sagebrush. A plan to control overgrazing on Crown lands should be developed and implemented. Any action including controlled grazing that increases the abundance of succulent forbs and grasses interspersed with sagebrush will enhance habitat for Nuttall's Cottontails.

*Degree of specialization*—Hall and Kelson (1951) report that in the northern part of its range Nuttall's Cottontail occurs mainly in sagebrush habitats but in the southern part of its range it also occurs in forested areas. In British Columbia it occurs primarily in sagebrush-steppe habitats (Sullivan *et al.* 1989, this study) but low numbers may also be found in agricultural habitats (Stevens and Lofts 1988, this study). Pellet count transects done throughout the south Okanagan during the fall of 1990 indicate that Nuttall's Cottontails use habitats other than sagebrush steppe but only to a minor extent (Table 4).

The variation in abundance of pellets among different locations in sagebrush habitat (Table 5) suggests that the presence of sagebrush alone may not determine habitat use for Nuttall's Cottontails. Other habitat factors likely affect selection of specific sites within sagebrush habitats. In Oregon, Nuttall's Cottontails are more abundant in areas of sagebrush habitat with rocky outcrops and abundant forbs (McKay and Verts 1978b). Pellet counts done during fall 1990 in the south Okanagan indicate that Nuttall's Cottontails are

more abundant in areas of sagebrush near rock bluffs and in areas ungrazed by cattle.

## DISTRIBUTION

### North America

Nuttall's Cottontails inhabit the western Great Plains region from Arizona and New Mexico north to the southern parts of the prairie provinces, and from the foothills of the eastern slopes of the Rocky Mountains west to the eastern slopes of the Cascade-Sierra Nevada Range (Fig. 2). Their range is mainly within the western United States where their distribution is reported to be stable (Chapman *et al.* 1982). However, Nuttall's Cottontails have been displaced by the eastern cottontail (*Sylvilagus floridanus*) in some areas (Chapman 1975).

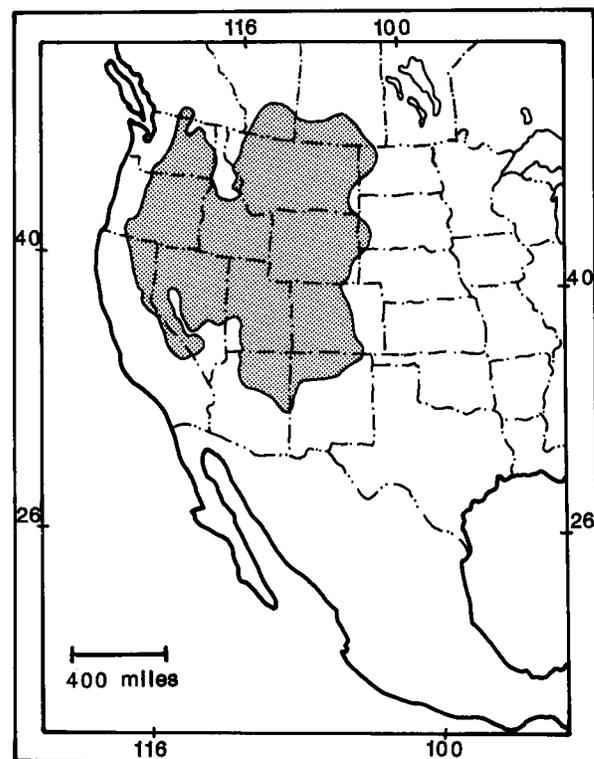


Figure 2. Distribution of Nuttall's Cottontails in North America : 1 *S. n. nuttallii* ; 2 *S. n. grangeri*; 3 *S. n. pintis* (from Chapman 1975).

## Canada and British Columbia

There are two recognized subspecies in Canada, *Sylvilagus nuttallii grangeri* and *Sylvilagus nuttallii nuttallii* (Fig. 3) (Banfield 1974).

*Sylvilagus nuttallii grangeri* (J.A. Allen), 1895 Bull. American Mus. Nat. Hist. 7:264. Alberta and Saskatchewan.

In the prairie provinces, Nuttall's Cottontail has enlarged its Canadian distribution during the last century. In Canada, it was first reported in southwestern Saskatchewan in 1909. In 1990, it is common in southwestern Saskatchewan and southeastern Alberta (Fig. 3) (H. Smith, pers. comm.).

*Sylvilagus nuttallii nuttallii* (Bachman) 1837, Jour. Acad. Nat. Sci. Philadelphia 7:345. Okanagan Valley, British Columbia.

