EFFECTS OF KERN COUNTY CATTLE RANCHING ON CALIFORNIA CONDOR HABITAT

By

Cynthia Dawn Studer

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ABSTRACT

EFFECTS OF KERN COUNTY CATTLE RANCHING
ON CALIFORNIA CONDOR HABITAT

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The California condor, an endangered species, is dependent upon the livestock ranches of southern California for its food supply and feeding habitat. This study reviews four factors which may be contributing to the condors' decline (an inadequate food supply, accidental poisoning, shooting, and habitat loss) and discusses the relationship between current ranch practices and these factors.

Data, obtained by interviewing Kern County cattle ranch operators, categorized ranches by size, length of operation, and ownership type. Operator responses were summarized and mapped to determine the extent and location of ranch activities.

Results indicate that there are no differences among the responses given by operators of different ranch types. The condors' food supply appears to be adequate to support the existing population. Shooting and use of poisons are widespread and may create hazardous feeding conditions. Most ranchers participate in programs which help them remain in business and indirectly help preserve condor habitat.

ACKNOWLEDGEMENTS

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INTRODUCTION

Context of the Problem

The California Condor, a federally listed endangered species, is dependent upon southern California's livestock ranches for most of its food and feeding habitat. Land management activities and land use changes which occur on ranches within the condors' range may significantly affect the welfare of these birds. This study investigates selected management activities on cattle ranches in Kern County, California and discusses the relationship between these activities and the quality or quantity of the condors' feeding habitat.

Population Size and Distribution

Only in the mountains and foothill regions of southern California is one now able to find North America's largest land bird, the California condor (Gymnogyps californianus). The approximately twenty condors remaining in the wild (Snyder 1982, p.6) represent a population which has been steadily declining and is now in grave danger of disappearing altogether. In the past when condors were much more numerous, their range extended from as far north as British Columbia, Canada to Baja California, Mexico on the south. Today the range is much reduced, including portions of only six counties in southern California. This wishbone shaped

area extends from San Luis Obispo and Tulare Counties southward to Ventura and Los Angeles Counties[1] (Figure 1). Within this range, the areas most often frequented by the condor are the rugged mountains and their adjacent foothills and rolling grasslands.

By the turn of the century it was well known that the population and range of the California condor had been and were continuing to decrease in size (Stewart 1908, p. 130, Verner 1978, p. 22), but it was not until the late 1930's that significant research and protective actions were begun. In 1937, the U.S. Forest Service established the 1,198 acre (485 ha.) Sisquoc Condor Sanctuary in Santa Barbara County. A decade later, the Sespe Condor Sanctuary was established in the Los Padres National Forest in Ventura County. This sanctuary originally contained 3,458,000 acres (14,000 ha.) but in 1951 it was expanded to 5,298,150 acres (21,450 ha.). Condors were further protected in 1953 when the State of California made it illegal to kill or capture any condor at any time (Section 1179.5 of the California Fish and Game Code).

The first major study of the California condor was undertaken by Carl Koford in 1939. Koford's report on the life history and ecology of the condor (1953) still stands out as the most comprehensive and in-depth study of this

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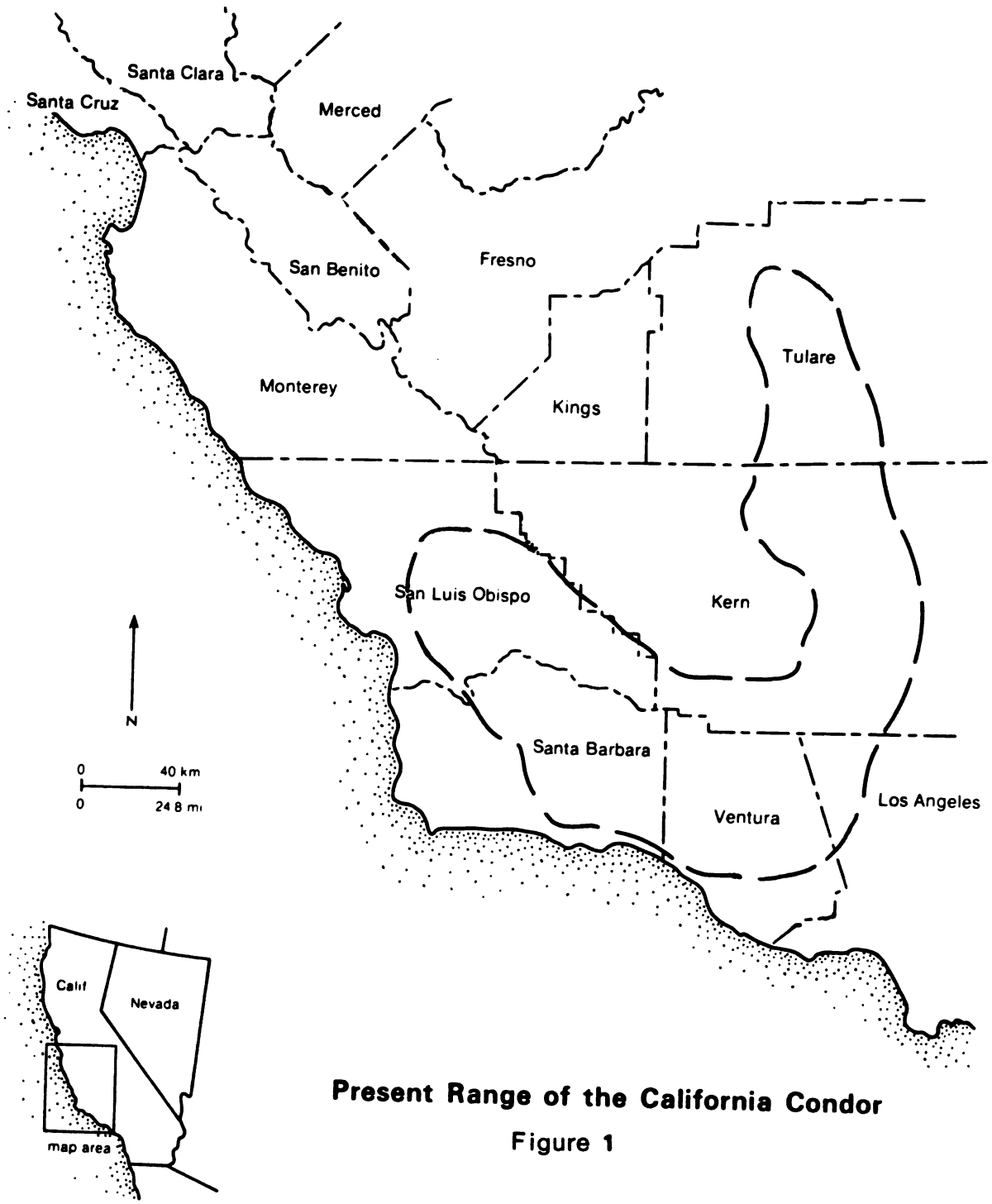
[1]Recent and fairly reliable condor sightings indicate that birds may occasionally visit areas further north along California's Coastal Range including portions of Monterey and, possibly, Santa Cruz Counties.



Present Range of the California Condor

Figure 1

bird ever published. Further studies such as those by Miller et al. (1965), Sibley (1969), and Wilbur (1972 and 1978), provided additional information on the condor and its problems and subsequently helped to form the limited fund of knowledge upon which past and present condor recovery programs have been based.

Condor Recovery Programs and Problems

According to the federal Endangered Species Act of 1973, a recovery team must be established to draft a recovery plan for each endangered species in the United States. The California Condor Recovery Team, composed of members from the U.S. Fish and Wildlife Service, the U.S. Forest Service, the California Department of Fish and Game, the National Audubon Society, and the U.S. Bureau of Land Management, was one of the first teams organized. Officially approved in 1975, the California Condor Recovery Plan outlines the measures necessary to save the condor from extinction. The goal of the recovery plan is to bring the species to a non-endangered status. By the time the plan was adopted many of the recommended measures had already been initiated or completed, however, the condor population still had not stabilized (Wilbur 1976, p. 47).

In September 1979, the same five agencies that drafted the recovery plan jointly signed the Cooperative California Condor Conservation Program thereby creating the Condor Research Center (CRC). Located in Ventura, California, the CRC conducts field research on the condor's problems and

assists in management programs designed to maintain the condor population and retain suitable habitat.

Despite the research and management programs which have already been conducted, far too little is known about the condor, its requirements for survival, and its current ecological problems. Researchers and others concerned with the welfare of the condor frequently disagree on issues such as why the species is declining and which methods, if any, should be employed to help save the bird from extinction.

A wide variety of reasons for the decrease in condor numbers has been suggested. Among those factors most responsible for the condor population decline before and during the early 1900's are the following: egg collecting, shooting, inadvertent trapping and poisoning, and the loss of habitat through the encroachment of civilization. The most frequently suggested and the most probable reasons for the birds' continued decline include inadvertent poisoning from attempts to control pest mammals, shooting, food shortages, low reproductive rates caused by pesticides and nest disturbance and loss of habitat resulting from land use conversions and the increased disturbance of natural settings by human intrusions into previously remote areas. To date there has not been sufficient evidence to establish any of these factors as the primary reason for the continued downward trend in the population.

Although the condors' range is now but a fraction of its original size, the amount of land included is still very

large and diverse. A wide variety of land-cover/land-use[2] types occur within the condors' range. Some areas are remote and rugged remaining very much in their natural state while others have been greatly modified by human activities. Research efforts geared towards understanding and clearly identifying the condors' problems are severely hampered by these areal changes, magnitudes, and diversities.

The land uses and activites which occur within the condors' range are regulated by various levels of government including local, county, state, and federal government units. Each unit has jurisdiction over certain specified land areas and can regulate certain land use activities. Local and county governments can regulate only those activities that occur within their boundaries and which are not already regulated by the state or federal governments (although they can in some instances enforce stricter regulations on activities which are already regulated by the state or federal governments). Often the county has the responsibility of seeing that certain state regulations or programs are enforced or implemented. Sometimes the county is permitted some degree of latitude in the implementation of these state programs. This array of government units, each with varying jurisdictions and duties adds further complexity to the

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[2]Land cover is simply the surface cover found on the specified land area (forest, grassland, water etc.). Land use identifies the actual human use of the area (mining, housing, cropland, etc.).

condors' range as one unit may be subject to different environmental regulations than other units.

The Importance of Land Use and Management

Many of the previously mentioned reasons for the condors' decline are directly or indirectly associated with land use and land management practices. The condor makes use of both public and private lands but the control of land uses on these two types of lands differs greatly.

On public lands,[3] the general public can have a voice in deciding how these lands are to be used and managed as long as the desired uses are not in conflict with the stated purposes and objectives of the land conservation system of which the land parcel is a part. Condor habitat situated within public lands can be managed so as to preserve important habitat qualities if the agency involved has the mandate to do so and has the necessary political and public support. Most of these public land areas have very stringent land use regulations which, when enforced, result in the preservation of land which is frequently less disturbed or developed than the surrounding privately owned properties. The inclusion of land within the federal land conservation systems has greatly benefited the condor in that important habitat has been preserved. This is especially true for most of the

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[3]The public lands which are of most importance to the condor include national forest lands administered by the U.S. Forest Service and national resource lands administered by the Bureau of Land Management.

condors' nesting and roosting sites. Unfortunately, most of the condors' feeding habitat is not so preserved.

The California condor is a scavenger, feeding only on dead animals. The feeding habitat of the condor consists primarily of the rolling grasslands and oak-studded savannas characteristic of the foothills of the Coast, Transverse, and Sierra Nevada ranges. These grasslands are predominantly used for livestock grazing on privately owned ranches. Beef cattle are the main livestock but sheep are also grazed. Livestock losses from these ranching operations provide the primary food source of the condor. The continuation of the use of the grasslands situated within the condors' range for livestock production is, therefore, vitally important to the survival of the condor.

Within certain limits, private landowners are free to use their land as they desire. This means that if ranch owners are able to convert their lands to more profitable activities such as irrigated agriculture or residential housing, they may decide to do so thereby removing such parcels from the supply of feeding habitat available to the condor. Similarly, if for some reason it becomes unprofitable or impossible for ranchers to remain in business, they may be forced to sell their properties to someone who may have no desire to retain ranches in their current use. Consequently, anything that adversely affects the southern California livestock industry could eventually have an adverse effect on the condor.

Some ranch management activities could also be of great importance to the condor and its ability to survive. For instance, ranchers may choose to undertake pest rodent control programs that will make their ranches more productive or better suited to the livestock being raised. Activities such as this may directly or indirectly affect the condor. However, such activities may be either beneficial or detrimental to the condor or may have no effect whatsoever on the bird.

It is important to know what activities are currently taking place on ranches within the condors' range and to identify activities that may have an effect on the species' survival. To minimize the possibility of condor mortality within its feeding habitat, areas that may pose possible or extraordinary threats to the condor should be located and investigated. It is also important to identify problems that could have a negative impact on the livestock industry or which may cause a rancher to sell his ranch thereby affecting the management or quality of feeding habitat.

Problem Statement

In order to effectively manage a condor recovery program, more information about the private lands located within the condors' range must be acquired. Much headway has been made in preserving public land and in restricting human activities on these areas for the benefit of the condor. However, condors depend on privately owned rangeland for

most of their feeding habitat and food supply. Recovery efforts must provide some methods of securing safe and sufficient habitat outside of the federal preserves.

The purpose of this study was to investigate certain cattle ranch management practices and land use activities which have been identified as having an impact on the California condor and/or its feeding habitat. Some ranch management practices such as administering a poisoning program for control of ground squirrels, permitting hunting on private lands, and replacing cow-calf herds with stocker cattle,[4] have been suggested as being detrimental to the welfare of the condor. Other activities such as placing ranch land under contract through participation in the Williamson Act[5] program and leaving carcasses out on the range, are viewed as being beneficial to the condor. This study sought to determine how widespread these ranch

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[4]Cow-calf operators maintain basic herds of cows which produce calf crops each year. These calves are generally sold after they are weaned at weights of approximately 400-500 lbs. (Mortimer 1980, p. 1). Stocker cattle operators ship in steers from other areas (generally from other states and/or Mexico) and graze them on their ranches for only a portion of the year (when range conditions are best). Consequently, stocker cattle ranching is a seasonal operation with high concentrations of cattle on the range during grazing periods and little or no cattle present during the off season after the steers have been fattened and sold (Miller et al. 1965, p. 21).

[5]The Williamson Act (State of California Government Code Sections 51200-51295) provides for differential assessment of agricultural lands so that land owners who restrict the legally permissable land use on their properties to agricultural crop or livestock production only enjoy a tax benefit over other lands that are not so restricted.

activities have been and to identify any areal variations in their existence or impact.

Although basic methods of livestock ranching will remain fairly constant from one ranch to another, there may be variations among the ranches in their approaches to several management issues. A secondary purpose of this study was to determine whether certain types of ranches were more likely to pursue management activities beneficial or detrimental to condors than others. The results of this study provided information which can be used to more clearly identify problem issues and situations which affect feeding habitat preservation and quality, provided information on possible causes of condor mortality, and located areas where potential hazards to the condor may exist.

Goals of the Study

The goals of this study included the following:

1. to determine how prevalent certain ranch activities identified as affecting the California Condor or its habitat are throughout the condors' Kern County range;
2. to locate any areal concentrations of these ranch activities; and
3. to determine whether certain types of ranches are more likely to be operated by using management activities which may be detrimental to condors.

Hypotheses

The condors' reliance on the continuation of the traditional livestock ranching industry within its range provides the major premise on which the basic hypothesis of this thesis was formulated. This basic hypothesis is as follows: Land uses and management activities on cattle ranches in Kern County, California have an effect on the quality of the California condors' feeding habitat and hence on this endangered species ability to survive.

Five sub-hypotheses were developed from this general hypothesis, namely:

1. The amount of food available to the California condor is affected by livestock management activities practiced on Kern County cattle ranches. This was investigated by testing the following null hypotheses:
    a. The amount of livestock (both cattle and sheep) produced annually in Kern County has not, during the past twenty years, declined to the point where the condors' food supply is affected.
    b. The number of Kern County ranches engaged in stocker cattle production has not significantly reduced the condors' food supply.
    c. Disposal methods used for livestock carcasses on Kern County ranches have not reduced the condors' food supply.
    d. The incidence and type of livestock mortality on Kern County cattle ranches have not reduced the

condors' food supply during the past twenty years.

e. The seasonality of calving on Kern County ranches has no influence on the condors' food supply.

2. Programs designed to control problem predators and pest rodents on Kern County cattle ranches create hazardous feeding conditions for the California condor.

3. Shooting for hunting, poaching, and vandalism purposes is common on Kern County cattle ranches and creates a hazardous feeding environment for the California condor. Some kinds of ranches, are more likely to have a higher incidence of any of the above three shooting activities. This was investigated by testing the following null hypotheses:

   a. Size of ranch has no influence on whether hunting by authorized private parties is permitted on the ranch.

   b. Length of time the ranch has been in operation has no influence on whether hunting by authorized private parties is permitted on the ranch.

   c. Ranch ownership/operator type has no influence on whether hunting by authorized private parties is permitted on the ranch.

   d. Ranch size has no influence on whether or not wanton shooting is a problem on the ranch.

   e. Ranch size has no influence on whether or not poaching is a problem on the ranch.

4. The loss of grazing land to other land uses has reduced the amount of land available to the California condor for feeding habitat. Within Kern County, rancher participation in the Williamson Act has helped retain land in livestock production. Some ranches are more likely to participate in the Williamson Act program. This was investigated by testing the following null hypotheses:
   a. Ranch ownership/operator type has no influence on whether the ranch land is contracted under the Williamson Act.
   b. Ranch size has no influence on whether the ranch land is contracted under the Williamson Act.
   c. Length of operation has no influence on whether the ranch land is contracted under the Williamson Act.
5. The current grazing permit systems used on Kern County's Bureau of Land Management and national forest lands benefits the California condor by aiding Kern County cattle ranchers.

Related Research

Very little research has specifically addressed the relationship between the human use of rangeland and the quality or quantity of the California condors' feeding habitat. Some authors have briefly addressed the topics which are analyzed in this study. Most notable are the works of

Koford (1953) and Miller et al. (1965). Both reports discuss shooting, poisoning, inadequate food supplies, and loss of habitat from land use conversions as factors in the condors' decline, but neither attempted to document the degree to which these activities occur on ranches within the condors' range. Their studies were, however, most helpful in determining which ranch activities should be included in my research. I have expanded upon the ideas expressed by Koford and Miller and systematically analyzed their validity within a portion of the condors' range.

Condor habitat loss has attracted slightly more attention than other factors which have been attributed to the condors' decline. One study reviews the loss of condor habitat to land development in Kern County (Buntin 1975). The author discusses land use changes and the potential for future habitat loss in areas of the county which have been identified as being or having been important to the condor. Because Buntin's study focused on specific development projects it provided very little background information for my research.

Although no one has investigated the use of rangeland and its relationship to condor feeding habitat, many have studied the relationship between agricultural practices and other wildlife species (Bode 1939, Leedy and Daniels 1947, Anderson 1949, Allen 1952, Shrubb 1980). These studies proved to be of little value to my research because they emphasized the biological responses to physical changes in the land cover

(species diversity, species density, reproductive success, etc.). Particular attention was given to the species' response to vegetation changes.

The destruction of wildlife habitat from land use changes has been the focus of some research (Gerstung 1973, Vogl 1976, Reynolds 1980, Hurst et al. 1980, Gorenzel et al. 1981). Again, the relevance of these works to my research was limited to the acknowledgement of the fact that changes in the physical use of the land are resulting in the loss of wildlife habitat.

The role of private land management in preserving wildlife habitat and in enhancing its quality has been recognized (Allen 1952, National Academy of Sciences 1970, Deknatel 1979, Svoboda 1980). These authors also emphasize the value of enhancing the quality of the land cover.

In summary, most research on land use and wildlife has been focused on preserving or enhancing the physical characteristics of the land which make it most suitable as habitat for game species. Information on the relationships between human activities and wildlife is limited but the need for research on the socio-economic aspects of wildlife management has been recognized (Allen 1952, Hendee and Schoenfeld 1973).

