

TABLE OF CONTENTS

Introduction	1
Objectives	1
Study Area	2
Methods	5
Results	8
Weather, Spring 1984	8
Historical Raptor Nesting Records	8
Raptor Use of Pinnacles National Monument During Spring 1984	12
Nesting Phenology	20
Occupancy	20
Productivity	25
Discussion	27
Evaluation of the 1984 Breeding Season	27
Raptor/Climber Conflicts	27
Potential Reintroduction of Peregrine Falcons and California Condors	30
Management Recommendations	32
Management of Nesting Raptors	32
Reintroduction and Management of the Peregrine Falcon and California Condor	34
Monitoring Plan	36
Acknowledgements	41
Literature Cited	42
Appendix 1. Scientific names of raptors mentioned.	44

LIST OF TABLES AND FIGURES

Table 1. Weather Recorded at Pinnacles National Monument for 1 April to 14 June 1984.	9
Table 2. Historical Weather Records at Pinnacles National Monument.	10
Table 3. Raptors Nesting at Pinnacles National Monument During Spring 1984.	13
Table 4. Nesting Phenology for Raptors Nesting at Pinnacles National Monument During Spring 1984.	22
Table 5. Population Size Estimates for Raptors at Pinnacles National Monument, Spring 1984.	24
Table 6. Number of Fledglings in Raptor Nests at Pinnacles National Monument During Spring 1984.	26
Table 7. Number of Raptor Nests Located Near Rock Climbing Routes at the Pinnacles National Monument During Spring 1984.	28
Figure 1. Base Map of the Pinnacles National Monument, Monterey and San Benito County, CA.	3
Figure 2. Compass Orientations of Cliff Faces for Prairie Falcon and Common Raven Nests at the Pinnacles National Monument in Spring 1984.	15
Figure 3. Location of Prairie Falcon Nests at Pinnacles National Monument in Spring 1984.	17
Figure 4. Location of Common Raven Nests at Pinnacles National Monument in Spring 1984.	18
Figure 5. Location of Red-tailed Hawk Nests and Possible Nesting Territories; Possible Golden Eagle Nesting Territories; and Communal Roosts of Turkey Vultures at Pinnacles National Monument During Spring 1984.	19
Figure 6. Nesting Phenology for Red-tailed Hawks, Common Ravens, and Prairie Falcons at the Pinnacles National Monument in Spring 1984.	21
Figure 7. Locations of All Occupied Raptor Nests at the Pinnacles National Monument in Spring 1984.	23

Figure 8. Location of Raptor Nests in Relation to Climbing Areas at the Pinnacles National Monument.	29
Figure 9. Sample Nest Observation Data Sheet to Monitor Raptors at the Pinnacles National Monument.	39
Figure 10. Completed Nest Observation Data Sheet.	40

INTRODUCTION

The concentration of high cliffs at Pinnacles National Monument (PNM) attracts large numbers of both human rock climbers and nesting raptors. Heaviest climbing use occurs during spring, coincident with the raptor breeding season. Conflicts between rock climbers and cliff nesting raptors at PNM have probably occurred since climbing began in the 1940s. Human visitation to the Monument has approximately tripled in the last 25 years, and is expected to increase in the future (National Park Service 1983). The potential for disturbance of nesting birds increases proportionately with elevated levels of visitor use.

The raptors of PNM have long been of interest (Bond 1936, Dixon 1940, Carnie 1950, Wauer 1958), but prior to 1984 no one had conducted a complete nesting survey. We initiated this study of nesting raptors to obtain information needed for management decisions concerning the effects of rock climbing on the raptors, and use of PNM as a possible site for the reintroduction of endangered raptors. Information from a companion study during this multi-faceted Resources Base Inventory, "The Effect of Rock Climbers on the Environment at Pinnacles National Monument, Monterey and San Benito Counties, California," (Genetti and Zenone 1987) was used to evaluate potential raptor/climber conflicts.

Objectives

The objectives of this study were as follows:

1. To summarize the few historical records of raptor nesting at PNM.
2. To locate nest sites and determine occupancy and productivity (number of fledglings) for each cliff-nesting pair of five predominant raptor species (turkey vulture, golden eagle, red-tailed hawk, prairie falcon, and common raven) at PNM during spring 1984, and to locate nests of other raptors if any occurred.
3. To determine if two former nesting species, the California condor and the peregrine falcon, currently nest in PNM.

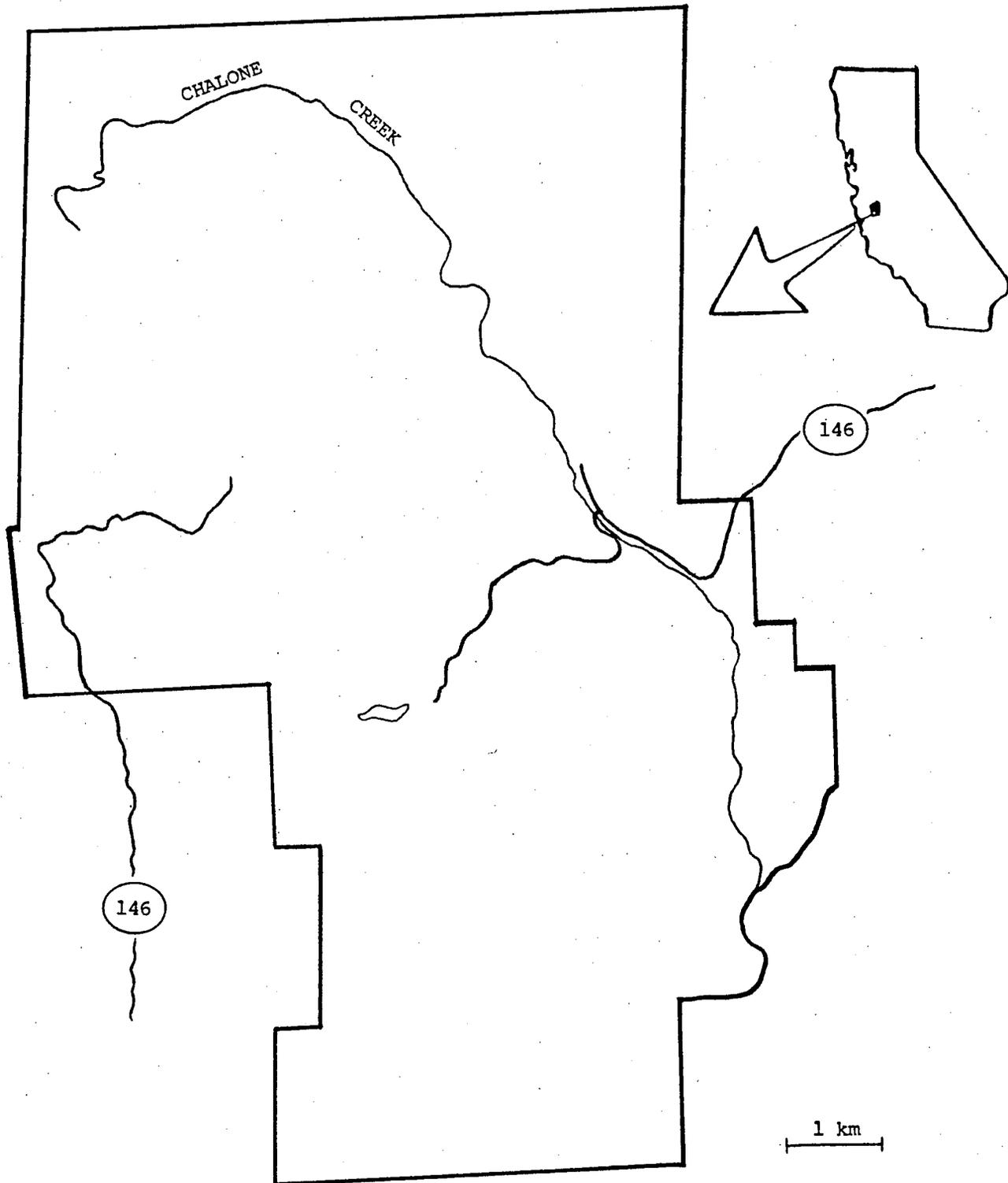
4. To assess the potential or present disturbance on nesting raptors by rock climbers.
5. To present recommendations for the management of nesting raptors at PNM.
6. To assess the potential for reintroduction of peregrine falcons and California condors as nesting residents, and to present management alternatives concerning such reintroductions.

Study Area

Pinnacles National Monument occupies 16,250 acres in the southern portion of the Gabilan Range, in eastern San Benito and western Monterey counties (Figure 1). The Gabilan Range, an inner Coast Range mountain chain in central California, forms the east rim of the broad, flat Salinas Valley.

The Pinnacles Formation, an exposed, jagged, and jutting mass of rock, is an outstanding and anomalous feature in an area predominated by low, gently rolling, chaparral-covered mountains. The pinnacled rocks, for which the Monument is named, were formed by a combination of violent volcanic activity 30,000,000 years ago, and subsequent lateral and vertical fault movements. The ancient rocks, rhyolitic and basaltic lava flows, compressed ash, and other pyroclastic deposits have since been eroded into the spires, cliffs, monoliths, and roofed canyons that characterize the Pinnacles Formation (National Park Service 1983).

