

**BALD EAGLE NESTING AND PRODUCTIVITY  
KATMAI NATIONAL PARK  
1994**

Abstract

Eagle surveys were conducted in Katmai National Park and Preserve in the Naknek drainage using fixed-wing aircraft. The activity/productivity dual survey method has been used at Katmai since 1991. A better defined version of the dual survey method was developed into a Protocol for eagle survey and used since 1993. Activity surveys were conducted in early May and productivity surveys were conducted in late July. All nesting locations were mapped on USGS maps. Additionally, during the Production survey, biologists employed the use of a lap top computer in conjunction with the airplane Global Positioning System to pinpoint locations of nests. Productivity values were calculated and are reported based on occupied, and the more specific subsets active and successful nests. All measures of productivity show declines since 1991, but because methods have been adjusted since that date, and standardized only since 1993, productivity data are statistically comparable only for 1993 and 1994. No statistical differences in productivity are demonstrated between these years. Information gathered during these flights was also used to report total bald eagles observed in May, estimate egg laying date for the population, describe nesting substrate, describe individual nest site use, and calculate distances between occupied nests. Additional information was collected and summarized from historic records with regard to territory occupancy (beyond nest occupancy).

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## INTRODUCTION

Pilot Joel Collins and I conducted surveys of nesting bald eagles (*Haliaeetus leucocephalus*) during 1994 in the Naknek drainage of Katmai National Park. We met the following objectives: 1) locate and accurately map all observed nests within the study area, 2) estimate eagle nesting productivity, and 3) to continue to gather information necessary to standardize surveys from year to year within the park and with areas outside of the park. The history of eagle studies at Katmai may be found in Savage (1993a), Savage (1993b) and Dewhurst (1991) and for the Alaska Peninsula in Dewhurst (1991).

## STUDY AREA AND METHODS

### Observations

We conducted aerial surveys using a Cessna 206 (on wheels for the May survey and on floats for the July survey) as described in the "Katmai Eagle Survey Protocol" (Savage, 1993a. Appendix I; Savage 1993b. Appendix II). The same areas outlined in this Protocol were surveyed except that we surveyed only downstream of the waterfall on Margot Creek, and did not survey downstream of the Grassy Island in the outlet of Naknek Lake (See Figure 1). Activity surveys were conducted on May 6 and 9, and the productivity survey was conducted on July 25. See attached memo's (Appendix I) for details.

During the activity survey, I collected data about each nest and each individual raptor as outlined in the Protocol. All individual eagles and nests were marked on 1:63,300 USGS maps which are kept for the sole purpose of eagle surveys. These maps were updated with all locational information about eagles collected since 1991. Using these historic data and the 1994 nest information, nest were renumber in 1994 as suggested in the Protocol (see Appendix II). Later, all locations (latitude and longitude) from occupied<sup>1</sup> nests were determined from the maps and these data were used in a demonstration of the ArcView software. This was the first step in recording this information for use in the Katmai Geographic Information System.

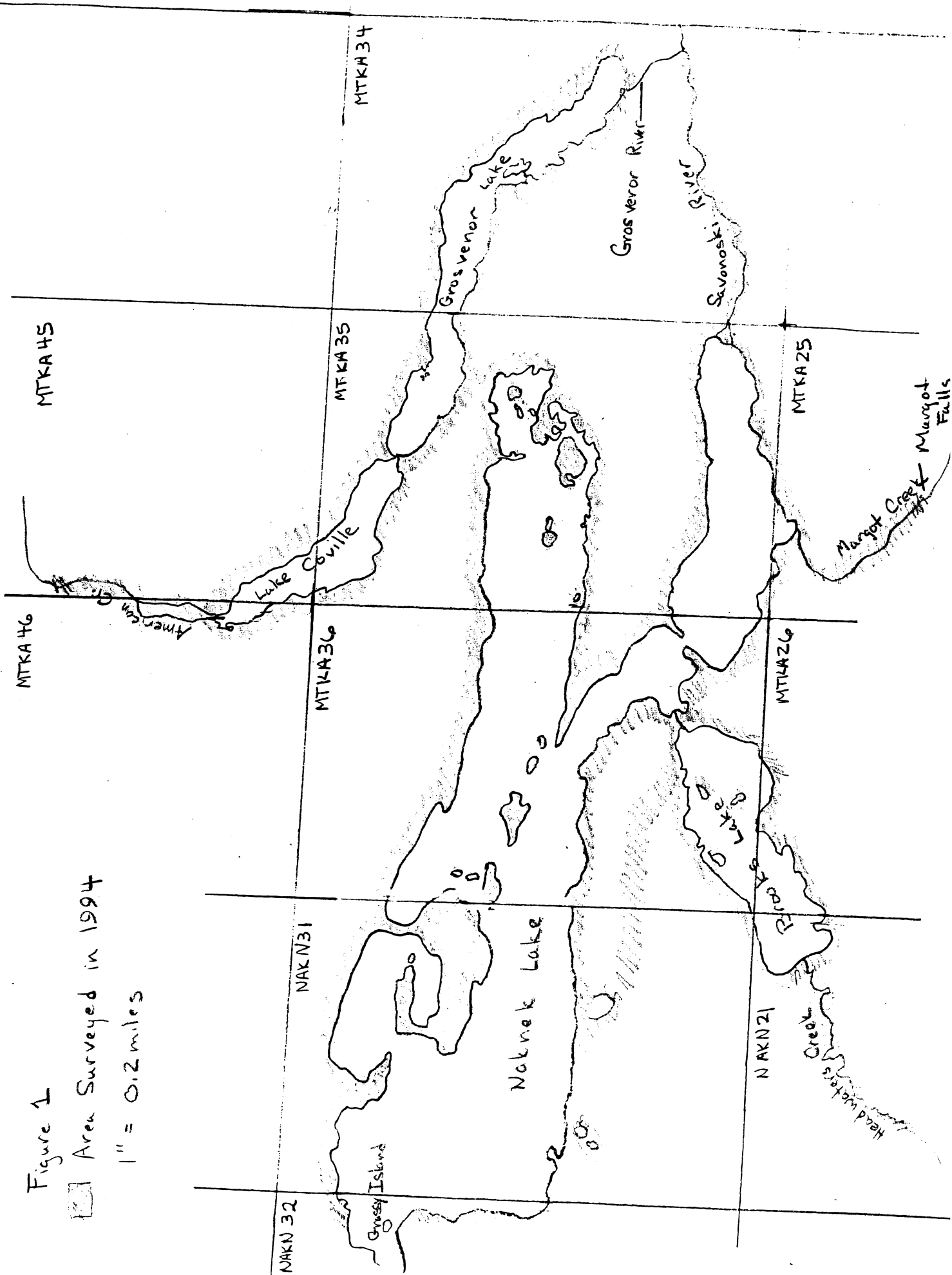
Nesting activity was described as suggested in the Protocol with the inclusion of the activity code "E?" (questionably empty; possible fresh material in the nest). Two nests were marked as such to ensure rechecking during the productivity survey. One of the nests marked as "E?" was later scored as "Occupied" because two adults were present on the Production survey and that particular nest was noted to be good shape on the activity survey. One of the nests marked at "E?" was scored as "Empty" because I was not confident that nest had signs of fresh material and therefore any likelihood of occupancy.

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<sup>1</sup> The term "occupied" nest will included the subset "active" nest as defined by Postupalsky (1974). In the text, I will continue to report values for the subset "active." Because of survey dates and methods used in 1991, these data are more comparable to the "active" subset. To be able to continue making comparisons to 1991 I have retained the "active" delineation for some comparisons.