CHAPTER II

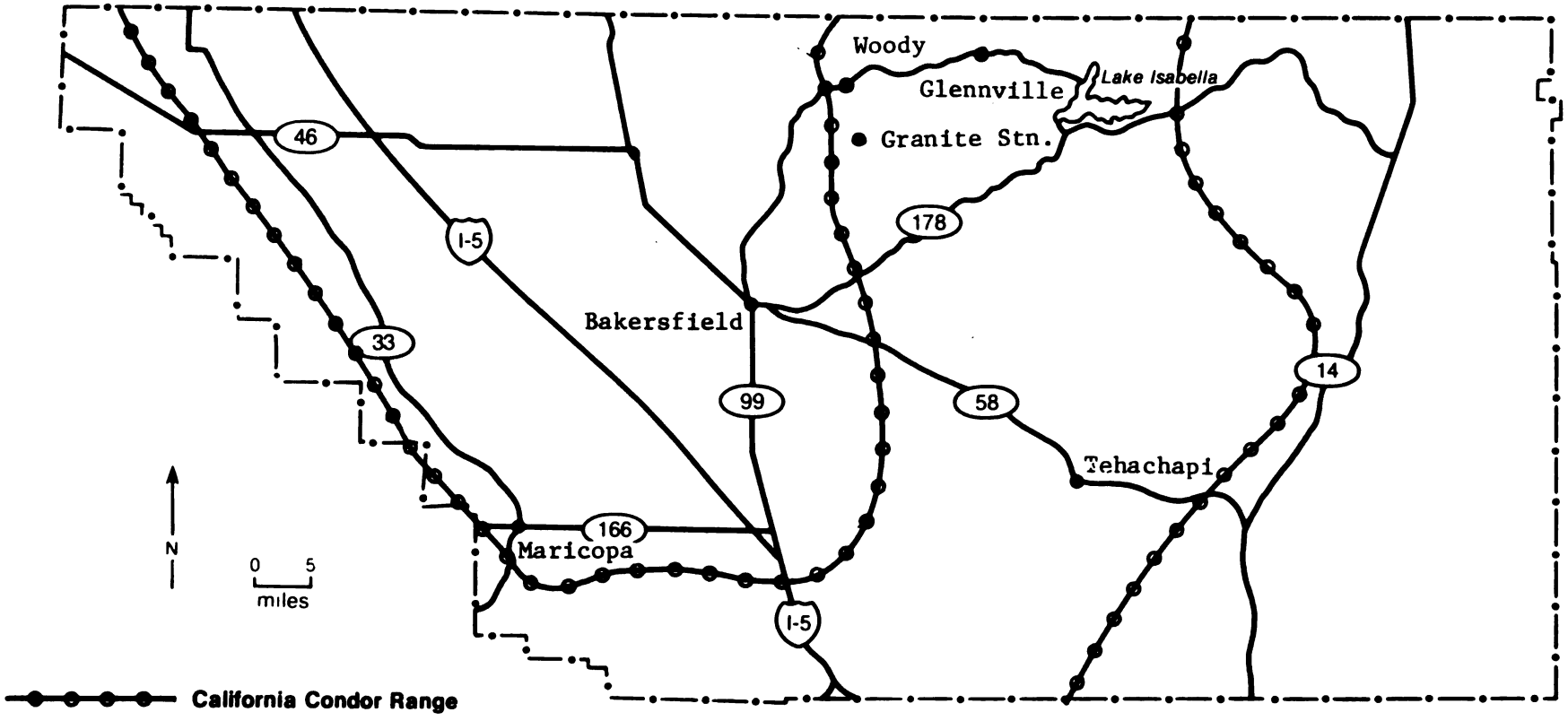
AREA OF STUDY

The County as an Areal Unit of Study

Because it would be very costly and time consuming to gather data on ranches throughout the condor range, the study area was limited to a single county, Kern County (Figure 2). A single county was chosen as the study area because many agricultural programs such as pest control and the administration of the agricultural preserve system are carried out at the county level and therefore, vary from county to county. Had a larger study area, or one based on a different areal unit, been chosen, it would have been difficult, if not impossible, to make comparisons among the ranches as some would be subject to different regulations and/or have different opportunities available to them. Focusing on a single county minimized jurisdictional complexities, facilitated data gathering, and reduced the variation within the sample by ensuring that all ranchers had the same programs available to them and were governed by the same laws. The county unit did, however, provide a large enough land area to ensure that a sufficient number of ranches could be studied.

Kern County was chosen for a number of reasons. First and foremost, much important feeding habitat is situated within this county. It is centrally located within the

KERN COUNTY, CALIFORNIA



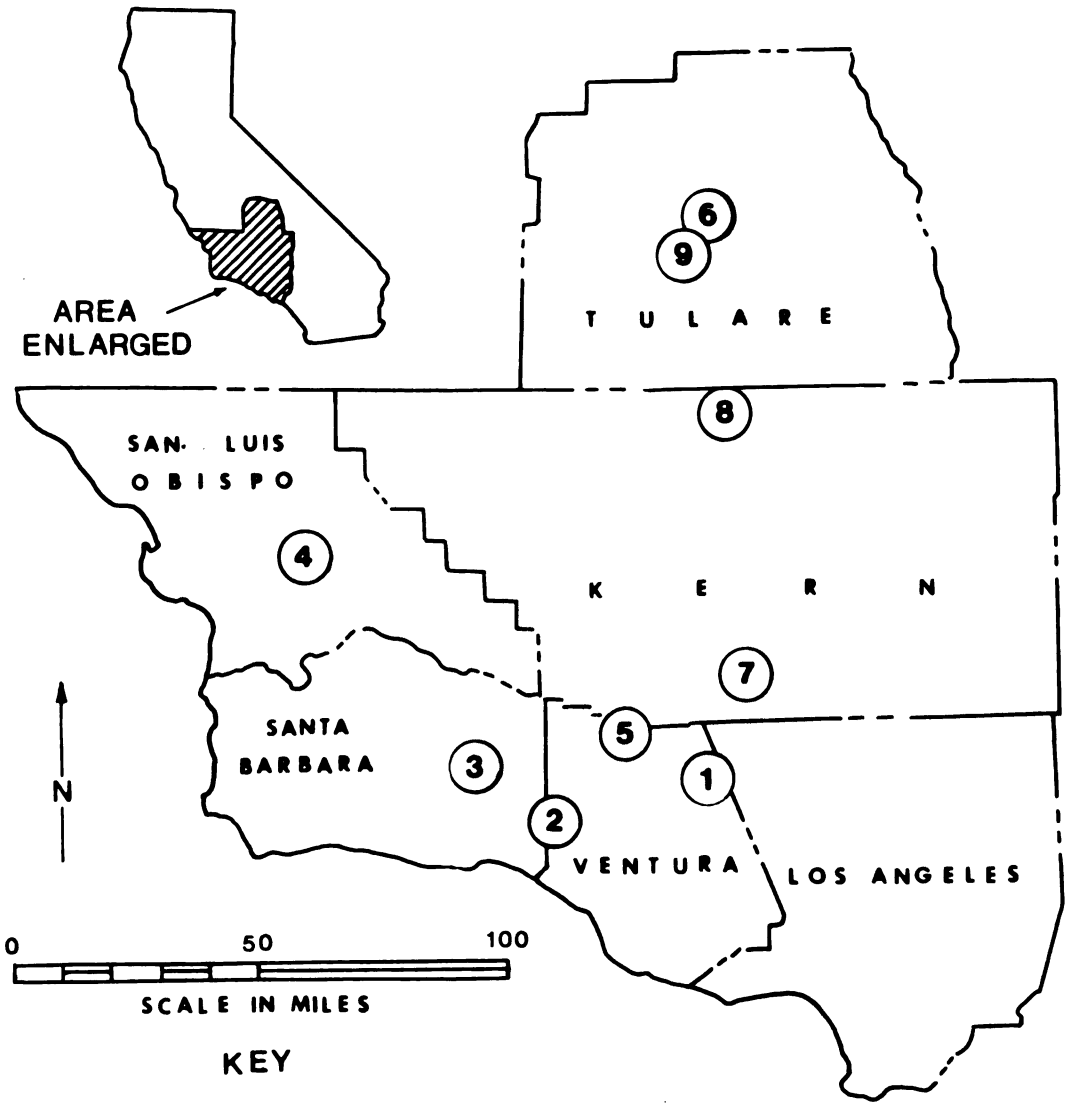
Source: Open Space and Conservation Element. Kern County Planning Commission. Bakersfield, California, 1972, p.27.

Figure 2

condors' range and is frequented by them on a year round basis. More than 350,000 acres (about 141,700 ha.) of land in southern and eastern Kern County are regularly used by the condor while portions of another important foraging region are located along the county's western border. (California Condor Recovery Team 1980, p. 3). Southern Kern County provides important feeding habitat for birds nesting in northern Ventura and Los Angeles Counties and is used regularly for feeding and roosting by all condors during the fall months. Portions of northern Kern County may provide important winter habitat for immature birds and other non-breeders. The county's importance to the condor is confirmed by the fact that two critical habitat areas and a portion of a third are situated within its borders (Figure 3).

Aside from its importance as condor foraging grounds, Kern County has other attributes which make it ideally suited for this study. Most of the land used by the condor in this county is privately owned and is used for livestock production. This large supply of private ranchland is situated within three foothill regions, the Temblor Range and the foothills of the Tehachapi and Sierra Nevada ranges.

CALIFORNIA CONDOR CRITICAL HABITAT



(1) Sespe-Piru Condor Area
(2) Matilija Condor Area
(3) Sisquoc-San Rafael Condor Area
(4) Hi Mountain-Beartrap Condor Areas
(5) Mt. Pinos Condor Area
(6) Blue Ridge Condor Area
(7) Tejon Ranch
(8) Kern County Rangelands
(9) Tulare County Rangelands

Source: California Condor Recovery Plan. California Condor Recovery Team. U.S. Fish and Wildlife Service, 1980, p. 60.

Figure 3

This topographic variety makes it possible to study ranches associated with two of the three mountain ranges used by the condor.[6]

Kern County's Location and Characteristics

Kern County, California is an inland county situated at the southern end of the San Joaquin Valley. Agriculture, both crop and livestock production, is the primary economic activity of the county although petroleum extraction is also important. The total land area of the county is 8,152 square miles (21,049.2 sq. km.). Of this total, 5,780 square miles (14,974.1 sq. km.) are devoted to agriculture (California State Office of Planning and Research 1981, p. 3). Range acreage accounts for 3,437.5 square miles or approximately 42% of the county's land area. This extensive range resource supports a livestock industry which consistently ranks among Kern County's top ten most valuable crops.

In 1980, Kern County had a total population of 403,089 people, an increase of 22.1% from 1970 (Kern Co. Planning Dept. 1981a, p. 1). This growth (approximately 2% per year)

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[6]The condors' range includes portions of the Coast, Transverse and Sierra Nevada ranges. In this study, the Coast Range is represented by the Temblor Mountains. The Tehachapi Mountains are actually a part of the Sierra Nevada range. The Transverse Range is considered by some to also be represented in a portion of southern Kern County situated within the Los Padres National Forest. Kern County's mountain regions will be discussed later in this chapter.

is expected to continue (Kern Co. Planning Dept. 1981b, p. I-1). Most of Kern County's population is located in the level lands of the San Joaquin Valley, especially in and around the city of Bakersfield. With a 1980 population of 105,611, Bakersfield is by far the county's largest city. Delano, the second largest town, is quite small in comparison with a population of only 16,491 people (Kern Co. Planning Dept., Population... 1981, p. 7). During the past two decades most of the population growth has been in the Bakersfield and Lake Isabella areas.

The physical environment of the county is quite diverse. Elevation ranges from under 500 feet (152.4 meters) in the San Joaquin Valley (central and north central Kern County) to over 7,000 feet (2,134.1 meters) in the mountain ranges bordering the southern and eastern sides of the valley. Precipitation (primarily rainfall although snow does occur at higher elevations) is strictly a phenomenon of the winter season which generally lasts from November to May. Annual precipitation ranges from six to thirty inches and is strongly influenced by the various mountain ranges. Rainfall is highest in the Sierra Nevada and Tehachapi mountain ranges and lowest in the Central Valley and the Mojave Desert, both being located on the leeward side of mountain ranges (Fugure 4). Summers are generally hot and winters warm and mild. Again, temperature will vary with altitude.

Kern County can be divided into three general regions based primarily on topographic and climatic characteristics.

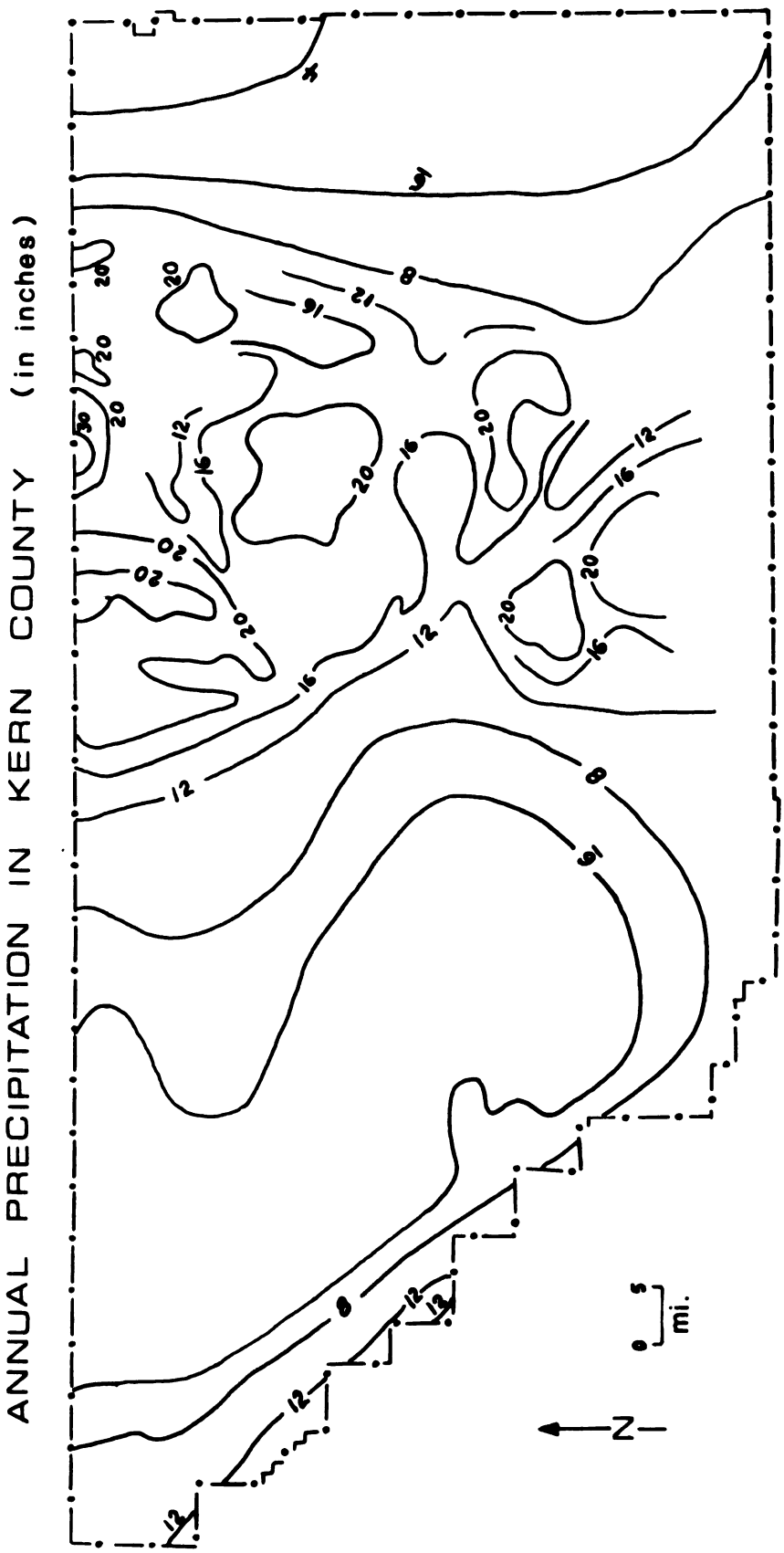

ANNUAL PRECIPITATION IN KERN COUNTY (in inches)
4
8
12
16
20
21
0
5
mi.
N

Figure 4

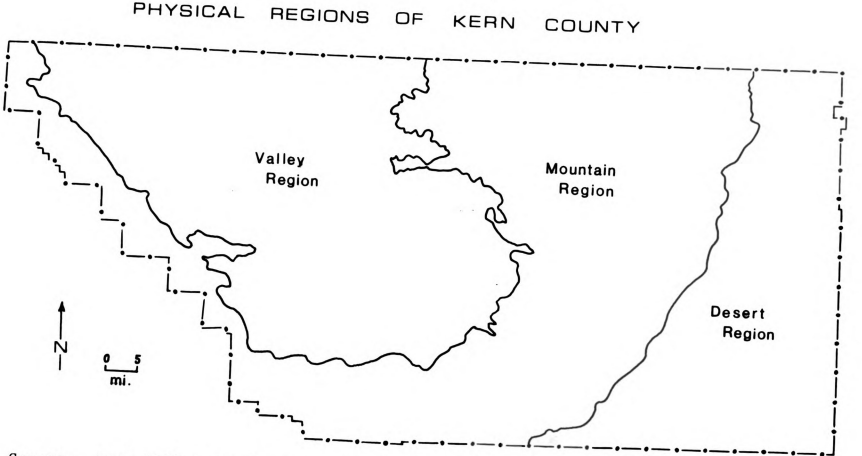
These regions are as follows: the valley region, the mountain region, and the desert region (Figure 5). Of these three, the mountain region is of greatest importance to the California condor.

The Desert Region

Part of the Mojave Desert is located in the far eastern portion of Kern County. It is bounded on the west and north west by the Tehachapi and Sierra Nevada ranges. This western portion of the Mojave is a gently sloping plain with an average elevation of between 2,100 and 3,000 feet (640.2 and 914.6 meters). Rising only about one thousand feet (304.9 meters) above this basin area are isolated hills and mountain ridges. Precipitation is scant and temperatures exhibit great diurnal ranges. Daytime temperatures are very high in the summer and moderately high in the winter. Although this area does support a varied flora and fauna, the condor seldom, if ever, is seen here.

The Valley Region

The central and north central portion of Kern County is occupied by the extreme southern end of the San Joaquin Valley which is the southern portion of California's Central Valley. This portion of the Central Valley (actually a structural depression not a valley) once drained into the San Joaquin River but the continued deposition of alluvial materials from the Kings and Kern Rivers sealed off the area creating two basins of interior drainage or bolsons. As



Source: Year 2000 General Plan. Kern County Planning Department. Bakersfield, California, 1981, p.I-8.

Figure 5

depicted in Figure 5, the valley region includes all of the southern San Joaquin below 1,000 feet in elevation (304.9 meters); however, most of the land is less than 500 feet (152.4 meters). The terrain is mostly very flat but becomes hilly along its borders as the mountain ranges which surround it on three sides are approached. On the west side of the valley is the Temblor Range and on the east are the Sierra Nevada Ranges. The Coast Ranges, a small portion of the Transverse Ranges, and the Tehachapi Mountains converge to form the valley's southern border.

In its pristine condition, the valley region was an extensive natural grassland community (Burcham 1957, pp. 66,90). As such it was an improtant part of the rangeland resource. Perennial bunchgrasses dominated the vegetation. Among these, the most important were purple needlegrass (Stipa pulchra) and nodding needlegrass (Stipa cernua) along with blue wildrye, pine bluegrass, and deergrass (Burcham 1957, p. 90).

Most of the valley region is now devoted to intensive irrigated agriculture. This agricultural production was not possible until after the completion of the Central Valley Project and the Wheeler Ridge/Maricopa portion of the California Aqueduct (a portion of the State Water Project) which provided inexpensive water for the valley farmers (Wilcock, et al. 1976; Mason 1973). Where cattle and sheep once grazed, one now sees cotton, grains, orchards, vineyards, and truck crops. It is possible that the condor once used these portions of the Central Valley, but more than

likely, the bird kept to the hilly valley edges where rangeland conversion has not been as great and condors are still sighted (Koford 1953, p. 69; Stewart 1908, p. 130).