Figure 1. Base map of the Pinnacles National Monument, Monterey and San Benito County, CA.



PNM and the surrounding area have a "Mediterranean" climate, characterized by hot, dry summers and cool, wet winters. Annual precipitation averages 41.9 centimeters. Temperature ranges from 49 C in August and September, to lows of -12 C in December and January. Due to this extreme climate and the rather shallow, infertile soil cover, chaparral vegetation characteristic of the Coast Range covers approximately 80% of the Monument. The remaining 20% is divided among riparian, foothill woodland, grassland, and xeric communities (National Park Service 1983).

PNM is surrounded by both private holdings and public lands under the Bureau of Land Management (BLM), most of which is used for cattle grazing (National Park Service 1983).

Human visitation to PNM has risen from 68,000 visitors in 1958 to 171,000 in 1982. Weekend and holiday crowds often exceed Monument capacity in the spring and fall.

METHODS

The principle goal of our field study was to survey the nesting populations of the five predominant raptors at Pinnacles National Monument. We focused primarily on locating and characterizing nest sites and determining occupancy and productivity of fledglings of these raptor species. We conducted field work from 10 April to 15 June 1984. The field season began after most raptors had already begun to occupy their nesting territories and ended when young in nests were fledged.

After consulting PNM staff, we conducted a cursory survey of the Monument in order to locate all suitable nesting areas. We then returned to each selected cliff to search for nesting raptors. Usually we were able to survey one or two general areas (e.g., Balconies Cliffs or North Chalone Peak) in a day. All cliffs within the boundary of PNM were surveyed (Figure 1), but because of the distance to remote areas, some cliffs were visited less frequently than others. Sightings of raptors reported to us by staff and visitors were also used to locate nesting birds.

Each potential raptor nest site was monitored by one or two observers for intervals of one to three hours. Observers recorded visible nests and behavioral evidence of breeding such as food exchanges, carrying food to a roost or ledge, or a bird or pair entering a nesting ledge on a cliff. Observations were made with binoculars or with a Celestron spotting scope. For each nest, the following information was recorded: species (ornithological field guides by Robbins et al., 1966, and Peterson, 1961, were used to identify species; species names are consistent with the American Ornithological Union Checklist, 1982); map location [nest locations were recorded on a USGS 1:24000 topographic map (1974), section numbers refer to sections on this map]; types of behavior observed; nest height (estimated); nest aspect (direction of nesting ledge as measured by a Silva compass); and nearby climbing routes (as named by Gagner 1983). Each nest site was photographed using a 35mm camera. Throughout the season, sightings at each nest were recorded in a log. Nests with nearly fledged young were monitored closely. Young seen in or around the nest in immature plumage were considered as having fledged. Those sites where we observed breeding

behavior but were not able to locate a nest we define as "probable nesting sites". Areas where pairs of raptors were seen but no evidence of nesting was observed are considered "possible nesting areas".

Additional observations, recorded throughout the field season, included sightings of other raptor species and non-breeding groups or individuals of study species, nest sites of other raptors, and tree nest sites or roost sites. We also attempted to identify prey items whenever feeding was observed.

The estimated population size for each study species was based on daily sightings and the location of known nesting pairs. We assumed that raptors occupy distinct territories during the breeding season and that individuals or pairs could be distinguished. Non-breeding populations were more difficult to assess and we, therefore, consider all estimates to be conservative minimums. The prairie falcon population was estimated to equal the number of nesting pairs found. For golden eagles and red-tailed hawks, individuals and small groups seen far from each other at approximately the same time were considered to be different, and these were summed to produce a population estimate. Turkey vultures and common ravens were frequently seen in large conspecific groups. Population size for the common raven was estimated from the maximum number of ravens observed at one time plus those individuals known to be nesting far from where the group was sighted. Relatively distinct groups of turkey vultures were seen regularly at several locations. After compensating for possible recounts, the numbers from these groups were summed to produce a population estimate.

Weather information was obtained from PNM records. Daily high and low temperatures and precipitation were measured at the Bear Gulch Ranger Station and Chaparral Ranger Station. Wind speed and direction were measured at 1400 hours daily at the Visitor Center.

Our methods did not guarantee that all nests were found. Nests on low-lying cliffs and other inaccessible areas were less likely to be located. Certain species (e.g., turkey vultures, red-tailed hawks, and golden eagles) are more elusive and cryptic than others and may not actively defend

their nesting territories when a person approaches, thus making it more difficult to locate their nests. The number of fledglings from a common raven nest was difficult to assess because their nests were often situated out of view deep within cracks. Moreover, immature ravens cannot be easily distinguished from adults.

Historical records for raptors nesting at PNM were compiled by Walton (1984) from field notes, interviews and published accounts from various naturalists, egg collectors, falconers, and residents who lived or worked in the Pinnacles area. The SCPBRG also provided information from researchers who have studied the relevant raptor species elsewhere in the state: Included in this group are Carl Thelander and Kent Carnie on golden eagles; Steve Herman, Hans Peeters, and Carl Thelander on peregrine falcons; Ron Garrett on prairie falcons; Peter Bloom concerning Swainson's hawks; and Sanford Wilbur and Lloyd Kiff concerning California condors.

RESULTS

Weather, Spring 1984

We present meteorological data (Table 1) recorded at Pinnacles National Monument during our field study in order to characterize the conditions of the 1984 breeding season. Future studies on raptor nesting at PNM should also consider the effects of weather.

Air temperatures in April were cool; the average daily high was 21 C, the average low was 1 C, and there were 14 days of below freezing temperatures; precipitation totaled only 0.86 centimeters. At the end of May the temperatures rose abruptly to exceed 38 C. During May, the average high temperature was 28 C, the average low was 5.5 C and 0.08 centimeters of rain fell. Temperatures during the first two weeks of June averaged 27 C and 6 C, and no rain fell during this period.

Comparison of weather data for 1979, 1983, and 1984 shows rather high variability among years in temperature and rainfall (Table 2). Weather conditions can effect timing of breeding as well as occupancy and productivity, and these data illustrate the annual variability of the nesting environment at PNM.

Historical Raptor Nesting Records

Most of the raptor species found in California and western North America have been sighted at PNM. Nesting or residency at PNM has been documented by past researchers for 15 species: turkey vulture, California condor, sharp-shinned hawk, Cooper's hawk, red-tailed hawk, Swainson's hawk, [?]golden eagle, American kestrel, peregrine falcon, prairie falcon, common barn-owl, western screech-owl, great horned owl, northern pygmy-owl, and common raven. Evidently the black-shouldered kite is a recent colonizer of the area as there are no nesting records for the species prior to the 1970s. Red-shouldered hawks and long-eared owls have probably nested in the area, but no records exist (B. Walton, pers. comm.).

↑ recorded nesting < 1984
see Avery

Table 1. Weather Recorded at Pinnacles National Monument for 1 April to 14 June 1984.

	TEMPERATURE				Total Precipitation (cm)	Predominant Wind Direction	Wind Speed (km/hr)	
	Average High	Average Low	High	Low			(C)	
<i>April</i>								
BG	71	22	2	35	0.20	.08	SE,SW,NW	4 6.4
Ch	69	20	-0.5	31	0.86	.34		
<i>May</i>								
BG	86	30	7	44	0.00	.00	SE	6 9.6
Ch	85	29	4	40	0.08	.03		
<i>June</i>								
BG	80	27	6	43	0.00	.0	SE	8 12.8
Ch	81	27	3	39	0.00	.0		

BG = Bear Gulch Ranger Station
Ch = Chaparral Ranger Station

Table 2. Historical Weather Records at Pinnacles National Monument.

	Average Maximum Temperature (C)		Average Minimum Temperature (C)		Total Precipitation (cm)
<i>April</i>					
1984	75	24 ²²	35	2	0.20 .08
1983	62	17	36	2	10.39 4.09
1979	69	20	39	4	0.81 .32
<i>May</i>					
1984	86	30	44	7	0.00 .0
1983	73	23	41	5	0.28 .11
1979	77	25	43	6	0.46 .18
<i>June</i>					
1984	86	27	43	6	0.00 .0
1983	84	29	45	7	0.15 .06
1979	90	32	46	8	0.00 .0

Bear Gulch Ranger Station

Two active turkey vulture nests were found in successive seasons during the 1950s. Both nests were in small, ground level caves; one at the base of the Balconies Cliffs, and the other across Bear Gulch from the superintendent's house. It is not known whether these two sites have been active since the 1950s (Walton 1984). One other nest was noted in Condor Gulch (Wauer 1958). One active nest was found in 1984 ^{← 1985?} (Avery and Van Riper 1986).

California condors nested in the High Peaks area at least until 1898. The nesting cavity used that year can be seen from the High Peaks Trail, just west of the junction with the Condor Gulch Trail. This large cavity is about two feet above the ground and a few feet off to the left as you walk west along the trail.

