BALD EAGLE NESTING AND PRODUCTIVITY
KATMAI NATIONAL PARK
1992

Abstract

Eagle surveys were conducted in Katmai National Park and Preserve in the Naknek drainage using fixed wing aircraft and along the Katmai coast using helicopter. Activity surveys were conducted in late May and early June and production surveys were conducted in late July. All nesting locations were mapped on USGS maps and on a set of blue line aerial photographs for the coast. Productivity values were calculated and will be reported based on active nests. Data collected in 1992 contains specific biases related to the dates and methods of data collection. Therefore, statistical comparisons of productivity were only performed between the coastal and Naknek data for 1992. These data will also be compared qualitatively to previous studies of eagle productivity at Katmai and in nearby areas on the Alaska Peninsula.

Additional information gathered during these flights will be used to estimate egg laying date, describe nesting substrate and site use, describe incidental information collected about prey items, and calculate distances between occupied nests. A protocol for future eagle monitoring in Katmai National Park and Preserve will be attached to this report. This protocol is intended to standardize surveys from year to year to eliminate biases so that changes in eagle productivity can be detected.

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INTRODUCTION

Surveys of nesting bald eagles (Haliaeetus leucocephalus) were conducted during 1992 in the Naknek drainage and along the entire Pacific coast of Katmai National Park. The objectives of these surveys were to: 1) locate and accurately map as many nests as possible within the study areas, 2) to estimate eagle nesting productivity, and 3) to gather information necessary to standardize surveys from year to year within the park and with areas outside of the park. These objectives were met. Two long term objectives for continual collection of these data are: 1) to monitor the relative health of the Katmai eagle population, and 2) to use eagle nesting success to assess long-term environmental or human induced changes in the Katmai ecosystem.

Eagle surveys have been conducted with regularity in the Naknek drainage since 1974 (see Table 1). Surveys at Katmai National Park were conducted by Troyer in 1974-1979 (Troyer 1974, 1975, 1976, 1977, 1978, 1979), in 1980 and 1981 (investigator unknown, data reported in Jope 1983), Jope from 1983-1987 (Jope 1983, 1984, 1985, 1986, 1987), Sowl in 1988, and Squibb in 1991. Surveys have been conducted on the Katmai coast[1] by Troyer (1975, 1976, 1977), Yurick in 1989 (Yurick, 1989), Portner in 1990 (Portner, 1991), Starr & Starr in 1991 (reported in Squibb, 1992). Many studies have resulted in mapped nest locations. Surveys have been conducted along parts of the coast of the nearby Becharof and Alaska Peninsula National Wildlife Refuges (NWR) and the islands off the Pacific Coast of these wildlife refuges (Alaska Maritime NWR) in 1989 and 1990 (Dewhurst 1989, 1990, Portner 1991). Dewhurst (1991) summarized the results of Alaska Peninsula eagle studies from 1911 until 1990.

Each investigator that conducted eagle surveys in the Katmai area used methods and means accepted at the time and available to them. Each survey is also subject to the harsh weather conditions that control flying on the Alaska Peninsula. This resulted in varying survey dates and varying areas of coverage. Because of the variable methods used, variable dates and variable areas covered, between year and area statistical comparisons are not possible.

In the last several years, and especially as a result of the Exxon Valdez oil spill (EVOS), attempts have been made to standardize the methods being used statewide so that changes in eagle nesting activity and productivity can be detected. Standardization is also a goal for Katmai eagle data collection so Katmai data can be compared to areas near the park. Both the 1991 and 1992 surveys made use of the activity/productivity dual survey method. The 1992 data provided detailed information about nesting stage that was analyzed to better predict egg laying dates. These results

[1] All islands within 5 miles of the Katmai coast are part of Katmai National Park.

suggest that further adjustments in survey time are needed to bring the survey in line with those being conducted elsewhere in Alaska. To ensure that these improved methods are known to future investigators, a protocol for eagle nest surveys has been developed and is attached (Appendix I).

STUDY AREA AND METHODS

Naknek Drainage Aerial surveys were conducted using a Cessna 172 on wheels or a Cessna 206 on floats with the pilot and observer sitting on the left side of the plane. Headsets were not available in the Cessna 172 so communication was by voice. Communication over the plane's intercom was possible when the Cessna 206 was used. The pilot flew at a slow cruising speed approximately 150 to 300 feet above ground level, circling nests when necessary to verify activity. The dates of the survey, observers and flying time are give in Table 2.

During the activity survey (initial survey to find nests and determine status), the pilot kept the shoreline to the left of the plane and the lakes were circumnavigated in a clockwise direction. The entire lake shores and island shores of Naknek Lake, Brooks Lake, Lake Coville, and Lake Grosvenor were surveyed along with all of American Creek and Hammersly Lake, the lower 12 miles of the Savonoski River, 7 miles of Headwaters Creek, and the lakes between Brooks and Dumpling Mountains. Margot Creek was not surveyed due to turbulent winds. However, the heavy equipment operator, Stredney, noted the activity of a historical nest previously known for Margot Creek. Historic maps of nesting activity were used to assist in the search for nests; new nests were found by intensively searching areas where one or two adults eagles were perched. All eagle nests were noted on photocopies of 1:250,000 USGS maps.

The nests were numbered consecutively, with a column on the data sheet for the nest's 1991 number if it was a repeat nest. For each nest the following information was noted: number of adults associated with nest, activity level, number of eggs or chicks, chick stage, nest substrate, behavior of adults. Nesting activity was described as follows: empty (0 or 1 adults associated with nest), occupied (2 adults nearby but no eggs or chicks), or active (eggs, chicks or incubating adult). These definitions are similar to, but not exactly the same as, those used by Postupalsky (1974, see definition given in Appendix 1, attachment III), which will lead to biases mentioned in the Discussion. Chick stage was defined according to Carter, (1990, see Appendix I, Attachment I). On the initial survey all eagles were counted whether they were associated with nests or not.

During the production survey (survey to determine the number of young produced) all active or occupied nests and the three nests scored as "considered empty" were revisited. A straight line was

flown between nests. The same data were recorded for each nest as for survey one. Because a complete survey was not done of the lake shore, incidental observations of individual eagles were not recorded. We attempted to use a new Global Positioning System (GPS) to determine latitude and longitude of nests, however the batteries lost charge half way through the survey and all stored locations were lost.

Pacific Coast Funding was provided from EVOS special funds through the Alaska Regional Office Coastal Programs Division to provide eagle nesting data as a follow up to the eagle surveys conducted during the EVOS. Aerial surveys were conducted using a Bell 206 helicopter on floats. The primary observer sat in the front left side and the secondary observer/data recorder sat in the rear left seat. Communication was possible through the helicopter's intercom system. Surveys were performed from 100-300 feet above the nest level. Incubating or brooding adult eagles were flushed off nests during the activity survey so that contents of nests could be determined. This was not necessary during the production survey as adults do not brood at this time. The entire coast of Katmai National Park from the Kamishak River to the boundary at Cape Kubugakli was flown. Routes flown depended on weather and fuel supplies. A fuel cache had been set up at Kukak Bay prior to the May 31 survey.

