

**U.S. Department of the Interior
National Park Service**

**Protocol for Assessing Nesting Territory Occupancy and Reproductive Success of
Golden Eagles (*Aquila chrysaetos*) in the Central Alaska Monitoring Network:
Denali National Park and Preserve, Alaska.**

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Important Note: This sampling protocol consists of the Protocol Narrative, eight Standard Operating Procedures (SOPs), and four appendices:

- SOP # 1: Before the field season
- SOP # 2: Conducting the occupancy survey
- SOP # 3: Conducting the production survey
- SOP # 4: Conducting nest visits.
- SOP # 5: Post-field season activities
- SOP # 6: Data management
- SOP # 7: Data analysis and management actions
- SOP # 8: Reporting
- Appendix A: Definitions and terminology
- Appendix B: Field data forms.
- Appendix C: Protocols for collecting blood, feather and egg samples.
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I. Background and Objectives

Issue being Addressed and Rationale for Monitoring Golden Eagle Reproductive Success

The Central Alaska Network (CAKN) adopted a holistic view of network ecosystems and tracks the major physical drivers of ecosystem change and responses of the two major components of the biota, plants and animals (MacCluskie and Oakley 2005). One of the top three Vital Signs in CAKN is *Fauna Distribution and Abundance* and one of the goals of the program is to describe the distribution of fauna across the landscape and track changes in both their distribution and abundance in the CAKN. The *Fauna Distribution and Abundance* Vital Sign includes monitoring efforts for a suite of vertebrate species including Golden Eagles (*Aquila chrysaetos*).

Golden Eagles are the most conspicuous raptor living in the mountainous regions of CAKN from March through September. Denali National Park and Preserve, Alaska (Denali) contains one of the largest reported nesting populations of Golden Eagles in North America (Kochert et al. 2002). Most of the Golden Eagles that nest in Denali are migratory, spending their winters far south of Denali across southern Canada, the western United States and northern Mexico. Territorial Golden Eagles return to Denali from mid-February to late March and usually leave the area by late September. Golden Eagles inhabit the mountainous regions of Denali, nesting and hunting in alpine and subalpine habitats usually below 1850 m (McIntyre and Adams 1999). Most nesting sites are on cliffs and rock outcrops. Golden Eagles in Denali prey primarily on snowshoe hare (*Lepus americanus*), arctic ground squirrel (*Spermophilus parryii*), hoary marmot (*Marmota caligata*), willow ptarmigan (*Lagopus lagopus*), and seasonally on Dall sheep (*Ovis dalli*) lambs and caribou (*Rangifer tarandus*) calves (McIntyre and Adams 1999). The Golden Eagle is the secondary largest avian predator in CAKN and occupies an important position in the subarctic food chain.

Golden Eagles are relatively long-lived, and once they acquire a nesting territory they may defend it for many consecutive years (Kochert et al. 2002). These large eagles are relatively easy to detect and they build large stick nests that are often relatively easy to detect during aerial surveys. During the nesting season, Golden Eagles are considered central place foragers with most of their activities based on an occupied nest or an occupied nesting area. Estimates of reproductive metrics including nesting area occupancy, brood size, fledgling production and nesting success often provide important indicators for assessing population status and trends for birds (Newton 1979, Rotenberry and Wiens 1989). The logistical and fiscal difficulty of collecting survival data for Golden Eagles necessitates the use of reproductive data to make inferences about their status (Newton 1979, Steenhof 1987) in Denali.

In a recent review of the status and trends of Golden Eagles in North America, Kochert and Steenhof (2002) recommended that the National Park Service continue long-term nesting surveys in Denali. Continuous data from the Denali study and other study areas in the temperate regions of North America provide valuable insights about the responses of Golden Eagles to different environmental problems in diverse geographical areas (Kochert and Steenhof 2002). We propose to continue monitoring the reproductive success of Golden Eagles in Denali via the CAKN to maintain consistency in our long-term studies.

Long-term monitoring in Denali from 1987 to 2006 revealed some of the ecological relationships between Golden Eagles, their prey and their habitat. For instance, interannual variation in the reproductive success of Golden Eagles in Denali was correlated with abundance of spring food supply, particularly snowshoe hare and Willow Ptarmigan (McIntyre and Adams 1999, McIntyre et al. 2006b). Further, more Golden Eagles laid eggs and raised young when the abundance of snowshoe hare was high (McIntyre and Adams 1999), suggesting that Golden Eagles are an indicator of large scale changes in the population size of snowshoe hare in Denali. Additionally, recent work in a study area adjacent to Denali suggested that Golden Eagles were significant predators of Dall sheep lambs, particularly in years when snowshoe hare populations were high and more Golden Eagles attempted to raise young (Arthur et al. 2004).

Golden Eagles may also provide insights into the effects of climate change on wildlife in Denali. For instance, Golden Eagle production was significantly lower in nesting areas that contained higher amounts of closed-canopy vegetation including forests and tall shrubs (McIntyre 2004). Paleoclimatic records indicate that the Arctic regions of Earth are now warmer than any time in the past 400 years (Overpeck et al. 1997) and climatic models project that rapid Arctic warming will continue, with Alaska warming by 5 to 12° F by 2100 (Payton et al. 2000). The effects of this warming could cause large-scale changes in vegetation patterns (i.e., increase in shrub and forest cover) (Rupp et al. 2000, Sturm et al. 2001) that could potentially negatively affect the nesting success of Golden Eagles (McIntyre 2004). For instance, there was strong evidence to suggest that afforestation contributed to declining overall production of Golden Eagles in Scotland (Whitfield et al. 2007). Further, the relative and absolute effects of climatic change in the next decades are likely to be greatest in high northern latitudes, particularly in mountainous regions (Beniston 2000). As the climate warms, treeline is expected to increase in altitude and alpine habitats may become more fragmented into smaller and more isolated patches (Martin 2001). Hence, wildlife communities in alpine regions may undergo significant changes in response to a warming climate. Monitoring the size of the territorial population and reproductive success of Golden Eagles in Denali has the potential to provide Denali's managers with opportunities for gaining a better understanding of wildlife's responses to climate change (Martin 2001, Inkley et al. 2004).

Historical Development of Golden Eagle Monitoring in CAKN

Sheldon (1930), Dixon (1938) and Murie (1944) all noted the abundance of Golden Eagles within the old Mount McKinley National Park (now part of Denali), and Murie (1944) estimated that at least 25 pairs of Golden Eagles nested in the northeast region of the park. In 1987, Denali biologists conducted the first formal inventory of Golden Eagle nesting sites and found >50 occupied nesting areas in the northeastern region of Denali. This exciting discovery spurred the National Park Service to develop a long-term study of the nesting ecology and reproductive success of Golden Eagles in Denali. To make comparisons with other study areas, Denali's biologists modeled their new program after the long-term Golden Eagle monitoring program in the Snake River Birds of Prey National Conservation Area in southwest Idaho (Steenhof and Kochert 1982, Steenhof et al. 1997, McIntyre and Adams 1999).

Results of Denali's long-term Golden Eagle studies have made significant contributions to the knowledge of the ecology of Golden Eagles in Alaska and North America (McIntyre and Adams

1999, McIntyre 2002, Kochert and Steenhof 2002, Kochert et al. 2002, McIntyre and Collopy 2006, McIntyre et al. 2006a, 2006b, 2006c,). Further, several studies building off the monitoring program were particularly useful for describing the differences in life history characteristics between northern migratory populations and southern resident populations of Golden Eagles in North America (McIntyre and Adams 1999, Kochert et al. 2002, McIntyre and Collopy 2006, McIntyre et al. 2006a).

There are few contemporary monitoring programs for nesting Golden Eagles in North America (Kochert and Steenhof 2002) and even fewer long-term monitoring programs for this species across its range (Watson 1997). The Denali study is one of two long-term Golden Eagle monitoring studies in Alaska; however it is the only contemporary study in Alaska monitoring ≥ 50 territorial pairs each year. Further, the continuity of this unique dataset is valuable for assessing long-term trends within and among a large number of nesting areas over a relatively long period time.

Measurable Objectives

1. Estimate annually occupancy and breeding activities at all known nesting territories.

- Revisit all known nesting territories and assess their occupancy.
- Search for new and previously unknown nesting territories and assess their occupancy.
- Document if eggs were laid at occupied nesting territories.
- Calculate the proportion of nesting pairs that successfully raise ≥ 1 fledgling.
- Record the number of fledglings and calculate the number of fledglings produced per territorial, nesting and successful pair.

2. Estimate annually nesting phenology.

- Estimate age of nestlings during nest visits or the production survey, and calculate estimated dates of egg-laying, hatching, and fledging.

3. Assess age structure and fidelity to nesting areas of territorial population.

- Use plumage characteristics to document age structure (adult or subadult) of territorial eagles in the study area.
- Use genetic analyses of naturally shed feathers to identify individual territory holders at a randomly selected sample of nesting areas (following Rudnick et al. 2005).

II. Sampling Design

Rationale for Selecting this Sampling Design over Others

Survey methods. All assessments of annual occupancy of nesting territories and reproductive success are made using two standardized aerial surveys, the occupancy survey and the production survey following recommendations made by Fraser et al. (1983). Additional ground-based observations are conducted as needed. Aerial surveys are an effective method to assess the

occupancy of nest sites and to collect data on reproductive parameters of large, cliff nesting raptors including Golden Eagles (Steidl et al. 1997). Additionally, aerial surveys yield information on population size, density, distribution, nesting territory occupancy rates, and within-area nest changes, all of which provide insights on population processes (Steidl et al. 1997).

All aerial surveys associated with this project are conducted using Robinson R-44 helicopters or similar models. Helicopters are assumed to be safer and more efficient for conducting aerial surveys for Golden Eagles in the mountainous and rugged terrain in the Denali study area. Fixed-wing aircraft maybe useful in some situations, but they are not effective at accessing the many tight box canyons throughout the study area.

The occupancy survey is conducted in late April after most clutches have been completed, before eggs hatch, and before most nest failures occur. The objectives of the occupancy survey are to assess the occupancy of all historic (known) and newly discovered nesting areas and record breeding activities observed in occupied nesting areas. The production survey is conducted in mid- to late July after most nestlings reach 80% of their age at fledging, but before many fledglings leave the nest. The objectives of the production survey are to record breeding outcome at all nests where eggs were laid (successful or failure), record number of fledglings produced at each successful nest, and estimate the age of fledglings at all occupied nests.

Survey area. The monitoring is conducted in the northeastern portion of Denali, the historical study area for the Denali Golden Eagle project (Figure 1).