A red-tailed hawk nest located in a tree in east Condor Gulch in the late 1950s represents the only historical record of this species (Wauer 1958). However, red-tailed hawks are believed to regularly nest in trees and occasionally on cliffs in and around PNM (Walton 1984).

Swainson's hawks formerly were common nesters in partially dead trees along riparian areas such as Chalone Creek (south of PNM's east entrance). No active nests have been recorded during the 1970s and 1980s.

Golden eagles are year-round residents in the Pinnacles area, and up to three nesting pairs per year have been reported in the immediate vicinity of PNM (Walton 1984). This species is known to have nested on the Balconies Cliffs, on the cliffs at North Chalone Peak, in a pine in Mann Canyon (just west of the Monument), and in other areas (Walton 1984). In the spring of 1983, PNM personnel observed golden eagles nesting within 100 feet of an infrequently used climb on the lower Balconies Cliffs. The climb, Balconies Regular Route, is used approximately four times each spring (C. Genetti, pers. comm.). Climbers were seen on the route during spring 1983 (C. Stonaker, pers. comm.). Golden eagles did not nest at this location during spring 1984.

Prairie falcons have nested on most major bluffs and cliff formations within and adjacent to PNM (Walton 1984). Particularly well used areas include both sides of the Balconies (nine locations), Machete Ridge, North Chalone Peak, various locations along the High Peaks Trail, Little

Pinnacles, Juniper Canyon, and Schmitt Ranch (three-kilometers east of the Monument boundary, also known as "Little Bryce"). No more than five pairs have been recorded in any one year (Dixon 1940, Walton 1984). *Probably more.*

Peregrine falcons have nested at several locations, including the Balconies Cliffs, Machete Ridge, Juniper Canyon, and the Schmitt Ranch. *Res Wall* *& Little Pinnacles?* No more than two pairs have been noted in any one year. Peregrines have been absent as nesters since the early 1960s (Walton 1984).

There are no historical records of the common raven nesting at PNM, although the species is considered a common resident of the area (Wauer 1958, Bond 1936). It is likely that earlier naturalists considered them common and failed to include them in their accounts.

Raptor Use of Pinnacles National Monument During Spring 1984

During spring 1984, we found 26 active raptor nest sites at Pinnacles National Monument. In addition, two probable and five possible nesting territories were thought to be occupied. The seven nesting species were the red-tailed hawk (one nest, one possible nesting area), golden eagle (one nest, one possible nesting area), American kestrel (six nests), prairie falcon (nine nests), common barn-owl (three nests), great horned owl (one nest), and common raven (five nests, two probable and three possible nesting areas). One turkey vulture, one black-shouldered kite nest and one Cooper's hawk nest were reported in another phase of this Resources Base Inventory by Avery and Van Riper (1986). In addition, we suspect that the western screech-owl, northern pygmy-owl, and northern saw-whet owl nested at PNM in 1984, but no nest sites were located. Population estimates are presented in Table 3. The turkey vulture, common raven, and prairie falcon were the numerically predominant raptors.

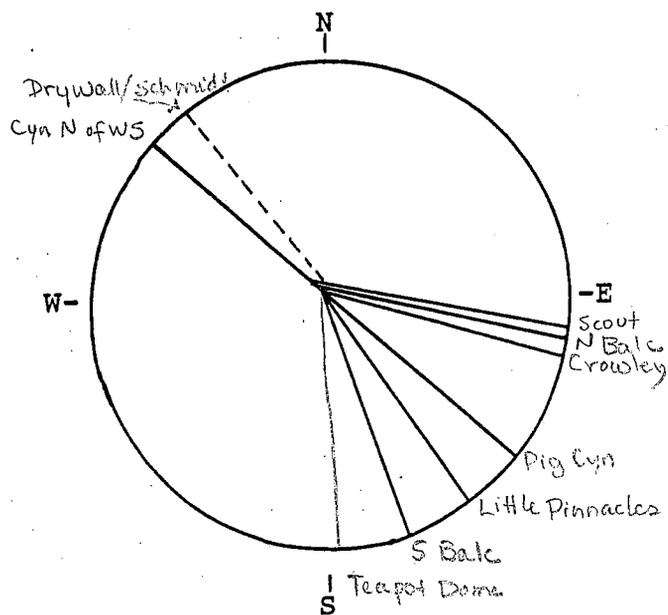
Table 3. Raptors Nesting at Pinnacles National Monument During Spring 1984.

Species	Number of Nests	Number of Probable Nests	Number of Possible Nesting Areas
Red-tailed Hawk	1	--	1
Golden Eagle	1*	--	1
American Kestrel	6	--	--
Prairie Falcon	9	--	--
Common Barn-Owl	3	--	--
Great Horned Owl	1*	--	--
Common Raven	5	2	3
TOTAL	26	2	5

*Tree nests

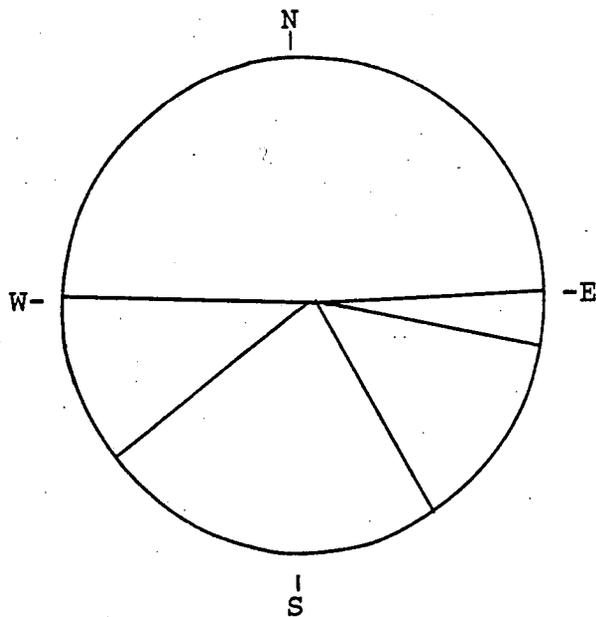
The prairie falcon was the most abundant nesting raptor at Pinnacles National Monument in 1984. Seven of the nine nests were located in large potholes or on ledges in volcanic cliffs; the other two were in holes in sandstone bluffs. More than half of the nest sites were within 50 feet of ground level but one eyrie was higher than 100 feet. Most nests were at least 20 feet below the top of the cliff. The orientation of cliff faces that prairie falcons nested on was predominantly east to south exposures (Figure 2).

Figure 2. Compass Orientations of Cliff Faces for Prairie Falcon and Common Raven Nests at the Pinnacles National Monument in Spring 1984.



PRAIRIE
FALCON

N=8



COMMON
RAVEN

N=5

Figure 3 shows the location of the prairie falcon nests occupied in 1984. Five of the nests were located far from any climbing activity, but the other four were near infrequently used routes (C. Genetti, pers. comm.).

Common ravens built their stick nests on ledges in volcanic rocks, usually deep within vertical chimney cracks. Two pairs possibly nested in sandstone bluffs. One nest was situated about 200 feet up, but generally nests were within 50 feet of the ground. Distance from the nest to the top of the cliff ranged from 5 to 60 feet. There was no strong trend in the direction that nests faced (Figure 2). The distribution of known, probable, and possible nests is presented in Figure 4.

Two raven nests were located directly on seldom-used climbing routes, Pigeon Crack on Machete Ridge and Lonely Shepherd (Gagner 1983; C. Genetti, pers. comm.). Another raven nest was located between two narrowly separated climbing routes, Portent and Nailbox Crack, on Discovery Wall (Gagner 1983). It is estimated that Portent is climbed eight or more times a week and Nailbox Crack is climbed about once every three weeks (C. Genetti, pers. comm.). All other raven nests were located away from climbing routes.

The only red-tailed hawk nest that we found during this study was located in The Fingers (Figure 5), in a large pothole in a ^(this is southwest!) southeast-facing cliff of volcanic composition about 30 feet above the ground and 50 feet below the top of the cliff. No climbing occurs in this area.

The one active golden eagle nest was in a Digger Pine (Pinus sabiniana), a few miles southwest of PNM. A golden eagle was seen building a nest on Balconies Cliff in mid-April but it was never completed and the site was used only as a roost (Figure 5). This eagle was seen with another adult southeast of Balconies several times after 20 May, but no nest was found.

Figure 3. Location of Prairie Falcon Nests at Pinnacles National Monument in Spring 1984.

