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CORMORANT NESTING
SAN LUIS OBISPO COUNTY, CALIFORNIA 1972 ^{1/}

by

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ABSTRACT

Reports of 1970 pelagic cormorant nesting failure and Brandt's cormorant reproductive distress in 1971 along the San Luis Obispo County coastline prompted a study in 1972. From April 15 through July 30, 1972, 63 pelagic cormorant nests were observed. Of these, 43 produced 106 eggs of which 44 hatched and fledged 38 birds.

Of the 100 Brandt's cormorant nests examined on Lion Rock on May 24, 1972, 57 were empty and 43 had eggs or young. Nine nests contained 15 young. Broken and thin shelled eggs were in evidence.

Factors contributing to depressed reproduction were undetermined.

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INTRODUCTION

Franklin Gress (1970) documented the reproductive failure of the California brown pelican on the Anacapa Island nest colony and linked the reproductive failure to thin-shelled eggs caused by DDT or a metabolite in the diet. This has raised serious concern over the possibility of similar reproductive failure by other seabirds.

Penhale (1972) expressed particular concern over the status of the pelagic cormorant (Phalacrocorax pelagicus) in 1970. Sixty-six eggs of pelagic cormorants failed to produce offspring in cliff colonies south of Montana de Oro State Park, San Luis Obispo County. The cause of reproductive failure was not determined, but Penhale suggested DDT in the diet as some pelagic cormorant eggs appeared soft-shelled and broke in the nest. He also suggested ground squirrel predation as a possible factor accounting for egg loss.

In 1971, Dr. T. L. Richards of California Polytechnical College, San Luis Obispo reported that the Brandt's cormorant (Phalacrocorax penicillatus) colony nesting on Lion Rock had exhibited reproductive distress. He examined 254 nests of which only 6 contained young; the remaining 248 averaged but 1.13 eggs per nest (Richards, per corr. 1971).

OBJECTIVES AND SCOPE

The objectives of the study were to determine the productivity of pelagic cormorant and Brandt's cormorant nest colonies on cliffs and near-shore rocks on Pecho Ranch property extending about 1.5 miles south from the southern boundary of Montana de Oro State Park, San Luis Obispo County.

STUDY AREA

The study area is located on private land south of, and immediately adjacent to, Montana de Oro State Park, San Luis Obispo County (Figure 1). Pelagic cormorants nest on ledges on verticle walls of the large near shore rocks and steep faces of shoreline cliffs.

At the extreme southern end of the Pecos Ranch, a colony of Brandt's cormorants nest on Lion Rock (Figure 1). Lion Rock, a small island 100 meters offshore, is located $\frac{1}{2}$ mile north of the Pacific Gas and Electric Diablo Canyon Nuclear Plant Facility which is presently under construction.

Wind prevails from the west with gusts from about 10-20 knots. Temperature ranged in the mid fifties to low seventies from March to June with full sun the rule. From mid June to the end of the study in July a morning and evening fog was common bringing the temperature down slightly. Rainfall was infrequent. Sea conditions were dependent on the amount of wind but were usually calm.

The adjacent shore area is grassland used for cattle grazing most of the year. The bluffs and grasslands support a high population of beechey ground squirrels (Otospermophilus beecheyi). At night the beaches and bluffs are frequented by foraging raccoons (Procyon lotor) and striped skunks (Mephitis mephitis). In addition to pelagic cormorants, other birds commonly seen during breeding season included the western gull (Larus occidentalis), black oystercatcher (Haematopus bachmani), and Brandt's cormorant (P. penicillatus) which nested in the area. An expanded species list of the area can be found in Appendix I.

METHODS

Aerial photographs of the study area were obtained prior to field work. A map of the shoreline was prepared based on photographs (Figure 2). A transect was established extending from the mouth of Coon Creek, 1.3 miles south. All nest colonies were visited on foot and observed directly or with the aid of binoculars. Nest contents were recorded in a notebook or on tape. Nesting colonies were visited at approximately four day intervals. Each nest was given a number and followed until abandoned. Photographs of each nest colony were taken by the author. Collection of eggs for shell thickness measurement and pesticide analysis was impossible because of the inaccessibility of the nest sites.

LIFE HISTORY

Pelagic cormorants are year round residents along the Pacific coast of the United States and Canada. The winter range extends south to the central Mexican coast (Bent 1964).

Breeding plumage of the pelagic cormorant, which is the smallest cormorant along the California coast, is much brighter than the winter plumage. The neck and back have a metallic blue-green sheen. The face patch is red and the two crests may be difficult to see. The best field mark in the spring is the white flank patches that clearly mark it an adult pelagic cormorant.

