Biology of a Feral Hog Population in South Central Florida

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Abstract: Ninety-three feral hogs (*Sus scrofa*) collected from July 1978 through June 1979 on the Fisheating Creek Wildlife Refuge in Glades County, Florida, were examined for physical condition, food habits, and reproductive status. Wild hog food habits were determined largely by food availability and nutritional requirements, which changed seasonally. Hogs collected on the study area were in better condition with regard to internal fat during fall and winter but appeared to be under greater stress during these periods as determined by adrenal weights. Farrowing peaks occurred after availability of acorn mast in the fall and "spring green-up." We hypothesize that sustained yield of wild hogs may best be achieved through late summer and early fall harvest.

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An extensive system of wildlife management areas comprising >2 million hectares is available to hunters in Florida through lease agreements between the Florida Game and Fresh Water Fish Commission (FGFWFC) and private landowners and other state and federal agencies. Management of wild hogs by FGFWFC consists primarily of setting hunting regulations and, until recently, relocating nuisance hogs to public hunting areas. The major challenge for FGFWFC on many wildlife management areas is maintaining hog population levels under heavy hunting without re-stocking. The objective of this study was to formulate a sustained yield management strategy based on biological data that could be tested during a simulated harvest study on the Fisheating Creek Wildlife Refuge.

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Methods

Study Area

The Fisheating Creek Wildlife Refuge, situated 7 km northeast of Palmdale in Glades County, Florida, was chosen as the study area because it had a dense population of feral hogs and was not publicly hunted. The terrain is flat, low (9 to 17 m above sea level), and subject to flooding, especially during the summer rainy season. Rainfall averages 127 cm annually. The climate is subtropical with infrequent freezing temperatures. The vegetation is characterized primarily by live oak (*Quercus virginiana*) and cabbage palm (*Sabal palmetto*) hammocks and slash pine (*Pinus elliottii*) and saw palmetto (*Serenoa repens*) flatwoods interspersed with bayheads, cypress strands, and shallow ponds and sloughs. Fire suppression has allowed live oak hammocks to increase in recent years. The principal land uses are cattle grazing, occasional logging and stumping, and removal of cabbage palms. The area is surrounded by similar habitat leased for hunting.

Observations and Collections

We examined the Fisheating Creek hog population by collecting specimens to evaluate their physical condition, food habits, and productivity. We also recorded man-hours spent hunting and noted sex and approximate age (adult, >30 kg; subadult, 10–30 kg; and juvenile, <10 kg) of hogs observed but not collected. Our intent was to collect 2 males and 2 females in each age class monthly from July 1978 through June 1979. Hogs were captured alive with dogs and dispatched immediately prior to necropsy, or killed in the field by shooting. Body weight (0.1 kg), body length (mm, total length less tail length), and heart girth (mm) were recorded upon collection.

Aging

The skull and mandibles were cleaned and used for aging by tooth eruption (Matschke 1967). After at least 6 months in 10% formalin, the lenses were removed from the eyeballs, oven-dried at 70 C, and weighed to 0.0001 g. Hogs >26 months old, as determined by tooth eruption pattern, were assigned an age in months using the eye lens regression equation $Y = 5348.16X^{3.80}$ (Henson 1975). For other hogs, age was estimated by averaging the ages predicted by the eye lens regression equations $Y = 346.32X^{1.96}$ (Henson 1975) and $Y = -3.95 + 93.85X$ (Sweeney et al. 1970).

Physical Condition

During necropsies, adrenal glands were preserved in AFA, and a femur was frozen. The adrenal glands were later trimmed of adhering tissue and weighed (0.01 g). A sample of marrow tissue was removed with forceps from the middle third of each femur. The sample was cleaned of bone chips, sectioned, and dried to a constant weight in an oven at 70 C. Dry weight was divided by wet weight and multiplied by 100% to obtain percent marrow dry weight.