USGS 1:63,300 maps with historic eagle nesting data from 1989 and 1990 were used to find historic nest sites and to plot new sites. The same numbering scheme used previously was used (nests numbered in 1989 or 1990 would retain their same number and consecutive numbers are assigned to each new nest for each 1:63,300 map). No Loran or GPS system was available in the helicopters. Data from these maps were used in the office to update the blue line aerial photographs.

Information noted about each located nest included: number of adults associated with nest, activity, number of eggs or chicks, chick stage, and nest substrate. Nest activity was described as in Postupalsky (1974, see Appendix I, attachment III) and chick stage as defined in Carter (1990). Survey dates and observers are given in Table 2.

Information noted for each nest on the production survey was similar to that of the activity survey. All nests that were active (had eggs, chicks or incubating adults) during the first survey were searched for. With regard to occupied nests searching was not consistent. This was the first productivity survey that the surveyor flew and the instructions for resurveying nests and the definition of occupied nest were misunderstood. Therefore, some nests occupied during the activity survey were checked while others were not. This will lead to some biases to be discussed further.

Analysis

Data regarding the nests was entered into a dBase file (eagnak92.dbf or eagcst92.dbf). The file structure is given in Appendix I, Attachment V.

Nest site: The location of nests will be displayed on photocopies of 1:250,000 USGS maps. Nest substrate use will be reported in table format comparing this information to previous years where comparable data are available. Mapped nest locations were used to measure straight line distances between all occupied nests. These were measured to the nearest 0.5 miles on the Naknek and 0.1 miles on the coast and the mean distance between nest was calculated.

Productivity: Nest productivity data will be reported as raw values and as calculated values. The following values will be reported: number of occupied nests, number of active nests, number of empty nests, number of nests that succeeded, number of chicks produced from all nests, number of chicks produced from active nests. The following values will be calculated: mean number of young per active nest, mean number of young per successful nest (only including active nests), percent active nest successful. Although number of eggs and young per nests were observed in the coastal survey, mean clutch size will not be calculated because nest/egg/young loss could have occurred by the time of the late May survey and might result in an underestimate of this value.

Values per occupied nest will not be reported because of biases discussed below, however the reader can calculate these should they choose. Only nests that were observed on both surveys (except empty nests which were not revisited) were used for the calculations. Only nests with chicks that reached stage 3 are considered successful, and only chicks at stage 3 are considered fledged (used in productivity calculations). Nestling stage on one or both surveys, presence of eggs on the activity survey, estimated length of incubation, and time to reach certain chick stages (Carter, 1990) are used to calculate an estimated egg laying date (see Appendix II).

Because of the limitations of the data that will be discussed later, statistical comparisons could only be performed comparing Naknek and coastal data sets for 1992. A standard t-test for small samples and unequal sample sizes was used. The following comparisons were conducted: mean number of young per active nest, mean number of young per successful nest, mean distance between occupied nests, and mean egg laying date.

RESULTS & DISCUSSION

Naknek Drainage

Activity surveys were flown on June 10, 12 on Naknek Lake, Brooks Lake, Headwaters Creek, Savonoski and on June 24 on Lake Coville, Lake Grosvenor and American Creek. The production survey was

flown on July 24. This was similar to the schedule used by Squibb in 1991 except that his production survey was flown on July 10 which created problems in scoring successful nests. This schedule was also similar to that used by Troyer (see Table 1) except Troyer's activity surveys were generally several weeks earlier. A total of 7 hours and 47 minutes flight time was required to complete the activity survey and 3 hours and 13 minutes was required to fly directly from nest to nest on the production survey (not including transit time). Turbulent winds prevented the low level survey of Margot Creek. Stredney reported that the nest on Margot Creek was not active in 1992. This nest was not included in the analysis for 1991 or for 1992. The area surveyed in 1992 compares to the 1991 survey except that American Creek was added in 1992. This accounted for an addition of 2 active and 1 empty nest.

Total Eagles: On the activity survey a total of 87 (Table 2) bald eagles were observed in the Naknek drainage. Of these, 33 (38%) were adults associated with nests, 40 (46%) were adults away from nest sites and 14 (16%) were immature birds not associated with nests. The expertise of the observer did not allow separation of fourth year birds (osprey plumage) from younger birds. The total number of eagles observed in 1991 was 50 birds. However, the proportion of adults to immatures was similar (84% adults in 1992 and 82% adults in 1991). Because of the similarity of survey dates and area covered, no explanation is known for the lesser number of birds in 1991.

Egg Laying Date: 1992 was the first year that an attempt was made to calculate egg laying date. The estimated egg laying date for the Naknek drainage was calculated using twelve nests (11 active nests found on the activity survey and 1 active nest found on the production survey). The range of estimated dates was April 7 (nest #13, chicks at stage 3D on July 24) to May 29 (nest #30, chicks were stage 2 on July 24). The mean egg laying date was calculated at April 29 and 90% of the eggs were predicted to be laid by May 5.

Nest Activity and Productivity: Naknek eagle nests are plotted on Figures 1a-1c. A total of 29 nests were observed on the initial survey and an additional 2 nests (one active but late in development, and one occupied) were found on the production survey. The 2 additional production survey nests were not used in the calculations as the data from these may bias results. Their locations were noted for checking in future years. Of the 29 nests observed on the initial survey, 8 were empty and had no adults associated with them, 3 had one adult near a nest that was empty or whose contents could not be seen (considered empty), 1 nest had two adults perched near an empty nest (occupied), and 17 nests were active. Of the 17 active nests 11 had actively incubating adults so the contents could not be seen, 3 had one chick and eggs, and three had two chicks. During the production

survey all of the "considered empty", occupied and active nests were searched for, however one active nest was not found. Therefore, the number of nests with complete data from both surveys is 28. All "considered empty" nests were empty and the occupied nest was found empty on the second survey. Of the 16 active nests, 5 failed, 6 raised one chick (at least to the 3B stage, and 5 raised 2 chicks (at least to the 3B stage) for a total of 16 fledglings. These data are presented in Table 3a. Squibb reported 13 young reached fledgling age by his July 10 production survey and estimated another 11 (of 14 downy young) fledged for a total of 24 fledglings. This is considerably higher number that the 16 for 1992 and is reflected in the calculated productivity values reported below.

Table 4 displays historical data indicating nest activity on the different bodies of the Naknek drainage. Comparable data exists for 75-79, 91 and 92. Number of active nests or territories appears to have shifted away from Lake Grosvenor and Grosvenor/Savaonoski River to Lake Coville and the Naknek. Activity appears to be fairly stable on Brooks Lake.