The Mountain Region

The mountain region occupies the western margin of Kern County as well as a large central area situated between the Central Valley and the Mojave Desert (Figure 5). Elevations in these highlands range from about 1,000 feet (304.9 meters) to over 8,000 feet (2,439 meters). Because most condor habitat is also located above 1,000 feet (Wilbur 1978, p. 7), this region is the most important to the species and hence is the focus of this study.

Along the western border of Kern County are the mountains which make up the northwest-southeast trending Temblor Range. These relatively low mountains (elevations seldom exceed 4,000 feet) form one of the most easterly ranges of the California Coast Range Province. Precipitation is scant because the Temblors are interior mountains lying to the east of other ranges.

Much of central Kern County is occupied by the Sierra Nevada ranges and their foothills. These fault-block mountains are the highest in the county and form a barrier to moisture bearing westerly winds. Consequently, the western slopes of the Sierra Nevada receive a greater amount of precipitation than any other area of the county. Along the county's southern border directly east of Interstate 5, are located the Tehachapi Mountains, the southern terminus of

the Sierra Nevada. Here the slightly east-of-south trend of the Sierra Nevada changes to west-of-south. The Tehachapi Mountains terminate at Tejon Pass (the present route for Interstate 5) where they are joined by both the southern extension of the Coastal Ranges and the northern edge of the Transverse Ranges.

Most of southern Kern County east of Interstate 5 is an extensive foothill region called the Pleito Hills. As one continues southward into these foothills, the terrain becomes increasingly rugged and eventually the northern most physiographic unit of the Transverse Ranges, the Pine Mountain--Frazier Mountain Interior Ranges, is reached (Durrenberger 1959, p. 21).

Vegetation: The type of vegetation found on the mountains and foothills of Kern County is primarily dictated by the altitude and the amount of rainfall received. As one travels away from the Central Valley toward any of the county's mountain ranges, the once extensive California grasslands become more conspicuous and widespread. The U-shaped foothill area bordering the valley represents the lowest and driest portion of the mountain region. Here, because the terrain is too hilly for cultivation, vast expanses of grassland remain although the species composition is greatly altered from that of the past. Extensive grazing together with other disturbances such as burning and the purposeful introduction of exotic plants have been responsible for the change in the

grassland plant cover. The native perennial bunchgrasses have primarily been replaced by annual plants, some of which are valuable as forage (wild oat, soft chess, filaree and bur clover) but most of which are of little or no value for livestock production (Burcham 1959, p. 125). Despite the reduction in livestock grazing capacity which has occurred on these grasslands through time, the foothill region is still an important rangeland resource.

The grasslands gradually merge into and mingle with the oak woodland as one proceeds upward in elevation or encounters areas with a greater amount of annual precipitation. Usually located at elevations below 2,500 feet (762.2 meters), the oak woodland occupies portions of both the Sierra Nevada and the Coast Ranges. Grass covered hills and valleys are dotted with trees, primarily interior live oak (Quercus wislizenii) and blue oak (Quercus douglasii) giving the area a park-like appearance. Usually only about 15 to 20 percent of the ground is tree covered (Durrenberger 1959, p. 61); therefore, the grassy remainder provides sufficient livestock forage to rank this vegetative association second only to the grasslands as a range resource (Burcham 1957, pp. 86-87).

Above the oak woodland zone, woodlands become denser and temperatures drop. The increase in altitude is accompanied by an increase in the proportion of conifers until eventually, at approximately 5,000 feet (1,524.4 meters) the vegetation is classified as coniferous forest or sometimes

as ponderosa pine forest (Burcham 1957, p. 81). Conifer snags[7] found in these forests provide roosting sites for the condor.

The above discussion of the altitudinal zonation of the vegetative cover describes the general physical setting encountered in the mountain region. However, conditions may vary from this norm at any particular site. Stands of chaparral are characteristically found on the drier slopes and ridges. Chaparral communities are composed of a wide variety of shrubs, mostly evergreens and are typically encountered between and intermingled with the oak woodland and the coniferous forest (Burcham 1957, Durrenberger 1959). Potreros, small grassy openings found within the brushland community, are locally significant. They provide valuable summer grazing areas for livestock and additional foraging grounds for the condor.

The two vegetative types which are most amenable to livestock grazing, the oak woodlands and the grasslands, are also the primary foraging grounds of the condor. These types contain the cattle ranches which provide the livestock carcasses that are the mainstay of the condor's diet.

Cattle Ranching

The term "ranch" is used for a wide variety of landholdings in California ranging from extensive range land

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[7]A conifer snag is the standing remains of a dead conifer tree (the trunk and usually some branches).

areas devoted to the grazing of livestock to very small units used primarily for intensive crop cultivation (Gregor 1951). In this study, the word will only be used to mean landholdings where grazing cattle on open rangeland (as opposed to the feeding of cattle on irrigated pasture, crop stubble, and/or at feedlots) is the primary land use activity.

Most ranches are located in the foothills between 500 and 2,500 feet (152.4 and 762.2 meters) above sea level. However, individual ranches may include parcels at higher or lower elevations (Burcham 1957, p. 215). It is a common practice to winter the livestock at lower elevations (the grasslands and most of the oak woodland areas) while the forage quality is high. As the dry summer season begins, the forage loses its succulence and is greatly reduced in quality. Cattle are then driven or transported to higher elevations where colder temperatures and snows reduce the growing season to a period from about May to November. The cattle are returned to the lower elevations before the onset of winter (Gregor 1974, p. 19; Burcham 1957, p. 217; Hartman 1964, p. 233).

This seasonal movement of cattle is dependent upon the availability of grazing land at higher elevations. In Kern County, most of this land is publicly owned. The issuance of permits for grazing on public land greatly aids many ranchers who would otherwise have to find alternative methods of feeding their livestock during the summer. Those ranchers who do not or cannot practice this type of transhumance may

grow or buy supplemental feed, own or rent irrigated pasture, graze stubble, or graze only seasonal stocker cattle thereby eliminating the need for summer range.

According to Burcham (1957, p. 214), the typical California ranch today is a "single family unit" meaning that one family operates a single ranch upon which about 150 to 250 head of breeding cows are run. Ranches owned by families are generally passed on to their children and may remain in a single family for many generations (Gregor 1974, p. 22). A ranch can, however, be operated by a single family and not be owned by them.

CHAPTER III

METHODOLOGY

This study seeks to investigate the extent of ranch management practices and land use activities that appear to influence habitat quality or quantity within a small portion of the condors' range. Unlike the data used in many land use studies, this research focuses upon ranch activities which are not outwardly apparent or may be apparent only during a portion of the year. Because of this, it was impossible to either observe the activities themselves or acquire information about them from air photos. The only viable alternative was to obtain information about ranch activities by interviewing the ranchers or foremen who actually oversee ranching activities. This chapter discusses the methods used in acquiring data and how this information was compiled and interpreted.

Instrument Design

A questionnaire was designed to provide data which could be used to classify each ranch and obtain information on four factors which have been suggested as being related to the condors' ability to survive. Questions 1 through 10 on the questionnaire (Appendix A) are concerned with the availability of food for the condor on the ranch. The topic of habitat preservation is briefly addressed by examining rancher participation in the Williamson act (Questions 13 to 15). Accidental poisoning or trapping of condors has been related

to predator or pest control methods used on ranches. These topics are dealt with in Questions 19 to 27. Finally, the topic of shooting as a hazard to the condor is investigated by Questions 28 to 32. All the remaining questions serve to classify the ranch using such variables as the size of the ranch, length of ranch ownership, and type of ownership.

The interview questions were carefully designed after speaking to persons who have associated with cattle ranchers and to two ranchers who are familiar with the Condor Research Center. These discussions acquainted me with general ranching activities and the problems of the rancher today. It was also necessary to obtain a feeling for what are and what are not acceptable questions to ask the ranchers. Some information about the ranch is considered strictly confidential and should not be requested (for example, the number of head of cattle on the ranch). Also, because of long standing controversies with conservationists concerning matters such as over grazing, rights of access to graze public land, and the use of certain traps and poisons to control predators, many ranchers are reluctant to discuss topics of this kind with persons who may be affiliated with environmental organizations. It is my belief that the final form of the questionnaire approaches such topics in an objective manner that elicits useful information but does not give the potential respondent the impression that he or she is speaking to a biased adversary or being implicated in an environmental controversy.

As suggested above, ranchers may feel reluctant or apprehensive about discussing their business activities with an outsider. Because of this, the first few questions are the most innocuous, dealing with very basic ranching matters. It is not until well into the interview that questions which the rancher may feel strongly about or which touch on controversial issues are presented. It should be noted, that the interview itself was to be kept as informal as possible so that the rancher felt more at ease. If at any time during the interview, the rancher talked about a topic that appeared later on the questionnaire, this topic was then pursued rather than attempting to postpone it until a later time. This method resulted in a more natural flow of conversation which probably increased the reliability of the responses.

Sampling

Before a sample can be selected, the population from which individuals are to be drawn must be defined. In this case, the sampling unit was individual ranches in Kern County. Contacting and interviewing the owner of the ranch lands may not produce the desired data. A ranch may have an absentee owner and be operated by a foreman or a single ranching operation may include both operator-owned land and parcels leased from other individuals or corporations. The population then is composed of operating ranch units, i.e., a certain amount of land (often scattered parcels managed as

a single operating entity by a person or a group of persons acting as a separate working unit (sometimes a family and sometimes a company or corporation). Unfortunately, there are no maps or lists giving the true locations of such units. The absence of such materials makes sampling difficult and random sampling virtually impossible.

Sampling from the county tax assessor's list of landowners proved to be impracticable. Landowners names are filed alphabetically but the only property information listed is the number and location of each of the parcels in that owner's name. A single landowner may have thousands of parcels listed under his or her name (Fellmeth 1971, p. I10); therefore, locating a particular landholding would have been incredibly time consuming and could have resulted in wasted effort because the property may not even be used as a cattle ranch.

Working in reverse, sampling from parcel maps and then identifying the landowner, also proved to be impractical. Although the location of a sampled parcel could be limited so that it lay within the study area boundaries, it was impossible to determine from the listing whether or not the land was being used for cattle grazing or if the landowner was a person actually operating the ranch or just the landholder.[8]

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[8]The fact that it is difficult to locate geographically large landholdings and their owners (in this case, operators) in California is supported by an earlier study where a similar activity was attempted. A Ralph Nader task force (Fellmeth 1971) attempted to identify the twenty largest

Neither was it possible to obtain lists of ranches or ranchers from public or private agencies that must contact ranchers for various reasons. Persons representing these groups were either unable or unwilling to supply such information.

The only practical and effective way of contacting potential ranch operating respondents proved to be through other ranchers. After suggesting improvements on the questionnaire, the two ranchers mentioned previously supplied the author with lists of ranchers that they knew. They also consented to having their names used as references when other ranchers were contacted.[9] The ranchers on these lists were approached and, if they were agreeable, interviews were set up. If an interview ran smoothly and the rancher appeared to be at ease with the interviewer, then he was asked to recommend a list of ranchers to be interviewed and permission to use him as a reference was requested. In this manner, a list of 49 ranchers was developed.

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landholdings in the State of California and in each of the state's counties. They encountered the same problems when investigating possible public information sources and noted that many other sources suppressed information.

[9]Supplying prospective interviewees with a reference proved to be most helpful. Ranchers seemed to be more open to the idea of being interviewed when they knew that someone else in the ranching community had already done so. At times ranchers contacted one of the references before agreeing to be interviewed. Without these references, it is likely that fewer ranchers would have participated in the study.

An attempt was made to include ranches from each of the foothill areas in Kern County. Because the greatest portion of the county's private range land is located in the foothills of the Sierra Nevada, ranchers from several different communities in this region were interviewed.

Time constraints and the cost of numerous trips to Kern County from the home base in Ventura dictated that the sample size remain relatively small. A minimum sample size of thirty respondents or three-fifths of the acquired list of ranches, was adopted although a larger sample size was desired. (Thirty-two ranches were eventually interviewed.) Had the sample been much smaller than thirty, the results of the chi-square tests used to analyze the data would have been questionable.

Time constraints hindered the acquisition of a larger sample. As the late spring (late April through early June) approached, ranchers were more difficult to contact because cattle were being moved to the high country. Ranchers were unable to say when they would definitely be available for interviewing since most ranchers move not only their own cattle but will also assist neighbors in moving theirs, requiring many days of absence from home. Because of this scheduling problem, I concluded the data gathering process, thereby limiting the sample size to the number of ranchers already contacted.

Additional information on rodent and predator control, hunting and poaching, agricultural land preservation, and

public land use was obtained by interviewing the county and federal government personnel in charge of programs involving these topics.

The Interview

All interviews were scheduled and conducted by the author. Although the time required to gather data was lengthened by having only one interviewer, consistency in interviewing technique was assured. Variation among the rancher responses resulting from differences in the administering technique was, therefore, largely eliminated.

Prospective respondents were first contacted by telephone and interviews were scheduled at the rancher's convenience. Most ranchers contacted were willing to be interviewed after having been given a brief description of the project and the name of the rancher who had offered to act as a reference. Only five ranchers did not wish to be interviewed. Twelve other ranchers (from the list of 49 potential respondents) were not interviewed because the author was unsuccessful in contacting them or a mutually convenient interviewing time could not be scheduled.

Interviewing took place during the months of March, April, and May of 1981. Most interviews were conducted at the rancher's home although some ranchers preferred to meet at a local restaurant. Depending on the rancher, the length of the interview varied, but generally took from one to three hours. Although only one person answered the

questions, ranchers were usually accompanied by other family members or ranch hands. It is my opinion that these other persons were often present because of the rancher's wariness. As stated earlier, interviews were conducted as informally as possible and after a short time most ranchers were readily answering the questions and supplying additional information that they felt was important or helpful. As a general rule, the respondents were most cooperative and congenial.

At the end of the interview, each respondent was handed a road map showing the portion of the county where his or her ranch was situated (Appendix A). The respondent was then asked to indicate the approximate location of the ranch's boundaries by drawing them on this map. This was done to determine the approximate shape and location of the ranch. Although it might have been helpful to determine the exact boundaries of the ranch, this was not regarded as essential and would have been extremely difficult in many cases. In addition, it was felt that defining property boundaries precisely would infringe upon the anonymity guaranteed to respondents and could, in fact, be information they would prefer not to give.

Data Compilation

Ranch Classification

First, each ranch was given an identification number (numbers 1-32) for use in place of the ranch operators' names. Ranches were then categorized by size, length of

operation, and type of ownership (Appendix B). Three different classes were created under each of the above categories.

Ranch size. Ranch size ranged from 1,500 acres to 260,00 acres (6073 ha. to 105,263.2 ha.). Using the JENKS method for data classification, three classes were established as follows: small (1,500 to 15,000 acres or 607.3 to 6,072.9 ha.), medium (15,001 to 33,000 acres or 6,073 to 13,360.3 ha.), and large (greater than 33,000 acres or 13,360.3 ha.)[10]. The JENKS method was used because it groups data so that within-class variation is minimized (Groop 1980, p. 3). Three classes were chosen because it was felt that a smaller number of categories would result in less distinct groupings, and an unnecessary loss of information; a larger number would create too many classes with too few observations in each. Unfortunately this method of classification still produced a class with very few observations (the large ranch class contains only 5). Because the chi-square test was to be used to compare responses from groups of ranchers, such a small size resulted in the violation of one of the test requirements. Therefore, the ranch

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[10]The largest ranch (260,000 acres of 105,263.2 ha.) was so much larger than the next largest (85,000 acres or 34,413 ha.) that it had actually been placed in a class by itself. Rather than having four classes, one of which would have been a single ranch, the author chose to combine the third and fourth classes. Excluding this anomaly was not practical because this ranch is known to be of great importance to the condor. Information concerning this large ranch is valuable to the study of condor habitat.

size classification given above (JENKS method) and an author-defined grouping of two classes were both used to test all hypotheses concerning relationships between management activities and ranch size.

The author-designed classification of ranch size is based on the figure Gregor (1974, p. 18) gives for the average size of a California livestock ranch--4,180 hectares or approximately 10,329 acres. Any ranch which is smaller than this average was classed as small while any ranch with a greater acreage was considered to be a large ranch.

Length of operation: Ranches were then classified according to the length of time each had been operated under the current owner. In the case of a family owned ranch, ownership length was determined by how long the ranch had been operated by that particular family. The length of operation in the case of a family, then, could include many generations not just the current owner/operator. For ranches which were composed entirely of leased land or were owned and operated by a company, the length of operation included only the time during which the current operator or company controlled the ranch business.

The length of operation on Kern County ranches ranged from three to 126 years. Ranch operation length was also divided into three classes: short (0-30 years), medium (31-60 years), and long (greater than 60 years). This author-designed classification is based upon the idea that

ranchers tend to pass their land on to succeeding generations who then continue their parents' operation (Gregor 1974, p. 22). A ranch which has been in extistence only a short time is, therefore, defined as one whose length of operation is one generation (approximately 30 years) or less. Two generations of operation is viewed as a medium time period and more than two is considered long. These classes provide an indication of the degree to which there has been owner/operator stability through time.

Type of ownership/operator: Ranches were also classified according to type of ownership. Two criteria were used to define three different ownership/operator classes: 1) whether the ranch is operated by a family or by some other person or group of persons, and, 2) if the operator is a family, whether or not the ranch land is deeded to the owner or if it is partially deeded and partially leased. The three resultant classes were: 1) family operator with only deeded land; 2) family operator with both deeded and leased land; and, 3) other (including family operators ranching leased land only, absentee ownerships, and ranches that are owned by or are part of a corporation or company which has business interests other than ranching or is not family-operated). The ownership/operator classification provides an indication of the operator's "tie-to-the-land". It was felt that those operators who owned all or part of their ranch land would have a stronger "tie-to-the-land" and,

therefore, may have different ranch management practices than those who lack such ties.

Compilation of Topic Responses

After the respondent ranches had been classified according to the above system, the ranchers' responses to the remaining questions were compiled for each topic. The total number of ranches with similar responses was counted for each class. The responses to some questions were summarized by ranch type so that comparisons among classes could be made (Appendix B).

Mapping of Data

The maps of ranch boundaries drawn by the ranchers were combined into a single map of Kern County showing the location of the thirty-two ranches as perceived by the ranchers themselves (Figure 6). From this map, one can see that some of the ranch boundaries were drawn inaccurately because some ranches overlap. In other words, the same piece of property has been included in more than one ranch. In addition, many of the ranches consist of two or more land parcels. These two factors make it difficult or impossible to identify individual ranches on this map.