This subspecies was first reported in British Columbia in 1939 (Cowan and Hatter 1940). Prior to 1939, the northern extent of their range west of the Rocky Mountains had been the slopes of the Columbia River Basin in eastern Washington. At the time of the first record in British Columbia, the range of Nuttall's Cottontails extended into British Columbia only as far as Osoyoos but it was reported to be gradually expanding northward (Cowan and Hatter 1940). Pellet counts conducted in fall 1990, specimen records and sightings indicate that the 1990 range of Nuttall's Cottontails in British Columbia extends throughout most of the Bunchgrass-Ponderosa Pine Biogeoclimatic zone (British Columbia Ministry of Forests 1988) to an elevation of approximately 700 m in both the Similkameen and Okanagan Valleys. Their range extends up the Similkameen Valley approximately 13 km west of Keremeos and up the Okanagan Valley to approximately 18 km north of Summerland (Fig. 1).

## POPULATION SIZE AND TREND

Sullivan *et al.* (1989) reported the density of Nuttall's Cottontails near Summerland varied between 22.5 (1985 and 1986) and 42.5 (1984) rabbits per 100 ha of sagebrush habitat. Conversion of the pellet count results which they report for the same periods indicates the average number of cottontail pellets/m<sup>2</sup> on their grid were 22.8 and 65.8 during 1985 and 1984 respectively. This suggests pellet density is positively correlated to population density. Assuming a linear relationship and using Sullivan *et al.* (1989) estimates, pellets/m<sup>2</sup> can be used as a rough index of cottontail abundance. This index is not statistically valid but is the only information available in British Columbia to estimate the number of Nuttall's Cottontails from pellet counts.

From pellet counts done between September and December 1990, the average number of pellets/m<sup>2</sup> of sagebrush habitat in the south Okanagan was 10.6 (SE=5.4, n=280). Using the population pellet conversion index and recognizing its weaknesses, the abundance of cottontails in the south Okanagan is crudely estimated as approximately 10 Nuttall's Cottontails per 100 ha of sagebrush habitat.

There is very little information available about past abundances of Nuttall's Cottontails in British Columbia. Doug Fraser (pers. comm.), a long time local resident and naturalist, believes that Nuttall's Cottontails have never been abundant in the south Okanagan. From the information available, there appears to be no apparent reduction in their abundance that would be outside the normal variation of a cottontail population. The distribution of Nuttall's Cottontails in the province has expanded when compared to the distribution previously reported by Cowan and Guiguet (1966) which may or may not indicate increased numbers.