Each hog was examined for fat around the heart and kidneys and in the mesentary. Zero, trace, moderate, and abundant amounts of fat at each location were assigned an index of 0, 1, 2, and 3, respectively. Totaling indices for all 3 locations provided an internal fat rating between 0 and 9. Backfat depth (mm) was measured just off the dorsal midline at the last rib.

Food Habits

Stomach contents were washed through 3 consecutive sieves of decreasing mesh size to separate the food items by size and to remove very fine particles of little value in identification (Korschgen 1962). Material remaining on the screens was identified to the lowest taxon possible. Relative item volume (total volume of 1 item as a percentage of the total volume of all items) was calculated for each collection season (summer: Jun–Aug, fall: Sep–Nov, winter: Dec–Feb, spring: Mar–May) (Martin et al. 1946).

Reproduction

Females were inspected for ovarian structures, fetuses, and lactating teats. Testis and epididymis weights (0.01 g) were determined for males. Farrowing month was estimated for hogs ≤30 weeks old by back-dating from the date of collection. Conception date was estimated by subtracting 116 days from the estimated farrowing date.

Data Analysis

Weights (body, adrenal, testis, and epididymis), heart girth, marrow fat percentage, back fat depth, and internal fat rating each were regressed against body length. To linearly model the nonlinear relationships among these variables and to stabilize error variance, body length, heart girth, and all weight measurements were log-transformed and back fat depth was square-root transformed. Regression parameter estimates then were used to adjust all measurements to a standard 1,000-mm body length for further analyses.

Body weight adjusted for body length served as a "plumpness index." This index was correlated to each of the length-adjusted physical condition measures (adrenal weights, heart girth, marrow fat percentage, and internal fat rating) to evaluate its use as a physical condition indicator for live hogs. Differences in length-adjusted measurements with respect to the 3 main effects of collection season, sex (non-barrow males and non-lactating females), and age (≤30 weeks and >30 weeks) were tested by analysis of variance (ANOVA).

Results and Discussion

Observations and Collections

Three hundred eighty-eight hogs were observed during the collection period. The number of hogs observed/hour was greatest during the spring and early summer months (Fig. 1). Percent juveniles observed increased in late fall and early winter and peaked in February and June (Fig. 1). Ninety-three (24%) of 388 hogs observed were collected; 51 (55%) were male and 42 (45%) were female. We were unable to collect the target of 144 hogs due to the unavailability of needed age and sex classes in some months.

The sex ratio among the 192 observed hogs for which sex could be ascertained was 1.00:1.00. However, males predominated in the juvenile and subadult classes (1.50:1.00) while females predominated (0.83:1.00) in the adult age class, a characteristic also noted for 121 hogs trapped in Levy County, Florida (Belden and Frankenberger 1979). In Great Smoky Mountains National Park, males predominated in samples of 550 (1.18:1.00) and 162 (1.08:1.00) European wild boar collected by Singer and Ackerman (1981) and Duncan (1974), respectively. The sex ratio of young hogs on the Dye Creek Ranch in Tehama County, California, was 1.00:1.00, but females predominated in the adult population (0.87:1.00), a phenome-