The purposes of mapping the ranches was to show the general location and size of the ranches so that any regional concentrations of ranch characteristics could be detected. Throughout the three months of interviewing it became apparent that several distinct ranching communities could be

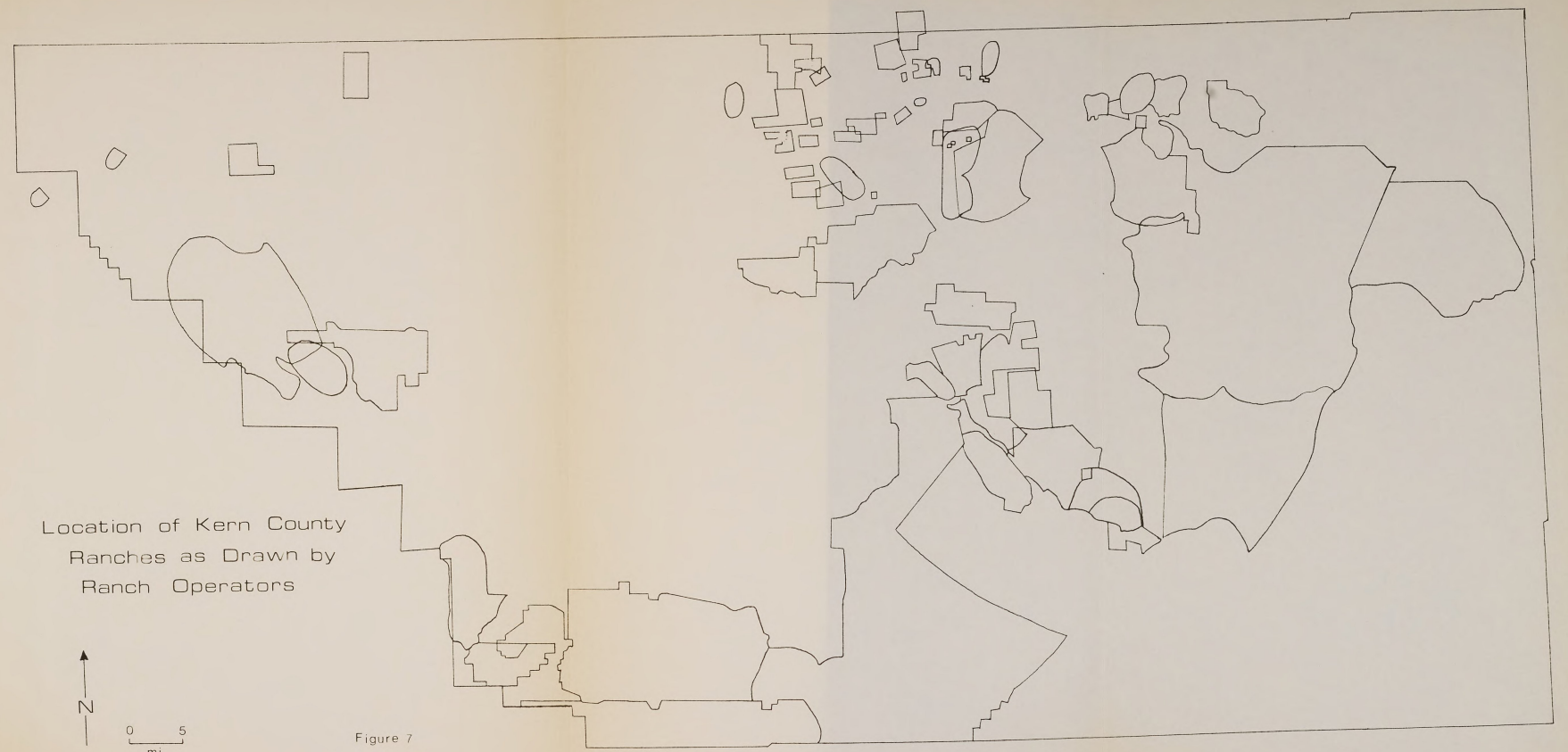
Location of Kern County
Ranches as Drawn by
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Figure 7

identified. For the purposes of this study a ranching community is defined as a group of ranches where the home bases (the main ranch, including the rancher's home, other buildings and corrals plus surrounding grazing land) are located in the same general area and the majority of the operators (ranchers) seem to be familiar with each other. In order to reduce the problems produced by mapping imprecise rancher responses and to more easily recognize any spatial concentrations of ranching characteristics, a new map was prepared with each ranch represented as a proportional square centered at the ranch's home base (Figure 7). The various ranching communities are more readily identified on this map. They are as follows: the Western Kern Community--the Temblor Range and Pleito Hills (Ranches 1-6)[11], the Tehachapi Mountain Community (Ranches 7,8,12, and 13), Walker's Basin/Caliente Community (Ranches 9,10,11, and 14), Lower Kern River Community (Ranches 15 and 16[12], Granite

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[11]The Western Kern ranches are actually more closely related to ranch communities that sit astride county boundaries. Ranches 1 and 3 are located in the Temblor Range. Most of the other Temblor ranches have their home bases in San Luis Obispo (S.L.O.) County. Ranches 2,4,5, and possibly, 6 tend to be more closely related to ranches located in the Caliente Range (S.L.O. County) and the Cuyama River Valley (S.L.O. and Santa Barbara Counties). The Western Kern ranches are, in this study, considered together because their physical environments are similar and very different from that of the other ranches.

[12]These two ranches do not appear to be a distinct community nor do they seem to be a part of any of the other groups. There may be a ranching community which the author was not able to identy because of the small sample size or they could have social ties with other groups yet be located at a distance from them. The latter seems more likely since

APPROXIMATE SIZE AND LOCATION OF RANCHES STUDIED IN KERN CO.

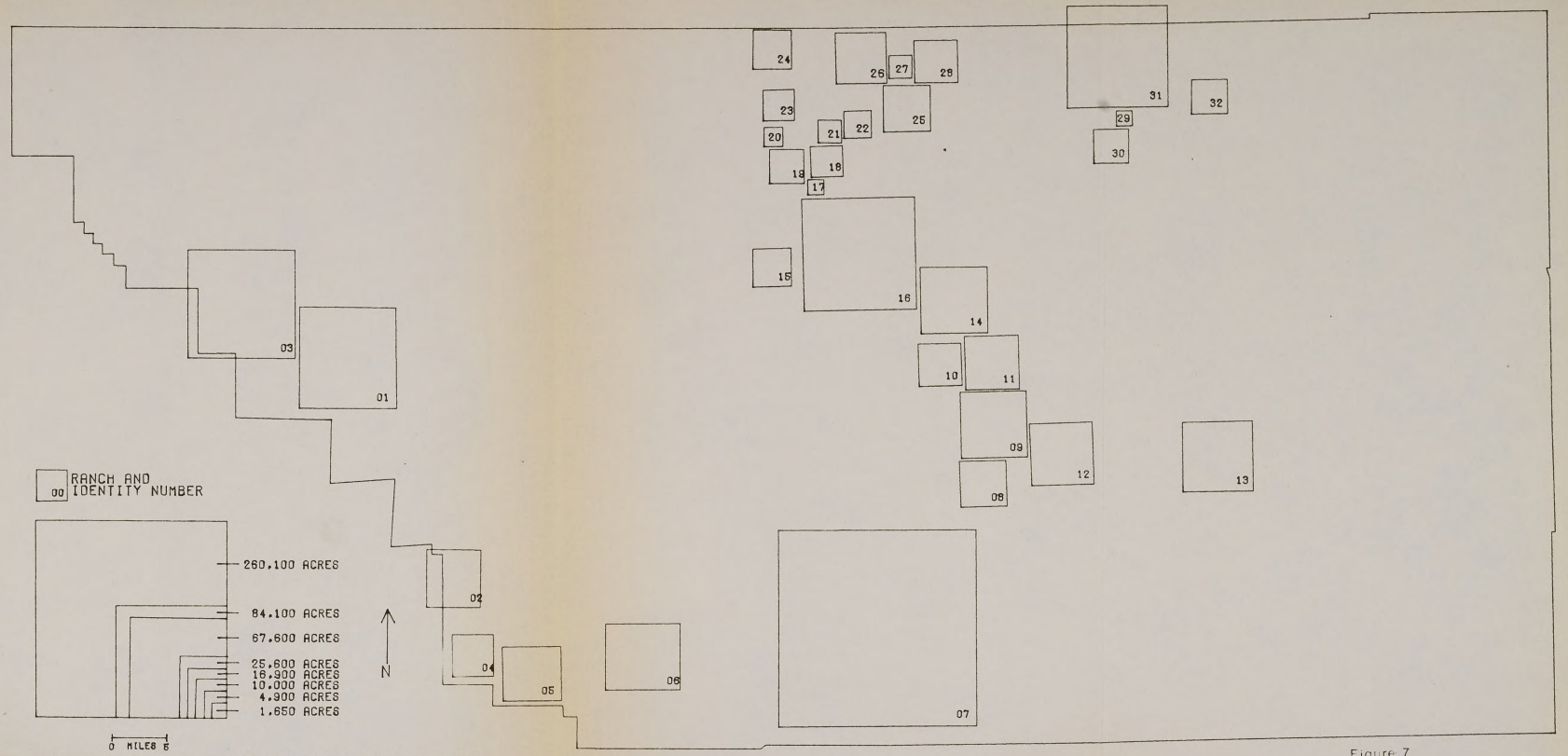

Figure 7

Station--Woody--Glennville Community (Ranches 17-28), and the Lake Isabella Community (Ranches 29-32). This mapping technique preserved the qualities of size and location necessary to detect areal concentrations even though the true shape and exact location of the ranches is not shown.

Data Interpretation

Hypotheses 1, 2 and 5 were investigated by using a simple frequency count of rancher responses. A ranch activity or management practice that occurred on the majority of the ranches (more than 16) was considered to be prevalent in the county. If this activity or practice had been suggested by previous authors and/or researchers as being detrimental to the welfare of the condor, then this hypothesized problem was considered to exist within the Kern County feeding habitat.

The above procedure was also carried out for Hypotheses 3 and 4. Chi-square tests were performed to determine whether the relationships suggested in null Hypotheses 3a-e and 4a-c were statistically significant.

Rancher 15 was recommended by a rancher from the Glennville area and Rancher 25 is a relative of a rancher in the Glennville area.

CHAPTER IV

RESULTS

Food Supply

Past Research

The adequacy of the condors' food supply has been discussed at length by several authors. However, no evidence presented to date conclusively supports the hypothesis that an inadequate food supply has reduced the condors' ability to reproduce or contributed to condor mortality. Koford (1953, p. 72) stated that, aside from molestation by humans, changes in food supply were the most important determinants of both condor numbers and distribution during the past century. On the other hand, a later study (Miller et al. 1965, p. 26) concluded that food supply was not a limiting factor in the condors' survival. Wilbur reviewed the food resources issue and concluded that earlier studies did not adequately examine the impact of local food shortages on breeding birds (Wilbur 1972). He felt that although food may be adequate for free-ranging nonbreeders, food shortages near nesting areas can have harmful effects. Current condor research and recovery programs recognize that further food supply studies are necessary and suggest methods of preserving key feeding areas and optimizing food sources (Condor Recovery Team 1980, p. 22).

Although opinions differ concerning the importance of food availability as a limiting factor in the condors'

survival, it is generally agreed that the amount of feeding habitat has been greatly reduced by conversion of grazing lands to other uses. Other factors which have been suggested as possibly affecting the amount of food available to the condor include: decreasing livestock mortality resulting from improved veterinary care and better livestock management; a decline in carcass availability because of an overall reduction in the amount of livestock produced on the range and improved range sanitation (removing, burning, or burying livestock carcasses); and, a growing tendency for cattle ranchers to change from traditional cow-calf operations to stocker cattle herds. The following section discusses these factors and how they relate to the condors' food supply in Kern County.

Kern County Livestock Production

Previous studies indicate that dead livestock from cattle and sheep ranching are the main food of the condor today (Koford 1953, Miller et al. 1965, Wilbur 1972). If this is true, a major decline in the number of range livestock would result in a food shortage for the condor. In Kern County, and generally throughout the condors' range, livestock numbers have fluctuated widely during the past century. From 1880 to 1940, the number of sheep produced in the condors' range declined dramatically while cattle numbers increased. Koford (1953, p. 69) noted this trend and stated that the increase in cattle was not enough to offset the loss of sheep as a condor food source. From 1940 to 1960

both sheep and cattle numbers increased in the condors' range leading Miller et al. (1965, p. 19) to conclude that livestock numbers were sufficient enough to provide an adequate food supply. These trends are reflected in Kern County's livestock statistics (Table 1).

TABLE 1

Kern County Livestock Numbers

	1880[1]	1940[1]	1960[2]	1980[2]
Cattle	32,989	92,899	204,000	94,200
Sheep	152,041	28,438	165,414	152,000

[1]Koford 1953, p. 69

[2]Kern County Agricultural Commissioner's Office 1960, 1980.

However, these data do show that Kern County livestock numbers, especially cattle, have declined considerably during the past twenty years. If dead calves are the condors' preferred food, then the decline in cattle numbers has probably reduced the condors' food supply compared to periods when cattle population peaked. On the other hand, condor numbers decreased during the last century while Kern County livestock numbers remained high or even exceeded the 1880 populations.

From 1960 to 1980 the amount of livestock produced in Kern County decreased substantially (Figures 8 and 9). Localized trends caused by market and climatic conditions may be more responsible for this recent slump than long term overall decline in the livestock industry. When asked why

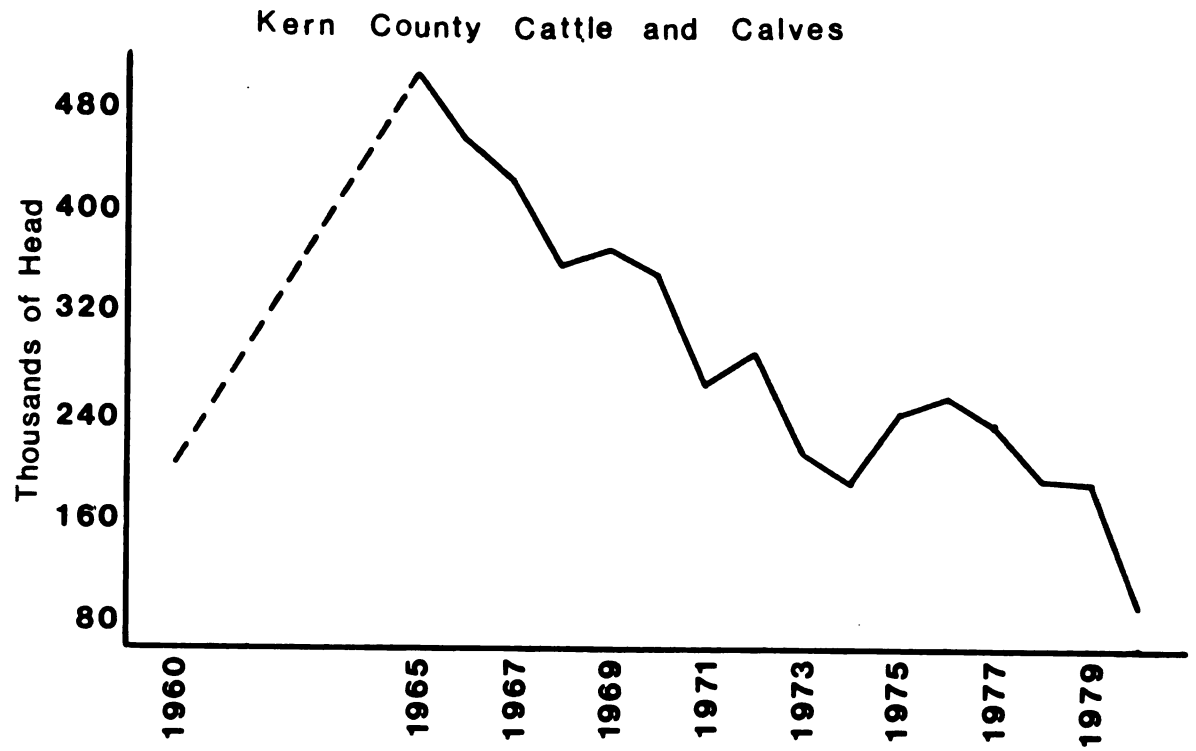

Figure 8

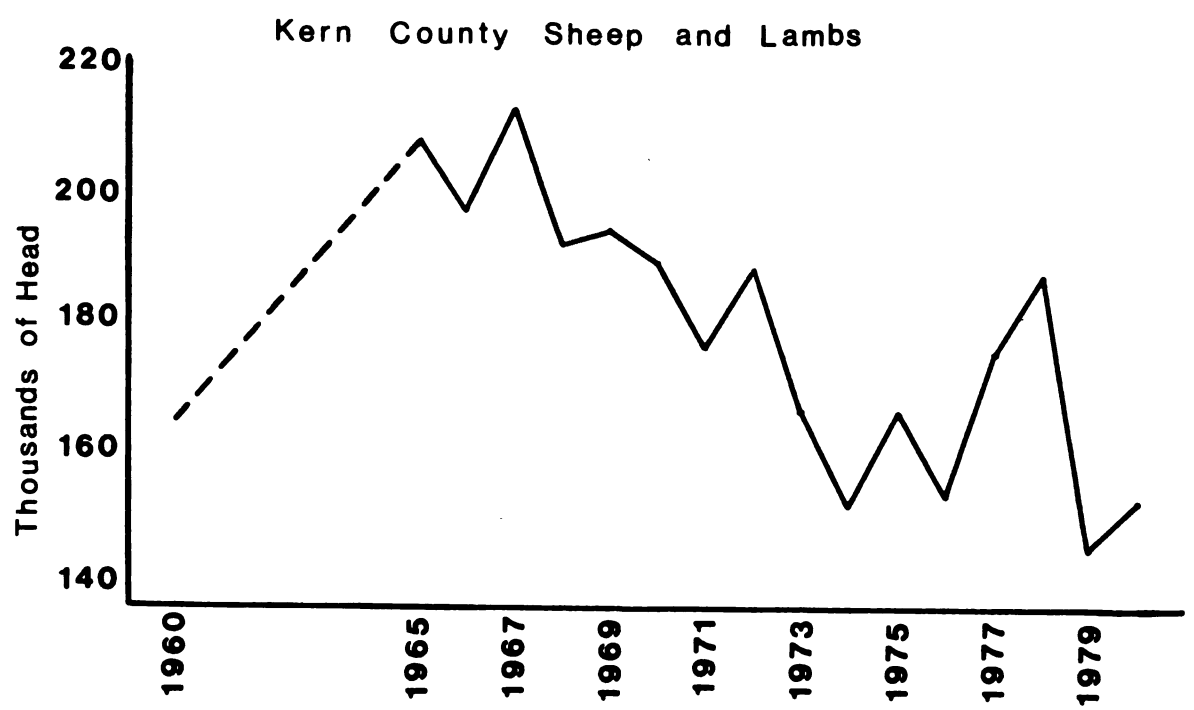

Figure 9

they would increase or decrease their livestock numbers, most ranchers indicated that the condition of the range and market conditions were the most important factors. The condition of rangeland in Southern California is very closely related to weather conditions. For example, a number of ranchers indicated they were forced to reduce the size of their herds during the drought years of 1976 to 1977. A similar but more localized situation existed when an unusually devastating wind storm swept through the Tehachapi Mountains and the southern Sierra Nevada foothills in 1977. Particles carried by the high winds denuded many hillsides requiring some ranchers to reseed portions of their rangeland.

The recent downward trend in Kern County livestock numbers may be temporary. If this is the case then one of the reasons listed for a possible current condor food shortage would be eliminated, especially when one considers the small size of the present condor population. If, however, the downward trend continues and many livestock are removed from areas which are most often frequented by the condors then their food supply may be severely affected.

Stocker Cattle Vs. Cow-Calf Ranching Operations

The practice of shipping steers in from other states or Mexico and grazing them on rangelands within the condors' range reduces the birds' food supply where it replaces traditional cow-calf ranching on a large scale. Stocker cattle are generally quite hardy and do not have high

mortality rates.[13] They are grazed for only a few months (when range productivity is at its highest) and then are removed for sale, reducing the number of cattle on the range during the dry season. There are three ways that the condors' food supply could be reduced if ranch operators shift their ranching efforts toward grazing a larger proportion of stocker cattle, namely:

1. Reduce food supplies during those months when stocker cattle are not on the range.
2. Eliminate (on 100 percent stocker ranches) one of the major causes of cattle mortality, that is, deaths related to pregnancy and calving.
3. Eliminate afterbirths (from calving) as a possible condor food source.

Year-round cow-calf operations, then, provide a more substantial and long-term food source for the condor than stocker cattle operations.

Burcham (1957, p. 213), Buntin (1975, p. 6), and Wilbur (1977, p. 135) all suggest that there has been a trend towards replacing cow-calf ranching with stocker cattle ranching on California rangelands. My interviews with ranchers indicate, however, that this is not the case in

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[13]They are, however, subject to "shipping fever", a sickness brought about by the stress of being transported. If death occurs, it is generally because the animal's weakened state facilitates the development of pneumonia.

Kern County. Of the thirty-two ranches studied only one could be classified as a stocker cattle operation (Table 2). This ranch (located east of Lake Isabella) has steadily decreased its cow-calf herd so that it now mainly grazes steers on a seasonal basis. Fourteen of the remaining ranches run both a cow-calf herd and stocker cattle. The majority of the ranches, however, are predominantly cow-calf operations, grazing steers only when the range is in such good condition it can carry more animals. The seasonal increase in numbers of cattle is directly dependent upon the condition of the range in any given year.

TABLE 2

Types of Cattle Grazed on Kern County Ranches

Type of Operation	Number of Ranches	% of Total
Cow-calf	17	53
Stocker cattle	1	3
Both	14	44

The fourteen ranches which run both types of cattle are fairly well distributed throughout the county's rangeland areas indicating that some stocker cattle are grazed within each of the foothill regions. It is interesting to note that almost all of the ranches in the Tehachapis (Ranches 7 through 11) fall in this category and that one of these ranches is currently increasing stocker numbers at the expense of its cow-calf herd. This may indicate that the Tehachapi foothills have higher concentrations of stocker cattle than other parts of Kern County.