Productivity data are reported in Table 3b. One offspring ($\pm$ 0.82, n = 16) was raised per nest scored as active on survey 1. For each nest that raised stage 3 offspring, 1.45 offspring ($\pm$ 0.52, n = 11) were raised. Of 16 nests scored as active on survey 1, 68.8% of these were successful in raising at least 1 offspring to stage 3.
Squibb reported young per occupied nest. In reviewing his raw data it appears that most nests considered occupied by Squibb would have scored as active by 1992 Naknek standards. Squibb calculated 1.49 young per occupied nest and 1.86 young per successful nest, both these values being higher that those of 1992 (see Table 5). Similarity, Troyer reported young per occupied nest and young per successful nest for the years 1976 through 1979 (see Table 5). For these years young per occupied nests ranged from 1.2 to 1.8 and young per successful nest ranged from 1.66 to 2.25. Higher values could result either from higher eagle productivity during previous years and/or from sampling bias (discussed below).

Nest Substrate: In 1992 Naknek system nests were located in cottonwood or spruce trees, on islands in trees, or on islands on cliff edges (see Table 6a). Information is reported for the 28 nests where complete productivity data is available. An equal number of active/occupied successful nests (5), number of fledglings raised (7), and nest failures (2) were located in cottonwood and spruce trees on or near lake shores. Three occupied/active nests were located in cottonwood trees on islands; one of these succeeded and raised 2 young. Of nine empty nests, 2 were in cottonwood trees and three were in spruce trees along the lake shore and 4 were in cottonwood trees on islands. An interesting observation is that nine of eleven successful nests

were located on creeks, rivers or on the lake shore at a creek or river mouth. Comparable data for 1991 is reported on the left side of Table 6a. Several fewer nests were located in mainland cottonwood trees and more in island cottonwood trees in 1992 than in 1991. When 1991 and 1992 island and mainland data are lumped, comparable use between spruces and cottonwoods is observed compared to Troyer's data (see Table 6b, upper half).

Nest Site Reuse: Of the 24 nests documented in 1991, 16 of these were refound in 1992. Of these 16 nests, 6 were empty and 10 were active or occupied. This is a reoccupancy rate of 63%.

Internest Distance: Mean interest distance was calculated to get an idea of territory size/habitat quality and tolerance distance between pairs. If the same areas are covered year to year this measure offers little more information than the number of nests on a system. The mean distance between 18 occupied nests was calculated to be 4.44 miles ($\pm$ 2.58). The range of distances was 0.5 to 8.5 miles. Two pairs of nests were located fairly closely and both pairs were on river systems (one on Headwaters Creek and one on American Creek). The close proximity of nests on river systems and the note above about location of successful nests may be indicators of the importance of river sites as prime eagle nesting habitat.

Pacific Coast

Activity surveys were flown on May 31 and June 1. The production surveys were flown on July 20 and 21. Two long days of flying were required to complete the activity survey and 11 hours and 54 minutes were required to fly the production survey (not including approximately 4 hours of transit time). The area surveyed in 1992 generally compares to the 1989 and 1990 surveys.

Egg Laying Date: Estimated mean egg laying date for the coast was April 25. This was calculated from 44 occupied or active nests and the range of dates was from April 12 to June 2. Ninety percent of nests were calculated to be laid by April 29. This is about 6 days earlier than the Naknek system. Phenology is generally thought to be slightly earlier on the Pacific coast than on the Bristol Bay side, however this difference could be due to the small sample size (especially for the Naknek Drainage) from which these values are being calculated. In 1989 Dewhurst conducted the activity survey on May 6 and in 1990 on May 9-11. Dewhurst (USFWS, King Salmon, pers. comm.) indicates that the first or second week of May is a good time to find eagles incubating nests on the Alaska Peninsula.

Nest Activity and Productivity: A total of 98 nests were observed on the initial survey and 1 additional nest was found on the production survey. The additional production survey nest was not used in the calculations. Of the 98 nests observed on the initial survey, 34 were empty and had no adults associated with them, 12

nests were scored as occupied, and 52 nests were active. Of the 52 active nests 16 contained 1 to 3 eggs, 12 contained 1 chick and 0-1 egg, 19 contained 2 chicks and 0-1 egg, and 4 had 3 chicks and no eggs.

Eagle nesting locations are plotted on Figure 2a-2f. On the production survey, 9 active/occupied nests were searched for but not found (could be failed or missed), 1 active nest was not surveyed due to weather conditions, and 6 were not surveyed because of misunderstood instructions (all occupied nests). Also, one of the nests that was empty on the activity survey was found to be active on the productions survey. However, Bowman (USFWS, Cordova, pers. comm.) recommended excluding this nest from the analysis. Therefore, the number of nests with complete data from both surveys is 81 (33 empty nests and 48 occupied or active nests). Of the 4 occupied and revisited nests, 1 raised 2 chicks to the 2 stage (could not be considered successful), and three failed. Of the 44 active nests, 20 failed, 8 raised 1 chick (at least to the 3B stage), 14 raised 2 chicks (at least to the 3B stage), and 2 raised 3 chicks (at least to the 3B stage). These data are presented in Table 3a. These dates for the production survey appear to be adequate as most chicks were growing contour feathers and well on their way to fledgling. It is probable that not many nests had fledged.

Troyer collected nesting data for the coast during the 1970's. Because the surveys were conducted with fixed wing aircraft, weather dictated areas surveyed and the ability to successful accomplish production surveys. Therefore, the data from the 1970's is difficult to compare to the current data. Because of the Exxon Valdez Oil Spill, eagle nesting data was collected for the Katmai Coast in 1989 and 1990. This is reported, along with data for the neighboring Alaska Peninsula/ Becharof (AKP/B) National Wildlife Refuge in Table 7. Data collection schemes in 1989 did not allow the collection of productivity data on all nests (only 39 were monitored for productivity). The number of occupied nests was similar in 1990 and 1992 and fewer than in 1989. The number of successful nests was similar in 1989 and 1992 and greater than during 1991 The number of young fledged is similar also in 1989 and 1992 and greater than in 1990. 1990 was the second year of the EVOS cleanup and heavy helicopter activity on the coast.

Eagle production data was collected in 1991 along the Katmai coast only at Amlik Bay. The data was collected using boat surveys by rangers that lived at Amlik Bay. Collection of data by boat versus aircraft and on a continuous basis rather by limited sampling observations will produce completely different information. Boat surveys may not detect empty nests or occupied nests. The definition of a nest's "occupancy" is determined on the basis of many observations rather than a single fly by. In this case an occupied nest would probably be equivalent to the

Postupalsky definition of active nest. Therefore nest occupancy may not be comparable. With continuous observations, the fledglings could be watched later into the season and success is a measure of those birds that actually fledged. Whereas, aircraft surveys only estimate those chicks that reach a specific stage. Estimates of success and productivity are not equivalent. Therefore, these data cannot be systematically compared to the 1989, 1990 or 1992 data.