Target population. The target population for monitoring occupancy and reproductive success is the territorial population of Golden Eagles in the northeastern portion of Denali (Figure 2). Although assessing the number of the non-territorial eagles in Denali is important for understanding the population dynamics of Golden Eagles in Denali (Penteriani et al. 2005), it is impossible to monitor this segment of the population without identifying individuals (by marking them) and following them over time.

Only occupied nesting territories and nesting pairs documented during the occupancy survey are used to calculate annual rates of occupancy and nesting. Similarly, only successful pairs and fledglings documented during the production survey are used to calculate success rate and production (Steenhof 1987). Occupied nests and laying pairs documented after the occupancy survey are used to assess the number of occupied nests that were missed during the occupancy survey. Similarly, successful nests and fledglings documented after the production survey are used to assess the number of successful nests and fledglings missed during the production survey.

Monitoring metrics. The metrics for this monitoring program were chosen to provide comparable data with other long-term Golden Eagle monitoring program in North America (McIntyre et al. 2006b). Each of these metrics provides insight into the mechanisms of the population's response to environmental changes. For instance, the best indicator of long-term change in population size of Eastern Imperial Eagles was the change in the proportion of

territories that were occupied (Katzner et al. 2007). Further, non-adult to adult ratios provides important information for assessing the status of eagle populations (Katzner et al. 2007). Additionally, information on nesting territory occupancy is useful for protecting Golden Eagles from disturbance. Terminology used to describe golden eagle nesting territory occupancy and reproductive success is summarized in Appendix A.

NOTE: A traditional measure of avian nesting success, the percentage of eggs that hatch and ultimately develop into fledglings, was not selected as a monitoring metric because intentionally flushing incubating eagles increases the likelihood of nest abandonment (Steenhof 1987).

Sampling Frequency and Replication

Occupancy and production surveys are conducted annually to maintain consistency with the historical data set and to assess occupancy and reproductive success among and within nesting territories. All known nesting territories are observed annually during the occupancy survey. Additionally, observers continue to search for new and/or previously undiscovered nesting territories during all survey work. All occupied-breeding nesting areas are observed annually during the production surveys. Nesting phenology and age structure of the territorial population are recorded annually. Feather collections are conducted annually.

III. Field Methods

This section briefly summarizes the activities necessary to conduct fieldwork each year. Please refer to the individual protocols for detailed instructions.

Field Season Preparations, Field Schedule and Equipment Setup

The Principal Investigator (PI) reviews this entire protocol at least five months before the start of the field season. Due to limited availability of survey aircraft, the PI develops a survey schedule and submits requests for aircraft to the Office of Aircraft Services (OAS) or the contractor at least four months before the field season. It is important to maintain consistency with the aircraft contractor to minimize problems with using inexperienced pilots during aerial surveys. At least a month before each survey, the PI prepares survey maps and ensures that adequate fuel is available at both the McKinley airstrip and the Kantishna airstrip for the survey work, and that housing is secured for both the observers and the pilot.

It is also important to schedule second observers well in advance of the field season. The second observer should have experience conducting aerial surveys for cliff nesting raptors in mountainous regions.

The occupancy surveys are conducted in late April and early May, after most pairs have completed clutches, before eggs hatch, and before most failures occur (McIntyre and Adams 1999). Nest visits are conducted in late June and early July, after most nestlings reach 21 days of age. Nest visits should not be conducted until nestlings are ≥ 21 days of age. Production surveys are conducted in mid- to late July, after most nestlings are $\geq 80\%$ of their fledging age (Steenhof 1987).

See SOP # 1: “Before the Field Season” for details on field season preparation.

Conducting the Aerial Surveys

The aerial surveys are conducted using Robinson R-44 helicopters which are relatively quiet, provide a good observation platform, and are more fuel efficient than other helicopters in this size category (i.e., Bell Jet Ranger, Hughes 500). All surveys are conducted by experienced wildlife survey pilots and experienced aerial raptor surveyor(s). Detailed methodologies for conducting the aerial surveys are found in SOP #2 “Conducting Occupancy Surveys” and SOP #3 “Conducting Production Surveys”.

Conducting the Nest Visits

The PI must be an experienced raptor biologist who is a competent rock climber. Detailed methodology for conducting nest visits and collecting shed feathers are found in SOP #4 “Conducting Nest Visits.”

IV. Data Management

The raptor database was developed following strategies and guidance for data handling and quality assurance/quality control in the CAKN Data Management Plan posted at <http://www.nature.nps.gov/im/units/cakn/DataMgt.htm>. Microsoft Access is the primary software environment for managing the raptor data. The database consists of two files in a front-end/back-end configuration that can be linked using the Linked Table Manager in MS Access. The front-end file *CAKN_GOEA.mdb* contains the forms, queries, and VBA code for the application itself and represents the user interface for the data. The back-end file *CAKN_GOEA_be.mdb* contains the actual data tables.

See SOP # 5, “Data management” for details.

V. Analysis and Reporting

See SOP #6 “Data Analysis” for details.

VI. Personnel Requirements and Training

Roles and Responsibilities:

The PI is responsible for implementing this monitoring protocol, and is supervised by the Branch Chief of the Wildlife Division at Denali. The data management aspect of the monitoring effort is the shared responsibility of the PI and the data manager. Typically, the PI is responsible for data collection, data entry, data verification and validation, data summary, analysis and reporting. The data manager is responsible for data archiving, data security, dissemination and database design. The data manager, in collaboration with the PI, also develops data entry forms and other database features as part of quality assurance and automates report generation. The data manager

is ultimately responsible that adequate QA/QC procedures are built into the database management system and appropriate data handling procedures followed.

Qualifications and Training:

Because of the need for a high level of training and consistency in implementing the protocol, the PI must have experience in aerial surveys for cliff nesting raptors in mountainous regions. The PI also must have extensive experience in conducting raptor nest visits and analyzing raptor nesting data. The most essential component for the collection of credible, high-quality data on Golden Eagles is a competent observer and pilot.

Pilot requirements. The pilot is responsible for safe and efficient flying during the aerial surveys, maintaining the desirable airspeed and altitude, and keeping the windows clear of impediments. The pilot must be experienced flying low level wildlife surveys in remote mountainous regions and must be certified by the Office of Aircraft Safety (OAS).

VII. Operational Requirements

Annual Workload and Field Schedule

Fieldwork begins in late April and continues through late July or early August. Occupancy surveys are conducted in late April and require 5 to 7 days. Nest visits are conducted in late June and early July and require 7 to 14 days depending on the number of nesting pairs and the logistics involved in getting to nests. Production surveys are conducted in late July and usually take 1 or 2 days. The total time commitment for fieldwork is approximately 15 to 22 days depending on the weather, the number of pairs that are nesting, and the number of nests that are accessible. Fieldwork requires between eight and 14 hours of work per day, depending on weather.

Facility and Equipment Needs

The Golden Eagle survey work does not require special facilities beyond normal office space and equipment storage needs. SOP#1 “Before the Field Season” summarizes all the equipment needs for this project.

Startup Costs and Budget

The estimated budgets for this program are summarized in Table 1 and 2. Table 2 summarizes the additional costs for assessing survey precision. There are no start-up costs associated with this project. Most of the funding for this project is used for aerial surveys (OAS costs). The funding for the PI comes directly from Denali and is not a factor in the budget.

Table 1. Estimated annual costs of conducting aerial surveys and nest visits for Golden Eagles in Denali National Park and Preserve, Alaska. 2007 to 2010.

Item	Estimated Costs
OAS costs: aerial surveys and nest visits	\$22,000.00^a
Travel	\$600.00
Equipment/supplies	\$400.00
Total	\$23,000.00

^a OAS costs are expected to increase as much as 10% annually as the price of avgas and other petroleum products increase.

Table 2. Estimated annual costs of conducting aerial surveys to estimate survey precision for Golden Eagles in Denali National Park and Preserve, Alaska, 2007 to 2010.

Item	Estimated Costs
OAS costs: aerial surveys	\$10,000.00^a
Travel	\$200.00
Equipment/supplies	\$200.00
Total	\$10,400.00

Procedure for Revising the Protocol and Archiving Previous Versions of the Protocol

Revisions to both the Protocol Narrative and to specific Standard Operating Procedures (SOPs) are to be expected. Careful documentation of changes to the protocol, and a library of previous protocol versions are essential for maintaining consistency in data collection and for appropriate treatment of the data during data summary and analysis. The MS Access database for each monitoring component contains a field that identifies which version of the protocol was being used when the data were collected.

The rationale for dividing a sampling protocol into a Protocol Narrative with supporting SOPs is based on the following:

- The Protocol Narrative is a general overview of the protocol that gives the history and justification for doing the work and an overview of the sampling methods, but that does not provide all of the methodological details. The Protocol Narrative will only be revised if major changes are made to the protocol.
- The SOPs, in contrast, are very specific systematic instructions for performing a given task. They are expected to be revised more frequently than the protocol narrative.
- When a SOP is revised, in most cases, it is not necessary to revise the Protocol Narrative to reflect the specific changes made to the SOP.
- All versions of the Protocol Narrative and SOPs will be archived in a Protocol Library.

The steps for changing the protocol (either the Protocol Narrative or the SOPs) are outlined in SOP #9, "Revising the Protocol". Each SOP contains a Revision History Log that will be filled out each time a SOP is revised to explain why the change was made, and to assign a new Version Number to the revised SOP. The new version of the SOP and/or Protocol Narrative will then be archived in the CAKN Protocol Library under the appropriate folder.

VIII. Acknowledgments

I thank Bill Thompson, National Park Service, and Susan Savage, US Fish and Wildlife Service, for their patience and for providing suggestions for improving this protocol and Al Smith, NPS, for creating the Golden Eagle database.

