SEX AND AGE RATIOS, PRODUCTIVITY AND PARASITE PREVALENCE OF TRAPPED AND UNTRAPPED RACCOON POPULATIONS IN NORTHEAST KANSAS

by

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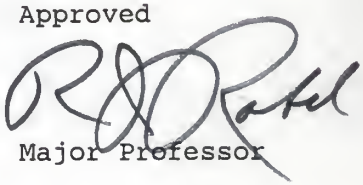

Major Professor

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INTRODUCTION

The raccoon (Procyon lotor) is a common furbearer throughout the United States of North America. P. lotor hirtus (Nelson and Goldman 1930) occurs in Kansas and is actively sought after by Kansas furharvesters. Kansas fur dealers purchased 56,136 raccoon pelts in 1985 from hunters and trappers (Fox 1985). Therefore, information concerning raccoon populations is economically and ecologically important.

Hunting has been found to substantially decrease raccoon numbers (Minser and Pelton 1982), while trapping appears less effective in controlling numbers (Atkeson and Hulse 1953). Although there has been no information published on the possible effects of trapping on raccoon populations, there is limited information regarding response of individuals (i.e. males, females, juveniles, adults) to trapping.

Moore and Kennedy (1985a) reported that adult males were recaptured more frequently than females or juveniles. This lends support to the idea that some heterogeneity in individual trappability may be due to variation in an individual's response to traps rather than variation in spatial distribution of raccoons to

traps. This could affect interpretation of data gathered from trapped raccoons.

The present study was undertaken to determine what, if any, differences occurred in sex and age ratios, productivity, and parasite prevalence between two populations of raccoons (trapped and untrapped) in northeast Kansas. One population sampled was from Fort Riley Military Installation (located approximately 25.7 km east of Manhattan, Kansas), which experiences low trapping pressure (no trapping is allowed; however, illegal trapping may occur to some extent). The second population experiences moderate to heavy trapping pressure and consisted of raccoons obtained from furharvesters trapping in the vicinity of Manhattan, Kansas.

LITERATURE REVIEW

Comprehensive studies of raccoon ecology have been conducted in Alabama (Johnson 1970), Kansas (Stains 1956) and Michigan (Stuewer 1943a), although most of the literature deals only with portions of the ecology of the raccoon. The author was unable to find any studies concerning the possible effects of trapping on raccoon populations.

Since it is usually not possible to directly measure how a population of animals reacts to certain pressures, various parameters can be used to indirectly assess the "health" of a population. These parameters include weight, sex and age ratios and productivity.

Johnson (1970) reported that weights of raccoons reached their maximum prior to the start of winter (October through December). In a 25-year study on raccoon populations in Illinois, no trend in the weight for males (either increasing or decreasing) was detected (Sanderson and Hubert 1981). Mean weights for adult males was 7.44 kg, juvenile males 5.12 kg, adult females (nulliparous) 6.38 kg, adult females (parous) 5.90 kg, and juvenile females 4.76 kg. Males always had a mean weight higher than females and the average weight of juvenile raccoons decreased with decreasing latitude (Sanderson and Hubert 1981). Moore and Kennedy (1985b) also found adult raccoons to be sexually dimorphic for

weight, males weighing approximately 1 kg more than females.

AGE AND SEX RATIOS

Several authors have examined age ratios of raccoon populations across the United States. Johnson (1970) reported 32% of 770 Alabama raccoons taken by steel traps were immature and concluded that steel traps were less biased toward juveniles than hunting with dogs. Combining all methods of capture, he reported 37% of the capture was comprised of juvenile animals. Sixty-five percent of raccoons trapped in Michigan were juvenile (Stuewer 1943a), while juveniles made up approximately 68% of an Illinois raccoon population (Sanderson and Hubert 1981). Soneshine and Winslow (1972) reported the age ratio of two raccoon populations in Virginia to be 27% juvenile and 29% juvenile, although they stated their samples were biased toward adults.

Caution must be taken when interpreting age ratio data. Caughley (1974) used simulated models to show a sudden rise or fall occurring equally across all age classes would not be detected in the age ratio. He states that age ratios are not adequate substitutes for relative or absolute density, and that age ratios often provide ambiguous information. Downing (1980) also cautions that it is difficult to interpret age ratios observed at any one time and indicates trapping samples

may be biased by the behavioral characteristics of certain age groups which could be manifested by movements or habitat use.

Still, age ratios are widely used and can provide useful information if carefully interpreted. Sanderson (1951) reported the raccoon population in Missouri was increasing between 1941 and 1949, as evidenced in the age ratio of males that went from 49% juvenile in 1941 to 56% juvenile in 1949. A knowledge of the relative size of each age class of females is also needed to interpret age-specific reproductive rates (Downing 1980).

Sex ratios have also been widely reported in the literature. Sex ratios are important in that they are essential to understand and interpret other population parameters which are expressed separately by sex. Sanderson and Hubert (1981) indicate that sex ratios are subject to a high degree of sampling variation. They suggest that reliable results can only be obtained by having a large sample size or sampling over long periods.

In earlier literature (e.g. Stuewer 1943b), sex ratios were reported as the number of males per 100 females. Downing (1980) suggests that sex ratios be expressed in percent, which gives males and females a common base. Additionally, Downing (1980) recommends

that sex ratios be measured periodically to determine if the sex ratio is within the range needed for normal reproductive performance.

Stains (1956) reported adult males in Kansas might slightly outnumber adult females in natural populations. At birth, the sex ratio of Kansas raccoons was approximately 1:1, while the ratio in the fall was 1.5 males : 1 female. Sanderson and Hubert (1981) also found a slightly greater percentage of males than females in Illinois raccoons. Fifty-two percent of the population they studied was comprised of males.

Males are generally more active and range over a greater area; therefore, they should be more subject to capture (Giles 1943, Johnson 1970, Moore and Kennedy 1985a). Johnson (1970) found that 62% of the Alabama raccoons were male when all methods of capture were combined. Steel traps were more biased toward males (64%), while the sex ratio of raccoons taken by hunting was more evenly divided with 56% of the capture being male. Sanderson (1951) reported that the method of capture in Missouri was not selective for sex. He found that trappers took in 59% males and hunters 62% males. A seasonal bias was noted by Johnson (1970) with males being more active during February and March because of increased visitation to females and also during May and June due to decreased activity of pregnant and lactating

females.

Reports of percent males in fall raccoon populations include: Tennessee 52% (Moore and Kennedy 1985b), Virginia 62% and 55% (Sonenshine and Winslow 1972), and Connecticut 51%, 52% and 60% (McComb 1981). On Swan Lake National Wildlife Refuge in Missouri, Sanderson (1951) found only 65 males to 100 females, while in other areas sexes were nearly equal or there were slightly more males than females. This was explained by the fact that males possess greater motility than females and probably moved out of the refuge when pursued while the less mobile females remained in the nonhunted areas (Sanderson 1951).

PRODUCTIVITY

Another important population parameter is productivity. In Kansas, matings occur from December to June, with the height of the mating season occurring in mid-February (Stains 1956). In other areas of the United States, the breeding season ranges from the first week in February to the first week in August (McKeever 1958, Johnson 1970, Fritzell 1978). There have been reports of litters occurring as early as mid-March in Michigan (George and Stitt 1951), and as late as mid-September in Indiana (Lehman 1968). The gestation period is 63 days (Stuewer 1943b).

There have been varying reports on what proportion

of yearling animals are sexually active. Sanderson (1950) stated that when the penis becomes extrudible, males can be sexually active. Males have bred successfully as yearlings (Pope 1944), but they become sexually potent three to four months later in the year than do older adult males (Stuewer 1943b, Sanderson 1951, Johnson 1970, Sanderson and Nalbandov 1973). Fritzell (1978) suggested that in North Dakota, yearling males are not sexually active.

Fifty percent of Michigan yearling females were found to reproduce (Stuewer 1943a, 1943b) as well as 50% of female yearlings in Kansas (Stains 1956). Johnson (1970) reported that less than 10% of the yearling females in Alabama produce young. Other authors also indicate reproduction takes place in yearling females (Pope 1944, Sanderson and Nalbandov 1973). Stuewer (1943b) remarked that it was exceptional for an adult female not to raise a litter.

Litter size is a way of measuring productivity in raccoons. Most litters have been reported to range from 2 to 7 (Table 1). The raccoon placenta is deciduous and endotheliochorial (Sanderson and Nalbandov 1973). An embryo that reaches one month of age is represented by an area of pigmentation, called a placental scar, that persists for 10 or more months (Sanderson and Nalbandov 1973). Placental scars have been found to be a fairly

Table 1. Reported litter sizes of raccoons from different locations in the United States.

Location	Litter Size		Source
	Range	Mean Size	
Alabama	2-3	2.40	Johnson 1970
Connecticut	not given	1.4	McComb 1981
Florida	2-5	3.2	McKeever 1958
Illinois	1-6	3.58	Fritzell et al. 1985
Kansas	4-7	4.6	Stains 1956
Michigan	3-7	4	Stuewer 1943a, 1943b
Missouri	1-10	2.66	Fritzell et al. 1985
North Dakota	not given	4.8	Fritzell 1978
Oregon	not given	2.6	Fiero and Verts 1986a

accurate indicator of the number of young produced (Sanderson 1950) and, if used with caution, are useful for estimating litter size and rate of productivity (Sanderson and Nalbandov 1973).

Ways of interpreting placental scars are variable. Sanderson and Nalbandov (1973) stated that the significance of multiple groups of scars (varying in intensity) is unclear and that placental scars apparently persist longer in wild females than in their captive counterparts. In the uteri, single groups of scars in the uteri and groups of dark scars (when two or more groups were present) were assumed to reflect the implantation rate or average litter size for the preceding breeding season (Sanderson and Hubert 1981). Dark placental scars may be visible on the outside of the uterine horns. These are considered scars from the most recent breeding season and are thought to persist as dark scars for one year (Sanderson 1950). Scars from earlier reproductive seasons (light or old scars) do not show on the outside since the pigment is confined to the mucosa (Sanderson 1950).

Junge and Sanderson (1982) found that 73% of the yearling females had placental scars and that almost 30% had two sets of scars (light and dark). This suggested that 30% of the first litters were unsuccessful and that females may have mated a second time. Also, a

relatively low percentage of older females with two sets of scars indicated that all groups of scars do not persist from one year to the next and not all light scars are from the previous year (Junge and Sanderson 1982). Studies using placental scar information usually use the darkest set of placental scars to calculate mean litter size (Fiero and Verts 1986a, Fritzell et al. 1985). Johnson (1970) evaluated litter sizes using dark scars, old scars and a combination of both, resulting in slightly different average litter sizes of 2.46, 2.38 and 2.43, respectively.

AGING RACCOONS

As mentioned, the age of raccoons in a population can also be a source of important information. Numerous methods have been developed to determine age in raccoons. Body weight, degree of ossification of the epiphyseal cartilage of the radius and ulna, tooth attrition, size and degree of ossification of the baculum (male) and condition of the nipples (female) have all been used (Petrides 1950, Petrides 1959, Sanderson 1961b, Johnson 1970, Grau et al. 1970, Fiero and Verts 1986b). These methods enable the researcher only to distinguish adults from juveniles. Grau et al. (1970) stated that tooth wear may not be reliable on an individual basis and Fiero and Verts (1986b) could not recommend it for separation of individuals other than

juvenile from adults.

Other methods are used to age the animals more precisely. Sanderson (1961a) found that the eye lens was useful in determining the month of birth for animals less than 12 months old. The sequence of deciduous and permanent tooth eruption was employed by Montgomery (1964) to age raccoons up to approximately 3 1/2 months of age. In animals older than three months, Junge and Hoffmeister (1980) used cranial suture obliteration and suggested that the technique may be used in conjunction with other methods to increase its accuracy. Grau et al (1970) found that the presence or absence of canine root foramina indicates a raccoon is a juvenile (open foramen) or adult (Grau et al. 1970) and has been used in other furbearers (Kuehn and Berg 1981, Kuehn and Berg 1983, Root and Payne 1984).

Various studies have employed the use of radiographs of canine teeth to obtain pulp cavity measurements (Churcher 1960, Johnson et al. 1981, Kuehn and Berg 1981, Tumlison and McDaniel 1981, Fredrickson 1981, Kuehn and Berg 1983, Fuller et al. 1984). There is some disagreement as to what information on age radiographs can actually contribute. Dix and Strickland (1986) concluded radiographs could distinguish adults from juveniles, but could not distinguish older animals. Jenks et al. (1986) determined radiographs were able to

distinguish four year-classes: juvenile, I, II, and III or older.

Age determination in raccoons and other furbearers has also been accomplished through analysis of cementum annuli. Canine teeth were used in determining the age of badgers (Taxidea taxas) (Crowe and Strickland 1975), striped skunk (Mephitis mephitis) (Casey and Webster 1975), coyotes (Canis latrans) (Linhart and Knowlton 1967), and raccoons (Kremke 1983). Grau et al. (1970) used raccoon incisor roots for histological preparations and Johnson (1970) used the fourth premolar and first molar of raccoons. In Oregon, Fiero and Verts (1986b) found raccoons did not have cementum annuli during their first two winters of life. Grau et al. (1970) reported that using cementum layers is reliable for aging specimens less than 60 months old. Ages of animals older than four years tended to be underestimated.

PARASITES

Parasites of the raccoon have been extensively studied. Evaluating gastro-intestinal parasites from populations experiencing different influences or pressures (e.g. high trapping versus low trapping pressure) may provide information indicating the health of the populations. Stains (1956) provided a summary of raccoon parasites reported in the literature up to the year 1956. Several parasites were probably incorrectly

identified or have been renamed since that time. Additional parasites have also been identified since 1956 (Table 2).

Table 2. Gastro-intestinal helminths reported from the raccoon (*Procyon lotor*).