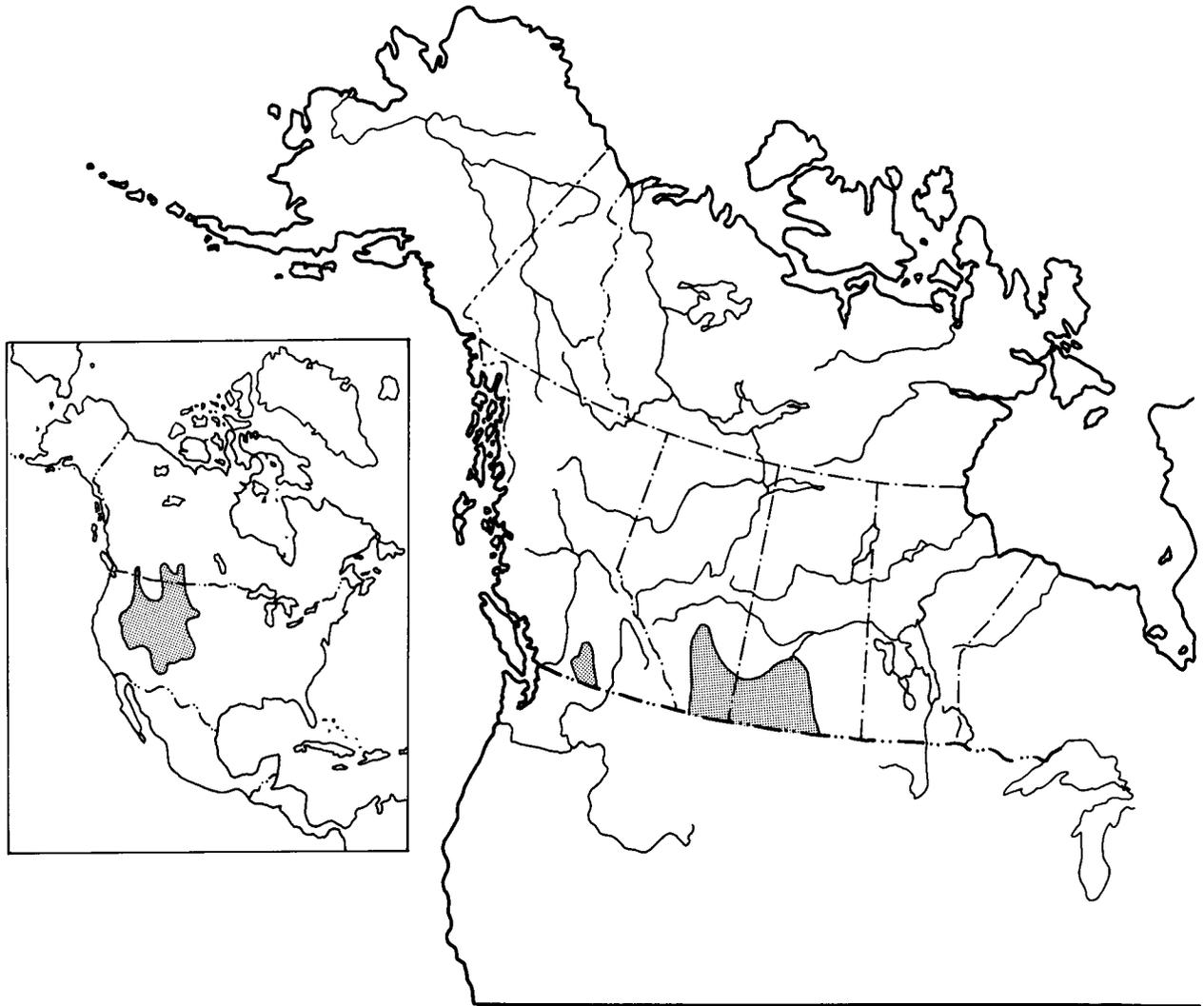


Figure 3. Distribution of Nuttall's Cottontail in Canada: 1 *S. n. nuttallii*; 2 *S. n. grangeri*; (from Banfield 1974).

The available information indicates a stable if not increasing population of Nuttall's Cottontails in the south Okanagan. The staff of the Agriculture Canada Research Station at Summerland report the abundance of Nuttall's Cottontails at that location to have increased recently to the point where they are now causing considerable damage to the ornamental plants grown at the station (G. Houg, pers. comm.)

## LEGAL PROTECTION

Nuttall's Cottontails are presently protected as wildlife by regulation under the Wildlife Act SBC 57 1982 and have been since at least 1966 under the previous act.. Hunting, capture, or possession of this species is not permitted.

## LIMITING FACTORS

Nuttall's Cottontails in British Columbia are most abundant in areas of sagebrush habitat with abundant vegetative cover (Sullivan *et al.* 1989). The amount of sagebrush habitat in the south Okanagan has been greatly reduced (Redpath 1990). Much of the remaining sagebrush habitat is used for grazing cattle, which probably leads to reduced densities of Nuttall's Cottontails in these areas. Although the abundance of Nuttall's Cottontails does not seem to be declining in the south Okanagan, the amount of habitat available to them has been greatly reduced. It is expected that their numbers would be substantially higher if more undisturbed sagebrush habitat was available.

## SPECIAL SIGNIFICANCE OF NUTTALL'S COTTONTAIL

Nuttall's Cottontails are not considered threatened in North America (Chapman *et al.* 1982). The bulk of their range occurs in the United States where their abundance and distribution is considered stable (D. Brittell, pers. comm.). Nuttall's Cottontails are reported to be common throughout

much of their range in the prairie provinces (H. Smith, pers. comm.). In British Columbia, the distribution of Nuttall's Cottontails is restricted to the South Okanagan, the northern limit of their range west of the Rocky Mountains.

The degree of public interest in Nuttall's Cottontails is moderate to low in the South Okanagan. This is likely because Nuttall's Cottontails are nocturnal and tend to remain in areas of thick cover thus reducing how many people see them. Their scarcity in British Columbia negates any positive or negative economic value they might have either as a game species or pest.

Except for the New England Cottontail (*Sylvilagus transitionalis*) (Chapman *et al.* 1982), cottontails in general are not considered threatened in North America.