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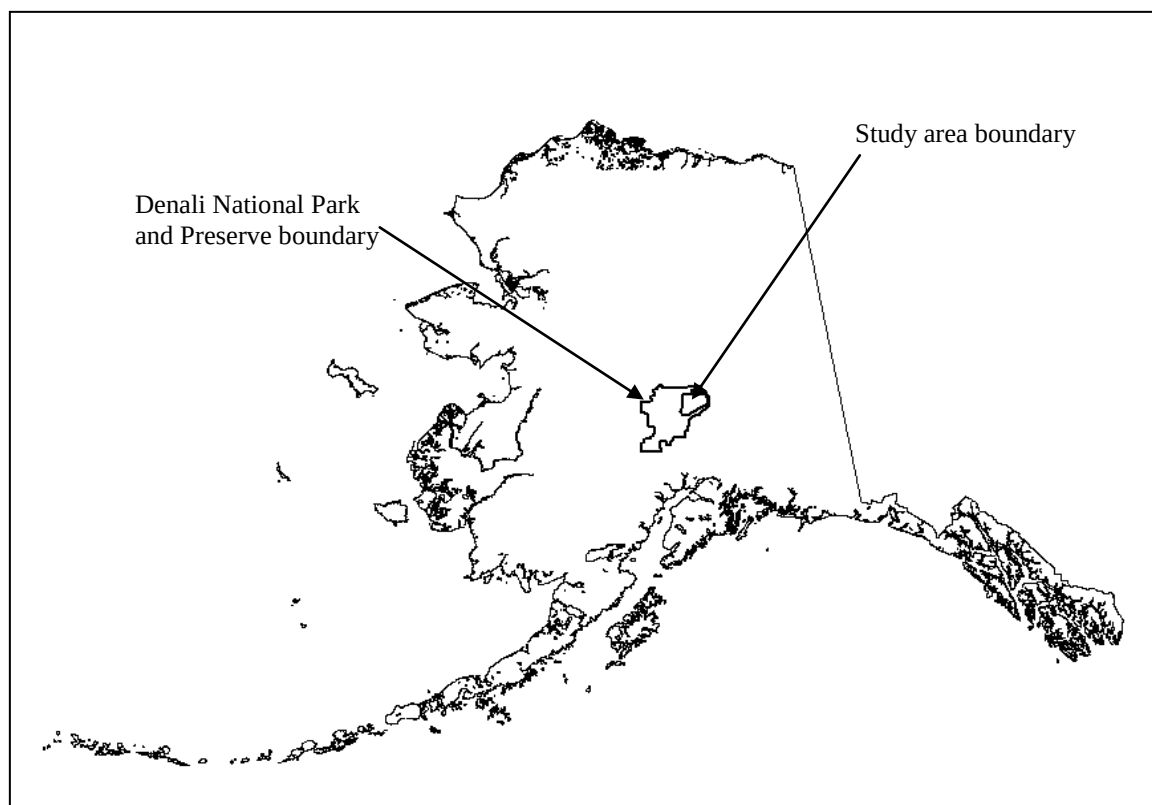


Figure 1. General location of study area in northeast portion of Denali National Park and Preserve, Alaska.

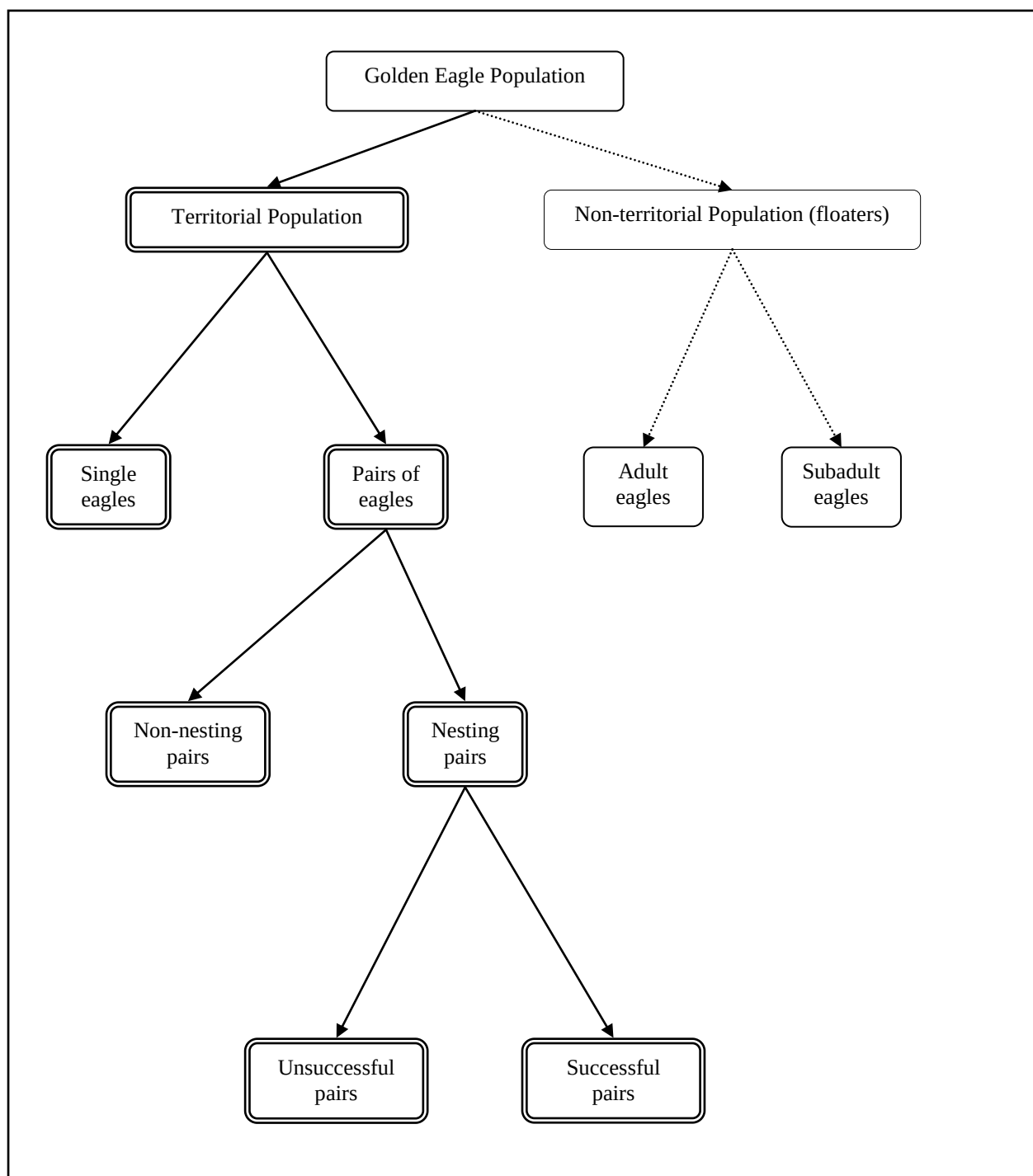


Figure 2. Structure of Denali's Golden Eagle populations (following Steenhof 1987). The targeted population for monitoring is illustrated by the double-lined boxes on the left side of the figure.

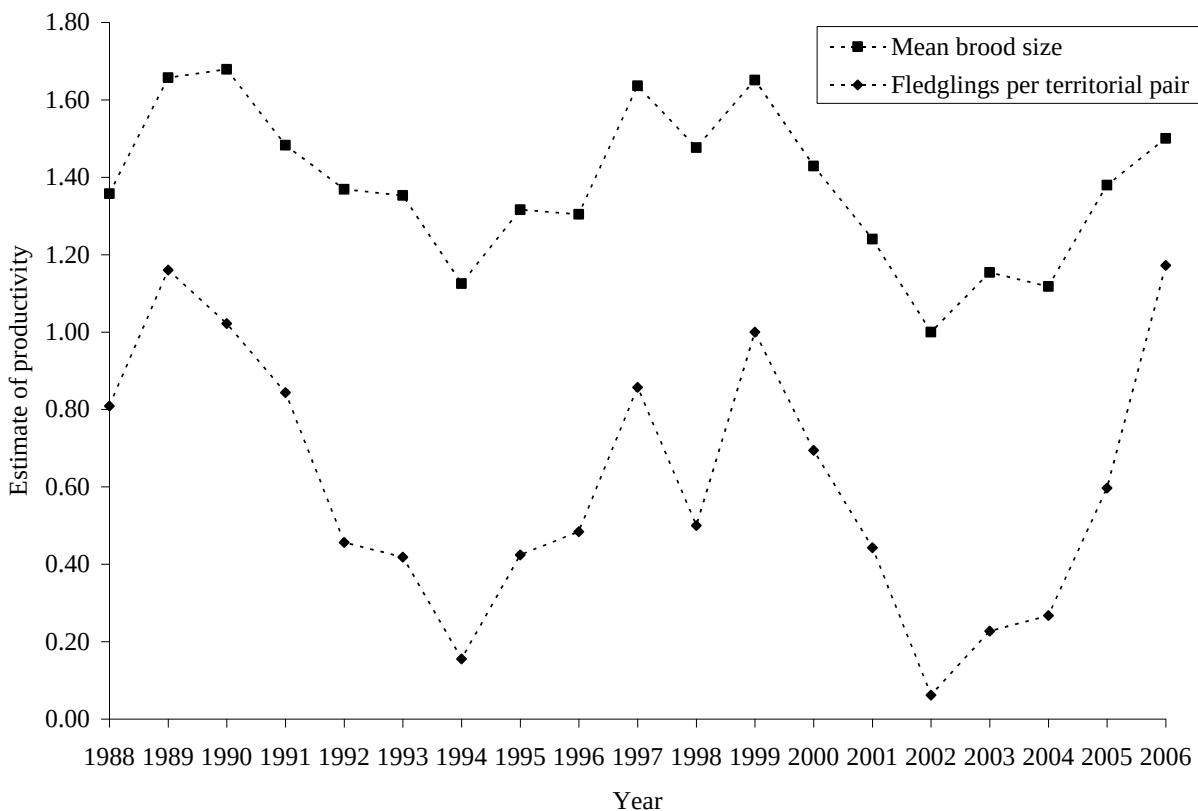


Figure 3. Estimates of annual production based on fledglings per successful nest (mean brood size) and fledglings per territorial pair (overall population production). The coefficient of variation for mean brood size was 14.31 and for overall population production was 54.98.

**Monitoring the Reproductive Success and Production of
Golden Eagles (*Aquila chrysaetos*) in the Central Alaska Monitoring Network:
Denali National Park and Preserve, Alaska.**

Standard Operating Procedure (SOP) #1

Before the Field Season

(December 2006)

Revision History Log:

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This SOP provides detailed instructions for preparing for the field season. The Principal Investigator (PI) for the Golden Eagle surveys will review this entire protocol, including all the SOPs and Appendices, several months before surveys begin. A critical component of this SOP is the scheduling of the surveys and aircraft.

