ERADICATION OF FERAL PIGS (*SUS SCROFA*) FROM SANTA ROSA ISLAND, CHANNEL ISLANDS NATIONAL PARK, CALIFORNIA

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ABSTRACT

Feral pigs were eradicated from Santa Rosa Island, Channel Islands National Park between July 1990 and March 1993. The eradication occurred in three phases. Phase I included planning and design of a monitoring program. Phase II was testing and refinement of the monitoring program. Monitoring involved recording the frequency and distribution of pig sign on eighty-two belt transects stratified by habitat. Removal of pigs, through baiting and shooting, was compared to shifts in distribution and changes in relative abundance of pigs. Phase III involved pig eradication by contract hunters. Prior to implementation of Phase III, aerial surveys estimated the pig population at 1,400 (SE=±400). A total of 1,175 pigs were killed. Eradication strategies included systematic ground hunts (n=816), systematic hunts with dogs (n=88), road hunts (n=4), aerial hunts (n=261) (including forward-looking infrared cameras (n=2), and trapping (n=6). National Park Service personnel expended 700 hours in search of pigs during Phase II. Contractors expended 7,000 hours in search of pigs during Phase III. Since March 1993, no pigs or fresh pig signs have been found on the island. Observations and preliminary data from post-eradication monitoring indicate a favorable response by some fleshy-rooted plants and vegetation communities.

Keywords: Santa Rosa Island, feral pigs, monitoring, eradication strategies.

INTRODUCTION

The origin of feral pigs on the California Channel Islands is uncertain. Pigs are presently found on Santa Catalina, Santa Cruz, and formerly on San Clemente and Santa Rosa islands (SRI). Many authors have suggested that Spaniards introduced pigs to the Channel Islands during the late 1600s in order to have a supply of fresh meat during subsequent landings. Early writings pertaining to SRI fail, however, to mention the presence of pigs prior to the mid-1800s (Holland 1962; Collins 1981). The origin of SRI pigs is most likely from an 1853 introduction by a former landowner.

San Clemente and Santa Catalina island populations are from original SRI stock (Overholt and Sargent 1971). A syndactyl breed of pig was introduced to Santa Catalina during the 1960s, although very few pigs currently remain on the island with this morphological characteristic (D. Garcelon, pers. comm. 1990). A transfer of pigs during the 1930s from Santa Rosa Island to Santa Catalina Island and a subsequent introduction from Catalina Island to San Clemente Island in the mid-1950s represents the anthropogenic expansion of feral pigs within the northern Channel Islands during the twentieth century.

The ecological effects of feral pig populations vary greatly from area to area, depending upon the density of pigs and relative sensitivity of the ecosystems (Singer 1981). In general, impacts are more severe where pig densities are high and within sensitive plant communities, especially where invasive exotic plants prevail and where sensitive surface-dwelling terrestrial vertebrates occur (Bratton 1975). The impacts of feral pigs on island ecosystems are well documented (Hochberg 1980; Baber 1985; Baber and Coblentz 1986; Coblentz and Baber 1987; Sterner 1990). Feral pig impacts on SRI were qualitatively determined to be increases in siltation and soil erosion along stream courses, damage to the island's rangelands, and severe soil erosion which undermined the root systems of endemic island oaks (*Quercus tomentilla*). Pig foraging on acorns prevented natural regeneration of island oak. Areas of pig rooting create optimum growing conditions for invasive exotic plants such as spiny clotbur (*Xanthium spinosum* L.), milk thistle (*Silybum marianum* L.), and burr thistle. Additionally, a number of native plant species had been impacted by feral pigs (Table 1). Archaeological sites, especially those located in caves, had been heavily impacted by feral pig rooting and bedding behavior (D. Morris, pers. comm. 1990; C. Lombardo, pers. obs. 1990).

