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SOCIAL BEHAVIOR OF THE COLLARED PECCARY
(PECARI TAJACU) IN THE TUCSON MOUNTAINS

by
Raymond Eugene Schweinsburg

A Dissertation Submitted to the Faculty of
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1969
I hereby recommend that this dissertation prepared under my direction by Raymond Eugene Schweinsburg entitled SOCIAL BEHAVIOR OF THE COLLARED PECCARY (PACARI TAJAGU) IN THE TUCSON MOUNTAINS be accepted as fulfilling the dissertation requirement of the degree of Doctor of Philosophy.

Dissertation Director

Date

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SIGNED: Raymond Eugen Schweinsburg
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ABSTRACT

This study of the social behavior of the collared peccary was conducted to obtain information on herd integrity, size and stability of home range, and individual and group behavior. The apparent high mortality of juveniles was also studied.

The study area was located in the Saguaro National Monument, Tucson Mountains, Pima County, Arizona. Supplementary observations of individual behavior were obtained of captive peccaries kept by the Unit at the Campbell Avenue Farm.

Five free-roaming herds were made recognizable by marked individuals that they contained, and their known home ranges were plotted by outlining the points that members of the herd moved, which were farthest from the center of the home range. Peccaries were obtained for marking by immobilization with the Cap-Chur Gun and trapping. Radio-tracking equipment was used to locate peccaries in the field. Evidence indicated that the home ranges were defended, and so were considered territories. Four of the known territories measured 0.21, 0.28, 0.47, and 0.59 square miles.

The members of an individual herd maintained contact with each other, but there were daily fluctuations in the number of peccaries found in the herd. These fluctuations were caused by individuals wandering, being chased by other peccaries, or being frightened in some manner, from the herd.
There were also alterations in the number of individuals contained in a herd. These alterations were caused by deaths, or individuals moving into or out of the herd. In each case that was observed of a peccary leaving one herd and joining another, the animal stayed within the territory of its adopted herd. It did not move back and forth between the two herds. Usually a peccary moved to the territory of an adjacent herd, but two peccaries were known to have moved distances of four and seven miles.

It was found that peccaries avoided harmful exposure to the elements. They avoided direct sunlight in the hottest months and bedded in mine shafts or overhangs during cold winter nights, although they were seen carrying on normal activities during the winter rains.

Both intraspecific and interspecific aggression relied heavily on threatening actions. The two most common intraspecific threatening actions were squabbling and tooth clacking. Fighting did occur, usually between boars, but most social conflicts were resolved by threatening. Some bristle erection was noted in intraspecific encounters, but not nearly to the extent noticed in all interspecific encounters. It is thought that bristling may make the peccary appear larger to a predator.

Social interactions were observed in which peccaries greeted each other according to patterns relating to their social position. The end point toward which all social interactions seemed to lead was "friendship" or established order. This was recognized when
two animals rubbed each other's scent gland with the side of the head. This was a common greeting and friendship motion that probably helped maintain the social hierarchy and herd integrity. The scent gland was also used to mark certain areas within the territory.

Sows usually responded to the squalling of young piglets, although sometimes they didn't when severely alarmed. Sows have also been known to both return and not return for lost piglets, depending on the circumstances. The high loss of young is thought to be related to this behavior of the sow and the fact that the young are precocial following their mothers from a few hours after birth.

Peccary scat stations were usually near favored bedding areas but single scats were also noticed on trails and feeding areas used by peccaries.

It is the opinion of many game men and hunters that peccary numbers are down in much of their range in Arizona. This is supported by the data presented by game managers as Job Completion Reports. Censusing techniques should be revised and checking stations used to obtain productivity data. Permit hunts should be established in those areas where herd size is definitely low. Herds should be managed to maintain a minimum herd size of at least 3.0 adult animals until such time that research proves that peccaries are reproductively flexible.

The effect that hunting has on herd integrity, productivity, and maintenance of territories should be studied.
CHAPTER 1

INTRODUCTION

The collared peccary, *Pecari tajacu*, is an important game animal in southern Arizona. Data are lacking on individual and group behavior, herd integrity, size, shape and stability of home range, mortality of young and population dynamics. These parameters must be understood before effective management of the species can be realized. This study was initiated to obtain these data in unhunted populations in their natural environment. Such information can be used in later studies to indicate the effect that man, domestic livestock, etc., have on the peccary population.

The Saguaro National Monument in the Tucson Mountains was chosen for the study area because (1) previous studies on peccaries had been done there, (2) the animals had not been hunted for several years, and (3) the area is similar to the Tortolita Mountains where the Arizona Game and Fish Department is carrying on a comparable study.

A review of the literature covering the collared peccary in general and its behavior in particular reveals surprisingly little information on this interesting animal. Probably the most comprehensive work to date is by Knipe (1957). This bulletin was drawn from data gathered over a 15 year period (1940-55) and covers the peccaries' distribution, numbers and behavior. Seton (1929), Neal
(1959), and Leopold (1959) also have some interesting notes on the natural history of the peccary.

In 1956 the Arizona Cooperative Wildlife Research Unit began a long term study of the peccary. Techniques of trapping, handling, and marking were developed by Neal (1957, 1959) working in the Tucson Mountains. These were modified somewhat by Minnamon (1962), Day (1963), and Bigler (1964). A food habits study was completed by Eddy (1959, 1961) in which he compared peccary food habits in three main habitat types; the saguaro-palo verde association (Tucson Mountains), the mesquite-grass savanna (Santa Rita Experimental Range), and oak-grassland (Canelo Hills). Minnamon (1962) studied home range and movements in the Tucson Mountains, and Bigler (1964) did a similar study in the Tortolita Mountains.

Few workers mentioned anything about herd integrity other than noting the characteristic gregariousness of the peccary. Neal (1959) and Minnamon (1962) indicated the numbers found in various herds, implying a certain stability, while Bigler (1964) found the herd composition fluctuated, but did not distinguish between fluctuation in herd size and alterations in herd size, that is, change brought about by movement of individuals from one herd to another.

Mearns (1907) reported that peccaries could be found in parties "of five or six to 12 or 15 individuals." Knipe (1957) reported the average size of 127 herds to be 8.5 animals. Bigler (1964) found that 14 herds contained an average of 7.5 peccaries while Minnamon (1962) found the average size of 11 herds to be seven.
I doubt if these figures reflect a useable herd size for management purposes, because they are taken from data gathered during all times of the year and hence contain all age groups. A herd during the farrowing peak may contain twice as many animals as it would in the winter after the young are lost. Thus, the herd size recorded for management purposes would depend on the time of year the count was taken and at what age immatures were counted as part of the herd. Reproductive rate should not be confused with productivity as defined by Leopold (1933), i.e., the addition of breeding animals to the population. Sowls (1961) used the cohort of 11 to 21 1/2 months to indicate production and survival of young while recognizing that the reproductive potential was actually much higher than that reflected by this cohort (Sowls 1966).

Seton (1929) recognized that peccary herds have home ranges and Knipe (1957) believed the cruising radius to be under three miles. Minnamon (1962) concluded that the home range of the peccary herds in the Tucson Mountains was no more than one and one-half square miles, while Bigler (1964) found the home range in the Tortolita Mountains varied from 1.03 to 3.12 square miles. In Texas, Jennings and Harris (1953) concluded that the normal home range was under three miles, and Williams (1967) found it to be under one and one half square miles. Bigler found that the home ranges overlapped to a large extent, a condition that has not been found by the other workers.

The high mortality of young was noticed in Texas by Jennings and Harris (1953) and evidence to suggest that predators were a
contributing factor was presented. Neal (1957) and Bigler (1961) both mentioned high mortality of young in the herds they worked with in Arizona. Sowls (1966) found that peccaries have a high reproductive potential, and that captives can produce more than one litter a year. Sowls (1961) found a positive correlation between the amount of rainfall and the survival of young and assumed it was tied in with vegetative abundance. However, rainfall may affect peccary populations differently in the various major habitat types. Also, precipitation may vary greatly between these areas in one year. Thus, the limiting factors in the saguaro-palo verde association may not be the same as those working, in the oak-grassland.

Population structure is fundamental to population dynamics (Mosby 1963). Kirkpatrick (1957) and Kirkpatrick and Sowls (1962) have found that ages of collared peccaries can be estimated by tooth emergence and replacement until they have a complete set of permanent teeth. Thereafter, peccaries can only be grouped into age classes according to tooth wear (Sowls 1961). Matschke (1967) similarly estimated the age of European wild hogs to 26 months by tooth eruption and replacement. Richardson (1966) found that the weight of the eye lens was not a reliable indication of age in peccary after the 13 to 18 months age class. Perhaps there is a discernible lamellation in the teeth as occurs in coyotes (Linhart and Knowlton 1967), black bear (Stoneberg and Jonkel 1966) and other mammals, that will correctly indicate age in the current wear class groups. Certainly an accurate life table cannot be set up until it is possible to correctly age peccaries.
Individual and group behavior of the peccary has not been intensively studied previously because of the difficulty of observing peccary for any length of time and locating them on consecutive days. The fact that they are largely nocturnal during the hottest parts of the year complicates observation.

Radio-telemetry was used to obtain the quantity of observations necessary for a behavioral study. Field observations were supplemented with observations of captive peccaries maintained by the Unit at the Campbell Avenue Farm of The University of Arizona.
CHAPTER 2

DESCRIPTION OF THE COLLARED PECCARY

Size

Seton (1929) gives an accurate general description of the collared peccary but I was able to gather some additional information. During the 1967 hunt I measured 112 adult peccaries. The average measurements were: body length (from end of snout, along body curve to tip of tail), 38.0 inches; tail length, 1.1 inches; hind foot, 7.7 inches; ear, 3.7 inches; girth (behind shoulders), 23.1 inches; height at shoulder, 20.2 inches; neck circumference, 17.5 inches; and average weight 33.5 pounds.

Color

The peccary is covered with coarse bristles that are banded black and white. There are four main types of these bristles according to their banding and length (Fig. 1). The over-all color is a dark salt and pepper gray. The collar is a light colored band that extends from in front of the withers down to the jaw line. This collar does not completely encircle the neck, but merges into the jaw line below and the dorsal band above (Fig. 2).

The dorsal band extends along the back when the bristles are erected. It begins between the ears and proceeds to the neck collar, then continues, less noticeably, along the back to the scent gland.
Figure 1. The four main types of bristles on the collared peccary. - a was taken from the collar and has a longer subterminal band of white than c, which was taken from the flank. b was taken from the back, just forward of the scent gland, and has a light colored base. d was taken from the back of the neck and has a dark colored base. b and d are longer than a and c and form the erectile mane along the back.
Figure 2. The front view of an alerted peccary. Note the prominent collar and dorsal band. Note also the light band at the base of each ear.
From the front the dorsal band is visible between the ears when the bristles are erect. There is also a short, light band at the base of each ear (Fig. 3).

The young are generally reddish brown with a black dorsal stripe and a distinct collar. They keep this coat until the second month when they obtain a gray adult-like pelage.
Figure 3. Side view of an alerted peccary. Note the collar and dorsal band.
CHAPTER 3

DESCRIPTION OF THE STUDY AREA

Location

The study was done on the Saguaro National Monument located in the Tucson Mountains west of Tucson, Pima County, Arizona.

The study area is bounded on three sides by Kinney Road starting at Ez-Kim-In-Zan Recreational Area and ending at Red Hills. A line connecting Ez-Kim-In-Zan and Red Hills completes the boundary (Fig. 4).

Topography

The lowest elevation on the study area was about 2,350 feet at the junction of Kinney and Palo Verde Roads. The highest point, 3,700 feet, was on the ridge north of Red Hills.

The terrain is rugged with numerous peaks and rocky outcrops throughout the area. The slopes are strewn with loose rocks and boulders and are cut by many ravines and canyons. These ravines lead into broad sandy washes which cross the lower outwash detrital slopes and flats.

Vegetation

Shreve (1942) has classified that area of the lower Sonoran Life Zone in which the study took place as the Arizona succulent
Figure 4. The study area and the known territories of Herds A, B, C, D, and E.
desert. The most distinctive feature of the Arizona succulent desert is the many forms of cacti which grow in association with creosote-bush (Larrea tridentata), mesquite (Prosopis juliflora), ironwood (Olneya tesota), and palo-verde (Cercidium spp.). The large stand of saguaro cactus (Carnegiea gigantea) found in this area is reflected in the name of the national park established for its protection. Other abundant cacti are the chollas and prickly pear (Opuntia spp.), hedgehog cactus (Echinocereus spp.), fishhook cactus (Mammillaria spp.), and barrel cactus (Ferocactus spp.).

Water

Two windmills are in the study area; one at Red Hills and the other at Adobe Robinson. The Adobe windmill was inoperative after the winter of 1965 and water had to be hauled in for trapping.

One artificial tank was established at North Sus. A vertical mine shaft located in South Sus 100 yards west of Sus Road contains water less than 15 feet below ground surface. This water, however, is apparently unavailable because of the steepness of the walls. During the rainy periods, several of the mine shafts also catch and retain water.