## RECOMMENDATIONS AND MANAGEMENT OPTIONS

### Public education

Attempts should be made to increase public awareness of the status of Nuttall's Cottontails in the South Okanagan. This awareness will bring forth more information about past abundance and areas of use, as well as increase the likelihood of future sightings being reported.

### Further research needs

- 1) In sagebrush habitats, the impact of cattle grazing on the abundance and distribution of Nuttall's Cottontails needs to be examined in greater detail. Can grazing practices be modified to enhance range land for Nuttall's Cottontails?
- 2) The use of agricultural habitats by Nuttall's Cottontails during the growing season needs to be examined to determine if these habitats are seasonally important to Nuttall's Cottontails.

- 3) The use of pesticides and herbicides in agricultural habitats needs to be examined to determine if their use influences the abundance and distribution of Nuttall's Cottontails.
- 4) The importance of burrows and crevices for nests and day beds needs to be examined to assess what role they play in habitat use and abundance of Nuttall's Cottontails.
- 5) The influence of changing agricultural and wildlife management practices in the south Okanagan needs to be examined. The relationship between Nuttall's Cottontails, their predators and other prey species needs to be examined to determine whether increased agriculture and changing management practices, such as reduced predator control, have served to enhance or reduce cottontail numbers.

### **Management options**

The remaining areas of relatively undisturbed sagebrush habitat in the south Okanagan should be identified and protected. Areas of sagebrush habitat which provide natural nest sites, such as rock crevices, should be made a priority for protection. Habitat restoration plans should be implemented on Crown lands known to support Nuttall's Cottontail populations. Management actions which increase the amount of sagebrush cover and the availability of succulent forage will enhance the habitat for Nuttall's Cottontails. A grazing plan for Crown lands throughout the south Okanagan should be developed and implemented to control cattle grazing.

### **EVALUATION**

Available information suggests that Nuttall's Cottontails are a fairly recent immigrant into the south Okanagan of British Columbia, having arrived in the province within the past 60 years (Cowan and Hatter 1940). Nuttall's Cottontails have never been reported to be abundant in the province and this may have as much to do with

their being at the northern limit of their range as any other factor. Since they were first reported in the province, they have expanded their range considerably in both the Okanagan and Similkameen Valleys to near the extent of the Bunchgrass Biogeoclimatic Zone. Because Nuttall's Cottontails invaded the province subsequent to human settlement in the south Okanagan it is difficult to evaluate what effect habitat disturbance has had on their distribution and abundance. The available evidence regarding their habitat use suggests that the loss of sagebrush vegetation communities has reduced the amount of habitat available to Nuttall's Cottontails in the south Okanagan.

Because their numbers seem to be fairly stable and their range has been expanding, Nuttall's Cottontails may be scarce but they are not threatened in British Columbia. Nuttall's Cottontails should, however, be considered somewhat vulnerable due to their limited distribution and the lack of undisturbed sagebrush habitat.

### **ACKNOWLEDGEMENTS**

The Ministry of Environment, Lands and Parks requested proposals that initiated the status report. The proposal submitted by Drs. F.L. Bunnell and A.S. Harestad was accepted. Dr. Harestad subcontracted D. Carter to conduct the field work and write the progress and final reports. Reports were reviewed and edited by Dr. Harestad. The final report incorporates comments by Ministry of Environment, Lands and Parks biologists and other reviewers.

Thanks are extended to the Inkameep and Similkameen Indian Bands who kindly allowed field work to be done on their lands, to the Royal British Columbia Museum for making available museum records and to the staff of the Wildlife Branch, Ministry of Environment, Lands and Parks, Penticton, for providing sightings and reports.

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**APPENDICES**

## APPENDIX 1. PROJECT FIELD WORK.

### Introduction

To determine the status of Nuttall's Cottontails in British Columbia, field work was conducted from 27 September to 13 December 1990, in the south Okanagan and Similkameen Valleys of British Columbia. The objectives of this field work were to assess the habitat use, abundance and distribution of Nuttall's Cottontails.

### Materials and Methods

1. Between 27 September and 13 December 1990, sightings and reports were gathered from the Wildlife Branch, B. C. Ministry of Environment, Penticton and 118 local land owners were interviewed. The results of this survey are shown on the British Columbia range map (Fig. A-1) and Table A-1.