In 1949 and again in the early 1950s, hog cholera was introduced to SRI as a means of controlling pig numbers. The first introduction produced about 80% mortality in the pigs, the second introduction was less effective (N.R. Vail, pers. comm. 1990). A survey of sera and tissues from 61 pigs collected from Santa Rosa in 1987 indicated that the virus was no longer active on the island (Nettles et al. 1989). During the period from the early 1960s until government ownership of the island in 1986, the Vail and Vickers Company maintained a shoot-on-sight policy in an effort to

Table 1. Plant species impacted by feral pigs on Santa Rosa Island, Channel Islands National Park.

Species	Common Name	Status[a]
Arabis hofmannii	Hoffman's rock cress	E
Arctostaphylos confertiflora	SRI manzanita	E
Castilleja hololeuca	island paintbrush	
Castilleja mollis	soft-leaved paintbrush	E
Coreopsis gigantea	giant coreopsis	
Dudleya blochmaniae s. insularis	SRI Island live-forever	
Galium buxifolium		E
Gilia tenuiflora hoffmanii		E
Heliantheum greeni	island rushrose	T
Heuchera maxima	island allum-root	
Lyonothamus floribundus	Santa Cruz Island ironwood	
Berberis pinnata s. Brachyloba	island barberry	E
Orobanche parishii s. Insularis	shortlobed broomrape	
Phacelia insularis s. Insularis	island phacelia	E
Pinus torreyana s. Insularis	Torrey pine	
Quercue tomentella	island oak	
Salvia branegei	SRI sage	

[a] Federal status reported only. E=Federally Endangered T=Federally Threatened

control pig numbers. Even with this action, pig numbers were affected more by the seasonal availability of food and water than by direct reduction (N. R. Vail, pers. comm. 1990).

National Park Service (NPS) management policies direct the control or eradication of exotic animal species which have a detrimental impact upon native ecosystems and ecological processes. The policy states: "Manipulation of population numbers of exotic plant and animal species, up to and including total eradication, will be undertaken whenever such species threaten protection or interpretation or resources being preserved in the park."

Many national parks are implementing control and eradication programs for feral/wild pigs with varied success. The goal of feral pig management on SRI was eradication of the population and eventual restoration of native ecosystems to pre-European conditions. The compounding effects of other large herbivores on the island may partially mask the recovery of SRI communities post-eradication, however, feral pig removal was identified as the highest natural resource management priority by both private and Federal interests within the Channel Islands.

The complete eradication of an exotic species such as feral pigs from large areas (>1000 hectares) is a huge endeavor. Eradication programs of the magnitude of the SRI program have been conducted on private and public lands, but never documented to any great degree (Goatcher 1989; C. Winchell, pers. comm., 1992). Successful control programs have been instituted on larger areas (Korn 1986; Hone and Stone 1989).

STUDY AREA

Channel Islands National Park (CHIS) was established to protect the nationally significant natural, scenic, wildlife, marine, ecological, archeological, cultural, and scientific values of the Channel Islands off the coast of southern California (P.L. 96-199, Title II, March 5, 1980). CHIS includes the northernmost five of the eight California Channel Islands (Anacapa, Santa Barbara, Santa Cruz, San Miguel, and SRI) and the surrounding one nautical mile of ocean. SRI was purchased from the Vail and Vickers Company in December 1986. Vail and Vickers continues a commercial hunt for nonnative deer and elk on SRI under a Special Use Permit. Between 2,500 and 5,000 cattle were on the island during the period of eradication.

SRI lies 72 km west of Ventura, and 48 km southwest of Santa Barbara, California. Approximately 21,450 hectares in size, the topography of SRI is dominated by an east-west trending highlands region with an impressive array of lateral canyons trending primarily north and south. The northern side of the island has an extensive marine terrace rising gently from steep sea bluffs to the central highlands. The south side possesses shorter, steeper and more narrow canyons extending from the highlands to the ocean. The coastline of SRI is dominated by rocky intertidal areas, with well developed sandy beaches and dunes on the southwestern and northeastern shores. A small tidal marsh is present on the eastern portion of the island.