Mine Shafts

There are five shafts along the main ridge. Three are located almost due west of Adobe which I call Gray Mine and Two Shafts. The other two are almost due south of Adobe on the Red Hill's side of the ridge which I called Hi-Lo shafts. They are also used for shelter during inclement weather.
Climate

The climate is characteristically hot and dry, because of high temperatures, high evaporation and low annual precipitation. There are two distinct periods of precipitation, the summer monsoon thunderstorms and the winter frontal storms that may last several days. Between these two periods of precipitation, the autumn and spring months are relatively dry, and are considered the critical periods for desert animals dependent on moisture for existence.

Table 1 gives the monthly high and low temperatures and precipitation in the study area from 1965 to 1967. The data were gathered by personnel of the National Park Service at the Deer Trap Ranger Station at an elevation of about 2,500 feet.
Table 1. Deer Trap Ranger Station weather data from 1965 to 1967.

<table>
<thead>
<tr>
<th>Month</th>
<th>1965</th>
<th>1966</th>
<th>1967</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Jan.</td>
<td>77</td>
<td>33</td>
<td>85</td>
</tr>
<tr>
<td>Feb.</td>
<td>80</td>
<td>24</td>
<td>74</td>
</tr>
<tr>
<td>Mar.</td>
<td>88</td>
<td>21</td>
<td>89</td>
</tr>
<tr>
<td>Apr.</td>
<td>99</td>
<td>40</td>
<td>90</td>
</tr>
<tr>
<td>May</td>
<td>101</td>
<td>-</td>
<td>101</td>
</tr>
<tr>
<td>June</td>
<td>104</td>
<td>54</td>
<td>109</td>
</tr>
<tr>
<td>July</td>
<td>108</td>
<td>68</td>
<td>108</td>
</tr>
<tr>
<td>Aug.</td>
<td>105</td>
<td>60</td>
<td>104</td>
</tr>
<tr>
<td>Sept.</td>
<td>100</td>
<td>52</td>
<td>101</td>
</tr>
<tr>
<td>Oct.</td>
<td>99</td>
<td>44</td>
<td>94</td>
</tr>
<tr>
<td>Nov.</td>
<td>87</td>
<td>40</td>
<td>87</td>
</tr>
<tr>
<td>Dec.</td>
<td>82</td>
<td>32</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>15.12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER 4

TECHNIQUES

Capturing Animals

Peccaries were captured and marked so that they could be recognized in the field as individuals.

Trapping

Trapping at water holes was the easiest way of obtaining peccaries for marking or fitting with a transmitter. Most of the trapping was done at Adobe, with some at North and South Sus. Only one animal was caught at N. Sus, E:1120; the rest were taken at Adobe. No trapping was done at Red Hills because of the roughness of the access road.

Minnamon (1962) described the box traps used to catch peccaries. Bait was placed as far back in the trap as possible and some was usually hung on the trigger string. The usual bait was lettuce, so the trigger string had to be raised approximately eight inches to prevent rabbits from springing the traps.

Other vegetables were used, but in each case lettuce was preferred by peccaries, so it was used almost exclusively. Besides rabbits, the only other unwanted species caught were gray foxes which were attracted by watermelon.
**Trapping Results.** The best seasons for trapping were during the spring and fall dry periods (Table 2). At first the animals could be caught only during these periods, but later some could be caught almost any time.

There was a large variation in individual susceptibility to trapping and retrapping. One animal, B:112h, was trapped 39 times while several were only caught once. Others could only be caught during the driest times, and then only infrequently. No fatalities were directly related to trapping. Fall trapping probably caused mortality of young by separating them from their mothers.

**Cap-Chur Gun**

The Cap-Chur Gun required skill, gained through experience, for effective use. It also had many inherent faults, i.e., gas leakage, faulty primers, varying gas pressure with temperature, etc.

I used Sernylan (l-(l-Phenylcyclohexyl) piperidine hydrochloride) and Sucostrin (Succinylcholine chloride) to immobilize peccaries. Sernylan was safe, but a quick-acting dose required several days for recovery. Sucostrin reacted quickly and recovery time was short, but an overdose was fatal.

Since these drugs act synergistically, Jerry Day of the Arizona Game and Fish Department, attempted to mix them in the hopes of obtaining a quick, safe field dose with a short recovery time (Appendix A). The final acceptable field dosage was 5.5 mg. of Sucostrin and 25 mg. of Sernylan. Wild animals seemed to have a higher susceptibility to drugs than the experimental captive animals,
Table 2. Trapping records for 1965 through 1967.

<table>
<thead>
<tr>
<th>Trapping Period</th>
<th>Number of Trap-nights</th>
<th>Total Number of Catches</th>
<th>Total Number of Previously Unmarked Animals Caught</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring 1965</td>
<td>483</td>
<td>44</td>
<td>8</td>
</tr>
<tr>
<td>Fall 1965</td>
<td>202</td>
<td>109</td>
<td>10</td>
</tr>
<tr>
<td>Spring 1966</td>
<td>199</td>
<td>56</td>
<td>7</td>
</tr>
<tr>
<td>Fall 1966</td>
<td>75</td>
<td>22</td>
<td>3</td>
</tr>
<tr>
<td>Spring 1967</td>
<td>69</td>
<td>27</td>
<td>3</td>
</tr>
<tr>
<td>Fall 1967</td>
<td>16</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1044</td>
<td>263</td>
<td>32</td>
</tr>
</tbody>
</table>
so an Ambu Resuscitator was carried when using this dose. When Ser-
nylan was used by itself 50 to 60 mg. was the usual dosage.

Several behavioral traits of peccaries can be taken advantage of to successfully capture them. First, they are easily approached against the wind. Second, if shot when not alerted, they will only run a short distance and then stand. If nothing else frightens them they may either relax or move off slowly. This pause gives the drug time to take effect. Third, peccaries reacted defensively to a close shot while they ran from the noise of one at a distance. A close shot also seemed to confuse them if the shooter remained hidden and quiet.

Several peccaries were killed by overdosing, but none by the dart's impact. A hind quarter was always the target and darts of 1/2 inch length were used to lessen the chance of breaking a bone.

The best success I had with the Cap-Chur Gun was in mine shafts during the coldest days of winter. Peccaries using them during this time could be blocked in by a portable woven wire gate before they emerged at dawn. The gate also provided protection from which to shoot. The peccaries huddled at the back of the shaft and would only attempt to come out when a drugged animal wobbled away from the group. They were easily stopped by the gate.

Handling Animals

Handling Crate

Because peccaries bite, their jaws were immobilized before attempting to work on them. At first I used a handling crate and
hog snare as reported by Neal (1957). The crate was heavy and re-
quired two to three men to handle an animal. Also the peccary was
not immobilized enough to allow close examination or critical work.

**Chloroform Crate**

The handling crate was soon rejected in favor of the chloro-
form crate which was a small, plexiglass covered box with a sliding
door at either end. The animal was shuttled into the crate from the
trap and chloroform administered through a hole in the top. Bottled
oxygen was fed through a tube to a hole in the side of the crate.
An average animal was usually manageable within 2-5 minutes and re-
mained unconscious approximately 15 minutes. This system was ideal
for close examination, but the crate was heavy requiring at least two
men to use it effectively. It was also possible to accidentally kill
the animal, and when three were killed its use was discontinued and
drugs were tried; at first orally with the help of the handling crate
and then intramuscularly with the aid of a squeeze crate and dart
pistol.

**Squeeze Crate and Dart Pistol**

The squeeze crate was of heavy woven wire over a steel frame
with a sliding door at each end. The animal was shuttled into the
squeeze crate from the trap, and a movable partition forced the
animal against one side where it was held immobile. It was then
drugged by hand injection through the wire.
I used Sernylan in much smaller dosages than was used in the Cap-Chur Gun. Usually 10 to 15 milligrams sufficiently immobilized a peccary for handling, yet allowed it to recover within four to five hours.

This method was superior to the others, but still required two men to operate. So, Dr. L. K. Sowls, Unit Leader, devised the dart pistol as a better method of injecting the drug (Sowls and Schweinsburg 1967).

This apparatus was very effective in administering a drug to a trapped animal and was also used to immobilize penned animals at the University Farm. Its limited range could undoubtedly be increased by a powder charge in front of the primer.

Nets
A net was occasionally used when conditions were right, such as, at the University pens or when a weak or disabled animal was encountered in the field. For example, a peccary was discovered with its front leg through the radio collar. With Jerry Day’s help the animal was netted and the collar adjusted.

Handling Young
Young peccaries were easily handled by throwing a burlap bag over them.

Marking
Bigler Harness
The Bigler harness (Bigler 1964) with modifications was used to mark adult animals. Instead of one strap, two were passed over
the shoulder, and the patch was made square instead of triangular. The strap between the legs was eliminated, allowing the front strap to be pulled tightly up under the neck. This was necessary because the animals got their front legs through the strap if it was low down on the chest. In this position the strap caused severe cutting behind the front legs and the animal often lost the harness. Also the harness was made wider to prevent binding and for easier identification in the field. After the proper size and design was determined, almost no irritation was noted and harness cutting became rare.

**Bar Tags and Streamers**

Numbered, aluminum ear tags were placed in both ears of adults and in the left ears of young.

Streamers of plasticized nylon cloth (Armor-Tite) 1/2 inch by 6 inches were placed in each ear. At first, a slit was cut in the ear for the streamer, but later a hole was punched in the streamer to fit the nub of the aluminum tag. When the tag was placed on the ear and clamped the streamer was locked in place. This method was developed by Sgt. William Watton of Fort Huachuca.

The best colors were orange, white, yellow, and blue. Green was confused with blue and red with orange in poor light.

Streamers lasted about six months and were clearly visible in the field from 100 to 300 yards.

**Collar**

The simplest method of marking was a collar. It consisted of a strip of Armor-Tite two inches wide and long enough to fit
around an animal's neck. It was riveted at the back of the neck. The disadvantages of the collars were their small width (thus small identifying numbers) and their resemblance to radio collars. The radio collar served as an identifying marker as well as a holder for a transmitter.

**Locating and Observing Herds**

Locating herds was first attempted by the simple means of walking and searching with 7 X 35 binoculars. The shortcomings of such a method were soon obvious, especially during the summer months when the herds were bedded during most of the daylight hours. Most of the observations of this period were of disturbed animals. In order to locate herds with a minimum of disturbance, tracking radios were tried.

**Description of Radio Equipment**

The transmitter circuit was similar to that described by Cochran and Lord (1963) with a pulsing circuit added. Four mercury batteries supplied the power, and the entire unit was imbedded in epoxy. The first transmitters provided access to an antenna tuning capacitor, but later units eliminated this by standardizing the length of the antenna. Transmission began when the antenna ends were connected.

The transmitter collar consisted of two straps of Armor-Tite two inches wide and 24 inches long. The transmitter was firmly held between the two pieces and riveted. The result was a small, central,
transmitter packet. The remaining Armor-Tite served as the attaching collar. A punched hole in the Armor-Tite allowed access to the tuning screw. The screw was sealed with epoxy after tuning.

The receiver was portable with an attached loop antenna very similar to that described by Cochran and Lord (1963). It operated on channel 23 of the Citizen's Band. Both the transmitters and receiver were built by Sgt. William Watton of Fort Huachuca.

Installing Radio Equipment

To place the transmitter on an animal, the inside strap was tightly riveted around the neck. Then the ends of the loop antenna were connected and soldered. The connection was wrapped with electricians tape. Finally the outside strap of Armor-Tite was brought up and riveted over the antenna to the under strap.

In this way, the inside strap carried the weight of the transmitter and the outside strap protected the antenna. Some of the first antennas broke after a month's use, but heavier antenna wire on succeeding transmitters eliminated breakage.

The collars caused little irritation if the width did not exceed two inches. Wider straps caused irritation behind the ears.

Sometimes the instrumented peccary got a front foot through the collar. This happened when the collar was installed loosely or when the animal lost weight. The fault was easily corrected by taking up the slack in a crimp and riveting tightly. This did not affect the signal.
Using Radio Equipment

The first transmitter was placed on a peccary on November 19, 1965. The transmitter lasted until the end of March, although the signal began to be erratic at the beginning of February and its performance dropped noticeably. Initially, a signal was picked up from a distance of a mile and a third, line of sight. Out of sight the performance varied from $1/2$ to $1/4$ mile depending on the terrain, but this was more than adequate.

Later transmitters were not as efficient as the first, either in range or life, because antennas broke and the receiver was out of adjustment.

Even faulty transmitters greatly facilitated finding herds, and allowed undisturbed observation of the animals by forewarning of their presence. Field time was used more efficiently due to the telemetry equipment, and animals could be "watched" even when out of sight.

I found that it was best to observe the herds from above whenever possible. First, the animals rarely winded me, as the warming air carried my scent upward or the strong wind on the ridge tops dissipated it. Second, it was much easier to keep the animals in sight from above, especially when they were moving.

Searching with binoculars and listening for the growls of squabbling peccaries from a vantage point was the best way to find the herds which contained no radio equipped peccaries. This was especially true during the summer farrowing peak when squabbles frequently occurred.
CHAPTER 5

HERD COMPOSITION AND HOME RANGE

Herd Composition

Five herds, A, B, C, D, and E (Fig. 4) were recognized by marked members and observed during the course of the study. The herd was considered to be the main group of animals found within the limits of its known territory. If an animal switched from one territory and herd to another, it was from then on considered a member of the second herd.