2. In total, 1496 km of vehicle transects along dirt and paved roads were conducted at night with the aid of a 750 000 candle power spotlight. Transects were placed in five separate regions of the south Okanagan where Nuttall's Cottontails have been historically reported. These regions included: (1) the area near White Lake, (2) the Similkameen Valley between Nighthawk and Cawston, (3) the area south of Richter Pass, (4) the Okanagan Valley from Osoyoos to Oliver, and (5) the Okanagan Valley from Oliver to Summerland. Attempts were made to sample all of the habitat types reported to be used by Nuttall's Cottontails in each region. It was not possible to equally sample each habitat type nor was it possible to adequately sample some of the habitat types. The results of the spotlight surveys are provided on the British Columbia range map (Fig. A-2) and Table A-2.

3. Besides vehicle transects, 50 walked transects, each 1.5 km long, were surveyed at night with the aid of the spotlight. Transects, stratified by region, were placed beside roads in sagebrush habitat and had three 0.5 km sides so as to return the observer to the road 0.5 km from the starting point. The results of these transects are provided on the British Columbia range map (Fig. A-2) and Table A-2.

4. In each region, line transects 300 m long were conducted to look for pellets. Two 1 m<sup>2</sup> plots were examined at 30 m intervals along the transect. Nuttall's Cottontail pellets were distinguished from other lagomorph pellets on the basis of size (< 6mm), shape and colour as determined from pellets known to be from an observed Nuttall's Cottontail. Though there is considerable overlap in size between the pellets of Nuttall's Cottontails and those of juvenile Snowshoe Hares (*Lepus americanus*), no Snowshoe Hares were observed in areas shown by pellet counts to be preferred by Nuttall's Cottontails during spotlight transects. Also, even if a large error of 20 or 30 percent was assumed, it would only serve to dismiss some of the minimally used and likely unimportant habitats and would not change the conclusion that sagebrush/antelope-brush habitats are by far the most used habitats (Table 3). The amount of vegetative cover, tall enough to act as security cover for a Nuttall's Cottontail (20 cm), was estimated in a 5 m<sup>2</sup> circular plot around the two pellet plots. The results of these transects are provided in Tables 3, 4 and 5 within the text of the status report.

5. Pellet counts were done at 5 km intervals adjacent to Highways 97, 3, and 3A to determine the north, west and east boundaries of the distribution of Nuttall's Cottontails in the south Okanagan. The results of these counts are given on the British Columbia range map (Fig. 1) within the text of the status report.