Eighteen distinct plant communities have been documented on SRI (Clark et al. 1990). Grassland accounts for over 65% of the total area, mixed-oak woodland comprises 0.35% of the island. The remainder of the island is covered by either low growing shrubs (25.2%; coastal sage scrub, mixed chaparral, and baccharis scrub) or is devoid of vegetation due to erosion and blowing sand (6.9%).

A depauperate native mammal fauna includes island fox (*Urocyon littoralis santarosae*), deer mice (*Peromycus maniculatus santarosae*), and spotted skunk (*Spirogale gracilis amphalia*). Introduced alien herbivores include cattle (*Bos taurus*), horses (*Equus caballus*), elk (*Cervus elaphus* spp.), mule deer (*Odocoileus hemionus*), and feral pigs. All sheep (*Ovis aries*) had been removed from the island by the late 1950s. Land birds are abundant locally as residents or seasonal migrants, 31species are known or conjectured to breed on the island (Diamond and Jones 1980). There are only four recorded species of reptiles and amphibians.

METHODS

Phase I Planning (Early efforts)

Davis (1987), in cooperation with pig removal experts and park managers, developed an initial strategy for removal of feral pigs from SRI which included: 1) dividing the island into six management units by erecting new pig proof fencing or modifying existing cattle fencing, 2) removal of 60 to 70% of pigs within each unit by trapping, 3) remove remaining pigs with coordinated teams of shooters, and 4) assure complete removal by hunting with trained pig dogs and population monitoring. This eradication strategy was a fail safe operation. If complete removal of pigs within an individual unit was not achieved, fencing would serve to limit future population expansion. In contrast to Davis (1987), Goatcher (1989) proposed trapping and the use of highly trained pig dogs as the primary means of effecting

complete eradication on SRI. Fencing was not considered a critical component of Goatcher's plan, rather it was viewed as providing a false sense of security for actual accomplishments.

In 1990, after redefining eradication objectives, a new strategy was developed which combined functional aspects of Davis (1987), Goatcher (1989), and other eradication programs. The resultant strategy was more or less an all or nothing approach and relied heavily on intensive eradication pressure applied evenly, although differential by method, throughout the program. The extensive use of helicopters as a shooting platform early in the eradication was viewed as an important first step in reducing pig numbers prior to more labor intensive eradication strategies.

Fencing to prevent or reduce pig movement was not used during the eradication program. Hone and Atkinson (1983) tested fence designs for their ability to stop feral pig crossings and reported that certain design and electrification configurations were effective in reducing or virtually eliminating pig movement, but only a complete wire mesh fencing was totally pig-proof. Davis (1987) estimated that approximately 40 miles of similar pig-proof fencing as either new construction or modification of existing cattle fencing would be needed to divide SRI into manageable units. The estimated cost for fencing would have exceeded $400,000.

Monitoring and Evaluation

For the pig eradication, the island was divided into seven management zones based upon geographical boundaries and existing cattle fencing (Figure 1). Two island-wide aerial surveys for pigs were conducted in early to mid-January 1991, at one week intervals. Surveys were begun in the early morning (0700 hrs) and concluded shortly after noon each day. Late afternoon/early evening (1500 to1700 hrs) searches were also conducted. Surveys were begun on the eastern portion of the island, covering each canyon/drainage at a low altitude (approx. 50 m) and slow forward air speed. Areas with broad flat terraces were surveyed at a higher altitude using the methods of Davis (1987). The approximate stopping point for the morning survey was the start point for the late afternoon search. Weather conditions at the time of survey (85° F) suggested that diurnal movements of pigs would be minimal or would not occur. This was substantiated during late morning when the majority of pigs were "flushed" from the cooler portions of lower canyons and from under dense brush. On each survey, the color of individual pigs, group size, and sex/age associations were carefully recorded. This survey methodology appeared to reduce double counting during afternoon surveys.