The animals were numbered by letter according to the herd with which they were first seen, plus their lowest and earliest ear tag number. For instance, the peccary with the ear tag numbers of 1672-1668 was first seen in Herd A. Therefore, it was numbered A:1668 even though it later switched herds. I considered herd composition to be the number of individuals present in a herd as well as their sex and age.

Herd A

Herd A was usually found at one of two general areas (Fig. 5 and Table 3). One area in the vicinity of Hi-Lo Shafts was normally used during the cold part of the winter. Later the herd was more likely to be found on the slope southeast of Adobe. A favorite bedding spot was the big wash just west of the Wasson Peak Trailhead.
Figure 5. Known territory of Herd A and some of the observed movements of its members. Note areas of intensive use around Hi-Lo Shafts and west of Wasson Peak Trailhead.
Table 3. Composition of Herd A from August 1965 to April 1967

<table>
<thead>
<tr>
<th>Date first seen in herd</th>
<th>Number</th>
<th>Sex</th>
<th>Wear Class</th>
<th>Date Examined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov. 18, 1965</td>
<td>A:1898</td>
<td>D</td>
<td>M</td>
<td>1</td>
</tr>
<tr>
<td>Nov. 20, 1965</td>
<td>A:1523</td>
<td>X</td>
<td>M</td>
<td>4</td>
</tr>
<tr>
<td>Nov. 18, 1965</td>
<td>A:1667</td>
<td>X</td>
<td>F</td>
<td>Juv</td>
</tr>
<tr>
<td>Nov. 18, 1965</td>
<td>A:1065</td>
<td>X</td>
<td>F</td>
<td>5</td>
</tr>
<tr>
<td>Nov. 18, 1965</td>
<td>A:1858</td>
<td>D</td>
<td>F</td>
<td>4</td>
</tr>
<tr>
<td>Nov. 20, 1965</td>
<td>A:1668</td>
<td>G</td>
<td>F</td>
<td>2</td>
</tr>
<tr>
<td>Nov. 20, 1965</td>
<td>A:1159</td>
<td>U</td>
<td>F</td>
<td>4</td>
</tr>
<tr>
<td>Apr. 29, 1967</td>
<td>Unmarked</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

D = Known to be dead

X = Present in herd at the beginning and end of study

G = Switched herds, gone.

N = Switched herds, present

U = Fate unknown
This herd contained eight animals when first observed: four adult females, A:1065, A:1858, A:1668, and A:1159; three adult boars, A:1546, A:1898, and A:1523; and one juvenile female, A:1667 (Table 3).

A:1546 had a missing right front leg which prevented him from following the herd. He became weaker and was last seen on August 11, 1965. I assumed that he died or was killed although his remains were never found.

Four more adult animals were lost from the herd during the course of the study. One, A:1668, moved to Herd B.

Another, A:1858, was apparently killed by dogs on November 6, 1966. She was caught that morning and released without handling. In the afternoon, I heard dogs baying a few hundred yards west of the Wasson Peak Trailhead. Two mongrels of about 30 pounds weight were sitting, barking at the peccary which was lying on her side breathing heavily. She could not raise her head and was almost dead, yet the dogs were wary about attacking her, jumping back at her slightest move. For this reason I doubt that the dogs were solely responsible for her death. Other evidence supported this when I skinned her the next day. Punctures that appeared to be bites were only on her hind legs. These were shallow and superficial, and could not have caused death. There was a good deal of blood in the body cavity, so perhaps the animal injured herself internally, in the trap or by a fall, and the dogs took advantage of her weakened condition.

A:1898 was killed by predators, possibly dogs, on June 10, 1966 while he lay in an open trap recovering from Sernylan.
A:2001 was found dead on May 10, 1967 south of Adobe about halfway up the slope. I could not determine the cause of death, although he was partially eaten.

There is no record of what happened to A:1159. She disappeared during the winter of 1966.

Three animals joined the herd during the study; A:2001, A:2013, and an unmarked peccary. A:2001 came from an unknown herd and died on May 10, 1967, as mentioned previously. The other two also came from unknown herds. One was caught and marked as A:2013 at Adobe on July 10, 1966; the other remained unmarked.

The only young successfully raised in this herd during the study was A:1667. She was born during the summer of 1965 and marked on October 18, 1965. I assumed her mother was A:1065, because she followed this peccary. A:1065 also was caught with a young of 13 pounds, A:2023, on November 5, 1966, but this one was not successfully raised. A:1065 was 12 years old when she was seen with A:2023.

At the end of the study, the herd consisted of A:1065, A:1667, A:1523, A:2013, and one unmarked peccary.

Herd B

The animals of Herd B spent most of their time in the large, rocky canyon northwest of Prospect, especially in the summer time. During the coldest nights of winter they usually bedded in the lower shaft of Two Shafts, emerging during the early morning hours. As with Herd A, they could be found on the slopes above Adobe during the late winter, usually bedded in the open on sunny ridge tops.
In the spring they bedded in brush above Adobe, and then as the days got hotter, bedded almost exclusively in the big canyon northwest of Prospect which I called Prospect Canyon (Fig. 6).

On June 26, 1965, seven animals were observed in this herd: two adult females, B:1166 and B:1877; four adult males, B:1122, B:1126, B:1896, and B:1892; and one juvenile female, B:1124 (Table 4).

By March 1966, however, when a radio was placed on B:1122, only four animals comprised the herd: B:1122, B:1124, and two with only orange streamers in their right ears. One was probably B:1896. The other one could have been B:1892 or B:1877. The whereabouts of the last two was unknown. Neither was trapped after the autumn of 1965.

Three animals were known to have died: B:1126, B:1166, and B:1896.

B:1126 reacted peculiarly to the drugs and trapping. He seemed to lose his fear of man and would not leave the trap site after release. He also became weak and dependent on the lettuce bait for food. Sometimes he had to be driven from the trap site before I could work. He became gradually weaker and more dangerous so he was taken to the farm where he died.

B:1166 died two days after being captured with the Cap-Chur Gun (40 mg. of Sernalyn) on January 20, 1965 in Two Shafts. She never regained her feet.

B:1896 died accidentally when his head became wedged under his body in a corner of a trap. He had been given 20 mg. of Sernylan for handling.
Figure 6. Known territory of Herd B and some of the observed movements of its members. Note areas of intensive use in Prospect Valley and southwest of Adobe Well.
Table 4. Composition of Herd B from June 1965 to April 1966.

<table>
<thead>
<tr>
<th>Date first seen in herd</th>
<th>Number</th>
<th>Sex</th>
<th>Wear Class</th>
<th>Date Examined</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 26, 1965</td>
<td>B:1122</td>
<td>X</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>June 22, 1967</td>
</tr>
<tr>
<td>June 26, 1965</td>
<td>B:1126</td>
<td>D</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>June 13, 1965</td>
</tr>
<tr>
<td>June 26, 1965</td>
<td>B:1892</td>
<td>U</td>
<td>M</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>June 19, 1965</td>
</tr>
<tr>
<td>June 26, 1965</td>
<td>B:1896</td>
<td>D</td>
<td>M</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>June 14, 1966</td>
</tr>
<tr>
<td>July 5, 1966</td>
<td>B:2011</td>
<td>N</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>June 20, 1966</td>
</tr>
<tr>
<td>June 26, 1965</td>
<td>B:1166</td>
<td>D</td>
<td>F</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Jan. 20, 1965</td>
</tr>
<tr>
<td>June 26, 1965</td>
<td>B:1124</td>
<td>X</td>
<td>F</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>June 21, 1966</td>
</tr>
<tr>
<td>June 26, 1965</td>
<td>B:1877</td>
<td>U</td>
<td>F</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>June 20, 1965</td>
</tr>
<tr>
<td>Apr. 18, 1966</td>
<td>A:1668</td>
<td>N</td>
<td>F</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>June 20, 1966</td>
</tr>
</tbody>
</table>

D = Known to be dead

X = Present in herd at the beginning and end of study

G = Switched herds, gone

N = Switched herds, present

U = Fate unknown
Two animals joined the herd. The first, A:1668, came from Herd A and was first seen in Herd B on April 18, 1966.

The second, B:2011, came from an unknown herd and was first seen in Herd B on July 5, 1966. It was next seen in Herd C on July 13, 1966.

The only young raised in this herd was B:1124 who followed and was apparently raised by the boar, B:1122.

Herd B contained four animals at the end of the study: B:1122, B:1124, A:1668, and one marked with an orange streamer in the right ear (possibly B:1892 or B:1877).

Herd C

During the summer, Herd C usually bedded in Rattlesnake Rocks in North Sus or the rocks of Upper Sus (Fig. 7). These peccaries moved and fed in South Sus and the area west of Adobe almost exclusively, using the high ridge in the middle of their territory only for crossing or feeding during the short periods when rains brought annuals to the slopes.

Once they were seen drinking in the upper shaft, but they were never observed in the lower shaft of Two Shafts, where Herd B habitually bedded during the cold nights. They usually bedded in the Day Overhang during the coldest winter nights.

This herd was not studied as extensively or as long as Herds A and B, so movements in and out of the herd were not as noticeable. A complete count of the herd was difficult because of its larger size, which also made absences or additions difficult to detect.
Figure 7. Known territory of Herd C and some of the observed movements of its members. Note areas of intensive use around Rattlesnake Rocks and Upper Sus. Most of the known territory of Herd E is shown.
The only animals known to have died were C:2005 and C:2015. The remains of C:2005 were found at Rattlesnake Rocks on August 24, 1967. His bones were not scattered about and the complete carcass was present so I assumed he died of old age or disease.

C:2015 was the animal I mentioned in the section on "Nets." He eventually crawled into a hole west of Rattlesnake Rocks and died.

The only peccary known to have joined Herd C was B:2011, which was first seen in Herd B on July 13, 1966.

I am not sure what the complete composition of Herd C was at the end of the study. It was probably close to that portrayed in Table 5.

Herd D

Herd D was observed mostly in North and South Sus east of Sus Road and around Apache Peak. It was only seen three times in the flats north of Kinney Road, so there is some question about the accuracy of the northern boundary of its territory (Fig. 8).

Due to the lack of a trapping site (permanent water) in North Sus, only three animals were caught (by Cap-Chur Gun) in Herd D: D:1681, D:1674, and D:2038. From the movements of these three, which were fitted with transmitters, the territory was mapped out and the herd made recognizable.

D:1674 was the first marked, but she disappeared two weeks after being captured.
Table 5. Composition of Herd C from July 1966 to February 1967.

<table>
<thead>
<tr>
<th>Date first seen in herd</th>
<th>Number</th>
<th>Sex</th>
<th>Wear Class</th>
<th>Date Examined</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 13, 1966</td>
<td>B:2011</td>
<td>N</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>July 19, 1966</td>
<td>C:1678</td>
<td>M</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>July 8, 1966</td>
<td>C:2009</td>
<td>F</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>July 13, 1966</td>
<td>C:2017</td>
<td>F</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>July 19, 1966</td>
<td>C:2024</td>
<td>F</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>July 19, 1966</td>
<td>C:2026</td>
<td>F</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Dec. 27, 1966</td>
<td>C:1688</td>
<td></td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>Dec. 27, 1966</td>
<td>C:2021</td>
<td></td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>July 19, 1966</td>
<td>C:2019</td>
<td></td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>Feb. 12, 1967</td>
<td>Unmarked</td>
<td></td>
<td>Juv</td>
<td></td>
</tr>
<tr>
<td>Dec. 27, 1966</td>
<td>Unmarked</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dec. 27, 1966</td>
<td>Unmarked</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

D = Known dead

N = Switched herds, present
Figure 8. Known territory of Herd D and some of the observed movements of its members. Note areas of intensive use in North and South Sus and around Apache Peak.
D:2038 also carried a transmitter for only two weeks. She got a front foot through the collar and had to be captured with the Cap-Chur Gun (20 mg. Sernylan), but she died the next day.

D:1684 was still with the herd at the end of the study and raised a young during 1967.

The herd contained eight adult animals in the summer of 1966 but increased to 11 adults during the next winter, so an animal must have come into the herd in addition to the two young raised (Table 6).

Herd E

I made observations on this herd while looking for the other herds. Their territory bounded that of Herds C and D in South Sus (Figs. 7 and 8).

Only one animal was marked in Herd E. E:1120 was the first animal I marked and the only one caught by trapping in South Sus. He was last seen in August 1967, with five other adults (Table 7).

Herd Integrity

I believe that some differentiation must be made between herd fluctuations, i.e., daily variations in number of individuals in the herd (Bigler 1964) and herd alterations or variations caused by individuals switching from one herd to another.

Herd Fluctuations

Herd numbers fluctuated from day to day as members became separated from the herd. Table 8 shows the variations that occurred in two herds for observation periods of about a week.
Table 6. Composition of Herd D.