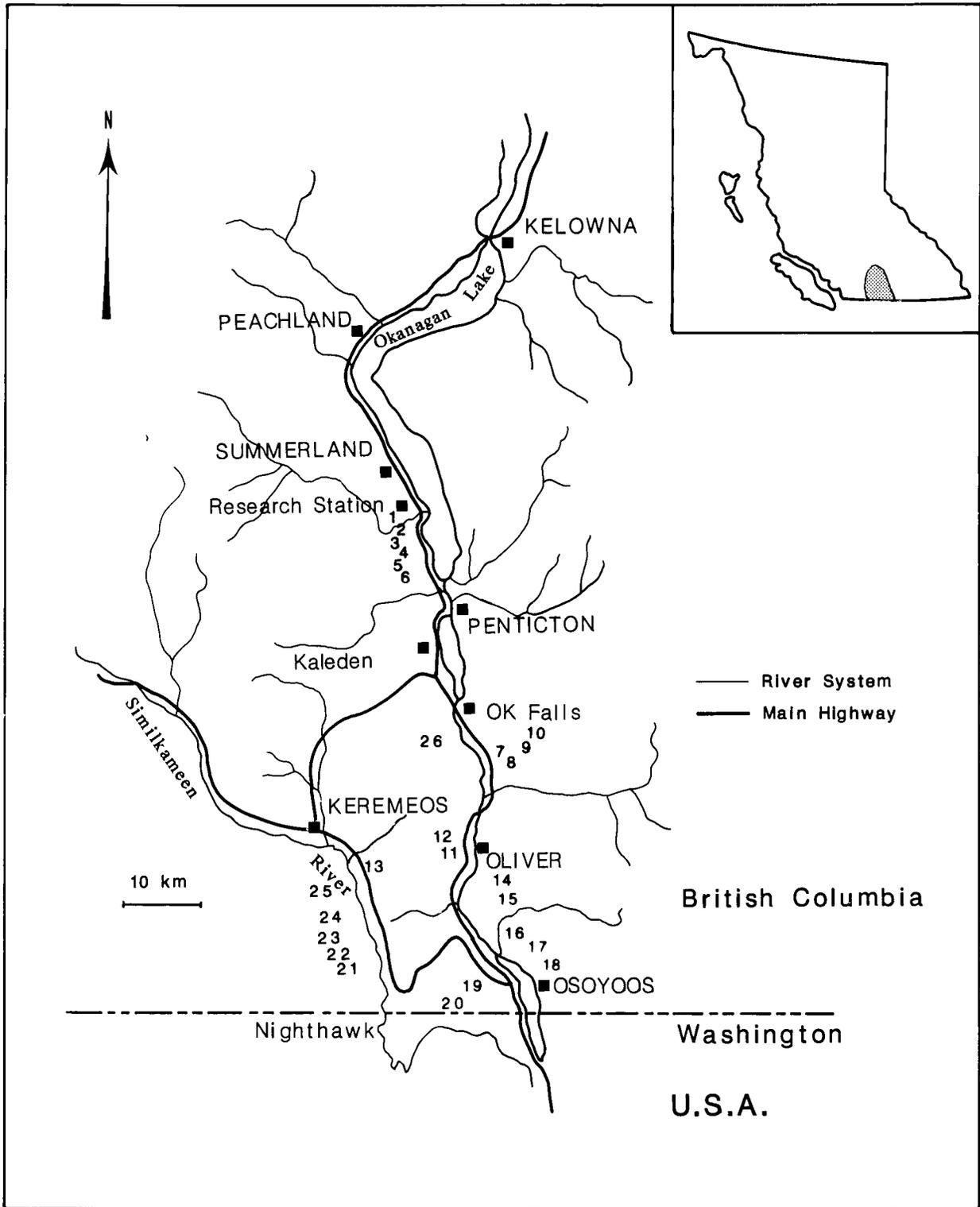


Figure A-1. Locations of Nuttall's Cottontails in the south Okanagan of British Columbia from sightings, reports and museum specimens. Specific locations are given in Table A-1.

**Table A-1. Sightings, reports and museum specimens of Nuttall's Cottontails in the south Okanagan of British Columbia.**

Number	Date	Location	Source
1	—	west of Oliver	MOELP
2	—	north of Osoyoos Lake	MOELP
3	—	south of Osoyoos Lake	MOELP
4	—	Anarchist Mountain	MOELP
5	—	north of Vaseux Lake	MOELP
6	—	east of Okanagan Falls	MOELP
7	—	west of Okanagan Falls	MOELP
8	1988	north of Summerland	Barkwill
9	1988	Keremeos	Quaedvleig
10	1989	Ecological Reserve 100	MOELP
11	1989	Anarchist Mountain	MOELP
12	1990	Indian Reserve #1	MOELP
13	1990	Indian Reserve #1	MOELP
14	1990	west of Osoyoos	MOELP
15	1988	south of Penticton	MOELP
16	1989	west of Ecological Reserve 33	MOELP
17	1990	Ecological Reserve 100	MOELP
18	1986	Ecological Reserve 100	MOELP
19	1990	Vaseux Lake floodplain	MOELP
20	1990	Summerland Research Station	Houg
21	1990	Prather Lake	EYC
22	1990	north of Summerland	EYC
23	1989	Trust Creek, Naramata	Dyer
24	1990	Chopaka	Sarell
25	1990	south of Vaseux Lake	Sarell
26	1990	Indian Reservation #8	S. Band
27	1990	Indian Reservation #8	S. Band
28	1989	south of Oliver	King
29	1989	Vaseux Lake	Macnaughton
30	1950s	Fairview	Macnaughton
31	1970	Ecological Reserve #100	Fraser
32	1939	Osoyoos	RBCM
33	1940	Osoyoos	RBCM
34	1940	Oliver	RBCM
35	1940	Osoyoos	RBCM

Sources: MOELP: Ministry of Environment, Lands and Parks  
 Barkwill (Bob Barkwill, Summerland)  
 Quaedvlieg (Mark Quaedvlieg, Keremeos)  
 Houg (G. Houg, Agriculture Canada Research Station, Summerland, B.C.)  
 EYC: Environment Youth Corps, MOELP, Penticton  
 Dyer: (Orville Dyer, MOELP, Penticton)  
 Sarell (Mike Sarell, MOELP, Penticton)  
 S. Band (Similkameen Indian Band, Keremeos)  
 King (Joan King, Osoyoos)  
 Macnaughton (Charlton Macnaughton, Vaseux Lake)  
 Fraser (Doug Fraser, Osoyoos)  
 RBCM: Royal British Columbia Museum