Parasite	Location[a]	Source(s)
ACANTHOCEPHALA		
Macracanthorhynchus ingens	SI, LI, R	2,3,4,6,11,17, 25,26,31,34, 38,42,46,47, 50,55,59,60
CESTODA		
Atriotaenia procyonis (= *Oochoristica procyonis*)	SI, LI	2,3,4,6,12,17, 20,26,28,31, 34,35,47,48, 50,51,59,60
Hydatigera taeniaeformis	SI	6
Mesocestoides spp.[b]	SI, LI	2,3,4,6,12,13, 16,17,26,30, 38,43,50,59, 60
Spirometra mansonoides	SI	26
NEMATODA		
Ancylostoma caninum	SI	15
Arthrocephalus lotoris (= *Placoconus lotoris*)	SI	2,3,4,12,17, 23,25,26,31, 34,35,38,39, 47,50,54,59, 60
Baylisascaris procyonis[c]	S, SI GI, LI	2,3,4,6,10,17, 19,32,33,35, 38,39,43,48, 50,59,60,61, 62,64,65

Table 2. Raccoon gastro-intestinal helminths (continued).

Parasite	Location[a]	Source(s)
NEMATODA cont'd		
Capillaria spp.[d]	E, S, SI	17,26,31,45, 50,60
Cosmocephalus spp.	LIV	26
Gnathostoma procyonis[e]	S, GI	1,2,3,4,11,12, 17,23,25,26, 31,34,47,50, 59,60
Gongylonema pulchrum	E	50
Heterakis spp.	GI	50
Molineus barbatus	SI	2,3,12,17,26, 31,34,49,50, 59,60
Physaloptera spp.[f]	E, S, SI	2,3,4,6,17,23, 25,26,28,30, 31,34,35,43, 47,48,49,50, 51,59,60
Porracaecum decifens	S	39
Strongyloides spp.	GI	50
Synhimantus spp.	GI, SI	12,50

Table 2. Raccoon gastro-intestinal helminths (continued).

Parasite	Location[a]	Source(s)
TREMATODA		
Alaria marcianae[g]	SI	28,56,57,58
Amphimerus speciousus	LIV	58
Apophallus venustus	SI	2,26,50,57
Ascocotyle spp.[h]	SI	23,25,26,41, 52
Brachylaemus pellucidum	SI	39
Brachylaima virginianum	SI	17,50
Carneophallus spp.[i]	GI, SI	7,23,25,26, 34,36,50,58
Euparyphium beaveri	SI	3,26,50,60
Euryhelmis squamala	SI	2,3,17,26,44
Eurytrema procyonis	P, SI	2,3,12,17,18, 26,27,31,49, 50
Fibricola spp.[j]	SI	2,3,4,12,14, 17,23,25,26, 29,43,49,50, 58,60
Gyrosoma singulare (= *Grysoma singularis*)	SI	9,17,26,57, 58,60
Gynaecotyla adunca	SI	23,25,26,50
Isthmiophora melis	SI	58
Linstowiella szidati	SI	58
Lyperosomum sinuosum	P, SI	2,23,25,26

Table 2. Raccoon gastro-intestinal helminths (continued).

Parasite	Location[a]	Source(s)
TREMATODA cont'd		
Maritrema spp.	GI	23
Maritreminoides nettae	SI	17,25,26,57, 58
Mesostephanus appendiculatoides	SI	17
Metagonimoides oregonensis	SI	2,17,26,49, 50,66
Metorchis conjunctus	LIV	50
Microphallus opacus	SI	28,48,58
Parallelorchis diglossus	SI	2,24,26,50
Parametorchis complexus	LIV, SI	26,50,57
Phagicola spp.[k]	SI	23,25,26,63
Pharyngostomoides procyonis[l]	SI	2,3,4,5,8,12 17,21,23,25, 26,28,31,40, 49,50,57,58
Plagiorchis spp.[m]	LIV, SI	28,50
Procyotrema marsupiformis	P	22,26,37,50
Prosthodendrium naviculum	SI	26,67
Ribeiroia ondatrae	E, S	50
Sellacotyle mustelae	SI	23,26,49
Stephanoprora spinosa	SI	50

Table 2. Raccoon gastro-intestinal helminths (continued).

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[a] E = esophagus, GI = gastro-intestinal tract, LI = large intestine, LIV = liver, P = pancreas, R = rectum, S = stomach, SI = small intestine.

[b] includes *Mesocestoides lineatus* and *M. variabilis*.

[c] includes *Baylisascaris columnaris* (= *Ascaris columnaris*), which are probably misidentifications.

[d] includes *Capillaria mustelorum*, *C. procyonis*, and *C. putorii*.

[e] includes reports of *Gnathostoma spinigerum*, which may be a misidentification.

[f] includes *Physaloptera maxillaris*, *P. rara*, and *P. turgida*.

[g] includes *Alaria mustelae*, which may be a misidentification.

[h] includes *Ascocotyle ampullacea*, *A. leighi*, and *A. pachycystis*.

[i] includes *Carneophallus basodactylophallus*, *C. choanophallus*, and *C. turgida*.

[j] includes *Fibricola cratera*, *F. lucida*, and *F. texensis*.

[k] includes *Phagicola angrensis*, *P. dimiuta*, and *P. longa*.

[l] includes *Pharyngostomoides adenocephala*, which may be a misidentification.

[m] includes *Plagiorchis elegans* and *P. muris*.

Table 2. Raccoon gastro-intestinal helminths (continued).

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1. Ash 1960.
2. Babero and Shepperson 1958.
3. Bafundo et al. 1980.
4. Barnstable and Dyer 1974.
5. Beckerdite et al. 1971.
6. Boddicker and Progulske 1968.
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8. Butterworth and Holmes 1984.
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10. Carlson and Nielsen 1984.
11. Chandler 1941.
12. Chandler 1942a.
13. Chandler 1942b.
14. Chandler 1942c.
15. Chitwood 1932.
16. Coatney 1936.
17. Cole and Shoop 1987.
18. Denton 1942.
19. Dubey 1982.
20. Gallati 1959.
21. Harkema 1942.
22. Harkema and Miller 1959.
23. Harkema and Miller 1961a.
24. Harkema and Miller 1961b.
25. Harkema and Miller 1962.
26. Harkema and Miller 1964.
27. Herman et al. 1957.
28. Hoberg and McGee 1982.
29. Hoffman 1955.
30. Ingram 1941.
31. Johnson 1970.
32. Jones and McGinnes 1983.
33. Jones et al. 1978.
34. Jordan and Hayes 1959.

Table 2. Raccoon gastro-intestinal helminths (continued).

35. Leigh 1940.
36. Leigh 1958.
37. Locke and Brown 1965.
38. McComb 1981.
39. McNeil and Krogsdale 1953.
40. Miller 1981.
41. Miller and Harkema 1962.
42. Moore 1946.
43. Morgan and Waller 1940.
44. Parker 1950.
45. Pence 1975.
46. Penner 1954.
47. Price and Harman 1983.
48. Rausch 1946.
49. Sawyer 1958.
50. Schaffer et al. 1981.
51. Schiller and Morgan 1949.
52. Schroeder and Leigh 1965.
53. Schwartz 1925.
54. Senger and Neiland 1955.
55. Shoemaker 1966.
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57. Shoop and Corkum 1981.
58. Shoop and Corkum 1982.
59. Smith et al. 1985.
60. Snyder and Fitzgerald 1985a.
61. Snyder and Fitzgerald 1985b.
62. Snyder and Fitzgerald 1987.
63. Sogandares-Bernal and Bridgman 1960.
64. Stains 1956.
65. Stone 1983.
66. Wallace and Wilson 1965.
67. Williams 1961.

METHODS

Animals

Raccoons were trapped between 9 November 1986 and 13 December 1986 in Clay, Geary, Pottawatomie, and Riley counties, Kansas. All animals were skinned prior to evisceration and any body parts collected were stored frozen until further examination.

Study Areas

The Fort Riley Military Installation is a 40,874 hectare tract of land in Geary and Riley counties on the western edge of the flint hills of Kansas. Old fields comprise 35% of the area, while grasslands, woodlands, and shrublands make up 30, 18, and 15% respectively. Approximately 2% of the land area is cropland (Klinger 1983).

Raccoons are commonly associated with the numerous drainages occurring on Fort Riley. Dry, Madison, Farnum, and Three-Mile creeks were four drainages selected for raccoon trapping (Figure 1). Traps used were 1 3/4 Montgomery coil-spring and 1 1/2 Victor long-spring traps. Trapping occurred in the Madison and Dry creek drainages from 9 to 16 November 1986, while Farnum and Three-Mile creeks were trapped from 1 to 13 December 1986 (Table 3).

Raccoon carcasses were also collected from drainages not on Fort Riley. Carcasses were obtained

Figure 1. Fort Riley Military Installation raccoon trapping locations, Fall 1986.

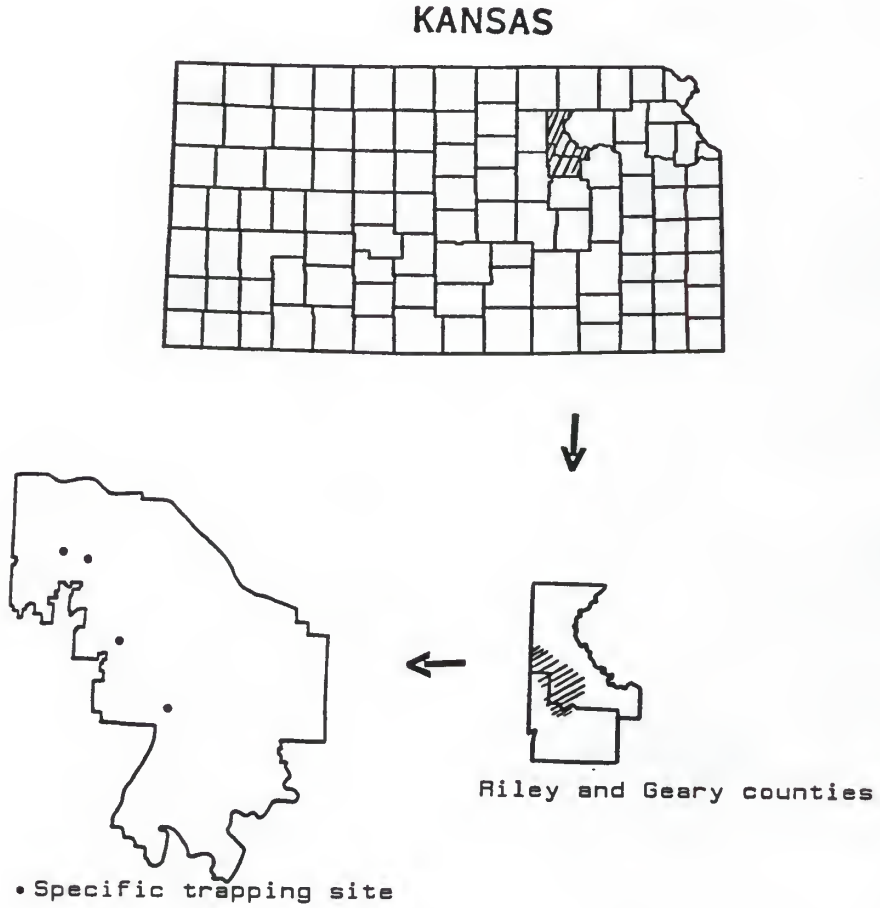
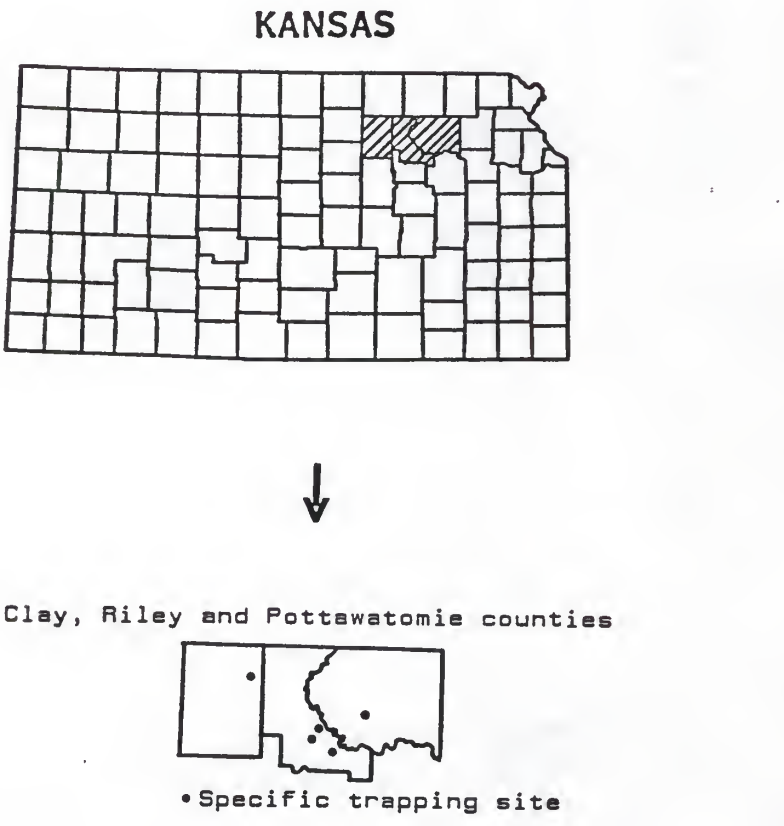


Table 3. Number and sex of raccoons trapped on the Fort Riley Military Installation, fall 1986.

Drainage	Trapping period	Trap nights	Raccoons caught		
			Male	Female	Total
Dry Creek	9-16 Nov.	50	1	7	8
Madison Creek	9-16 Nov.	558	6	8	14
Farnum Creek	1- 6 Dec.	227	3	5	8
Three-mile Creek	4-13 Dec.	459	4	2	6
TOTALS			14	22	36

from five local trappers from creeks and the Kansas River in or around Manhattan, Kansas (Figure 2). Creeks trapped include Fancy Creek, Rock Creek, Little Kitten Creek and Phiel Creek. The vegetation and terrain of these areas was similar to the Fort Riley trapping locations. The Kansas River was the only major drainage trapped and habitat may be slightly different from the smaller drainages used in this study.

Figure 2. Raccoon trapping sites located off Fort Riley Military Installation, fall 1986.