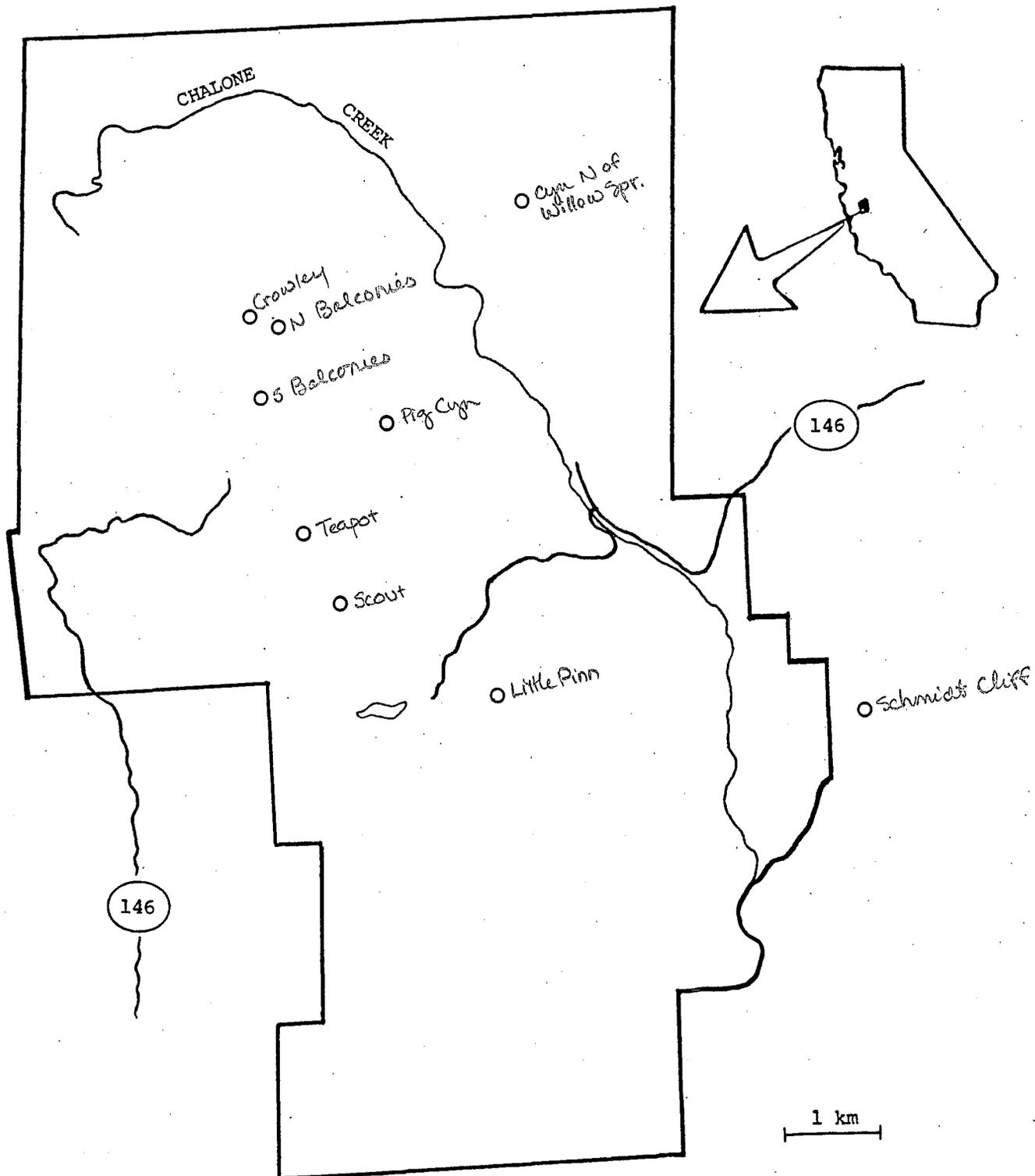


Figure 4. Location of Common Raven Nests at Pinnacles National Monument in Spring 1984.

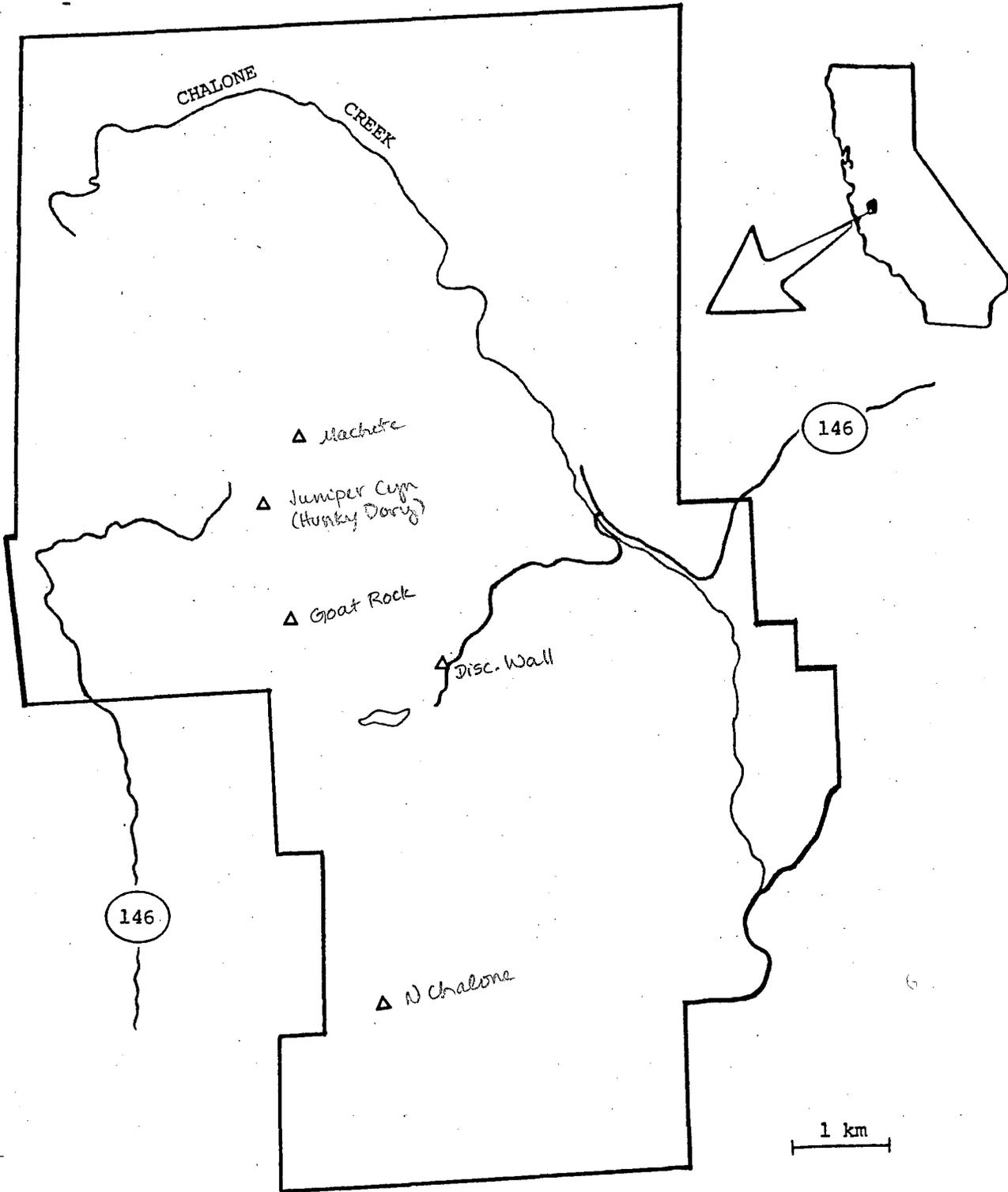
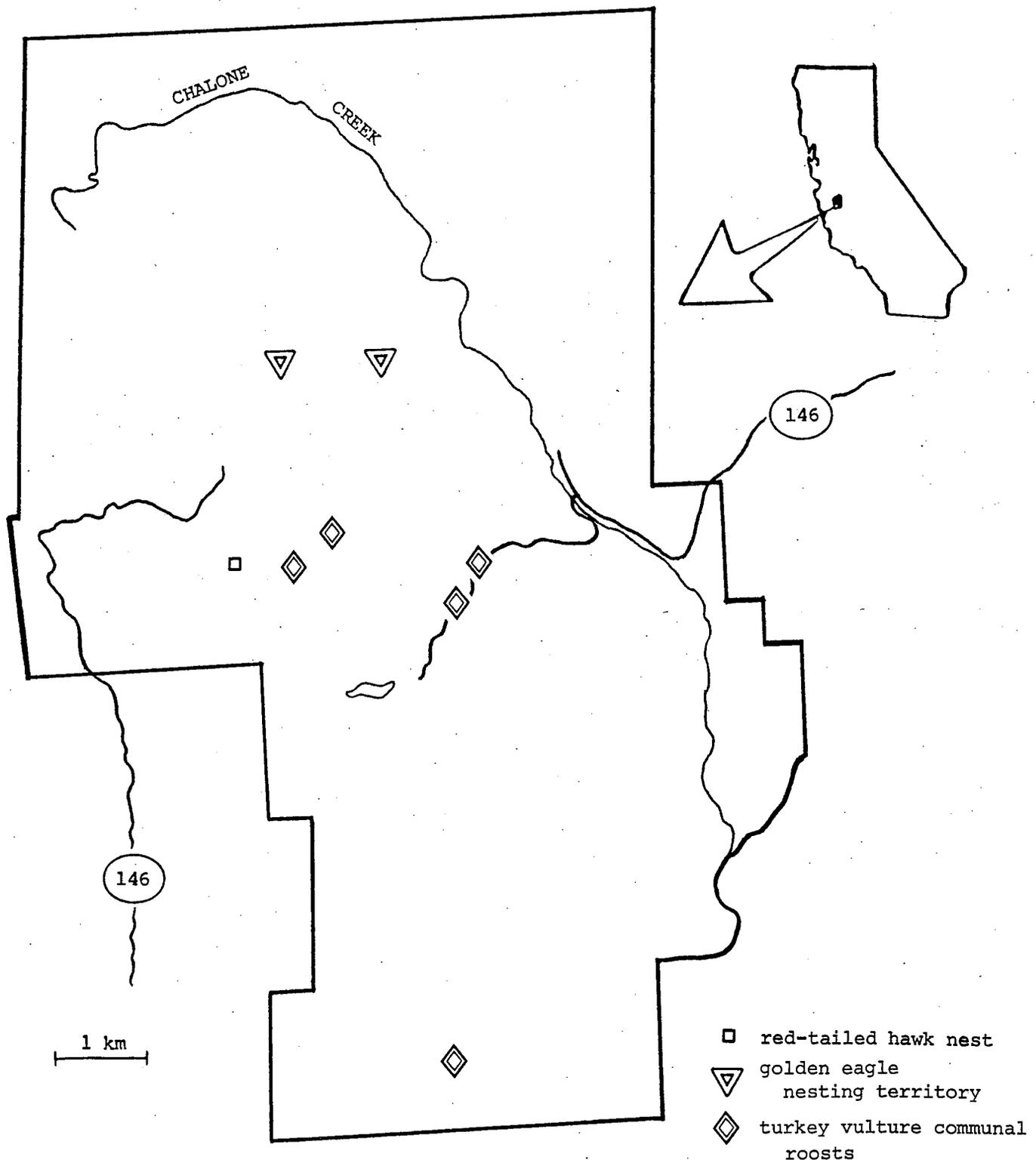