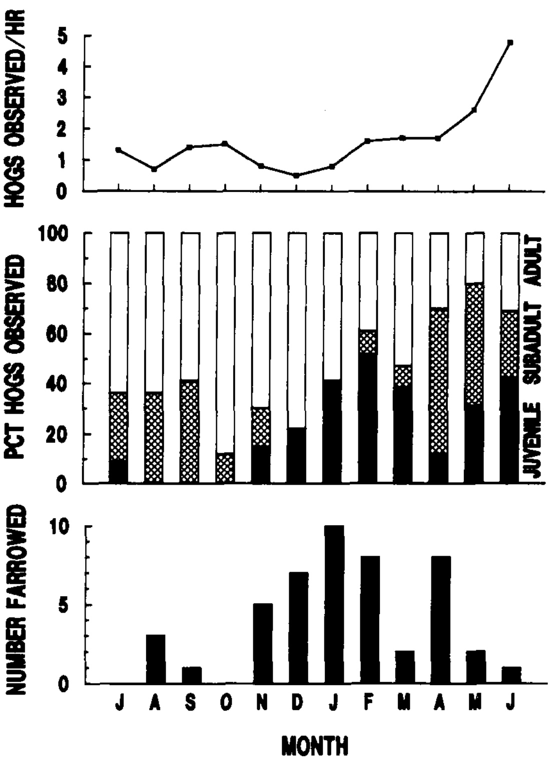

Figure 1. Hogs observed per hour, age class composition of observed hogs, and farrowing distribution of hogs <30 weeks old, by month on the Fisheating Creek Study Area, Florida, 1978–79.

non attributed to the selection for boars by hunters in past years (Barrett 1978). Conley et al. (1972) reported a preponderance of females among animals killed during the fall hunts on the Tellico Wildlife Management Area in Tennessee. We hypothesize that under natural, unhunted conditions, the adult sex ratio would be equal or would slightly favor males because of female mortality due to reproduction.

Physical Condition

We measured (weight, length, and girth) 86 hogs. As many as 82 (adrenal weight) and as few as 45 (back fat depth) of these hogs were measured for the remaining physiological characteristics (Table 1). Each measurement was positively related to body length ($P < 0.0001$).

Stribling et al. (1984) developed a body fat index by homogenizing whole carcasses from 2 feral hog populations and extracting lipids from subsample aliquots. This index was correlated with other measurements and indices to predict overall body condition. They concluded that no marrow index, external measurement, or combination of body measurements and/or body weight explained a significant proportion of the variability in the fat index. In our study, however, the plumpness index was positively correlated with a length-adjusted external measurement, heart girth, and 2 length-adjusted internal measurements, back fat depth, and internal fat rating ($P < 0.05$, Table 1). Thus, plumpness in live hogs may adequately reflect the component of physical condition related to internal fat measurements. In addition, heart girth, easier to measure on a live hog than weight, may be used in place of plumpness.

Adrenal cortical hormones are believed to be primarily involved in counteracting the effects of stress stimuli, and changes in the amount of adrenocortical tissue may reflect changes in the amounts of cortical hormones produced. Consequently, the

Table 1. Summaries of physiological measurements regressed on body length (mm) and of body weight measurement correlated with condition measures for hogs collected on the Fisheating Creek study area, Florida, July 1978–June 1979. Regression estimates were used to adjust weight and condition measures for body length prior to correlation analysis. Results are listed in descending order of correlation strength.

	Regression of measurement on body length			Correlation of length-adjusted body weight with length-adjusted measurement	
Measurement	*N*	b[a]	SE	*r*	*P*
ln (body weight [kg])	86	2.696	0.0517	–	–
ln (heart girth [mm])	86	1.012	0.0262	0.8341	<0.0001
(Back fat depth [mm])$^{0.5}$	45	3.113	0.6344	0.6634	<0.0001
Internal fat rating	48	7.283	1.2710	0.5339	0.0001
Marrow fat (% dry matter)	51	54.280	7.4770	0.1801	0.2061
ln (adrenal weight [g])	82	2.572	0.1383	0.0564	0.6148

[a] Estimated regression slope.

Table 2. Least squares means, standard errors, sample sizes, and back-transformed means of condition measures fit to ANOVA models with season, sex, and age effects for hogs collected on the Fisheating Creek Study Area, Florida, July 1978–June 1979. Condition measures were adjusted for body length (mm) via linear regression on body length. Means represent average condition measures standardized to a 1000 mm body length.

