ECOLOGICAL COMPARISON OF TWO WILD PIG POPULATIONS IN SEMI-ARID AND SUB-ALPINE AUSTRALIA

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Abstract: The ecology of two distinct feral pig populations in south-eastern Australia were compared. Study sites consisted of: 1. a sub-alpine region with open grassy plains and heavily timbered mountains; 2. permanent marshes surrounded by perennial grasslands of the semi-arid western plains. Parameters examined included reproductive data, age structures, mortality rates, food availability, population density, health and age-specific morphometrics. The sub-alpine population appeared to be relatively stable and had a marked seasonality of breeding with a general period of anoestrus through autumn and early winter. This was attributed to a decreasing availability of high protein food during these seasons. Population density was then much lower as that of marsh population which had a relatively constant rate of conceptions throughout the year and potential rates of explosive increase dependant on food availability. Age-specific body weight and body length were greater in the sub-alpine population. Similarly, overall health was much better with no evidence of the heavy parasitic burdens which were found in the semi-arid population.

Keywords: Feral pig, *Sus scrofa,* Suidae, Reproduction, Density, Health, Environment, Food availability.

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1. Introduction

The feral pig *(Sus scrofa)* is the only member of the family Suidae to be found wild in Australia and is also the most common and widespread feral domestic mammal (Wilson *et al.*, 1992). Pullar (1953) concluded that Australian feral pigs originated from escaped domestic stock and that there was no evidence of their existence prior to European settlement. Similarly there was no evidence to suggest the deliberate release of the true Eurasian Wild boar. Pigs are considered a major pest of agriculture and the environment, and at the same time have positive resource values for recreational hunting and export of game meat (O'Brien & Meek, 1992). The information presented in this paper resulted from two separate field studies of feral pigs reported by Giles (1980) and Saunders (1988). Because the studies were conducted at different times using various sampling strategies, statistical significance has not been ascribed to the comparisons which are presented.

2. Methods

2.1. Study sites

1. Sub-alpine: The Long Plain/Yarrangobilly Caves are situated in Kosciusko National Park (36°43'S,148°32'E), south-eastern New South Wales. The park is mostly wilderness and topography varies from large areas of open grassy plains at altitudes of 1,100 m to heavily timbered mountains, the highest at 1,620 m. The climate is cool, moist temperate, with no month frost free. Snow cover is not often continuous, but occasionally heavy snowfalls may lie on the ground for a number of weeks. Average yearly rainfall is approximately 1,500 mm, with high reliability. Temperatures range from average maximums of 21.2°C in January to 4.0°C in July.

2. Semi-arid: 'Oxley' station, primarily a cattle grazing property, is situated at the southern edge of the Macquarie Marshes in the western plains of N.S.W. (30°15'S, 149°29'E). The site is dominated by shallow marsh with the remainder, open woodland and perennial grassland. The climate is hot and semi-arid with temperatures ranging from average maximums of 34.6°C in January to 16.8°C in July. Rainfall in the area can vary greatly from year to year with an average of approximately 440 mm.

2.2. Population structure, reproduction and mortality

Capture-recapture programmes were conducted at both sites. Animals required for post-mortem were either shot, trapped or captured by dogs. Age of captured animals was determined by

tooth eruption and molar wear (Matschke, 1967). All adult sows were examined for signs of pregnancy or lactation. Crown-rump measurements were used to estimate foetal age (Henry, 1968). A gestation period of 114 days (Day, 1962) was used to calculate birth dates. Life tables for both populations were constructed using methods described by Caughley (1977). Age classes were delineated so that there was no overlap between breeding seasons.

2.3. Variations in age specific body measurements

The relationship of mean age with body weight and head/body length was used to examine comparative growth rates and body condition at the two sites. These were assumed to vary according to food supply and energy requirements.

2.4. Food habits, diseases and parasites

Post-mortem examinations, for evidence of pathogenic or parasitic infection, were made of animals destroyed during the course of the studies. Stomach contents for adult pigs were examined macroscopically with the relative volumes of major food items estimated visually.

2.5. Population estimates

Total population estimates were derived at both study sites. At Kosciusko the method of estimating population size involved the laying of bait stations every 1 km along fire trails, each of which was checked daily over 33 days of a trapping evaluation. By fitting a model to the percentage of bait trails removed by pigs against the cumulative number of pigs destroyed it was possible to estimate the total kill required to reduce the percentage bait take to zero, presumably equivalent to a pig population of zero. At Oxley, estimates were obtained from aerial survey using the index-removal method (Caughley, *op. cit.*). Aerial surveys of feral pig abundance using helicopters were conducted immediately before and after an extensive control program during which a known number of individuals were removed from the population.

3. Results

3.1. Population structures, reproduction and mortality

The distribution of conceptions at Oxley was relatively constant throughout the year indicating no seasonal trend in reproduction. Distribution of births (N=536) was less predictable although this tendency reflected variation among seasons in juvenile survival rather than variation in births. This, however, was in marked contrast to Kosciusko where there was a strong tendency for births to occur in summer and early autumn (N=177). Of a sample of 155 adult sows shot throughout the year, no pregnancies were recorded from March through to the end of July (N=89). These observations are also reflected in the estimated annual frequency of births (1.93 at Oxley compared to 0.84 at Kosciusko).

Comparative life tables for the sub-alpine and semi-arid populations are presented in table 1. All other comparative population parameters are presented in table 2.

3.2. Variations in age specific body measurements

Morphometric measurements were collected from 182 pigs at Kosciusko and 242 at Oxley. For any given age, males and females at Kosciusko were markedly larger, particularly in body weight, than their Oxley counterparts.