Procedures:

I. General Preparation and Review:

Develop a schedule for aerial surveys and nest visits: The occupancy surveys are completed between 22 April and 8 May after most clutches are completed, before most clutches fail, and before hatching; plan for 4 to 6 hours of flight time on 5 to 7 consecutive days to complete the survey. Nest visits are completed after most nestlings reach 21 days of age but before they reach 51 days of age (historically between 21 June and 15 July). To prevent premature fledgling during nest visits, do not schedule nest visits near the end of the nestling period (>51 days of age). For nest visits, schedule aircraft to gain access to nesting territories that are not easily accessible by walking from the Denali park road. Schedule five full days of fieldwork with aircraft assistance for nest visits and ten full days of fieldwork for nest visits on foot. The production survey is completed after most nestlings reach 51 days of age but before most leave the nest (historically between 18 July and 2 August); plan for 6 to 8 hours of flight time on one day to conduct the production survey.

Review NPS requirements for personnel using aircraft. The Department of the Interior and the National Park Service has many regulations and guidelines pertaining to personnel using aircraft, particularly helicopters. These regulations often change among years. All personnel

must have the required training for using aircraft and that you must use only OAS approved aircraft and pilots. This is an important task because most aircraft trainings are scheduled in the spring of each year.

Review NPS and Office of Aircraft Safety (OAS) requirements for procuring aircraft. The NPS and OAS requirements for procuring aircraft are subject to change. The PI must know all the current rules and regulations for procuring aircraft.

Review flight following requirements. Denali's flight following requirements are subject to change. The PI must know all the current protocols for flight following in Denali.

Review database and maps with nest locations. The PI must be familiar with the locations and histories of all nests and nesting areas. Pay special attention to territories where Gyrfalcons also nest.

Generate data sheets and survey maps with the names and location of nesting territories, and the individual nest structures with the nesting territories. The data sheets and survey maps are generated using the location data in the MS Access Database *CAKN_GOEA* and a Geographic Information System (GIS).

II. Scheduling Surveys:

Schedule aircraft for surveys early in the season: Aircraft availability is often limited; therefore, it is critical to contact the aircraft contractors or submit requests for appropriate survey aircraft to the Office of Aircraft Services (OAS) in January of the current survey year. Call local aircraft vendors in Fairbanks before contacting vendors in other areas of the State to reduce ferry time expenses. Ferry time between Fairbanks and Denali is substantially less than ferry time between Denali and Anchorage. Remember to use only OAS approved aircraft and pilots.

Discuss the survey schedule with the contractor and the pilot. Once you contract an aircraft, discuss the work with the contractor and the pilot. It is critical that the contractor understands the nature of the surveys and that the pilot fully understands the objectives of each component of fieldwork. It is advantageous to work with pilots who have with aerial raptor surveys in mountainous areas.

Ensure that fuel is available at the McKinley and Kantishna airstrips. Work with Denali park staff who oversee aircraft fuel to ensure that adequate fuel is available at both bulk tanks for the survey periods. When using a Robinson R-44 helicopter, estimate fuel needs of 320 gallon for the occupancy survey and 240 gallons for the production survey (based on fuel efficiency rating of 16 gallons per hour).

Print and prepare Denali park flight plans. The PI must be familiar with the Denali park flight following procedures and the park flight plan data sheets. Talk with the Denali communications center (dispatchers) and let them know about your fieldwork including survey dates, aircraft type, and any other relevant information regarding the surveys.

Schedule housing for pilots and observers. Contact personnel responsible for housing in Denali to schedule temporary housing for pilots and observers.

III. Organizing Supplies and Equipment:

Prepare all field gear. Table 1.01 lists the field gear necessary for aerial surveys. See SOP #4 “Conducting Nest Visits for Collecting Blood and Feather Samples” for a list of gear needed for nest visits.

Table 1.01 Field gear necessary for conducting aerial surveys for Golden Eagles in Denali National Park and Preserve, Alaska.

Number	Item
1	Aircraft procurement forms
1	Flight following forms
1	Laminated survey maps
1	Set of survey data sheets for appropriate survey (occupancy or production)
4	Fine point permanent pens
2	Clipboard
1	Satellite phone
1	Handheld FM radio for communicating with park dispatch
2	Nomex flight suits
2	Massif Gear (or similar) Nomex winter flight gear
2	OAS approved helicopter helmets with communications systems
2	Leather boots (or cold weather boots for occupancy survey)
2	Pairs of small snow shoes for occupancy survey
1	First aid kit
2	10 x 40 binoculars (high quality such as Zeiss or Leica)
1	15-60 power zoom spotting scope
1	Sturdy tripod for spotting scope
1	Digital camera
1	Emergency kit

**Monitoring the Reproductive Success and Production of
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Denali National Park and Preserve, Alaska.**

Standard Operating Procedure (SOP) #2

Conducting the Occupancy Survey

(December 2007)

Revision History Log:

Prevision Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

This SOP gives step-by-step instructions for conducting occupancy surveys for Golden Eagles in the Central Alaska Network using aerial surveys. The purpose of the occupancy survey is to document the number of nesting areas that are occupied by territorial pairs of Golden Eagles and to document breeding activities at each occupied nesting area. Additionally, observers record the age (determined by plumage) of all Golden Eagles observed during the survey. The occupancy survey demands that the primary observer make all observations, record the data, and assist the pilot with navigating throughout the study area. All the data forms associated with this SOP are in Appendix B.

NOTE: The occupancy survey must be conducted after most clutches are completed, before the first brood hatches, and before most nest failures occur. Historically, the occupancy survey was conducted on five to seven consecutive days between 22 April and 5 May. It is very helpful to have a primary observer conduct the survey and a secondary observer assist with the survey, particularly during the ground-based observations associated with this survey.

I. Preparing for the survey.

Prepare and review maps and data sheets: At least one week before the occupancy survey, print and review maps printed with the location of each nest and history of each nesting area, and print and review all the field data forms (See Appendix B).

Compile and organize equipment: Several days before the occupancy survey, gather all survey equipment (Table 1.01).

Inspecting the aircraft. The PI must check the pilots OAS certification card and the OAS certification for the aircraft before starting the survey.

II. Planning the survey.

Planning the daily survey route: Conduct surveys between 0700 ADT and 2000 ADT to avoid low light and excessive shadows. Plan the survey route to take advantage of weather conditions and fuel sources. Turbulence is usually more severe later in the day (afternoon); hence, plan most aerial observations during the early hours of the day and use the afternoon hours for making ground observations. If survey conditions are good (i.e., good lighting and flying conditions), plan on surveying as much of the study area as possible without making ground-based observations. Conduct ground observations at areas where occupancy was not determined from the air later in the same survey day or later in the same survey period.

Use the distribution of nests and nesting territories as a guide to plan the survey route. It is advantageous to survey all the nests/nesting areas within a local area before moving to the next valley.

Be sure to relay your survey strategy to your pilot. Some pilots may ask for the coordinates of all the nests; this is not necessary if the primary observer is familiar with the survey area and can help the pilot navigate throughout the survey area.

Expect to make changes in the survey route due to weather conditions and other unforeseen events.

Avoid observer and pilot fatigue and observer airsickness: The primary observer must be aware of observer fatigue and take measures to reduce it. A tired observer may not make accurate assessments of the occupancy of a nest/nesting area. Equally as important, a tired pilot may not make accurate assessments of the flying conditions. Therefore, plan to get adequate rest before and during the survey. During the survey day, plan on taking 15 to 20 minute breaks every 60 to 90 minutes to reduce observer and pilot fatigue.

Similarly, the primary observer must be aware of airsickness and take measures to minimize it or avoid it. An airsick observer can introduce bias into the survey results.

If the primary observer is airsick, he or she must discontinue the survey until the airsickness is completely gone. The airsick observer should inform the pilot immediately of their condition.

Weather conditions: Do not conduct surveys when survey conditions are poor including periods of high turbulence, winds exceeding >20 mph, snowstorms, or rainstorms. These factors can reduce visibility and introduce bias in to the survey results.

III. Conducting the survey

During this survey, observers first search for and observe nests and their contents. Once the nest is located, observers record its status and the species using the nest.

Observers: The primary observer sits in the front seat of the helicopter next to the pilot. The secondary observer sits directly behind the primary observer, unless instructed otherwise by the pilot. The primary observer is responsible for conducting all aspects of the survey including making observations, serving as navigator, communicating with the flight following dispatcher, and all other aspects of the survey. The secondary observer is responsible for assisting with observations.

Approaching a nest: Request the pilot to keep the helicopter directly in front of the nest as you approach it. Avoid approaching a nest from directly above or behind it to minimize disturbance to nesting eagles and their eggs and nestlings. (Flying directly over an incubating eagle may startle it and cause it to flush off the nest and destroy eggs.) During all survey flights, approach known nests slowly (≤ 30 kilometers per hour) and maintain at least 300-m between the helicopter and the nest. Avoid hovering directly over the nest to minimize the potential of flushing the eagle from the nest.

Observing the contents of nest: Once you visually locate the nest structure(s), instruct the pilot to slowly fly toward the nest, but do not approach closer than 300 meters. If you observe an incubating eagle or other incubating raptor on the nest, inform the pilot of your observation and ask the pilot to slowly turn the helicopter away from the nest and leave the area immediately to minimize disturbance to the incubating eagle or other raptor. NOTE: Gyrfalcons often use Golden Eagle nest structures for their own nesting attempts. Gyrfalcon may leave their nest or perch, fly toward the helicopter, and may attack the helicopter. Under these circumstances, you should leave the area immediately and record the nest and area as occupied by territorial Gyrfalcons.

Evidence of occupation: Evidence of occupation includes observations of any of the following: 1) incubating eagle on the nest, 2) eggs, young, or fresh greenery in the nest, 3) fresh sticks or other nest building materials on the nest, and 4) territorial or breeding behavior. If you do not observe an incubating eagle, look for other signs of occupation including nest building, nest decorating (fresh sticks, grass, or other vegetation) or territorial behavior (i.e., undulating flight, copulation, vocalizing).

Do not flush incubating eagles off their nest. If an eagle flushes off a nest when you approach, leave the area immediately. If you observe eggs in a nest, but no eagle incubating the eggs, note the number of eggs and continue to the next nesting area.

Ground observations: If you do not find evidence of occupation of the nesting area using the aerial survey, you must land at a vantage point that provides a full view of the nests and the area immediately surrounding them and watch this immediate area for evidence of occupation. Most often this requires making observations at 2 to 3 km from the nests. Observers must diligently search the area for perched or flying eagles. Historically, evidence of occupation was secured within 60 minutes of starting ground observations.

During ground observations, use a spotting scope with a zoom (20-60X) to scan ridgelines and the surrounding area for perched eagles. Once an eagle is located, you must decide if it is the territorial eagle of that respective nesting area. If two eagles are observed, it is imperative to

watch both to decide if they show an affinity to the area or if one or both are simply passing through the area.