Figure 5. Location of Red-tailed Hawk Nests and Possible Nesting Territories; Possible Golden Eagle Nesting Territories; and Communal Roosts of Turkey Vultures at Pinnacles National Monument During Spring 1984.



Nesting Phenology

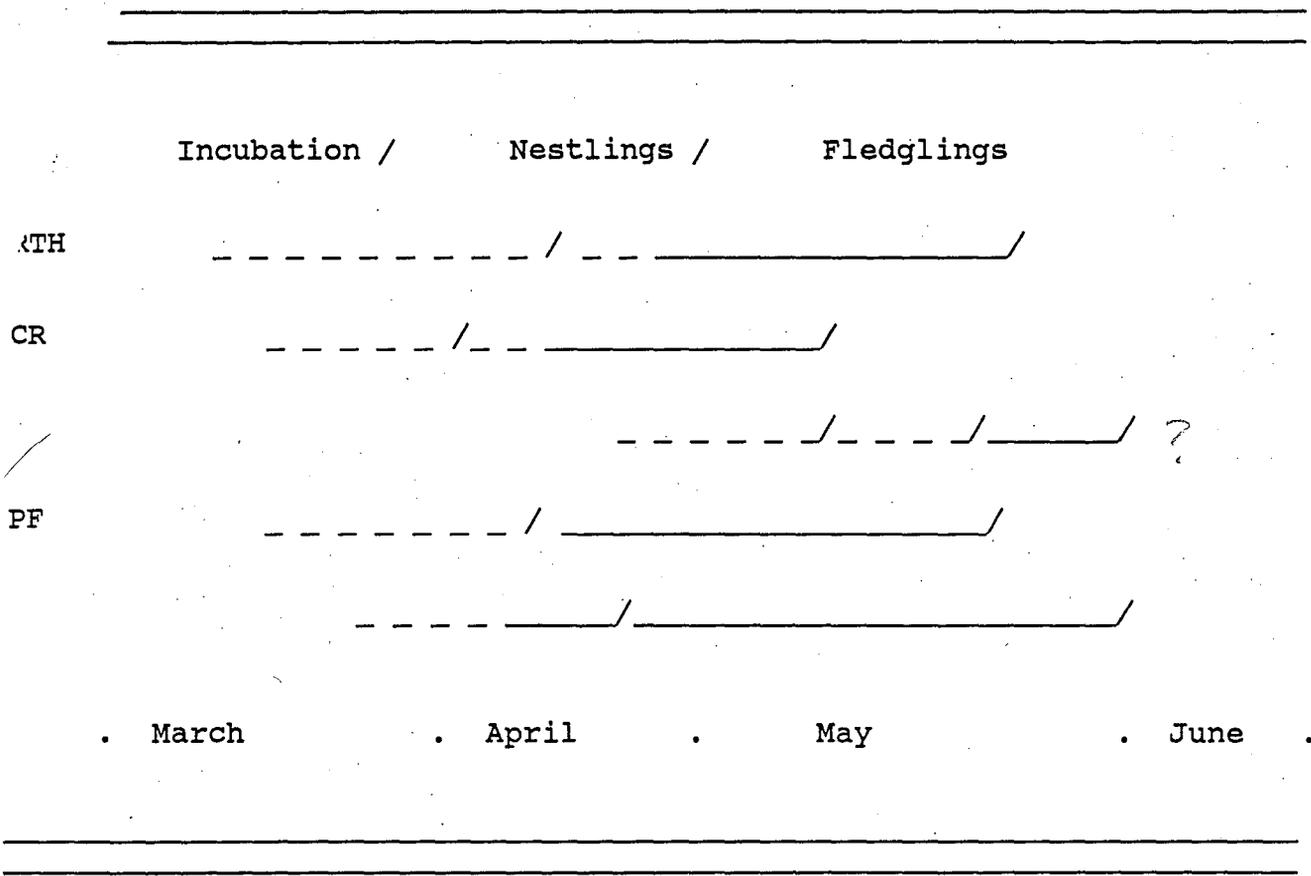
Our observations indicate that the general raptor breeding season for red-tailed hawks, common ravens and prairie falcons in 1984 lasted from 7 March to 8 June (Figure 6). Phenology is estimated by extrapolating back from fledging dates based on data provided for these species by Brown and Amadon (1968) and Harrison (1978). Table 4 gives important dates of observation for nests found, eggs seen, young seen, and young fledged. These dates are similar to dates recorded by Walton in the mid-1970s (B. Walton, pers. obs.). Nesting dates can be seasonably variable, but further collection of data would be expected to produce additional information falling in a similar range as seen here.

During observation to determine phenology, we also observed raptors in normal courtship, breeding, feeding and roosting behavior at or near nest ledges on cliffs. Our observations indicate that existing trees in the PNM are important at some time as raptor roosts or feeding posts.

Occupancy

The location of all raptor nests that we observed are described in Figure 7. The estimated population size for these five species, however, was quite variable (Table 5). The Pinnacles is occupied in the breeding season by both breeding and non-breeding raptors (non-breeders include some adults as well as immatures who may be incapable of reproducing). It is likely that most prairie falcon, golden eagle, and raven nests were located but that several turkey vulture and possibly some red-tailed hawk nests were missed. Occupancy for the region appeared high. Few, if any, "territories" that appeared suitable were determined unoccupied.

Figure 6. Nesting Phenology for Red-tailed Hawks, Common Ravens, and Prairie Falcons, at the Pinnacles National Monument in Spring 1984.



----- = Extrapolated
 _____ = Observed

Table 4. Nesting Phenology for Raptors Nesting at Pinnacles National Monument During Spring 1984.