The pelagic cormorant nests on small ledges and outcroppings of ocean bluffs and offshore rocks and is extremely shy about its breeding grounds. Clutch size averages 3-5 eggs and young hatch after an incubation period of 26 days (Bent op. cit.). Nestlings orient themselves towards the face of the cliff. Young do not flee the nest when threatened as do the young Brandt's cormorants which are not cliff nesters. Apparently this is an adaptation to cliff nesting (Emlen 1963). Fish are brought to the nest by the parents and regurgitated for the young.

The immature are dull brown with washed out brown underparts and do not molt into the breeding plumage until the second year (Bent op. cit.).

Pelagic cormorants are usually silent and make only hoarse moaning sounds. When disturbed they vibrate their gular sac in an apparent threat display. Nestlings exhibit this behavior when the nests are approached too close.

CORMORANT NESTING
Pelagic Cormorant

Nesting had begun before the field work so the first date of nest building and egg laying for the 1972 season is unknown. However, Penhale reported that in 1970 nest building began April 4 and egg laying began April 18 with the last egg hatching July 26. On April 15, 1972 when the field work for this study began, several nests already had eggs. On April 21 the first young hatched indicating a much earlier onset of breeding than in 1970.

Nests were constructed primarily of seaweed and grass. As the season progressed, the top and outer edges of the nest and rocks below took on a white color from the excrement of the cormorants. This made it easy to spot nests on the foggiest days.

Seven nest colonies were located, 3 on nearshore rocks and 4 on bluffs of the mainland (Figure 2). Each colony was given a number and each nest was assigned a letter. Nest colony #1 had 6 nests, #2 had 5 nests, #3 had 12 nests, #4 had 6 nests, #5 had 9 nests, #6 had 10 nests and #7 had 15 nests. Typical of the pelagic cormorant, nests were located on narrow ledges and outcroppings of nearly verticle stone cliffs.

OBSERVATIONS
Pelagic Cormorant

Nesting

Table 1 lists number of eggs in each nest and eggs observed. This record is complete as possible as nests were not checked daily. The number of eggs counted is therefore a minimum number. Appendix B is the individual history of the pelagic cormorant nests observed during the study.

Twenty of the 63 nests produced no eggs. Nests with 2 or 3 eggs occurred in 29 nests and the maximum number of eggs observed in any one nest was 5. Each colony appeared to have more adult burds in the area than the number of nesting pairs. Whether this was due to shortage of nest sites or presence of a certain percentage of nonbreeding birds was undetermined.

TABLE 1
Pelagic Cormorant Nesting

<u>Colony</u>	<u>Number of Eggs Per Nest</u>					<u>Nests</u>	<u>Eggs</u>	
	<u>0</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>			<u>5</u>
1	-	2	3	1	-	-	6	11
2	4	-	1	-	-	-	5	2
3	1	1	2	5	2	1	12	33
4	2	1	3	-	-	-	6	7
5	3	1	2	3	-	-	9	14
6	1	-	3	2	3	1	10	29
7	2	2	4	-	-	-	15	10
Total	20	7	18	11	5	2	63	106

Hatching Success

Clutch size averaged 2.2 eggs in 1970 and 2.5 eggs in 1972. Twenty nests were abandoned after cormorants had been observed occupying them. Forty-one percent of all eggs observed hatched. Of the 106 eggs laid in the 43 nests, 44 hatched and fledged 38 young. Sixty two eggs (58%) failed to hatch and disappeared from the nests during the period of incubation. Table 2 summarizes the hatching success and Table 3 identifies the colonies and eggs lost during incubation.

TABLE 2
Hatching Success*

	<u>Nests</u>	<u>Eggs</u>	<u>Eggs Hatched</u>	<u>Hatched/ Nest</u>	<u>Percent Hatched</u>
Nesting, 1970 (Penhale)	30	66	2	0.1	3
Nesting, 1972	43	106	44	1.0	41

Note: An additional 20 nests produced no eggs

Examination of Table 3 reveals that 62 eggs disappeared from the nests during the laying and incubation period. This accounted for 58 percent of the eggs. Significantly 78% of the eggs lost disappeared from the mainland colonies; whereas, only 29% of the eggs lost were from colonies located near shore rocks. This mortality difference might be indicative of mammalian predation.

