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Reproduction of the California Red-Backed Vole in Western Oregon

Abstract

Two hundred and sixty *Clethrionomys californicus* specimens were collected in western Oregon from 1952 to 1965. The sex ratio of 258 animals was 49 percent males. The range of shortest body lengths for fecund animals was 90 to 99 mm for males and 80 to 89 mm for females. Males were in breeding condition from February to October and females from April to November, based on the combined years. Average number per set of corpora lutea was 2.86, placental scars 2.91, and embryos 2.63. Seventeen percent of the lactating females had postpartum pregnancies and the calculated minimum number of litters per year was 3.1.

California red-backed voles *(Clethrionomys californicus)* occur from the Columbia River southward along the coast to Sonoma County, California. They frequent the deep woods in the Transition and Canadian life zones from the upper western edge of the ponderosa pine *(Pinus ponderosa)* type on the eastern slope of the Cascade Mountains to the Pacific Ocean (Bailey, 1936; Ingles, 1965; and Maser and Storm, 1970).

During the course of a forest-wildlife ecological study in Oregon from 1952 to 1967, 260 red-backed voles were collected and 243 were given post-mortem examinations. Although the samples were not as well distributed throughout the year nor as large as desired, considerable new knowledge about California red-backed voles was obtained.

Location and Description of Study Area

Voles were collected on the Half Pint area, Lakes Ranger District, Mt. Hood National Forest, Clackamas Co., and on the H. J. Andrews Experimental Forest and vicinity, Blue River Ranger District, Willamette National Forest, Lane and Linn counties, Oregon. Both areas are on the west slope of the Cascade Mountains in the northern half of the state. The undulating terrain is composed of irregular benches alternating with steep slopes and the soils are generally a porous, clay loam. Precipitation ranges from about 200 to 320 cm per year, and occurs mostly in winter.

Most of the voles were caught in old-growth timber, primarily Douglas-fir *(Pseudotsuga menziesii)* with smaller amounts of western hemlock *(Tsuga heterophylla)* and western redcedar *(Thuja plicata)*. Scattered throughout the forest were western yew *(Taxus brevifolia)*, vine maple *(Acer circinatum)*, big-leaf maple *(Acer macrophyllum)*, and flowering dogwood *(Cornus nuttallii)*. Ground cover in the mature forest was variable but was largely shrubby and often of salal *(Gaultheria shallon)*, sword fern *(Polystichum munitum)*, Oregon grape *(Berberis nervosa)*, rhododendron *(Rhododendron macrophyllum)*, twin-flower *(Linnaea borealis)*, and gold-thread *(Coptis laciniata)*. Grasses and sedges formed only a small percentage of the vegetation.

Methods

Red-backed voles were caught in ordinary household and Museum Special kill-traps set on line transects. Some specimens came from animals which succumbed in Sherman live-traps set on a grid pattern and on line transects. Most of the trapping in the mature forest was at elevations ranging from about 396 to 1,219 m and on a spring and fall schedule.

Measurements and other external information, such as condition of genital organs, were obtained before the specimens were dissected. A small number of slides were made, primarily from testes, and examined for sperm abundance. Large (8.0 mm and longer) pink and turgid testes, and cauda epididymides tubules visible to the unaided eye were considered evidence of male fecundity. The size and condition of the seminal vesicles were also evaluated. Females were considered fecund if they had embryos or were lactating; perforate vulvas, recent ovulation, and general size and condition of the sex organs were also considered in the evaluation. Voles having evidence of present or past sexual activity were classed as adults.

Scientific names of mammals and plants used in this article follow Bailey (1936) and Hitchcock *et al.* (1955-69), respectively.

Results and Discussion

Yearly *Clethrionomys* samples were generally small and too variable to be treated separately so the data were combined by months for the entire period. Even so, the March, April, and August samples are very small.

Sex Ratios. Males made up 49 percent (126) of the 258 animals examined. There was no significant difference (t test, $P < 0.05$) in the number of males and females captured. The males formed the bulk of the small samples in February, March, and August, and were equal to or only slightly less abundant than females in May, June, July, September, October, and November. Females dominated the samples in January, April, and December. The sex ratio of 97 *Clethrionomys californicus* captured during the early part of this study was 56 percent males (Gashwiler, 1959), a greater percentage than for the larger sample. Of 15 California red-backed voles captured in Oregon from 1893 to 1937 by several collectors (Macnab and Dirks, 1941), 40 percent (6) were males. However, this sample is a very small one and the results are probably not representative.