If you observe an eagle carrying nesting material, watch it until it makes its delivery at the nest. This is often the best way to find previously unknown or new nests. Further, if you observe two eagles flying together, and then watch one or both dive into a valley and not return to the area, visit that area using the helicopter to determine if there is a new or previously undiscovered nest in that area.

Documenting all eagles observed during the surveys. All eagles observed during the survey should be noted on the survey map and tallied at the end of the survey. This includes all flying and perched eagles observed from the air and during ground observations. When possible, classify the age of the observed eagle based on their plumage. Classify eagles with no white in their tails or their wings as “adult” and eagles with any white in their tails or wings as “immature”; do not attempt to distinguish between subadult and adult (Ligouri 2004). *NOTE:* You cannot age most incubating or perched eagles using plumage characteristics. Do not attempt to flush the eagle off their nest or perch to determine their age; instead, attempt to record the age of the territory holders when you return for a nest visit or during the production survey.

Completing observations at a nesting area: Once you record the status of the nesting area (occupied, unoccupied, unknown), proceed to the next nesting area and continue with the survey. If you cannot find evidence of occupation, plan to make ground observations at this area later during the occupancy survey. Call the nesting area “occupancy unknown” if you cannot find evidence of occupation after making observations for at least two consecutive hours or after making repeated visits to the area during the occupancy survey; however, plan to return to this area on foot later in the nesting season to assess its occupancy.

Recording survey data: Currently, the most efficient way to record observations of nests, nesting areas, and eagle observed during this aerial survey is on a survey map. Transfer the survey data to the data sheet (Table B-1) at the end of the survey data. This allows the observer to quickly summarize the day’s results and plan for the next day of survey work. Fill out a new “Nest characteristics data form” (Table B-7) when you find a new nest. An example of a portion of a completed survey map is shown in Figure 2.1 and a list of notations is summarized in Table B-1.2.

NOTE: Some researchers are suggesting the use of laptop computers for data recording during aerial surveys. While this technology has potential to be used during this survey, the glare associated with a computer screen and the bulkiness of a laptop computer may be detrimental to using a laptop during the actual surveys at this time. With the advancement of Global Positioning Systems (GPS) tracking, newer and more efficient data recording tools are becoming available for recording data during aerial surveys. A system similar to the voice-activated geo-referenced tracking system currently used by the US Fish and Wildlife Service in Alaska during their aerial waterfowl surveys should be field-tested for this project.

Completing the survey: The survey is defined as complete after all of the known nesting areas are observed and their status is recorded. If the status of individual nesting areas is unknown

within the time limitations of this survey, note those territories as “occupancy unknown” and try to make additional observations at these territories during the breeding season. Historically, 2 to 6% of all surveyed territories required additional foot survey to confirm the occupancy status of the area each year.

IV. Other topics of concern

Laying pairs are easier to detect than non-laying pairs. We assume that the probability of finding a territorial pair or an occupied nest varies among years. For instance, it is often easier to find evidence of occupancy of nesting areas when an incubating eagle is present at a known nest in a known nesting area than in years when eagles are not laying eggs. As such, plan to spend more time making ground observations in years when snowshoe hare abundance is low and fewer eagles are laying eggs.

Importance of looking for undocumented or new nesting areas. Basing estimates of nesting area occupancy and reproductive success strictly on historic nesting areas or nests can result in biased estimates of those metrics and in misinterpretations of the distribution of Golden Eagle nesting areas in the study area. The PI must acknowledge the dynamic, rather than static, nature of Golden Eagle nests and continue to search for new or previously undiscovered nests during all surveys. Studying the spatial distribution of all known nesting areas and identifying areas that do not contain nesting areas is a good method for pinpointing areas that deserve further survey efforts. Further attempts should be made to use a dual-frame sampling approach for this project (B. Thompson, personal communication).

It is very important to look for undocumented or new nests within known nesting areas annual. Many nests fall or become unusable, and eagles build new nests for a variety of reasons. You should not assume that you have 100% detectability of nests or the eagles that occupy them.

V. References

Ligori, J. 2004. How to age Golden Eagles. Techniques for birds observed in flight. Birding 32(2): 278-283.

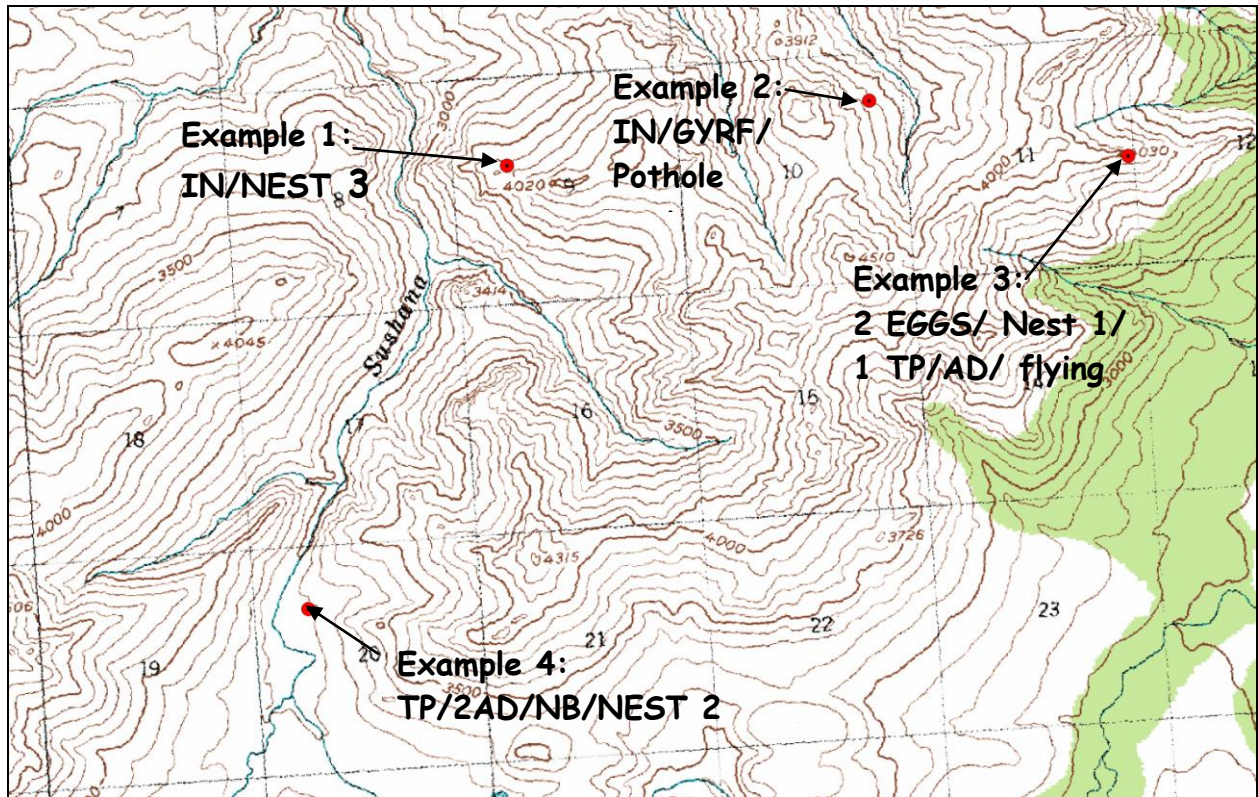


Figure 1. Example of occupancy survey map with notations. Notations for survey maps are summarized in Table B-1.1. On this map Example 1 represents a Golden Eagle that is incubating in nest 3, Example 2 represents a Gyrfalcons incubating in the pothole nest, Example 3 represents two golden eagle eggs in nest one and one territorial adult flying in this nesting area; and Example 4 represents two territorial adults observed as well as nest building activities at nest 2.

Table 2.01. Recording occupancy and egg-laying by Golden Eagles in Denali National Park and Preserve, Alaska.

Observation	Map symbol	Occupied	Egg(s) laid
Eagle incubating ^a	IE	Y	Y ^a
Eggs in nest	EG	Y	Y
Young in nest	YG	Y	Y
Fresh egg shells in nest	ES	Y	Y
Fresh greenery in nest	FG	Y	?
Recently built and repaired nest ^b	NB	Y	?
One or two eagles in the immediate vicinity exhibiting territorial ^c or courtship behavior ^d	TP	Y	?
Two eagles copulating	CP	Y	
Two eagles performing undulating flight	UF-2		
One eagle performing undulating flight	UF-1		
One or two eagles perched in vicinity, but not exhibiting territorial or breeding behavior ^e	TP?	?	?

^a An eagle in an incubation position on a nest is assumed to have eggs beneath it.

^b Must be able to distinguish old nest material from new nest material.

^c Territorial behavior includes undulating flight and aggressive behavior towards conspecifics.

^d Courtship behavior includes copulation, bill preening, and nest building.

^e If one or two eagles are observed in or near a nesting area, but do not exhibit territorial or breeding behavior, the area should be visited later in the occupancy survey to look for evidence of occupation.

**Monitoring the Reproductive Success and Production of
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Denali National Park and Preserve, Alaska.**

Standard Operating Procedure (SOP) #3

Conducting the Production Survey

(December 2006)

Revision History Log:

Prevision Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

This SOP gives step-by-step instructions for using aerial surveys to conduct production surveys for Golden Eagles in the Central Alaska Network. The production survey is conducted to count the number of successful nests and fledglings. All the data forms associated with this SOP are found in Appendix B.

NOTE: The production survey must be conducted after most nestlings reach 80% of their fledging age (about 7 weeks old) but before most fledging occurs. Historically, the occupancy survey was conducted on one day between 15 July and 5 August.

Procedures

I. Preparing for the Survey

Prepare and Review Maps and Data Sheets: Before the production survey, print and review maps with the location of each nest that was classified as “occupied-breeding” during the occupancy survey, and print and review field data forms (Appendix B).

Compile and Organize Equipment: Several days before the production survey, gather all survey equipment including maps, data forms, pencils/pens, park-radio, binoculars, spotting scope, tripod, field note book, and extra park-radio batteries.

II. Conducting the Survey

Daily Survey Schedule: Conduct surveys between 0700 ADT and 2000 ADT to avoid poor lighting and excessive shadows.

Weather Conditions: Do not conduct surveys during periods of high turbulence, when winds exceed > 30 mph, snowstorms, or rainstorms. These factors can reduce visibility and accuracy of survey results.