<table>
<thead>
<tr>
<th>Date first seen in herd</th>
<th>Number</th>
<th>Sex</th>
<th>Wear Class</th>
<th>Date Examined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec. 30, 1965</td>
<td>D:1674</td>
<td>U</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>Feb. 23, 1966</td>
<td>D:2038</td>
<td>D</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>Aug. 9, 1967</td>
<td>Unmarked</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aug. 9, 1967</td>
<td>Unmarked</td>
<td></td>
<td></td>
<td></td>
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<td>Aug. 9, 1967</td>
<td>Unmarked</td>
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<td></td>
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<tr>
<td>Aug. 9, 1967</td>
<td>Unmarked</td>
<td></td>
<td></td>
<td>Juv</td>
</tr>
<tr>
<td>Aug. 9, 1967</td>
<td>Unmarked</td>
<td></td>
<td></td>
<td>Juv</td>
</tr>
</tbody>
</table>

D = Known dead
U = Fate unknown
Table 7. Composition of Herd E.

<table>
<thead>
<tr>
<th>Date first seen in herd</th>
<th>Number</th>
<th>Sex</th>
<th>Wear Class</th>
<th>Date Examined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar. 21, 1966</td>
<td>E:1120</td>
<td>M</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Mar. 21, 1966</td>
<td>Unmarked</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar. 21, 1966</td>
<td>Unmarked</td>
<td></td>
<td></td>
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<tr>
<td>Mar. 21, 1967</td>
<td>Unmarked</td>
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<tr>
<td>Mar. 21, 1967</td>
<td>Unmarked</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar. 21, 1967</td>
<td>Unmarked</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 8. Fluctuations in Herds A and B over a period of approximately a week.

<table>
<thead>
<tr>
<th>Date</th>
<th>Individuals in Herd A</th>
<th>Individuals in Herd B</th>
</tr>
</thead>
</table>
I observed peccaries undisturbed by human activity leave a herd four times. On one occasion, two unmarked animals from Herd C moved down Upper Sus while the rest moved up toward Day Overhang. Darkness came before I could see whether or not they swung around and rejoined the herd.

Another time, the members of Herd C were feeding in the wash southeast of Rattlesnake Rocks when squabbling broke out in the herd. C:2026 left the herd and went down and bedded in Rattlesnake Rocks. She had a piglet with her. Two other sows with young bedded in the wash across from Rattlesnake Rocks, while the main herd stayed above the rocks. I do not know if they rejoined the herd in the evening.

During September of 1965 I observed another separation in Herd C apparently involving a sow with young. The herd was feeding above Rattlesnake Rocks when a terrific squabble broke out in the brush above the rocks. Four peccaries broke out of the herd and moved south up the hill. One was moving at a running walk in the lead and was apparently chased by another peccary that was followed by a piglet. Another followed the one with the piglet. These four moved up the hill out of sight, while the rest of the herd bedded at Rattlesnake Rocks.

During the evening of July 17, 1966, Herd D which was bedded in North Sus moved off toward the north and east. There were five adults and two piglets. Two other animals which had been bedded about 100 yards from the others moved up to the herd’s bedding area and sniffed around. They rubbed scent glands and stood about with
the stiff-legged attitude of just awakened peccaries. Finally, they moved off to the south.

The most frequent cause of herd fluctuations that I observed was not of this kind, but rather was alarms in which the herd members scattered in every direction. I caused most of the alarms as I could not stay within 100 yards of a herd for any length of time, because of the shifting wind currents. Also, I frequently alarmed animals before realizing they were there. Sometimes, the herd would alarm itself and a chain reaction would be set up with the peccaries alarming each other over and over by their flight noises.

Deer sometimes alarmed peccaries, especially if the deer snorted. I frightened a doe that ran by a herd in Ex-Kim-In-Zan Recreational Area. The herd was not frightened by the deer until she snorted. Then the peccaries scattered, but regrouped after she left. Another time a buck ran through Herd D. The animals did not scatter until he snorted. Again they were not too alarmed.

One day during the spring, however, Herd C was thoroughly scattered by a doe. The peccaries and doe fed toward each other, but the wind was toward the deer. The peccaries were not alarmed until the leading animals detected the deer's presence. They wheeled and alarmed the others, scattering them out of the valley.

Low flying aircraft twice frightened peccaries. On November 25, 1965, three low flying helicopters scattered Herd A. On July 19, 1966, C:2011 was in Upper Sus with an unmarked animal when a jet roared over. C:2011 ran 50 yards and scooted under a rock, but the other paid no attention to the noise.
Attachments usually affected the manner in which a herd split. Certain animals had an affinity for each other, such as, sows with young. Similarly, if two animals were close together when startled, they were more likely to stay together while running than if they were further apart when alarmed. A good example of this was the association between B:1122 and B:1124. B:1124 stayed close to B:1122 even after she was grown, and they were almost invariably seen together.

Another example of this affinity occurred in Herd A during November and December of 1965. The female, A:1668, and two boars, A:1523 and A:1898, formed an in-herd association. They would usually feed close together and bed side by side, often touching one another. They stayed with the rest of the herd yet remained apart. This association could have been sexual as A:1523 was once seen to mount A:1668.

There is probably a seasonal variation in herd fluctuations, especially during the mating and farrowing periods, but I was unable to follow one herd consecutively for a year to prove it. Apparently the herds were much more scattered in the summer farrowing peak than at any other time. Aggressive actions were much more frequent during this time and may have caused the apparent herd fluctuations. It seemed that boars traveled in a group during the farrowing period and the females with young did the same, although I have little more than impressions to support this. Certainly the females are much more aggressive when they have young. This could segregate the boars and sows without young from the sows with young.
Herd Alterations

Two animals moved from one known to another known herd. The first to do this was a member of Herd A, A:1668. She was first seen in Herd B on April 18, 1966. The second, B:2011, joined Herd B from an unknown herd July 5, 1966 and on July 13, 1966 was seen in Herd C.

Three peccaries moved from an unknown to a known herd. All joined Herd A sometime during 1966 or early 1967. Two were later marked, A:2001 and A:2013. The third remained unmarked. As mentioned before, an animal probably joined Herd D, but since none were marked this is unproven.

These alterations were of a more or less permanent nature because the peccary left its old herd and territory and stayed with the new herd. None shuttled between herds. A:1668 was observed with Herd A from November to March of 1965. It was still a member of Herd B at the end of the study and was never seen in Herd A again. B:2011 was seen in Herd B for a week during July 1966, and was still with Herd C at the end of the summer of 1967.

Several peccaries were marked and observed in herds before disappearing. They could have died or moved out of the study area to unmarked herds. Two peccaries returned by hunters show that this occurs. Both were marked by previous workers on the Monument.

1640 was marked at Deer Trap and was killed at Ironwood Picnic Area, a distance of about seven miles from Deer Trap. The other, 1283, was marked at Sus, and killed at Wasson Peak, a distance
of about four miles. So peccaries not only move short distances from herd to herd, but also move longer distances as well.

**Solitary Peccaries**

The solitary peccary may be an old (Neal 1959) or infirm animal. I saw four of them during the study (three boars, A:1846, A:1523, and C:2005, and one sow, A:1065). One of the boars was a cripple and the other two were sick, while the sow was old and weak.

There was no evidence that solitary peccaries were anything but infirm animals, unable to keep up with the herd. They stayed in their herd's territory, although their movements were more restricted than those of the herd. They were friendly with members of the herd and one individual, A:1523, rejoined the herd when he regained his strength. Thus, solitary peccaries were infirm rather than socially ostracized animals and could be of either sex.

**Home Range or Territory**

Blair (1953) considers home range to be that area over which an individual travels in its normal, daily activities. Territory is any defended area within an animal's home range (Burt 1943; Noble 1939), and may include part or all of the animal's home range (Cockrum 1962). The evidence I have indicates that the entire home range of a herd of peccaries is defended from other herds, so I consider it a territory and call it so in this paper. However, there are areas of overlap around the boundaries of each territory so perhaps the monopolized zone of Jewell (1966) may more adequately describe the situation.
Size of Territory

The territories of Herds A, B, C, and D were mapped out by connecting the locations where the herds were observed, which were farthest from the center of their territory. This area remained rather constant throughout the year, and the herd was always found within its confines. In fact, the territory could be completely known within a few weeks of consecutive tracking. This is because a peccary herd traveled and retraveled its territory during a few days' time.

A computer was used in an attempt to discover if there was any connection between herd size and roughness of terrain. A matrix was made of the terrain by placing a 1/4 inch grid over a topographical map of the territory's area (scale: 12 inches = 1 mile) and the elevations at each grid corner recorded. The program then computed and added together the area of each square of the matrix. The total was called the true area. A projected area was similarly computed by placing the matrix at one elevation describing a flat surface. A comparison of the computer projected area to the area given by a planimeter always showed the computed area slightly larger (Table 9).

There were several sources of error in the computer system. First the elevation points were too far apart to portray the terrain accurately. Points that fell between contour lines were interpolated, but this also was inaccurate. Probably the largest source of error was that the boundary could not be accurately described by squares of the size I used.
Table 9. The computed true area, the computed projected area, the planimeter projected area, the computed true to projected area ratio and the peccaries per square mile using the largest known herd size available for each herd, and the projected area as determined by planimeter.

<table>
<thead>
<tr>
<th>Herd*</th>
<th>Computed True Area</th>
<th>Computed Proj. Area</th>
<th>Planimeter Proj. Area</th>
<th>Ratio Comp. T/P</th>
<th>Peccary Sq. Mile</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.58 sq. mi.</td>
<td>0.52 sq. mi.</td>
<td>0.47 sq. mi.</td>
<td>1.11</td>
<td>22</td>
</tr>
<tr>
<td>B</td>
<td>0.25 sq. mi.</td>
<td>0.23 sq. mi.</td>
<td>0.21 sq. mi.</td>
<td>1.14</td>
<td>35</td>
</tr>
<tr>
<td>C</td>
<td>0.32 sq. mi.</td>
<td>0.29 sq. mi.</td>
<td>0.28 sq. mi.</td>
<td>1.10</td>
<td>47</td>
</tr>
<tr>
<td>D</td>
<td>0.66 sq. mi.</td>
<td>0.60 sq. mi.</td>
<td>0.59 sq. mi.</td>
<td>1.10</td>
<td>18</td>
</tr>
</tbody>
</table>

* I used a herd size of 11 for Herd A which I got from William Jolly's notes for December 1964. There is no early herd size for Herd B so I used 7 which was the largest that I ever observed. A herd size of 14 was used for Herd C and of 11 for Herd D.
There was no correlation between peccaries per square mile and
the computer true area because (1) the herds that had unnatural fatal-
ities were not at carrying capacity, or (2) there are more important
factors affecting the numbers of peccaries in a particular area than
roughness of terrain.

Maintenance of Territorial Boundaries

The boundaries of A and B did not change noticeably for over
two years. Herd C and D were studied for a shorter time, but their
boundaries also showed little change. There was an overlap of about
100 to 200 yards between the boundaries of most of the territories,
so over a long period of time they may change.

Certain choice areas, such as Adobe Well, were used by several
herds. Herds A, B, and C all used Adobe. Herds C, D, and E used
Rattlesnake Rocks in North Sus for bedding, but Herd C used it much
more than either of the others. The rocks in Upper Sus were also
used almost exclusively by Herd C, but Herd E was once observed to
bed there. The deep, lower shaft of Two Shafts was used by Herd B
to bed on cold nights. Herd C often moved by Two Shafts and was once
seen in the upper shaft, but they were never seen in the lower shaft.
At no time were two herds seen to use any of these areas at the same
time.

Evidence that the boundaries are defended is mostly circum-
stantial. First, no herd was ever seen more than two hundred yards
inside the boundaries of another herd's territory and the peccaries
acted uneasy in the boundary area as did Kaufmann's (1962) coatis.
Second, the peccaries frequently rubbed their scent glands against rocks and trees as if marking. I observed Herd B approach a pile of boulders north of Prospect by the Hugh Norris Trail on the boundary of Herd C. The entire herd smelled and nosed a small brittle bush (Encelia sp.) and a nearby rock. Two rubbed their scent glands on the rock. They moved among the boulders smelling the ground and droppings, and finally moved off. This marking may serve as a warning to other peccaries.

Third, on one instance I saw two herds meet and one repelled the other in a skirmish of about 15 minutes. Unfortunately, none of the animals were marked and most of the aggressive action was heard, not seen. However, I saw four animals chased away by a boar and two other peccaries of one herd. On two other occasions I saw Herd D approach Rattlesnake Rocks where Herd C was bedded. Each time Herd D apparently winded Herd C and turned and ran north in obvious alarm; even leaving young behind.

Although mostly circumstantial I believe such evidence shows that boundaries are defended. If this is true then a small herd could take up as much room as a large herd, which would be important in the management of the species.

Calhoun and Webb (1953) mentioned that animals move into areas cleared of their species "as if in an attempt to encounter again the stimuli produced by neighbors." It would be interesting to remove a herd, say Herd B, and see if Herd A or C moves into Herd B's territory.
Individuals Crossing Territorial Boundaries

Several times I have seen peccaries joining or rejoining a herd which seems contrary to the idea of defended boundaries. For instance, I saw two peccaries feeding westerly in the ravine below Gray Mine. These I will call #1 and #2. The wind was at their backs. A herd fed toward them into the wind. Two of the herd, which I shall call X and Y winded the two solitary peccaries and stopped with a typical heads up, noses pointed into the wind, attitude. X ran over to #1 and both assumed the defensive posture of a mild squabble. Then #1 layed down on its stomach, apparently cowed. Next #2 came up, but it walked up to X and they sniffed and rubbed scent glands. #1 remained down until the rest of the herd advanced. In the turmoil of scent gland rubbing and moving about I could not identify any animal. Finally, they all moved off together. This is one possible way a new animal may be accepted.