Species	Dates				
	Topo Map Section	Nest Found	Eggs Seen	Young Seen	All Young Fledged
Red-tailed Hawk	4	4/24	—	4/24-5/15	6/03
Golden Eagle	20*	4/20	4/20	**	
Prairie Falcon	3	4/22	—	4/22	5/28
	34	5/11	—	5/13	5/29
	11	5/12	—	5/12	after 5/30
	26	5/14	—	5/14	after 5/31
	28	4/12	—	5/13	6/01
	33-34	4/13	4/13	5/07	after 6/01
	3	4/10	4/10	4/27	6/03
	27	4/13	—	5/30	—
	13*	5/12	—	5/12	—
Common Raven	3	4/21	—	4/21	5/15
	3	4/22	—	4/23	5/15
	34	4/20	—	4/20	5/15
	15	4/30	—	4/30	after 5/18
	10	5/06	—	5/06	after 5/06
	13*	5/12	—	5/12	after 6/01
	2	5/29	—	5/29	6/08

Scout
 Pig Cyn
 Little Pinn
 Cyn N WS
 Crowley
 S Balc
 Teapot
 N Balc
 Dry Wall
 Goat Rock
 Juniper Cyn
 ? Macheta
 N Chalona
 Rubble Wall
 Dry Wall
 Discovery Wall

* Outside monument boundaries

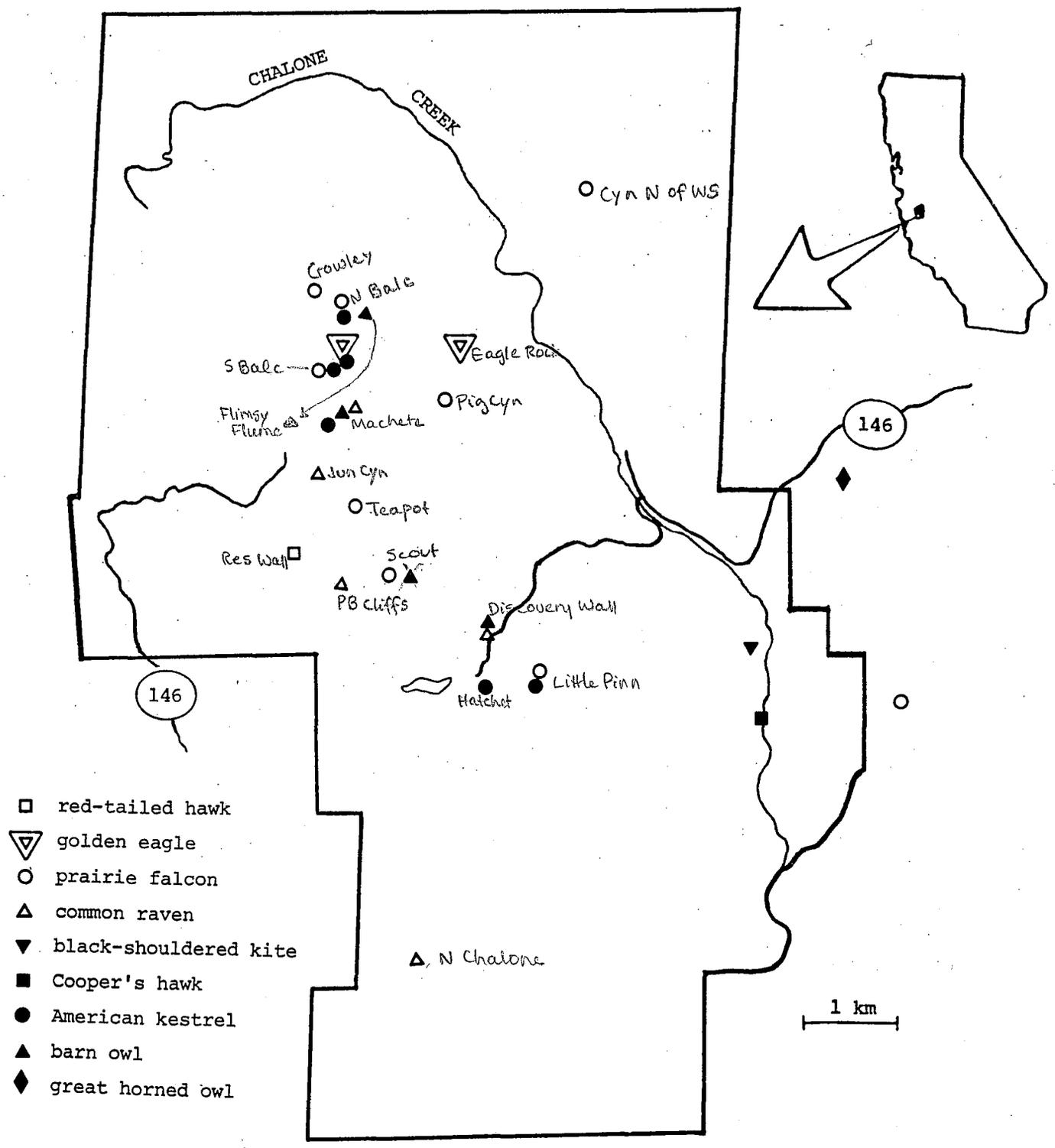
** Empty when checked on 5/20

Barn Owl 34

Flimsy Flume
 Macheta
 Discovery Wall

Kestrel - only one with young - Machete Ridge

Figure 7. Locations of All Occupied Raptor Nests at the Pinnacles National Monument in Spring 1984.



**Table 5. Population Size Estimates for Raptors at Pinnacles National Monument
During Spring 1984.**

Species	Maximum Number Observed At One Time	Estimated Total Number*
Turkey Vulture	25	55**
Red-tailed Hawk	3	9-13 (3 immature)
Golden Eagle	4	6 (3 immature plumage)
Prairie Falcon	2	18
Common Raven	18	20-24

* Prior to fledging of young

** may include non-residents and migrants

In addition, 22 American kestrels and six kestrel nests, three barn-owl nests and numerous non-breeding barn-owls, one black-shouldered kite nest, one great horned owl nest, and one Cooper's hawk nest also were occupied in 1984. The black-shouldered kite, great horned owl, and Cooper's hawk nests were in trees.

Both northern pygmy-owls and northern saw-whet owls were seen hunting in family groups, and western screech-owls also were heard in the PNM in 1984 (Avery and Van Riper 1986).

Thus, we conclude that the raptor population at the PNM is large, and occupancy of available territories was high in 1984. Future studies are needed to determine actual degree of occupancy and trends in these populations.

Productivity

The number of fledglings were counted at each nest whenever possible (Table 6). The significance of any trend in these data can not be determined in a one-year study. There were no indication of problems with egg or young loss, and the observed number of fledglings are consistent with other studies of these species in other areas of North America (Craighead and Craighead 1969, Brown and Amadon 1968, and BLM 1985). Future observations can now add information and describe trends based on our baseline observations.

Table 6. Number of Fledglings in Raptor Nests at Pinnacles National Monument During Spring 1984.

Species	Species Average For 1984	Individual Nests By Topo Map Section	Number of Fledglings/Nest	
Red-tailed Hawk	3	4	3	Res. Wall
Golden Eagle	0.0	20*	0	Main Cyn
Prairie Falcon	3.3	3	3	Scout
		34	4	Pig Cyn
		11	3-4	Little Pinn
		26	3-4	Cyn W WS
		28	3	Crowley
		33-34	2	S Balconies
		3	5	Teapot
		27	2-3	W Balconies
		13*	?	Dry Wall
Common Raven	1.5	3	?	Goat Rock
		3	1-2	Juniper Cyn
		34	1-2	Machete
		15	?	W Chalona
		10	?	Rubble Wall
		13	?	Dry Wall
		2	1-3	Discovery Wall

*Tree Nests

DISCUSSION

Evaluation of the 1984 Breeding Season

We saw no evidence of raptor management problems during the 1984 breeding season at PNM. There may have been some unconfirmed unoccupied territories, and some pairs were unsuccessful in production of fledglings. Most species fledged young, and some populations were large, especially turkey vultures and prairie falcons. The density of prairie falcons is similar to the highest densities recorded at the Snake River Birds of Prey National Recreational Area in Idaho, (BLM 1985). Nests of pairs on the Balconies cliffs were 1200 to 4000 feet apart.