COLLECTION OF INFORMATION FROM CARCASSES

Carcasses obtained from Fort Riley were weighed before they were skinned. Skinned carcasses from local furtappers were not weighed. All carcasses were necropsied at the College of Veterinary Medicine's Clinical Science building at Kansas State University. Protective clothing, rubber boots and gloves were worn at all times during necropsies.

Skinned carcasses were placed ventral side up on a stainless-steel table, with the head oriented away from the person performing the necropsy. Sex was preliminarily determined by the presence or absence of external genetalia and confirmed by direct gonadal inspection.

Excess subcutaneous fat was removed from the underbelly. Muscle in the inguinal region was grasped and pulled away from the body cavity to protect internal organs from the initial incision. Straight-blade blunt-end scissors were used to make the cut from the inguinal area anteriorly along the ventral midline to the sternum. The edges of the diaphragm attached to the body wall were cut to allow for easier removal of the digestive tract.

Bone shears were employed to cut through the sternum and ribcage. A straight-blade knife was used to continue the incision from the throat area alongside the

trachea and esophagus anteriorly to the glottis. Muscles surrounding these two tubes were cut away until the trachea was fully exposed. The trachea and esophagus were pulled away from the throat and were severed where they joined the back of the mouth. The trachea and esophagus were seperated manually and the membranes joining the two were sliced with a straight-blade knife. Care was taken to ensure that neither tube was damaged in the separation process.

The trachea, heart and lungs were then removed from the body cavity. At this time, taking blood from the raccoons trapped on Fort Riley Military Installation was attempted (four to six hours after death). The heart was cut open and blood was removed from the heart and thoracic cavity. Blood was placed into vaccutainers and refrigerated. In some instances, the blood had already coagulated by the time of evisceration and was impossible to collect. No blood samples were taken from raccoon carcasses coming from locations other than the Fort Riley Military Installation.

If the bladder was full it was either emptied or tied off and removed at this point to facilitate the removal of the gastro-intestinal tract. Before continuing with evisceration in females, the reproductive tract was located. Ligaments or membranes connecting the ovaries, uterine horns and uterine body

to the rest of the internal organs were severed. The cervix was located and the vagina cut posteriorly to ensure the entire uterine body was collected. The uterine horns were opened by cutting from the tubo-uterine junction anteriorly to the base of the ovary. Placental scars were counted and recorded. The entire reproductive tract was stored in a plastic bag and frozen.

The esophagus was pulled gently through the diaphragm and any connections of the stomach with the diaphragm were cut. The stomach, esophagus and small intestine were taken out of the body cavity. Any extraneous lattice work of fat was also removed at this time. The pelvic bone was severed with bone shears,and the hind legs were pulled apart to expose the rectum. A sample of fecal material was taken from the rectum with a cotton swab and placed in a vial of 10% buffered formalin. To facilitate a more thorough examination of the gastro-intestinal tract at a later date, the mesentary was stripped away from the small intestine by holding a straight-blade knife against the small intestine and pulling the tract gently away from the knife. The gastro-intestinal tract was frozen in a plastic bag.

The tongue and other muscles surrounding the lower jaw were dissected until the jaw could be pried open.

The lower jaw was seperated from the rest of the skull by cutting the bone directly above the last molar with bone shears. In some instances, it was impossible to collect the lower jaw because the lower canines were not present. The upper jaw was substituted for the lower jaw in these cases.

The gastro-intestinal tracts, female reproductive tracts and jaws were frozen at -5 C for one to three months. Further analysis was then conducted.

Population Information

Raccoon lower jaws were placed in a pressure cooker and boiled for approximately two hours to remove extraneous tissue. Both canine teeth were then extracted and air dried for two hours. After drying, age-class (juvenile or adult) was determined by examining the canine root foramina. An open root foramen was considered to be from a juvenile animal and a completely closed foramen from an adult (Grau et al 1970).

One canine tooth from each adult was sent to Matson's (Box 308, Milltown, Montana) for aging by cementum annuli into one of four year-classes (I, II, III, or IV+). The other canine tooth from each adult was examined using radiographs. One hundred twenty eight teeth were placed on two 27.9 x 35.6 cm pieces of mounting board using transparent tape. Each board was divided into 66 3 x 4 cm cells with one tooth placed in each cell. Juvenile teeth that had split during drying were not used. Radiographs were made on Cronex 7 high-plus Quanta III film, exposed at 200 mA for 0.005 seconds at a 46 Kv peak. Exposures were made at 40 cm with a Picker GX 600 machine with no added filters. The radiographs were developed and examined visually. It was determined, however, that no additional information regarding age could be obtained from examining the

radiographs.

After freezing, uteri were thawed, re-examined and implantation sites were differentiated into light and dark scars. Dark scars were more complete, more distinct, and darker in color than the light scars. Dark scars were considered to be from the most recent breeding season. Scar counts were later verified by independent experts.

Fecal samples were stained with Lugol's iodine, and microscopically examined for the presence Giardia spp. and other helminth eggs. The presence or absence of unsporulated Eimeria spp. oocysts, oocysts of Sarcocystis spp. and Cryptosporidium parvum, and some helminth eggs were noted by fecal flotation in a concentrated sucrose solution (sp. gr. 1.18).

Gastro-intestinal tracts were thawed for 12 hours prior to examination. The esophagus was then seperated from the stomach, cut longitudinally through its orifice, and examined for parasites. Any parasites collected were placed in 10% buffered formalin. The stomach was disjoined from the small intestine after confirming that no parasites would be severed during the process of separation. Stomach contents and mucosal scrapings were preserved in 10% buffered formalin.

The junction of the small and large intestine was determined and the two organs were disjoined from each

other. The small intestine was then divided into three sections to facilitate the flushing of its contents. Contents were manually removed, after which each section was cut longitudinally and the mucosa scraped with a knife. Both the small intestine mucosa and contents were placed in 10% buffered formalin.

The stomach contents, small intestine contents, and mucosa were each emptied separately into a 30-mesh sieve with an opening width of 0.052 cm. Contents and mucosa were gently washed with water, placed in a glass petri dish and examined for parasites under a dissecting microscope. Parasites were preserved in 10% buffered formalin.

Cestode and trematode parasites were stained using Semichon's acetocarmine stain. The stain was prepared by heating 50 ml water, 50 ml glacial acetic acid, and 1 g carmine to 95 C for 20 minutes in a boiling water bath. The solution was then cooled to room temperature and filtered through #1 Whatman filter paper. The filtrate was measured, and an equal amount of 70% ethanol (EtOH) was added (Pritchard and Kruse 1982).

Trematodes and cestodes were placed directly in Semichon's stain for 20 minutes and then rinsed in 70% ethanol for five minutes. The parasites were briefly destained briefly in acid alcohol (70% EtOH and 1 N HCl) prior to additional drying in 95% EtOH for five minutes

and 100% EtOH for 10 minutes. The worms were then placed in toluene for five minutes. Trematodes were mounted whole on the slide using permount and a coverslip.

Cestodes were cut into three representative segments with a razor, one sement containing the scolex, one a mature proglottid, and the other gravid proglottids. Cestodes were identified without staining after several distinguishing characteristics were discovered from the stained worms. Nematodes were identified either under a binocular microscope or using a wet mount.

Statistical analyses were aided by the use of the SAS software package. Tests of significance to detect whether or not population means or proportions were different employed Chi-square, Student's t and F values. When population means appeared to be different, further separation of means was studied using Fisher's protected LSD. The probability of rejected null hypotheses when true was set at $p = 0.05$ for all tests.

RESULTS

One hundred and twenty-eight raccoons were collected (36 from Fort Riley and 92 from off-Fort locations). Raccoon weights from the Fort Riley Military Installation (herein referred to as the Fort population) were not significantly different between the sexes (males = 7.85 kg, females = 7.04 kg). However, adults (8.61 kg) were significantly heavier than juveniles (4.12 kg). Mean weights for adult males (9.82 kg), adult females (8.07 kg), juvenile males (5.24 kg), and juvenile females (2.45 kg) were also significantly different (Table 4). Mean body weight for parous females (8.20 kg) was not significantly different than nulliparous females (7.60 kg).

The proportion of males (39%) and females (61%) in the Fort population was not significantly different from the proportion of males (47%) and females (53%) in the sample obtained from local furtrappers (herein referred to as the off-Fort population) (Figure 3). The Fort population contained significantly more adults (72%) than the off-Fort population (38% adults) (Figure 4).

The Fort population consisted of 22% male adults, 50% female adults, 17% male juveniles, and 11% female juveniles (Figure 5). The proportions of the off-Fort raccoons were significantly different (14, 24, 33, and 29 %, respectively). Juveniles comprised 18.2% of the

Table 4. Mean weights for raccoons taken from Fort Riley Military Installation, fall 1986 (weights are means ± 1 SE).

Sex/Age-Class	Number	Weight (kg)
SEX		
Males (adult, juvenile)	14	7.85 ± 0.73A[a]
Females (adult, juvenile)	22	7.04 ± 0.50A
AGE-CLASS		
Adults (male, female)	26	8.61 ± 0.27A
Juveniles (male, female)	10	4.12 ± 0.54B
SEX/AGE-CLASS		
Adult Male	8	9.82 ± 0.61A
Adult Female	18	8.07 ± 0.19B
parous	14	8.20 ± 0.19B
nulliparous	4	7.60 ± 0.47B
Juvenile Male	6	5.24 ± 0.43C
Juvenile Female	4	2.45 ± 0.41C

[a] Means followed by the same capital letter within a sex/age category are not significantly different.

FIGURE 3. SEX COMPOSITION OF TWO RACCOON POPULATIONS COLLECTED IN FALL, 1986

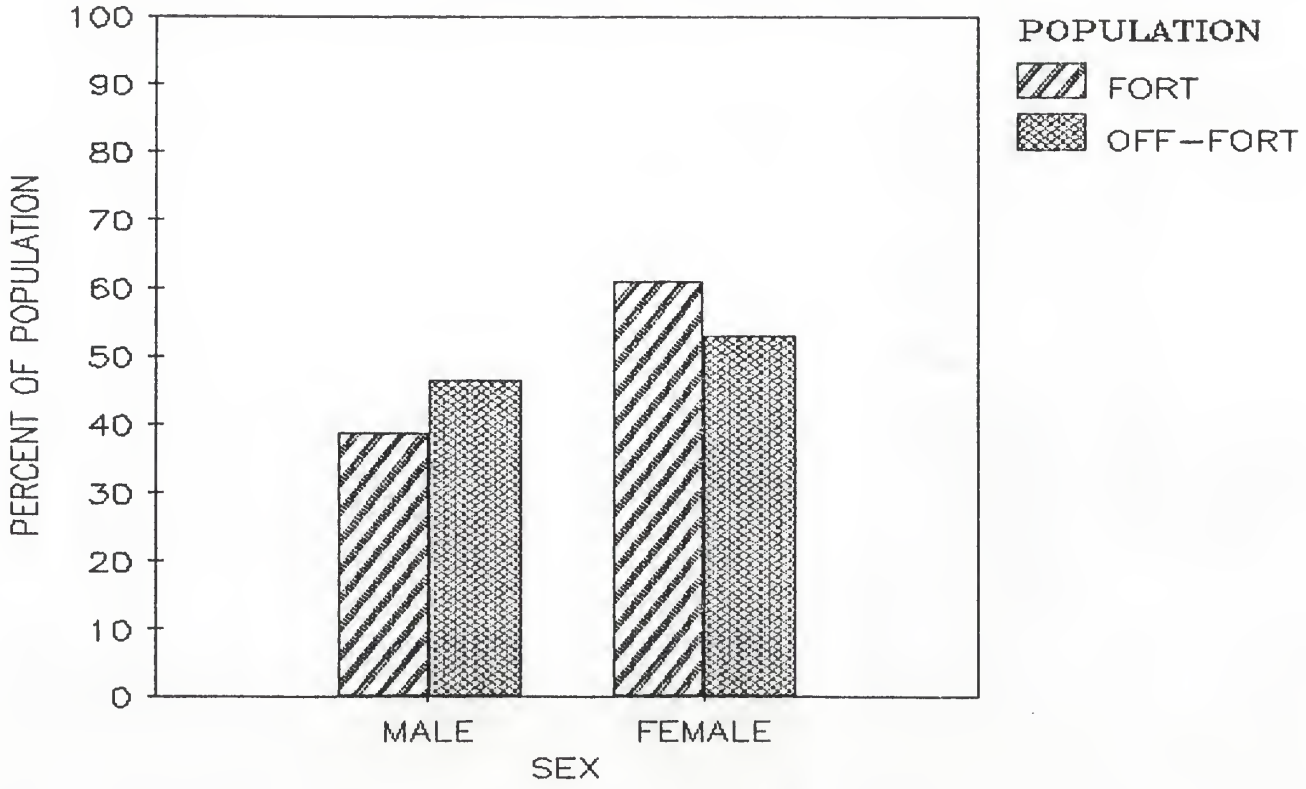
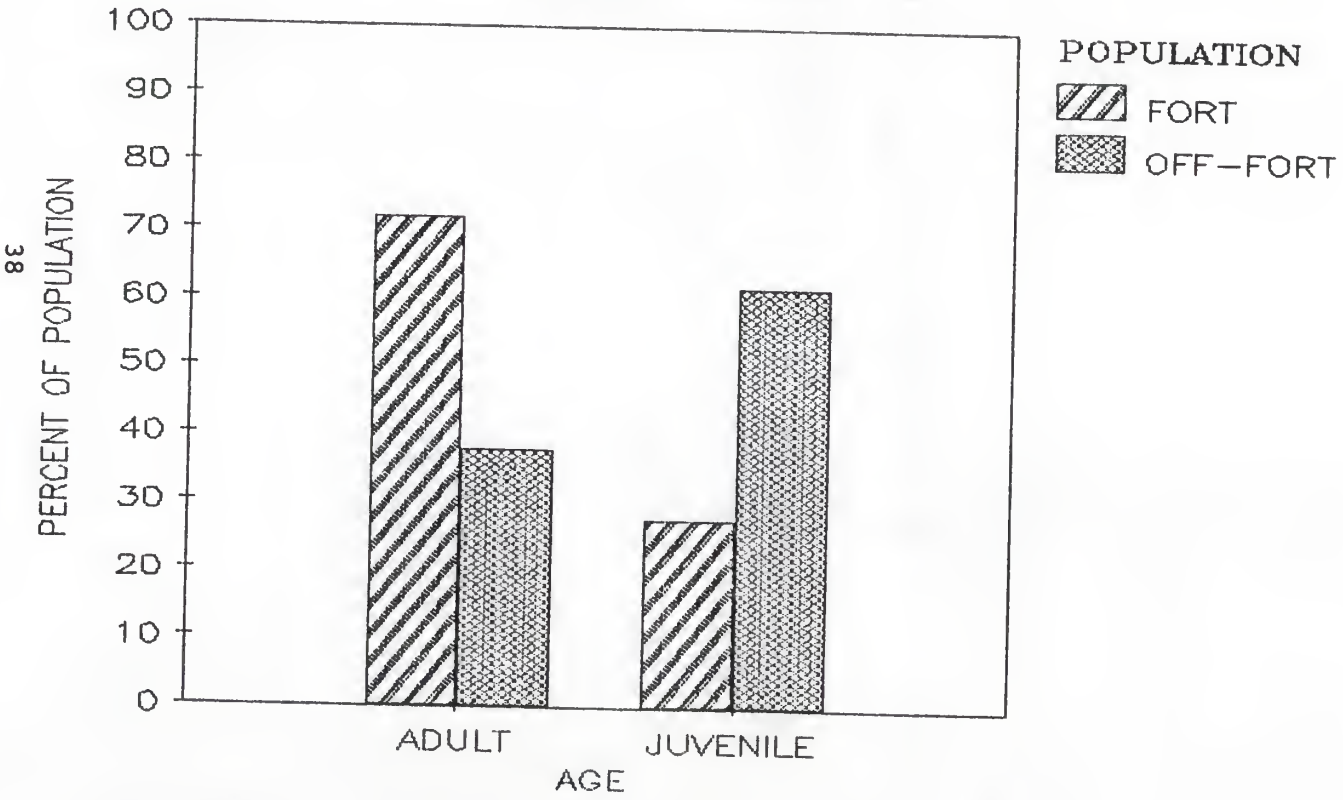