The distribution of pig sign (dung, tracks, rooting, wallows, and observations) was surveyed at three month intervals and in response to management actions by walking 82 belt transects (2 m wide and up to 5 km long) stratified by habitat important to pigs. Areas of particular concern for transect location were canyon bottoms, coastal sage scrub,

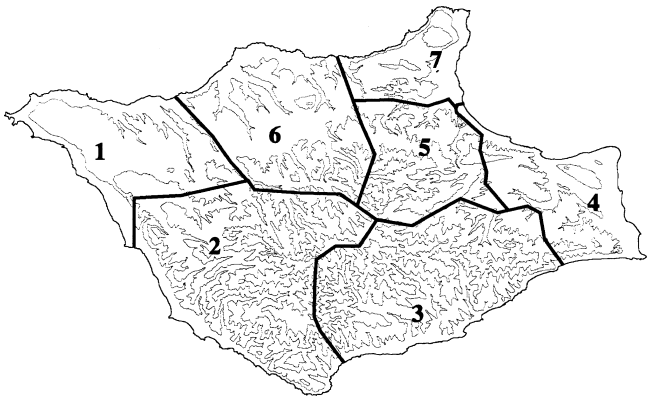

Figure 1. Management Zones for feral pig eradication, Santa Rosa Island, Channel Islands National Park.

baccharis scrub, and mixed woodland communities. Transect locations were established to be sensitive to shifts in habitat use, including daily, seasonal, and environmentally determined patterns such as prolonged drought. All dung was removed from transects to avoid double counting on subsequent runs.

It was apparent that the absence of impermeable boundaries, such as pig proof fencing, would enable pigs to immigrate to already searched areas. Therefore, partial transect surveys (n=7) within individual management units and in adjacent units were conducted to detect immigration and shifts in distribution by pigs in response to management activities. Partial surveys also were used as a measure of contractor effort and performance evaluation. Additionally, aerial searches within individual management units were conducted by NPS personnel to evaluate contractor performance.

Eradication Techniques

Two separate phases of pig removal were conducted, systematic ground hunts and trapping by NPS employees, and a three phase contract for eradication conducted by professional hunters. NPS employees utilized box traps (Williamson and Pelton 1971) and conducted systematic ground hunts in selected areas for pigs to test the efficacy of the monitoring design. Pigs were dispatched island-wide over a four month period. During this time period, the frequency of pig sign on transects was surveyed to monitor changes in relative abundance and pig distribution.

The techniques used to remove pigs during the contract phase of the program were dependent upon pig densities and local environmental conditions such as precipitation and fog. Aerial hunts, trapping, ground hunts, and ground hunts with trained pig dogs were employed systematically throughout the contract phase of the eradication. The dogs used in this program were primarily of the Catahoula breed and were trained to avoid non-target species.

During a one week period in February 1992, a Forward Looking Infrared (FLIR) system mounted to the underbelly of a Hughes 500E helicopter was used as an additional search method. FLIR technology, first developed for

military and law enforcement applications, utilizes a thermal imaging system which registers heat reflectance from a viewing area. Dependent upon surrounding surface temperatures of the biotic (vegetation, trees, etc.) and abiotic (rocks, earth, etc.) community, warm-blooded organisms register as white-hot images and in many cases can be identified to the species level. FLIR technology has been employed in Hawaii on goats and pigs with varying success (L. Katahira, pers. comm. 1992).

The methods employed to eradicate pigs were the most humane available to accomplish the goal of a pig free island. Pig carcasses were left in the field to decompose as the California Department of Agriculture and the USDA-Animal Plant Health Inspection Service opposed the relocation or transportation of feral pigs from SRI because of the prevalence of pseudorabies (Glosser, unpublished 1988). Also, it is unlikely that live capture would have achieved the goal of eradication of pigs from SRI. Butchering of pigs was not a feasible option due to USDA's standards for human consumption of meat, the need for onsite inspectors, special handling procedures, disease free certification of individual animals, costly refrigeration units on the island and on transport vessels, and the logistical constraints of such an operation.