Calculated values of productivity are presented in Table 3b for 1992. The number of fledglings per 44 active nests was 0.95 ($\pm$ 0.987) The number of fledglings per 24 successful active nests was 1.75 ($\pm$ 0.608). The percent of active nests that was successful was 54.4%. Historic production values are given in Table 7 for the Katmai and AKP/B coast. Young per occupied nest increased in 1992 over that reported in 1990 for the Katmai coast and was similar

between that reported for the AKP/B coast in 1989 and 1990. The number of young per successful nest increased in 1992 (1.75) over that observed in 1989 and 1990 (1.2 and 1.27 respectively) for the Katmai coast and was similar to but slightly greater than that observed for the AKP/B coast in 1989 and 1990 (1.55 and 1.71 respectively). The percentage of successful occupied nests varied from year to year along the Katmai coast (82% in 1989 when only selected nests were monitored, 42% in 1990 and 52% in 1992 when not all occupied nests were monitored for production). The Katmai 1992 percentage of successful nests is similar to that reported for the AKP/B coast in 1989 and 1990.

Nest Substrate: Along the Pacific Coast the nesting substrate use is so different from the Naknek drainage that a completely different categorization system is used. This system is based upon Dewhurst 1991 modified from Sherrod et.al. 1977. Coastal nest substrate use is presented in Table 8 for 1990 and 1992. Information is reported for the 81 nests where complete productivity data is available. Troyer's coastal nest substrate data is reported in Table 6b. The majority of nests were located on sea stacks or in cottonwood trees. This is similar to use reported in 1990, however more hilltops and cliffs were used in 1990. Obvious nest substrate use shifts as trees become unavailable for use further south along the Alaska Peninsula. No tree use is reported along the Alaska Peninsula/Becharof coast. It is difficult to make statements about nest site selection or preference because of lack of quantitative info about nest substrate availability. Nest substrate use may also relate to nest damage and repair by adult eagles. Eagles are known in other locations (Postupalsky, 1974; Stalmaster, 1987) to have more than one nest per territory. Multiple nests within a limited distance have also been observed along the Alaska Peninsula, but general territories have not been mapped. Nest substrate for these grouped nests has not been analyzed and it is possible that a pair make use of a nest in one substrate in one year and in another substrate in the next year.

Internest Distance: The mean distance between 64 occupied nests was calculated to be 2.04 miles ($\pm$ 1.86). The range was from 0.5 to 12.3 miles.

Prey Items: Prey items present in nests were noted during the coastal surveys. On the activity survey 5 nests were noted to contain fish and 3 nests were noted to contain bird remains (1 was a gull and 1 was an oystercatcher). On the production survey 1 nest was noted to contain meat and 1 was noted to contain salmon.

Statistical Comparisons

After carefully examining the different methods used to collect eagle nesting data from year to year it was decided that the only statistical comparisons that should be performed were comparing the Naknek and coastal data for 1992. Mean egg laying dates were

compared between the coast and Naknek and were not found to be statistically different (t_s=1.31, df=54, $t_{(0.5,54)}$=2.01). Standard t-tests comparing number of young per successful nest (Naknek x=1.45, coast x=1.75) found no significant difference between these measures (t_s=1.40, df=33, $t_{(0.5,33)}$=2.04). No significant difference was found between number of young per active nest (Naknek x=1.0, coast x=0.95) for these data sets (t_s=0.18, df=58, $t_{(0.5,58)}$=2.00). Mean distance between nests on the Naknek versus the coast (Naknek x=4.4; coast x=2.04 miles) were found to be significantly different (t_s=4.05, df=80, $t_{(0.5,80)}$=2.00). Percentage of successful nests to active nests could not be compared statistically because this would require a sample size of over 200 for a test of equality between two percentages (Sokal & Rohlf, 1969).

Biases

Three major sampling inconsistencies have prevented Katmai eagle data to be comparable from year to year. These sampling problems are: geographical area sampled, timing of sampling, definition of active/occupied nest and resampling. These problems will be discussed as to why they create problems and how they can be eliminated in the future.

For the Naknek system, the number of active or occupied nests are not completely comparable because the areas surveyed from year to year are not identical (Tables 1 & 4). The standardization of areas surveyed is necessary to manage this problem. In lieu of this, production data should be kept so that it can be extracted on a geographical basis. Then comparable areas could be selected overlapping for all years and the data extracted for that area only. This subsample may eliminate the non comparability of areas, however sample sizes would be decreased diminishing the ability to perform statistical comparisons. Geographical incomparability also occurs on the coast as islands or small sections of coast may be missed because weather precludes sampling, but the larger sample size decreases the effect of these missed samples.

The second confounding factor for these data are the dates of survey. Because Troyer used the dual survey method, and his activity surveys were in May or early June, his data are generally more comparable to the 1991 and 1992 data sets than that collected by Jope and Sowl who conducted only one survey per season. Jope's numbers will reflect only nests that were active by late June or July. These cannot be compared with the number of active nests counted earlier as some nest failure may have occurred by this time. Also, this does not give an indication of success because some of these nests could have failed to raise fledged young. The data collected during this period is valuable mostly to document history of individual nests that were active at least to mid June.

The data from Troyer, Squibb and this year may be comparable

within itself but does not represent the ideal time for sampling. Most authorities (Postupalsky, 1974; Stalmaster, 1987; Bowman, 1992) feel that the presentation of productivity results based on occupied nests gives a more complete representation of the productivity of the population. Occupied nests include those where adults are actively territorial and display interest in a nesting site to the point of repairing a nest. These adults may or may not produce eggs and young. When territorial pairs do not produce eggs, this is a type of nest failure and will only be documented by calculating productivity based on occupancy rather than activity (presence of eggs/young). Surveys that are conducted well past the nest initiation date (egg laying date) will not detect these early nests that were occupied or early active nests that failed (underestimate the number of active or occupied nests) and will result in an overestimate of nest success (Bowman, 1992). This is true whether the measure is based on occupied or active nests. This comment applies to the 1992 Naknek and Coastal surveys. Therefore to obtain an accurate measure of productivity and to make these studies consistent with others being conducted in the state, activity surveys must be performed earlier in the breeding cycle.

Another confounding factor for surveys is leaf-out date. Once cottonwood trees have leaves, detection of nests becomes increasingly difficult. Leaf-out depends on spring temperatures, but is generally underway by the third week in May in the Katmai area.

The timing of productivity surveys is also critical. Surveys that are too early may overestimate production in that nest failures in the late nestling stages will not be detected. However, surveys that are too late may miss successful nests that have already fledged. It is possible that the 1992 surveys were past the ideal survey dates and successfully fledged nests were missed.

Most studies in the Alaska make use of the dual survey method. One draw back exists from this method in that the fate of late nests may not be known and their contribution to productivity will not be counted. Unless a second production survey can be conducted to document the fate of late nests, these will be scored as failed or will not be included in the data set. This generally applies to nests that are occupied by the activity survey and become active by the production survey.