FIGURE 4. AGE COMPOSTION OF TWO RACCOON POPULATIONS COLLECTED IN FALL 1986.



females in the Fort population, which was significantly less than 55.1% juveniles of the females from the off-Fort population. The proportion of males that were juveniles was not signficantly different between the two populations (Fort = 43% , off-Fort = 70%).

There was no significant difference between the proportion of individuals of year-class I in the two populations (Figure 6, 7). However, the proportion of raccoons in year-classes III and IV+ was significantly higher from the Fort population (year-class 3 = 19.4%, 4 = 25.0%) than from the off-Fort population (3 = 3.3%, 4 = 8.7%). When the year-class information was analyzed by sex, the two populations were not significantly different (Figures 8, 9). Analyzing year-class composition within each population indicated no significant differences between the sexes (Figures 10, 11).

A female was considered parous if there were placental scars (light, dark, or both) in the uterus. The proportion of adult females in the Fort population exhibiting one or more dark placental scars (44.4%) was significantly less than the off-Fort population (81.8%). When both light and dark scars were considered, the percentage of adult females in the off-Fort population with scars did not change, but the Fort population increased to 78.8% (not significantly

FIGURE 5. SEX/AGE-CLASSES FOR TWO RACCOON POPULATIONS COLLECTED IN FALL, 1986.