Necropsies were performed on a majority of the pigs dispatched during the initial phase of this program. Biological data collected from necropsied animals included pelage color, sex, age, reproductive condition, rump fat thickness, and presence or absence of internal and external parasites. Data concerning animal behavior, movements, and other ancillary biological information were collected through observation and post-mortem examinations.

RESULTS

Monitoring and Evaluation

Nine 8-hour days, utilizing a two person crew, were required to survey all monitoring transects. The time required to complete partial surveys (n=7; x=20.26±10.3 hr) was dependent upon local topography and transect length. Complete transect surveys were conducted at milestones throughout the program. Two complete surveys were conducted during Phase II of eradication and three were conducted during Phase III. Following Phase III, a final survey of all monitoring transects was conducted over a six-month period. Significant decreases ($P < 0.10$) in overall pig sign were noted between transect surveys (Table 2). The frequency of pig dung on transects appeared to provide the most reliable measure of reduction in pig numbers (Table 3). Data collected during partial surveys were used to assess shifts in pig distribution and to help direct contractor efforts. These data are not presented. Shifts in pig distribution were most apparent during Phase III of the program when intensive systematic ground hunts were concentrated within individual units.

The reliability of transects to detect reductions in pig numbers became questionable as the pig population was reduced to remnant (≤ 20) animals within individual management units. At this point in the eradication effort, transects were shifted to perceived "refuge" areas which feral pigs seemed to migrate to in response to management actions. Transects surveys within these areas were coordinated with active eradication efforts to increase the likelihood that encountered pigs were dispatched.

Table 2. Summary of feral pig sign along 82 belt transects on Santa Rosa Island, Channel Islands National Park.

	Transect Surveys[a]				
Sign Type[b]	T1	T2	T3	T4	T5
Observation	76 A[c]	81 A	10 B	0 C	0 C
Scats	1254 A	462 B	92 C	15 C	0 C
Wallows	126 A	86 B	15 C	1 C	0 C

a Information is reported for transect surveys during Phase II and Phase III.

b Total observations of individual sign types.

c Within row valyes with the same letter designation are not significantly different at P<0.10.

Table 3. Number of scats found along 82 belt transects, stratified by zone, Santa Rosa Island, Channel Islands National Park.

	Transect Surveys				
Zone	T1	T2	T3	T4	T5
1	83 A[a]	51 B	22 C	1 C	0 C
2	503 A	127 B	16 C	0 C	0 C
3	207 A	71 B	0 C	2 C	0 C
4	105 A	28 B	33 C	2 C	0 C
5	109 A	34 B	0 C	10 B	0 C
6	230 A	66 B	16 C	0 C	0 C
7	17 A	85 B	5 C	0 C	0 C
Totals	1254	462	92	15	0

a Within row values with same letter designation are not significantly different at P<0.10.

Eradication Techniques

A total of 1,175 pigs were killed during the course of this program; 455 by NPS staff, 450 by contractors, and 270 by non-government personnel linked with the private cattle ranch located on the island. NPS removal techniques included ground hunts (n=447) and trapping (n=8). A total of 700 hours (1.6 hrs per pig) were expended by NPS personnel conducting ground hunts. An additional 120 hours (15 hrs per pig) were devoted to trapping. Twenty pigs were dispatched enroute to hunt area destinations and are included in ground hunt totals.

Contractors expended a total of 7,000 hours in search of pigs over a 12-month period. Aerial hunts, used exclusively during Phase III, accounted for 263 pigs (Table 4). One hundred thirty-four hours were devoted to aerial hunts for a per unit effort of 0.51 hrs/pig. Systematic ground hunts accounted for 97 pigs with a per unit effort of 22 hrs/pig. Searches with trained pig dogs yielded 87 pigs with a corresponding effort of 54.1 hrs/pig. Eradication techniques were not employed simultaneously, therefore, comparisons between methods provide limited value.