The third confounding factor for the Katmai studies has been the scoring of nest activity. It is unclear from the reports of the 70's how nests were scored as to activity (i.e., Troyer used the word "active." If he used Postupalsky's definitions, his work excludes occupied nests). Jope defined an active nest as one with a pair associated with it. This would be closer to Postupalsky's definition of occupied nest had it been taken earlier in the breeding season, but by late June or July is most likely

equivalent to active nest that have succeeded past early failures. An analysis of Squibb's raw data indicates that all occupied nests were active. The lateness of his activity survey might miss early occupied nests or active nests that failed by mid June.

During the 1992 Naknek study, determination of activity for three nests was judgmental. Three nests were scored as "Empty?" These were nests with one adult nearby that may or may not have been repaired. Hence, the question remains, were these nests occupied? For the analysis performed they were scored as empty. The inability to score these nests was one reason the analysis was presented on the basis of active nests. Similarly for the coastal data, because of misunderstandings of what constituted an occupied nest versus an active nest, all nests that were occupied on survey 1 were not resurveyed. One of four coastal occupied nests that were resurveyed produced young to stage two - too young to be scored as fledged by the date of the production survey. This inconsistency of resurveying occupied nests on the coast was another reason the 1992 data was analyzed based on active nests. If the reader takes the reported number of occupied nests and calculates young per occupied nest or percent occupied nests successful they should consider these biases when making comparisons to other studies. Occupied nests may be under represented thus giving an overestimate of nesting success.

One final note about sampling is the need to be able to refind nests on the production survey. This is facilitated by the consistency of pilot/observer on both surveys and with the aid of advanced electronic location equipment. During the 1992 study one nest in the Naknek drainage and several nests on the coast scored as active during the activity survey were not refound during the production survey. These nests may have failed, fledged or been active but not refound. These were all excluded from the analysis reducing the sample size. If they were failed (most likely for the Naknek nest), inclusion of these nests would have decreased the measures of nest success. If they were still active (possible for the coastal nests as adults were in the vicinity for several of these nests), inclusion of these nests may have increased the measures of nest success.

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TABLE 1. History of Katmai eagle nesting data collection.

Name	Year	Months	Locations - check	Note
Troyer	1974	5/6 & 8	Naknek[2], Nonvianuk, Kulik, & coast	--
Troyer	1975	5	Naknek, Amer. Cr., Nonvianuk, Kulik, Kukaklek, Algnak & coast	Map
Troyer	1976	5 & 7/8	Naknek, Amer. Cr., Nonvianuk, Kulik, & coast	Map
Troyer	1977	5 & 8	Naknek, Amer. Cr., & coast	Map
Troyer	1978	5 & 8	Naknek, Amer. Cr., & coast	--
Troyer	1979	5 & 8	Naknek, Nonvianuk L & R, Kukaklek & coast	Map
Unknown, see Jope 1983	1980	unk	Naknek - unknown	--
Unknown, see Jope 1983	1981	unk	Naknek - unknown	--
Jope	1983	7	Naknek, Amer. Cr., Nonvianuk & Kulik	Map
Jope	1984	7	Naknek (restricted)	Map
Jope	1985	7	Naknek, Amer. Cr., Nonvianuk & Kulik	Map
Jope	1986	6/7	Naknek, Amer. Cr., Nonvianuk & Kulik	Map
Jope	1987	6/7	Naknek, Amer. Cr., Nonvianuk, Kulik, Kukaklek & Alagnak	Map
Sowl	1988	5	Naknek, Amer. Cr., Rainbow R, Nonvianuk & Alagnak	Map
Portner	1990	5 & 7	Coast	Map
Squib, Starr & Starr	1991	6 & 7	Naknek & Amlik Bay	Map

[2] Naknek includes the Naknek drainage: Naknek Lake, Brooks Lake, Headwaters Creek, Margot Creek, Savonoski R., Coville L., and Grosvenor Lake. In any one year weather conditions may have prevented full survey of the entire system.

TABLE 2. Survey dates, flight times, observers, nests and eagles observed

Date	Plane	Pilot[3]	Observer[4]	Flight Time	Survey Time	Nests Total	Act/Occ Nests	Adult w/nest	Lone Adult	Imma-tures
Naknek Drainage										
6/10	Cessna 172 7	WW	SS	3 h 55 m	3 h 45 m	13	10	19	25	
6/12	Cessna 172 0	WW	SS	2 h 45 m[5]	2 h 04 m	7	4	7	3	
6/24	Cessna 206 7	JC	SS	3 h 00 m	1 h 58 m	9	4	7	12	
7/24	Cessna 206	JC	SS	---	3 h 13 m	22[6]		25	-[7]	-
Pacific Coast										
05/31	Bell 206	--	DD TS	---	---	57	40	51[8]	-	-
6/01	Bell 206	--	DD RP	---	---	41	25	45	-	-
7/20	Bell 206	CH	SS KB	---	6 h 48 m	62	8	35	-	-
7/21	Bell 206	CH	DD SS	---	5 hr 6 m	59	19	21	-	-

[3]WW - Windy Windell, JC - Joel Collins, CH - Charlie Hamilton

[4]KB-Kirsten Brennan, DD-Donna Dewhurst, RP-Rick Potts, SS-Susan Savage, TS-Tom Smith

[5]Flight times are approximations

[6]Includes one new active nests and one new inactive nest

[7]Only adults associated with nests were counted on the production survey, therefore immatures were not included.

[8]Only adults associated with nests are noted

TABLE 3a. Nest occupancy, activity, and success for 1992

	Naknek	Coast
Occupancy		
1. Nests found on S1	29	98
2. Nests with complete data (item 3+4+5)	28[9]	81[10]
Activity (Breakdown of item 2)		
3. Nests found on S1 that were empty	11	33
4. Nests with complete data that were occupied on S1	1	4
5. Nests with complete data that were active on S1	16	44
6. Total S1 occupied/active nests (item 4+5)	17	48
Success		
7. Occupied nests (item 4) that succeeded by S2	0	0[11]
8. Active nests (item 5) that succeeded by S2	11	24
9. Total Successful Nests	11	24
Chicks Raised		
10. Chicks produced from occupied nests	0	0[12]
11. Chicks produced from active nests	16	42
12. Total chicks produced	16	42

[9] 2 nests found on S2 were not counted, 1 nest found on S1 was not found on S2.

[10] 9 of 98 nests were not found on 2nd survey, 1 was not surveyed due to weather, 6 occupied nests were not surveyed due to misunderstood instructions, and 1 empty nest became active. Two new nests found active on 2nd survey are not included in calculations.

[11] Although one occupied nest was still active on the productivity survey, chicks were at stage 2 and criteria for successful has been defined in this paper as stage 3.

[12] Two chicks from one occupied nest, as stated in the previous footnote, only reached stage 2 by the time of the production survey and cannot be counted toward productivity.

