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Demographic Analysis of Pine Vole Populations in Two Orchard
Types in Southwest Virginia

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Few long term studies have been conducted to analyze the population dynamics of pine and meadow voles in orchard environments. Such studies are needed to provide basic biological information for use in orchard management and vole control programs. To satisfy these needs, a three year study was begun in December, 1979, to monitor vole populations in a maintained and an abandoned apple orchard in Southwest Virginia. Two objectives of this study were (1) to follow population dynamics of pine and meadow voles in two orchard types and (2) to provide data for the development and validation of computer modeling efforts currently underway at Virginia Tech (Jordan and Tipton 1982). Lindquist et al. (1981) gave preliminary results from the field study after one year of trapping. This paper presents data from the second year of trapping (December 1980, to December, 1981) and compares the pine vole populations in the two orchards during the two years.

The two orchards have been live-trapped monthly since December, 1979. Both orchards are in the Roanoke Valley in Southwest Virginia and are within 1 mile of each other. The maintained orchard has not been commercially managed for the last 4 years but has been mowed 2-3 times during spring and summer. The abandoned orchard has had no maintenance in the last 5 years.

Both orchards were live-trapped 3 consecutive days during the middle of each month. The trap grids were each about 1/3 hectare in area and measure 6 tree rows by 12-13 trees. Two Sherman live traps were placed in tunnels or runways under each tree and checked twice daily. Traps were set early in the morning and closed each day after the second trap check. Tar paper was placed over the traps. For each vole trapped, location of capture, sex, age, body weight, body length and reproductive condition were recorded. Voles were marked by toe and ear clipping for identification and released. To allow comparisons with the results of Lindquist et al. (1981), age was determined by body weight. Juveniles were voles weighing less than 15g, subadults weighed greater than or equal to 15g but less than 21g, and adults were greater than or equal to 21g body weight.

Population densities were calculated as the minimum number of voles known to be alive (MNA) in the orchards for each trapping session. MNA was significantly ($P < 0.001$) higher in the maintained orchard than in the abandoned orchard during the first year (Table 1). However, there was no difference in population size between the two orchards during the second year. There were significantly ($P < 0.001$) more pine voles in the maintained orchard during the first year of trapping than in the second year but there was no difference in the abandoned orchard during the two years. From February, 1981, to

Table 1. Minimum number of pine voles known to be alive (MNA) in a maintained and an abandoned apple orchard for each month from December, 1979, to December, 1981.

MONTH	MAINTAINED ORCHARD		ABANDONED ORCHARD	
	79-80	80-81	79-80	80-81
DEC	183	169	55	58
JAN	184	116	45	62
FEB	201	58	47	79
MAR	209	39	55	76
APR	267	27	45	68
MAY	197	25	28	52
JUNE	183	19	34	21
JULY	103	18	21	13
AUG	92	16	15	11
SEPT	97	14	15	15
OCT	145	17	45	19
NOV	174	55	61	46
DEC	169	44	58	37

May, 1981, the MNA in the abandoned orchard was higher than in the maintained orchard.

There were significantly ($P < 0.003$) more males and females captured the first year in the maintained orchard than in the second year. In the second year most captures occurred from December, 1980, to February, 1981, and then declined until October, 1981. The highest number caught was observed in December, 1980 (122). There was no difference ($P > 0.05$) in the number of pine voles captured in the abandoned orchard between the two years. In the second year higher numbers were captured in February (60), March (64) and April (60). Although the male:female ratio varied monthly in both orchards, the yearly totals during the second year were 1.1:1.0 in the maintained orchard and 1.2:1.0 in the abandoned orchard. This was similar to the ratio in the two orchards during the first year (Lindquist et al. 1981).

The number of voles captured in both orchards declined dramatically in July, August and September of 1980 and from June through September in 1981. Lindquist et al. (1981) speculated the decline in number of captures and in MNA during summer was caused by a decrease in trappability and not by an actual decrease in population size. A calculation was made of the percent catch of those known alive for each month in both orchards (Table 2). To compute this percentage the total number of pine voles captured each month (including voles on unknown sex) was divided by the MNA for that month. There were no significant differences in percent catch between the two orchards nor between the two years. However, the percentage dropped below 50% from July to September in the maintained orchard both years. The abandoned orchard had similar trends. Thus, there was some decline in trappability in summer in both orchards which reduced the number of voles captured and estimates of population size.

The percentage of juveniles, subadults and adults was not significantly different between the two orchards during the second year of trapping (Tables 3 and 4). Juveniles and subadults were captured each month in the maintained orchard during the first year of trapping but during the second year no juveniles were captured in 6 months and no subadults captured in 2 months (Table 3). The percentage of adults captured dropped below 60% during fall of the second year and was only 37% in December, 1981. Small sample sizes may have accounted for these low percentages. In the abandoned orchard there were significantly ($P < 0.03$) more juveniles captured the second year than in the first year (Table 4). The percentage of adults captured stayed above 70% except from July to September but small sample sizes may again have caused some bias.

Adult males captured in the maintained orchard during the first year had significantly ($P < 0.001$) higher body weights than those captured the second year. Adult female body weights were not different ($P > 0.05$) between the two years. In the abandoned orchard there was no difference in either male or female body weight between the two years. Adults captured the first year tended to be heavier in the maintained orchard than in the abandoned orchard (males $P = 0.0516$; females $P = 0.077$). There was no such trend during the second year.

Table 2. Percent catch of those known alive for each month in a maintained and an abandoned apple orchard near Roanoke, Virginia. Number captured is indicated in parentheses.