3.3. Food habits, diseases and parasites

Specific details of food habits are provided in Giles (*op. cit.*). Examination of the stomach

Table 1: Comparative life tables for sub-alpine and semi-arid wild pig populations.

Age Class	Sub-alpine			Semi-arid		
x	lx	dx	qx	lx	dx	qx
0	1.00	0.85	0.85	1.00	0.89	0.89
1	0.15	0.06	0.40	0.11	0.03	0.27
2	0.09	0.02	0.22	0.08	0.02	0.28
3	0.07	0.02	0.29	0.06	0.03	0.45
>4	0.05	0.02	1.00	0.03	0.03	1.00

Table 2: Comparative population parameters for sub-alpine and semi-arid wild pig populations.

Population Parameters	Sub-alpine (Kosciusko)	Semi-arid (Oxley)
Mean Litter Size	6.58	6.36-7.39
Sex Ratio (M:F)	1:1 (106:106)	1.2:1 (898:755)
Yearly Frequency of Births	0.84	1.93
Population Density (/ km^2)	1.6	10

contents of a small number of pigs from Kosciusko revealed the stems and roots of Poaceae to be the most common food item. The only other common plant item was *Medicago* sp. At both sites, green herbaceous material and roots, fruit and seed made up the bulk of the stomach contents. Animal material, mostly carrion from cattle, was commonly found at Oxley but not Kosciusko, reflecting the difference in enterprises at the two sites. Frogs were the next most common animal item followed by beetles, earthworms and insect larvae. Most pigs examined post-mortem at Kosciusko were in extremely good condition with a low incidence of disease and parasites. The most common parasites were those found in the gut (*Ascarops strongylina*, *Hyostrongylus rubidus* and *Physocephalus sexalatus*), although none of these were found at high levels of infestation. Infection with gut parasites in the Oxley population was much more severe, particularly for *Macracanthorhyncus hirudenaceus* and *P. sexalatus*. The extent to which these infections reduced fitness and survival of pigs at Oxley could not be determined. However, post-mortem observations such as thickening of the intestinal wall and partial occlusions of the lumen, particularly in juvenile pigs, suggest that body condition at least would have suffered.

3.4. Population estimates

At Kosciusko a number of models were fitted by regression to the percentage of bait stations removed by pigs against the cumulative number of pigs destroyed during the trapping evaluation. The most appropriate model was that which assumed the cumulative rate of kill approximated a quadratic curve. This model was used to estimate the cumulative kill required to reduce the percentage bait take per day to zero. The predicted kill and hence population size was 229 pigs using the following model:

$$y = 228.9 - 484\,x + 301\,x^2 \qquad (R^2 = .792)$$

A population of 229 is equivalent to a density of approximately 1.6 animals per km^2 over the entire study site. At Oxley, the population indices calculated from the helicopter surveys were 432 before reduction and 87 immediately after. A total of 989 pigs were removed during the control exercise giving an initial estimated population of 1238 pigs which was equivalent to 10/km^2. Crude estimates derived previously during capture/recapture programmes indicated that in favourable conditions pig populations on Oxley could peak as high as 50/km^2.

4. Discussion

The most notable difference between the two populations was the marked seasonality in reproductive activity found at Kosciusko compared to continuous breeding at Oxley. The available evidence suggests that a regular seasonal decline in food supply at Kosciusko was the initiate of anoestrus. A high-protein food available in the spring increased body condition and initiated breeding while a decreasing availability of high-protein food in the autumn and winter months caused reduced rates of conception. In an environment such as Kosciusko where winter growth of these plants would be retarded by frost and snow, a flush of growth, and hence increased protein and energy levels, would be expected in the spring. For example, the seasonal accumulation of total dry matter (kg / ha) for *Poa* grass increases by 530% from minimum yearly production in winter to a maximum in spring (Robinson & Archer, 1988). At Oxley, pig populations fluctuated markedly in response to seasonal conditions, and were limited by the availability of dietary protein. This was obtained mostly through ingestion of fresh green legumes, grasses and forbs. Animal matter (mostly as carrion) was a valuable supplement when available. Fresh green vegetation was available only after heavy rain. When it was short in supply, pigs obtained most of their food from roots and other starch rich plant organs, which are relatively rich in digestible carbohydrate, but contain lit-

tle protein. When little green pasture was available, survival of young piglets was very low, mostly due to a lack of dietary protein for suckling sows, but most adult sows continued to breed. Despite the seasonal variation in reproduction at Kosciusko, there was no evidence to suggest that longer-term population trends were other than stable. This apparent stability is probably related to the relative consistency in climate for the area. Variation in climate is greater in semi-arid regions where pig populations have the potential to double as a result of favourable rainfall and temperature.

A population density of 1.6 pigs/km^2 at Kosciusko was markedly less than the peak estimates of 50/km^2 suggested at Oxley. These probably reflect the productivity of the respective environments. Age-specific body weight and body length at Kosciusko were greater than those found at Oxley (Saunders, 1993). Age-specific weight and length measurements declined markedly at Oxley when competition for available food was particularly high. Large body size can confer advantages consistent with the effect of a harsh environment. These include: reduction in relative heat loss; the ability to move longer distances in search of food; and the ability to survive on qualitatively inferior food (Clutton-Brock & Harvey, 1983).

In conclusion, the differences between the Kosciusko and Oxley populations are substantial. The sub-alpine habitat was obviously marginal for feral pigs as evidenced by environmental productivity, population density and seasonality of breeding. In seeming contradiction was the relative good health and body size of Kosciusko's pigs. This was attributable to low densities, the lack of competition for resources and biological advantages associated with large body size. In contrast to the stability of the sub-alpine population, the semi-arid study revealed potential rates of increase to be explosive dependant on prevailing seasonal conditions.

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