Table 3b. Productivity Calculations for 1992

	Naknek	Coast
Reproductive Success based on Active Nests		
Young per active nest (Mean number of young/act nest)	1.00 ± 0.816	0.95 ± 0.987
Young per successful nest (Mean number of young/succ nest)	1.45 ± 0.52	1.75[13] ± 0.61
Percent active nests successful (item 8/item 5)	68.8%	54.5%
Reproductive Success based on Occupied[14] Nests		
Young per occupied or active nest (item 12/item 6)	0.94	0.88
Percent occupied or active nest successful (item 9/item 6)	64.7%	52.1%[15]

[13]This calculation is biased for the same reasons given above; it may be an under or over estimate of young per successful nest.

[14]As mentioned in the text, these calculations are fraught with biases.

[15]This is a biased estimate of success for occupied nests for the same reasons given above. This is an overestimate.

TABLE 4. Historical data indicating number of active nests on each water body of Katmai Interior.

Year	75	76	77	78	79	80	81[16]	83[17]	84	85	86	87	88	91	92
Naknek Lake	3	2	6	5	5	2	0	5	1	1	1	4	2[18]	7	8
Savonoski/Gros R.	2	5	4	4	3	0	1	2	1	1	3	1	2	1	1
Margot Creek	-	-	-	-	-	-	-	-	-	-	-	-	0	1	-
Brooks Lake	0	3	3	4	2	1	3	3	3	1	3	0	3	4	2
Headwaters Creek	-	-	-	-	-	-	-	-	-	-	-	-	1	2	3
Coville Lake	0	1	1	1	1	1	0	1	-	4	4	0	-	3	2
Grosvenor Lake	4	4	4	4	4	1	3	1	-	1	0	0	-	0	0
American Creek	1	2	3	2	0	0	1	1	-	0	1	2	2	-	2
Nonvianuk Lake	2	0	0	0	2	0	0	6	-	2	2	2	4	-	-
Kulik Lake	1	0	0	0	0	0	0	0	-	0	0	0	-	-	-
Kukaklek Lake	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-
Alagnak	-	-	-	-	-	-	-	-	-	-	-	4	6[19]	-	-

[16] Years 1975-1981 were summarized in Jope 1983

[17] Active nests defined from 83-87 are pairs on nests.

[18] Excludes North Arm

[19] Does not include branch to Kukaklek

TABLE 5. Historical Naknek drainage nest activity and production, lakes and creeks not identically represented from year to year.

	74	75	76	77	78	79	83	84	85	86	87	88	91	92
Empty nests	14												7	11
Occupied nests	25[20]	22	20	27	23	28	19	5	10	10	14	20	17	17
			15[21]	17	17	22								
Active nests														16
Successful nests			12	15	11	16							[22]	11
Total Nests													24	28
Young produced			27	25	20	30							24[23]	16
Young/occ nest			1.8	1.47	1.2	1.36							1.49	--
Young/act nest														1.0
Young/succ nest			2.25	1.66	1.82	1.88							1.86	1.45
% Occ nest succ			80	88	65	73							--	--
% Act nest succ														69

[20] Troyer's definition of occupied or active are unknown.

[21] Troyer based his productivity data on the number of occupied/active nests that were resurveyed (given in this second line).

[22] Squibb calculated productivity from an "estimated" number of young produced because of the earliness of his productivity survey.

[23] Estimated.

TABLE 6a. Nest Substrate Use - Naknek

	1991				1992			
		Active/Occupied				Active/Occupied		
	Empty	Success[1]	Failed	Total	Empty	Success	Failed	Total
Trees								
Cottonwood	3	7(12)[2]	1	11	2	5(7)	2	9
Spruce	1	5(12)	1	7	3	5(7)	2	10
Unspecified	-	-	-	-	2	-	-	2
Islands								
Cottonwood	3	2(3)	0	5	4	1(2)	2	7
Cliff Top	0	0	1	1	0	0	0	0
TOTAL				24				28

TABLE 6b. Nest Substrate Use (Troyer) active nests reported

	74	75	76	77	78	79
NAKNEK						
Cottonwood	15	12	16	19	15	15
Spruce	8	10	4	7	8	12
Cliffs	2	0	0	1	0	1
COAST[24]						
Cottonwood	5	2	4	4	-	-
Spruce	1	9	0	0	-	-
Cliffs	26	41	24	20	-	-

[24]1975 and 1976 data include Kamishak area.

TABLE 7. Historical Katmai Coast and Alaska Peninsula/Becharof NWR coast nest activity and production.

	Katmai			AKP/B NWR[25]	
	89[26]	90	92	89	90
Empty nests	-	-	33	-	28
Occ/Acc nests	60	48	48	72	78
Active nests	-	-	44	-	-
Successful nests	49	20	44	40	41
Total Nests	-	70	81	-	106
Young produced	47[27]	28	42	62	70
Young/occ nest	-	0.62	-	0.86	0.90
Young/act nest	-	-	0.95	-	-
Young/succ nest	1.20	1.27	1.75	1.55	1.71
% Occ nest succ	82	42	-	55	53
% Act nest succ	-	-	55	-	-

[25] Cape Kubugulki to Cape Kunmik.

[26] Data from Dewhurst, 1991, Table 6 for 1989 and 1990.

[27] Based on 39 nests monitored for productivity.

TABLE 8. Nest Substrate Use - Coast

	Empty	Success	Failed	Total	Katmai Coast 1992 KATM	Coastal 1990 B/AKP[28]	ANIA	Total	
I)	Sea stacks	9	6(12)	3	18	13	32	5	50
II)	Coastal Ridges	2	2(4)	3	7	4	27	2	33
III)	Connected Sea stacks	1	3(5)	2	6	1	15	3	19
IV)	Islets/Islands	2	2(3)	1	5	8	0	-	8
	I) Sea stacks	0	1(1)	0	1	-	32	-	32
	II) Ridges	0	1(1)	0	1	-	6	-	6
	III) Conn. Stack	0	0	1	1	-	9	-	9
	IV) Smaller Islet	-	-	-	-	-	1	-	1
	Va) Hilltop	-	-	-	-	-	20	-	20
	Vb) Hillside	-	-	-	-	-	32	-	32
	X) Tree	0	0	1	1	-	-	-	-
Va)	Hilltops	-	-	-	-	2	42	5	49
Vb)	Hillsides (cliff)	3	2(4)	2	7	9	12	2	23
X)	Trees								
	I) Unspecified	1	2(3)	1	4	8	0	0	8
	II) Cottonwood	6	3(6)	6	15	-	-	-	-
	III) Spruce	1	0	1	1	-	-	-	-
Unspecified		8	3(5)	2	13	-	-	-	-

[28]NWR includes Becharof, Alaska Peninsula and Alaska Maritime Refuge. Alaska Maritime refuge includes all islands along the coast except those within 5 miles of the Katmai Coast.