Insert Figure 1

Figure 1  
 Area Surveyed in 1994  
 1" = 0.2 miles





APPENDIX IV. Naknek Bald Eagle Nest Data, 1994

MAP No.	NST No.	S1 AC	S2 AC	S1# ADT	S1# Egg	S2# ADT	S2# CHK	CHK STG	NEST SUBSTRATE	S1/S2NOTE
NAKN31	02B	A	A1	2	U	2	1	3B	SPRUCE	IN AREA INCUBATING, NEW NEST-OLD TERRI
MTKA34	003	E		0	0	0	0		COTTONWOOD	EMPTY, BAD SHAPE
MTKA34	004	E		0	0	0	0		COTTONWOOD	EMPTY, BAD SHAPE
MTKA34	005	E		0	0	0	0		COT,ISL	EMPTY, GOOD SHAPE
MTKA34	007	E		0	0	0	0		COTTONWOOD	EMPTY
MTKA34	02A	E		0	0	0	0		COTTONWOOD	OLD,BAD SHAPE
MTKA34	02B	E?	E	0	0	0	0		COTTONWOOD	GOOD SHAPENEST CHECKED, NO ACTIVITY
MTKA35	001	E		0	0	0	0		COT,ISL	POOR CONDITION
MTKA35	008	E		0	0	0	0		COTTONWOOD	EMPTY, OLD, BAD SHAPE
MTKA35	010	E		0	0	0	0		COT,ISL	EMPTY
MTKA35	013	E		0	0	0	0		SPRUCE	EMPTY,BAD SHAPE
MTKA35	014	E		0	0	0	0		COTTONWOOD	OLD,BAD SHAPE
MTKA35	06B	E		0	0	0	0		COTTONWOOD	EMPTY,OLD
MTKA35	11A	E		0	0	0	0		SPR,ISL	EMPTY
MTKA35	12A	E		0	0	0	0		COTTONWOOD	EMPTY
MTKA35	12B	E		0	0	0	0		COTTONWOOD	EMPTY
MTKA35	15B	E		0	0	0	0		COTTONWOOD	OLD
MTKA36	01B	E		0	0	0	0		NOT NOTED	OLD,EMPTY
NAKN21	003	E		0	0	0	0		COTTONWOOD	EMPTY
NAKN31	001	E		0	0	0	0		COTTONWOOD	EMPTY

APPENDIX IV. Naknek Bald Eagle Nest Data, 1994

MAP No.	NST No.	S1 AC	S2 AC	S1# ADT	S1# Egg	S2# ADT	S2# CHK	CHK STG	NEST SUBSTRATE	S1/S2NOTE
MTKA25	002	O	F	1	0	2	0		COTTONWOOD	PERCH NEAR NEST, NO EGGS/ TERR OCCUPIED, NO PRODUCTION
MTKA34	008	A	A1	1	U	1	1	3B	COTTONWOOD	INCUBATING, lat/long by GPS
MTKA35	003	A	F	1	U	0	0		COTTONWOOD	INCUBATING/NEST EMPTY
MTKA35	016	O	F	1	0	0	0		SPRUCE	ADLT PERCH BY NEST/ NO ACTIVITY, NO PRODUCTION
MTKA35	017	A	NF	1	U	2	0		COTTONWOOD	INCUBATING/NEST NOT FOUND, ADULTS PRESENT
MTKA35	06D	O	F	1	0	0	0		SPRUCE, ISL	PERCH NEAR NEST /NO ACTIVITY, NO PRODUCTION
MTKA35	15A	A	F	1	U	0	0		COTTONWOOD	INCUBATING, lat/long by GPS/ NEST EMPTY, NO ACTIVITY NO PRODUCT
MTKA36	004	O	F	2	0	2	0		COTTONWOOD	AD PERCH BY NEST/ TERRITORY OCCUPIED, NO PRODUCT
MTKA36	006	O	F	2	0	2	0		COTTONWOOD	PERCH BY NEST /TERRITORY OCCUPIED, NO PRODUCT
MTKA36	01A	A	F	2	U	0	0		SPRUCE	INCUBATING/NEST EMPTY, NO ACTIVITY
MTKA36	002	EO	F	0	0	2	0		COT, ISL	NO ADULTS/ TERRITORY OCCUPIED, NO PRODUCTION
MTKA45	001	A	F	1	U	2	0		COTTONWOOD	INCUBATING/NEST EMPTY, NO PRODUCTION
MTKA46	002	A	F	2	U	1	0		DEAD SPRUCE	INCUBATING/ NEST EMPTY
NAKN31	003	A	A2	1	0	0	2	3C	COTTONWOOD	INCUBATING
NAKN31	004	A	A1	1	U	2	1	3C	COTTONWOOD	INCUBATING
NAKN31	005	A	A2	1	U	1	2	3B	COTTONWOOD	INCUBATING, NEW NEST-NEW TERRI /ONE CHK 3B, ONE CHK 3C
NAKN31	006	A	NF	2	U	0	0		SPRUCE	NEW, INCUBATING/ NEST NF, 0 ADULTS



During the productivity survey we revisited all occupied and questionably empty nests. Additionally, in our desire to look for territory occupancy (a step beyond nest occupancy), we checked 9 of 14 areas where two adults had been sighted on the activity survey. The pilot flew a clockwise pattern around the drainage, however he flew straight from known nests or adult pair sightings to other nests or pair sightings and did not follow the lake margin. During this survey a Student Conservation Association volunteer, Sarah Stuart, sat in the right front seat and assisted in observation and mapping. We used a lap top computer connected to the airplane GPS unit to record the path of the survey (recorded a coordinate every second). Exact nest locations were "hot keyed" into the computer. We recorded, on paper, the attributes about the nest (number of adults, number of chicks, chick stage, and confirmation of nest substrate). Attributes recorded about the "territory" included number of adults present and presence of a historic nest.

### Analysis

On the activity survey, observations of all individual eagles were recorded by eagle age. These will be qualitatively compared to previous years' observations.

Data regarding each nest and adult pair were entered into a dBase file (eagnak94.dbf) of the structure similar to that identified in the Protocol. Several fields were added to the structure of the file to accommodate information about the adult pairs (see Appendix III). A print out of the 1994 nest data is attached in Appendix IV. Information about territories will be presented in Table 4.

This year's nest locations are displayed in Figure 2. The convention of measuring in miles is retained because of the convenience of section numbering from USGS maps. Mapped nest locations (on 1:63,300 field maps) were used to measure straight line distances between all occupied nests. Distances were measured to the nearest 0.1 miles and the mean distance between nests was calculated. Distances between occupied nests (rounded to the nearest 1/2 mile in 1992) were compared between 1992, 1993, and 1994 using a one way ANOVA.

Nest substrate use is reported in table format and described in the text.

I calculated egg laying date (ELD) using the instructions in Bowman (1992) and Appendix II of Savage (1993a). For all nests observed in 1994, the adults were incubating or brooding during the activity survey. Therefore no information on presence of eggs versus chicks or chick age is available from the first survey. ELDs were calculated using chick age from the productivity survey. ELDs were compared between 1992, 1993, and 1994 using a Mann-Whitney U-Test.

Individual nest histories were used to describe nest reoccupancy from 1992 to 1994.