Individuals could also switch herds when groups meet. Even though most of the peccaries repel each other at such times, herd members could possibly be exchanged.

Studies of aggressive behavior in penned animals indicate there is an individual variability in degree of aggressiveness; thus some members may be accepted readily if they are either passive or exceedingly aggressive. Likewise an animal may shuttle from herd to herd until accepted. This could account for the long distances traveled by 1640 and 1283.
CHAPTER 6

DAILY ACTIVITY PATTERNS

Seasonal and Daily Movements

I tried to determine what influence the environmental factors of air temperature, wind direction and velocity, and nebulosity had on the daily movements of the collared peccary. Observations were broken into 15 minute periods and as many of the factors as possible were recorded. However, it was soon apparent that the factors I recorded several hundred yards away and usually at a different elevation could not be the same as those surrounding the peccaries. Wind currents were very erratic in the broken terrain. Air temperatures also varied in the irregular terrain as did relative humidity. Radiation was probably more important in the peccaries' movements, especially in the summer and winter, than was the air temperature. Conduction during bedding periods from large rocks or the earth was not measured, but was also probably important. More sophisticated equipment and techniques than those used would be necessary for a meaningful micro-climatic study of the collared peccary.

Seasonal Movements

There was a definite seasonal variation in time of daily movements. Eddy (1959) and Bigler (1964) also noticed this and their timetables of diurnal activities were similar to those which I found.
Variations in daily activities were caused by differences in nebulosity, air temperature, and precipitation.

In the summer the animals were bedded, usually in very dense brush or under boulders, by the time the sun came up; they did not move again until sunset. Most of the feeding in summer was probably done at night.

As the days cooled in the autumn and winter, peccaries fed later in the morning and started moving sooner in the afternoon. They bedded for only a few hours around noon on sunny ridgetops in the open or in thin brush. They could almost always be found under an overhang or in a mine shaft at dawn, so they probably spent the coldest part of the night in such places.

As spring advanced they reversed the pattern, bedding sooner in the morning and moving later in the evening. Bedding places were under thick brush in washes and ravines.

**Effect of Temperature on Movements**

My observations of peccary herds indicate that they avoided harmful exposure to the elements. During the hot summer days they spent almost all of the time in the shade. Sometimes in the morning when the sun was at a low angle they were seen feeding in direct sunlight, but later they stayed in the shade.

They bedded in the summer when the air temperature approached 80 degrees (Fahrenheit) and moved in the evenings when it dropped to around 90 degrees. Eddy (1959) found that peccaries stopped feeding in the spring and summer at a temperature of 88-92 degrees and
resumed activity when evening temperatures declined to 90 degrees. I could not predict movements during the rest of the year by air temperatures.

In the winter, they used mine shafts and overhangs to avoid the cold. Neal (1959) also found them using such places in the winter. When bedded outside they chose sheltered places to avoid cold, winds or precipitation.

Although peccaries avoided the direct rays of the sun in the summer, they fed up the slopes into the rays of the rising sun on cold winter mornings.

**Effect of Precipitation on Movements**

Eddy (1959) reported that peccaries did not feed during periods of high winds, hail, rains, or electrical storms. I could detect no difference in the peccaries' behavior during the winter rains except they were more active during the middle of the day. Otherwise, I saw them feeding, bedding, and even copulating during rain. Herd A moved in the rain for three days during November 1965 and the only difference in their movements was locality; they stayed exclusively by Hi-Lo Shafts while it rained and tracks indicated that they sheltered there during the night. After the rains they were found on the north as well as the south side of the ridge.

On February 9, 1966 I captured three peccaries with the Cap-Chur Gun while they were feeding on a high wind and snow storm, but I never observed peccaries during a summer electrical storm.
Effect of Wind on Movements

Of the total time I observed peccaries feeding, 46 percent of it was spent moving against the wind, 35 percent moving with the wind and 19 percent with the wind quartering.

Of the total time I observed peccaries traveling (moving but not feeding), 54 percent was spent moving against the wind, 38 percent with the wind and 8 percent quartering.

Apparently peccaries prefer to move either into or with the wind; however, the wind currents that I measured may not have been those surrounding the animals.

Effect of Terrain on Movements

At one time or another the four herds used almost all of their territories for feeding, bedding or traveling. The only exceptions were the tops of the steepest slopes south of Adobe Wells, talus slopes, and sheer bluffs. Herds A, B, and C spent most of their time between 3,000 and 3,500 feet. There is little food and cover on the higher slopes except for the annuals that grow briefly after the rains. Peccaries are then found on the upper slopes feeding on the young plants and in the morning sunshine.

I found that peccaries spent 59 percent of their feeding time moving on a contour, 25 percent of the time moving down and 16 percent of the time moving up. Directions were determined by the general movement of one member of the herd (usually the instrumented one) over a 15 minute period.
High ridges form a barrier to feeding peccaries. These high ridges were usually crossed quickly either during an alarm or when traveling. Sometimes, of course, peccaries did feed up and over a ridge, but usually they followed easier routes.
Feeding Behavior

Spiny cactus constituted a large part of the peccaries' diet (Eddy 1959). In captivity they can consume about one-third of their body weight in prickly pear daily (Sowls 1966). A stomach analysis of wild animals taken during February hunts showed that prickly pear (Opuntia sp.) constituted 95 percent of the animals' diet at this time (Eddy 1959). I found that peccaries ate prickly pear at all times but ate it almost exclusively during the drier parts of the year.

To eat prickly pear, a peccary first removed a pad either by using its snout, teeth, or a forefoot. Then the animal stripped a small piece off with its incisors while holding the pad on the ground with a forefoot. Peccaries usually chewed the pear with a characteristic head extended position that cattle also use when chewing cactus. The pad was turned and trampled, perhaps to break off the spines. Donaldson (1965) observed a peccary knock spines off a pad by striking it on a rock. Usually one side of the pad was stripped and eaten before the other. Prickly pear pads were also eaten right on the plant leaving stringy, chewed areas. Old, browner cactus showed the heaviest use while young green plants were virtually untouched.
Staghorn cholla (*Opuntia* spp.) was eaten with even less care for the spines. The animal would nibble along the length of a joint. At the end of a joint a peccary simply put its mouth over the joint and pulled back stripping the spines and pulp from the woody skeleton.

Spines were frequently found in the snouts of trapped peccaries, but I did not find any in their mouths, nor any evidence of injury caused by spines.

Peccaries were very delicate feeders at all times, taking small bites and thoroughly masticating each bite before taking another. They opened their mouths with each mastication making a smacking sound. They also sometimes ground their teeth with a squeaking sound while chewing.

As peccaries fed they emitted little soft grunts. Enders (1930) described this as a contentment grunt. I believe this was a means of maintaining contact with each other while feeding as did Neal (1959). Several times while I tried to get close to a herd an animal heard me and gave a soft, inquisitive grunt. When I remained quiet the animal became alarmed and moved away or circled to get my wind.

Peccaries used their noses to root up the ground while feeding or preparatory to bedding. An animal would poke its nose down on the ground and move it into the earth and forward by jerks of the head. One such furrow that I measured was three inches deep and 22 inches long and was made by a single continuous plowing motion.
Shelter-Seeking Behavior

As mentioned previously, peccaries sought the shelter of rocks, brush, overhangs, and mine shafts to escape severe environmental conditions. They also used such places for hiding when frightened.

On one occasion I alarmed Herd B. It ran down to Prospect Valley and hid under boulders. Another time Herd A winded me and A:1968 ran uphill about 200 yards and hid under a shelf of rock. She came out one-half hour later and rejoined the herd. Jerry Day shot a peccary with the Cap-Chur Gun south of Apache Peak. Four other peccaries immediately scooted into a narrow crevice under a large granitic rock and would not come out even though shot.

We caught peccaries in the mine shafts of Gray Mine and Two Shafts by advancing toward them behind portable wire gates. Hiding behavior was very noticeable as we advanced on the animals. They sometimes squabbled as they climbed on top of each other at the back of the cave, but then they waited quietly, rarely shifting or turning their heads.

Intraspecific Aggressive Behavior

Aggressive behavior was studied at the University Farm where individuals were released into a 20 by 30 foot enclosure. This method gave an insight into the meaning of similar patterns observed in the field that could be obtained in no other way.

Intraspecific specific aggressive behavior could be divided into (1) threatening actions, (2) fighting actions, (3) submissive
actions following a fight, (4) social interactions not involving a fight, and (5) retreating actions.

**Threatening Actions**

Sowls (1966) indicated that peccaries have a hierarchy, and this was very noticeable in captivity. There were also signs of a social hierarchy in the field, but no pattern could be determined for any individual herd. Threatening actions were far more common than actual fights and undoubtedly contributed to the establishment and maintenance of the social hierarchy.

**The Squabble.** I applied the term "squabble" to the commonest non-fighting aggressive action. Figure 9 shows a typical squabble between two animals engaged in mutual threat. The two stood in braced positions and bit at each other's snouts. If dominance was already established, the dominant animal held his snout above that of the subordinate animal in the same manner as the dominant wolf described by Schenkel (1943) and some of the Indian ungulates described by Schaller (1967). The biting was usually not frontal, but from the side of the mouth and appeared to be restrained or inhibited. Sometimes canines were clashed together, but more often the snouts did not touch. This was accompanied by tooth clacking and deep, raucous growls that could be heard one-half mile away or more on a still day. The ears of both animals were held flattened against the back of the head or perked forward. Sometimes there was brief bristling of dorsal hairs of one or both animals. Squabbles rarely lasted more than ten seconds and often recurred. Finally, the animals either separated or remained together and rubbed each other's scent glands.
Figure 9. The characteristic stance of two peccaries involved in a squabble. Note the braced positions and exaggerated turning of the head of the peccary on the right to bite from the side of the mouth. This peccary's elevated snout indicates dominance.
The majority of the squabbles between peccaries appeared to be initiated by the dominant animal. There was usually, however, some action by the subordinate which released the dominant animal's response, such as, trying to pass on a trail, approaching too near the dominant animal, standing in the dominant animal's way, or approaching while the dominant animal was eating. The first overt aggressive action was a threatening by the dominant animal which resulted in an assumption of the defensive posture (Fig. 10) by the subordinate animal. The threat could be merely a look, a growl, tooth clacking, or an advance upon the subordinate animal, which usually resulted in a squabble. Sometimes a squabble was avoided if the subordinate animal became complacent at the nuzzlings of the dominant animal, if the subordinate animal retreated at the first sign of threat, or if the dominant animal retreated before the defensive posture of the subordinate animal.

During the first few weeks of motherhood, females were exceedingly protective of their young, and more squabbles occurred at this time than in any other period of similar duration. Females with young seemed to temporarily attain higher positions in the social hierarchy or were at least exceedingly aggressive toward the other adult animals.

Disputes over bedding positions also caused squabbling. Captive animals frequently squabbled over food, and a wild herd was observed squabbling over a barrel cactus which had a hole scooped in it only large enough for one animal to eat through at a time.
Figure 10. The defensive posture. - The ears are perked forward to flattened to the head and the peccary stands in a braced position.
Squabbles were often sudden and short. At one moment the herd would be lying quietly and the next moment a squabble would start. A short time later the same animals involved in the squabble would again be lying quietly. Sometimes a "chain reaction" seemed to start when a subordinate animal, trying to escape one animal, came too close to another.

**Teeth Clacking.** When annoyed, peccaries clacked their teeth together with a rapid up-and-down movement of the lower jaw. The sound produced in this manner resembled that which is made by sharply striking together two leg bones of some large animal. The upper lips were pulled upward exposing the canines and it appeared that the sound was made by the striking together of these teeth and the incisors. The fact that young animals used a similar threat, without the sharp clacking sound, before their canines and incisors were developed supports this theory.

The intensity of tooth clacking depended upon the strength of the annoyance. When one peccary was mildly annoyed by another, it clacked its teeth together gently. As the annoyance increased, it emitted a gentle "woof" and intensified its teeth-clacking. When thoroughly aroused, a peccary focused all its attention on the annoying animal. It erected the bristles on the top of its head, neck, and shoulders and lunged toward the other animal. At the end of the lunge, it woofed explosively and clacked its teeth in a sharp staccato sound.
Behavior which may be similar to peccary teeth clacking in relation to aggressive actions have been observed in voles by Clarke (1956), and in Uinta ground squirrels by Balph and Stokes (1963).

**Fighting Actions**

The second category of intraspecific aggression, fighting, had several well-defined components. However, there was not always a clear line between threatening and fighting actions, so we concluded that a fight had occurred when the opponents went through most of the following stages and fought to exhaustion or one became clearly dominant.

**The Charge.** Fights began with a headlong charge by either or both opponents. The ears were perked forward and the mouths were held open. Bristling and tooth clacking sometimes accompanied the charge. A fight or squabble ensued if the charged animal responded in an aggressive manner to the charge. Animals that exhibited submissive actions were never bitten.