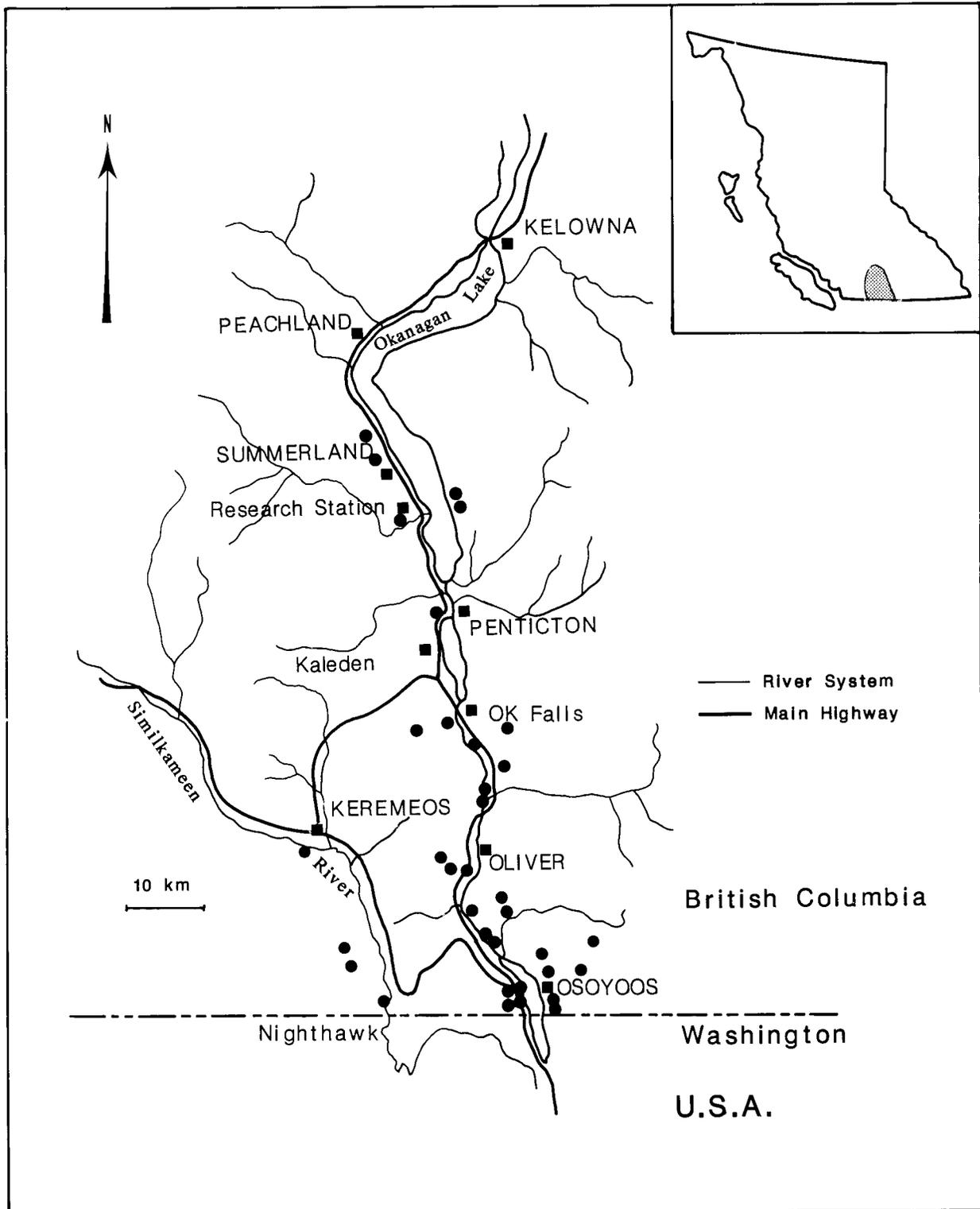


Fig. A-2. Locations of Nuttall's Cottontails sighted during vehicle and walked spotlight transects conducted between 27 September and 13 December 1990, in the south Okanagan of British Columbia. Locations and site descriptions are provided in Table A-2.