TABLE 3
Egg Loss

<u>Colony</u>	<u>Eggs Laid</u>	<u>Eggs Lost</u>	<u>Percent Loss</u>
Mainland			
1	11	6	54
2	2	-	-
3	33	22	67
6	29	23	79
	<u>75</u>	<u>53</u>	<u>71</u>
Offshore			
4	7	2	29
5	14	5	36
7	10	2	20
	<u>31</u>	<u>9</u>	<u>29</u>

Brandt's Cormorants

Observations of Brandt's cormorant nesting was limited to a May 24, 1972 landing on Lion Rock. One hundred Brandt's cormorant nests were examined and 51 eggs and 15 young were counted. Table 4 summarizes the findings.

TABLE 4
 Brandt's Cormorant Nesting
 Lion Rock, San Luis Obispo County, 1972*

<u>Nests</u>	<u>Eggs Per Nest</u>	<u>Young Per Nest</u>	<u>Eggs</u>	<u>Young</u>
57	0	-	0	-
25	1	-	25	-
7	2	-	14	-
2	3	-	6	-
1	-	1	-	1
5	-	2	-	10
2	2	1	4	2
<u>1</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>
100			51	15

Note: Observation made on May 24, 1972

The ground between the nests was littered with broken egg shells and dead embryos. Many of the shells appeared thin. One egg had no shell at all. Ten eggs were collected, each from a different nest. No eggs were collected from nests containing young. Six of the eggs were in satisfactory condition and were submitted to the Pesticides Investigation Section at the Department's field station. Inconsistency in chemical analysis of pesticide residues resulted in discard of the laboratory analysis.

DISCUSSION

Cause of pelagic cormorant egg lost and failure of 20 nests to produce eggs could not be identified. Nest colonies are located on private property and are not accessible to the public. Human disturbance is at a minimum. During the study, nest sites were approached by the investigator as quietly as possible to minimize disturbance. At two colonies some disturbance could not be avoided because nest contents could not be determined without approaching the nests directly from above. The proximity of the investigator at these sites frightened adult cormorants and caused nest abandonment. Colony 1 produced 2 offspring from 1 nest; but, 4 other nests were abandoned without producing eggs. Colony 6 produced 6 offspring from 3 nests with 2 nests abandoned without producing any eggs.

Predation by mammals on the mainland colonies is a possible factor reducing productivity. Ground squirrels occupy the bluffs and adjacent fields and could be robbing eggs from the nests. The author did not observe squirrels taking eggs; however, many nests appeared to be accessible to such predation. Western gulls nesting on the mainland suffered 100% egg loss attributable to squirrel depredation. Raccoons frequent the bluffs and beaches nightly and could be another source of predation. Gulls although mentioned in literature as the greatest enemy of cormorants (Bent op. cit.) were never observed taking cormorant eggs although in many cases nests were left unattended for several minutes.

There was evidence of broken shells in 3 nests (1 had 2 flattened eggs) but the cause of breakage is not known. These eggs did not have holes nor were shell fragments scattered as they would be if a predator had fed on their contents. Unfortunately because of the inaccessibility of the nests and inability of the author to approach these nests by rope, pelagic cormorant eggs could not be collected.

RECOMMENDATIONS

To more fully determine the productivity of pelagic cormorant and Brandt's cormorant nesting, it is recommended that:

1. The Cormorant nesting study on the Peco Ranch, San Luis Obispo County, be continued another breeding season.
2. Special effort be made to collect eggs for pesticide residue determination.
3. Effort be directed to determine if mammalian predation is occurring and to what degree.

LITERATURE CITED

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- Penhale, Leonard. 1972 Reproductive failure of pelagic cormorant, San Luis Obispo County, California, 1970. Calif. Dept. of Fish and Game 58(3): 238.
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APPENDIX A
Animals Observed in Study Area

MAMMALS

Black-tailed jackrabbit (Lepus californicus)
Cottontail (Sylvilagus audubonii)
Beechey ground squirrel (Otospermophilus beecheyi)
Coyote (Canis latrans)
Long-tailed weasel (Mustela frenata)
Badger (Taxidea taxus)
Striped Skunk (Mephitis mephitis)
Bobcat (Lynx rufus)
Mule deer (Odocoileus hemionus)

BIRDS

Brown pelican (Pelicanus occidentalis)
Double-Crested cormorant (P. auritus)
Brandt's cormorant (Phalacrocorax penicillatus)
Black oystercatcher (Haematopus bachmani)
Surf bird (Aphriza virgata)
Willet (Catoptrophorus semipalmatus)
Glaucous-winged gull (Larus glaucescens)
Western gull (L. occidentalis)
Herring gull (L. argentatus)
Ringed-billed gull (L. delawarensis)
Heermann's gull (L. heermanni)
Sabine's gull (Xema sabini)
Forster's tern (Sterna forsteri)
Caspian tern (Hydroprogne caspia)