		ln(total weight [kg])				ln(heart girth [mm])				ln(adrenal weight [g])			
Effect	Level	$\bar{x}$	SE	N	$\bar{x}'$[a]	$\bar{x}$	SE	N	$\bar{x}'$	$\bar{x}$	SE	N	$\bar{x}'$
Season[b]	Summer	3.33A[e]	0.0307	26	27.9	6.493A	0.01484	26	661	−0.196A	0.0748	25	0.82
	Fall	3.28A	0.0361	19	26.6	6.482A	0.01746	19	653	0.141B	0.0885	18	1.15
	Winter	3.35A	0.0390	16	28.5	6.558B	0.01890	16	705	0.299B	0.0970	15	1.35
	Spring	3.42A	0.0402	16	30.6	6.552AB	0.01945	16	701	0.032AB	0.1000	15	1.03
Sex[c]	Male	3.36A	0.0244	42	28.8	6.531A	0.01181	42	686	0.005A	0.0609	39	1.00
	Female	3.33A	0.0268	35	27.9	6.512A	0.01299	35	673	0.134A	0.0657	34	1.14
Age[d]	Young	3.34A	0.0244	43	28.2	6.515A	0.01182	43	675	0.022A	0.0589	42	1.02
	Adult	3.36A	0.0276	34	28.8	6.528A	0.01338	34	684	0.117A	0.0700	31	1.12

		Marrow fat (% dry matter)			(Back fat depth [mm])$^{0.5}$				Internal fat index		
Effect	Level	$\bar{x}$	SE	N	$\bar{x}$	SE	N	$\bar{x}'$	$\bar{x}$	SE	N
Season	Summer	48.6A	5.23	12	3.09A	0.421	10	9.5	1.6AB	0.48	14
	Fall	80.9B	8.17	5	2.68A	0.336	15	7.2	2.8B	0.49	13
	Winter	67.2AB	4.86	13	3.74A	0.418	10	14.0	6.4C	0.54	11
	Spring	57.3AB	4.83	15	3.60A	0.532	6	12.9	−0.2A	0.89	4
Sex	Male	60.5A	3.53	27	3.17A	0.293	21	10.0	2.4A	0.42	20
	Female	66.5A	4.41	18	3.39A	0.314	20	11.5	2.9A	0.41	22
Age	Young	65.5A	3.93	29	3.25A	0.300	20	10.6	3.0A	0.44	20
	Adult	61.5A	4.41	16	3.30A	0.296	21	10.9	2.3A	0.39	22

[a]Back-transformed mean: $\bar{x}' = e^{\bar{x}}$ for log-transformed data; $\bar{x}' = \bar{x}^2$ for square-root transformed data.
[b]Summer: Jun–Aug; fall: Sep–Nov; winter: Dec–Feb; spring: Mar–May.
[c]Male: all non-barrow males; female: all non-lactating females.
[d]Young: ≤30 weeks; adult: >30 weeks.
[e]Means with the same letters are not different at the Bonferroni-protected 0.05 significance level.

amount of cortical tissue, as measured by adrenal weight, is an indirect measure of stress (Christian and Davis 1955). Both adrenal weight and internal fat levels were greater among hogs collected in fall and winter than in spring and summer (Table 2). Elevated stress may be associated with the fall and winter increase in social interaction related to breeding, farrowing, and pig raising. Springer (1977) observed the same trends in physical condition for hogs in Texas by using a visual assessment of body fat and general appearance.

Food Habits

In the spring and summer, the most important food categories by volume were herbage/foliage and roots/stems (Table 3). Ninety-seven percent of this volume consisted of various grasses (Gramineae), pickerel weed (*Pontederia* sp.), Asiatic pennywort (*Centella asiatica*), and other leaves. During fall and winter months, fruits/seeds was the most important food. Acorns (*Quercus* sp.), cabbage palm seeds, and citrus constituted 99% of this volume. The volume of animal material was small throughout the year (≤15%). Invertebrates comprised the greatest volume of animal material, primarily love bug (*Plecia nearctica*) and other Dipteran larvae (95%).