**Table A-2. Nuttall's Cottontails sighted during vehicle and walked spotlight transects conducted in south Okanagan.**

Number	Location	Habitat	% Vegetative cover
1	south of Summerland	mixed sagebrush	40
2	south of Summerland	mixed sagebrush	30
3	south of Summerland	Ponderosa pine-mixed sagebrush	20
4	south of Summerland	mixed sagebrush	30
5	south of Summerland	mixed sagebrush	35
6	south of Summerland	mixed sagebrush	40
7	east of Vaseux Lake	mixed sagebrush	20
8	east of Vaseux Lake	mixed sagebrush	20
9	east of Vaseux Lake	Ponderosa pine	10
10	east of Vaseux Lake	Ponderosa pine	10
11	Fairview-Cawston	riparian	20
12	Fairview-Cawston	riparian	20
13	Fairview-Cawston	mixed sagebrush	30
14	south of Inkaneep	big sagebrush	15
15	south of Inkaneep	mixed sagebrush	20
16	north of Mica Creek	mixed sagebrush	25
17	north of Mica Creek	mixed sagebrush	20
18	Mica Creek	mixed sagebrush	30
19	Blue Lake	mixed sagebrush	30
20	Blue Lake	mixed sagebrush	35
21	north of Chopaka	mixed sagebrush	30
22	north of Chopaka	mixed sagebrush	40
23	north of Chopaka	hay field edge	5
24	north of Chopaka	mixed sagebrush	45
25	north of Chopaka	mixed sagebrush	40
26	north of Chopaka	mixed sagebrush	45

**Appendix 2. Possible nest or day refuge.**

During a spotlight transect conducted in the Vaseux-Bighorn National Wildlife Area on October 18th, a single Nuttall's Cottontail was observed browsing on sagebrush (*Artemisia tridentata*) (Photograph 1). The animal was followed and observed to enter the rock crevice shown in Photographs 2 and 3. This crevice, examined the following day, had numerous rabbit pellets near its entrance. A pile of twigs, grass and fur was located in the crevice 60 cm from the entrance.



**Photograph 1. Sagebrush browsed by Nuttall's Cottontail.**



**Photograph 2. Entrance of the rock crevice used by Nuttall's Cottontail.**



**Photograph 3. Close up of the Entrance to the rock crevice showing debris and pellets.**

Wildlife Working Reports should not be cited because of the preliminary nature of the data they contain. Working Reports 1 - 10 are out of print.

- WR-11 Effect of wolf control on black-tailed deer in the Nimpkish Valley on Vancouver Island. Progress report -1983 August 31 to 1984 August 31. K. Atkinson and D. Janz. March 1985. 22pp.
- WR-12 1983 southeastern Skeena regional moose abundance and composition survey. B. van Drimmelen. June 1985. 47pp.
- WR-13 Kechika Enhancement Project of northeastern B.C.: wolf/ungulate management. 1984-85 annual report. J.P. Elliott. September 1985. 28pp.
- WR-14 Muskwa Wolf Management Project of northeastern B.C. 1984-85 annual report. J.P. Elliott. September 1985. 44pp.
- WR-15 Caribou habitat use on the Level Mountain and Horseranch ranges, British Columbia. M.A. Fenger, D.S. Eastman, C.J. Clement, and R.E. Page. 1986. 41pp + 4 maps. (Also printed as Surveys and Resource Mapping Branch Working Report WR-8).
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- WR-24 Impacts of a hydro-electric reservoir on populations of caribou and grizzly bear in southern British Columbia. K. Simpson. February 1987. 40pp.
- WR-25 The effects of snowmobiling on winter range use by mountain caribou. K. Simpson. February 1987. 15pp.
- WR-26 Quesnel Highlands wolf control project. D. Hebert. January 1987. 10pp.
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- WR-28 Vancouver Island wolf control project. Year 1 progress report. D. Janz. July 1987. 11pp.
- WR-29 Habitat survey of the Mackenzie Heritage Trail corridor. V. Hignett. June 1987. 21pp + 5 maps.
- WR-30 A proposal to manage coyote and cougar populations of the Junction Wildlife Management Area. D. Hebert. September 1987. 11pp.
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- WR-32 Research priorities for furbearers in British Columbia. D. Blood. June 1988. 49pp.
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- WR-36 Explanatory legend for vegetation maps of the Kamloops Lake bio-physical study area. E.C. Lea. December 1988. 78pp.
- WR-37 Bio-physical habitat units and interpretations for moose use of the upper Cariboo River Wildlife Management Area. E.C. Lea, T. Vold, J. Young, M. Beets, D. Blower, J. Youds, A. Roberts. December 1988. 24pp.
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- WR-39 Managing habitat through guidelines: How far can you go? M. Fenger and V. Stevens, eds. February 1989. 48pp.
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