Contractor search effort increased in relative proportion to total pigs killed expressed as per unit effort except during the last four months of the eradication when the pig population was reduced to remnant animals (Figure 2). A dramatic increase in search effort occurred for pigs 434 to 443 which was followed by a decrease in effort. An explanation for the prominent fluctuation in effort is explained in the Discussion section below.

NPS personnel expended forty hours of helicopter searches to monitor contractor effort within individual zones and to provide additional eradication pressure on the pig population. After the contractor had completed work in an individual management zone, on ground transect surveys were conducted to document reductions in pig numbers and to determined whether an aerial search was necessary. Pigs (n=6) encountered during these aerial searches were dispatched.

Pig activity during Phase II and the early stages of Phase III of the eradication was generally associated with the availability of water and the presence of artificial food supplements that were distributed throughout the island for cattle and horses. The location of these artificial supplements was a convenient starting point for searches. The majority of pigs dispatched during Phase II and the beginning of Phase III of the program were found within 400±100 meters (P <0.05) of artificial supplements. Behavioral changes in response to eradication pressure later in the program resulted in opportunistic, rather than routine, use of artificial supplements by pigs.

Table 4. Pigs killed, by method, during Phase III of feral pig eradication, Santa Rosa Island, Channel Islands National Park.

	Number of Pigs Killed				
Method	Adult	Juvenile	Piglet	Totals	Hours
Helicopter	136	64	61	261	134
Ground Searches	55	22	20	97	2150
Ground Searches with Traind Dogs	52	16	20	88	4704
Driving	4	0	0	4	12
Totals	**247**	**102**	**101**	**450**	**7000**

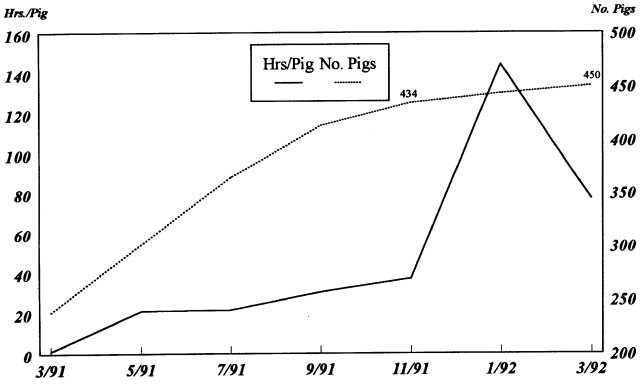

Figure 2. Search effort in relation to cumulative number of pigs killed during Phase III of feral pig eradication, Santa Rosa Island, Channel Islands National Park.

Population Parameters and Sex/Age Structure

Most pigs appeared to be in good to fair body condition at the onset of the eradication (Riney 1960). Approximately one-third of pigs in the oldest age class of each sex were rated as excellent. Environmental parameters (excessive drought) contributed to the poor physical condition of pigs early in the eradication, but with increasing precipitation and milder temperatures, the physical condition of pigs improved as reflected by our data.

The sex ratio of pigs dispatched during Phase II was 1:0.9 (237M:218F) and differed slightly from 1:1 (Table 5). The extensive use of helicopters early in Phase III precluded sex identification on each downed pig due to excessive cost. Of the 450 pigs dispatched during Phase III, sex determinations were made on 291. The sex ratio of the these was 1:0.76 (165M:126F) and differed slightly from 1:1.

The age structure of the necropsied sample (n=415) was similar to that reported in the literature (Table 5) (Barrett 1978; Sterner 1990). Coat coloration suggested a feral/hybrid cross. Black and white spotted (37.5%) and all black (32.3%) was the most common coloration pattern. The wild/grizzled or agouti coat coloration, characteristic of wild boar, was present in 12.5% of the sample. Stippled coats on juveniles were present in 5 out of 120 piglets.

Table 5. Age and sex of feral pigs killed during Phase II of pig eradication, Santa Rosa Island, Channel Islands National Park.