Annual Timing of Production Survey: Conduct the production survey after most nestlings reach 80% of their fledging age but before many actually leave the nest (fledge). Historically, the sampling period for the occupancy survey was 15 July through 2 August. The production surveys require four to eight hours of flight time, depending on the number of pairs with eggs (i.e., more time is required to conduct the survey in years when more pairs lay eggs).

Airstrips and Fuel: In Denali, surveys usually begin at the McKinley Park Strip. Plan to leave the strip with a full tank of fuel and schedule the survey to take advantage of the best survey conditions. For instance, if it is snowing in the higher mountains to the south, start the survey in the northern portion of the study area. Refuel at the Kantishna airstrip or the McKinley Park strip. Both Avgas (for Robinson R-44) and Jet B fuel (for Bell Jet Ranger) are available at the McKinley Park strip and the Kantishna airstrip. Keys to access the fuel tanks are available from resource management.

Planning the Survey Route: Use the distribution of occupied-breeding nesting areas as a guide for the survey route. It is advantageous to observe all occupied-breeding nests within a local area before moving to the next valley. Be sure to relay your survey strategy to your pilot. Some pilots may ask for the latitude and longitude for all nests; this is not necessary if the primary observer is familiar with the survey area and can help the pilot navigate throughout the survey area.

Avoid Observer Fatigue: The primary observer must be aware of observer fatigue. A tired observer may not make accurate assessments of the occupancy of a nest/nesting area. Therefore, plan to take several 15 to 20 minute breaks every 60 to 90 minutes to reduce observer fatigue.

Approaching a Nest: Always approach a nest structure by remaining in full sight of the nestlings and adults attending the nest. Never approach a nest structure from directly above or behind the nest structure because this may cause the adults or nestling to flush off the nest, and become injured or die. During all survey flights, approach known nests slowly (≤ 30 kilometers per hour) and maintain at least 300 m between the helicopter and the nest. Avoid hovering directly over the nest to minimize the potential of flushing eagles from the nest.

Optics for Observing Nests: Use binoculars to view the contents of the nest. Image stabilizing binoculars are not necessary, but are helpful for some observers.

Observing Contents of Nest: Once you locate the occupied nest structure, instruct the pilot to slowly fly toward the nest until you can assess if the nest contains nestlings. Make sure to stay at least 300 meters away from the nest. Once you locate the nestlings, count them and use their feather characteristics to estimate their age in weeks (not days). Also note and count any unhatched (or addled) eggs or dead nestlings in the nest.

Evaluating Nest Success: A nest is considered successful if it contains at least one nestling that has reached at least 8 weeks of age. If see splotches of fresh white wash behind and below the nest, or fresh prey or fresh greenery in the nest (evidence of recent occupation by nestlings or nest attendance by the breeding pair), but no nestlings in or near the nest, make several slow flights around the nests to search for nestling that may have fledged before the survey. If you cannot locate recently fledged eagles from the helicopter, you should land and continue to make observations from a vantage point on the ground. Search the area around the nest thoroughly, and listen for the calls of the fledglings (yelps).

If the nestlings are <80% of their fledging age, note their age and plan to return to the area when the nestlings are >80% of their fledging age to document nest success.

Recording Nest Failure: If you do not observe nestlings and the nest contains no fresh white wash, prey, or fresh, record the nest as failed and continue on to the next occupied nest and repeat steps 12 to 14. Similarly, if the nest contains no nestlings, but contains unhatched (addled) eggs, note this on the data sheet and record the number of eggs.

Documenting all eagles observed during the surveys. Note all free-flying eagles observed during the survey on the survey map. This includes all flying and perched eagles observed from the air and during ground observations. When possible, classify the age of the observed eagle based on their plumage. Classify eagles with no white in their tails or their wings as “adult” and eagles with any white in their tails or wings as “immature”; do not attempt to distinguish between subadult and adult (Ligouri 2004). *NOTE:* You cannot age of most perched eagles and never attempt to flush the eagle off their nest or perch to see their plumage.

Recording Survey Data: Record all information regarding the nest/nesting area on the survey map immediately after making observations. At the end of the day, summarize your survey results and enter data into computer database within two days of completing the survey. Use Tables B-2 to B-5 for recording survey event data (see Appendix B).

NOTE: We are exploring the possibility of using the computerized “moving map” mapping system for recording survey data. The moving map system is used by the US Fish and Wildlife Service during all aerial survey work in Alaska. The system includes a two panel mounted computers (Aero-PC) that run survey software developed by John I.Hodges, USFWS-Alaska (retired). The software provides a moving map for situational awareness and allows observers to record their observations through a microphone (sound files) that are linked to coordinates from the aircraft GPS (latitude and longitude). After the survey, another computer program is used to transcribe the linked sound files and produce a text file. The text files contain all relevant data for each observation.

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Denali National Park and Preserve, Alaska.**

Standard Operating Procedure (SOP) # 4

Conducting Nest Visits

(December 2007)

Protocol Revision History Log

Prevision Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

This SOP provides instructions for conducting nest visits for banding nestlings, collecting blood samples, collecting feather samples, collecting addled eggs, and collecting prey remains. Only personnel with extensive experience using rock climbing techniques to enter raptor nests, banding nestling raptors, and collecting blood and feather samples should conduct nest visits. A USGS Bird Banding Permit is required for banding eagles and eaglets. All the data forms for conducting nest visits are found in Appendix B.

All protocols for collecting samples are in Appendix C. Blood samples are collected to assess genetic diversity of the population of Golden Eagles in Denali. Shed feathers are collected to identify territorial eagles at nesting areas and conduct contaminant analysis (e.g., mercury and lead). Addled eggs are collected for contaminant analyses. The blood, feather, and addled egg sampling are conducted in cooperation with the USGS Alaska Science Center, Molecular Genetics Lab and the USFWS Northern Field Office, Environmental Contaminants Lab. Prey remains are collected to assess food habits of Golden Eagle nestlings in Denali.

I. General Preparation and Review

Review the entire SOP. Before conducting nest visits, the Principal Investigator (PI) will review this entire protocol and prepare equipment needed for the individual components of the nest visit.

Review federal and state permits. Banding nestlings and collecting samples requires federal and state permits. The PI is the holder of these permits and is responsible to maintaining current status with both permits and reporting. Banding requires that the PI holds a USGS master bird

banding permit or an USGS station permit for Denali and all banding and collecting activities require a State of Alaska Scientific Permit.

Schedule fieldwork and assistants. Conduct nest visits after nestlings are between 21 and 51 days of age. If you are visiting a nest solely to collect shed feathers, wait until after the fledglings leave the nest. The fieldwork schedule will depend on the number of nests to visit, accessibility of the nests, transportation requirements (fly versus walk), and weather. Two experienced personnel are required to conduct the nest visits.

Never conduct nest visits during rain or snowstorms, or when nestlings are exposed to full sun. If a territorial eagle is present at the nest when you arrive for the nest visit, wait until it leaves before continuing your work.

II. Traveling to and entering nests

Traveling to the nest. The methods used for traveling to nests including walking from the Denali park road or State Highway # 3, or flying via helicopter to a nearby area and then walking to the nest. Generally, nests that are ≤ 5 kilometers of the Denali park road or State Highway #3 are accessed by walking and nests that are > 5 kilometers from these roads are accessed by helicopter.

Entering the nest. Use standard rock climbing techniques to enter nests. Use webbing to build an anchor network on rocks and suitable vegetation above the nest and a static rope to either rappel or climb to the nest. Never set a rope directly above a nest so as to avoid injuring nestlings during climbing events. Some nests are accessible without ropes, but use care to avoid falling from apparently easy-access nests. Do not use pitons or other imbedded rock climbing devices during nest visits. Use care to avoid damaging the nest and the cliff supporting the nest. Many nests are built on unstable rock formations.

III. Banding nestlings.

Only personnel with extensive banding experience should band the nestlings. When nestlings are present during a nest visit, band all nestlings with size 9, pop-rivet USGS aluminum leg bands on the right leg. Secure all nestlings when entering the nests to prevent nestlings from falling out of the nest. In nests with >1 nestling, sit in the nest and place one nestling behind you while you work on the first nestling. Secure the nestling in your lap during the banding, blood collecting, and measuring processes.

Check the size of the crop and estimate its fullness as empty, 25%, 50%, or 100%.

Record all data on banding data form (Table B-8).

IV. Collecting blood and feather samples for genetics analyses.

Follow the USGS protocols for collecting blood and feather samples for genetics analysis (Appendix C-1) and record data on the sample collection form (Table C-1). Collect blood

samples from nestlings immediately after banding each individual. (e.g., enter nest, band, measure, and collect blood from first nestling before banding the other nestling(s)).

V. Collecting feather samples for contaminants analyses.

Follow the USGS protocols for collecting feather samples for contaminants analysis (Appendix D-2)

VI. Collecting Addled Eggs.

Follow the USFWS protocol for collecting addled eggs for contaminant analysis (Appendix C-3).

VII. Recording and collecting prey remains.

Record all prey remains observed in the nest on nest visit data form (Appendix B, Table B-8). Do not collect prey remains, unless they cannot be identified in the nest. For those items that cannot be identified in the nest, collect the item and place it in a zip-lock bag, label the bag with location, time, and date, and identify the item back in the lab.

VIII. Recording nest characteristics.

Record all nest characteristics of the nest visit data sheet (Table B-7).

Table 4.01. Climbing equipment needed for Golden Eagle nest visits.

Number	Item
65 meters	12-mm Static rope (for climbing)
65 meters	9-12 mm Dynamic rope (for belaying)
65 meters	Small mm accessory cord
10	Pre-made webbing anchors; small, medium, and large.
20	Locking carabineers
2	Climbing helmets
2	Climbing harnesses (fit for climber, belayer)
2	Chest harnesses
2	Belaying devices
2	Self-braking descender
2 sets	Ascending device (Jumars)
2	Rope Bags

Table 4.02. Nest visit kit.

Number	Item
1-3	USFWS # 9 pop-rivet aluminum leg bands
1	Pliers
1	Pop Rivet Gun
5	Pop rivets (suitable for use with USFWS # pop-rivet aluminum leg bands)
1	Calipers
1	Pesola scale (capacity = 5 kg)
1	Pre-made bag (made of rip stop Cordura material) for placing nestlings for weighing
1	15 cm ruler
1	3 meter tape (for measuring size of nest)
1	Digital camera (for photographing nestlings, prey remains, nest contents)
1	Banding notebook, with pre-made banding data forms
2	Leather falconer's hoods (to calm nestlings if necessary)
1 set	Two-way radios; hand held
10	Gallon size zip-lock bags for prey collection
2	20 Gallon trash bags (for prey collection)
1	Blood sampling kit
1	Feather sampling kit
1	Addled egg sampling kit
1	Banding kit
1	Digital camera
2	Large day packs
1	Large fanny pack (for climber)
1	Hand-held GPS unit (to get coordinates and elevation of nest)
1	Hand-held compass (to get aspect of nest)

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Standard Operating Procedure (SOP) #5

Post-field season activities

(December 2007)

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

This Standard Operating Procedure (SOP) describes general post field-season procedures for monitoring Golden Eagles in CAKN. Observers should review and follow this SOP upon completion of the field season.