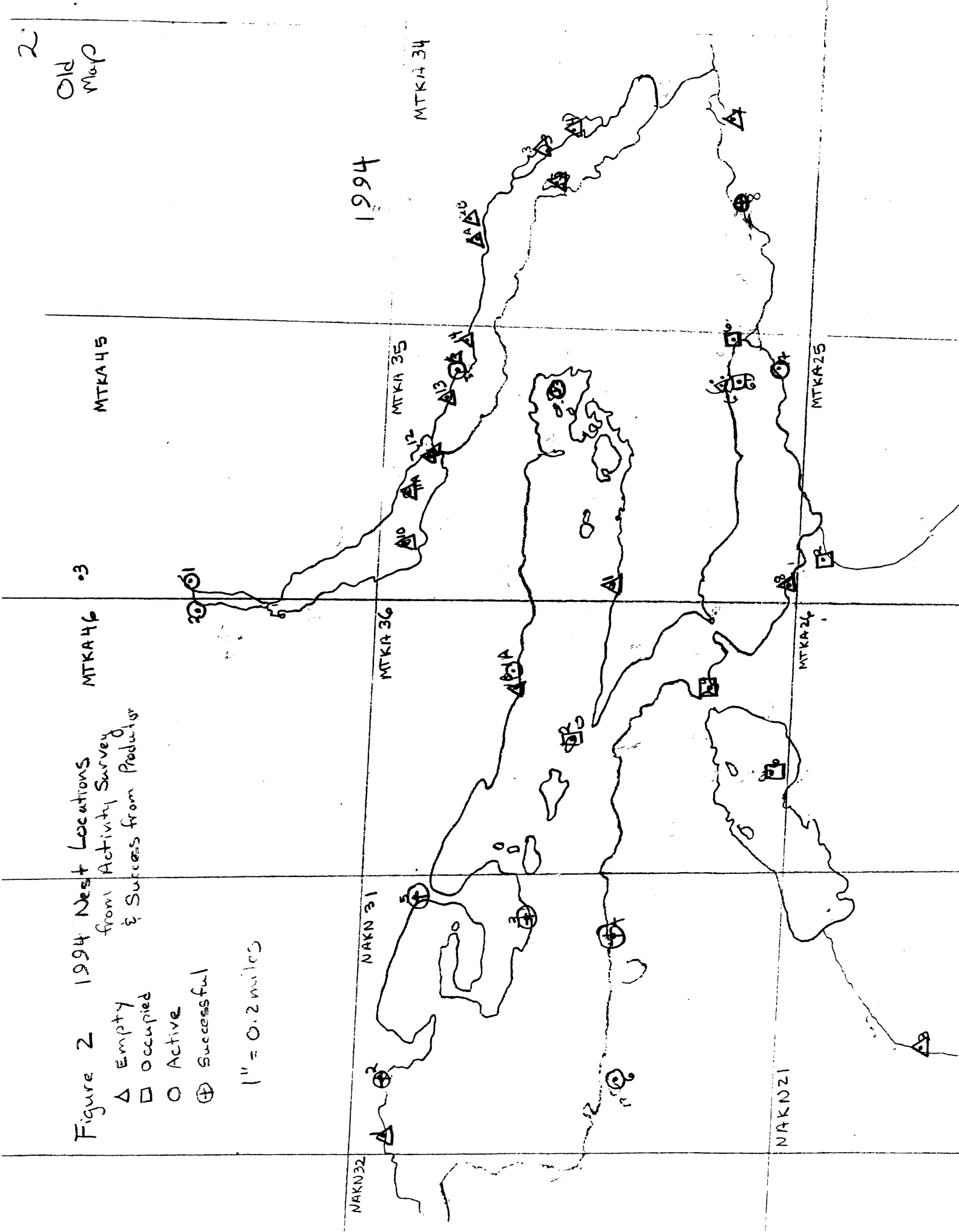
Insert Figure 2

2.  
Old Map

Figure 2 1994 Nest Locations  
from Activity Survey  
& Success from Production

- △ Empty
- Occupied
- Active
- ⊕ Successful

1" = 0.2 miles





Nest productivity data were reported as raw values and as calculated values as suggested in the Protocol. Only those nests observed on both surveys (except empty nests which were not revisited) were used for the productivity tables and calculations. Productivity values were calculated by taking the mean number of chicks per each category of nest success. All chicks observed on the productivity survey had reached stage 3; stage 3 is the criteria used to score a nest as successful. Because of significant survey timing differences between previous years and the 1993 and 1994 surveys, statistical comparisons before 1993 will not be made. Although the activity surveys were conducted slightly earlier this year (see biases), statistical comparisons between 1993 and 1994 productivity data were conducted. I used the Mann-Whitney U-test to compare chicks per successful nest, chicks per occupied nest, and the subset - chicks per active nest. This test was applied to individual nest productivity values (e.g., for chicks per successful nest the number of chicks in each successful nest was compared; for 1993 the values were 1,1,2,2,2,2 versus 1994 values of 1,1,1,2,2).

Information will be presented describing nest reoccupancy as done in 1993. Information about territory occupancy resulting from rechecking areas where pairs were spotted in May will also be presented. Information was categorized and mapped and will be presented in descriptive format.

## **RESULTS & DISCUSSION**

Collins and I flew activity surveys on May 6 and 9, a week earlier than in 1993. We flew out on May 6 to see if nests had been initiated (the previously calculated 90% ELD for the Naknek Drainage was May 3). Finding two nests with incubating females, we decided to go ahead and begin the survey. It is desirable to conduct the activity survey shortly after the expected ELD so that all initiated nests may be found and early nesting failure will be documented. Productivity therefore is based on number of nests initiated. We flew the productivity survey on July 25, about the same time as in 1993.

The area surveyed in 1994 compares to the 1993 survey except that in 1994 we did not survey the upper two miles of the Naknek River. One nest was known to be occupied in this area in 1994 (personal observation during a non-survey period), but no nests had been documented in this area in the past three years.

### Survey Scheduling

This was the second year that calculated ELD was used to schedule survey dates. In 1992 this area experienced an especially cold spring and in 1993 we experienced an especially warm spring. The 1993 ELD may have been skewed by nests that may have fledged before productivity was measured. (If fledglings were missed, this will cause the remaining data to result in a later calculated ELD and lower productivity values.) In 1994 we decided to use these early May dates to schedule the activity survey and we were pleased to see a high level of incubation on the nests that we deemed as occupied. I recommend conducting the activity surveys during 6-10 of May in future, unless we have a very cold spring. Better phenological data is needed to indicate to new biologists what defines a "cold spring."

Basing the productivity survey on this ELD, and figuring an incubation time of 5 weeks and approximately 7 weeks to Stage 3B chicks, the productivity survey should be conducted around July 25/26. Nests initiated two to three weeks prior to early May still should be detected with chicks in the 3D stage during a July 25 survey. However, to ensure that fledglings are not missed in future, I recommend scheduling the productivity survey closer to July 18-20 (unless, as above, it is a very cold spring).

#### Total Eagles

On the activity survey we observed a total of 67 bald eagles in the Naknek drainage. Eagles associated with nests included 22 adults (33%). Eagles not associated with nests at the time of observation included 45 adults (67%). In 1991 the total number of birds on the June activity survey was 50. In 1992 the total number of birds on the late May/June activity survey was 87. In 1993 the mid-May activity survey yielded 70 birds. In past years the number of immature birds observed during the activity surveys averaged around 16-18% (16% immatures in 1993, 16% immatures in 1992, and 18% immatures in 1991). In 1994, not one immature bird was observed during the activity survey. That is a significant change from past years that may be due to the timing of the survey or to factors unknown.

#### Nest Locations and Inter-nest Distance

Nest locations are presented above in Figure 2. This Figure indicates the position of empty, occupied nests, the subset of occupied nests that were active, and the subset of occupied that were successful. Nest locations are plotted as the best estimate of location by geographic features. GPS coordinates were also plotted for each nest location as "hot keyed" during the productivity survey. However, because of GPS scrambling and map inaccuracy, these often landed in the lake or in a geographic location known not to be "true." Therefore, latitude and longitude as calculated from maps and as reported from the GPS, each having a different use, were both entered into the database.

I calculated mean inter-nest distance to get an idea of territory size/habitat quality and tolerance distance between pairs. Occupied nests were fairly well dispersed in 1994 over the entire Naknek drainage. The mean distance between 18 occupied nests (all nests scored as "occupied" on the activity survey were used) was 4.0 miles ( $\pm 2.0$ ). This is less than the 4.4 miles ( $\pm 2.6$ ) reported in 1992, and greater than the 3.2 miles ( $\pm 2.7$ ) recorded in 1993. However, the smaller standard deviation in 1994 indicates that the nests were more evenly distributed. The range of distances between nests was 1.2 to 8.6 miles. Naknek system inter-nest distance was compared statistically for 1992, 1993 and 1994 using a one way ANOVA and was not found to differ significantly between years ( $F = 1.12$ ,  $df 2,50$ ).