All reported food habits studies of wild hogs have shown forage selection to be highly seasonal and dependent on food availability (Sweeney 1970, Scott and Pelton 1975, Springer 1977, Barrett 1978, and Wood and Roark 1980). Plant material comprised most of the hog's diet in nearly all of these studies, with mast, particularly oak, predominating in fall and winter and herbage/foliage, particularly grasses, predominating in spring and summer. Animal matter, primarily invertebrates, was present in all studies.

The pig, a monogastric animal, is not well adapted to feeding solely on roughage

Table 3. Contents (% volume) of 93 wild hog stomachs collected in Fisheating Creek Study Area, Florida, 1978–79.

Food category	Summer[a](27[b])	Fall(20)	Winter(21)	Spring(25)	Overall(93)
Herbage/foliage	67.6	28.7	25.5	46.6	46.9
Fruits/seeds	0.1	56.9	47.0	6.3	22.6
Roots/stems	23.1	7.3	6.0	34.0	18.8
Mushrooms	0.1	0.3	0.0	0.1	0.1
Total plant	90.9	93.2	78.5	87.0	88.4
Invertebrates	3.3	2.0	14.1	8.4	6.0
Vertebrates	tr[c]	0.2	0.9	0.3	0.3
Total animal	3.3	2.2	15.0	8.7	6.3
Miscellaneous	5.8	4.6	6.5	4.3	5.3
Total	100.0	100.0	100.0	100.0	100.0

[a] Summer: Jun–Aug; fall: Sep–Nov; Winter: Dec–Feb; Spring: Mar–May.
[b] Number of stomachs examined.
[c] <0.1%.

and must obtain from its diet certain essential vitamins and amino acids (Barrett 1978), the latter derived from dietary protein (Pond and Houpt 1978). Animal matter is the best source of essential amino acids, but young, fresh forbs provide reasonably high-quality protein (Barrett 1978).

Successful hog reproduction in some areas is directly related to acorn mast (Matschke 1964, Henry 1966, Henry and Conley 1972, Singer and Ackerman 1981), most likely due to the increased energy intake and subsequent "flushing" of the ovaries (Zimmerman et al. 1960). However, acorns contain relatively little crude protein in relation to total energy (Barrett 1978). Therefore, hogs must balance an acorn-heavy diet with increased intake of protein. Because protein needs are particularly great for lactating sows and thus influence piglet survival, it can be a limiting factor to hog productivity (Barrett 1978).

Grass, which comprised most of the hog's diet in our study area, is a relatively poor source of energy as highly indigestible cellulose constitutes most of its carbohydrate content (Barrett 1978). Therefore, the wild hog's diet may be seasonally deficient in energy and protein. Hogs may obtain sufficient energy from a fall and winter acorn diet, but protein deficiencies may limit efficient use of this energy source. The herbage/foliage diet of the spring and summer is probably well balanced, but its high cellulose content may limit energy availability (Barrett 1978).

Reproduction

Thirty-one of 42 (74%) female hogs collected were of reproductive age (>6 months), and 19 (61%) of these were reproductively active (either pregnant or lactating). The mean number of corpora lutea, fetuses, and lactating teats among reproductively active females was 7.3, 6.5, and 3.5, respectively. Productivity (number of corpora lutea) among 8 > 1-year-old females ($\bar{x}$ = 8.0; SD = 2.39) was not appreciably greater than that among 4 < 1-year-olds ($\bar{x}$ = 6.0; SD = 2.45, t = 1.36, P = .2049). These reproductive parameters are comparable to those derived in other studies on wild hogs (Table 4). Mean number of fetuses per pregnant sow was high when compared to other hog studies, whereas litter size based on the number of lactating teats was low.