Appendix I. Katmai Eagle Survey Protocol

Bald eagles are frequently found breeding along the fresh water bodies and Pacific Coast of Katmai National Park and Preserve. Katmai staff has attempted to obtain some measure of breeding activity or success for eagles nearly yearly since 1974. A thorough examination of this information has identified the need for a standardized protocol for surveying eagles. It is hoped that this measure can be used in the future to indicate changes in eagle breeding activity and success and that this may be an indicator or environmental change either from natural or man made causes. Potential threats to eagles include: loss of food resources (primarily salmon during the summer months), development on state or private land within the boundaries of the park, increased human use (increased disturbance near nesting areas), and environmental contamination.

Objectives:
The minimal objectives are:

To establish baseline data on bald eagle population size and trends in Katmai National Park.

To monitor reproductive success of nesting bald eagles.

Identify bald eagle breeding habitat and document individual territory nesting success history. These data will be managed in the near future with a Geographical Information System.

These will be accomplished by: locating every nest (geographically) and determine if it is Empty, Occupied or Active during the activity survey and determine how many young are present and their stage of development on the productivity survey.

Additional objectives can be:

Identifying nest substrate use
Information about eagle feeding ecology
Distance between nests
Determine hatching success and periods of highest nest failure (require more frequent surveys).

NAKNEK DRAINAGE
Surveys will be conducted that include the lakeshores of all major lakes, rivers and creeks in the Naknek Drainage.

Dates: Activity Survey - May 10-20
Productivity Survey - July 22-27
Dates may be adjusted if the observer suspects an unusually early or late spring. Leaf out should also be a considered factor in scheduling surveys.

The objective is to complete the activity survey shortly after 90% of the nests are laid (estimated to be May 5 for Naknek Drainage and April 29 for Katmai coast) and before many have failed. The production survey should be flown late enough so that most chicks have reached the mid to late 3 stages but have not yet fledged.

Methods (Logistics):
Activity survey A fixed wing aircraft (preferably on floats) should be used with both pilot and observer sitting on the left side of the plane. The aircraft must be OAS certified for low level flying. The height of survey should be 150 to 300 feet above ground level, circling nests when necessary to verify activity. Speed should be slow (70-100 knots). An airplane with an intercom is recommended to facilitate communication between pilot and observer. If possible, employ the airplane GPS system to collect exact information about the location of each nest. It has been suggested that it is preferable to conduct surveys during the morning hours and this standardization will be followed when practical.

The lakeshore and all rivers of the Naknek drainage should be flown. With pilots and observer on the left side, the lakes should be circumnavigated in a clockwise direction flying slightly offshore to see inland from the beach. Survey should include: entire Naknek Lake including all islands, Brooks Lake, drainage area between Dumpling and Brooks Mountain, Headwaters Creek (at least 7 miles upstream), Margot Creek, Savonoski River (to Grosvenor River), Grosvenor River, Lake Grosvenor, Lake Coville, American Creek (until it bends east).

Scheduling: The activity survey requires approximately 8 hours of survey time plus transition between the beginning and end of the survey.

Observer: It is desirable that the same pilot and observer conduct both the activity and productivity survey to facilitate refinding the nest and to standardize categorization of nest stage and chick stage. The observer must be familiar with nest activity and chick stage scoring and the plotting of nests on topographic maps. Ability to operate a GPS system is also desirable. The observer must be able to tolerate intense circling.

Data to collect: Location of nest (preferably use 1:63,000 or 1:250,000 USGS map and GPS system if available), contents of nest (fresh nest material, eggs, chicks, prey items, adults incubating), stage of chicks (according to Carter, 1990 see Attachment I), nest substrate (see Attachment II), number of adults present (also note if they are fully adult), adult activity. Contents of nest should be collected with regard to scoring nest activity (empty, occupied, active - see Postupalsky, 1974 and Attachment III). A copy of a suggested data sheet is included in Attachment IV. Because a complete survey of the

lakeshore is being conducted it is desirable to also collect information about the number, age, activity and substrate use of all eagles observed.

Data Management: Data should be entered in to a dBase or comparable data file (see Attachment V for data file structure) upon return from the flight. A data printout should be prepared for use on the production survey. Nest locations should be marked on a set of base maps kept for this purpose only. Nest numbering will follow a modified USFWS protocol: each nest has a map and quadrangle number and an individual nest number for that quadrangle. When several years data have been plotted, nest territory numbers may be assigned.

Productivity Survey A fixed-wing aircraft should be used as above. It is not necessary to fly the entire lakeshore as for the activity survey. Each nest that was occupied or active on the activity survey should be checked. Therefore, the observers can fly straight line paths between each nest. The GPS system can be used to help relocate the nests. If new nests are found on this survey, these should be noted and data collected, however these nests should not be used in the final analysis of productivity. Flight height should be adjusted to see the contents of the nest. It is necessary to have a clear view of how many chicks are present and their developmental stage.

Scheduling: The productivity survey requires about 3.5 hours of flight time.

Data to collect: location (to verify it is the same nest), number of adults present, number of chicks/eggs present, stage of chick (using same terminology), prey items present.

Upon returning to the office, the data should be entered into the data file to complete the record for each nest.

Data Analysis:
The following values are desirable to report:

- Number of birds and age observed on activity survey
- Number of nests observed
- Location of nests (marked on map)
- Of these - How many empty
  - How many occupied
  - How many active
  - How many successful
- How many chicks produced
- Number of nests in each substrate type

The following values are desirable to compute:

- Estimated egg laying date
- Percent nests occupied
- Percent reoccupancy from year to year

Number of young/occupied nest
Number of young/active nest
Number of young/successful nest
Percent occupied nests successful

Percent active nests successful
Distance between occupied nests

Statistical comparisons can be performed between coastal and Naknek data or between years if methods used are comparable. Statistical comparisons may use a t-test adjusted for small and unequal sample sizes or non-parametric (Kruskal-Wallis test or Mann-Whitney U-test) statistics may be applied.

These data will be compiled in an annual report and will be sent to the USFWS Raptor Biologist in Juneau and the Wildlife Biologist at Alaska Peninsula/Becharof NWR as well as the NPS Resource Management Division in the Alaska Regional Office.

KATMAI COAST

Dates: Activity Survey - May 5-15
Productivity Survey - July 17-22

Methods (Logistics):
Logistics: Because of the unpredictability of weather between the coast and King Salmon (flight base) it is recommended that a small helicopter on floats (Bell 206, Hughes 500 or equivalent) be used to conduct both the activity and productivity survey. To make these surveys most efficient, a fuel cache and overnight base should be established on the coast. This will save extra flying time for refueling and save the hours needed to commute to King Salmon for overnights. The activity survey takes more than one day's time to complete and the transportation time between the coast and King Salmon is about one hour. Using a second observer/data recorder is also recommended because the number of maps and paper work associated with this survey is great and a second observer facilitates handling this material. Also a second observer seated in the back seat of the helicopter can often see nest contents that the pilot or first observer cannot see.

Activity survey The height of survey should be 150 to 300 feet above ground level, circling nests when necessary to verify activity. Speed should be slow enough to allow complete searching of coastline (60-80 knots). An intercom is necessary to facilitate communication between pilot and observer. If possible, a helicopter with GPS system should be used to collect exact information about the location of each nest.