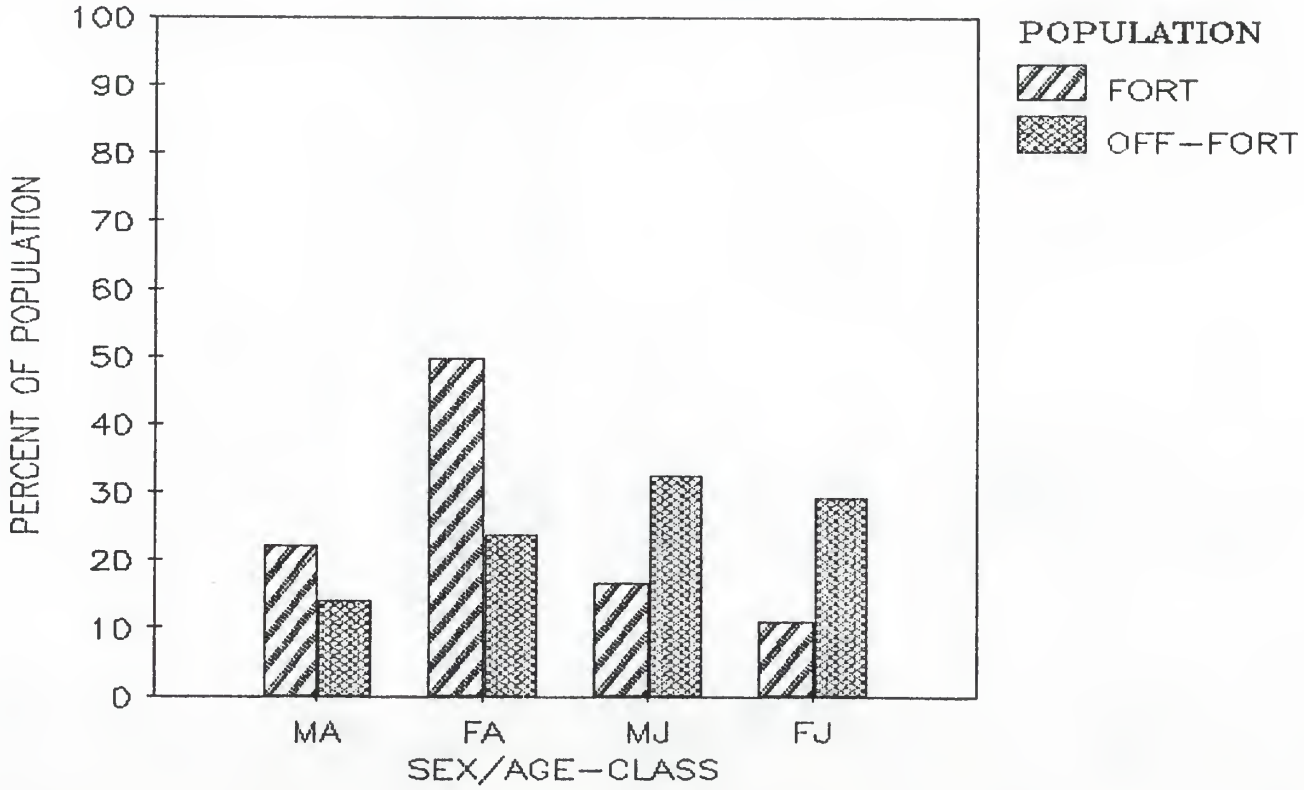


FIGURE 6. YEAR-CLASS STRUCTURE FOR TWO RACCOON POPULATIONS, FALL 1986

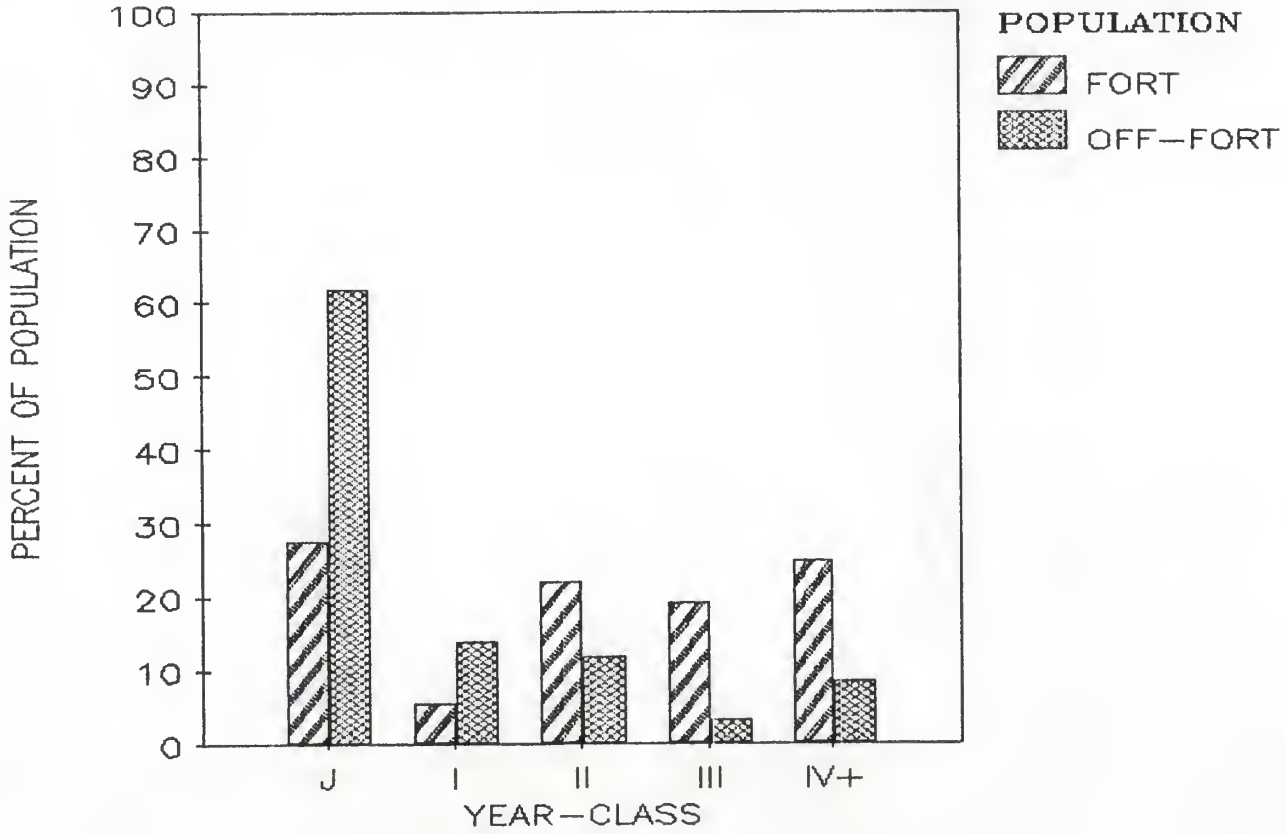


FIGURE 7. CUMULATIVE PERCENT OF RACCOONS AS A FUNCTION OF YEAR-CLASS FOR TWO POPULATIONS, FALL 1986

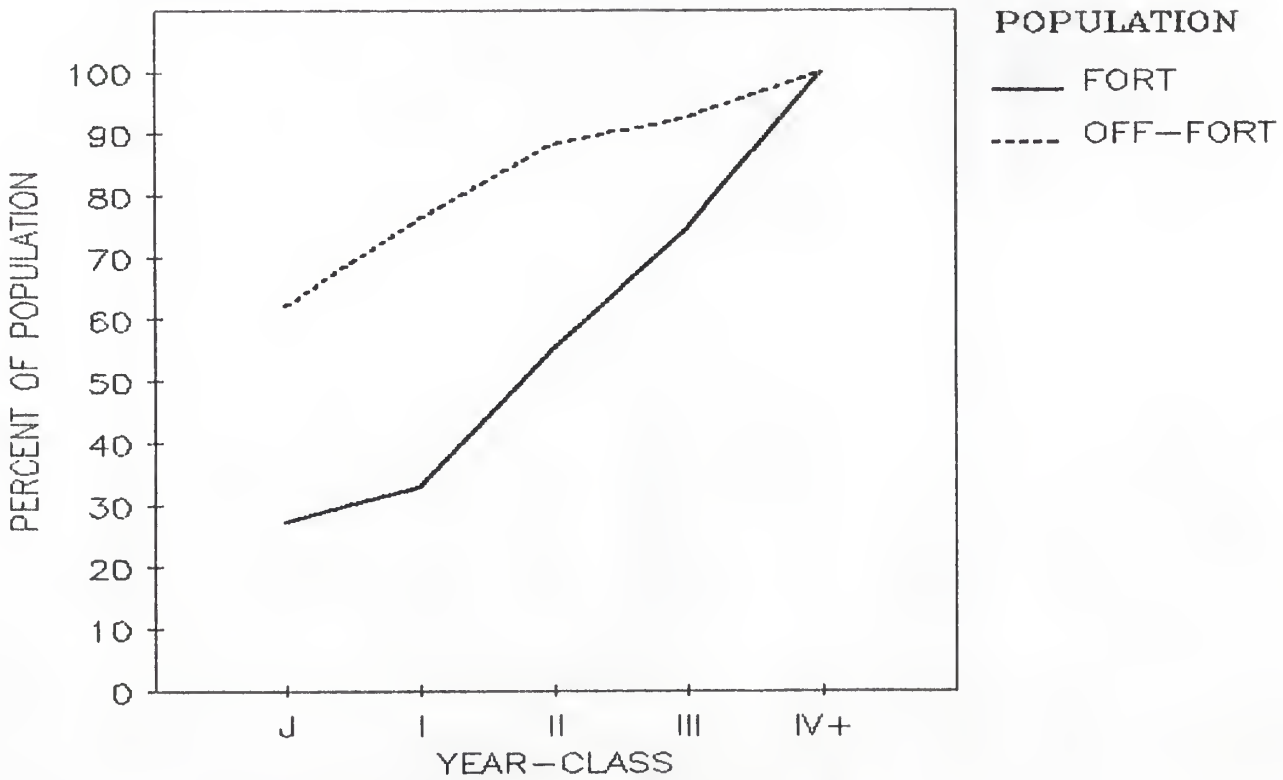


FIGURE 8. YEAR-CLASS STRUCTURE FOR FEMALE RACCOONS FROM TWO POPULATIONS, FALL 1986

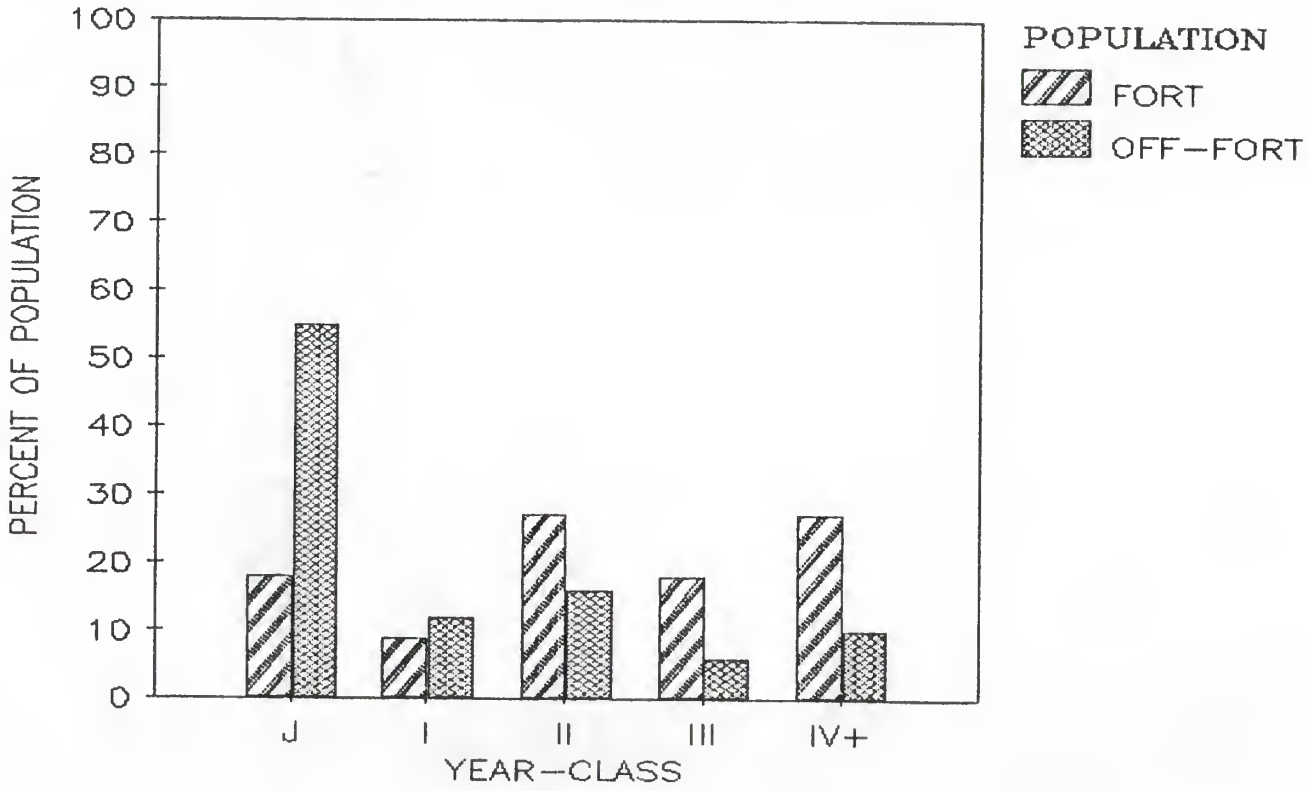


FIGURE 9. YEAR-CLASS STRUCTURE FOR MALE RACCOONS FROM TWO POPULATIONS, FALL 1986

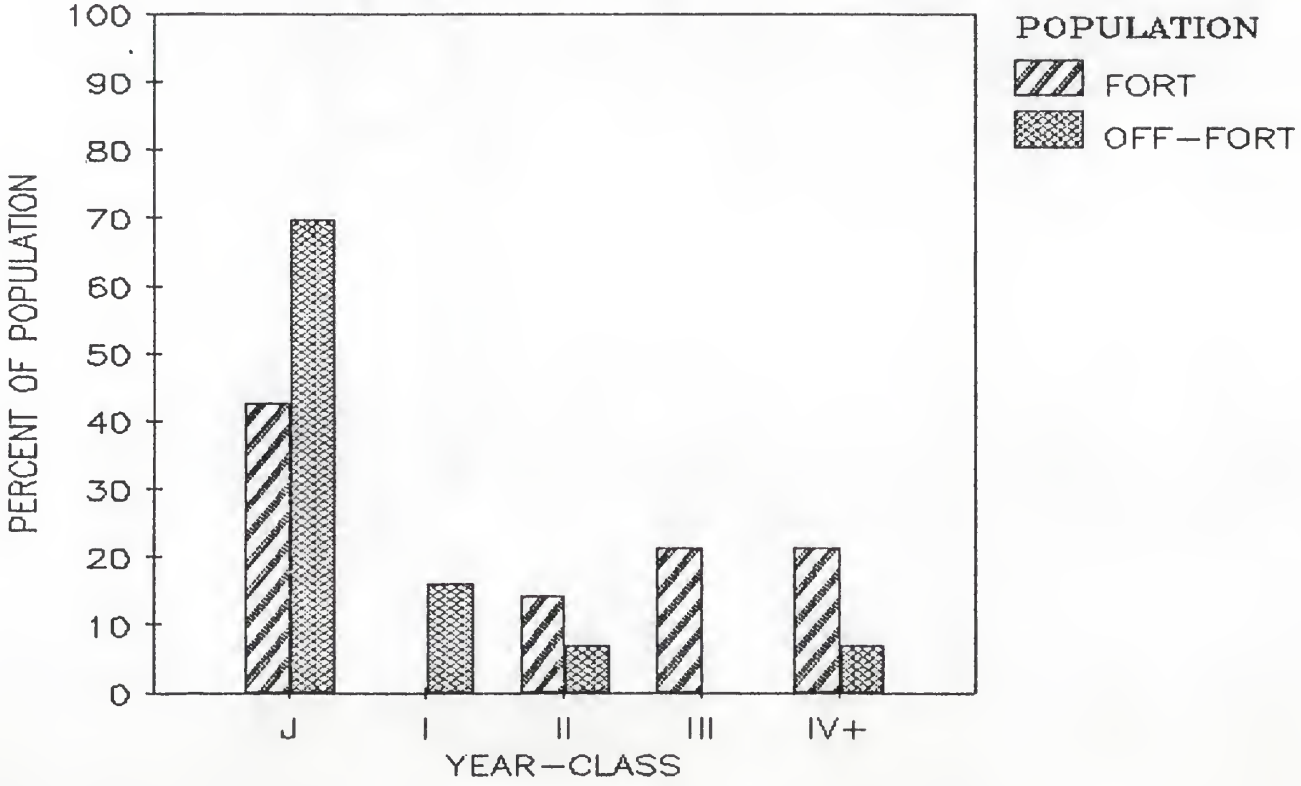


FIGURE 10. YEAR–CLASS STRUCTURE FOR RACCOONS TAKEN FROM THE FORT RILEY MILITARY INSTALLATION, FALL 1986

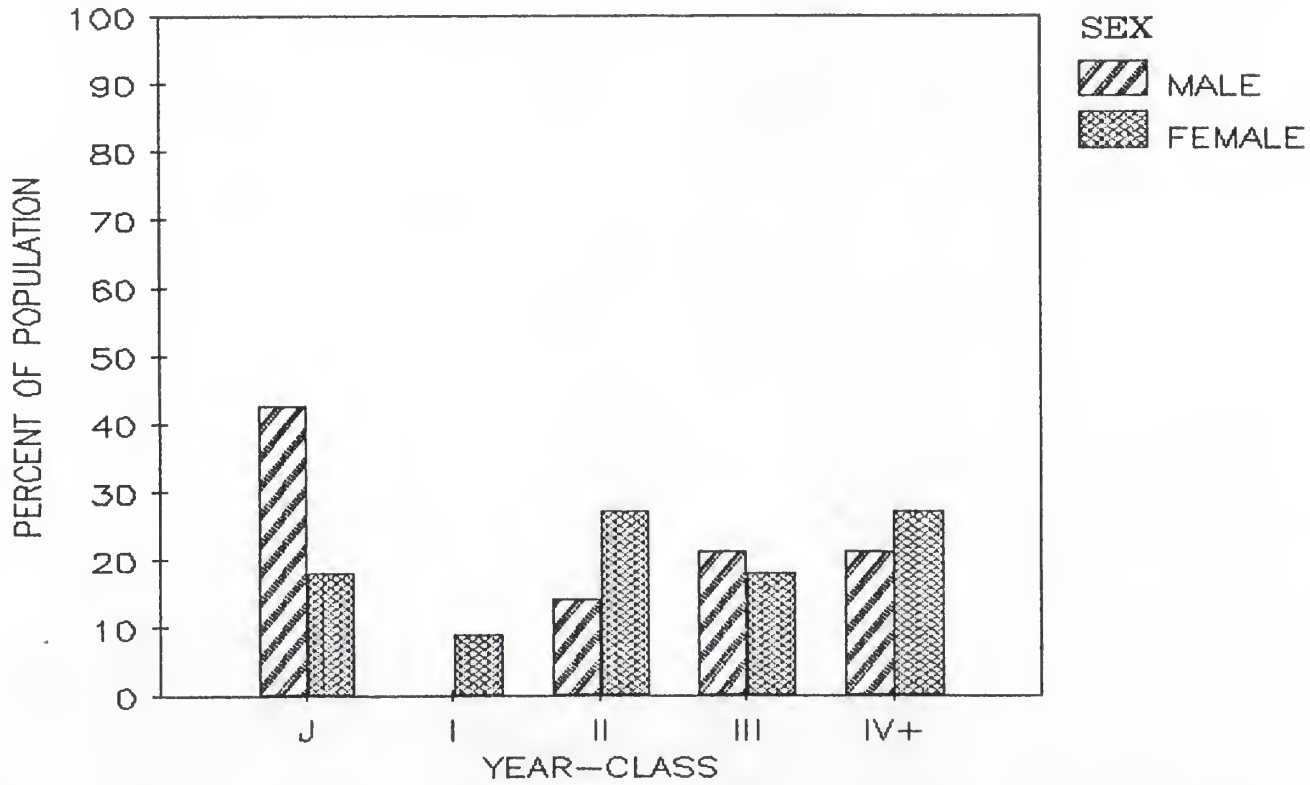
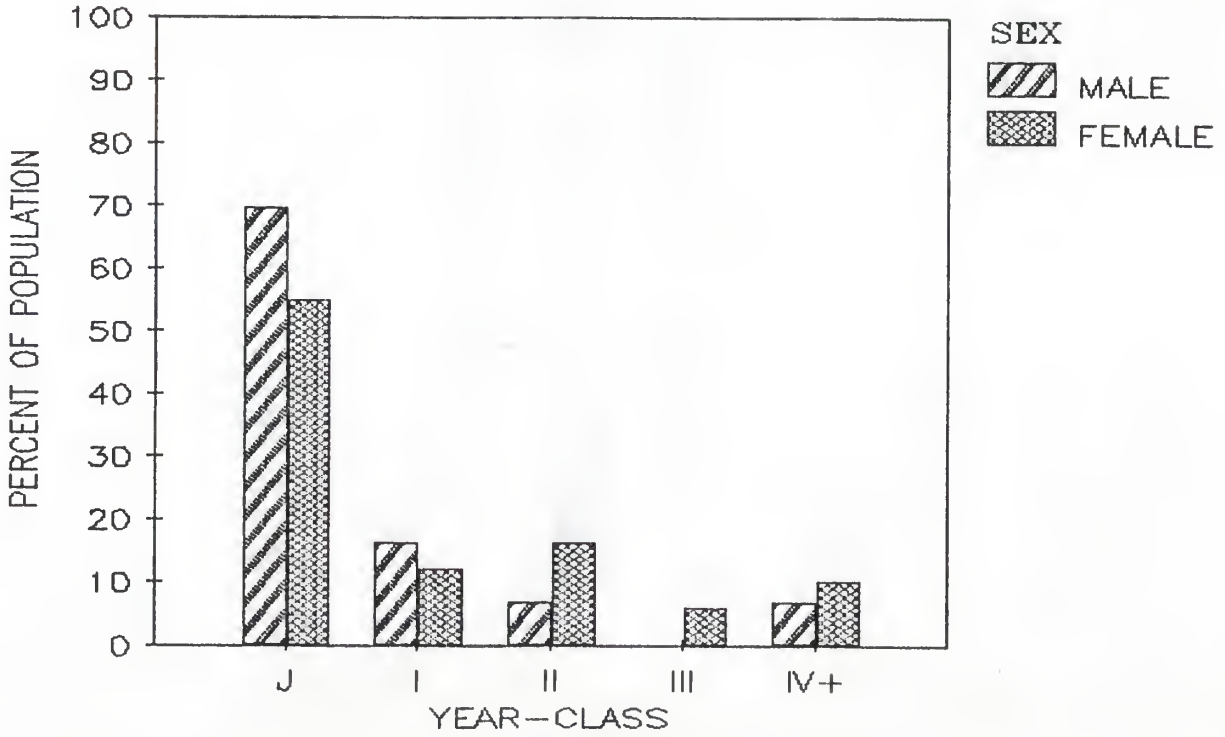


FIGURE 11. YEAR-CLASS STRUCTURE FOR RACCOONS OBTAINED FROM THE VICINITY OF MANHATTAN, KS, FALL 1986



different from 81.8%).

No females classified as juveniles in either population had placental scars, thus juvenile females were not included in calculating mean placental scars for females. The mean number of total placental scars (light and dark) per adult female was not significantly different between the two populations (Table 5). The mean scars per female from the Fort population was 3.0 whereas the mean number of scars per female from the off-Fort population was 3.9. When just the dark scars were analyzed, means of the two populations decreased, but were not signficantly different (Fort = 1.5, off-Fort = 2.45).

Ten adult females from the Fort population did not exhibit any dark scars, although six of these ten did possess light scars. Four adult females from the off-Fort population did not exhibit any light or dark scars. When females with dark placental scars only were considered, an average of 3.0 and 3.4 dark scars was counted per female in the off-Fort and Fort populations, respectively. The means were not significantly different. Considering only parous females, the mean number of scars (total scars in uteri with one set of scars or dark scars only in uteri with two sets of scars) per parous female was unchanged for females from the off-Fort population, but decreased slightly for the

Table 5. Placental scar counts for female adult raccoons from two populations in northeast Kansas, fall 1986. Values are means ± 1 SE.