Several studies related the proportion of reproductively active females in the hog population to acorn crop success. Barrett (1978) reported reduced litter sizes in sows fed diets either very high or very low in digestible energy and diets deficient in individual nutrients, particularly protein. Singer and Ackerman (1981) reported averages of 52% and 8% of females >6 months old breeding during each season of abundant food (37%–56%/season) and during a 12-month period following a mast failure, respectively. Conley et al. (1972) reported 0%–100% ($\bar{x}$ = 39.4%) of 154 females examined during 1961–1969 on the Tellico Wildlife Management Area in Tennessee were reproductively active. He attributed the year-to-year variation to annual differences in mast availability. Conception rates < 100% also may be caused by high hog density, sow obesity (Conley et al. 1972), abnormal anatomy, cystic follicles, bacterial infections in the female reproductive tract, bacterial infections in

Table 4. Summary of female wild hog reproductive data from this study and from the literature.

		P/L[b]		Corpora lutea			Fetuses			Lactating teats				
Location	Source[a]	%	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N	Prenatal loss %[c]	Post partum loss %[d]
Florida	This study	61	31	7.3	2.5	12	6.5	2.4	4	3.5	1.2	6	11	46
	2.	69	13	6.4	1.8	9	5.5	0.7	2	3.6	1.3	8	14	35
	3.			8.3		7	6.8		6	4.8	2.2	26	18	29
California	4.	100	71	8.5	0.6	64	5.6	0.5	54				34	
	5.						5.0							
South Carolina	6.	69	16	9.8	3.8	10	7.4	2.4	8				24	
	7.						5.3	2.1	41	4.3	1.8	34		19
Tennessee	8.	39	154	6.3		37	4.8		50	4.2			24	12
	9.	73	56	5.6	1.6	8	3.0	0.9	6	3.8	1.1	5	46	
	10.	52					4.8	0.6	24	2.9	0.2	57[e]		40
Texas	11.						4.2							
Overall		66		7.5	1.5	7	5.4	1.2	11	3.9	0.6	7	28	28

[a]Sources: 2. Belden and Frankenberger (1979). 3. Strand (1980). 4. Barrett (1978). 5. Pine and Gerdes (1973). 6. Sweeney (1970). 7. Wood and Brenneman (1977). 8. Conley et al. (1972). 9. Duncan (1974). 10. Singer and Ackerman (1981). 11. Springer (1977).

[b]Percent of mature females examined which were either pregnant or lactating.

[c]100-($\bar{x}$ fetuses)/$\bar{x}$ corpora lutea).

[d]100-($\bar{x}$ lactating teats)/($\bar{x}$ fetuses).

[e]Based on observation of litters <4 months old.

boar semen, and reproductive diseases including brucellosis and leptospirosis (Pond and Houpt 1978).

Domestic gilts typically reach puberty near 200 days of age (150–250 days, Pond and Houpt 1978). The age class of the youngest pregnant female in our study was 20–33 weeks, but only 2 of 8 females collected in this age class were pregnant. Sixty percent of females 30–51 weeks and 79% of females >1 year old were reproductively active. Reflecting this trend, mean numbers of fetuses per sow <1 year old and >1 year old were 4.5 (SD = 0.7) and 8.5 (SD = 0.7), respectively. The ovulation rate in domestic hogs increases with succeeding parities up to 7 or more, but the number of pigs born peaks at about the fourth or fifth parity (Anderson 1974).

Duncan (1974) related testis weight to sexual maturity by examining the tail of the epididymis for the presence of spermatozoa. Testis weights of some male hogs 20–33 weeks old on the Fisheating Creek Study Area are similar to those of mature hogs in Duncan's (1974) study; thus, males may reach puberty in this age class. Based on testis weights, 1 of 6 in this age class was sexually mature, whereas 5 of 6 in the 30–51 week age class and all 11 males >1 year old were sexually mature. Some variation in age at maturity is attributed to rate of growth with earlier maturity associated with faster growth. Nutrition also influences age at puberty as severe limits on the total feed intake, certain vitamin deficiencies (particularly vitamin B_{12}), protein deficiency, and obesity all retard sexual maturity (Pond and Houpt 1978).