It is interesting to note that although occupied nests were scattered evenly throughout the drainage this year, successful nests were geographically concentrated. Four of five successful nests were located in the west end of the lake, with the fifth nest being on the Savonoski River. Per the typical pattern, four of five of these nests are located on small creeks or on rivers. Three of the western lake nests had not been used in 1993.

### Nest Substrate

In 1994, Naknek system nests were located in cottonwood or spruce trees along the lake shore, or in trees on islands. See Table 1. Only occupied nests that were located on both surveys are included in Table 1. Most nests were located in cottonwood trees (69%). This was not always so in the past (see Savage, 1993a). Most nests were located on the mainland (80%), the rest on islands. No island nests successfully raised chicks this year.

TABLE 1. Nest Substrate Use

	<u>Empty</u>	<u>Occupied/ Success</u>	<u>Occupied/ Failed</u>	<u>Total</u>
Trees				
Cottonwood	13	4(6) <sup>1</sup>	6	23
Spruce	1	1(1)	3	5
Islands				
Cottonwood	3	0(0)	1	4
Spruce	1	0(0)	1	2
Cliff Top	0	0	0	0
Not Recorded	1	-	-	1
TOTAL				35

<sup>1</sup> Number in parenthesis represents number of young.

### Egg Laying Date

This was the third year that I made an attempt to calculate ELD. The estimated ELD was calculated using five nests. The range of estimated dates was April 21 (two nests) to May 5 (two nests). The range was somewhat reduced from 1993 (April 18-May 15) probably because of the small number of nests. The mean ELD was calculated to be April 28 and 90% of the eggs were predicted to be laid by May 4.

Mean ELDs were compared between the 1992 and 1994 and between 1993 and 1994 using Mann-Whitney U-tests. No significant differences between years were detected at the  $p=0.05$  level. [Test null hypothesis:  $ELD_{92} = ELD_{94}$  and  $ELD_{93} = ELD_{94}$  versus alternate hypothesis of not being equal, for 92 versus 94  $W=40.0$ , significant at 0.96, for 93 versus 94  $W=52$  significant at 0.61.]

### Nest Site History/ Reoccupancy

In 1993 I estimated territory occupancy only from nests that were found in 1993, and discounted territories known from old surveys. According to this method in 1993 I had 34 territories with 17 occupied for an occupancy rate of 50%. In 1994 I found 37 nests, 5 representing multiple nests on a territory for a total of 32 territories with 16 occupied nests. These also yielded an occupancy rate of 50%.

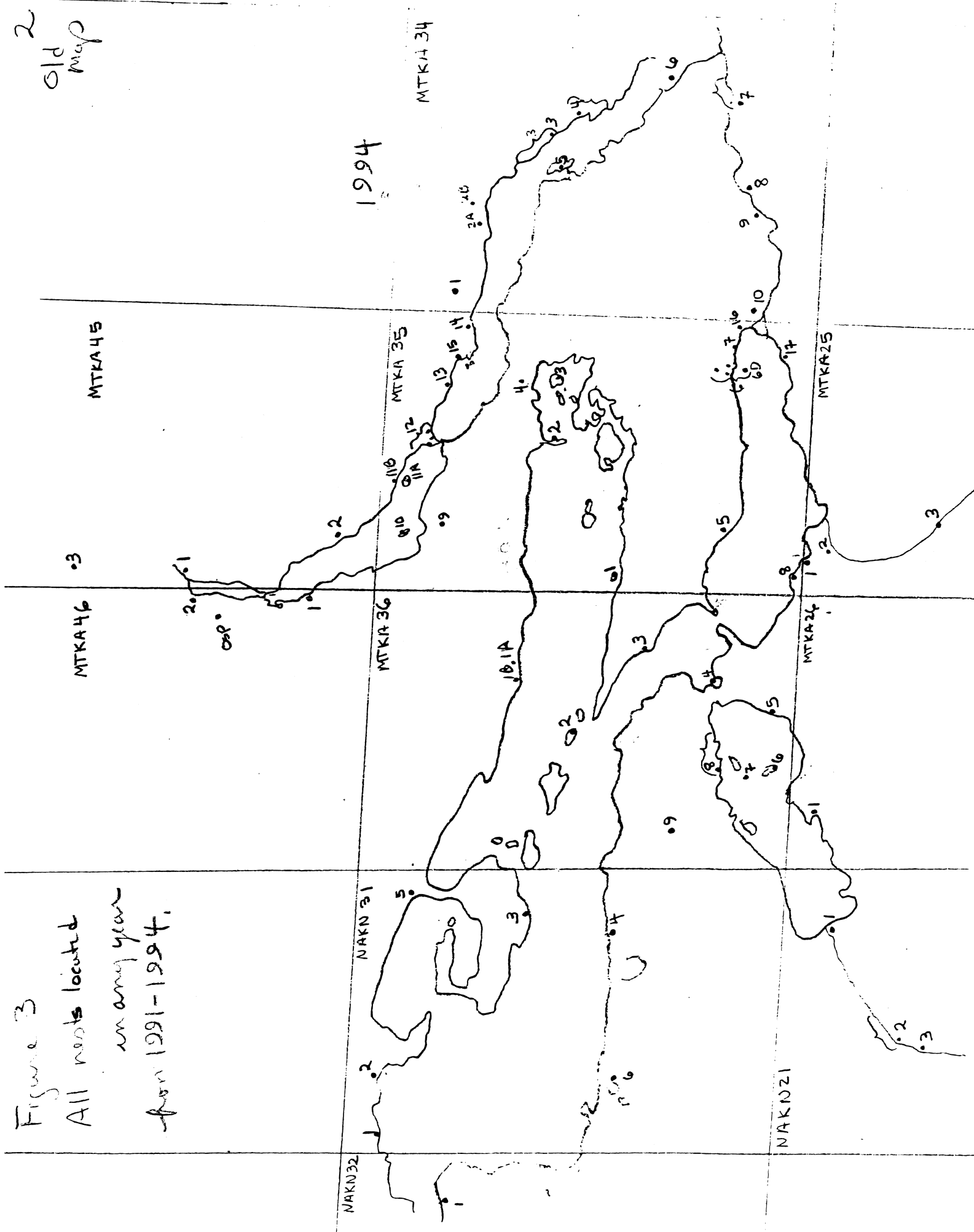
This year with the mapping of all known nests since 1991 and with the renumbering of nests, I gained a clearer picture of territory boundaries and the history of use of nests in these territories. Figure 3 locates all nests since 1991. Nests within one mile of each other were generally

Insert Figure 3



Figure 3

All nests located  
in any year  
from 1991-1994.



2  
Old map



grouped to form nest territories, unless two pairs of eagles simultaneously occupied those nests. Appendix II provides a review of the activity of individual nests/territories.

With this reorganization of data, a different picture of nest and territory reoccupancy can be summarized (also see below under "Breeding Territory Occupancy"). Twenty five nests were located in 1993 that were relocated in 1994. Seven of these nests were empty in 1993 and remained empty in 1994. Five nests that were empty in 1993 were occupied in 1994. Seven nests that were occupied in 1993 were occupied in 1994. Six nests that were occupied in 1993 remained empty in 1994. Using the 1992 calculation method on the 1994 data, the number of occupied nests in 1994 that were counted in 1993 (12) divided by the total 1993 nests relocated in 1994 (25) was 48%. Only two of five successful nests had been occupied and active in 1993.

Reoccupancy was also examined based on nests that were occupied in 1993. Of the 16 nests known to be occupied sometime in the 1993 season, 12 were relocated and only 7 of these were occupied in 1994. This is a reoccupancy rate of 58% (7/12). Of 6 known successful 1993 nests, 3 were occupied in 1994 and only 1 of these were known to be successful in 1994.