Raptor/Climber Conflicts

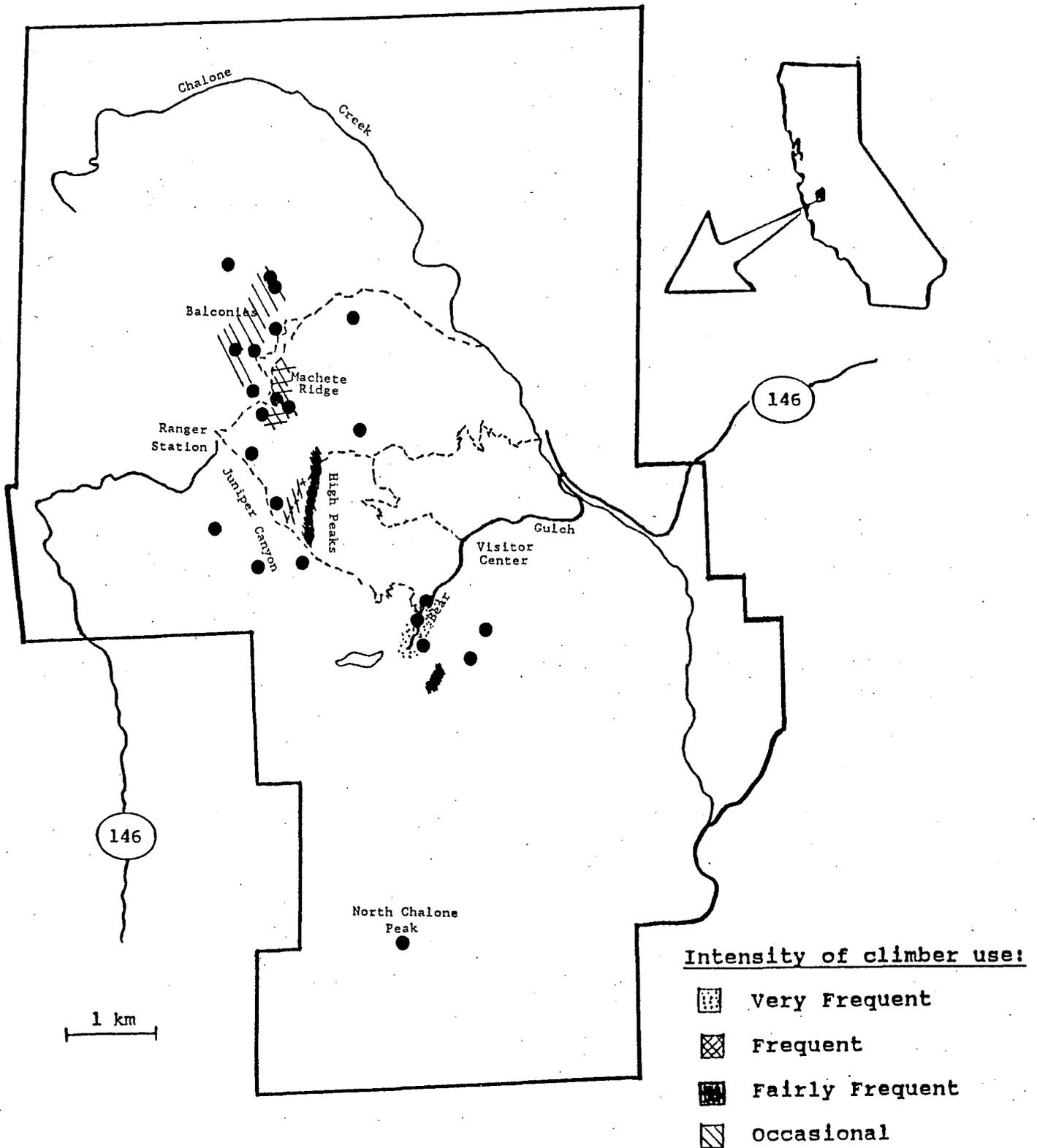
Table 7 and Figure 8 describes current raptor/climber areas of interaction. Most raptors currently nest away from areas of frequent climbing activity. As a result, there currently are few (none in 1984) raptor/climber conflicts. We must be careful, however, not to extrapolate and suggest that there were never any interactions. The year of our observation (1984) is several years after climbing became popular, and our observation probably only describe the final response of raptors after interaction occurred. Most raptors have been seen to relocate the year following a negative reaction (Thelander 1974). Hence, raptors may have nested in climbing areas prior to increased climbing activities and have subsequently been displaced.

Table 7. Number of Raptor Nests Located Near Rock Climbing Routes at the Pinnacles National Monument During Spring 1984.

Species	Not Near A Climb	<i>Intensity of Climber Use</i>		
		Infrequent	Occasional	Very Frequent
Red-tailed Hawk	1			
Golden Eagle	1			
Prairie Falcon	7	2		
Common Raven	5	2*	1	1
TOTAL	14	4	1	1

*Directly on climbing route

Figure 8. Location of Raptor Nests in Relation to Climbing Areas at the Pinnacles National Monument in Spring 1984.



In the future, climbing at active sites can be expected to increase territoriality or nest defense, followed in subsequent spring breeding seasons with shifts first to different ledges, then different cliffs, then abandonment of territories. The end result would likely be a significant reduction in raptor population density and size at PNM. This may have already occurred, but additional studies are necessary to document further trends. Raptor/climber interactions could result in loss of eggs or young if conflicts are frequent, or of extended duration (Call 1979, Snow 1973).

It seems likely that climbing and high density and productive raptor nesting can occur at PNM due to a high degree of cliff and nest ledge or tree site availability in nesting territories. Managers may be able to set aside areas for each activity. We feel monitoring is essential to enable final management plans and appropriate selection of use area for each type of activity.

Potential Reintroduction of Peregrine Falcons and California Condors

In the past, both California condors and peregrine falcons nested at Pinnacles National Monument. Peregrines are still sighted occasionally at PNM, but no breeding has occurred since the 1960s (Peeters and Herman, pers. comm.). Unverified sightings of condors were reported irregularly through June of 1983, most often from North Chalone Peak, but currently there are no free-ranging condors in California.

Peregrine falcon population declines have been linked to pesticide (DDT and DDE) related egg-shell thinning and reproductive failure (Ratcliffe 1980). Abandonment of PNM as a nesting area for peregrines probably has little to do with resource management activities at the Monument itself, but instead is the result of a general collapse of the entire west coast population (Herman 1971). The California condor population has declined steadily during this century and during the last decade the species has become extinct in the wild (Koford 1953, Wilbur 1978). Insufficient prey, loss of habitat, and perhaps pesticide contamination and dietary deficiencies are the probable causes (Wilbur 1978, Snyder 1983).

Judging from historical records and conversations with long time residents of the area, it appears that the habitat in and around PNM has not been significantly altered from the time when

condors and peregrines nested in the area. The one change at PNM in the last century, and particularly in the last twenty years, is the greatly increased number of human visitors. At the present time, visitors have unlimited access to all areas for hiking and climbing. Closure to certain areas during releases, and possibly closures to enable reoccupation of nest sites will need to be considered if PNM enters into a release program.

Food availability is probably not a barrier to nesting. Peregrines prey on small or medium-sized birds, which are abundant in the region (Avery and Van Riper 1986). Competition for food between the Prairie and Peregrine falcon has not proven to be a substantial problem for either species in other areas where both nest. *"In ... regions of joint occupancy, the prairie falcon utilizes a much wider variety of vertebrate species than does the peregrine."* (Porter and White 1973). Conflicts between sympatric peregrine and prairie falcons have been observed, but in general both species are able to maintain eyries even when in close proximity (Porter and White 1973). The deer, sheep, goat, feral hog, and especially cattle populations within condor foraging range (160 km; Koford 1953) of the Monument, can probably support at least one pair of nesting condors. The turkey vulture population in the Pinnacles region is currently large with no evidence of food shortage, and condors are dominant over turkey vultures when feeding at the same carcass (Koford 1953).

MANAGEMENT RECOMMENDATIONS

Management of Nesting Raptors

In part, this study was initiated to address the possible conflicts between climbers and cliff-nesting raptors, and to recommend actions to ensure the birds' preservation. In this section we present recommendations for protection of currently nesting raptor species. Management of species that historically nested at the Pinnacles, the peregrine falcon and California condor, will be discussed later. The following recommendations are based on the assumption that the use of PNM by both climbers and nesting raptors is desirable and in accordance with the Monument's management plan (National Park Service 1983).

1. Monitor active raptor nest sites (as identified in this study) and document changes, especially nest relocation to historical or previously unused sites.
2. Monitor rock climbing throughout the Monument, watching for changes in routes and frequency of use.

Both raptor nesting and rock climbing must be assessed carefully in order to ensure fair management decisions. Known nests should be checked, sufficiently late in the season to determine if chicks are raised to fledging. Every ten years, a thorough survey of raptor nests at PNM should be conducted to document changes in breeding populations. Details for a raptor monitoring plan are presented in the following section. A plan for monitoring climbers is suggested by Genetti and Zenone (1987). It may be necessary to develop ways to assess changes in intensity of use and routes used by climbers.

3. Designate certain areas to be used solely by nesting raptors (i.e., no climbing).

If visitor/climber use and raptor use are equally desirable, separate areas may need to be designated for each. The selection of areas to be preserved for nesting should consider that most raptor species nest annually in the same territories and nest ledges (Newton 1979). Setting aside an area that appears to be good habitat, but that is not presently or was not historically used by nesting raptors, offers no guarantee that the birds will use the site. The optimal choice would be an area that already supports nesting raptors but is not used frequently by climbers. Obviously any area that contains large cliffs with suitable nesting ledges could suffice, but current bird activity is the best evidence of quality habitat. If small areas are chosen, more than one should be set aside.

4. Decide whether to protect raptor territories in heavily used climbing areas.

In areas where climbers and nesting raptors are in direct conflict, the PNM staff must establish use priorities. In some cases, it may be possible to notify climbers and provide detours around nests. In cases where this is not practical or where the nest at risk is of a relatively abundant species (such as ravens), non-interference may be the best policy. At present the most sensitive area is Balconies-Machete Ridge.

5. Educate climbers and visitors about the importance and vulnerability of raptors nesting on cliffs. Ask for their assistance in recording sightings and provide identification information.

Climbers should be directed to limit time spent close to raptor nests. Information explaining which seasons and areas are most sensitive should be available. Updated lists of climbing routes where conflict may occur should be posted. However, it would be best to avoid stating the exact location of active nests.

6. Include in the Pinnacles National Monument's "Rock Climbing Policy and Guidelines" a guideline about respecting raptor nesting.

The above guideline might read: "Birds of prey nest in the cliffs of the Pinnacles National Monument, often on or near climbing routes. These birds are federally protected and they must not be disturbed during spring breeding season, climbers should be careful not to flush these birds or keep them away from nests on cliffs. If a nest is encountered while climbing, abandon the route and notify a ranger as to the nest's location."