Mean summer and fall testis and epididymis weights, adjusted for body length, were slightly, but not significantly, greater than those of winter and spring (Table 5). Although male hogs are capable of breeding year-round, a peak in reproductive activity in these seasons agrees with the late summer and early fall peak observed

Table 5. Least squares means, standard errors, sample sizes, and back-transformed means of male reproductive tract measures, fit to ANOVA models with season and age effects, for hogs collected on the Fisheating Creek Study Area, Florida, July 1978–June 1979. Reproductive tract measures were adjusted for body length (mm) via linear regression on body length. Means represent average reproductive tract measures standardized to a 1,000-mm body length.

		ln(testes weight [g])				ln(epididymis weight [g])			
Effect	Level	$\bar{x}$	SE	N	$\bar{x}'$[a]	$\bar{x}$	SE	N	$\bar{x}'$
	Summer	3.755A[d]	0.1284	10	42.73	2.645A	0.0996	10	14.08
Season[b]	Fall	3.758A	0.1306	10	42.86	2.588A	0.1013	10	13.30
	Winter	3.612A	0.1365	9	37.04	2.278A	0.1059	9	9.76
	Spring	3.638A	0.1306	10	38.02	2.382A	0.1013	10	10.83
Age[c]	Young	3.724A	0.0890	22	41.43	2.494A	0.0683	22	12.11
	Adult	3.658A	0.1013	17	38.78	2.452A	0.0786	17	11.61

[a]Back-transformed mean: $\bar{x}' = e^{\bar{x}}$ for log-transformed data.
[b]Summer: Jun–Aug; Fall: Sep–Nov; Winter: Dec–Feb; Spring: Mar–May.
[c]Young: ≤30 weeks; Adult: >30 weeks.
[d]Means with the same letters are not different at the Bonferroni-protected 0.05 significance level.

in breeding activity. The peak farrowing period was from December through February, with a smaller surge in April (Fig. 1).

All studies that have addressed wild hog reproduction indicate that hogs can breed and farrow year-round. However, all studies, with the exception of Singer and Ackerman (1981), have reported farrowing peaks. Two peaks are somewhat distinct: 1 in late fall and winter, and 1 in spring and early summer. These periods are close to the "natural" early summer and late autumn breeding seasons for domestic swine (Barrett 1978). Reproduction in feral populations is undoubtedly closely tied to nutrition through its effects on estrus and breeding behavior, growth and sexual maturity, gestation, lactation, and frequency of breeding. On the Fisheating Creek Study Area, breeding activity probably increases with the beginning of the acorn drop in August and continues through the fall as long as mast is available. A smaller surge is associated with the "spring green-up." The resulting farrowing peak is in December through February with a smaller peak in April. On areas without oak trees or in years of mast failure, a spring and early summer farrowing peak should be expected.

Management Implications

Data gathered in this study suggest that late summer and early fall is the best time to harvest a south Florida hog population on a sustained yield basis. At this time of year, there are few suckling sows, and the subadult population (the harvestable surplus) relative to the adult breeding population (free of dependent pigs) is at its greatest. Harvesting during this period also would reduce the population immediately prior to the acorn drop, thereby reducing the competition for available food and raising the nutritional plane for the remaining breeding stock. In turn, number and survival of pigs farrowed should increase, augmenting the harvestable surplus for the next year.

Literature Cited

Anderson, L. L. 1974. Pigs. Pages 275–287 *in* E. S. E. Hafez, ed., Reproduction in farm animals. Lea and Febinger, Philadelphia, Pa.

Barrett, R. H. 1978. The feral hog on the Dye Creek Ranch, California. Hilgardia 49:281–355.

Belden, R. C. and W. B. Frankenberger. 1979. Job completion report—Brunswick hog study. P-R Proj. W-41-R, Study XIII-B-I. Fla. Game and Fresh Water Fish Comm. 7pp.