Placental scars	Fort Riley		Off-Fort Riley	
	All (n=18)	Parous (n=8)[a]	All (n=22)	Parous (n=18)
Light	0.4 ± 0.23	1.0 ± 0.46	1.4 ± 0.44	1.7 ± 0.52
Dark	1.5 ± 0.44	3.4 ± 0.38	2.5 ± 0.28	3.0 ± 0.16
Total	3.0 ± 0.46	4.4 ± 0.46	3.9 ± 0.56	4.7 ± 0.48

[a]Only females with dark placental scars were considered parous.

females from the Fort population (3.3). There was no significant difference in the mean number of scars between the populations.

Age-specific reproduction was determined by calculating the mean number of scars per female in a specific year-class (Table 6). In the Fort population, two females in year-class I exhibited no placental scars. Six females in year-class II had a mean of 2.3 dark and 3.0 total scars. The four females in year-class III had 0.3 dark and 2.3 total scars, and the six IV+ year-class females had 2.0 dark and 4.5 total scars. Dark placental scar means were not significantly different between year-classes, but total placental scar means were statistically different between the III and IV+ year-classes.

Considering only parous females from the Fort population, means for dark and total placental scars were as follows: year-class II (n=5) 2.8 and 3.6, year-class III (n=3) 0.3 and 3.0, and year-class IV+ (n=6) 2.0 and 4.5. Means of dark and total placental scars were not signficantly different among parous females. Mean scars for females with placental scars were calculated by using only dark scars or light scars if no dark scars were present (Sanderson and Hubert 1981). Means for dark scars only were 3.5, 1.0, and 4.0 for year-classes II (n=4), III (n=1) and IV+ (n=3),

Table 6. Age-specific reproduction of female raccoons from two populations in northeast Kansas, Fall 1986.

	Fort Riley				Off-Fort Riley			
Year-Class	N[a]	% with scars	litter size[b]	two sets scars-%	N	% with scars	litter size	two sets scars-%
I	0	0	-	0	2	33	3.0±1.0	0
II	5	83	3.4±0.3	17	8	100	3.1±0.2	25
III	3	75	2.0±0.6	25	3	100	2.7±0.3	67
IV+	6	100	3.8±0.2	33	5	100	3.0±0.3	100
Total/mean	14	78	3.3±0.2	22	18	82	3.0±0.2	41

[a]number of animals in year-class with scars.

[b]mean number of scars (±1 SE) in uteri with one set, or number of dark scars in uteri with two sets.

respectively. When light scars were used if no dark scars were present, means for females in year-classes II (n=5), III (n=3) and IV+ (n=6) were 3.4, 2.0, and 3.8, respectively, for the Fort population.

Age-related reproductive success was analyzed in a similar manner for females in the off-Fort population. For females in year-classes I (n=6), II (n=8), III (n=3), and IV+ (n=5), the means for dark placental scars were 1.0, 3.1, 2.7, and 3.0, respectively. The mean number of total placental scars (light and dark) for these same year-classes were 1.0, 4.1, 4.3, and 6.6, respectively. The mean number of total placental scars exceeded the mean number of dark scars, in all of the year-classes except year-class I. The yearling females (year-class I) had only experienced one breeding season at the time of collection. The mean number of dark placental scars was significantly less in year-class I than in year-classes II, III, and IV+. The mean number of total scars per female was again significantly different between year-class I and the other year-classes; however, year-class II and year-class IV+ were also significantly different.

If only parous females from off-Fort locations were considered, means for dark and total placental scars of females in year-class I (n=2) were 3.0 and 3.0, respectively. Year-class II (n=8), III (n=3), and IV+

(n=5) remained unchanged from the means reported earlier. Means for dark placental scars among year-classes of parous females were not significantly different. Means for total placental scars were significantly less in year-classes I and II than in year-class IV+. Mean scars for parous females were also calculated by using only dark scars or light scars if no dark scars were present (Sanderson and Hubert 1981). Means for these two different calculations did not differ for females from the off-Fort population because all parous females had dark scars. Mean number of placental scars per parous female calculated in the manner described above were 3.0, 3.1, 2.7 and 3.0 for year-classes I (n=2), II (n=8), III (n=3), and IV+ (n=5), respectively, for the off-Fort population.

The majority of comparisons of mean placental scars (dark and total) of year-classes between the Fort and off-Fort populations were not significantly different. The only two significant differences were dark placental scars from all females in year-class III and dark placental scars between parous females in year-class III.

Parasites

All of the animals from the Fort population and 96% of those from the off-Fort population were infected with some type of gastro-intestinal parasite.[a] A total of six species of gastro-intestinal helminths were recovered and identified (Table 7). Three nematodes (Baylisascaris procyonis, Molineus barbatus, Physaloptera rara), two cestodes (Atriotaenia procyonis, Mesocestoides spp.), and one acanthocephalan (Macracanthorhynchus ingens) were found. Three of the six species (B. procyonis, P. rara, Macracanthorhynchus ingens) were counted (= intesity of infection), while the other three species were recorded as present or absent.

A significantly higher percentage of raccoons from the Fort population (25%) were infected with Molineus barbatus than were the raccoons from the off-Fort population (2%). No juveniles from either population were infected with this parasite.

Both species of cestodes were more prevalent in the off-Fort population than in the Fort population. A. procyonis was less common in both populations than Mesocestoides spp. The proportion of animals infected with A. procyonis from the Fort population (5.6%) was

[a] Although some trematodes were recovered, they could not be identified because of their poor condition due to the freezing of the gastro-intestinal tracts. Therefore, they were excluded from this study.

Table 7. Number (%) and mean intensity (MI) of parasites taken from two raccoon populations, Fort Riley (n=36) and off-Fort Riley (n=92).

Parasite	Location[a]	Fort Riley Number (%)	Fort Riley MI	Off-Fort Riley Number (%)	Off-Fort Riley MI	Overall Prevalence % (n =128)
ACANTHOCEPHALA						
Macracanthorhynchus ingens	SI	0 (0.0)A[b]	-	16 (17.4)B	3	12.5
CESTODA						
Atriotaenia procyonis	SI	2 (5.6)A	-	21 (22.8)B	-	18.0
Mesocestoides spp.	SI	6 (16.7)A	-	39 (42.4)B	-	35.2
NEMATODA						
Baylisascaris procyonis	S, SI	12 (33.3)A	124	69 (75.0)B	263	63.3
Molineus barbatus	SI	9 (25.0)A	-	2 (2.2)B	-	8.6
Physaloptera rara	E, S, SI	32 (88.9)A	251	77 (83.7)A	200	85.2
PROTOZOA						
Eimeria spp.	F	8 (22.2)A	-	25 (27.2)A	-	25.8
Sarcocystis spp.	F	0 (0.0)A	-	5 (5.4)A	-	3.9

[a]E = esophagus, F = fecal material, S = stomach, SI = small intestine.

[b]Percentages in the same row with the same capital letter are not significantly different between the populations for each parasite.

significantly less than the proportion of animals infected in the off-Fort population (22.8%). The same was true for Mesocestoides spp. Approximately 17% of the animals from the Fort population were infected compared to 42% of the off-Fort population. Mesocestoides spp. did not differentially infect animals of a particular sex, age, or any combination thereof. However, the only two individuals from the Fort population infected with A. procyonis were adult females.

No raccoons from the Fort population were infected with Macracanthorhynchus ingens. Sixteen of 92 animals (17.4%) from the off-Fort population were found to have M. ingens. in their small intestines. The most intense infection was 3 (range 1-3) M. ingens and occurred in an adult male and a juvenile female (Table 8). The mean number of M. ingens per animals infected was 1.38.

There was no significant difference between the percentage of raccoons infected with Physaloptera rara in the Fort (88.9%) and off-Fort (83.7%) populations (Table 9). The mean number of P. rara per animal for the Fort population (19.7) was not significantly different from the mean number per animal from the off-Fort population (16.1).

No significant differences were noted between the percentage of males or females infected and the

Table 8. Age/sex relationships in Macracanthorhynchus ingens infected raccoons from the off-Fort population in northeast Kansas, fall 1986.

Age/Sex Class	Number (%) Infected	Parasite Intensity[a] All Animals	Infected Animals (Range)
All Animals (n=92)	16 (17.4)	0.2 ± 0.1	1.4 ± 0.2 (1-3)
SEX			
Males (n=43)	7 (16.3)	0.2 ± 0.1	1.4 ± 0.3 (1-3)
Females (n=49)	9 (18.4)	0.2 ± 0.1	1.3 ± 0.2 (1-3)
AGE-CLASS			
Adults (n=35)	6 (17.1)	0.2 ± 0.1	1.3 ± 0.3 (1-3)
Juveniles (n=57)	10 (17.5)	0.3 ± 0.1	1.4 ± 0.2 (1-3)
SEX/AGE-CLASS			
Ad. Males (n=13)	3 (23.1)	0.4 ± 0.2	1.7 ± 0.7 (1-3)
Ad. Females (n=22)	3 (13.6)	0.1 ± 0.1	1.0 ± 0.0 (1)
Juv. Males (n=30)	4 (13.3)	0.2 ± 0.1	1.3 ± 0.3 (1-2)
Juv. Females (n=27)	6 (22.2)	0.3 ± 0.1	1.5 ± 0.3 (1-3)

[a] Means ± 1 SE.

Table 9. Comparison of number of raccoons infected with *Baylisascaris procyonis* and *Physaloptera rara* between two populations (Fort and Off) from northeast Kansas, fall 1986.

Sex/Age Class	% infected			
	B. procyonis		*P. rara*	
	Fort	Off	Fort	Off
All Animals	33.3A[a]	75.0B	88.9C	83.7C
SEX				
Males	50.0A	81.4B	85.7C	90.7C
Females	22.7A	69.4B	90.9C	77.6C
AGE-CLASS				
Adults	23.1A	48.6B	96.2C	60.0D
Juveniles	60.0A	91.2B	70.0C	98.3D
SEX/AGE-CLASS				
Ad. Males	25.0A	61.5A	100C	69.2C
Ad. Females	22.2A	40.9A	94.4C	54.6D
Juv. Males	83.3A	90.0A	66.7C	100D
Juv. Females	25.0A	92.6B	75.0C	96.3D

[a]Means with same capital letter are not significantly different for comparisons made between populations for specified sex/age combination and parasite.

intensity of P. rara infection. The percentage of adults (96%) and juveniles (70%) infected in the Fort population was significantly different from the number of adults (60%) and juveniles (98%) infected in the off-Fort population. The mean number of P. rara per juvenile or adult was not significantly different. Of the four possible sex and age-class combinations, the percentage of individuals infected was significantly different in the adult females (off-Fort = 55%, Fort = 94%) and juvenile males (off-Fort = 100%, Fort = 67%) between the populations. Again, the mean number of P. rara per adult female or juvenile male, either for all animals or only infected animals, were not significantly different.

In the Fort population, the percentage of adults (96%) infected with P. rara was significantly different from the percentage of juveniles (70%) infected (Table 10). In the off-Fort population, more juveniles (98%) were infected than adults (60%) (Table 11). The number of adult females (55%) and adult males (69%) infected from the off-Fort population was significantly less than the percent of juvenile females (96%) and juvenile males (100%) infected with P. rara. Additionally, the mean number of P. rara per adult male (4.4) and adult female (2.0) was significantly different from the means of juvenile males (22.9) and juvenile females (25.6) in the

Table 10. Age/sex relationships in Physaloptera rara infected raccoons from the Fort population in northeast Kansas, fall 1986 (intensity is mean ± 1 SE).

Sex/Age Class	Number (%) Infected	Parasite Intensity: All Animals	Parasite Intensity: Infected Animals (Range)
All Animals (n=36)	32 (88.9)	19.7 ± 7.9	22.2 ± 8.8 (1-251)
SEX			
Males (n=14)	12 (85.7)A[a]	36.6 ±19.2A	42.8 ±22.0A (1-251)
Females (n=22)	20 (90.9)A	8.9 ± 3.2A	9.8 ± 3.5A (1- 54)
AGE-CLASS			
Adults (n=26)	25 (96.2)A	9.1 ± 3.6A	9.5 ± 3.7A (1- 83)
Juveniles (n=10)	7 (70.0)B	47.2 ±25.8A	67.4 ±34.5A (1-251)
SEX/AGE-CLASS			
Ad. Males (n= 8)	8 (100)A	12.9 ±10.0A	12.9 ±10.0A (1- 83)
Ad. Females (n=18)	17 (94.4)A	7.4 ± 2.9A	7.9 ± 3.0A (1- 54)
Juv. Males (n= 6)	4 (66.7)B	68.3 ±41.2B	102.5 ±55.5B (8-251)
Juv. Females (n= 4)	3 (75.0)B	15.5 ±12.9A	20.7 ±16.8A (1- 54)

[a]Means or % infected in the same column with the same capital letter are not significantly different among sex/age-classes.

Table 11. Age/sex relationships in Physaloptera rara infected raccoons from the off-Fort population in northeast Kansas, fall 1986 (intensity is mean ± 1 SE).

Sex/Age Class	Number (%) Infected	Parasite Intensity: All Animals	Parasite Intensity: Infected Animals (Range)
All Animals (n=92)	77 (83.7)	16.1 ± 3.1	19.2 ± 3.6 (1-200)
SEX			
Males (n=43)	39 (90.7)A[a]	17.3 ± 4.1A	19.1 ± 4.5A(1-163)
Females (n=49)	38 (77.6)A	15.0 ± 4.6A	19.4 ± 5.8A(1-200)
AGE-CLASS			
Adults (n=35)	21 (60.0)A	2.9 ± 0.6A	4.8 ± 0.8A(1- 16)
Juveniles (n=57)	56 (98.3)B	24.2 ± 4.7A	24.6 ± 4.8B(2-200)
SEX/AGE-CLASS			
Ad. Males (n=13)	9 (69.2)A	4.4 ± 1.3A	6.3 ± 1.5A(1- 16)
Ad. Females (n=22)	12 (54.6)A	2.0 ± 0.5A	3.7 ± 0.6A(1- 7)
Juv. Males (n=30)	30 (100)B	22.9 ± 5.6B	22.9 ± 5.6B(2-163)
Juv. Females (n=27)	26 (96.3)B	25.6 ± 7.8B	26.6 ± 8.1B(2-200)

[a]Means or % infected in the same column with the same capital letter are not significantly different among sex/age-classes.

off-Fort population. In the Fort population, juvenile males had a significantly higher mean intensity of P. rara (68.3) than juvenile females (15.5), adult males (12.9), and adult females (7.4).