Ten of the fourteen ranches which run both herd types have always operated as such. In general, these ranches increase one herd type over the other in response to market conditons and the quality of the range, therefore, the total numbers of each type of cattle vary.

In Kern County there does not appear to be any significant trend towards increasing stocker cattle numbers at the expense of cow-calf herds. Hypothesis 1b "the number of Kern County ranchers engaged in stocker cattle production has not significantly reduced the condors' food supply.", cannot be rejected. The condors' food supply in this county has probably not been reduced as a result of an influx of stocker cattle.

Removal of Livestock Carcasses

Another factor which has been suggested as limiting the supply of livestock carcasses available to condors is the practice of removing dead animals from the range to assure better range sanitation (Koford 1953, p. 70, Wilbur 1977, p. 135, Condor Recovery Team 1980, p. 12). Miller et al. (1965, p. 20) noted, however, that when death occurs on the range the carcass is almost always left where it lies. The removal of diseased carcasses is obviously necessary in order to reduce the possibility of further contamination of livestock, water sources, or wildlife. The removal, burning, or burial of "clean" carcasses on the other hand, provides little benefit other than improved aesthetics.

Almost all of the ranchers interviewed said that they left livestock carcasses out on the range but qualified this statement by adding that if the animal died near ranch buildings, corrals, roads, or water supplies then they hauled the carcass away to a different location (generally a ditch, gully, canyon, hill, or a dump). Only three ranchers mentioned burying the carcass rather than leaving or moving it, but again, this was only if the carcass was near the ranch headquarters. Only one rancher makes a conscious effort to remove carcasses from his land because he does not like having dead livestock lying around. He takes his carcasses to the tallow works.

Carcass removal, burning, or burying has probably not increased greatly as a result of an increased awareness of the importance of range sanitation. Diseased animals are either burned or buried but it is unlikely that this would affect the overall supply of food available to the condor and may protect it and other species from contamination. If the above is accepted then it is not possible to reject Hypothesis 1c, namely that "Dispoal methods used for livestock carcasses on Kern County ranches have not reduced the condors' food supply." Some qualifiers to such a conclusion must be mentioned. The practice of relocating carcasses could affect the availability of the condors' food supply if the dead animals are deposited in places which are inaccessible to the condor. This does not appear to be common but

it may be helpful to encourage ranchers to place those carcasses they have to move in accessible locations.

Two ranchers mentioned that increased recreational use of BLM and USFS lands has prompted federal officials to more frequently require the removal or burning of livestock which die on public lands. Where dead animals may be a public nuisance, this is a valid request, but in areas of low human use, carcass removal should not be required. I did not investigate the extent to which carcass removal is required on public lands. Information on livestock carcass policies and practices should be obtained from the BLM and USFS.

Livestock Mortality

The development of various veterinary medicines such as antibiotics and vaccines has helped to reduce livestock losses resulting from disease. Better management has also tended to decrease livestock deaths. The supply of food available to the condor from livestock losses has probably been reduced because of these two factors (Koford 1953, p. 72, Ricklefs 1978, p. 11, Condor Recovery Team 1980, p. 3).

Although the major advances in loss reduction due to mismanagement and disease probably took place prior to 1960, the interviewed ranchers were asked to comment only on livestock mortality occurring during the past twenty years (1961-1981) so that current mortality trends could be assessed. Ranchers were asked whether livestock mortality on their ranches had increased, decreased, or remained the

same during the past twenty years and what was the current major cause of livestock mortality.

Most of the ranchers (19; 59%) felt that livestock mortality had remained the same throughout the past twenty years. Of the remaining thirteen ranchers, nine said that mortality had decreased, three felt it had increased, and one was not sure. The primary reasons cited for decreased mortality were better livestock management and the use and availability of antibiotics or better medicine. Reasons given for increased mortality include the occurrence of more diseases as a result of increased movement (shipping) of cattle and an increase in cattle rustling or other losses resulting from illegal activities of people not connected with the ranches.

A wide variety of causes of livestock deaths were supplied by the ranchers. Most felt that there was no single major mortality factor and suggested two or more principal causes or named primary and secondary causes. The most common reason given for livestock deaths was pneumonia (10 responses) but if responses are divided into primary and secondary causes, calving or pregnancy related problems (6 responses) and pneumonia (6 responses) become the two most frequently mentioned causes. Poison weeds (6 responses) was most frequently cited as a secondary mortality factor (Table 3).

TABLE 3

Causes of Livestock Mortality

Primary Cause (First Choice)	No. of Responses
Calving or pregnancy related	6
Pneumonia	6
People	5
Disease	5
Natural causes (old age)	3
Anaplasmosis	2
Foothill abortion	1
Predators	1
Drought	1
Poison weeds (including grass tetany and/or bloat)	1
Black Leg	1
Anthrax	1
Secondary Cause (Second Choice)	
Poison weed (including grass tetany and/or bloat)	6
Shipping problems	4
People	4
Pneumonia	4
Disease (sickness)	3
Calving problems	3
Predators	2
Weather	3
Natural causes	2
Cancer	1
Heart Failure	1
Totals	
Pneumonia	10
Calving or pregnancy related	9
People	9
Disease	8

Table 3 (continued)

Totals	No. of Responses
Poison weeds (including grass tetany and/or bloat)	7
Natural causes	5
Shipping problems	4
Weather (including drought)	4
Predators	3
Anaplasmosis	2
Foothill abortion	1
Black leg	1
Anthrax	1
Cancer	1
Heart failure	1

It is interesting to compare this list of mortality factors to those mentioned by Carl Koford in 1953 and Miller et al. in 1965. Koford (1953, pp. 70,71) cited anthrax as the most consistent cause of cattle deaths but noted that in the recent past, mismanagement and drought had been important. None of these appear to be significant causes of cattle mortality in Kern County today. Livestock losses due to diseases and weaknesses related to calf rearing were cited as being most important by Miller et al. (1965, p. 20); they also mention toxic plant deaths. All three of these causes are commonplace today. Cattle deaths resulting from people's action were often included by respondents in my study but this cause was not mentioned by Koford or Miller. One cannot be sure wehther deaths caused by people ("rustling" for beef or wanton shooting) are more commonplace today

than in the past or whether better management and closer supervision of livestock herds has made this problem more obvious.

In summary, major gains in livestock mortality reduction took place some time ago and for the past twenty years mortality has stabilized at a low level. Although some of the more common previous causes of death appear to be of lesser importance today, some ranchers feel that new disease problems are being produced by transporting stocker cattle long distances. For the condor, reduction in livestock deaths from calving problems is important because calves may be preferred over larger carcasses as a food source. If one considers only the past twenty years, then reductions in livestock mortality have probably not been great enough to affect the condors' food supply. Hypothesis 1d, ("The incidence and type of livestock mortality on Kern County cattle ranches have not reduced the condors' food supply during the past twenty years."), should not, therefore, be rejected. As long as there remains a wide variety of reasons for cattle mortality then there will probably be enough carcasses available to sustain the current condor population.[12]

Seasonality of Food Supplies

All of the factors discussed above concern the numbers of dead cattle available to condors on ranches in Kern

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[12]It must be kept in mind that the condors' food source does not consist solely of cattle. Other animal losses will contribute to their food supply.

County. However, these data do not indicate the availability of this food supply at any given time of the year, nor do they consider other sources of food for the condor. Wilbur (1972, pp. 13,14) suggested that since livestock losses are greatest between September and February and because deer losses also occur during this period, it is possible that there is a condor food shortage during the spring and summer months. Koford, on the other hand, felt that poor winter weather, the lack of poisoned ground squirrels as a food source, and the congregation of most of the condors in the southern portion of the condors' range all contributed to making winter the most critical time of year for condor food availability (Koford 1953, p. 132). In contrast, Miller et al. (1965, p. 25) felt that because the peak die-offs of livestock, deer (April to June plus a smaller summer die-off), and small mammals occur at different times throughout the year, there would be no season when the condor food supply would be limited.

If one agrees that calves represent the most important food source of the condor, then it would follow that the calving time on any particular ranch would be an optimum condor food production time. Those months when few if any calving losses occur would represent a time of year during which the food supply is limited or dependent upon other animal losses.

Calf deaths occur most frequently during calving time. In Kern County calving usually takes place from October to

December but also commonly occurs during the winter and late in the summer. Figure 10 shows the number of times that each month was mentioned by ranchers as being a part of their ranch's calving season. It is apparent that there is considerably less calving during the summer months (May to June). Calving recorded for this period is primarily attributable to five ranchers indicating that calving occurs throughout the year on their ranches. Most of their calves, however, are born in the autumn. One can conclude, therefore, that young calves are in limited supply during the summer. Other food sources must supplement the condors' diet during this period. Calving season may not, however, adequately represent the availability of calves as a food source as some calves are lost as a result of abortions. These losses would occur prior to the calving season, i.e., at the end of or during summer.

Ground squirrel, deer, and sheep carcasses may be an important food source when cattle carcasses are scarce. Sheep losses, especially from lambing, generally occur in late winter and early spring. Deer mortality is probably highest when young are born (in the spring) and during hunting season (the autumn months), but other die-offs could occur as a result of adverse weather or range conditions.

Some have suggested that the ground squirrel poisoning programs conducted by county agricultural agents have provided condors with a valuable summer food supply (Koford 1953, p. 72; Miller et al. 1965, pp. 24-25). This source of

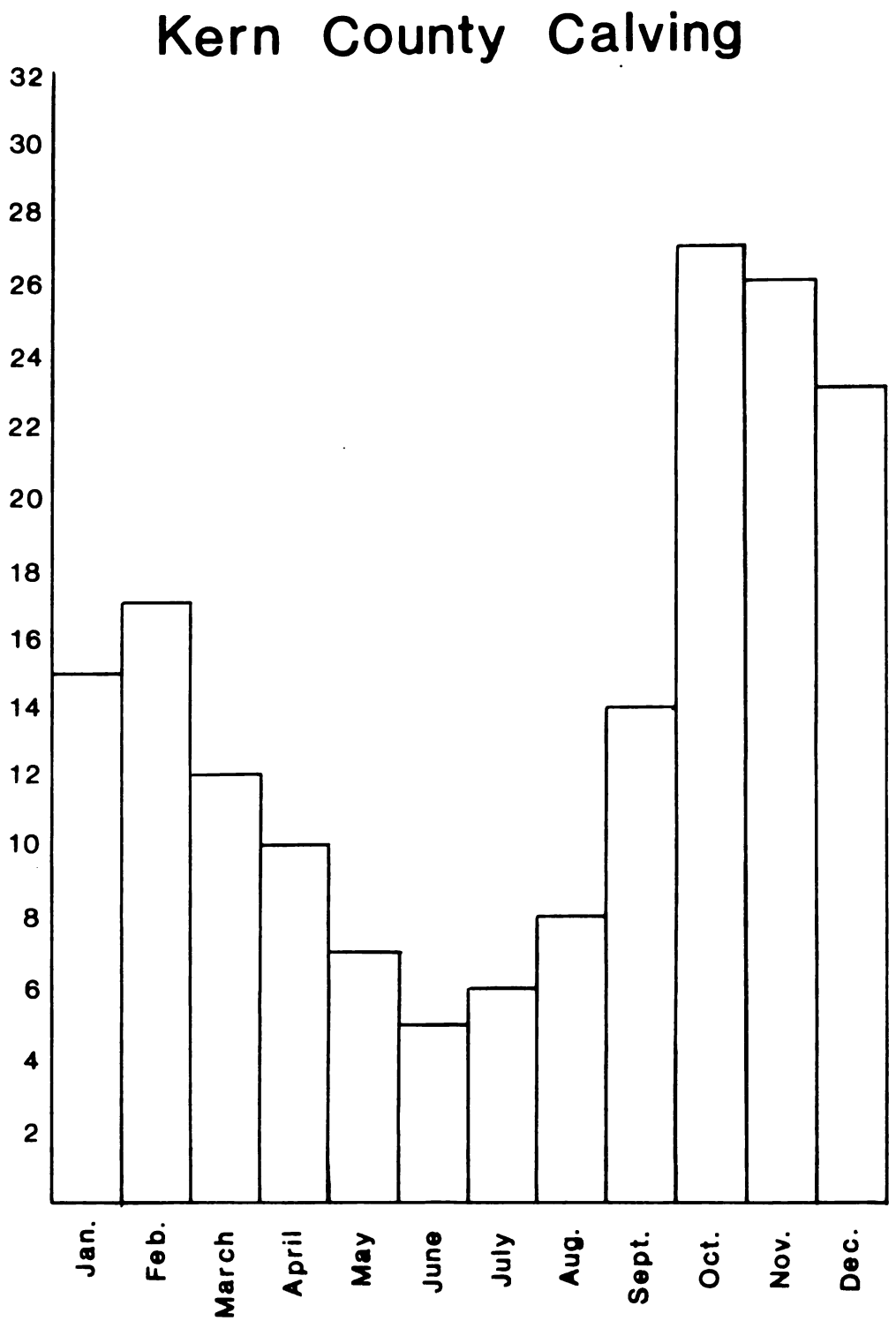
Kern County Calving
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
Jan.
Feb.
March
April
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.

Figure 10

food may not be as available as it has been in the past. Since the inception of Kern County's poisoning program, the amount of rodenticides used during poisoning campaigns has been greatly reduced. Now, about 95% of the squirrels die below the ground (Snodgrass 1981). These squirrels are not available for consumption by scavengers.

In Kern County, if there is a time of year when the availability of an adequate condor food supply is questionable, it would be the summer. Fewer livestock and wild ungulate deaths appear to occur during this season. The relatively low level of calving at that time contributes to this problem. Hypothesis 1e, "The seasonality of calving on Kern County ranches has no influence on the condors' food supply.", should therefore be rejected. Even though calves are not the only food source for the condor the seasonality of calving plays an important role in determining the availability of carcasses.

Fire Suppression

One other factor which could affect the amount of food available to the condor has been suggested. Cowles (1958) pointed out that fire protection programs have rendered inaccessible many foraging areas once used by the condor because dense chaparral stands have grown unchecked. Chaparral areas that are periodically burned support larger wildlife populations. Fires also create open areas in which the condor is more able to land and take off thereby increasing the available foraging area. Carrier, however, noted that in 1962

and 1967 two large burns occurred on lands adjacent to a former condor use area but there was no subsequent increase in condor use of the burn area (Carrier 1973). This aspect of condor survival merits further research.

Depradatory Mammal Control

Accidental Poisoning of Condors

The possibility of accidental poisoning of condors through the ingestion of toxic substances used to control depradatory mammals has been frequently debated and is considered to be a possible factor in both past and present condor deaths. There are two basic types of poisoning situations which are considered when possible condor poisoning incidents are discussed: the use of treated carcasses (generally with strychnine) placed to control livestock predators and the use of rodenticide-treated grain baits in the control of pest rodents on rangeland. Condors may be directly or secondarily poisoned through consumption of treated carcasses or through consuming dead rodents. Of the two, poisoning from strychnine-treated carcasses has been more frequently and strongly suggested as a possible problem.

There is no substantial evidence to support theories that the condor population has suffered great losses because of inadvertent poisoning. Turn-of-the-century reports about hundreds of condors dying after feeding on poisoned carcasses are unsubstantiated. To date, there are only three known firsthand accounts of condors having been affected by

poisons used in this manner. Wilbur (1978, p. 21) cites an observation by W. Fry (reported in a 1926 Sequoia National Park pamphlet) of two condors that had died after feeding on a poisoned sheep carcass. This incident occurred in 1890. Three condors were found near a strychnine-baited carcass in Kern County in 1950 (Miller et al. 1965, p. 36). One of these birds was dead and the other two were very ill but recovered days later. The chemist who analyzed the digestive tract of the dead bird emphasized the fact that only a trace of strychnine was present. Another sick condor was found near a strychnine-baited calf carcass in 1966 (Borneman 1966). This condor also recovered after days of treatment.

All the above incidents of condor poisonings were associated with predator control methods using poisoned carcasses as bait. There are no known instances of condors having become sick or dying from the accidental intake of poisons used in rodent control programs. However, condors which died of undetermined causes have been found in areas where rodent poisoning had recently occurred (Miller et al. 1965).

Ground Squirrel Control in Kern County

In most of California's counties, vertebrate pest control is a function of the county agricultural commissioner's office. Of all the vertebrate species controlled by the the county agricultural commissioners in California, ground squirrels are the most significant (Handley 1978).

In Kern County, programs for the control of ground squirrels (Spermophilus beechyi) have been in existence since the early part of this century. The county's original program was initiated to control the bubonic plague (Snodgrass 1981). Today ground squirrel control programs are primarily conducted for the purpose of reducing crop or forage losses.

There is little doubt that ground squirrels are or can be a problem to ranchers. Experiments have shown that ground squirrels actually do reduce the amount of forage available to cattle, especially during the winter grazing period when plant growth is slow (Fitch 1948, Howard et al. 1959). Squirrels also damage rangeland by clearing and trampling vegetation around burrows.

Most of the ranchers interviewed in Kern County (27 out of 32 ranchers) considered ground squirrels to be a pest problem on their ranches. Almost all of these ranchers believe that the squirrels are a problem because they destroy the range and compete with livestock for valuable forage. Eleven ranchers felt that ground squirrels are a problem because they create holes which are hazardous to horses and cattle. Seven ranchers indicated that the rodents are disease carriers (primarily of the bubonic plague).

Rodenticides Used on Kern County Ranches

Prior to World War II, thallium sulfate was used to control pest rodents in Kern County. The use of thallium

sulfate was officially banned in 1967 (California Dept. of Food and Agriculture 1982, pp. 10-10) because of hazards associated with its use. Compound 1080 (sodium monofluoroacetate) replaced thallium sulfate and is still the most popular poison available to control ground squirrels in Kern County (Snodgrass 1981). Other poisons which have been or are being used to control ground squirrels in Kern County include strychnine, zinc phosphide, and a variety of anticoagulants.

Twenty-six of the interviewed ranchers used 1080 to control their ground squirrel problems (Table 4). Most of these ranchers, however, use 1080 and zinc phosphide. Sometimes both poisons are used in the same year or sometimes one poison is used during one year and the other is used the following year.

TABLE 4

Methods Used by Ranchers to Control Ground Squirrels

Control Method	Rancher Responses
Compound 1080	26
Zinc Phosphide	20
Shooting	3
Strychnine	2
Anticoagulants	1
Thallium	1
Smoke Bombs	1
Dogs	1

The use of 1080 is most popular because it is highly toxic and very effective in controlling rodents. Because of

1080's high toxicity, its use is strictly controlled by the State of California and the federal government. Stringent restrictions on the use of 1080 and a recent county program regulation requiring ranchers to pay for the cost of the poison and its application may have contributed to a decline in the use of 1080 on Kern County ranches (Snodgrass 1981). Although not asked, many ranchers (17) stated that they had reduced their use of 1080.

Twenty of the thirty-two ranchers interviewed use zinc phosphide to control ground squirrels on their land (Table 4). The use of zinc phosphide has been increasing and may now be used almost as often as 1080 (Snodgrass 1981). Zinc phosphide is more easily acquired, costs less than 1080, and can be used by the rancher without direct supervision from the county. If used properly, zinc phosphide can be an effective rodenticide. Its misuse or over-use can result in bait shyness which will greatly reduce its effectiveness (Prakash et al. 1971).

Other poisons used by Kern County ranchers to control ground squirrels include strychnine, anticoagulants, and thallium. Anticoagulants are used less frequently for the control of ground squirrels than are other poisons (Handley 1978) but their use is increasing (Clark 1978). The primary reason anticoagulants are infrequently used in rangeland areas is their high cost. Strychnine is generally not used for ground squirrel control on rangeland as broadcast baiting

is not recommended by the California Department of Food and Agriculture (1975, p. 522-3). The use of thallium sulfate for pest management is now illegal.