7. Any proposed trail construction or habitat management (e.g., prey manipulation or controlled burns) should be evaluated for impacts on raptors prior to initiation.

Trail construction should be limited in areas of known raptor nesting, and construction of any kind should cease in sensitive areas during raptor breeding season (particularly during courtship and incubation phases). Pest management activities, such as ground squirrel abatement, should be analyzed for possible secondary effects on raptors. Controlled burns should not occur in areas with active raptor nests during the breeding season.

Reintroduction and Management of the Peregrine Falcon and California Condor

The management alternatives for reintroducing the peregrine falcon as a nesting species at PNM are as follows:

1. Nestling peregrines can be cross-fostered into prairie falcon nests.
2. Peregrines can be hacked (released by humans without the presence of adult peregrines or prairie falcons).
3. Wait for natural reoccupation by birds dispersing from wild populations or other management areas (e.g., the Big Sur coast).

Hacking and cross-fostering are two methods used to reintroduce young peregrines into areas of historic occupation. Hacking refers to the release of newly fledged falcons from a large box built on a cliff or tower in an area of suitable habitat. Initially, the front of the box is barred, allowing birds to acclimate to their surroundings, but preventing them from escaping. Food is dropped into the box via a chute to prevent association of food with humans. After a week, the bars are removed and the young birds are free to fly. Fledglings return to the hack box for food while they instinctively learn to fly and hunt. Gradually they become as independent and wild as young raised under natural conditions.

Cross-fostering involves the placement of peregrine chicks into an active prairie falcon nest. The chicks are switched at roughly three weeks of age, before there is a pronounced difference between the two species. The prairie falcons accept the peregrine chicks and raise them in much the same way as would adult peregrines.

Cross-fostering has several advantages over hacking, and one is reduced predation on the young. Predation by golden eagles and great horned owls is less when adult falcons are present (Walton and Thelander 1983). Furthermore, cross-fostering is less labor intensive. Cross-fostering requires only one attendant to monitor the effort, while two are needed for hacking. Cross-fostering requires no hack box installation, no supplemental food source, and no radio telemetry. Cross-fostering is probably the best alternative for reintroducing peregrine falcons at PNM. For more information about raptor management and current reintroduction efforts in California refer to Olendorff et al. 1980, Sherrod et al. 1982, Walton and Thelander 1983, and Linthicum 1987.

If through reintroduction or natural colonization, peregrines start to nest at PNM, their nest sites must be fully protected from human disturbance (such as rock climbing) and low flying aircraft. Any climbing route in the vicinity of an active nest should be closed until chicks are fully independent.

The question of reintroducing the California condor is much more difficult to address. A captive breeding program for the condor is currently underway at the Los Angeles and San Diego

Zoo's. Captive-bred condor fledglings are scheduled to be released by hacking. The first few condors will be released in southern California, in areas last inhabited by wild birds. Expansion into areas of historic occupation could occur in time if the captive breeding program is successful. If Pinnacles National Monument is to be a suitable nesting area for condors, a portion may have to be made inaccessible to humans. If there are no natural cavities, structures made of artificial rock might work instead (Wilbur 1978). Alternately, cavities could be blasted or drilled in rock faces. Careful studies will have to be conducted to determine the suitability of the Gabilan Range as condor habitat, before any decision is made to reintroduce condors at PNM.

Monitoring Plan

A monitoring program is one of the best ways to detect changes in use patterns over time. Monitoring of nesting raptors will document fluctuation in population size, nest site usage and relocation, and conflicts between humans and raptors. Monitoring of nesting raptors and climbers at Pinnacles National Monument will facilitate fair management decisions. The following monitoring plan is suggested to ensure the continued health of the raptor nesting population at PNM.

A complete monitoring program should survey all known and prospective nest sites identified in this report. New nests that are located should also be checked in subsequent years. It would be optimal to visit each nest site at least four times each spring. It is essential to monitor nests early in the breeding season, prior to incubation, in order to identify sensitive nest sites (and take protective action) and to document nest abandonment. The exact timing of breeding fluctuates from year to year in response to effects of weather and prey availability. In 1984, the earliest incubation started in mid-March, but raptors occupied their nesting territories much earlier. Nests must also be surveyed close to the time of fledging to determine nesting success. By visiting each nest several times the chances of missing important events, such as fledging or abandonment, are diminished.

Since golden eagles did not nest successfully during 1984, special efforts should be made to locate any future nests. Snow (1973) suggests that human activity should be restricted around golden eagle eyries from the start of incubation until the eaglets are two weeks old (approximately two months). Eagles in California can start incubating by early February, but most lay eggs from mid-February to mid-March (Bent 1937).

The following information should be collected as part of the monitoring program:

1. Is the nesting area occupied? Is the same nest being used?
2. Is the nest on or near a climbing route? If so, how frequently is the route used?
3. What sources of human disturbance might impact this nest? What, if any, protective action should be taken?
4. Are there eggs or is the female incubating?
5. Are there young in the nest? How many?
6. How many young successfully fledged?

A sample blank data sheet for nest observations is presented as Figure 9. All observations taken at a nest during one breeding season could be included on the same data sheet. A sample completed data sheet is presented in Figure 10. Two qualified observers should be sufficient to monitor raptor nesting each season. Three potential sources of observers are: 1) training of Monument staff, 2) soliciting interns from local universities or ornithological groups, or 3) hiring professionals.

Training and use of Monument personnel might be most efficient. Many nests are easily accessible and could be checked during the staff member's other duties. However, a complete and comprehensive nest census is time consuming and at least periodically (e.g., during egg-laying and fledging) requires full attention. Spring is a busy season at PNM and it may not be possible to

assign staff personnel to full-time duty monitoring raptor nests. Interns from nearby universities or groups such as the National Audubon Society would probably provide an inexpensive and interested work force. However, some time and effort would be required to solicit, interview, and organize volunteers. Optimally, one pair of qualified observers should work the entire season. Aid with room and board at the Monument might attract more dedicated and able volunteers. Hiring professional observers might be more expensive, but this would likely provide the best data. This option should be considered at least for the suggested major census every ten years. No matter what their origin, well-trained observers who understand the purpose of the monitoring program will produce the most accurate results. Once trained, Monument staff members could at least contribute year-round incidental observations of raptors.

Figure 9. Sample Nest Observation Data Sheet to Monitor Raptors at the Pinnacles National Monument.

NEST OBSERVATION DATA SHEET

Position of nest: Quad _____

Description of location:

Is the same hole being used?

Nearest climb:

Is the nest directly on or adjacent to this climb?

Date/Time	# of Adults seen	on eggs (#)	#young in nest	# fledglings	# climbers	Observations (prev items, hunting areas, human/raptor conflicts, sketches)

dates:

observer:

location:

Figure 10. Completed Nest Observation Data Sheet.

Location: JUNIPER CANYON
 SPECIES: Prairie Falcon
 observer: H. Cymerys
 dates: 4/10-6/3/87

Nest Observation Data Sheet

Position of nest: Quad 3 Description of location NW of Junction of Juniper Canyon trail and Tunnel Trail Is the same hole being used? yes
 Nearest climb: Teapot Domes Is the nest directly on or adjacent to this climb? same as 1983

Date/Time	# of adults seen	on eggs(#)	# young in nest	# fledgings	# climbers	observations (prey items, hunting area, human/raptor conflicts, sketches)
4/10 1040-1300	2	probably				both adults were seen out of the nest for a short period, calling. Then one flew into the nest and the other flew off - south.
5/8 1200-1300	1		2 seen			Adult (♀) was feeding young - two downy young observed.
5/21 0720-0800	2			5		The young are no longer in downy stage immature plumage. They are standing up calling. Both adults feeding them.
6/3 0910-0930				5 successfully fledged		The young are out of the nest on a nearby rock
						No climbers were seen at this site during observations but the nest is close to Juniper Canyon trail and a number of visitors have commented on their nesting.

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APPENDIX 1

Scientific names of raptors mentioned

Turkey Vulture- Cathartes aura

California Condor- Gymnogyps californianus

Black-shouldered Kite- Elanus caeruleus

Sharp-shinned Hawk- Accipiter striatus

Cooper's Hawk- Accipiter cooperii

Red-shouldered Hawk- Buteo lineatus

Swainson's Hawk- Buteo swainsoni

Red-tailed Hawk- Buteo jamaicensis

Golden Eagle- Aquila chrysaetos

American Kestrel- Falco sparverius

Peregrine Falcon- Falco peregrinus

Prairie Falcon- Falco mexicanus

Common Barn-Owl- Tyto alba

Western Screech-Owl- Otus kennicottii

Great Horned Owl- Bubo virginianus

Northern Pygmy-Owl- Glaucidium gnoma

Long-eared Owl- Asio otus

Northern Saw-whet Owl- Aegolius acadicus

Common Raven- Corvus corax

* Source 1982 American Ornithologists' Union Check-list of North American Birds

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