#### Nest Activity and Productivity

We observed a total of 37 nests on the activity survey. Of these, we found seventeen occupied, twelve of which were active, two questionably empty and eighteen empty. As mentioned above one of the questionably empty nests was later scored as occupied and one was scored as empty. All twelve active nests had actively incubating/brooding adults so the contents of the nest could not be seen. During the productivity survey two active nests were not relocated (MTKA35-017 and NAKN31-006) although one of these nests had two adults still present. These nests will be dropped from analysis. All six nests that were occupied but not active, failed to raise young. Of the ten active nests remaining in the analysis, five failed, three raised one chick, and two raised two chicks for a total of seven fledglings. Thirty-five nests had complete data from both surveys. These data are presented in Table 2.

In 1994, 0.44 (sd  $\pm$  0.73, n = 16) fledglings were raised per occupied nests, 0.70 (sd  $\pm$  0.82, n = 10) fledglings were raised per the active nest subset, and 1.40 (sd  $\pm$  0.55, n = 5) fledglings were raised per successful nest. Of sixteen nests scored as occupied on the activity survey, 31.3% raised at least one offspring; of ten nests scored in the active subset of occupied on the activity survey, 50% of these raised at least one offspring. Calculated productivity rates are reported in Table 3 for 1991 through 1994.

Productivity values may be used to compare data sets from different geographic areas or different years when survey methodologies are similar between sets. Katmai data sets from 1991-1994 are not completely comparable and these reasons are described in notes to Table 2. Statistical comparisons were applied to the 1993 and 1994 data sets. Mann-Whitney statistics comparing chicks per successful nest, chicks per occupied nest, or chicks per the subset active nest, do not detect significant differences between years. [Test null hypothesis: chicks 93 = chicks 94 versus alternate hypothesis of not being equal, for chicks per successful nest  $W=40.0$ , significant at

Table 2. Nest occupancy, activity, and success for 1991-1994.

	'91	'92	'93	'94
<u>Occupancy</u>				
1. Nests found on activity survey (S1)	24	29	35	37
2. Nests with complete data (item 3+4+5, below)	23	28	33	35
<u>Activity (Breakdown of item 2)</u>				
3. Nests found on S1 that were empty	7	11	20	19
4. Nests that were occupied but not active on S1	16 <sup>1</sup>	1	3	6
5. Nests that were active on S1		16	10	10
6. Total S1 occupied nests (item 4+5)	16	17	13	16
<u>Success</u>				
7. Occupied, but not active nests (item 4) that succeeded by productivity survey (S2)	- <sup>2</sup>	0	0	0
8. Active nests (item 5) that succeeded by S2	-	11	6	5
9. Total Successful Nests	-	11	6	5
<u>Chicks Raised</u>				
10. Chicks produced from occupied but not active nests	-	0	0	0
11. Chicks produced from active nests	-	16	10	7
12. Total chicks produced	24 <sup>2</sup>	16	10	7

<sup>1</sup> Because the activity survey in 1991 was late, nests discovered on this survey correspond more closely with the definition of active used in 1993 and 1994.

<sup>2</sup> 1991 data for successful nests and chicks fledged was based on estimated production because the productivity survey was conducted too early (7/10); many stage 2 young were detected which could not be confidently scored as fledged, see Squibb (1992).

0.52, for chicks per occupied nest  $W=214.5$ , significant at 0.40, and for chicks per active nest  $W= 114.0$  significant at 0.52.]

Although productivity values from 1991 through 1994 are not statistically comparable, it is worth noting that since 1991 slightly fewer nests activated and notably fewer chicks were raised (item 12, Table 2) in 1994. Activity survey data indicates in 1991, 17 nests were "occupied" (corresponds to 93/94 active nests because of the late survey; note: Table 2 reports occupied nests that had complete data from activity and productivity surveys). In 1992 18 nests were "occupied" (corresponds more closely to 93/94 active nests because of the late survey). In 1993 15 nests were occupied and 11 of these were active. In 1994 16 nests were occupied and 12 of these active. If the 1993 and 1994 surveys had been conducted later in May (as in 1991 and 1992), it is probable that occupied nests may not have been scored as occupied and some active nests may have failed resulting in less occupied, and the subset active, nests in these later years.

Table 3. Productivity Calculations for 1991-94

	'91	'92	'93	'94
<u>Success based on Occupied Nests</u>				
Young per occupied nest	--	0.94	0.77	0.44
Percent occupied nest successful (item 9/item 6)	--	64.7%	46.0%	31.3%
<u>Success based on Active Nest Subset</u>				
Young per active nest	1.49 <sup>1</sup>	1.00	1.00	0.70
Percent active nests successful (item 8/item 5)	--	68.8%	60.0%	50.0%
<u>Success based on Successful Nest Subset</u>				
Young per successful nest	1.86 <sup>2</sup>	1.45	1.67	1.40

<sup>1</sup> See note 1, Table 2.

<sup>2</sup> Estimate, see note 2, Table 2.

Regarding young fledged, in 1991 Squibb (1992) reported 13 young reached fledgling age by his July 10 productivity survey and estimated another 11 (of 14 downy young) fledged for a total of 24 fledglings. In 1992 16 chicks reached fledgling criteria. In 1993 only 10 chicks reached fledgling criteria, and in 1994 only 7 young reached fledgling criteria. When the reader examines these numbers, consider that the area surveyed increased by at least one nesting territory in 1992, at least two more nesting territories by 1993. Although the area may have decreased by one nesting territory in 1994, because this territory was not active previous to 1994, this does not affect the number of territories compared.

Higher calculated production values in 1991 and 1992 could result from the bias presented by later activity surveys. Low production values in 1993 could have been caused by missed fledglings because of the early spring. However, in 1994 the spring was neither particularly early or particularly late, so I have no evidence to support the idea that fledglings were missed in 1994 by early fledging. Indications are that production was indeed down in 1994. Activity survey information indicates that fewer nests were active (had eggs laid) in 1993 and in 1994 than in the previous two years. And in 1994 the productivity per nest is also low. I therefore conclude that Naknek drainage eagle production is down in 1994. Possible reasons for reduced production in 1994 may be: an exceptionally rainy June and July, a late and smaller than usual run of sockeye<sup>2</sup>, or a changing age composition of the population (as indicated by no immature birds on the

<sup>2</sup> The Naknek escapement was record breaking in 1991 due to the fishing strike, compared with 1994 which was below the escapement goal.

activity survey). Also see the interesting trend of location of successful nests (above) and nest sight history (above).

### Breeding Territory Occupancy

Adult eagles may return to their territories and occupy them, yet not initiate nests. This is considered a form of reproductive failure by some authors. Postupalsky (1973) states:

"Productivity of the population should be calculated on the basis of all territorial pairs, including the nonbreeders, because in raptor populations individual pairs may, under a variety of conditions, refrain from breeding in some years. Nonbreeding (i.e., failure to lay eggs) should be regarded as a type of nest failure, and its extent carefully assessed in population studies rather than ignored or dismissed as an attribute of subadult birds."

A breeding territory is one in which one or more nests occur within the range of a mated pair of birds (Postupalsky, 1973). Breeding territory occupancy is difficult to document. A pair of adults must be observed on that territory (known to have a nest) during the limited observation time frame of the activity or productivity survey. The possibilities of missing a pair on a territory that are not actively supporting a nest are high.

In 1994, I decided to attempt to collect additional information regarding Breeding territory (vs. nest) occupancy. This did not occur until the productivity surveys. We attempted to revisit most areas where two adults had been noted in May during the Activity Survey. We resurveyed approximately 9 of 14 areas. However, with the additional complication of using the new GPS technology, all information about these areas was not systematically recorded. The additional information collected was added to the Naknek Eagle Database.