Compound 1080, Zinc Phosphide, and Condors. Of all the poisons used to control rodents on rangelands, 1080 has been most frequently criticized as being potentially dangerous to the condor. No condors are known to have died from ingesting 1080 even though the birds have been seen following the poisoning crews to feed on the dead rodents (Koford 1953, p. 72; Miller et al. 1965, pp. 39-40).

The effect of 1080 on condors is not clearly known. Birds, amphibians, and primates tend to be highly resistant to 1080 (Roszkowski 1967, p. 1083) and studies indicate that the turkey vulture is considerably resistant to its toxicity (Ward and Spencer 1947). Poisons, however, are very species specific, therefore 1080 may affect a condor quite differently than other Cathartids.

Comparatively, zinc phosphide is less toxic than 1080, the anticoagulants, or thallium sulfate (Roszkowski 1967, Schoof 1970). Its odor, color, and taste make it somewhat unattractive to non-target animals but causes of primary and secondary poisoning have been documented (Stowe et al. 1978, Shivanandappa et al. 1979, Schoof 1970). I was unable to find any reported incidences of scavenging birds or birds of prey having been poisoned from the use of zinc phosphide or to locate any references to the toxicity of zinc to these species. Because there are fewer restrictions on the use

of this poison, the potential for misuse and accidental poisoning is enhanced.

Compound 1080 and zinc phosphide are both widely used on Kern County's rangelands. These poisons could be contributing to condor mortalities. Although no rodenticide poisoned condors have been found it is possible that a condor may not immediately feel the effects of the poison and may later die in an area far removed from the poison source.

Kangaroo Rats in Kern County

Miller et al. (1965) suggested that the consumption of poisoned kangaroo rats by condors may pose a greater poisoning risk than the consumption of ground squirrels. Dr. Aryan I. Roest noted that when feeding on ground squirrels, turkey vultures never consumed the head or the intestinal tract of the squirrel (California Dept. of Food and Agriculture 1977, p. 10). The kangaroo rat, however, is smaller and may be consumed whole. If the rat has stored poison grain pellets in its cheek pouches a condor could directly ingest these pellets by swallowing the entire rat. Lethal doses of a poison may be more quickly consumed in this manner. The possible rodenticide related condor deaths which Miller et al. (1965) report all occur in areas where kangaroo rats are common.

Of the ranchers interviewed, only eight stated that kangaroo rats are a problem on their ranch. Two felt that the rats are sometimes a problem. A map depicting those

ranches which have kangaroo rat problems shows that there is a concentration of such ranches in the Granite Station-Woody-Glennville area of Kern County (Figure 11). This is also the same general area which Miller et al. discussed in their study. This area has been designated as a Condor Critical Habitat Area in the Condor Recovery Plan (Condor Recovery Team 1980). A greater overall poisoning threat may be present in this area than in other ranching areas of Kern County if condors forage there during the early summer months.

Predator Problems and Control Methods

The first hand and best documented incidences of possible condor poisonings have been associated with the use of poisoned carcasses placed for the control of livestock predators. The use of poisoned carcasses and tallow drop baits is now illegal in both the State of California and on federal lands (Butchko 1981). Trapping is the primary method of predator control used at present but M-44 cyanide capsules can be used to control coyotes and other canids. Accidental trapping of birds, including the condor, is rare (Butchko 1981, Miller et al. 1965, p. 44), but Koford (1953, p. 131) reported five incidents of accidental trapping of condors. Two of these incidents resulted in the death of the bird.

In Kern County, most predator control efforts are directed towards reducing livestock losses (most frequently sheep but sometimes cattle) from coyote predation. Other

KANGAROO RATS ON KERN COUNTY RANCHES

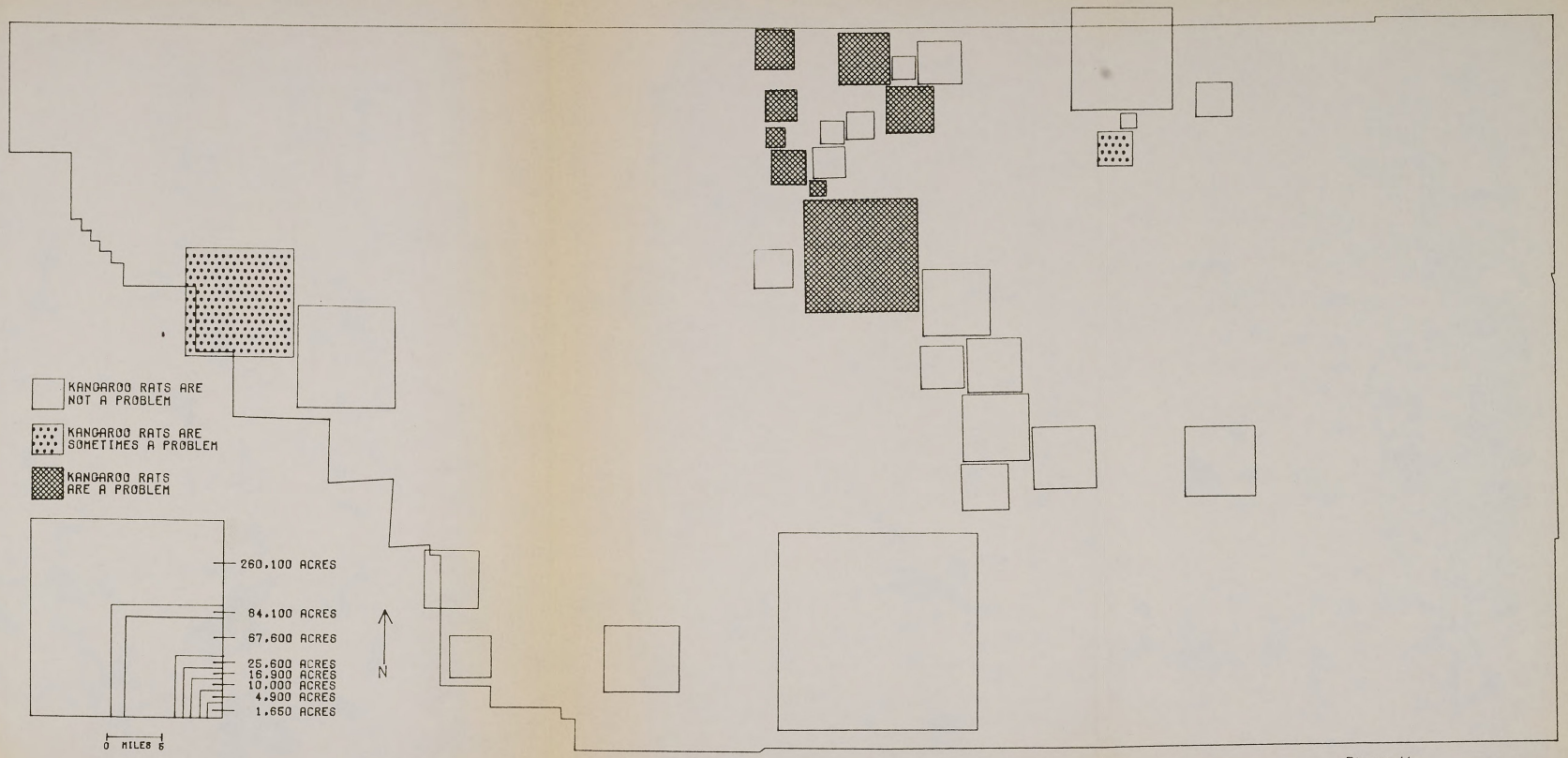

Figure 11

species which sometime require control include Mountain lion, bear, and dogs.

Most of the cattle ranchers interviewed in Kern County did not feel that they had a predator problem. Of the fifteen ranchers who did say they have a problem, eleven cited the coyote as being the problem predator. Coyotes pose the greatest threat to cattle operations during the calving season when they can prey upon the young and vulnerable animals. The Mountain lion was the second most common problem predator mentioned (6 responses) followed by dogs (5 responses). The Golden eagle and the California condor were each mentioned once. It is interesting to note that although most ranchers are quite knowledgeable about the local flora and fauna, one rancher still mistakenly classified the condor as a predator.

Most ranchers control problem predators by trapping, usually by employing a private or a government trapper, but sometimes the rancher does the trapping himself (Table 5). Four ranchers indicated that they use alternative methods of controlling predators but refused to define these methods. Whether these responses indicate that illegal control methods, such as the use of poison baits, are being employed is speculative but possible.

TABLE 5

Predator Control Methods Used by Kern County Ranchers

Control Method	Responses
Government and/or Private Trappers	13
Shooting (by the rancher)	4
Undefined methods	4
Trapping (by the rancher)	2
Cyanide (M-44)	1

Predator Control and the Condor. Current predator control activities could negatively affect the California condor in two ways. First, because the accidental trapping of condors has been known to occur, it is possible that such an event could occur again. Secondly, the practice of shooting predators may indirectly contribute to condor mortalities if the predator's carcass is not retrieved by the hunter. A condor feeding on such a carcass could ingest lead shot and become the victim of lead poisoning.

Both of the above possibilities of condor mortalities are probably remote but even a single death of a condor is highly significant in view of the small population size. Therefore, any activity which may affect these birds should be carefully monitored. Predator control programs probably do not pose a significant threat to condors. However, if predators become an unusually great problem to ranchers they may resort to using illegal eradication methods or current restrictions on predator control may be eased. Current proposals aimed at removing the ban on using 1080 and

strychnine baited carcasses to control predators will, if approved, increase the risk of accidentally poisoning condors.

Depradatory Mammal Control--Summary

Depradatory mammal control techniques are commonly used throughout Kern County's rangelands, therefore hypothesis two, "Programs designed to control problem predators and pest rodents on Kern County cattle ranches create hazardous feeding conditions for the California condor.", cannot be rejected. The effect of these programs on the condor is not adequately understood, particularly any effects rodent poisoning may have on this species. The risk of condors being poisoned by mammal control programs may have been so greatly reduced from more stringent restrictions, increased care in handling of poisons and a reduction in the amount of poisons being used in grain baits that it is now insignificant. Further research is needed before the poison risk can be effectively evaluated.

Shooting and the California Condor

Past Incidents and Studies

There can be no doubt that condors have been shot in the past. Miller et al. (1965) records numerous instances of condors being shot at and in some instances killed. Wilbur (1978) observes that condor losses from shooting are better documented than other possible mortality factors and notes that there are records of forty-one condors shot

between 1806 and 1976. The last reported incident occurred in 1976 (Verner 1978, p. 24). Much of the case for shooting being a serious problem is based on the vulnerability of the condor, the attitudes of some shooters and hunters, and the apparently large amount of wanton or vandal shooting which takes place within the condors' range, especially on public lands during deer hunting season.

From a study conducted during the 1975 deer hunting season in the Los Padres National Forest, Mt. Pinos area, Van Vuren (1976) concluded that hunting could be both beneficial and detrimental to the condor. During the mid 1970's, the deer season at Mt. Pinos coincided with a time of year when condors are also known to frequent the area. Hunting pressure is very high particularly during opening weekend and much shooting occurs. After interviewing hunters, Van Vuren (1976, p. 50) noted that the prevailing attitude of the hunters towards the condor is one of respect for the protected status of the bird. He also observed that there is a small minority of hunters who appear to have questionable shooting ethics as evidenced by vandal shooting and the shooting of non-game animals. These hunters present a threat to the condor.

Hunting may provide an additional food source for the condor in the form of abandoned deer carcasses and entrails or wounded deer which later die in the area. Van Vuren (1976, p. 49) observed condors with bulging crops on two mornings during the 1975 hunting season indicating that the

condors had recently been feeding and had probably done so nearby. These birds could have fed on deer carcasses. More recently, members of the condor research team have seen condors at deer carcasses on private ranches. It has been suggested that the frequency of condor sightings in the Mt. Pinos area during deer hunting season may be related to the availability of a food supply created by the hunters. In order to reduce the possibility of condors being shot in the Mt. Pinos area during August and early September, the deer hunting season for this area has recently been changed to the "Inland Season" which begins in late September (Borneman and Ogden 1981, p. 3). This season change may answer the question of whether or not condors are attracted to this area during hunting season because of deer carcasses and "gut piles".

Because the condor is large and often a curious bird, it may be more vulnerable to shooting than other birds. In addition, some hunters have questionable ethics and engage in a considerable amount of "plinking" and "target shooting" that could be a threat to the welfare of the condor.

Hunting on Kern County Ranches

Hunting on private lands provides an important supplement to the designated hunting areas on public lands and helps to ease the crowded conditions on the latter. The rangelands of southern California are particularly important in this regard because they provide additional hunting

areas to help meet the recreational demands of the growing urban population.

Within Kern County, only six of the thirty-two ranchers interviewed permit hunting by authorized private parties on their land. Nineteen allow family members and/or friends to hunt but the amount of hunting is generally very limited. For analytical purposes, those ranchers who only allowed family or friends to hunt were classified as not allowing hunting by private parties on their ranches.

Chi-square tests indicate that there is no relationship between the size of the ranch and whether or not hunting was allowed. This was true for both the author-defined ranch size classification and the JENKS classification. A person who owns or operates a large ranch is not more likely to permit hunting than a small ranch operator and vice versa; therefore Hypothesis 3a[15] cannot be rejected.[16]

Before this study was initiated the author felt that family owned and operated ranches would be less likely to permit hunting on their ranches. Again, chi-square tests indicated that there is no relationship between ownership type and whether hunting is allowed. Similarly, there is no

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[15]Size of ranch has no influence on whether hunting by authorized private parties is permitted on the ranch.

[16]For summaries of the number of ranches in each category and how they responded to hunting, vandal shooting, poaching, and Williamson Act participation questions see Appendix B. For chi-square test results see Appendix C.

relationship between the length of time a ranch has been in operation and whether or not hunting is allowed. Both Hypotheses 3b[17] and 3c[18] cannot be rejected. There appears to be no particular type of ranch which is more likely to allow hunting by private parties on the ranch premises.

Ranchers who do permit hunting on their ranches, either by private parties or by friends and/or family, do impose a number of restrictions and limitations on this activity. Aside from restricting hunting to friends and/or family, these limitations include the following: limiting the area within which hunting is permitted (8 responses), restricting the number of hunters that can be hunting at any one time (11 responses), limiting the amount of game taken (3 responses), controlling the type of person permitted to hunt on the rancher's land (3 responses), and requiring that the hunter be accompanied by the rancher or a member of the rancher's family (1 response).

Hunting on Kern County ranches is limited and highly regulated. Ranchers are concerned about the manner in which hunting is pursued on their property. As a result, during hunting season their ranches are probably much safer for protected species than the public land areas where hunting is permitted. There are also hunting restrictions on public

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[17]Length of time the ranch has been in operation has no influence on whether hunting by authorized private parties is permitted on the ranch.

[18]Ranch ownership/operator type has no influence on whether hunting by authorized private parties is permitted on the ranch.

lands but the regulations on private lands are stricter and are more likely to be obeyed as the hunter will not want to lose the privilege of hunting on these less crowded areas.

The time of the year during which hunting can take place and the species to be hunted are restricted by law on both private and public lands. The greatest amount of shooting associated with hunting occurs during the specified hunting season of the most frequently hunted game species. The species most frequently hunted on the ranches studied include various types of fowl (quail, dove, chukar, duck) and deer. For each of these game species the hunting season occurs sometime between September to January. Some ranchers also permit the hunting of animals which have lengthier or different seasons. These include fox (November through February) and jackrabbit and coyote (all year). Most hunting on the ranches does, however, take place during the autumn.

Poaching and Vandal Shooting

Although most hunting occurs during the fall, it does not necessarily follow that most of the shooting, especially illegal and wanton shooting, also takes place during this period. Hunting may account for the majority of the shooting which occurs during the hunting season but most hunters probably would not shoot at a condor. Shooting from poachers and vandals is probably a much greater threat to the condor than shooting from hunters. In the case of the former, these individuals have already demonstrated that

they will disregard some laws. The type of person who will shoot cattle, signs, water tanks, public facilities, locks, etc., will probably also shoot at other targets including protected wildlife.

Poaching and vandal shooting have been increasing in Kern County. Both occur throughout the year although vandal shooting appears to increase when the local schools close for the summer and again when they reopen in the fall (Allen 1981). Most of the ranchers interviewed felt that both poaching and wanton shooting are problems on their ranches (Table 6). Representatives from the Bureau of Land Management and the U.S. Forest Service also believe that these activities are problems on Kern County's public lands. The California State Dept. of Fish and Game patrol lieutenant (acting captain) in charge of Kern County's wildlife law enforcement confirmed that both vandal shooting and poaching are problems in Kern County. Unfortunately, these activities are difficult to control because of the large areas which would have to be patrolled and the shortage of law enforcement personnel.

TABLE 6

Illegal Shooting Problems on Kern County Ranches

Activity	Number of Responses		
	Is a Problem	Is Sometimes a Problem	Is not a Problem
Poaching	25	3	4
Wanton Shooting	19	6	7

The first step in controlling vandal shooting or poaching is to identify those who engage in these activities and to locate where these crimes are most likely to occur. I felt that large ranches would be more likely to have shooting problems from poaching and vandals than smaller ranches because a large ranch would be more difficult to patrol. However, chi-square tests indicated that there was no relationship between the size of the ranch and whether or not poaching or wanton shooting was a problem on that ranch. This result could be anticipated just by noting the overwhelming number of surveyed ranchers who indicated that these shooting activities are at least sometimes a problem. Hypotheses 3d[19] and 3e[20] cannot, therefore, be rejected. It is possible that other ranch characteristics such as distance from urban centers and accessibility of ranch roads may affect the frequency and location of illegal shooting. These possibilities should be investigated.

Current knowledge about poaching and vandal shooting in Kern County is based on the personal observations of people who, for some reason or another, are concerned about these problems. Wanton shooting is a serious problem on BLM lands and is a cause of concern to the ranchers because cattle sometimes get shot (Heinz 1981). The situation is similar on national forest lands

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[19] Ranch size has no influence on whether or not wanton shooting is a problem on the ranch.

[20] Ranch size has no influence on whether or not poaching is a problem on the ranch.

(Nelson 1981). These problems may be more frequent on public lands because these areas are accessible to the general public whereas private ranches are not.

The officer in charge of Kern County's wildlife law enforcement feels that vandal shooting occurs more frequently in remote areas (Allen 1981). He qualified this statement by adding that the area must be situated near a driveable road. The most likely places for wanton shooting seem to be along lesser traveled roads which traverse the more remote areas of the county. Plenty of places fitting this description can be found within the foothill regions of Kern County.

Locating specific poaching and vandal shooting areas is difficult. In Kern County, poaching tends to occur in those areas where deer populations are largest and which are reasonably accessible. It is likely to be a problem in any of the foothill areas but perhaps more so where private land borders public land (Allen 1981). There does not appear to be any typical type of person who poaches.

Research is needed to identify with any certainty where, why, and by whom poaching and vandal shooting is occurring. The best source of information on these topics is arrest records. Unfortunately, studies based on this data source will be biased because arrests can only take place in those areas which are patrolled.

Because poachers and vandal shooters are difficult to identify and even more difficult to locate and to catch in

the act of committing such a crime, it is difficult to control this type of shooting. More arrests and harsher penalties may deter others from participating in such activities, but because a small number of enforcement personnel must cover a very large area, this may not significantly reduce the number of poaching and vandalism crimes committed. Because poaching and vandal shooting is a problem on most Kern County ranches, condors may be in some danger of being shot at while feeding or foraging. Enhancing the public's awareness of the condors' situation and its protected status may help to reduce the possibility of these birds being killed. On the other hand, such an awareness may make the condor a more highly prized target.

The California Land Conservation Act

Rangeland Conversion and Habitat Loss

It is generally agreed (although poorly documented) that loss of habitat has substantially contributed to the decline of the California condor. Habitat loss is most commonly a result of changing patterns of land use, therefore those areas of the condors' habitat which are situated near human population growth centers or which have special characteristics which make them more easily developed are most likely to become less useful to the condor. Feeding habitat is particularly vulnerable to land use changes because much of this habitat type is under private ownership. As stated earlier, the landowner has the right, within certain limits, to use his land as he pleases.

Most of the condors' feeding habitat is currently used for livestock grazing. The amount of rangeland in Kern County has steadily declined during the past twenty years (Table 7). The decline in acreage has been gradual, consisting of a loss of 500,000 acres over twenty years or an 18% decrease (Kern County Agricultural Commissioner's Office 1960, 1980). Much of this loss can be attributed to increased irrigated agriculture and new housing developments.