The entire coastline from the Kamishak River to Cape Kubugakli including offshore islands and seastacks should be searched. River valleys lined with cottonwoods or spruce should be searched from the coast to 3-5 miles inland. Maps with previous nesting history should be used to facilitate relocation of nests.

Scheduling: The activity survey requires approximately 2 - 10 hour days of survey time plus transport to King Salmon if an

overnight base is not established.

Observer: Same as Naknek Survey.

Data to collect: Same as Naknek Survey. Nest substrate categories will differ.

Data Management: Same as Naknek Survey.

Productivity Survey A helicopter should be used as for the coastal activity survey. All other procedures are the same as the Naknek Survey.

Scheduling: The productivity survey requires about 2 days of flight time.

Data to collect: Same as Naknek Survey.

Data Analysis: Same as Naknek Survey.

	Budget & FTE			
NAKNEK DRAINAGE	Flying Hours	Pilot Hours	Biol Hours	Obsv Hours
Flying time	14	14	14	
Data entry/clean up			6	
Mapping			2	
Data analysis/report writing			32	
KATMAI COAST				
Flying time	40[29]	40	40	40
Data entry/clean up			16	
Mapping			6	
Data analysis/report writing			32	

[29] Estimated

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Attachment I
Chick Stage Diagrams

Attachment II
Nesting Substrate

NAKNEK DRAINAGE

I. Mainland (Lakeshores)
  A. Tree
    1. Cottonwood
    2. Spruce
  B. Hill
    1. Side or Cliff
    2. Hilltop

II. Islets/Islands
  A. Tree
    1. Cottonwood
    2. Spruce
  B. Hill
    1. Side or Cliff
    2. Hilltop

COAST

I. Sea stacks (pinnacles sticking out of the sea, top usually smaller than bottom)

II. Coastal Ridges (small peninsulas still connected to the mainland)

III. Connected Sea stacks (ridges that have been partially worn away, leaving a stack sill connected to mainland by a lower, saddle -shaped arm)

IV. Islets/Islands
  A. Sea stacks
  B. Ridges
  C. Conn. Stack
  D. Smaller Islet (off an island)
  E. Hill (Cliff), altitude reported when possible
    1. Top
    2. Side
  F. Tree
    1. Cottonwood
    2. Spruce

V. Hill (cliff), altitude reported when possible
  A. Tops
  B. Sides

VI. Trees
  A. Cottonwood
  B. Spruce

Attachment III
Terminology - Nest Activity

Activity Survey:

E Empty. Includes empty nests, old nests with only 1 adult or 1 subadult/juvenile near nest.

NF Not Found. Only used on this survey if historic nests being looked for.

O Occupied. Nest with two adults actively defending. Or nest with fresh nesting material. One adult near and empty unrepaired nest does not constitute occupied.

A Active. Eggs, chicks or adult incubating nest. A subset of occupied. (See below)

AE1 Active nest with one egg.

AE2 Active nest with two eggs.

AE3 Active nest with three eggs.

A1 Active nest with one chick.

A2 Active nest with two chicks.

A3 Active nest with three chicks.

Production Survey:

EP Empty. Any new empty nests detected since activity survey.

F Failed. A nest that was occupied or active is now empty.

NF Not Found. An occupied or active nest that cannot be relocated.

NS Not Surveyed. Nest was not surveyed due to weather or logistical problems.

O Occupied. Same as above; not likely during a production survey.

A Active nest with eggs.

A1 Active nest with one chick.

A2 Active nest with two chicks.

A3 Active nest with three chicks.

Attachment IV
Activity Survey Data Sheet

Date_____
Time Start_____
Time Stop _____

Nest #	Frsh Matl Lat/Long	# Eggs	# Chk	Chk Stg	Nest Substrate	Adlt Age	Adlt Behavior	Adlt Substrate	Misc/

Attachment V
Dbase III+ file structure for eagle nest data

Structure for database: C:katmania\eagnakxx.dbf or C:katmania\eagcstxx.dbf

Field	Field Name	Type	Width	Dec
1	MAP_NO	Character	6	
2	NEST_NO	Character	3	
3	LAT	Character	7	
4	LONG	Character	8	
5	S1_DATE	Date	8	
6	S1_OBS	Character	7	
7	S1_NO_ADLT	Numeric	1	
8	S1_NO_EGG	Numeric	1	
9	S1_NO_CHK	Numeric	1	
10	S1_CHK_STG	Character	2	
11	S1_NOTE	Character	30	
12	S1_AC	Character	2	
13	S1_ELD	Date	8	
14	S2_DATE	Date	8	
15	S2_OBS	Character	7	
16	S2_NO_ADLT	Numeric	1	
17	S2_NO_EGG	Numeric	1	
18	S2_NO_CHK	Numeric	1	
19	S2_CHK_STG	Character	2	
20	S2_NOTE	Character	30	
21	S2_AC	Character	2	
22	S2_ELD	Date	8	
23	NEST_SUB	Character	10	
24	HABITAT	Character	25	
** Total **			180	

Appendix II - Calculation of Egg Laying Date

Estimates of Egg Laying Date were calculated following a preset formula. Data from chick stage on survey two and presence of eggs or chicks on survey one was used to estimate the egg laying date. Data was used only from nests that had young on the second survey. This may bias data from earlier nesters that failed or succeeded. An estimated egg laying date was predicted for each nest and these dates were then averaged to determine mean egg laying date. These were also plotted and accumulated to determine the date by which 90% of all nests had been laid.

Egg laying date was calculated by back dating from the best available information. The rules used to calculate egg laying date for each nest were as follows:

An average number of weeks to each developmental stage including incubation was determined by adding 5 weeks of incubation to chick ages given by Carter (chicks at stage 1a were 5.5 weeks $\pm$ 3.5 days past ELD, stage 1b - 6.5 wks $\pm$ 3.5 days, stage 2 - 8 wks $\pm$ 1 wk, stage 3a - 9.75 wks $\pm$ 5 days, stage 3b - 11.5 $\pm$ 7 days, stage 3c - 13.5 wks $\pm$ 7 days and stage 3d - 15.5 wks $\pm$ 7 days).

For nests where contents were seen only on survey two, the best guess ELD is counted back the number of weeks from their stage on survey two.

For nests where contents were seen on both survey one and two an earliest and latest possible date are calculated using the ranges from the count backs for both survey 1 and 2 stages. If these two windows overlapped, an average is taken for the time of overlap. If the two windows did not overlap, the closer earliest/latest dates for survey one and two are taken and an average is taken between these. However if a nest on survey one was know to contain a 1A chick or egg, this would dictate the earliest possible egg laying date for that nest.

1. For 1991 these values represent maximum number of successful nests and maximum number of young. Reported numbers include young that were still downy on second survey of 7/10/91.

2. Number in parenthesis represents number of young.