The percentage of raccoons infected with Baylisascaris procyonis was significantly higher in the off-Fort population (75%) compared to the Fort population (33%). The proportion of females (69%) and males (81%) infected in the off-Fort population was also higher when compared to the percentage of females (23%) and males (50%) infected in the Fort population (Table 9). B. procyonis infected the adults and juveniles significantly more in the off-Fort population (49 and 91 %, respectively) than in the Fort population (23 and 60 %, respectively). One of the four juvenile females (25%) from the Fort population was infected contrasted with 25 of 27 (93%) juvenile females from the off-Fort population.

The mean intensity of B. procyonis per raccoon in the Fort population was significantly less (4.7) than the mean intensity in the off-Fort population (15.4). The mean number of B. procyonis per female and per infected female was significantly lower in females from the Fort population (1.0 and 4.2, respectively) than it was for females (18.3) and infected females (26.4) from the off-Fort population. A similar relationship was

discovered with the mean intensity of B. procyonis in all juveniles and infected juveniles between the Fort population (2.3 and 3.8) and off-Fort population (20.4 and 22.4, respectively). Juvenile males and juvenile females from the Fort population had a significantly lower mean intensity of B. procyonis (3.0 and 1.3, respectively) than did juvenile males and juvenile females from the off-Fort population (14.6 and 26.9, respectively).

When the populations were considered separately (Tables 12, 13), the percentage of adults infected was significantly less than the proportion of juveniles infected in the Fort population (23 vs 60 %) and the off-Fort population (49 vs 91%). No significant differences were detected when comparing the mean intensity of B. procyonis of different groups of raccoons from the Fort population. Two significant differences in mean intensity were found in raccoons from the off-Fort population. The average number of ascarids per juvenile (20.4) was higher than the adult average (7.2). Also, the mean intensity for juvenile females (26.9) was higher than the mean intensity for adult males (6.2). The largest infection occurred in a juvenile female from the off-Fort population which had 263 worms.

Two protozoan parasites were detected during fecal

Table 12. Age/sex relationships in Baylisascaris procyonis infected raccoons from the Fort population in northeast Kansas, fall 1986 (intensity is mean ± 1 SE).

Sex/Age Class	Number (%) Infected	Parasite Intensity	
		All Animals	Infected Animals (Range)
All Animals (n=36)	12 (33.3)	4.7 ± 3.4	14.0 ±10.0 (1-124)
SEX			
Males (n=14)	7 (50.0)A[a]	10.5 ± 8.8A	21.0 ±17.2A (1-124)
Females (n=22)	5 (22.7)A	1.0 ± 0.5A	4.2 ± 1.8A (1- 11)
AGE-CLASS			
Adults (n=26)	6 (23.1)A	5.6 ± 4.8A	24.2 ±20.0A (1-124)
Juveniles (n=10)	6 (60.0)B	2.3 ± 0.9A	3.8 ± 1.1A (1- 8)
SEX/AGE-CLASS			
Ad. Males (n= 8)	2 (25.0)A	16.1 ±15.4A	64.5 ±59.5A (5-124)
Ad. Females (n=18)	4 (22.2)A	0.9 ± 0.6A	4.0 ± 2.3A (1- 11)
Juv. Males (n= 6)	5 (83.3)B	3.0 ± 1.2A	3.6 ± 1.4A (1- 8)
Juv. Females (n= 4)	1 (25.0)A	1.3 ± 1.3A	5.0 ± 0.0A (5)

[a]Means or % infected in the same column with the same capital letter are not significantly different among sex/age-classes.

Table 13. Age/sex relationships in Baylisascaris procyonis infected raccoons from the off-Fort population in northeast Kansas, fall 1986 (intensity is mean ± 1 SE).

Sex/Age Class	Number (%) Infected	Parasite Intensity: All Animals	Parasite Intensity: Infected Animals (Range)
All Animals (n=92)	69 (75.0)	15.4 ± 3.4	20.5 ± 4.4 (1-263)
SEX			
Males (n=43)	35 (81.4)A[a]	12.0 ± 2.7A	14.8 ± 3.1A (1- 81)
Females (n=49)	34 (69.4)A	18.3 ± 6.0A	26.4 ± 8.3A (1-263)
AGE-CLASS			
Adults (n=35)	17 (48.6)A	7.2 ± 2.6A	14.8 ± 4.8A (1- 73)
Juveniles (n=57)	52 (91.2)B	20.4 ± 5.2A	22.4 ± 5.6A (1-263)
SEX/AGE-CLASS			
Ad. Males (n=13)	8 (61.5)A	6.2 ± 3.2A	10.0 ± 4.8A (1- 42)
Ad. Females (n=22)	9 (40.9)A	7.8 ± 3.8A	19.1 ± 8.1A (1- 73)
Juv. Males (n=30)	27 (90.0)B	14.6 ± 3.5A	16.2 ± 3.8A (1- 81)
Juv. Females (n=27)	25 (92.6)B	26.9 ±10.2A	29.0 ±10.9A (2-263)

[a]Means or % infected in the same column with the same capital letter are not significantly different among sex/age-classes.

flotation. Unsporulated Eimeria spp. oocysts were found in both populations, infecting 22% of the Fort population and 27% of the off-Fort population. Sarcocystis spp. was found only in the raccoons from the off-Fort population, where five of 92 animals were infected. No Giardia spp. or Cryptosporidium spp.were found in the raccoons examined in this study.

DISCUSSION

The weights of the raccoons from the Fort population at the time the animals were trapped were probably close to their maximum (Mech et al. 1968, Johnson 1970). The mean weight for males was approximately 0.80 kg higher than females, which is in agreement with other studies (Sanderson and Hubert 1981, Moore and Kennedy 1985b). However, there was much overlap in individual weights indicating this would not be an acceptable method for distinguishing sex of Fort Riley raccoons.

The mean weights for adult males and adult females (parous and nulliparous) was higher than weights reported for Illinois raccoons (Sanderson and Hubert 1981) while the mean weight of juvenile males was similar. The mean weight of juvenile females was much less (2.45 kg) than the 4.7 kg reported from approximately the same latitude in Illinois (Sanderson and Hubert 1981). This could be due to the small sample size of juvenile females (n=4) or possibly some of the juvenile females captured were from litters born later in the year.

Mean weight of adults was significantly higher than juveniles. Little overlap occurred, indicating it may be fairly accurate to use weights to separate live animals from Fort Riley into adults or juveniles. Of

course, a larger sample size and a sample from all months of the year would be desirable before attempting to age the raccoons from Fort Riley by weights. Sanderson (1961b) and Johnson (1970) both employed weights as a way of separating raccoons into age-classes.

Sex ratios in the present study were reported as percent males and percent females as recommended by Downing (1980). In both populations, females outnumbered males, which is contrary to what Stains (1956) believed to be true for Kansas raccoons. Most previous studies found the percentage of males to be greater than the percentage of females (Sanderson 1951, Johnson 1970, Sonenshine and Winslow 1972, McComb 1981, Moore and Kennedy 1985b), although Sanderson (1951) found only 65 males per 100 females in a refuge area where no hunting or trapping occurred. If the percentage of males in the Fort population (which could be considered a refuge with only approximately nine raccoon hunters annually) is converted to similar units, it was found to contain 64 males per 100 females. The sex ratio of the off-Fort population was more nearly equal with 47% males and 53% females.

It has been shown that males are more active and range over greater areas (Giles 1943, Johnson 1970, Moore and Kennedy 1985a); hence, they should be more

subject to capture. This was not evident in the present study. However, Sanderson and Hubert (1981) indicate that sex ratios are subject to considerable sampling variation and that reliable results can only be obtained by having a large sample size or sampling over long periods. Neither criteria was met in the present study which represents only a total of 128 raccoons (36 in Fort population, 92 in off-Fort population). Sampling occurred during November and December 1986. Therefore, the sex ratios obtained must be viewed with caution.

Caution must also be taken when interpreting age ratios (Caughley 1974), especially those observed at any one time (Downing 1980). The age ratio of the Fort population (72% adults, 28% juveniles) was in fairly close agreement with some previous studies (Johnson 1970, Soneshine and Winslow 1972). However, other studies reported a higher percentage of juveniles (Stuewer 1943a, Sanderson and Hubert 1981), as was the case with the off-Fort population (38% adults, 62% juveniles). Although this information may not reflect the true age ratios in each population accurately, it does provide a crude means of comparison between the two populations.

Since both populations were sampled in a similar manner (trapping), any bias toward one age-class should be consistent for each population. The off-Fort

population contained a substantially larger number of juveniles than did the Fort population. This indicates that the Fort population is comprised of older individuals. These animals have been exposed to much lower (close to non-existent) trapping pressure than have the raccoons of the off-Fort population. The Fort population does not have to replace individuals lost to trapping; therefore, the percentage of juveniles is relatively low. Other causes of mortality, besides man, do not seem to affect raccoons to any great extent (Stuewer 1943a, Johnson 1970).

Population turnover is the number of years required for a year-class to shrink to zero. The turnover period for Missouri and Alabama raccoons was 7.4 years (Sanderson 1951) and 10 years (Johnson 1970), respectively. The turnover time for the off-Fort population was calculated to be 6.5 years in the manner described by Sanderson (1951). The percent juveniles in each population was assumed to approximately equal the annual mortality rate. The turnover period for the Fort population was 17.1 years. As expected, the turnover period was much longer in the population experiencing low trapping pressure than in the population experiencing greater trapping pressure.

Other evidence supporting the idea the Fort population is comprised of older animals was given when

year-class composition was analyzed between the two populations. Not only was there a higher percentage of adults, but there was a higher percentage of adults in the older year-classes III and IV+ than in the off-Fort population. The longevity of the animals in the Fort population was calculated to be 3.6 years, while in the off-Fort population it was 1.6 years. This is what one should expect since man is the greatest cause of mortality in adult raccoons.

Productivity of the female raccoons in this study was measured by counting plactental scars in the uterine horns. Sanderson (1950) found placental scars to be a fairly accurate indicator of litter size. However, they must be interpreted with caution. In the course of examining the litter of raccoons in this study, two types of placental scars were encountered. Dark scars were heavily pigmented, continuous bands in the internal mucosa of the uterine horns. Light scars were lightly pigmented and usually not continuous.

The meaning of multiple groups of scars of varying intensity is unclear (Sanderson and Nalbandov 1973). Although it is fairly certain that dark scars (as described above) represent implantation sites from the most recent breeding season, scars lighter in nature could represent several things. Junge and Sanderson (1982) found approximately 30% of yearling females had

two sets of placental scars. The second set of placental scars was thought to represent unsuccessful first litters. Therefore, light placental scars could indicate reabsorbed or aborted embryos. Sanderson and Nalbandov (1973) indicated an embryo that reaches one month of age is represented by one scar that persists for ten or more months; thus considering light and dark scars together may not be a valid indication of litter size.

Light scars may also represent scars from breeding seasons prior to the most recent. Although it is not precisely known how long scars persist in wild raccoons, it has been noted that scars probably persist longer in wild females than in their captive counterparts (Sanderson and Nalbandov 1973). Correct interpretation of light scars would depend on the known reproductive history for individual raccoons. Genetic and geographic variation may also play a role in the meaning of lighter scars.

Placental scar counts of raccoons in this study were analyzed in several different ways. Using only dark placental scars, which the author feels to be a conservative estimate of litter size, revealed the average litter sizes for the Fort and off-Fort populations to be 1.5 and 2.5, respectively. These estimates are generally lower than those reported in the

literature (Table 2). Stains (1956) reported litter sizes in Kansas to average 4.6. Johnson (1970) stated that there is a general trend toward larger litter sizes in the northern latitudes. If only dark scars are considered, the mean litter sizes are comparable to those reported from southern states (Johnson 1970).

Although dark placental scars may accurately reflect the litters of the most recent breeding season, individuals who did not breed that season or had unsuccessful litters would be left out of the calculations. Therefore, mean litter size, calculated by using total placental scars from uteri with one set of scars or dark scars only if two sets were present, may be a more reliable indicator of litter size (Sanderson and Hubert 1981). The mean litter size increased to 3.3 for the parous females in the Fort population and 3.0 for the off-Fort parous females. Regardless of method of calculation, no significant differences were detected between the litter sizes of the two populations.

There was a difference in the percentage of females with dark scars. Approximately 44% of females in the Fort population exhibited dark placental scars, while nearly 82% of females in the off-Fort population had them. This may indicate the number of females who were reproductively active in the last breeding season, but

it could be highly conservative for reasons already discussed. Therefore, the percentage of parous females (animals with at least one placental scar) in each population was compared. It was found not to be significant with the Fort population percentage rising to almost 79% and the off-Fort percentage remaining unchanged.

Age-specific reproductive rates were also analyzed. The sample of yearling females in each population was small. Two females were in year-class I from the Fort population and neither exhibited placental scars. Two of the six yearling females (33%) in the off-Fort population had dark placental scars. Up to 50% of yearling females have been reported as being reproductively active (Stuewer 1943a, 1943b, Stains 1956). This may be a crude indication that, with little or no trapping pressure, yearling females need not be reproductively active to maintain the population. In each year-class (II, III, and IV+), the percentage of females with scars or with two sets of scars in the Fort population was lower than the corresponding percentages in the off-Fort population. One hundred percent of the females in all year-classes higher than I from the off-Fort population had placental scars.