The results of this extended survey are given in Table 4. The suspected territories are scored as "Historic," "Empty Nest," "Questionable," "Probable," and "Occupied" territories. The known territories are scored as before: "Occupied Nest" and the subset "Active Nest." (Note: a difference exists between occupied territory and occupied nest). "Historic" represents a territory that was known in the past to contain a nest, but in 1994 the nest was not found and no pairs were found in the area of the old nest. "Empty Nest" indicates that the old, empty nest was found but no pairs were near by. "Questionable" indicate that a pair was in an area on either the activity or productivity survey, but a nest has not been found in that area and is not known from previous years. "Probable" indicates either 1) a pair was noted on the activity or productivity survey and a nest was known in the past, but was not observed in 1994, OR 2) a pair was observed in an area on both the activity and productivity survey. Territories were scored as "Occupied" if a pair was noted on a territory on either activity or productivity survey and an empty nest was recorded in 1994. Pairs were considered on a territory with a historic nest or empty nest if they were observed within 1 mile of that nest. The additional information about these territories will be noted on Figure 4.

2  
old  
map

Figure 4  
Nest occupancy +  
Territory occupancy

- Historic
- Empty Nest
- Questionable
- Probable
- Occupied Territory
- Occupied Nest
- Active Nest

H E P P T O

1994

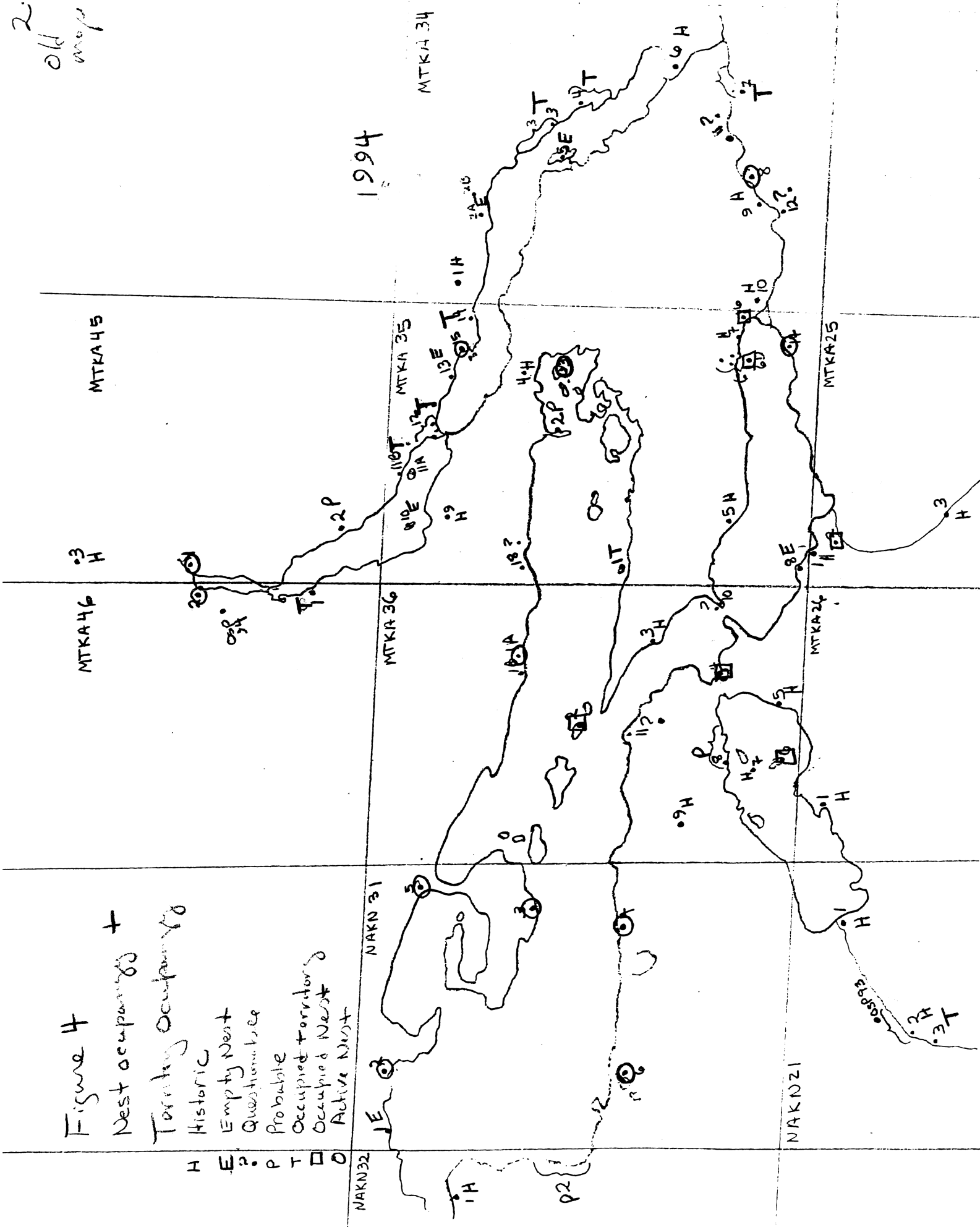






Table 4. 1994 Eagle Territory Activity

Because not all territories are rechecked on the production survey, the possibility of mis-scoring the first four categories is moderate. Date in parenthesis indicates the last year that the nest/territory had an occupied, or more specifically, active nest. Information known only since 1991. See text for description of categories.

<u>Historic</u>	<u>Questionable</u>	<u>Occupied Nest</u>
MTKA45 003	MTKA36 010	MTKA36 002
NAKN32 001	MTKA36 011	MTKA36 004
MTKA36 003(92)	MTKA35 018	MTKA36 006
MTKA36 005(93)	MTKA34 011	MTKA35 06D
MTKA36 007(91)	MTKA34 012	MTKA35 016
MTKA36 009		MTKA25 002
MTKA35 004(91)	<u>Probable</u>	
MTKA35 005(93?)	MTKA45 002	<u>Active Nest</u>
MTKA35 007	NAKN32 002	MTKA46 002
MTKA35 009(91)	MTKA35 002(92)	MTKA45 001
MTKA34 001	MTKA36 008	NAKN31 02B
MTKA34 006(93)		NAKN31 003
MTKA34 009(91)	<u>Occupied Terr</u>	NAKN31 004
MTKA34 010(93)	MTKA46 001(92)	NAKN31 005
NAKN21 001(93)	MTKA35 001(93O?)	NAKN31 006
NANK21 002(92)	MTKA35 11B(93)	MTKA36 01A
MTKA26 001(92)	MTKA35 12C(93)	MTKA35 003
MTKA25 001(93)	MTKA35 014	MTKA35 15A
MTKA25 003(91)	MTKA34 03	MTKA35 017
	MTKA34 04	MTKA34 08A
	NAKN21 003(93)	
<u>Empty Nest</u>	MTKA34 07(93)	
NAKN31 001(91)		
MTKA35 008(92)		
MTKA35 010(93)		
MTKA35 013		
MTKA34 002		
MTKA34 005		

Because not all territories were rechecked during the production survey, the possibility of mis-scoring may occur. Therefore these are estimates of territory occupancy. From these data we have approximately 61 territories within the study area. Twenty-five of these were not occupied (Historic or Empty Nest). The status of another five of these was "questionable." Four territories were probably occupied, and for an additional nine we have strong evidence of territory occupation. Six territories were occupied with the pairs repairing nests (occupied nest), and only 12 pairs fully initiated nesting (active nest). Therefore, 18 (30%) of 61 territories contained occupied nests, and approximately 31 (51%) of 61 territories were probably occupied. At least 25 (41%) were not occupied.

### Biases

The same procedure for surveying Bald Eagles was used in 1993 and 1994. A minor adjustment was made in the timing of survey in 1994. This was not anticipated to create any significant impacts to the productivity values. Another slight adjustment to the timing of the productivity survey is recommended for 1995. The impact of this will be analyzed at that time. Adding the investigation of occupied territory to the survey will add an additional layer of information, but not add any biases to the calculations.

The area sampled changed by one territory (that of the upper Naknek River). Because this territory had not been used by eagles in past years, the deletion of this territory in 1994 should not bias these results. If this territory is surveyed in future years, bias will have to be considered at that time.