Age (months)	n	%	Male	Female	Sex Ratio (M:F)
<12	252	55.4	132	120	1:0.9
12-24	102	22.4	47	55	1:1.1
25-36	57	12.5	32	25	1:0.8
37-48	31	6.8	16	15	1:1.06
49-60	10	2.2	7	3	1:2.3
>60	3	0.7	3	0	-
Totals	**455**	**100**	**237**	**218**	1:0.9

DISCUSSION

Feral Pig Population

Environmental conditions existing at the beginning of the eradication were near optimum for the task of removing all pigs from SRI. A natural reduction in pig numbers due to drought stress, reduced vegetation which improved visibility, and the extent of grassland on SRI maintained by other large herbivores presented a unique opportunity for success. Goatcher (1989) estimated the pig population on SRI to be 3,200 pigs and conjectured that persistent drought conditions would further reduce the population. At the start of the eradication, it was estimated that the pig population was at its lowest level in 12 years.

Monitoring and Search Effort

The monitoring strategy used during the eradication provided the level of detail necessary to document a relative

decrease in pig numbers and provided a broad measure for detecting shifts in pig distribution. Barrett et al. (1988) utilized a comparable monitoring strategy as an index to pig reduction at Annandel State Park, California. A similar method was reported for national park areas in Australia and Hawaii (Hone and Stone 1989).

The relationship of shifts in distribution to search effort, and the ability to recognize and modify standard monitoring strategies, was highlighted during the last few months of the eradication. During Phase II of the eradication, distribution shifts were less apparent than during the mid- to later stages of Phase III. The shifts in distribution appeared to be in a roughly west to east direction, which followed the general pattern of hunting activity. A partial explanation could be that pigs had been previously exposed to limited intensity hunting (one to two shooters) during Phase II and were more likely to return to a particular drainage/canyon than when repeatedly pressured by a larger hunting party or a hunting party utilizing dogs as a method of search.

Search effort during Phase III of the eradication, as expected, increased as pig numbers decreased except for the last few pigs removed by contractors. The tendency of pigs to migrate toward areas with limited disturbance was identified through monitoring transects and field observations. Area specific searches within these "refuge" areas reduced per unit effort expenditures. The amount of effort to remove the last pig recorded during Phase III, although greater than the first 400 pigs, was less than anticipated. The documented last pig removed during Phase III, was located in an area which had been identified as a "refuge" area.

Surveillance on monitoring transects continued at infrequent intervals over a one year period following Phase III of the eradication. Nine months after Phase III was complete and the last pig was thought to have been killed, a barely discernable wallow was discovered in the same drainage as the documented last pig of Phase III. An intensive search in the surrounding drainages uncovered no addtional pig activity. Three months later, a two to three day old wallow and a single pig track was found at the same location. Two days later, a pack of dogs ran down the last feral pig on SRI. Since March 1993, no pigs or fresh pig sign have been found on the island.

Coat Coloration

Mayer (1983) and Mayer and Brisbin (1990) used various multivariate analyses to categorize pigs based upon phenotypic and morphologic characteristics. The percentage of pigs on SRI which exhibited the wild/grizzled agouti coloration (12.5%) is consistent with the lower end range of values reported for a feral/hybrid cross. Goatcher (1989) reported the wild/grizzled agouti coat coloration was present in 20% of SRI pigs. A reduced population size and the fact that coat coloration was not recorded during Phase III of the eradication may explain the small difference between our estimate and that of Goatcher (J. J. Mayer, pers. comm. 1996). Although no documentation exists to reflect an introduction of European wild boar to SRI (N. Vail, pers. comm. 1990), a previous introduction is realistic in terms of commercial hunting activities on the island prior to Federal ownership and the pattern of agouti coat coloration in adult pigs.

MANAGEMENT IMPLICATIONS

The methods used to eradicate feral pigs from SRI have broad usage for eradication programs elsewhere, although site specific conditions will play a large role in their timing, duration, and intensity. An intense, unrelenting eradication effort will, in the long run, be more cost and labor efficient than long-term or sporadic control.

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