TABLE 7[1]

Kern County Rangeland

	1960	1965	1970	1975	1980
Acres	2,700,000	2,700,000	2,612,200	2,475,000	2,200,000

[1]All acreage figures are from Kern County's annual Agricultural Crop Reports.

Livestock grazing yields low economic returns when compared with most other land use activities. It may be more profitable and, hence, desirable for ranchers to sell their land to a developer or to develop the land themselves than to remain in livestock production. On the other hand, ranchers may desire to remain in business but may be unable to do so because they are unable to pay property taxes which are based on more profitable land uses or because of other financial problems or conditions (the low market price of beef cattle for instance) which are beyond their control. In either case, ranches may be ultimately sold and

converted to some other use thereby reducing the amount of feeding habitat available to the condor.

The Williamson Act

If one assumes that most ranchers are engaged in this occupation because they want to be and that they would like to remain in business, then the preservation of much condor feeding habitat hinges on making it economically viable for them to do so. A few institutions provide financial aid (either directly or indirectly) to Kern County ranchers. The Production Credit Association provides loans to farmers and ranchers. Both the BLM and the USFS provide low-cost grazing to ranchers who have grazing permits. Of considerable importance to Kern County ranchers is the tax savings gained through participating in the agricultural land preservation program established by the California Land Conservation Act of 1965 (California State Government Code Sections 51200-51295) also known as the Williamson Act.

The Williamson Act permits taxation of agricultural land at its current value rather than its market value. To qualify for differential assessment under the Williamson Act, land must meet certain open space and/or agricultural criteria and be located in areas designated as an agricultural preserve. Owners of properties lying within these preserves are eligible for voluntary contracts which restrict the use of the land to agricultural or open space uses only. In return, these properties are assessed at their current use value. The contract is set for a ten year period and automatically

renews each year for an additional year, unless it is terminated. If terminated, the contract continues for the remaining nine years and property taxes are continually increased until, at the end of the contract period, they are computed at full market value.

Being State Permissive Legislation, the California Land Conservation Act is administered by local government. The act establishes regulations which counties or cities must adhere to when implementing their contract programs but also allows a certain amount of latitude. Cities or counties may contract with owners of any or all of the following land categories: agricultural, scenic highway corridors, recreational areas, salt ponds, wildlife habitat areas, managed wetlands and submerged areas (California State Government Code Section 51205). They may also choose to enforce more stringent contract requirements or may decide not to implement the act at all.

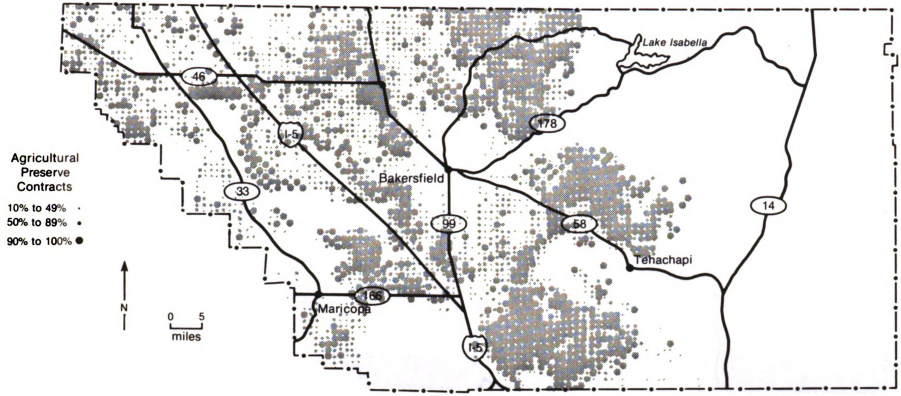
Kern County Condor Habitat and the Williamson Act

Kern County began its agricultural preserve program in December 1967 but has adopted only those portions of the CLCA which apply to the preservation of agricultural lands. To qualify, lands must be located within an agricultural preserve, be used for the production of agricultural commodities or devoted to livestock grazing for commercial purposes, and be classified as intensive agriculture, extensive agriculture, or open space in the Kern County Land Use Plan (Evans 1980).

In analyzing whether or not the Williamson Act has assisted in the preservation of condor habitat it is necessary to determine if significant amounts of grazing land have been placed under contract and if this contracted land is located in areas of known condor use. Agricultural lands placed under contract are classified as urban prime land, other prime land, or non-prime land for the purposes of collecting some of the county's lost tax revenue from the state subvention program (California State Board of Equalization 1980). Contract lands which would be used by the condor (rangeland) would primarily be classified as non-prime. In February of 1968, 557,471 acres of non-prime land were placed under contract (Evans 1980, p. 2). This increased to 862,000 acres in 1972 (Kern County Planning Commission 1972, p. 13) but decreased to 829,987 acres by March 1980 (Evans 1980, p. 2).

Figure 12 shows the amount of land under contract in Kern County in 1971 and the range of the California Condor. From this map one can see that a considerable portion of the lands within the condors' range is under contract and is therefore, required to be retained in agricultural uses for ten years. Much land, however, is not under contract, notably around Lake Isabella, near Tehachapi, and in southwestern Kern County. The lack of contracts in these regions can be explained to a great extent by the large amounts of public land located there (BLM lands, Sequoia National Forest, and the Los Padres National Forest, Figure 13). Much

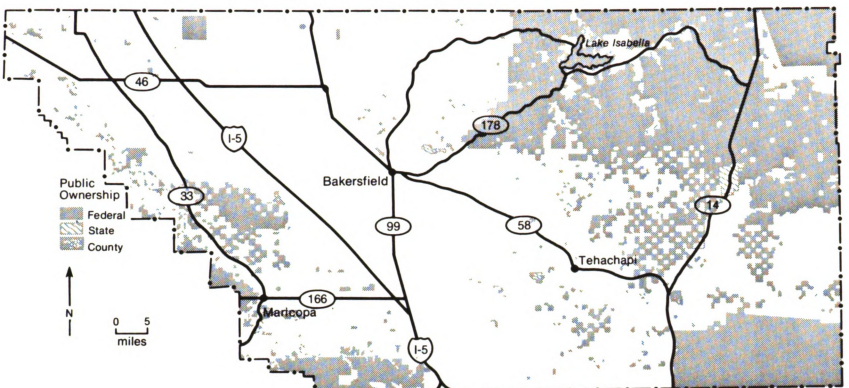
AGRICULTURAL PRESERVE CONTRACTS IN KERN COUNTY



Source: Open Space and Conservation Element. Kern County Planning Commission. Bakersfield, California, 1972, p.14.

Figure 12

PUBLIC LAND IN KERN COUNTY



Source: Open Space and Conservation Element. Kern County Planning Commission. Bakersfield, California, 1972, p.96.

Figure 13

of the ranching lands in southern and western Kern County have since been put under contract so these contracts do not appear on the 1971 map. A very sizeable portion of the condors' Kern County range is either under contract or is federally managed.

Rancher Participation in the Williamson Act

Among the thirty-two ranchers interviewed in Kern County, only five do not have all or part of their land under contract. Fourteen ranchers placed all of their land under contract while thirteen only contracted part of their ranches (Figure 14). Many of the ranchers who had placed their land under contract stated that they could not remain in business without the CLCA because their taxes would be too high. One rancher who, on the advice of her lawyer, did not place her land under contract found it necessary to do so four years later as the taxes based on subdivision market value became too great to handle.

The contracted lands of the ranches in this study are well distributed throughout the entire foothill region of Kern County. Those ranches which have no contracted land are all located in the Sierra Nevada foothills. One of these ranches is adjacent to the Mojave Desert where there is little pressure to develop rangeland. The market value-based taxes of that ranch were not much higher than if the land had been contracted. The other totally non-contracted ranches do not appear to have any other common spatial characteristics.

WILLIAMSON ACT CONTRACTS ON KERN CO. RANCHES

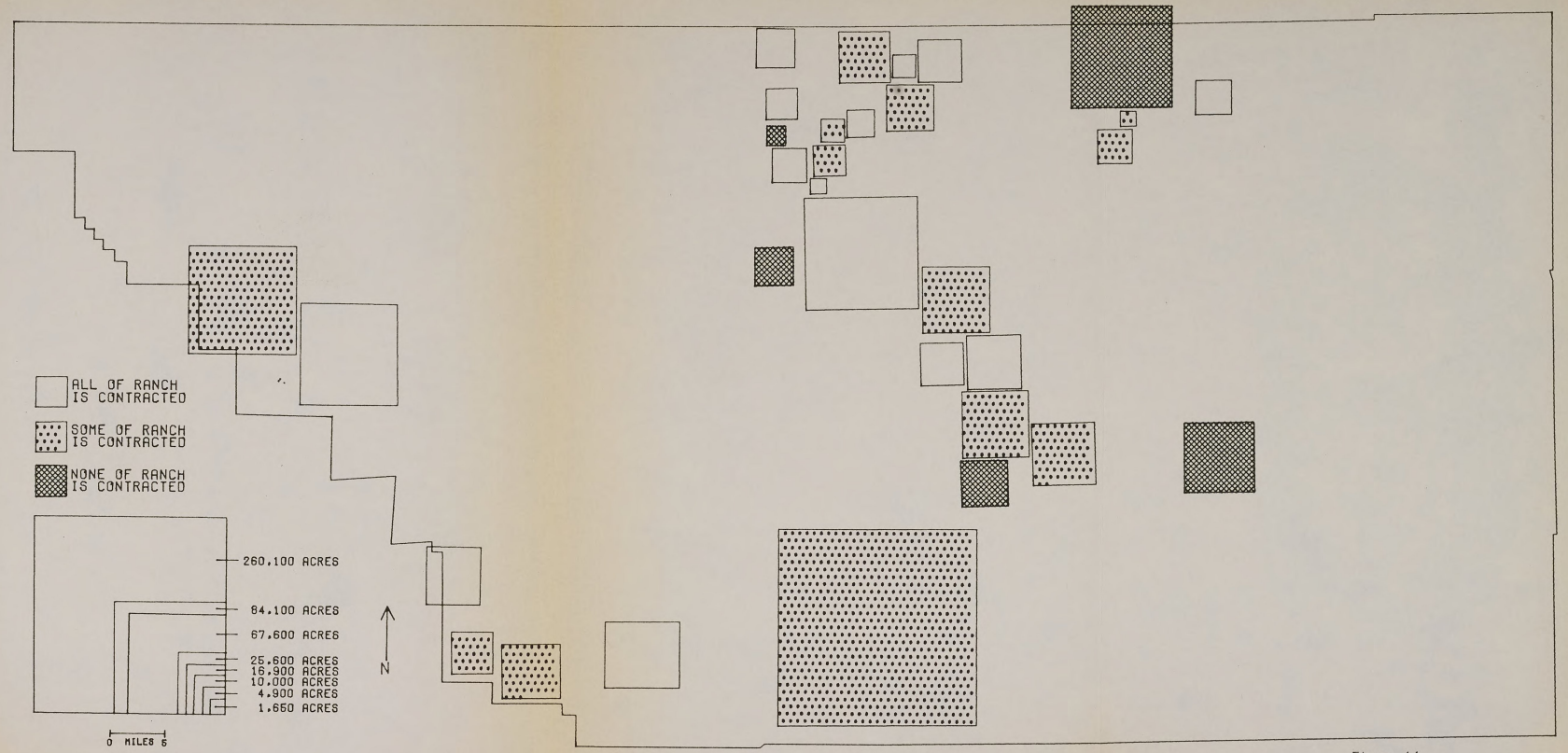


Figure 14

I originally felt that ranches which are not owned and operated by a family may be less likely to include their land in the Williamson Act. It also seemed probable that those ranchers who had been in business for a long period of time would do all they could to retain their land for future generations and would therefore be more likely to contract their land. Chi-square tests do not support either of the hypotheses. Nor is there a relationship between the size of the ranch and whether or not land is contracted under the Williamson Act. Hypotheses 4a, 4b, and 4c[21] cannot be rejected. Other factors must be influencing the rancher's decision to contract his land. Some possibilities are the magnitude of the perceived savings in taxes and feelings for or against land use restrictions.

The Effectiveness of the CLCA as a Tool for Habitat Preservation

A great deal of criticism has been directed at the Williamson Act for not accomplishing what it set out to do, that is, preserve prime agricultural land and open space, especially those areas close to urban centers (Hansen and Schwartz 1976, Hansen and Schwartz 1977, and Schwartz, Hansen, and Foin 1976). It has, however, been of considerable value in helping the ranchers retain their lands as

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[21] Ho4a: Ranch ownership/operator type has no influence on whether the ranch land is contracted under the Williamson Act. Ho4b: Ranch size has no influence on whether the ranch land is contracted under the Williamson Act. Ho4c: Length of operation has no influence on whether the ranch land is contracted under the Williamson Act.

rangeland. Unfortunately, the practice of only contracting part of a ranch is a major flaw in the ability of the Williamson Act to preserve condor feeding habitat. It is feasible, under the current act regulations, for a rancher to place only part of his ranch under contract. He then is able to considerably reduce his taxes while at the same time leave the portions of the ranch which are most suitable for future development out of the use restricting contract. If portions of these ranches are developed then the condors' feeding habitat may become so fragmented that it is useless to the bird.

The Williamson Act is therefore not sufficient to ensure preservation of large scale condor feeding habitat. Additional land preservation incentives could be implemented under the Williamson Act. This would reduce the need for new legislation and would facilitate the land preservation process. Other methods of habitat protection such as land acquisition or purchase of conservation easements are effective but very costly and are only feasible for the protection of small key portions of the condors' habitat. Ultimately, preserving sufficient feeding habitat rests primarily on making it highly desirable for private land owners to retain the needed condor foraging areas in livestock grazing.

Public Lands

History of Grazing on Public Lands

Although the purpose of this study is to examine management activities on private ranch lands within the condors'

feeding habitat, no discussion of ranching in Kern County would be complete without mentioning the important role of the public lands. Historically, grazing has always been a major activity on the western public lands, whether by wild ungulates or by domestic livestock. Initially grazing was allowed to proceed unregulated on the western public domain. Then, in the early 1900's, substantial portions of these lands were withdrawn for national parks and forests. Regulation of grazing on the remaining unappropriated portions of the public domain (now under the supervision of the Bureau of Land Management) did not begin until 1934 with the passage of the Taylor Grazing Act. This slow implementation of grazing regulations served to firmly establish livestock grazing as a primary use on much of the public lands.

Public Land Grazing in Kern County

Livestock grazing is still an important land use activity on the national forests and the BLM lands. Many Kern County ranchers graze livestock on public land. If they were not permitted to use these lands, many would not be able to remain in business or would have to drastically reduce their herd sizes. The rancher is permitted grazing rights for a fee which is substantially less than similar grazing would cost on private land.

The public land leasing or permit system (depending on the agency and the piece of land) has resulted in the organization of relatively stable grazing allotments. Many of the permits are quite old having been passed on from one

generation of ranchers to the next. In a very real sense, some of these public land parcels are a part of the ranch to which they are permitted (leased). The rancher who has always used the same public lands depends on being able to continue to do so.

Half of the ranchers interviewed (sixteen) have public land grazing permits. The location of these ranches generally coincides with the location of public lands in Kern County (Figure 13). These public lands include the Los Padres National Forest (southwestern Kern County), the Sequoia National Forest (central Kern County), and the vast acreage of the public domain situated primarily in the eastern and far western portions of the county. Both the BLM and the Forest Service give first consideration to adjacent landowners when grazing permits are issued. This fact helps to explain the spatial pattern of ranches with permits noted above. Currently, demand for public land grazing permits exceeds the supply of public land available for this use, therefore the permits are relatively stable, i.e., they continue to be issued to the same rancher year after year.

The present system of permitting grazing on public lands situated within the condors' range benefits the rancher and may be a significant contributing factor in his ability to remain in business. By aiding the ranchers, grazing permits indirectly help in the preservation of condor feeding habitat, therefore Hypothesis 5, "The current grazing permit

systems used on Kern County's Bureau of Land Management and national forest lands benefits the California condor by aiding Kern County cattle ranchers.", cannot be rejected.

CHAPTER V

CONCLUSIONS, DISCUSSION AND RECOMMENDATIONS

Conclusions

This study indicates that a number of human activities which can create hazardous feeding environments for condors are indeed common on ranches through the bird's Kern County range. Documentation of the existence and extent of these activities fulfilled the first goal of this study. The use of poisons to control pest rodents and the use of firearms by vandals and poachers are activities which occur on almost every ranch studied. If it is determined that condors are dying or are becoming ill from consuming poisoned ground squirrels or kangaroo rats then some alternative means of rodent control will have to be found for the ranchers in order to reduce the risk to condors. Because so many ranchers have, or believe they have, a rodent problem, it will not be possible to ban the use of rodenticides without providing substitute methods of rodent control which are shown to be as effective as the poisons currently used.

If the major cause of condor mortality turns out to be shooting, eliminating or greatly reducing condor deaths will be more difficult. The condors' range is so large and law enforcement personnel are so few that it will be difficult to curb the amount of vandal shooting and shooting by poachers which this study indicates is occurring. Most ranchers indicated they have problems with vandals and

poachers. Condors could easily be shot on remote portions of any of the ranches studied without the operator's knowledge. Some hunters may shoot at condors but, in general, hunters respect the bird and would not harm it. Hunting by authorized private parties is not common on Kern County ranches although many ranchers permit hunting by family and friends. However, ranchers generally exert tight control of all hunting on their lands. The chances of a condor being shot by an authorized person hunting legally on a Kern County ranch are much less than the possibility of a condor being shot by a poacher or a vandal.

At present there does not appear to be a shortage of food available to the California condor. Total numbers of livestock produced in Kern County have declined in the past twenty years but are not less than they were in the late 1800's. Condor numbers, on the other hand, have steadily declined during the past century. There are undoubtedly plenty of animal carcasses available to support the approximately twenty condors remaining in the wild. A number of this study's findings support this position. First, although most ranchers feel that livestock mortality has declined during the past twenty years (mainly because of better veterinary medicine), a wide variety of reasons for livestock deaths still exists and some of these are difficult to reduce or eliminate. Also, the vast majority of ranchers leave their livestock carcasses out on the range so that they are available to scavengers.

The results do indicate that there may be less food available for the condor in the summer. Nevertheless, field biologists who have been observing condors for years indicate that the birds still appear to be finding food during this period. Nesting pairs with chicks seem to be having no trouble bringing regular meals to their young (condors are at the nestling stage during the summer) (Ogden 1980, pp. 5-6). Biologists at the Condor Research Center also note that even though condors may be aware of an accessible carcass during the summer, they may never feed upon it. This suggests that these birds at least are not desperate for food. Currently then, food is probably not a limiting factor in the condors' ability to survive.

Loss of feeding habitat caused by land use changes is occurring in the condors' range. If ranchers wish to develop their lands, there is little that can be done to stop such changes. Poor market prices for cattle and high taxes may be making it difficult for some ranchers to continue grazing their lands, thereby encouraging conversion to other more profitable uses. However, property tax reductions from land contracting under the Williamson Act and low-cost permits to graze livestock on public lands have helped reduce operating costs for many ranchers. The majority of Kern County ranchers participate in one or both of these programs. Tax concessions and subsidies such as these help ranchers to continue livestock raising and therefore indirectly preserve condor feeding habitat.

The noticeable similarity of rancher responses to the interview questions indicates that there are comparatively few differences among Kern County ranches with regard to management practices that may affect the condor. Ranchers tend to run similar operations and have, for the most part, the same problems. Large ranches did not have more problems with poaching and vandal shooting or tend to allow more hunting than small ranches. Large ranch owner/operators did not contract their ranch lands under the Williamson Act more than those running small ranches. Similarly, neither the type of ranch ownership nor the length of ranch operation is related to whether or not ranchers participate in the Williamson Act or if the ranchers permit hunting on their lands. It is possible that a similar study conducted with a larger sample drawn from more counties and including more ranches from the Coast Range may find differences among the ranch types defined in this study. On the other hand, because ranching is such a traditional business, the degree of operator uniformity found in this study may be typical throughout the condors' range.