We accomplished activity surveys before cottonwood leaf out so detection of nests was good. However, detection of nests below the cottonwood canopy in July still prevents relocation of some nests on the productivity survey, and no solution to this problem is known.

Using the same observer and pilot both years improved nest detection. Joel Collins has been the pilot on this survey since 1991 and I have been the observer since 1992. Employing the GPS in future may help relocate some of these nests.

#### Other Raptor Observations

During the productivity survey we found an osprey nest. The nest was located on American Creek about 1-2 miles downstream from the eagle nests noted there. The osprey nest was located in the top of a spruce tree. The nest was located by seeing the adult osprey perched in the tree. Two additional passes were made, however I was never confident of the number of chicks. The pilot said there were 5 chicks. The chicks were more difficult to see than eagle chicks.

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**APPENDIX I. Memos of 5/12/94 and 8/1/94 RE: Eagle Survey**





# United States Department of the Interior

## NATIONAL PARK SERVICE

Katmai National Park and Preserve  
Aniakchak National Monument and Preserve

P.O. Box 7  
King Salmon, Alaska 99613



IN REPLY REFER TO:

N1419(KATM)

May 12, 1994

Memorandum

To: Staff, File

From: S. Savage *S. Savage*

Subject: Eagle Survey

On 5/6/94 Joel Collins and I began an eagle survey of the Naknek drainage. We completed this survey on 5/9/94. We tacked the survey on to another flying mission and therefore saved some travel time to the lake. The survey took 5.2 hours of flying time or 4.1 hours of actual survey time. Both surveys were conducted in the morning and/or early afternoon. We surveyed the entire Naknek drainage including: Naknek Lake, Margot Creek, Brooks Lake, Headwaters Creek, lakes between Dumpling and Brooks Mountains, Brooks River, Savonoski River to Grosvenor River, Grosvenor River, Grosvenor Lake, Lake Coville, American Creek until it turns east. All nests were mapped on 1:63,300 USGS quadrants.

On both days the weather was good for the survey. The survey made use of the park Cessna 206 on wheels. The plane equipped with floats would have been more practical for the survey but this was not possible due to timing of the survey and timing of the instillation of floats. Because of the early date of the survey there was no interference with cottonwood leaves. The survey methods used were those outlined in the draft Katmai Eagle Survey Protocol (Appendix I of Bald Eagle Nesting & Productivity, Katmai National Park, 1992 with amendments).

The survey was conducted about one week earlier than last year. However, it was still one day past the calculated average egg laying date from 1992. I used the 1992 calculated egg laying date because it appears that we are having an average spring (actually 1992 was a late spring), not an early spring as in 1993. I concluded from the activity level that was observed that this year's survey was right on target.

We observed 37 nests, 12 of which appeared to be active (with incubating/brooding parent), 5 were occupied (1-2 adults with a repaired nest), 2 were questionably empty (what looked like a repaired nest but no adults), 18 empty (0 adults and no repairs to nest). As all the active nest females were incubating, no eggs or young were observed.

The 1994 survey covered the same area as 1993, with the exception of excluding the Naknek River (no nests found in 1993). Consequently we have standardized the area of coverage.

Since 1992, Margot Creek and Grosvenor River have been added. The number of nests observe in 1994 was similar to the number observed in 1993 (35 nests: 11 active, 4 occupied, 2 questionably occupied, 3 questionably empty, and 16 empty). The number seems to be slightly down from 1992 and 1991. In 1994 and 1992 a few more active/occupied nests were found even though the surveys were conducted later and early nest failures may have occurred reducing the number of active/occupied nests detected.

I have renumbered the nests according to the recommendations in the protocol. It is now possible to reconstruct histories for individual territories and nests since 1991 (see Table 1). Twenty five of the 1994 nests were observe in 1993. Twelve of the 1994 nests were observed in 1993 and 1992, and nine of these nests have been observed every year since 1991. Seven of the nests active or occupied in 1994 were active or occupied in 1993. Four nests that are active/occupied in 1994 were reinitiated from nests that were empty in 1993. Six nests in 1994 are new. There appears to be a significant shift in active nests from the upper portions of the drainage back to the main body of Naknek Lake (with the exception that the two American Creek nests remain active).

Along with the nest surveys, all eagles are counted on the activity survey. One major difference was detected between the mid May/June surveys conducted previously and the early May survey conducted this year. Although the total number of birds on the survey was similar to last year, in 1994 not one immature eagle was observed! Usually 16-18% (16% immatures in 1993, 16% immatures in 1992, and 18% immatures in 1991) of birds observed are immature birds (see Table 2). This may indicate that younger birds do not "hang-out" along the lake margin earlier in the year, OR perhaps the age structure of the population is significantly change to having fewer younger birds.

Incidental observations were not formally taken. However it should be noted that numerous moose were noted on the north side of the Naknek drainage and around the west and south sides of Brooks Lake, numerous caribou were noted on the north side of the drainage, and two bears were seen, one 1/2 mile south of Grosvenor Lodge and one near the confluence of the Grosvenor and Savonoski Rivers (near a large piece of flesh-probably moose).

A second survey to assess the production of these nests will be conducted around the third/fourth week of July.





# United States Department of the Interior

## NATIONAL PARK SERVICE

Katmai National Park and Preserve  
Aniakchak National Monument and Preserve  
P.O. Box 7  
King Salmon, Alaska 99613



IN REPLY REFER TO:

N1419(KATM)

August 1, 1994

### Memorandum

To: Staff, File

From: Subsistence/Resource Specialist *[Signature]*

Subject: Eagle Survey

On 7/25/94 Joel Collins (park pilot) and I completed the 1994 bald eagle survey of the Naknek drainage by conducting a production survey. Sarah Stuart accompanied us to assist us with the use of some new technology. Owen Guthrie set up the NBS lap top computer so that it could be used in conjunction with the plane GPS unit to track our course and obtain specific locations for eagle nests and other geographically based information. Thanks both to Sarah and Owen for their assistance with this project. The survey methods used were those outlined in the draft Katmai Eagle Survey Protocol (Appendix I of Bald Eagle Nesting & Productivity, Katmai National Park, 1992).

We used the USFWS C-206 on floats as the park C-206 was not functional. We departed King Salmon about 1030 and flew directly to Brooks Camp where we dropped off Cary Brown and picked up Sarah. We began the survey after the pickup and flew clockwise around the lake perimeter going specifically to known occupied nests and also checking "territories" where two adults had been observed on the activity survey. We took a short break at Grosvenor Lake. We continued around the drainage back to Brooks Camp. Joel had to transport the Superintendent at 1400 to King Salmon and this was done. We returned to Naknek Lake and Brooks Lake and finished the survey around 1600, taking a short break at the mouth of Headwaters Creek. The weather was overcast with occasional rain showers.

Sarah kept paper records while I used the lap top to "hot key" in locations of nests and locations of pairs of adults. Currently Owen is working on the data file to extract the information that was input. This will give us exact locations (lat/long) for active/occupied nests, and pairs.

We checked 19 nests [all scored as active (12), occupied (5) or questionably empty (2) on the activity survey]. We found no additional active nests. Of the 12 nests that were active in May, 5 have chicks, 5 have failed and two were not found (although their approximate locations were circled three times; three of the failed or not found nests had 1 or 2 adults still on the territory). All occupied and both questionably empty nests were found to be empty (although four of these had adults still on the territory). Of the 5 productive nests, 3 had one chick and 2 had two

chicks (7 chicks total). All chicks had begun to develop contour feathers (all had reached at least the 3B stage). Twelve of these 19 territories appeared to still have resident adults.

In 1991, 16 nests were occupied/active and produced approximately 24 chicks. In 1992, 17 nests were occupied/active and produced 16 chicks. In 1993, 13 nests were occupied/active and produced 10 chicks. Although data from all years is not completely comparable because of changing method, survey timing, and survey area, it appears that eagle production in the Naknek drainage, within the Park, continues a downward slide. A complete analysis of production will be conducted in the forthcoming report.