Procedures:

Clean and repair equipment. After each survey and after nest visits, clean and repair all equipment prior to returning them to their proper storage areas.

Complete OAS forms. After each survey, complete Office of Aircraft Safety (OAS) Form OAS 27 and mail to the appropriate OAS office.

Review annual budget. Review budget to check annual progress.

Compile field data. Organize field data sheets and check that they have been filled out completely. As a rule, all data sheets need to be reviewed for completeness before the observer(s) leaves the field.

Enter data. Enter data into CAKN_GOEA database as per instructions in SOP#6 Database Management.

Label photographs. Label all digital photographs and store on hard drive.

Transfer samples. Send all feather, blood and egg samples to respective researchers following instructions outlined in SOP#4 Nest Visits.

Summarize data. Write an annual progress report as per instructions in SOP #7 Data Analysis and SOP #8 Reporting.

**Monitoring the Reproductive Success and Production of
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Denali National Park and Preserve, Alaska.**

Standard Operating Procedure (SOP) #6

Data Management

(December 2007)

Revision History Log:

Prevision Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

This SOP describes the Microsoft Access database *CAKN_GOEA.mdb* and provides instructions for data entry and data validation, and database administration of the monitoring data collected by the Golden Eagle Monitoring project for Central Alaska Network (CAKN). This SOP also documents the database tables (including lookup tables) and standardized queries used for basic data summary. This SOP is being developed following strategies and guidance for data handling and quality assurance/quality control in the CAKN Data Management Plan posted at <http://www.nature.nps.gov/im/units/cakn/DataMgt.htm>. Microsoft Access is the primary software environment for managing bird and habitat data.

NOTE: Al Smith, CAKN Data Manager, redesigned this database and it is currently in the beta test mode. This SOP will be completed after the database is tested and completed. The database tables are located in Appendix D.

I. CAKN Golden Eagle Database - Data Model:

The database consists of two files in a front-end/back-end configuration that can be linked using the Linked Table Manager in MS Access. The front-end file *CAKN_GOEA.mdb* contains the forms, queries, and VBA code for the application itself and represents the user interface for the data. The back-end file *CAKN_GOEA_be.mdb* contains the actual data tables. The simple relationships among the primary tables in the database are shown in Figure 1.

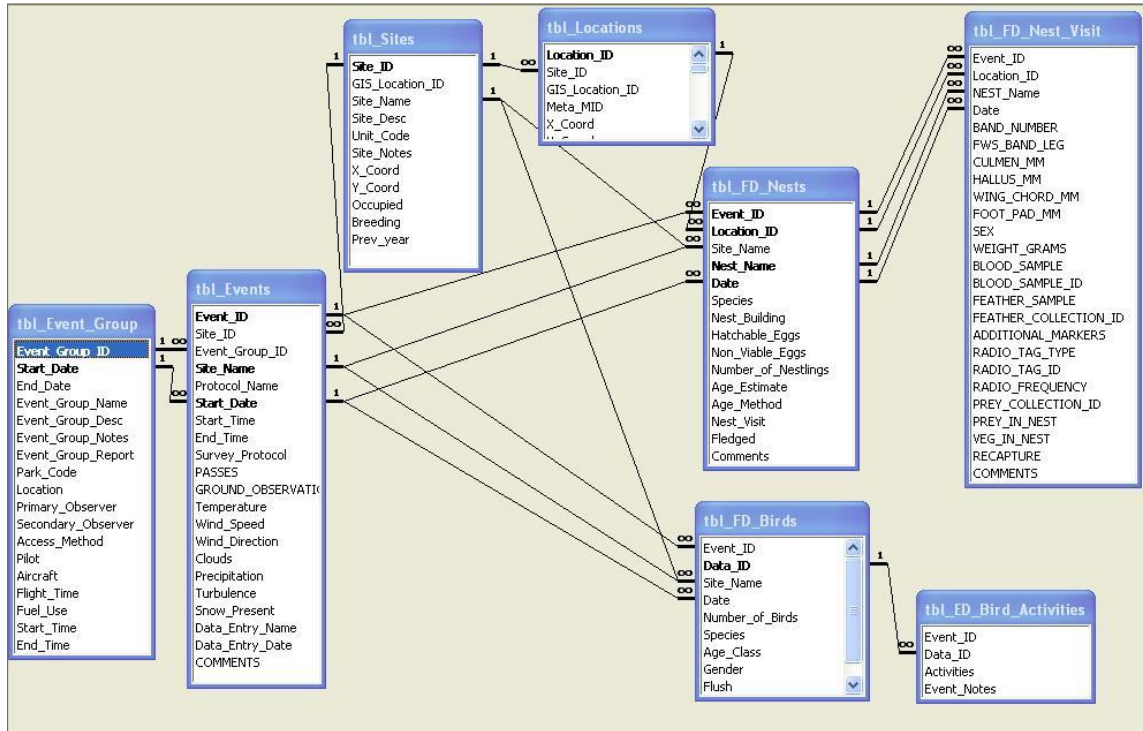


Figure 1. Diagram of database structure for CAKN_GOEa.mdb.

II. Data Entry and Validation:

This section of the Data Management SOP provides instructions for how the original data sheets coming back in from the field are reviewed and archived, and how data on the datasheets are entered into the CAKN_GOEA Database (*CAKN_GOEA.mdb*). Data entry and validation is also discussed in SOP #8, “After the Field Season.”

Procedures:

1. **Copy the original data sheets and survey maps.** As soon as possible upon returning from the field, make a copy of each original field data sheet and survey map. Review each copied data sheet for clarity. The copied data sheets will be used for data entry so it is important that the copied data sheets are readable.
2. **Archive the original data sheets and survey maps.** Organize the original field data sheets and maps and store in the designated fireproof safe or cabinet used by the Golden Eagle Monitoring project.
3. **Proofread the copied data sheets.** Proofread the copied datasheets, making sure that they have been filled out completely. All data sheets should have been reviewed for

completeness while in the field. However, some deficiencies in data recording may not be identified until all data sheets have been reviewed as a group and some errors are inevitable.

4. **Mark corrections on copied data sheets with red pen.** Any corrected errors, or changes made by the data “proofer” (that are entered differently into the database than they appear on the data sheet) should be circled and corrected using a red fine-point Sharpie marker. Notes, in red ink, should be written on the margins or in the comments section whenever necessary to document the reason for the corrections.
5. **Enter the data into CAKN_GOEA.mdb.** The PI will enter all of the data into the MS Access database using the data entry form.
6. **Proof Initial Data Entry.** When all data for a given data entry bout have been entered, the same person that entered the data will proof the data in the database, reviewing the data forms and sorting summaries (from queries) to check for typos, errors, and blank fields. As each datasheet is proofed, date and initial the “Data Proofed” line.
7. **Independent Proof of Data Entry.** After the data have been entered and proofed once (Step 6), a different person will proof the data from that year.
 - a. Data forms (in the database) from that season should be proofed individually. Once this has been completed, a final proofing can be done using the observation tables, sorting the different columns and searching for any aberrant data or typos. Note errors and corrections in the database log.
8. **Backup CAKN_GOEA.mdb on a designated hard disk.** Once the second proofing process has been completed, save the *CAKN_GOEA_be.mdb* (Note the “be”!) backend database into a backup file on the designated drive. The backup file name shall consist of the normal file name with an extra underbar (“_”) and 8-digit date (as in “*CAKN_GOEA_be_07132005.mdb*”). The backend database file will similarly be saved onto a CD-ROM along with any additional files deemed important. The CD-ROM will then be labeled as “CAKN Raptor database backup” (with the date clearly written as well) and placed in a fireproof file cabinet in the YUGA offices.

III. Database Administration:

This section of the SOP addresses administration of all data and electronic files relating to the Golden Eagle Monitoring Protocol. The data management procedures that are common to all monitoring protocols implemented by the CAKN monitoring program are outlined in the Network the Data Management Plan (<http://www.nature.nps.gov/im/units/cakn/DataMgt.htm>).

1. **Data Maintenance. The PI and Data Manager accomplish any editing of archived data jointly. Every change must be documented in the edit log and accompanied by an explanation that includes pre- and post-edit data descriptions. All data collected using this protocol is subject to the following two caveats:**
 - 1) Only make changes that improve or update the data while maintaining data integrity.
 - 2) Once archived, document any changes made to the data set.
2. **Computer File Organization:**
3. **Version Control. Before any major changes in either the front-end or backend for the CAKN Golden Eagle database, a copy is stored with the appropriate version number to allow for tracking of changes over time. Versioning of archived data sets is handled by adding an eight-digit number to the file name that represents the month (2 digits), day (2 digits) and year (4 digits). Frequent users of the data are notified of the updates, and provided with a copy of the most recent archived version.**
4. **Data Logs and Backups.** Once the data are archived, any changes made to the data must be documented in an edit log. Original field forms are not altered. Field forms can be reconciled to the database using the edit log. Once a data set has passed the QA/QC procedures specified in the “After the Field Season” SOP, a formal entry is made in the I&M Data Set Catalog and the NPS NR-GIS Data Store. Subsequently, an electronic version of the data set is maintained in a read-only format on the program server. Backup copies of the data are maintained on an AKRO server and the NR-GIS Data Store. Tape backups of all project databases residing on YUGA servers are made daily and stored in a fire- and water-proof safe.

**Monitoring the Reproductive Success and Production of
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Standard Operating Procedure (SOP) #7

Data Analysis and Management Actions

(December 2007)

Revision History Log:

Prevision Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

This standardized operating procedure (SOP) contains detailed instructions for summarizing the following data and estimates and for running routine data analysis on reproductive characteristics.

- A. Survey results.
- B. Nesting area occupancy, reproductive characteristics and success, and fledgling production.
- C. Nesting phenology: estimated dates of laying, hatching, and fledging.
- D. Adult to immature ratio.