**Biting.** Fighting animals bit vigorously at each other's head and shoulders at the beginning of a fight (Fig. 11). They reared onto their hind legs or jumped into the air, uttering deep raucous growls. As they tired, however, they directed their bites to the other's flanks and hindquarters.

The severest injuries were caused by this reciprocal biting of flanks and hindquarters. The heavy skull, flaring occiput, and thick covering of bristles along the top of the neck and skull shielded the neck from serious damage. Also, when bitten from a
Figure 11. Biting at head and shoulders at the beginning of a fight.
facing position a peccary usually returned the bite immediately
forcing the opponent to release its bite before severe damage could
be done.

**Whirl-Around.** As the fighting animals tired, one sometimes
grabbed the head or snout of the other or the two locked jaws to-
gether. The bitten animal emitted harsh groans and appeared to be
in great pain. The attempts of the bitten animal to escape and the
holding back of the other, resulted in a circular motion of both
animals at a walking pace which I have called the "whirl-around"
(Fig. 12). This action often continued until the bitten animal pulled
away or was thrown down. This hold seemed to be important in deciding
the outcome of the fight with the bitten animal becoming increasingly
on the defensive thereafter.

**The Throw-Down.** The "throw-down" usually occurred when both
animals were near exhaustion. One animal gripped the other somewhere
on the head or shoulders and then twisted his head in a throwing
motion which flipped the opponent off his feet. As the opponent fell,
the other also fell because of his reluctance to release the hold.
Both animals then lay on their sides, breathing heavily. After, a
time, the bitten animal made feeble attempts to release itself. His
struggles intensified until the hold was broken, then both sprang to
their feet.

The above cycle was often repeated several times but the
various events did not necessarily occur in the same order each time.
The animals sometimes continued fighting until the dominant animal
Figure 12. The whirl-around. - The nearest animal has a grip on the side of the other's head. The pulling away of the bitten animal results in both animals walking around in a circle.
was nearly exhausted. The weaker animal merely returned the attacks of the aggressor.

**The Defensive Posture.** At the end of the fight, the opponents separated and the subordinate animal assumed the "defensive" posture. This was a braced position with the head lowered in which the subordinate animal always faced the dominant animal (Fig. 10 and 13). The ears of the subordinate animal were flattened against the head and the mouth was opened as a warning whenever the other animal moved or threatened. Low growls were emitted by the subordinate animal. The dominant animal sometimes resumed the attack, but usually he backed up a few steps and then turned his back to the subordinate animal.

It was significant, and another indication of dominance, that the dominant animal turned its back to the other. The subordinate animal, however, always faced the dominant animal immediately after an aggressive encounter, or whenever the dominant animal was too near.

The turning away of the dominant animal after an aggressive action should not be confused with the retreat of a subordinate animal which will be described later. As soon as the dominant peccary was far enough away, the subordinate animal hurried to a corner of the pen and assumed the defensive position whenever the dominant animal came near.

As in the squabble, the intensity and frequency of fights after dominance had been established seemed to be determined by the dominant animal. After the dominant animal had rested, it frequently moved toward the subordinate peccary. The subordinate peccary
Figure 13. At the end of the fight the opponents broke off and faced each other in this manner. The animal on the right is dominant as indicated by his elevated snout.
assumed the defensive posture and began growling. The growling increased in volume as the dominant animal approached. The dominant animal usually stopped a few feet away and emitted soft grunts that resembled feeding grunts. Sometimes it shook its head up and down while opening its mouth, showing the canines. Then the dominant peccary either moved away or rushed in and fought again.

Fights occurred most often between unacquainted boars. Sows seldom fought, and fights between sows and boars have never been observed in my studies.

Submissive Actions Following a Fight

When one peccary is dominated by another, his submission ranges between extremes of partial submission to complete submission, and the stages of submission are indicated by several interesting postures. Whereas the defensive posture just described falls into the aggressive end of this range, the partially submissive posture falls near the center of the range and indicates still less aggressiveness and more submission than the defensive posture, while the completely submissive posture indicates complete submission.

The Partially Submissive Posture. In this position, the snout and forequarters were held low, almost touching the ground, with the front legs kneeling or extended. The hindquarters remained erect, but in the braced position. The animal growled, clacked its teeth, and shifted to face the dominant peccary when it approached. Thus, the front part of the animal indicated almost complete submission, while the erect hindquarters, growling, teeth clacking,
and shifting indicated aggressiveness (Fig. 14). Simpson (1964) reports a similar position in defeated wart hogs.

As in the defensive posture, the partially submissive posture was initiated by the dominant animal moving toward the subordinate animal.

The Completely Submissive Posture. A completely submissive peccary simply layed down and displayed no overt aggressive signs. It allowed the dominant animal to move behind it and even permitted itself to be sniffed and nuzzled by the dominant animal (Fig. 15).

Social Interactions Not Involving a Fight

Most of the submissive actions described previously occurred in defeated or subordinate animals following a fight. Frequently, however, the animals released into the enclosure did not fight; nevertheless they interacted socially and certain patterns were recognizable. These patterns were of a "friendly" or passive nature, as distinguished from the overt aggressive actions such as fighting and threatening. Nevertheless, these patterns were important as most of the peccaries used them rather than fighting and threatening upon first meeting each other.

The Subordinate Approach. When a subordinate animal approached a dominant peccary, the approaching animal held its snout in the subordinate position, i.e., below that of the other (Fig. 16). The dominant or approached animal sometimes assumed the defensive position and clacked its teeth when the other animal moved toward it, but usually it reacted favorably as long as the other's snout remained lowered.
Figure 14. The partially submissive posture. The defeated peccary sometimes assumed this posture after a fight. The lowered forequarters indicate submission, while the raised hindquarters, shifting to face opponent, and teeth clacking indicate aggression.
Figure 15. A completely submissive peccary (on left) allowing itself to be sniffed by the dominant peccary after a fight. - Note the turning away of the head by the submissive peccary.
Figure 16. The subordinate approach. The subordinate animal (on the left) approaches the other with a lowered snout. The dominant peccary may accept or rebuff the subordinate.
If the inferior animal was threatened by the other, it would back away and try again later. One particular instance occurred when a sow in heat was placed with a boar that had just been fighting and was still belligerent. The female continually approached the boar with her snout below his, but was rebuffed for over an hour. Finally, the boar accepted her.

The Dominant Approach. If one animal approached another with snout above the other's in a dominant attitude, then the approaching animal was usually rebuffed (Fig. 17). I believe that the difference between this dominant approach and that of a dominant animal approaching a subordinate animal after a fight is in the mood or intent of the approaching animal. The dominant animal's approach of a subordinate after a fight seemed to be a testing of the subordinate peccary's willingness to continue fighting, while the dominant approach seemed to be a friendly greeting. The actions of the approaching animal were unhurried and placid. No overt aggressive displays were made other than the raised snout.

Invariably the animal which was approached in such a manner assumed the defensive posture. Usually the dominant animal turned away when the other threatened and sometimes a squabble occurred. Rarely was the dominant animal able to overcome the rebuffs of the subordinate animal with a dominant approach.

I also observed peccaries approaching each other when it was impossible to determine dominance by snout position. Such animals extended their snouts at the same level and lightly touched. This
Figure 17. The dominant approach. - The animal on the right is dominant and has approached the other with an elevated snout. The subordinate animal usually rebuffs such an approach.
was repeated with longer sniffings of the snouts and heads and then
down the bodies which led to scent gland rubbing. These approaches
were seen between sows, sows and boars, boars that had no inclination
to fight, and young and adults.

Interpretation of the patterns was difficult because the same
pair of animals did not always react in the same way, even when only
a short interval occurred between successive encounters. Mood of the
participants was probably very important.

Retreating Actions

Retreat was probably inhibited in the enclosure, probably
forcing the defeated animal to assume the various defense positions.
These have also been observed in the field, but retreat is much more
common, probably because of the freedom of movement.

Following a fight, the defeated peccary retreated from the
victor's presence as soon as the winner turned away. The defeated
peccary ran to the nearest corner and again wheeled and faced the
other. Its retreat was characterized by a furtive mien, with the
head lowered and the ears against the head. Its movements were hur­
ried and nervous. In contrast to this was the turning away of the
winner. His movements were calm and unhurried and he paid little
attention to the other. Occasionally the dominant animal chased the
subordinate peccary. When the subordinate peccary was too hard
pressed it whipped around and assumed the defensive posture.
Interspecific Aggressive Behavior

Interspecific aggression is necessary for the protection of the species, and the peccary relies heavily on bluffing rather than fighting. Wounds received during a fight could lessen the individual's chance of survival, so I was not surprised to notice bluffing displayed by peccaries during all interspecific encounters. Bristling, a frequent reaction, probably makes peccaries appear larger to other species and so may be considered a bluff.

During bristling, the bristles in the collar region stand out from the others, and were most noticeable at the top of the collar where the collar joins the dorsal band. Bristle erection was almost absent at the bottom of the collar. Viewed from the front, the collar was extended the most where the head is widest and the least at the jawline where the head is narrowest. Thus, the collar, along with the dorsal band outlines the head, and possibly makes the head appear larger.

Threat and retreat were both observed as defensive measures during encounters with other species of animals, but I have not seen any interspecific fight involving a peccary. However, I made up stuffed dummies imitating human beings and exposed these to some of the more aggressive captive animals. In these instances bristling was intense as the peccaries charged the dummy and bit at its legs. No discharge of musk was noticed in these encounters.

I have seen captive peccaries charge dogs and people that were close to their pens. Extreme bristling was observed in every
case. When I saw peccaries chase dogs in the field, extreme bristling was evident. Tooth clacking was also extensive during interspecific bluff.

Submissive behavior toward animals of another species would be disadvantageous to the individual and to the population. A possible exception to this is the fact that very young animals have been reported to "play possum" when alarmed.

**Sexual Behavior**

Breeding takes place in all months of the year (Neal 1959; Sowls 1966), but the majority of observations that I obtained of breeding peccaries occurred in February and March. Only two were obtained at another time and they were in July and November. The February and March breeding season seems to be correlated with the July - August farrowing peak.

There are several references (Neal 1959; McCullough 1955; Sowls 1966) that state that members of the herd pay little attention to a mating pair. This is true in a general way, especially in a small herd where the social hierarchy is probably well established and recognized by each member. Neal (1959) however, noticed once that a mating boar chased another away. I observed this several times in the wild. At 7:30 A.M. on March 25, 1966 I observed a boar mounting a female three times. None of these mounts were very enthusiastic and each lasted only a few seconds. The mating boar, however, chased another away when it approached. There was chasing among the herd members all morning disrupting their feeding and
several times scattering the entire herd. On the East Saguaro Monu-
ment I observed another mounted boar chase away a peccary (sex unde-
termined) that was approaching the mounted pair.

Intensified aggressive behavior probably occurs during
breeding because of the unusual disturbance and amount of movement
in the herds. Most of the aggression, however, is difficult to detect
and is mostly of a chasing nature. I have observed a peccary suddenly
change direction while feeding or even move off at the approach of
another feeding animal. At first this appeared to be normal feeding
behavior, but if the same two animals were watched I could see that
one was chasing the other. Furthermore, there were several couples
or trios throughout the herd involved in this moving which rarely
resulted in a squabble, but constantly kept the herd stirred up. I
could not detect whether these were boars chasing other boars or boars
chasing sows just coming into estrus. Unfortunately, I did not be-
come familiar enough with the aggressive actions of peccary to detect
this behavior until the end of the study. Then it was too late to
gather enough data to determine whether or not there is more aggres-
sion at this time.

My two observations of peccary mounting outside of the
"regular" breeding season entailed no aggression among the herd mem-
ers. However, both copulation attempts occurred in small herds
(Herd A and B) which may account for this. On November 25, 1965 in
Herd A, A:1668 was mounted for five seconds by A:1523. He slid off
and nuzzled the sow and then mounted again for five to ten seconds,
but only stood. He seemed very tired and after dismounting they moved apart. For several weeks A:1668, A:1523, and A:1898, another boar, were together almost continually, but this was the only time I saw them mate. On July 5, 1966 after A:1668 switched to Herd B, I observed her mounted again, this time by B:1122. It was at 6:45 A.M.; they were in the shade with a temperature of 80°. At 6:48 A.M. B:1122 mounted briefly. He got off and they nuzzled and rubbed each other. The sow seemed to be the instigator and did most of the nuzzling and rubbing. She also reached under the boar's belly and sniffed or licked his penis. The boar mounted again for four and one-half minutes, sometimes thrusting, but the majority of the time not moving. He got off briefly and then mounted again for two minutes and forty seconds. He sniffed the sow's hind parts and mounted again, but immediately slid off to the right side. He mounted again for thirty seconds and then got off and walked a few feet to the left of the sow. He returned and rubbed the sow's hindquarters with his chin and the sow turned and rubbed his withers with her chin. The boar mounted again, but was off in twenty seconds. They rubbed each other's necks and foreparts and then both moved under a saguaro and appeared to be eating fallen fruit. They moved downhill and bedded.

While watching breeding behavior of peccary at the farm I also noticed the sow licking and sniffing the boar's penis. They also both sniffed each other's anal regions much in the manner of dogs. Frequently, when a boar would pay no attention to a sow in heat the sow kept nuzzling, sniffing, and mounting him until his
interest was aroused. At other times the boar mounted with no hesita-
tion. Sows have been observed to mount other sows, but this is not a reliable sign of estrus in females (Sowls 1966).