A potential change in eagle production calculation prompted us to collect some additional information this year. At WRST, Cozie has used a slightly different definition of an "occupied" territory. Cozie has been conducting eagle surveys regularly at WRST parallel to our surveys at KATM. It would be useful to standardize all NPS eagle surveys in future. I rechecked 8 of 9 areas where two adults were present in the spring. These areas may fit the new definition of "occupied" territory. Some of these areas have had nests on them in past years. They represent pairs of adults that are not reproducing for some reason. These data were "hot keyed" into the lap top and I cannot report them until the file is manipulated.

I was very happy with the use of the GPS/lap top unit overall. Although occasionally it did not appear to respond to the keying command. Another problem with its use on eagle surveys is that I could not key in different information quickly. That is, it was not possible for me to key the exact location of the nest as I was over it and also the exact status of the nest (how many chicks and chick stage). In future we will use the technology to key in locations of nest on the activity survey, and use it to help us relocate nests on the production survey (and possibly key data into the lap top or use paper recordings).

Incidental observations include:

2 moose including 1 large bull up Headwaters Creek

Several brown bear including one mother with 2 COY near the Grosvenor/Savonoski confluence, and one at American Creek

1 Osprey and nest with possibly 5 chicks (American Creek, within 1 mile of Eagle nest), nest in top of spruce

APPENDIX II: EAGLE NEST NUMBER STANDARDIZATION

For 1991-1993 number given is nest number assigned during that year's survey. For all years codes indicate: E = Empty, O = Occupied, A = Active (subset of Occupied). Bolded type means successful nest. Squibb's (Squibb, 1992) criteria used for 1991. For 1994 standardized numbers used with USGS map abbreviation. Codes indicate: 1a = one adult, 2a = 2 adults, s1 = activity survey, s2 = productivity survey.

<u>USGS MAP</u>	<u>ABREV</u>	<u>STAN</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>
MtKatmai D6	MTKA46	1	22A	<b>23A</b>	4E	E 1a,s1 2a,s2
		2	-	<b>25A</b>	<b>6A</b>	A
MtKatmai D5	MTKA45	1	-	<b>24A</b>	<b>5A</b>	A
		2	-	-	old	2a,s2
		3	-	26E	-	-
Naknek C2	NAKN32	1	11E	-	-	-
		2?	-	-	-	2a,s1s2
Naknek C1	NAKN31	1	<b>1A</b>	1E	-	E
		2A	-	2A	-	-
		2B	-	-	-	A
		3	<b>2A</b>	<b>3A</b>	<b>1A</b>	A
		4	<b>10A</b>	<b>13A</b>	11E	A
		5	-	-	-	A
MtKatmai C6	MTKA36	1A	<b>4A</b>	<b>4A</b>	2E	A
		1B	-	-	-	E
		2	3A	7O	10EE	O
		3	-	8A	-	-
		4	-	-	12O	O
		5	13A	<b>17A</b>	<b>13A</b>	-
		6	<b>14A</b>	16E	14O	O
		7	12A	15E	-	-
		8	-	14E	17E	2a,s1
		9	18E	-	-	-
		10	-	-	-	2a,s1
11	-	-	-	2a,s1		

<u>USGS MAP</u>	<u>ABREV</u>	<u>STAN</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>
MtKatmai C5	MTKA35	1	5E	6O?	9O?	E 2a,s1
		2	-	5A	-	2a,s1
		3	-	-	26E	A
		4	<b>19A</b>	21E	-	-
		5	-	-	18O?	-
		6A	6A	-	-	-
		6B	7E	-	-	E
		6C	-	9O?	-	-
		6D	-	-	36A <sup>3</sup>	O
		7	7?E	-	19E	-
		8	9 <sup>4</sup>	12A	-	E
		9	21A	-	-	-
		10	20E	<b>22A</b>	3A	E
		11A	23A	-	<b>8A</b>	E
		11B	-	27E	-	2a,s1
		12A	-	-	7A	E
		12B	-	-	27E	E
		12C	-	28E	28E	-
			-	-	-	2a,s1
		13	-	-	29E	E
		14	-	-	30E	E
			-	-	-	2a,s1
		15A	-	-	-	A
		15B	-	-	-	E
		16	-	-	-	O
		17	-	-	-	A <sup>5</sup>
		18	-	-	-	2a,s2

<sup>3</sup> Activity determined on Survey 2.

<sup>4</sup> Used by Great Horned Owl

<sup>5</sup> Not Found on Survey 2.

<u>USGS MAP</u>	<u>ABREV</u>	<u>STAN</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>
MtKatmai C4	MTKA34	1	24E	-	-	-
		2A	-	-	31E	E
		2B	-	-	-	EE
		3	-	-	32E	E
		3b	-	-	-	1a,s1/ 2a,s2
		4	-	-	33E	E
		4B	-	-	-	2a,s1
		5	25E	29E	34E	E
		6	-	-	22A	-
		7	-	11A <sup>6</sup>	23O	E
		7B	-	-	-	2a,s2
		8A	-	-	24A <sup>6</sup>	A
		8B	-	-	21E	-
9	8A	-	-	-		
10	-	10A	20A	-		
11	-	-	-	2a,s1		
12	-	-	-	2a,s1		
Naknek B1	NAKN21	1A	-	30A	-	-
		1B	-	-	37A <sup>7</sup>	-
		2	16A	19A	15E	-
		2/3	-	-	-	2a,s1 2a,s2
		3	17A	20A	16A	E
MtKatmai B6	MTKA26	1	15A	18A	-	-
MtKatmai B5	MTKA25	1	-	-	25O	-
		2	-	-	35E	O
		3	26A	-	-	-

<sup>6</sup> Nest not found on survey 2.

<sup>7</sup> Activity determined on survey 2.

APPENDIX III. dBase Structure which included fields for Occupied Territory

<u>Field</u>	<u>Field Name</u>	<u>Type</u>	<u>Width</u>	<u>Description</u>
1	MAP_NO	Character	6	USGS coded map number
2	NEST_NO	Character	3	Nest number
3	NAME	Character	12	Descriptive name/location of nest
4	LAT	Character	8	Latitude as determined from map
5	LONG	Character	9	Longitude as determined from map
6	GPSLAT	Character	8	Latitude as determined from GPS unit
7	GPSLONG	Character	9	Longitude as determined from GPS unit
8	S1_DATE	Date	8	Date of activity survey (AS)
9	S1_OBS	Character	7	Initials of observers on AS
10	S1_NO_ADLT	Numeric	1	Number of adults present on AS
11	S1_FRSH_MT	Character	1	Fresh material present in nest (Y/N)
12	S1_NO_EGG	Character	1	Number of eggs present on AS
13	S1_NO_CHK	Numeric	1	Number of chicks present on AS
14	S1_CHK_STG	Character	2	Chick stage on AS
15	S1_NOTE	Character	30	Notes about nest taken on AS
16	S1_AC_NST	Character	2	Activity score of nest per AS
17	S1_AC_TERR	Character	2	Activity score of territory per AS
18	S1_ELD	Date	8	Egg Laying Date as estimated per AS
19	S2_DATE	Date	8	Date of productivity survey (PS)
20	S2_OBS	Character	7	Initials of observers on PS
21	S2_NO_ADLT	Numeric	1	Number of adults present on PS
22	S2_NO_EGG	Numeric	1	Number of eggs present on PS
23	S2_NO_CHK	Numeric	1	Number of chicks present on PS
24	S2_CHK_STG	Character	2	Chick stage on PS
25	S2_NOTE	Character	30	Notes about nest taken on PS
26	S2_AC_NST	Character	2	Activity score of nest per PS
27	S2_AC_TERR	Character	2	Activity score of territory per PS
28	S2_ELD	Date	8	Egg Laying Date as estimated per PS
29	NEST_SUB	Character	10	Nest substrate
30	HABITAT	Character	25	Habitat/location of nest
** Total **			216	