Junge and Sanderson (1982) reported that 4.5% of 44 females two years or older were nulliparous. Two out of

16 (12.5%) females two years or older from the Fort population were nulliparous. One was in year-class II and the other in year-class III. A possible explanation could be that the specimens were aged incorrectly, using cementum annuli by Matson's. The age of the three year old was nearly certain. Examination of its lower jaw indicates that it was at least a two year old (Grau et al. 1970). The nulliparous female in year-class II was determined to be correctly aged by also examining its lower jaw.

Parasites

Although trematodes were encountered in some of the gastro-intestinal tracts, the worms were in poor condition and essentially unidentifiable. There was neither the quantity of trematodes nor the number of species that have been reported in other studies (e.g., Bafundo et al. 1980, Cole and Shoop 1987). This was attributed to the method in which the gastro-intestinal tracts were stored. Shoop et al. (1987) points out that upon freezing, water expands followed by the formation of ice crystals. Cell membranes are ruptured and soft bodied trematodes are among the first parasite groups to be lost (Shoop et al. 1987).

One acanthocephalan, Macracanthorhynchus ingens, was found to occur in the raccoons from the off-Fort population but not the Fort population. Prevalance

(17.4%) was lower than most studies (eg. Harkema and Miller 1964, Schaffer et al. 1981) as was intensity. The maximum number of worms found in one raccoon was three. Price and Harman (1983) reported a range of one to 931 M. ingens in raccoons from Georgia.

The life cycle of M. ingens was repoted by Moore (1946). The intermediate hosts were found to be grubs of scarabaeid beetles, with frogs labelled as possible paratenic hosts. It is probable that the raccoon can become directly infected by ingesting grubs, adult beetles or frogs (Moore 1946). A possible explanation of the absence of M. ingens from raccoons in the Fort population is a difference in numbers and/or distribution of suitable intermediate hosts in the areas that were trapped.

Two species of cestodes were recovered from raccoons in both populations. Atriotaenia procyonis (=Oochoristica procyonis) occurred in 5.6% of the Fort population and 22.8% of the off-Fort population. In Illinois, it has been reported in 17%, 14%, and 55% of raccoons examined by Leigh 1940, Barnstable and Dyer 1974, Snyder and Fitzgerald 1985a, respectively. Gallati (1959) found the intermediate host in the laboratory to be the flour beetle Tribolium castaneum. Here again, differences in prevalance between the Fort and off-Fort populations may be due to differences in

abundance of intermediate hosts.

Mesocestoides spp. were found to be more prevalent in both populations than Atriotaenia procyonis. Seventeen percent of the Fort population was infected and 42% of the off-Fort population were found to have Mesocestoides spp. Barnstable and Dyer (1974) and Cole and Shoop (1987) also found Mesocestoides spp. to be more prevalent in raccoons from Illinois and Kentucky, respectively. Although several species of Mesocestoides have tentatively been reported from raccoons, no attempt was made to identify the worms to species as there is much confusion in the literature due to the morphological variation and lack of life history data (Snyder and Fitzgerald 1985a).

No specimens of the raccoon hookworm, Arthrocephalus lotoris (=Placoconus lotoris), were recovered from raccoons in either population. This absence is puzzling since A. lotoris is reported commonly from raccoons across the United States. In Illinois, 34 to 61% of raccoons examined were found to have A. lotoris (Leigh 1940, Barnstable and Dyer 1974, Snyder and Fitzgerald 1985a). Bafundo et al. (1980), Smith et al. (1985), and Cole and Shoop (1987) have reported that from 22 to 80% of raccoons in Kentucky and Tennessee are infected with A. lotoris. The prevalence of A. lotoris in the southeastern states is over 50%

(Harkema and Miller 1964).

The life cycle involves free-living stages (Balasingam 1964) and is direct. Balsingam (1964) believes the only mode of entry for infective larvae is the oral route. It is not known why such a common raccoon parasite was not found in this study. It could be due, in part, to the freezing of gastro-intestinal tracts during storage.

Another fairly common parasite of the raccoon that was not found in this study is the nematode, Gnathostoma procyonis. The first intermediate hosts are cyclopoid copepods. Paratenic hosts include snakes, turtles, and other poikilothermic vertebrates (Ash 1960). Once the worms mature and inhabit the stomach, a characteristic feature of infection are the presence of nodules. Cole and Shoop (1987) found that animals not infected with adults at the time of necropsy had closed nodules which they considered to be an indication fo past infection. Nodules of this type were noted in the stomach walls of several raccoons but were not recorded.

Prevalence of G. procyonis in other studies has been low: 5.6% and nonexistent in Illinois (Barnstable and Dyer 1974, Snyder and Fitzgerald 1985a, respectively), not found in South Dakota (Boddicker and Progulske 1968), and 14% in Kentucky and Tennessee (Smith et al. 1985). Chandler (1942a) reported that G.

procyonis has a seasonal occurence in east Texas, with a higher prevalence in December than in May or September. This parasite may also have a seasonal occurrence in Kansas. Presently, there are no studies regarding this phenomenon.

Molineus barbatus was the only parasite which was significantly more common in animals from the Fort population than in animals from the off-Fort population. It has been shown to have a direct life cycle and the third-stage larva infects the host orally or percutaneously (Gupta 1961). It is unclear why M. barbatus had a higher prevalence in the Fort population. This parasite was not found in Illinois raccoons by Barnstable and Dyer (1974); however, they examined only 36 carcasses. Snyder and Fitzgerald (1985a) found M. barbatus to occur in 5% of 245 Illinois raccoons. Studies from areas farther east and south of Kansas have reported prevalences above 50% of M. Barbatus (eg. Harkema and Miller 1964, Smith et al. 1985, Cole and Shoop 1987).

Physaloptera rara was the most common gastro-intestinal parasite in both populations with the prevalence being 89% in the Fort population and 84% in the off-Fort population. It was found in the esophagus, stomach and small intestine. P. rara has been widely reported in the literature. Snyder and Fitzgerald

(1985a) found this parasite in 94% of Illinois raccoons examined and Barnstable and Dyer (1974) found P. rara in 69% of raccoons also from Illinois. The highest prevalence (98%) was reported by Smith et al. (1985) in raccoons from Tennesse and Kentucky.

Differences in prevalence of P. rara were detected between the age classes when the populations were analyzed seperately. A higher percentage of adults (96%) were infected in the Fort population than were juveniles (70%) in this same population. However, the situation was reversed in the off-Fort poppulation with 60% of adults and 98% of juveniles parasitized. With fewer juveniles in the Fort population, it is less likely that they can become infected. Adults are not trapped out of the population; thus, once an infection becomes established, it is not removed. Chandler (1955) indicates the life cycle of Physaloptera spp. is indirect and involves cockroaches, earwigs, bettles,and crickets as intermediate hosts.

The highest intensity of P. rara in Fort raccoons and off-Fort raccoons was 251 and 200 worms, respectively. Snyder and Fitzgerald (1985a) found in large infections, many small ulcerations could be observed in the stomach wall which were points of prior worm atachment. Possibly, the ulcerations noted during the course of examination were due to P. rara rather

than previous infections with Gnathostoma procyonis.

Baylisascaris procyonis was found in the Fort population and off-Fort population with a prevalence of 33% and 75% respectively. It is unclear why the percentage of infected raccoons was less in the Fort population than it was in the off-Fort population. The Fort population was considerably smaller (36 animals) than the off-Fort popualtion (92 animals) which may have contributed to the differences noted.

B. procyonis has been reported to cause sickness and death in raccoons, primarily due to intestinal obstruction (Stone 1983, Carlson and Nielsen 1984). One such case was found in an adult male from the Fort population, 123 adult B. procyonis were recovered from approximately 10 cm of small intestine. The largest infection was 263 worms in a juvenile female from the off-Fort population, although the worms were not recorded as constituting an intestinal obstruction.

In each population, more juveniles were infected than were adults, similar to the finding of Snyder and Fitzgerald (1985b, 1987). However, the intensity of B. procyonis was lower in the Fort population (with figures being inflated due to one adult male with the intestinal obstruction) than it was in the off-Fort population (Tables 12, 13). Juveniles apparently are susceptible to infective eggs while adult raccoons are susceptible

by the intermediate host (mice) route only (Kazacos 1983a). It would appear, then, that juveniles may be more apt to acquire the infection than adults.

Prevalences of B. procyonis have ranged from 3.4% in Tennessee and Kentucky (Smith et al. 1985) to 86% in Illinois (Snyder and Fitzgerald 1987), with several studies reporting intermediate prevalences (Barnstable and Dyer 1974, Bafundo et al. 1980, Jones and McGinnes 1983, Cole and Shoop 1987). In earlier studies (eg. Morgan and Waller 1940), ascarids other than B. procyonis have been reported in raccoons. Sprent (1968) states that these parasites were probably B. procyonis.

Baylisascaris procyonis is of particular interest due to its potential to cause disease (fatal cerebrospinal nematodiasis and ocular and visceral larva migration) in various other animals, including humans (Jacobson et al. 1976, Kazacos 1983b, Huff et al. 1984, Kazacos et al. 1984, Fox et al. 1985, Kazacos et al. 1985). Egg prvalence is high and has been reported at a mean intensity of 26,215 eggs per gram of feces (Snyder and Fitzgerald 1987) indicating that contamination potential is high.

No Giardia spp. were encountered in either population of raccoons. This is not surprising since there are no previous records of raccoons naturally infected with Giardia spp. In addition, oocysts of

Cryptosporidium parvum, a coccidian capable of infecting a wide range of mammals, including humans, was not found. However, two other types of apicomplexan oocysts were recovered from raccoons. Unsporulated coccidian oocysts were found in both populations. Both Eimeria procyonis and E. nuttalli have been reported from raccoons (Inabnit et al. 1972, Adams et al. 1981, Dubey 1982), but the similarity of their unsporulated oocysts precluded specific diagnosis. No differences in prevalence were detected between the Fort population (22%) and the off-Fort population (27%). Oocysts of Sarcocystis spp. were also found in five (5.4%) raccoons from the off-Fort population while no raccoons from the Fort population were found to be infected. This could be due to the smaller sample size of raccoons from the Fort population (n=36) since the prevalence in the off-Fort population was low. Adams et al. (1981) indicate that it is most likely S. leporum that infects raccoons, which utilizes a raccoon or cat/rabbit life cycle. Dubey (1982) suggests that raccoons do not have an important role in the epidemiology of sarcocystis of food animals.

CONCLUSIONS

The following conclusions appear justified based on data gathered in this study:

1. The mean weights of adult male raccoons (9.82 kg) and adult females (8.07 kg) from the Fort population were higher than those reported for raccoons from comparable habitats in Illinois, while the mean weight of juvenile males (5.24 kg) was similar and the mean weight of juvenile females (2.45 kg) was less than Illinois raccoons. Mean weight of males (7.85 kg) was approximately 0.80 kg higher than the mean weight of females (7.04 kg).
2. The sex ratio of the Fort population was not significantly different (39% males) from the off-Fort population (47% males). In both populations, females outnumbered males.
3. Age ratios of the two populations were very different. The Fort population was comprised of 72% adults and 28% juveniles. The off-Fort population had 38% adults and 62% juveniles.
4. The mean litter sizes of the Fort population and the off-Fort population were 3.4 and 3.0, respectively. These values were not significantly different.
5. Forty-four percent and 82% of the adult females in the Fort population and off-Fort population,

respectively, were considered reproductively active (exhibited dark placental scars) in the most recent breeding season.

6. Six gastro-intestinal helminths were recovered and identified: one acanthocephalan (Macracanthorhynchus ingens), two cestodes (Atriotaenia procyonis and Mesocestoides spp.) and three nematodes (Baylisascaris procyonis, Molineus barbatus and Physaloptera rara). The off-Fort population had a higher percentage of raccoons infected with the acanthocephalan, both cestodes, and B. procyonis. The percentage of animals infected with P. rara was similar between the two populations and more individuals in the Fort population were infected with Molineus barbatus than in the off-Fort population.

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SEX AND AGE RATIOS, PRODUCTIVITY AND PARASITE PREVALENCE OF TRAPPED AND UNTRAPPED RACCOON POPULATIONS IN NORTHEAST KANSAS

by

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A total of 128 raccoons (Procyon lotor) were trapped from two populations in northeast Kansas during November and December 1986 to determine the effects of long-term exposure to trapping on raccoon populations. The sex and age ratios, productivity, and parasite prevalence of 36 raccoons from the Fort Riley Military Installation (an untrapped population) were compared to those of 92 raccoons taken from a previously trapped population in the vicinity of Manhattan, Kansas.

Weights were obtained for the Fort population only. Mean weight of males (7.85 kg) was approximately 0.80 kg higher than females (7.04 kg). Mean adult weight (8.61 kg) was higher than mean juvenile weight (4.12 kg). Mean weight of parous adult females (8.20 kg) was not significantly different than mean weight of nulliparous adult females (7.60 kg).

The sex ratio of the Fort population (39% males) was not significantly different from the off-Fort population (47% males). In both populations, females outnumbered males. Age ratios, on the other hand, were very different. The Fort population was comprised of 72% adults and 28% juveniles. The off-Fort population contained 38% adults and 62% juveniles.

The mean litter sizes of adult parous females in the Fort population and off-Fort population were 3.4 and 3.0, respectively (using only dark placental scars to

calculate mean litter size). It appeared that a higher percentage of females from the off-Fort population (82%) were reproductively active during the most recent breeding season (i.e. exhibited dark placental scars) than in the Fort population (44%).

Six gastro-intestinal helminths were recovered and identified from the raccoons: one acanthocephalan (Macracanthorhynchus ingens), two cestodes (Atriotaenia procyonis and Mesocestoides spp.) and three nematodes (Baylisascaris procyonis, Molineus barbatus and Physaloptera rara). The off-Fort population had a higher percentage of raccoons infected with the acanthocephalan, both cestodes and B. procyonis. The percentage of raccoons infected with P. rara was similar between the Fort and off-Fort populations (89 and 84%, respectively), and more individuals in the Fort population were infected with Molineus barbatus than in the off-Fort population.