Since the ranchers' responses to the questions asked were so uniform, there was also very little spatial variation in the ranch activities and problems studied. The one major exception was the concentration of ranches having a kangaroo rat problem in the Glennville--Woody--Granite Station portion of the condors' range. There may be a greater possibility of accidental condor poisonings in this region. The practice of

offering adjacent landowners the first option to graze on federal lands explains the concentration of ranches with such permits around the public land areas.

Contrary to what I anticipated at the beginning of this study, no other areal variations in rancher activities or problems was noted. It seemed likely that there would be some differences between the ranches located in the drier portions of the county (western and south-western Kern County) and those located in areas which receive more rainfall. These arid areas tend to be more remote and are receiving much less development pressure than the Sierra Nevada foothill region. Even though socio-economic and physical differences exist, basic ranching practices and problems are the same. On the other hand, differences in ranch operation methods could have been missed by this study because very few eastern Coastal Range ranches are located in Kern County. Most are located in Santa Barbara and San Luis Obispo Counties so were not included in the sample. Ongoing research, however, is beginning to reveal similar situations on ranches in these dry remote regions except that there may be fewer problems with poaching and vandalism. Whether there actually are any significant differences between eastern Coastal Range ranches and western Sierra Nevada foothill ranches remains to be seen.

Discussion

It is important to remember that the results of this study apply only to cattle ranches located in Kern County

and more specifically to a sample of the total population of ranches within this county. One cannot, from this study, make generalizations about the situation on all private ranches located within the condors' range or about the characteristics or quality of all of the condors' feeding habitat. It is possible that cattle ranches in other counties may exhibit different characteristics and have different problems than those ranches studied in Kern County, especially if county agricultural programs differ greatly from one another. Similarly, sheep ranches may operate completely differently. Since condors do feed on sheep carcasses it will be necessary to learn what activities occur on these ranches as well as on cattle ranches.

Thirty-two Kern County ranchers were interviewed in this study representing approximately 931,845 acres of private ranch land. This is about 42.4% of the total amount of rangeland in Kern County. However, one large ranch (260,000 acres) accounts for nearly one-third of the area included. The study covered a large portion of the condors' Kern County feeding habitat but actually acccounted for a much smaller proportion of the total number of ranches operating within that area.

It is doubtful that a larger sample would have yielded different results. Most of the remaining Kern County ranches are small, family ranches located in the Sierra Nevada foothills, an area and ranch type already heavily represented in this study. There are fewer ranches in

southern and western Kern County and nearly all were included in this investigation. These livestock operations account for most of Kern County's large ranches. The only type of ranch which may not have been adequately represented is the non-family ranch, that is, those with absentee owners or operated as part of a non-family business. Most of the remaining ranches were not of this type but I am aware that a number of non-family ranches not included in this study are located near the town of Tehachapi.

In general, the sample appears to reflect the population characteristics. This opinion is supported by my recent and ongoing research activities concerned with condor habitat on private lands. All contacts I have subsequently had with Kern County ranchers not included in the sample have supported the results of this initial study and have confirmed the adequacy of the sample.

However, a larger sample size would have assured that the Chi-square test requirements were not violated. This would have enhanced the reliability of the statistical tests. Similarly, if a random sample had been possible and if some of the questions had been structured so that numerical responses were obtained, then more rigorous statistical tests could have been conducted.

Because this study was a first attempt to actually document whether suggested possible condor mortality causes are linked to ranch activities or management problems, the topics discussed with ranchers were rather broad in scope.

This was necessary to obtain an overview of what is occurring on private lands within the condors' range so that potential mortality causes could be better understood. After the general information addressed in this study is obtained for most of the ranches which condors are known to frequent, then researchers should study selected topics in greater depth. For example, a study focused entirely on shooting on ranch lands may identify certain areas or types of areas where shooting more frequently occurs or possibly provide an indication of the amount or frequency of shooting activities.

Unfortunately biologists do not presently know which of the many possible mortality factors are actually contributing to condor losses. In-depth studies of selected problems will be more practical after data from the Condor Research Center's radio-telemetry program has provided information on condor use areas and mortality causes.

The study has, however, accomplished what it set out to do. It outlined the degree to which certain ranch related activities occur in Kern County and discusses their possible relationship to the welfare of the condor. The study also identified certain topics which, if studied further, offer greater potential for more clearly defining condor feeding habitat; its quality, quantity, and stability as habitat. Most importantly, this study provides a framework within which future studies can be conducted and provides a research format which can be restructured and refined based upon its results, problems, and limitations.

Recommendations for Future Studies

Two different approaches should be taken when conducting future research on land management problems and use activities within the condors' feeding habitat. One approach is to identify a specific issue which affects either the quality or the quantity of habitat and to intensively study various aspects of this issue. The study should include as much of the condors' range as possible and possibly incorporate temporal aspects along with the spatial. The key to this approach is narrowly focusing on a single topic. Any of the issues discussed in this report could be studied in such a manner (food supply, rodenticide use, predator control, shooting, and participation in programs which aid ranchers).

Through this research approach, a thorough understanding should be gained of the topic including identifying the factors which influence it, locating areas where it is a serious problem and formulating more effective control measures or programs. This type of research should probably not be undertaken unless it is fairly certain that the topic being studied is indeed having a significant effect on condors or their habitat.

The second approach to investigating land use issues within the condors' range is to identify and intensively study a specific portion of the condors' range which the birds use regularly, that is, an area which is of critical importance to the species. All characteristics both natural and cultural as well as land use activities should be

explored. The goals of such a study would be to identify why the study area is attractive to the birds, what differentiates this area from surrounding lands, and what, if anything, is happening on this land which may pose a threat to the condor.

The need for in-depth studies of selected portions of the condors' range has been accentuated by information recently obtained from two condors (both birds were captured, equipped with small radio transmitters, and released in the fall of 1982). Signals received from the radio transmitters enable researchers to determine the location of a tagged bird at any time. Through radio telemetry, biologists at the Condor Research Center have identified four locations which appear to be significant condor use areas. Two of these areas are located within Kern County. One of the radio-tagged condors spent most of the winter on private ranch lands around the rural community of Glennville. More often than not, he was with other condors. This information confirms the importance of the Glennville area to condors. The second area identified as being important to the condor is situated in the southwestern portion of Kern County and comprises three ranches which were included in this study (Ranches 4,5 and 6). Based on data obtained thus far, some condor use areas may be most frequently used by the birds during only a portion of the year indicating that seasonal differences (either because of the birds'

internal biology or because of external habitat conditions) play a role in foraging habitat selection.

Unfortunately my research was completed before the radio-telemetry project was initiated; therefore, I was unable to incorporate the new information on the condors' use of Kern County into my work. Data obtained from radio-telemetry will, however, be invaluable in designing future habitat studies. Research projects designed to intensively study newly identified condor use areas may reveal necessary conditions which make foraging areas suitable and attractive to condors. Identifying these essential conditions will aid in defining habitat which, in turn, will help to identify other potential condor use areas.

Finally, the issue of habitat quantity should be studied. Condor habitat is being lost to a variety of other land uses including energy development (oil, solar, and wind), irrigated and dry land farming, housing developments, and recreational activities. The total impact on any of these land uses on condor survival is unknown. High priority should be given to identifying portions of the condors' habitat which have already been converted to these uses and to predict future trends. Some of the land uses listed above may be compatible with condor foraging habitat if human activity levels are low and only small amounts of land are affected; other uses may be completely incompatible with the condors' needs. A comprehensive understanding of where, how, and why rangeland is being converted to other

uses will be very difficult to obtain but will provide the base upon which a condor feeding habitat protection program can be founded.

APPENDICES

APPENDIX A

APPENDIX A

The Rancher Questionaire

1. What type of livestock do you raise on your ranch?
2. Is your ranch a cow-calf or stocker cattle operation?
3. Has your ranch always been run as a cow-calf--stocker cattle operation, or has the emphasis changed from one to the other?
4. If the ranch is a cow-calf operation: Have you considered going into a stocker cattle operation?
5. If the ranch is a stocker cattle operation: Have you considered going into a cow-calf operation?
6. When is calving on your ranch?
7. Do you feel that livestock mortality on your ranch has increased, decreased, or remained the same during the past twenty years? If increase or decrease: Why?
8. What do you feel is the major cause of livestock mortality on your ranch?
9. Do you remove, burn, or bury livestock carcasses, or do you leave them out on the range?
10. What is the major reason that you would increase or decrease livestock numbers on your ranch?
11. How long has this ranch been in operation under its present ownership?
12. Is this ranch a family operation? If so, how long has this ranch been operated by this family?
13. Is your ranch located within an agricultural preserve?

14. Is your ranch placed under a contract under the Williamson Act?
15. Have you removed any of your ranch land from contract? If so, why?
16. What is the acreage of your ranch?
17. Do you lease range land from private land owners?
18. Do you have a BLM or USFS grazing permit?
19. Do you have any predator problems on your ranch? If so, which predators are a problem?
20. Do you have any predator control programs on your ranch?
21. Do you feel that ground squirrels are a problem on your ranch? If so, why?
22. How do you control ground squirrels on your ranch?
23. If question 22 is answered with poison: What type of rodenticide do you use?
24. How is the rodenticide applied, by a ground crew or by aerial application?
25. During what time of the year is the poisoning program conducted?
26. Is the poison applied more than once a year?
27. Are kangaroo rats a problem on your ranch?
28. Do you allow hunting on your ranch?
29. Do you place any restrictions on hunting on your ranch? If so, what are they?
30. What game is hunted on your ranch?
31. Do you consider poaching to be a problem on your ranch?

32. Do you consider wanton shooting (plinking, shooting signs, water tanks, equipment, etc.) to be a problem on your ranch?

APPENDIX B

APPENDIX B

Ranch Categories and Compiled Responses for Chi-Square Tests

RANCH SIZE -- JENKS

Ranch Classification	Ranch #[1]	Rancher Responses: W'mson Act Contract[2]	Hunting[3]	Poaching[4]	Wanton Shooting[4]
Small	..	S	P	Y	Y
	..	A	N	N	N
	..	N	F	Y	Y
	..	A	P	Y	S
	..	S	F	N	Y
	..	A	F	Y	Y
	..	A	F	Y	Y
	..	S	F	Y	S
	..	A	F	Y	N
	..	A	N	N	Y
	..	S	P	Y	Y
	..	N	N	Y	Y
	..	A	F	Y	S
	..	A	F	N	N
	..	S	F	Y	Y
	..	A	N	S	N
	..	S	P	Y	Y
	..	N	N	Y	S
Medium	..	S	F	Y	N
	..	S	F	Y	Y
	..	A	F	Y	Y
	..	A	F	Y	Y
	..	S	F	S	N
	..	S	F	Y	Y
	..	A	N	Y	Y
	..	S	F	Y	Y
	..	N	F	Y	Y
Large	..	A	F	Y	N
	..	N	P	Y	Y
	..	S	F	S	S
	..	A	N	Y	Y
	..	S	P	Y	S

[1] Ranch identity numbers are omitted to retain rancher anonymity.

[2] A = All; S = Some; N = None.

[3] N = No hunting; F = Hunting by family and/or friends only; P = Hunting by private parties is permitted.

[4] Y = Yes; N = No; S = Sometimes.

RANCH SIZE -- AUTHOR DEFINED

Rancher Responses

Ranch Classification	Ranch #	W'mson Act Contract	Hunting	Poaching	Wanton Shooting
Small	..	S	P	Y	Y
	..	A	N	N	N
	..	N	F	Y	Y
	..	A	P	Y	S
	..	S	F	N	Y
	..	A	F	Y	Y
	..	A	F	Y	Y
	..	S	F	Y	S
	..	A	F	Y	N
	..	A	N	N	Y
	..	S	P	Y	Y
	..	N	N	Y	Y
	..	A	F	Y	S
Large	..	A	F	N	N
	..	S	F	Y	Y
	..	A	N	S	N
	..	S	P	Y	Y
	..	N	N	Y	S
	..	S	F	Y	N
	..	S	F	Y	Y
	..	A	F	Y	Y
	..	A	F	Y	Y
	..	S	F	S	N
	..	S	F	Y	Y
	..	A	N	Y	Y
	..	S	F	Y	Y
	..	N	F	Y	Y
	..	A	F	Y	N
	..	N	P	Y	Y
	..	S	F	S	S
	..	A	N	Y	Y
	..	S	P	Y	S

LENGTH OF OPERATION

Rancher Responses

Ranch Classification	Ranch #	W'mson Act Contract	Hunting
Short	..	A	F
	..	N	N
	..	A	N
	..	A	N
	..	A	F
	..	S	F
	..	S	F
Medium	..	N	F
	..	A	F
	..	A	N
	..	N	N
	..	N	P
	..	S	P
	..	S	F
Long	..	S	P
	..	A	F
	..	A	N
	..	S	F
	..	S	F
	..	S	F
	..	A	F
	..	S	P
	..	A	F
	..	A	P
	..	S	P
	..	N	F
	..	S	F
	..	A	F
	..	S	F
	..	S	F
	..	A	N
	..	A	F

TYPE OF OWNERSHIP/OPERATOR

Rancher Responses

Ranch Classification	Ranch #	W'mson Act Contract	Hunting
Deeded Only	..	S	F
	..	A	N
	..	N	F
	..	S	F
	..	A	N
	..	S	P
	..	A	P
	..	S	P
	..	A	N
Deeded and Leased	..	A	F
	..	S	F
	..	S	F
	..	A	F
	..	N	N
	..	S	F
	..	A	F
	..	N	F
	..	S	F
	..	A	F
	..	S	F
	..	S	P
Other	..	A	F
	..	N	N
	..	A	F
	..	S	F
	..	A	F
	..	S	F
	..	A	N
	..	S	P
	..	A	N
	..	A	F
	..	N	P

APPENDIX C

APPENDIX C

Chi-Square Tests for Ho3a-e and Ho4a-c

Ho3a: Ranch size has no influence on whether hunting by private parties is permitted on the ranch.

Author defined classification.

Observed Frequencies:

	Allowed	Not Allowed	Total
Small	3	10	13
Large	3	16	19
Total	6	26	32

Expected Frequencies:

	Allowed	Not Allowed
Small	2.4	10.6
Large	3.6	15.4

$X^2 = 0.3$

X^2 (α=.05, df= 1)= 3.84

Cannot reject Ho3a at the 0.05 level of significance.

Ho3a: Ranch size has no influence on whether hunting by private parties is permitted on the ranch.

JENKS method of classification.

Observed Frequencies:

	Allowed	Not Allowed	Total
Small	4	14	18
Medium	0	9	9

Observed Frequencies:
continued

	Allowed	Not Allowed	Total
Large	2	3	5
Total	6	26	32

Expected Frequencies:

	Allowed	Not Allowed
Small	3.4	14.6
Medium	1.7	7.3
Large	.9	4.1

$X^2 = 3.866$

X^2 (α=.05, df= 2)= 5.99

Cannot reject Ho3a at the 0.05 level of significance.

Ho3b: The length of time the ranch has been in operation under the present owner/operator has no influence on whether hunting by private parties is permitted on the ranch.

Observed Frequencies:

	Allowed	Not Allowed	Total
Short	0	7	7
Medium	2	5	7
Long	4	14	18
Total	6	26	32

Expected Frequencies:

	Allowed	Not Allowed
Short	1.3	5.7
Medium	1.3	5.7
Long	3.4	14.6

$X^2 = 2.2$

X^2 (α=.05, df= 2)= 5.99

Cannot reject Ho3b at the 0.05 level of significance.

Ho3c: Ranch ownership/operator type has no influence on whether hunting by private parties is permitted on the ranch.

Observed Frequencies:

	Allowed	Not Allowed	Total
Deeded	3	6	9
Deeded and Leased	1	11	12
Other	2	9	11
Total	6	26	32

Expected Frequencies:

	Allowed	Not Allowed
Deeded	1.7	7.3
Deeded and Leased	2.2	9.8
Other	2.1	8.9

$X^2 = 2$

X^2 (α=.05, df= 2)= 5.99

Cannot reject Ho3c at the 0.05 level of significance.

Ho3d: Ranch size has no influence on whether or not wanton shooting is a problem on the ranch.

Author defined classification.

Observed Frequencies:

	Yes*	No	Total
Small	11	2	13
Large	14	5	19
Total	25	7	32

*Sometimes is included in the yes category.

Expected Frequencies:

	Yes	No
Small	10.2	2.8
Large	14.8	4.2

$X^2 = .48$

X^2 ($\alpha = .05$, df= 1)= 3.84

Cannot reject Ho3d at the 0.05 level of significance.

Ho3d: Ranch size has no influence on whether or not wanton shooting is a problem on the ranch.

JENKS method of classification.

Observed Frequencies:

	Yes*	No	Total
Small	14	4	18
Medium	7	2	9
Large	4	1	5
Total	25	7	32

*Sometimes is included in the yes category.

Expected Frequencies:

	Yes	No
Small	14.1	3.9
Medium	7.0	2.0
Large	3.9	1.1

$X^2 = 0.014$

X^2 (α=.05, df= 2)= 5.99

Cannot reject Ho3d at the 0.05 level of significance.

Ho3e: Ranch size has no influence on whether or not poaching is a problem on the ranch.

Author defined classification.

Observed Frequencies:

	Yes*	No	Total
Small	10	3	13
Large	18	1	19
Total	28	4	32

*Sometimes is included in the yes category.

Expected Frequencies:

	Yes	No
Small	11.4	1.6
Large	16.6	2.4

$X^2 = 2.33$

X^2 (α=.05, df= 1)= 3.84

Cannot reject Ho3e at the 0.05 level of significance.

Ho3e: Ranch size has no influence on whether or not poaching is a problem on the ranch.

JENKS method of classification.

Observed Frequencies:

	Yes*	No	Total
Small	14	4	18
Medium	9	0	9
Large	5	0	5
Total	28	4	32

*Sometimes is included in the yes category.

Expected Frequencies:

	Yes	No
Small	15.8	2.2
Medium	7.9	1.1
Large	4.4	.6

$X^2 = 3.613$

X^2 (α=.05, df= 2)= 5.99

Cannot reject Ho3e at the 0.05 level of significance.

Ho4a: Ranch ownership/operator type has no influence on whether the ranch land is contracted under the Williamson Act.

Observed Frequencies:

	All	None	Some	Total
Deeded	4	1	4	9
Deeded and Leased	4	2	6	12
Other	6	2	3	11
Total	14	5	13	32

Expected Frequencies:

	All	None	Some
Deeded	3.9	1.4	3.6
Deeded and Leased	5.2	1.9	4.9
Other	4.8	1.7	4.5

$X^2 = 1.542$

X^2 (α=.05, df= 4)= 9.49

Cannot reject H04a at the 0.05 level of significance.

Ho4b: Ranch size has no influence on whether the ranch land is contracted under the Williamson Act.

Author defined classification.

Observed Frequencies:

	All	None	Some	Total
Small	7	2	4	13
Large	7	3	9	19
Total	14	5	13	32

Expected Frequencies:

	All	None	Some
Small	5.7	2.0	5.3
Large	8.3	3.0	7.7

$X^2 = 1.04$

X^2 (α=.05, df= 2)= 5.99

Cannot reject Ho4b at the 0.05 level of significance.

Ho4b: Ranch size has no influence on whether the ranch land is contracted under the Williamson Act.

JENKS method of classification.

Observed Frequencies:

	All	None	Some	Total
Small	9	3	6	18
Medium	3	1	5	9
Large	2	1	2	5
Total	14	5	13	32

Expected Frequencies:

	All	None	Some
Small	7.9	2.8	7.3
Medium	3.9	1.4	3.6
Large	2.2	.8	2.0

$X^2 = 1.33$

X^2 (α=.05, df= 4)= 9.49

Cannot reject H04b at the 0.05 level of significance.

Ho4c: The length of time the ranch has been in operation under the present owner/operator has no influence on whether the ranch land is contracted under the Williamson Act.

Observed Frequencies:

	All	None	Some	Total
Short	4	1	2	7
Medium	2	3	2	7
Long	8	1	9	18
Total	14	5	13	32

Expected Frequencies:

	All	None	Some
Short	3.1	1.1	2.8
Medium	3.1	1.1	2.8
Long	7.9	2.8	7.3

$X^2 = 5.931$

X^2 ($\alpha = .05$, df= 4)= 9.49

Cannot reject Ho4c at the 0.05 level of significance.

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