Mutual Grooming and Care-Giving Behavior

The peccary being a highly social animal has evolved several behavioral patterns that are used among friendly animals to develop and reinforce friendship. These patterns also probably help maintain social dominance within the herds. Others were used to mark and maintain territorial boundaries.

Behaviorisms Centered Around the Scent Gland

The reciprocal rubbing of the scent gland has been briefly mentioned in connection with squabbling, fighting and the establishment of dominance among herd members. These emphasize the importance of this gland to the peccary, but certainly there are still other behavioral patterns in which the scent gland plays an important role.

The peccary is the only member of the superfamily Suoiidea which has such a gland. It is located on the back, a few inches above the base of the tail. This gland appears externally to be a raised area of skin measuring approximately two by three inches with a nipple-like protuberance in the center (Fig. 18). A complete description of the scent gland has been presented by Epling (1956). The exact purpose of the gland is not understood. Some people believe that it is a defense mechanism similar to the musk gland of a skunk. Seton (1929) suggested that the musk served as an insect repellent
Figure 18. The position of the eye in relation to the scent gland during the reciprocal action of scent gland rubbing.
and Neal (1959) thought it served as an alarm system and a means of keeping the herd together. Werner, Dalquest and Roberts (1952) believed that it served as a means of maintaining herd integrity and helped in identifying friends.

**Rubbing Scent Gland.** I believe that many of the behavioral patterns which serve to establish and reinforce the social order have evolved around the scent gland. The components of these patterns are not aggressive and probably originated from grooming movements.

The rubbing of scent glands was a reciprocal action and occurred between friendly animals. Two animals stood head to tail with sides touching and vigorously rubbed the sides of their heads against the other's hind quarters and scent glands (Fig. 19). The side of the face and the area around the eyes of the animal moved over the scent gland of the other animal.

The reciprocal rubbing was beneficial in suppressing the build-up of crusty material around the eyes that results from chronic non-pathological eye infections which are common even in wild animals. When kept singly in pens many individuals had a heavy build-up of crusty material around the eyes. This build-up did not occur when friendly animals were kept together, even though there was evidence of eye infections. The reciprocal rubbing removed the crusts as quickly as they were formed.

Frequently one-sided rubbings were forced upon a submissive animal by a dominant or larger animal. One instance was observed where a dominant animal nuzzled and rubbed the scent gland of a
Figure 19. Characteristic head to tail position of two peccaries engaged in reciprocal scent gland rubbing.
temporarily submissive animal. During later encounters, the temporary submissiveness ended and the two fought. On another occasion a young peccary (two-thirds grown) was placed with an adult boar. The adult immediately rubbed the scent gland of the smaller animal, but the action was not returned. Several instances of adult animals rubbing the scent gland of a young (one to two months) animal have been seen. I have never seen very young animals rub each other's scent glands, but have seen animals of about two months of age do so.

There is evidence that the trait is inherent as young peccaries raised away from members of their own species rubbed their heads against objects. It seemed to be a carry over from nursing head movements.

Scent gland rubbing was easily observed and usually occurred when the animals were active, although feeble attempts by bedded animals have been observed. Rubbing usually took place immediately after rising from a bed, but could occur at any time when two animals were near each other.

Scent Gland Smelling. When two animals met, they commonly smelled each other's scent gland (Fig. 20), and various other parts of the body. Smelling was most frequent before and after scent gland rubbing. It did not matter which animal was dominant or subordinate, but apparently depended upon their previous mutual experience. This type of activity seemed to be analogous to the anal smelling of dogs.

Squirting of Musk. I observed the squirting of musk several times among free-running wild animals and also among captives. The
Figure 20. Scent gland smelling. -The peccary on the left is smelling the scent gland of the other.
animal raised and shook its bristles all along the back in a quick side to side motion and at the same time emitted a stream of musk. There was no reaction to this by nearby peccaries. I have extracted musk from the glands and have found that the amount in each animal varies. Musk apparently builds up in considerable quantity and must be eliminated. The squirting of musk may simply be a means of getting rid of excess musk. Wounded animals sometimes squirt musk, but this is probably due to muscular spasms rather than to any protective or warning behavior.

**Pawing and Marking.** Peccaries often rubbed their scent glands against a rock, tree or some other inanimate object. Pawing the ground often accompanied this type of scent gland rubbing. By use of the front feet the animal tore up the ground and threw bits of grass and debris behind him. The animal sniffed the ground both before and after pawing. After pawing the animal backed up against an object, raised the bristles around the gland, and rubbed it back and forth against the object.

The scent undoubtedly served as a means of communication between individuals of a herd and helped those olfactory-guided animals to maintain herd integrity. Behavioral patterns that have evolved around the scent gland probably help the animals to recognize one another and help establish and reinforce the social hierarchy and territories.

**Nuzzling.** I have called the rubbing of the snout of one animal against the snout, head or neck of another "nuzzling" (Fig. 21).
Figure 21. Nuzzling, in this case, preparatory to mounting.
This action is apparently a very important contactual experience between friendly animals. Even the flanks and hindquarters were rubbed sufficiently hard to disarrange the bristles. A female in heat nuzzled a male to arouse his interest. Nuzzling almost invariably led to scent gland rubbing.

Maternal Behavior

Knipe (1957) and Neal (1959) both considered the collared peccary to be a poor mother, and thought this was the reason for the high mortality of young. Knipe stated that sows paid little attention to their young and in domestic stock this trait accounts for the high loss of young. I do not feel domestic species can be compared to the peccary, but in captivity peccaries rarely lose any of the young and are very successful in raising them to adulthood.

Certainly the mother peccary pays attention to her young and defends them from other peccaries as well as other species. I found that peccaries protected their young from other peccaries, and there were more squabbles during the farrowing peak than at any other time. For instance, a piglet in Herd C squalled when stepped on by another adult. The mother immediately jumped up and attacked the adult. A squabble ensued. Another time, three peccaries in Herd D, one with a piglet, stood up and rubbed scent glands. Suddenly a squabble broke out. The three peccaries were all braced around the piglet with their snouts pointed toward it. Finally, one moved off and the other two nuzzled the piglet. The second lay down and the third moved off with the piglet.
I have frequently seen peccaries nuzzle their young and several times have been close enough to hear the mothers grunting contentedly while the young nursed. I once observed a sow start to lie down, but a piglet moved under her and began nursing. She stayed in a kneeling position and as the piglet nursed, closed her eyes and started grunting in apparent contentment.

I have never seen peccaries fail to respond to the squall of a piglet if they are near enough to hear it. One time a herd of peccaries crossed Wasson Peak Road. One red piglet became separated in the confusion and stopped and squalled. Immediately three adults returned to the young and then left the way they came with the young one following. On August 24, 1966, I witnessed the birth of two peccaries. Even though the rest of the herd ran off, the mother was exceedingly aggressive, clacking her teeth and lunging at me several times. She did not leave the area even though I forced her out in the hot sunshine. Another time I shot a sow with an immobilization dart that had a half-grown piglet with her. The dart failed to go off and the sow ran over a small hill. The piglet became separated and stopped and squalled. The squall was more of a hollow rumble in its chest than a younger piglet's squall. The sow immediately came back over the hill and recovered the piglet.

Peccaries will also return to look for their young which are lost. I came upon Herd D in North Sus. The peccaries scattered in every direction. I climbed to the top of a boulder to watch the progress of some of the frightened animals. Suddenly a sow appeared
and came stamping toward me even though the wind was directly to her. She passed below me and moved to a small brittle bush. Two piglets ran out and joined her. She returned the way she came with the young following. Bigler (1964) also mentioned similar behavior in sows.

Although I have never seen a young peccary taken by a predator, I have no doubt that the mother would rush to its defense at the first squall. In every instance, except the death of A:1858 that I observed dogs come in contact with peccaries the peccaries have chased the dogs.

There are several probable reasons for the large mortality of young. First, the young are precocious. From the time they are a few hours old they follow their mothers everywhere. The young of deer and antelope, species used by Neal (1959) in comparing maternal behavior, do not do this. Young peccaries are about five inches high and weigh around one pound at birth. A baby this size has much difficulty keeping up with adult animals that are running or traveling quickly in rough terrain for distances of a quarter mile or more.

Second, even though sows usually returned when separated young squalled, sometimes they did not. In every instance that I observed the latter, the adults were badly frightened and ran long distances. Twice I was watching Herd D during the summer of 1966 when it spooked after winding another herd. Several young piglets were left over three hundred yards behind each time. By dark I still did not see the mothers return. Such piglets are easy prey for predators. Perhaps the mothers do not realize they have lost their young
until they stop, and then do not know where to look for them. I once alarmed Herd D out of North Sus. The animals ran north toward Kinney Road and bedded. While watching them bed down, a red piglet walked by me. It headed back toward the place where I scared the herd. It disappeared in a wash and I never discovered its fate, although it was only 150 yards from the bed ground when it went out of sight.

Third, the characteristic scattering and chain reaction fright during an alarm gives plenty of opportunity for the young to become separated from the mother before they are large enough to keep up. The severe summer showers may contribute to this. First the loud thunder may scatter the herd and second, the rain may wash out the trail of the piglets.

Peccaries will adopt the young of other peccaries or rather piglets will follow adults other than their mother if they lose her. A case in point is B:1121, who followed B:1122, a boar, from the time she was two to three months old to adulthood. Jerry Day also told me about a piglet that he observed try to nurse and follow a sow which was not its mother. I have never seen a piglet nurse on any sow other than the one it was following. Of course, since the piglets look much alike it is possible that there was some switching.

The maternal behavior of the sow giving birth was probably affected by my presence. At 9:30 A. M. I approached Herd D, bedded in North Sus. I alarmed two peccaries, but could hear a third woofing behind a large boulder that was partially covered by a spreading palo verde. The sow was under the palo verde and stood

1 Jerry Day, personal correspondence (1963).
up as I approached. At 9:34 A. M. a piglet was visible and protruded about one half of its length from her vulva. The young dropped out and she nuzzled it. It squalled a few times. The calls increased in intensity for the next half hour because it fell into a crevice. The squalls excited the mother. The sow lay down and at 9:43 A. M. gave birth to another which took less than a minute. She apparently ate the placenta as I could find no evidence of it. Some was still hanging from her vulva when I disturbed her to inspect the young.

Behavior of Young

I raised a young peccary from the time of its birth to study its behavior. Most of the following observations were of that animal and another that lived only one week.

Nursing

From the first day of birth the piglets showed a strong nursing drive and nursed on my female Weimaraner. Invariably they would choose the last two nipples to suck on although they had eight of equal size to choose from. This trait would undoubtedly be an advantage to them in the wild as the only completely functional pair of mammae in peccaries are the posterior two (Neal 1959; Sowls 1966). A close examination of the piglets' heads showed that they were covered with vibrissae from two to three inches in length. Since the last two mammae are the only ones completely covered by the dog's hind leg, perhaps the vibrissae received a tactile stimulus from the leg to guide the piglet.
Peccaries are able to eat solid food from one to two months after birth, but a six-months old piglet nursed several times on C:2021 during December of 1967. I did not know whether the sow was dry.

First Days After Birth

The piglets were very precocious and followed any familiar moving object within three hours after birth when most of their unsteadiness left them. Later on, they would not follow a strange object, and seemed to identify known objects by both hearing and scent.

Of four new-born piglets that I observed, each lost his umbilical cord three days after birth. All were born with four canines and two lower incisors, and each displayed the defensive actions of bristling and biting when alarmed. They also snapped at objects that moved quickly near them.

The young ones constantly made a low purring sound in their throats when awake. This sound modulated into the squall when left alone or a squealing growl when annoyed. This sound probably develops into the feeding grunt of adult peccaries.

Although they had little or no contact with other peccaries the piglets showed several of the adult behavior patterns, such as bristling, curiosity posture and held foot, woofing when alarmed, pawing while lying on their sides, rubbing the side of the head against some object, and rubbing the scent gland against objects.
One woofed and clacked her teeth at the age of 39 days when brought in contact with another piglet and later when food was taken from her.

The first exudation from the scent gland was noticed on a female 41 days after birth.

**Play**

The young played by gamboling about. This was also observed in the field with the piglets rolling and tumbling over each other in the manner of puppies. They also chewed objects and carried them around in their mouths while shaking their heads. Most of a solitary piglet's play was running or lying on its side taking nips at the air.

**Eliminative Behavior**

The scat station has been mentioned by Bigler (1964). I have found that the larger ones are in proximity to bedding areas and contain both old and new scats. I do not think that peccaries have specific defecating areas as their scats are found spread throughout their feeding areas and trails. Rather, the large number of scats in certain areas are a result of peccaries using those areas for bedding or other purposes and defecating nearby, thus accumulating scats. Undoubtedly the scent of droppings does serve as a releasing stimulus and I have seen peccaries defecate after sniffing a scat. They will also defecate and micturate in their beds after rising. The pawing action noted before and during bedding may be useful in cleaning their beds of droppings and insects.
The scat itself varies in shape depending on diet. The most usual form resembles a small cow chip. Others resemble that of a large dog and during the forb season they are very loose. When peccaries are feeding almost exclusively on saguaro fruits the droppings are cylinders of compacted saguaro seeds. The first defecation of piglets resembled little black beads in a greenish mucous.