APPENDIX B

Individual Histories of Pelagic Cormorant Nests, San Luis Obispo County, 1972

Colony #1	Observation Date														
	4/15	4/21	4/28	5/5	5/13	5/23	5/29	6/3	6/9	6/15	6/25	7/4	7/11	7/18	7/30
A	0	0	0	0	0	2E	2E	2E	0	abandoned					
B	1E	1E	0	abandoned											
C	1E	2E	0	abandoned											
D	1E	3E	3E	3E	2Y	2Y	2Y	2Y	2Y	2Y	1Y	1F			
E	2E	2E	2E	2Y	2Y	2Y	2Y	2Y	2Y	2Y	2F				
F				1E	0	abandoned									
#2															
A	C	0	abandoned												
B	0	0	abandoned												
C	0	0	abandoned												
D	C	0	abandoned												
E	C	C	1E	2E	C	C	2Y	2Y	1Y	1Y	1F				
#3															
A	C	C	C	C	2Y	2Y	2Y	2F							
B	C	C	C	0	0	abandoned									
C	C	C	C	C	C	1Y	1Y	1Y	1Y	1Y	1F				
D	C	3E	1Y	1Y	1Y	1Y	1F								
E	C	0	0	0	2E	3E	3E	3E	2E	2E	2Y	2Y	2Y	2Y	2F
F	C	4E	4E	4E	C	2Y	1Y	1Y	1Y	1Y	1Y	1Y	1Y	1F	
G	C	C	4E	C	3E	C	2E	1E	0	abandoned					
H	C	2E	C	C	0	3E	3E	3E	2E	1E	0	abandoned			
I	C	1E	3E	C	C	2Y	2Y	1Y	1Y	1Y	1Y	1F			
J	C	1E	C	C	0	2E	1E	0	abandoned						
K	C	C	3E	2E	2E	0	abandoned								
L	C	C	C	2E	1Y	1E	1Y	1Y	1Y	1Y	1Y	1F			
#4															
A	C	C	C	0	C	C	C	C	0	0	abandoned				
B	C	C	C	C	C	2Y	2Y	2Y	2Y	2Y	2F				
C	C	C	C	2Y	C	2Y	C	2Y	2Y	2F					
D	0	C	C	2E	0	abandoned									
E	0	C	C	0	0	C	C	C	C	C	C	1Y	C	0	
F						C	0	C	0	0	abandoned				

APPENDIX B continued

4/15 4/21 4/28 5/5 5/13 5/23 5/29 6/3 6/9 6/15 6/25 7/4 7/11 7/18 7/30

Colony

#5

A	C	C	2Y	2Y	2Y	1Y	1Y	1F									
B	C	C	1Y	1Y	C	3Y	3Y	3Y	3Y	3Y	3F						
C	C	C	1Y	1Y	3Y	3Y	3Y	3Y	3Y	3Y	3Y	3F					
D	C	C	0	C	C	0	C	C	C	0	0	abandoned					
E	C	C	0	0	0	abandoned											
F	0	2E	0	1E	0	0	0	C	0	0	abandoned						
G	0	0	0	0	0	0	0	0	0	0	2E	0	0	abandoned			
H						C	0	0	0	0	C	1E	1E	0			
I							C	0	C	0	abandoned						

#6

A	C	2E	2E	0	0	2E	3E	0	0	0	abandoned						
B	C	2Y	2Y	2Y	2Y	2Y	2Y	2F									
C	4E	1E	0	abandoned													
D	3Y	2Y	2Y	2Y	2Y	2Y	2Y	2F									
E			4E	3E	2E	0	0	0	0	abandoned							
F				1E	4E	3E	3E	2E	2E	0	0	abandoned					
G				C	0	C	0	0	0	abandoned							
H				C	0	0	1E	2E	1E	0	abandoned						
I					C	1E	2E	2Y	2Y	2Y	2Y	2Y	2Y	2Y	2Y	2F	
J					C	2E	3E	3E	2E	1E	1E	1E	1E	1E	1E	0	

#7

A	C	C	C	C	C	0	abandoned										
B	C	C	C	C	C	C	2Y	2Y	2Y	2Y	2Y	2Y	2Y	2F			
C			C	C	0	abandoned											
D			C	C	C	C	C	1Y	1Y	1Y	1Y	1Y	1Y	1Y	1F		
E			C	C	C	C	C	0	C	0	0	abandoned					
F			C	C	C	C	C	0	C	0	abandoned						
G			C	C	2Y	2Y	2Y	2Y	2Y	2Y	2Y	2F					
H			C	C	C	C	C	0	0	abandoned							
I			C	C	C	C	C	0	0	abandoned							
J			C	C	C	C	C	1Y	1Y	1Y	1Y	1F					
K			C	0	2E	0	abandoned										
L			C	C	2Y	2Y	2Y	2Y	2Y	2Y	2F						
M			C	C	C	C	C	C	0	0	abandoned						
N			C	C	0	C	0	0	C	0	abandoned						
O			C	C	C	C	C	C	C	0	abandoned						