MONTH	MAINTAINED ORCHARD		ABANDONED ORCHARD	
	79-80	80-81	79-80	80-81
DEC	100 (183)	73 (124)	100 (55)	52 (30)
JAN	68 (126)	83 (96)	73 (33)	53 (33)
FEB	62 (125)	88 (51)	62 (29)	77 (61)
MAR	56 (117)	79 (31)	87 (48)	84 (64)
APR	87 (233)	78 (21)	78 (35)	88 (60)
MAY	78 (151)	84 (21)	71 (20)	85 (44)
JUNE	77 (141)	58 (11)	91 (31)	71 (15)
JULY	31 (32)	39 (7)	71 (15)	23 (3)
AUG	15 (14)	19 (3)	7 (1)	-- (0)
SEPT	24 (23)	7 (1)	7 (1)	53 (8)
OCT	60 (87)	53 (9)	73 (33)	53 (10)
NOV	63 (113)	95 (52)	72 (44)	87 (40)
DEC	73 (124)	100 (44)	52 (30)	100 (37)

Table 3. Percent of juvenile (JUV), subadult (SAD) and adult (ADU) pine voles captured each month in a maintained apple orchard near Roanoke, Virginia, from December, 1979, to December, 1981. Voles of questionable sex are not included.

MONTH	DEC, 1979-DEC, 1980				DEC, 1980-DEC, 1981			
	N	JUV	SAD	ADU	N	JUV	SAD	ADU
DEC	168	6.0	7.7	86.3	122	2.5	15.6	82.0
JAN	115	0.0 ¹	0.0 ¹	0.0 ¹	96	1.0	23.0	76.0
FE B	121	4.1	19.8	76.0	51	0.0	19.6	80.4
MAR	209	5.5	16.5	78.0	31	0.0	9.7	90.3
APR	267	8.0	23.5	68.5	21	0.0	14.7	85.7
MAY	143	2.1	16.8	81.1	21	14.3	0.0	85.7
JUNE	119	5.0	6.7	88.2	11	9.1	18.2	72.7
JULY	29	3.5	24.1	72.4	7	0.0	28.6	71.4
AUG	14	7.1	14.2	78.6	3	33.3	33.3	33.3
SEPT	21	4.8	9.6	85.7	1	0.0	0.0	100.0
OCT	145	9.3	26.8	64.0	9	0.0	44.4	55.5
NOV	113	6.2	39.8	54.0	52	13.5	34.6	51.9
DEC	122	2.5	15.6	82.0	43	18.6	44.2	37.2

¹ Data not included because most animals were not weighed.

Table 4. Percent of juvenile (JUV), subadult (SAD) and adult (ADU) pine voles captured each month in an abandoned apple orchard near Roanoke, Virginia, from December, 1979, to December, 1981. Voles of questionable sex are not included.

MONTH	DEC, 1979-DEC, 1980				DEC, 1980-DEC, 1981			
	N	JUV	SAD	ADU	N	JUV	SAD	ADU
DEC	49	2.0	6.1	91.8	30	6.7	10.0	83.3
JAN	31	0.0 ¹	0.0 ¹	0.0 ¹	33	6.1	6.1	87.9
FEB	29	0.0	10.4	89.7	60	3.3	16.7	80.0
MARCH	47	0.0	17.0	83.0	64	4.7	7.8	87.5
APRIL	34	0.0	2.9	97.1	68	8.3	11.7	80.0
MAY	20	0.0	5.0	95.0	44	13.6	11.4	75.0
JUNE	29	6.9	3.5	89.7	21	13.3	13.3	73.3
JULY	15	6.7	33.3	60.0	3	0.0	33.3	66.7
AUGUST	1	0.0	100.0	0.0	1	0.0	0.0	100.0
SEPT	1	0.0	100.0	0.0	7	14.3	28.6	57.2
OCT	33	9.1	18.2	72.7	10	0.0	10.0	90.0
NOV	43	0.0	25.6	74.4	41	7.3	22.0	70.7
DEC	30	6.7	10.0	83.3	37	5.4	18.9	75.7

¹ Data not included because most animals were not weighed.

The dramatic decline in the pine vole population in the maintained orchard and the differences reported between the two orchard types may be due to several factors. In the maintained orchard a very poor apple crop in 1981, coupled with reduced vegetative cover, caused the apples on the ground to deteriorate much faster than in previous years. This may have produced an environment which could not support the high vole density found in the maintained orchard in 1980. A severe drought during the summer and fall of 1981 may also have had a greater impact on the population in the maintained orchard than in the abandoned orchard. Another explanation might be that successional changes in the vegetation are occurring in the maintained orchard since it is no longer being commercially managed (i.e. no insecticides, tree pruning or herbicides). Finally, it has never been determined if pine voles exhibit cyclic density fluctuations as do other species of microtines. In an optimum environment such as a maintained orchard pine voles may be cyclic. The population in 1980 may have reached a peak density with the decline phase following in 1981. The population density in the abandoned orchard was much more stable over the two year period, perhaps because the habitat is not as favorable for high reproductive output or survival. The vole population did decline in the summer of 1981 in the abandoned orchard, but this may be due to the extremely dry weather reducing either the population size or trappability.

Vegetation will be sampled in both orchards this spring and summer. Temperature and rainfall data will also be analyzed to determine if these factors were correlated with the decline in both orchards during the summer of 1981. Data which is currently being collected will be analyzed to provide more insight into body weight dynamics, seasonal reproduction and survival, and spatial dynamics of both pine and meadow vole populations in both orchards.

LITERATURE CITED

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