Christian, J. J. and D. E. Davis. 1955. Reduction of adrenal weight in rodents by reducing population size. Trans. North Am. Wildl. Conf. 20:177–189.

Conley, R. H., V. G. Henry, and G. H. Matschke. 1972. Final report for the European wild hog research project W-34. Tenn. Game and Fish Comm. 259pp.

Duncan, R.W. 1974. Reproductive biology of the European wild hog (*Sus scrofa*) in the Great Smoky Mountains National Park. M.S. Thesis, Univ. Tenn., Knoxville. 95pp.

Henry, V. G. 1966. The European wild hog hunting season recommendations based on reproductive data. Proc. Annu. Conf. Southeast Assoc. Game and Fish Comm. 20:139–145.

——— and R. H. Conley. 1972. Fall foods of European wild hogs in the southern Appalachians. J. Wildl. Manage. 36:854–860.

Henson, T. M. 1975. Age determination and age structure of European wild hog (*Sus scrofa*). Tenn. Wildl. Resour. Agency Tech. Rep. 75–8. 59pp.

Korschgen, L. J. 1962. Food of Missouri deer, with some management implications. J. Wildl. Manage. 26:164–172.

Martin, A. C., R. H. Gensch, and C. P. Brown. 1946. Alternative methods in upland gamebird food analysis. J. Wildl. Manage. 10:3–12.

Matschke, G. H. 1964. The influence of oak mast on European wild hog reproduction. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 18:35–39.

———. 1967. Aging European wild hogs by dentition. J. Wildl. Manage. 31:109–113.

Pine, D. S. and G. L. Gerdes. 1973. Wild pigs in Monterey County, California. Calif. Fish and Game 59:126–127.

Pond, W. G. and K. A. Houpt. 1978. The biology of the pig. Cornell Univ. Press, Ithaca, N.Y. 371pp.

Scott, C. D. and M. R. Pelton. 1975. Seasonal food habits of the European wild hog in the Great Smoky Mountains National Park. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 29:585–593.

Singer, F. J. and B. B. Ackerman. 1981. Food availability, reproduction, and condition of European wild boar in Great Smoky Mountains National Park. Res./Resour. Manage. Rep. 43, Upland Field Res. Lab., Great Smoky Mountains Natl. Park. 52pp.

Springer, M. D. 1977. Ecologic and economic aspects of wild hogs in Texas. Pages 37–46 *in* G. W. Wood, ed., Research and management of wild hog populations. The Belle W. Baruch For. Sci. Inst. Clemson Univ., Georgetown, S.C.

Strand, D. K. 1980. Reproductive ecology and behavior of the Florida feral hog (*Sus scrofa*). M.S. Thesis. Fla. Inst. Tech. 163pp.

Stribling, H. L., I. L. Brisbin, Jr., J. R. Sweeney, and L. A. Stribling. 1984. Body fat reserves and their prediction in two populations of feral swine. J. Wildl. Manage. 48:635–639.

Sweeney, J. M. 1970. Preliminary investigations of a feral hog (*Sus scrofa*) population on the Savannah River Plant, S.C. M.S. Thesis, Univ. Ga. 58pp.

———, E. E. Provost, and J. R. Sweeney. 1970. A comparison of eye lens weight and tooth irruption pattern in age determination of feral hogs (*Sus scrofa*). Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 24:285–291.

Wood, G. W. and R. E. Brenneman. 1977. Research and management of feral hogs on Hobcaw Barony. Pages 23–35 *in* G. W. Wood, ed., Research and management of wild hog populations. Belle W. Baruch For. Sci. Inst., Georgetown, S.C.

——— and D. N. Roark. 1980. Food habits of feral hogs in coastal South Carolina. J. Wildl. Manage. 44:506–511.

Zimmerman, D. R., H. G. Spies, H. L. Self, and L. E. Casida. 1960. Ovulation rate in swine as affected by increased energy intake just prior to ovulation. J. Anim. Sci. 19:295.