There is little ceremony in either defecating or urinating. Sometimes the animal will paw and sniff the spot, but more usually it just moves off. Both sexes usually squat a little while defecating. Females squat noticeably while urinating with hind legs spread apart while males do not assume a special position.

**Following and Imitative Behavior**

The precocity of piglets and their following of a familiar object has been mentioned. In the field the piglets followed their mothers closely, purring the while. This following behavior was strongly ingrained in the young and they followed their mother closely until they were over a year old.

Adults also displayed a strong tendency to follow one another, both while scattered in a loose group and when in file. The file of alarmed peccaries was especially noticeable. If the herd was not alarmed too badly they all moved off in the same file. Each animal closely followed the one ahead, taking the same path of departure as its predecessor. If the animals were scattered, those that were close together formed a file and moved off. Peccaries traveling in this manner would make frequent listening stops and then proceed.
I could find no pattern of leadership during the alarm files. The leading animals were usually, but not always, the flightiest. Even juveniles were sometimes seen leading a file.

**Investigative Behavior**

From a very early age peccaries displayed curiosity of strange objects and surroundings. They also showed a remarkable ability to remember and frequent familiar areas and pathways which were learned as a result of this investigative behavior.

In the field they showed every indication that they were completely familiar with their territory, moving unhesitatingly to water, bedding areas, etc. On July 31, 1966 I frightened Herd C out of Rattlesnake Rocks. It was late in the morning and I forced them out in the hot sun. They immediately headed south in a direct line for the large boulders in Upper Sus, the only other place that they habitually bedded at that time.

Peccaries used several curiosity and investigative patterns when they were trying to identify a stimulus. A peccary assumed a listening posture when it received an external stimulus, but was not sure of the source. The posture could lead to retreat or bluff, or change back to a more relaxed position if the stimulus was not repeated. The animal stood motionless with ears perked forward or cocked in varying positions to catch sound (Fig. 22). The feet were usually parallel to each other, giving the animal a stiff-legged appearance. The head was down or raised and almost invariably at an angle to the long body axis. In the case of an olfactory stimulus
Figure 22. Listening posture of an alerted peccary.
the nose was extended upward and moved in a sniffing manner. This position lasted from five to thirty minutes and was gradually relaxed if no further stimulus was received. If the stimulus was strong or was increased, the animal assumed the curiosity posture.

**Mild Curiosity Posture**

The two most notable characteristics of the mild curiosity posture were the erect bristles from the head to the withers and a raised leg (Fig. 23). This posture closely resembled the stance of a bird dog on point. The leg position was a result of the peculiar gait of a curious peccary, which was a stiff-legged walk. The front legs were bent sharply at the knee and then stamped to the ground. When the animal stopped one of the legs remained in the bent position. The right front leg was the one most commonly held, indicating that the animal had a predilection to stop at that point in its gait. Occasionally, the left front leg or a hind leg was held up.

Another peculiar action that was observed was a head-bobbing motion of a curious animal. It consisted of a quick lowering and raising of the head with the snout pointed toward the stimulus and the ears perked forward. Bristling occurred and the peccary then went into the mild curiosity walk and posture to investigate the stimulus.

**Intense Curiosity Posture**

As the intensity of the stimulus increased, the intensity of the walk and posture also increased (Fig. 24). The stamping motion was very pronounced and a woof was released as each front foot struck
Figure 23. Mild curiosity posture. - Note held leg and slight bristling from between ears to top of withers.
Figure 24. Intense curiosity posture. -Note intense bristling all along back.
the ground. There was excessive bristling all along the backbone. If the stimulus could not be identified, the animal continued this stamping walk, circling into a favorable position to scent the intruder. Frequently, peccaries were observed to walk right up to a man while they were attempting to circle. The scent of a man, however, caused them to suddenly retreat.

Retreat. When the stimulus prompted retreat, such as when a man was scented, the peccary ran off at a leaping gallop, "woofing" at every bound with bristles fully erected. After the initial sprint peccaries assumed a running walk stopping frequently to listen. The woofing was continued for a considerable distance.

The bristles surrounding the scent gland were erected in a fan shape exposing the white underparts of the bristles. This lighter patch may be helpful to a following animal or to a young while following its mother.
In recent years the interest of Arizona sportsmen in hunting the peccary has greatly increased. With this interest there has also been a large increase in the number of peccaries killed. The number of peccary licenses sold has gone up each year. In 1950, 9,294 tags were sold compared to 29,793 in 1968 (Arizona Game Management Data Survey 1968). The estimated number of animals killed has also steadily increased from 1,344 in 1950 to 5,082 in 1968.

Meanwhile there is abundant evidence that the herd size has steadily declined in most of the peccaries' range in southern Arizona. The opinion of many long-term hunters that the peccary populations have declined seems to be substantiated by the data presented in Arizona Big Game Investigation, Game Management Division, Job Completion Reports (1961 through 1968). In several management units the herd sizes reported have been as low as 1.0 animals per herd. These figures contain piglets of all sizes so that the average herd size of producing animals is undoubtedly even lower. In many instances (especially in units reporting larger herds) the number of herds reported is so small as to be inadequate.

In the Tucson Mountains the average herd size has declined from 13.0 animals per herd in 1961 to 4.9 animals per herd in 1968.
The percentage of juvenile animals and average herd size reached a new low throughout the Tucson Mountains. There has been a downward trend in average herd size for the Tucson Mountains since 1941, although javelina continue to be observed at a high rate in the Saguaro National Monument. The main cause for the reduced population in the Tucson Mountain Wildlife Area is thought to be the increasing exposure of the species to human interference (Brown 1968).

At the present time the Arizona Game and Fish Department conducts its peccary surveys simultaneously with the deer surveys. Knipe (1957) has pointed out that the policy of conducting peccary surveys concurrently with deer surveys has not been very effective and recommended that surveys in March and April be conducted as well.

To form an adequate method of gathering the needed information to set the hunting seasons on peccary, the survey techniques should meet the following requirements.

1. Surveys should be made in March and April when human disturbance and peccary reproduction is at a minimum, and would include only adult animals in the average herd size for management purposes. This is essential because of the high mortality of young.

2. The surveys should cover the same routes annually, by each individual game manager so that factors of varying vegetation, water, terrain, and population are entered into the data.

3. Variation in individual ability of survey workers to see peccaries in the field should be minimized. This undoubtedly contributes to the low number of peccaries reported in some units.

4. Track counts should be used to estimate numbers of peccaries only after a system is devised to utilize tracks in this manner.
5. The data collection should be made only during a time when hunts are not being conducted. Human activity at this time could affect herd fluctuations.

6. Ideally, each mountain range should be surveyed during March and April by helicopter by the same men following the same route. This would give a better indication of the average herd size for each mountain range and a better index to the true population.

The number of animals killed each year is hardly a valid indication of the condition of the peccary population since it probably will not reflect the fact that the size of the herds is decreasing. The apparent discrepancy between increasing kill and declining herd size is readily explained. Since a herd tends to occupy the same area year after year, the same herd will provide continuous hunting even though declining in numbers. The average hunter uses a walking method of hunting, so it is nearly as easy to find a herd of four animals as a herd of ten. The remaining animals provide hunting for several years. Thus, hunter returns will not show a decline until the herds are virtually wiped out. Also the fact that the numbers of hunters in the field is increasing, increases the number killed as long as there are any peccaries remaining.

Production can be determined by the number of animals in the cohort of 11 to 21-1/2 months plus wear class one (since it is only 2-1/2 months long and easily determined. Such data should be collected at checking stations each year. Jaw boards could be used at checking stations and so standardized, that uniform data could be
obtained. The number falling in this category as a percentage of the total kill would give a more realistic picture of yearly production. If this is done every year, production trends would develop that could be correlated with decimating factors.

Ideally peccaries should be managed for each mountain range. Lacking that, they should be managed according to the three main habitat types of Eddy (1959) until such time that research may indicate there is no difference in the total population.

A life table should be set up for a hunted population in the total peccary habitat or an individual one set up for each habitat type. This could be done in several ways. The easiest would be by collecting animals at a checking station. This, of course, would introduce hunter bias. Another possible way would be to collect total herds at random. This could be done by experienced riflemen or by corral trapping entire herds. Either method would give a cross section of the peccary population in hunted areas. This table could then be used as a standard to compare checking station data and as an index of the total population.

Permit hunts should be introduced, especially in the mountain ranges where the peccary numbers are definitely low. The herds should be managed to maintain an average herd size of around 8.0 animals until such time that research proves that large herds are not needed for adequate production. To do this the reproductive flexibility of herds of different sizes should be studied to determine if small herds of peccaries respond by producing more young and if they are more successful in raising their young than are large herds.
The intensified aggression noticed in the larger herds may affect production, so there may also be an upper optimum limit to herd size for maximum production of huntable animals.

Research should be done on transplanted animals to determine their wanderings and herd alterations and their ability to repopulate vacant areas. The effect of hunting on herd integrity, maintenance of territories, and production should also be studied.
# APPENDIX A

Table 10. Experimental dosages used to develop a mixed field dose of Sucostrin and Sernylan.

<table>
<thead>
<tr>
<th>Weight (lbs.)</th>
<th>Sucrostrin Dosage</th>
<th>Sernylan Dosage</th>
<th>Time Down (min.)</th>
<th>Time Up (min.)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>53.0</td>
<td>0.2 mg./lb.</td>
<td>0.2 mg./lb.</td>
<td>2.5</td>
<td>18.0</td>
<td>Used Ambu</td>
</tr>
<tr>
<td>52.5</td>
<td>8.3 mg.</td>
<td>11.0 mg.</td>
<td>2.4</td>
<td>72.0</td>
<td>Used Ambu</td>
</tr>
<tr>
<td>52.0</td>
<td>6.0 mg.</td>
<td>12.0 mg.</td>
<td>11.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>52.5</td>
<td>6.4 mg.</td>
<td>13.3 mg.</td>
<td>5.3</td>
<td>21.0</td>
<td>Ataxic; able to bite</td>
</tr>
<tr>
<td>53.0</td>
<td>6.3 mg.</td>
<td>15.9 mg.</td>
<td>3.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>52.0</td>
<td>6.2 mg.</td>
<td>14.4 mg.</td>
<td>10.2</td>
<td>32.0</td>
<td>Ataxic; able to bite</td>
</tr>
<tr>
<td>55.0</td>
<td>6.3 mg.</td>
<td>20.0 mg.</td>
<td>6.0</td>
<td>24.5</td>
<td>Good reaction</td>
</tr>
<tr>
<td>56.0</td>
<td>5.8 mg.</td>
<td>19.3 mg.</td>
<td>6.0</td>
<td></td>
<td>Good reaction</td>
</tr>
<tr>
<td>52.0</td>
<td>6.6 mg.</td>
<td>22.0 mg.</td>
<td>11.0</td>
<td></td>
<td>Poor hit</td>
</tr>
<tr>
<td>52.0</td>
<td>6.0 mg.</td>
<td>20.0 mg.</td>
<td>5.0</td>
<td>30.0</td>
<td>Good reaction</td>
</tr>
<tr>
<td>60.0</td>
<td>7.0 mg.</td>
<td>24.8 mg.</td>
<td>4.5</td>
<td></td>
<td>Good reaction</td>
</tr>
<tr>
<td>52.0</td>
<td>6.0 mg.</td>
<td>20.8 mg.</td>
<td></td>
<td></td>
<td>Poor reaction</td>
</tr>
<tr>
<td>52.0</td>
<td>6.4 mg.</td>
<td>23.0 mg.</td>
<td>4.8</td>
<td>51.0</td>
<td></td>
</tr>
<tr>
<td>53.0</td>
<td>8.7 mg.</td>
<td>24.8 mg.</td>
<td>2.0</td>
<td>90.0</td>
<td>Good reaction</td>
</tr>
<tr>
<td>56.0</td>
<td>6.0 mg.</td>
<td>27.6 mg.</td>
<td>4.5</td>
<td>150.00</td>
<td>Good reaction</td>
</tr>
<tr>
<td>52.0</td>
<td>7.0 mg.</td>
<td>31.2 mg.</td>
<td>4.3</td>
<td></td>
<td>Good reaction</td>
</tr>
<tr>
<td>54.0</td>
<td>7.0 mg.</td>
<td>31.2 mg.</td>
<td>9.0</td>
<td>60.0</td>
<td>Handleable 13.3 min.</td>
</tr>
<tr>
<td>62.0</td>
<td>8.0 mg.</td>
<td>30.0 mg.</td>
<td>3.3</td>
<td></td>
<td>Handleable 7.8 min.</td>
</tr>
<tr>
<td>56.0</td>
<td>7.0 mg.</td>
<td>30.0 mg.</td>
<td>4.0</td>
<td></td>
<td>Handleable 7.2 min.</td>
</tr>
</tbody>
</table>
REFERENCES

Arizona Big Game Investigations, Game Management Division, Job Completion Reports. 1961 through 1968.

Arizona Game Management Data Survey. 1968.