Reproductive Periods and Fecundity Rates. The male breeding season lasted nine months; it began in February, and most males were in breeding condition from March to September (Table I). Only a few males were fecund in October. The females had a shorter (8 months) breeding season which started in April, two months later than the males. The sample of females, however, was very small from January to March, and fecund females could easily have been missed. High fecundity rates of females prevailed until September when a moderate decline occurred. This decline continued gradually until November when no females were found in breeding condition. The weighted fecundity percentage (each monthly percentage divided by the total sum of all monthly percentages) for both sexes was relatively uniform from March to September (Table 1) which suggests a continuous productivity period and numerous litters per season for each female. I reported earlier that red-backed voles in Oregon are in breeding condition from April through November on the basis of a smaller sample (Gashwiler, 1959).

In the present study both sexes of red-backed voles were found reproductively active

TABLE 1. Number and percentage of adult fecund red-backed voles by month, sex, total, and weighted values.[a]

Months	Males			Females			Total			
	No. coll.	No. fecund	% fecund	No. coll.	No. fecund	% fecund	No. coll.	No. fecund	% fecund	Weighted % fecund
Jan.	—	—	—	2	0	0	2	0	0	0.0
Feb.	8	2	25	1	0	0	9	2	22	3.0
Mar.	4	4	100	1	0	0	5	4	80	10.9
April	2	2	100	4	4	100	6	6	100	13.6
May	19	19	100	20	19	95	39	38	97	13.2
June	6	6	100	7	7	100	13	13	100	13.6
July	1	1	100	2	2	100	3	3	100	13.6
Aug.	6	6	100	3	3	100	9	9	100	13.6
Sept.	16	14	88	24	19	79	40	33	83	11.3
Oct.	37	8	22	44	27	61	81	35	43	5.8
Nov.	12	0	0	17	3	18	29	3	10	1.4
Dec.	4	0	0	3	0	0	7	0	0	0.0
Total and avg.	115	62	54	128	84	66	243	146	60	100.0

[a] See text for definition of fecundity for each sex, and weighting procedure.

from February through November, a 10-month period. Since this sample is a composite of many years, it probably includes years in which reproduction began early as well as late, and may represent a longer breeding period than occurs in any one year.

Early born *Clethrionomys* probably matured and became part of the breeding population of the year. The red-backed voles were grouped into 10mm body length classes, *i.e.,* 80 to 89 mm, etc. The smallest male red-backed voles considered fecund were in the 90 to 99 mm body length class. Smaller males, in the 80 to 89 mm class, were not captured until September, and were considered late young of the year. The smallest mature females were in the 80 to 89 mm body length class. The data suggest that females reach sexual maturity at a shorter body length (younger age) than males.

Litter size. Averages and ranges of litter size as determined by corpora lutea, placental scars, and embryo sets for California red-backed voles are given in Table 2 by reproductive stage. The average number of placental scars was slightly greater than the number of corpora lutea (2.91 vs. 2.86); this figure may be the result of sample differences or formation of some multiple zygotes from single follicles. Beer *et al.* (1957) thought multiple zygotes might exist among cricetid rodents in Minnesota. However, the hypothesis of sample differences seems more likely for my data since the average number of embryos per female was 2.63 as compared to 2.86 corpora lutea. Maser and Storm (1970) reported a range of one to six young (embryos by inference) per litter with

TABLE 2. Number of corpora lutea, placental scars, and embryos of red-backed voles.

Reproductive stage	No. of sets	Total No. of entities	Ave. Sets and SE	Mode of sets	Range of sets
Corpora lutea	81	232	2.86 ± 0.13	3	2-7
Placental scars	57	166	2.91 ± 0.12	2	1-7
Embryos	24	63	2.63 ± 0.02	3	1-4

most litters ranging from two to four for the red-backed vole in Oregon. This is a greater spread in range than was found in the present study, but the mode may have been the same. Larger samples would probably bring the two sets of data into closer agreement.

Postpartum Pregnancies. Four of the 24 pregnant red-backed voles were also lactating; thus at least 17 percent of the females had bred soon after parturition. Palmer (1954) reported a female that bred within 12 hours after giving birth. Seventeen percent is probably a minimum figure, since early stages of pregnancy could easily be overlooked. The ability to sustain reproductive processes over a possible eight-month or longer period and capability to produce postpartum pregnancies gives the red-backed vole great breeding potential. On the other hand, the relatively small average litter size of 2.6 young tends to restrict this potential.

Calculated Number of Litters Per Year. Number of litters per year was calculated by the method used by Gashwiler (1972). The monthly percentage of pregnant females was summed for the year and multiplied by the total number of days in the months with pregnancies. This product was divided by 18, the average number of days in the gestation period (Palmer, 1954). The resulting figure was then divided by the number of months in which pregnancies were found to give the estimated number of litters per year. The California red-backed voles averaged 3.1 litters per year. However, this figure is considered low since the samples in July and August were only one and two females and no pregnancies were found. If the June percentage of pregnancy is assumed for July and the September percentage for August, a very rough estimate of 4.6 litters per year is obtained. Obviously, such an estimate should be used very cautiously since the July and August pregnancy percentages are unknown.

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