KEY:

- C: covered by adult
- E: eggs
- Y: young
- F: fledged
- 0: empty

FIGURE I
Location of Pecos Ranch

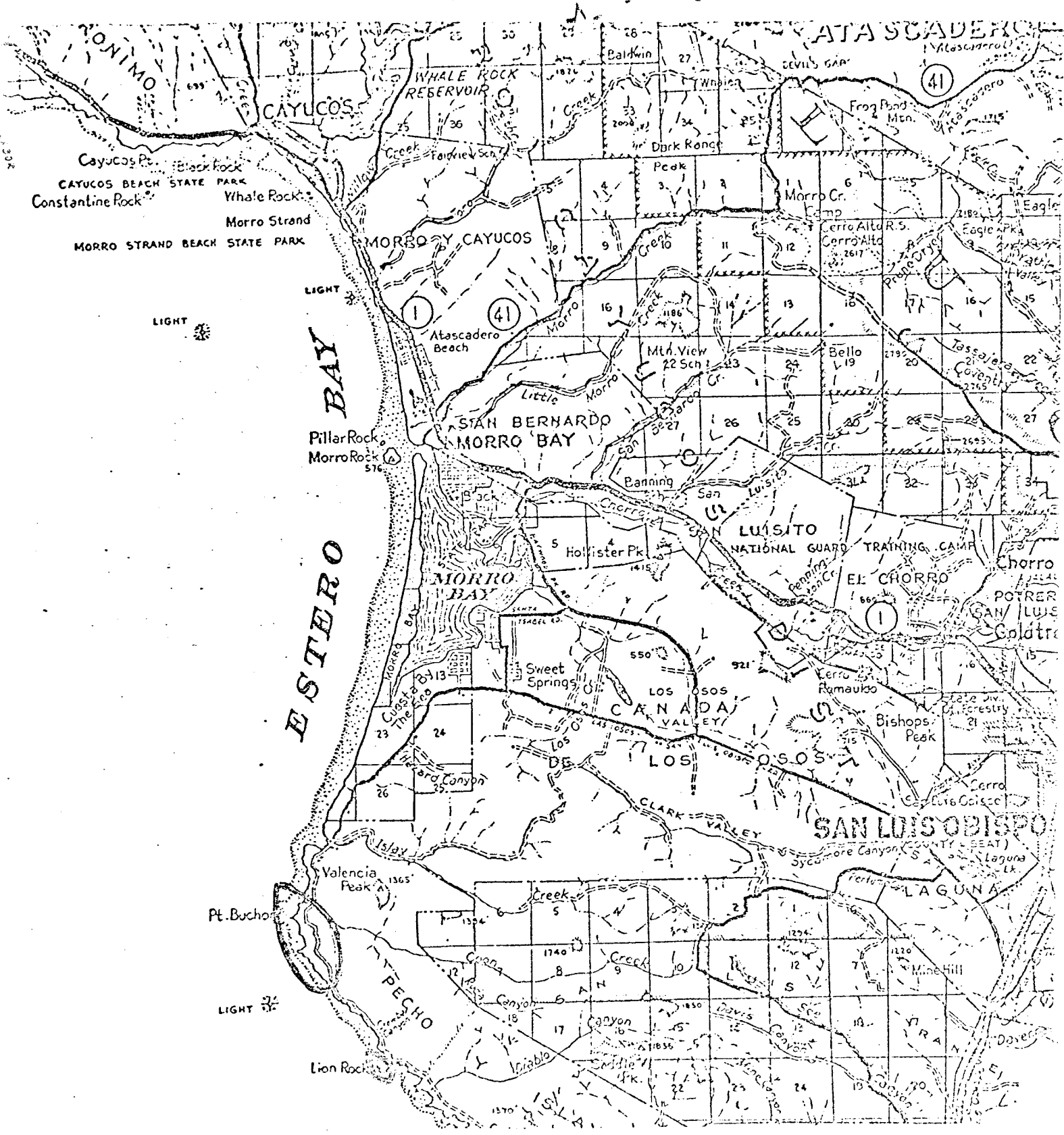


FIGURE 2
Location of Pelagic Cormorant Nest Colonies