I. Annual summaries

The following components should be completed and included in annual project reports. We anticipate using the StatServer web-based statistical package to develop routines to generate these annual summaries. The major goals of the monitoring are to estimate the number of occupied nesting areas, nesting pairs, successful pairs, and fledglings in the study area annually.

A. Summary statistics

Summarize and report the following each year:

- Dates of occupancy survey, nest visits, and production survey.
- Names of observers, pilots, and field assistants.

- Hours and days used to conduct each survey or nest visits. Include both aerial survey time and ground observation time.
- Number of passes required to determine occupancy at each occupied nest.
- Proportion of eagles that flushed off the nest during the occupancy survey.

B. Nesting area occupancy and reproductive success.

The following estimates should be generated annually using data collected during the occupancy and production surveys.

Nesting area occupancy rate: Number of occupied nesting areas/number surveyed nesting areas. NOTE: Use only data collected during the incubation period. Do not include occupied nesting areas located during the nestling or postfledging periods in this calculation.

Nesting rate: Number of nesting pairs/number of occupied nesting areas. NOTE: Use only data collected during the incubation period. Do not include nesting pairs located during the nestling or postfledging periods in this calculation.

Success rate: Number of successful pairs/number of nesting pairs.

Mean brood size: Number of fledglings/number of successful nests. NOTE: Do not include fledglings counted after the production surveys in this calculation.

Overall population production: Number of fledglings/number of occupied nesting areas. NOTE: Do not include fledglings counted after the production survey in this calculation.

C. Nesting phenology. Calculate estimates of laying, hatch, and fledge dates for each nestling. (NOTE: Routine to calculate these estimates is being developed in the CAKN_GOEA database).

- Step 1: Estimate age of nestling to the nearest week during nest visits or production survey.
- Step 2: Estimated hatch date: Subtract estimated age of nestling from calendar day (CD) on which the age was estimated.
- Step Three: Estimated laying date: Subtracting 43 days from the estimated hatch date.
- Step Four: Estimated fledge date: Add 70 days to the date of hatching.

Example:

- Step 1: Estimated age of nestling on 15 July: 7 weeks (49 days).
- Step 2: Estimated hatching date: 15 July = CD 196; 196-49 days = CD 147.
CD 147 = 27 May.
- Step 3: Estimated laying date: 27 May (CD 147) - 43 days = CD 104 = 14 April.
- Step 4: Estimated fledging date: 27 May (CD 147) + 70 days = CD 217 = 5 August.

D. Index of population age structure: This index is constructed to identify potential changes in the age structure of the territorial population. The index is the number of territorial non-adult

golden eagles versus the number of territorial adult golden eagles detected during the occupancy survey.

II. Evaluating changes in nesting area occupancy, reproductive characteristics, nesting phenology, and age structure.

The historical estimates of nesting area occupancy, nesting, success, and production provide benchmarks by which to compare future population performance. Historical characteristics of nesting area occupancy, nesting rate, success rate, and production and expectations of future population performance are summarized in Table 9.01.

Table 9.01. Historical characteristics of nesting area occupancy, reproductive performance (nesting rate, success rate, mean brood size, overall population production), flushing rate, adult to non-adult ratio, and nesting phenology of Golden Eagles in Denali National Park and Preserve, Alaska, 1988 to 2006.

Metric	Range	Average	CV (%)	Expectation
Nesting area occupancy (%)	70 – 93 % ^a	85 %	6.6	Occupancy should remain >70% and interannual variance should be low.
Nesting rate (%)	15 – 90 %	63 %	34.3	Remain within historic range and exhibit cyclic patterns; expect higher nesting rates during peaks of snowshoe hare cycle and lower nesting rates during low years of snowshoe hare cycles.
Success (%)	40 – 88 %	70 %	22.2	Remain within historic range.
Mean brood size	1.00 - 1.68	1.37	14.7	Remain within historic range.
Overall population production	0.06 - 1.16	0.50	54.9	Remain within historic range.
Flushing rate (%)	0.00 – 3.45 %	<1%	na	Remain within historic range.
Adult – nonadult index	0.00 – 0.03			Remain within historic range.
Nesting phenology: hatch date	2 May to 25 June	26 May	5.6	Remain within historic range.

III. Research and Management Actions.

1. **Decrease in nesting area occupancy rate.** These tasks should be considered if nesting area occupancy rate remains below 70% for two consecutive years:

- a. Assess survey precision and detectability. Are observers underestimating occupancy rate?
 - b. Consult with other Golden Eagle studies in Alaska to determine if pattern of lower occupancy is detected in other study areas.
 - c. Assess adult to non-adult ratio. Has age structure changed? Are more non-adult Golden Eagles holding territories?
 - d. Assess increases in disturbance activities, including overflights and foot traffic.
2. **Decrease in nesting rate and nesting success.** These tasks should be considered if nesting rate and nesting success drop below historical ranges:
 - a. Assess survey protocols. Are you missing incubating birds during the occupancy survey?
 - b. Assess disturbance activities and levels. Has disturbance increased in the nesting area?
 - c. Assess changes in landscape characteristics, prey availability, and climatic conditions.
3. **Decrease in mean brood size:** These tasks should be considered if mean brood sizes drops below historic ranges:
 - a. Assess survey protocol. Are you accurately counting nestlings/fledglings?
 - b. Assess disturbance activities and levels. Has disturbance increased in the nesting area?
 - c. Assess changes in landscape characteristics, prey availability, and climatic conditions.
4. **Increased flushing rate.** These tasks should be considered if the flushing rates is > 1% annually or > 4% in a given year:
 - a. Assess survey protocols.
 - i. Are you flying too close to the nest?
 - ii. Are you using a larger, noisier helicopter?
 - b. Assess adult-nonadult ratios. Are more non-adult nesting?
5. **Increased number of non-adult Golden Eagles holding territories.** These tasks should be consider if the proportion of the territorial population consisting of non-adult Golden Eagles increases to more than 3% of the territorial population:
 - a. Assessing aging protocol.
 - i. Are you making accurate estimates of age?
 - b. Consult with other Golden Eagle studies in Alaska to determine if pattern of higher number of non-adults is consistent in other study area.

**Monitoring the Reproductive Success and Production
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Standard Operating Procedure (SOP) #8 Reporting

(December 2007)

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

Overview: This SOP addresses reports on Golden Eagle monitoring in the Central Alaska Network. This SOP describes specifically how to implement the reporting strategy of the Central Alaska Vital Signs Network as described in Chapter 7 of the Monitoring Plan; MacCluskie and Oakley 2005). The network reporting strategy identifies the following reports:

1. Annual Reports
2. Analysis and Synthesis Reports – Trends
3. Protocol Review Reports
4. Scientific journal articles and book chapters
5. CAKN Vital Signs Monitoring Conference (Biennial)
6. Other Symposia, Meetings, and Workshops.

Version 1 of this SOP provides detailed instructions for preparation of Annual Reports. For the other types of reports, this SOP provides general guidance about how the Project Leader will approach these efforts.

Prerequisites, Definitions, Caveats: This SOP begins where SOP#7 on Data Analysis left off. All written reports for the CAKN Golden Eagle Protocol will also adhere to guidance of the following Network SOPs:

- Report Format
- Report Review Procedures
- Report Distribution Procedures

A. Annual Reports

Overview: The CAKN reporting strategy requires Annual Reports for each Vital Sign. Purposes of the Annual Reports are to:

- Archive annual data and document monitoring activities for the year;
- Describe the current condition of the resource and provide alerts if data are outside bounds of known variation;
- Document changes in monitoring protocols;
- Promote communication within the park or network;

CAKN has adopted an annual reporting schedule. Annual Reports are produced in March-April for the prior phenological year (October-September).

Prerequisites: This SOP for producing the Annual Report begins where the SOP for Data Analysis left off. The Data Analysis SOP produces various tables and graphics in other software formats that must be imported into the (Microsoft Word) Annual Report Template for the Golden Eagle Vital Sign Protocol.

Instructions:

1. The Project Leader writes an Annual Report on the CAKN Golden Eagle Vital Sign for submittal to the Network Coordinator in March/April of every year, according to specific deadlines set by the Network Coordinator.

B. Analysis and Synthesis Reports – Trends

Overview: The CAKN reporting strategy requires periodic Analysis and Synthesis reports for each Vital Sign. Purposes of the Analysis and Synthesis reports are to:

- Evaluate patterns/trends in condition of resources being monitored;
- Discover new characteristics of resources and correlations among resources being monitored;
- Analyze data to determine amount of change that can be detected by this type and level of sampling;
- Interpret data for the park within a multi-park, regional or national context;
- Recommend changes to management of resources (feedback for adaptive management).

Instructions:

1. In preparing the Annual Work Plan for Golden Eagle Monitoring, the Project Leader will plan and budget for preparation of an Analysis and Synthesis report, at least every 5 years.

C. Protocol Review Reports

Overview: The CAKN reporting strategy requires periodic Protocol Review reports for each Vital Sign. The anticipated schedule is that review would be held at about 5 year intervals. Purposes of the Protocol Review reports are to:

- Periodic formal reviews of operations and results;

- Review protocol design and products to determine if changes needed;
- Part of quality assurance – peer review process;

Instructions:

1. Working with the Network Coordinator, the Project Leader will plan and budget for a Protocol Review Workshop and report about every 5 years, beginning 5 years after the initial protocol is approved and after completion of the first Analysis and Synthesis Report on Trends.
2. The Project Leader will follow the Network SOP# on Revising Protocols in incorporating any changes recommended by the protocol review process.

D. Scientific Journal Articles and Book Chapters

Overview: The CAKN reporting strategy encourages periodic publication of monitoring program results in scientific journal articles and book chapters. Purposes of these peer-reviewed publications are to:

- Document and communicate advances in knowledge;
- Part of quality assurance – peer review process;

Instructions:

1. In preparing the Annual Work Plan for Golden Eagle Monitoring, the Project Leader will plan and budget for writing of manuscripts suitable for submission to peer-reviewed scientific publications, as findings warrant.

E. CAKN Vital Signs Monitoring Conference (Biennial)

Overview: The CAKN reporting strategy includes a Vital Signs Monitoring Conference to be held every two years. Purposes of the conference are to:

- Review and summarize information on CAKN Vital Signs;
- Help identify emerging issues and generate new ideas;

Instructions:

1. In preparing the Annual Work Plan for Golden Eagle Monitoring, the Project Leader will plan and budget for travel to the Biennial CAKN Vital Signs Monitoring Conference.

F. Other Symposia, Meetings and Workshops

Overview: The CAKN reporting strategy requires participation in symposia, meetings and workshops, at regular intervals. Purposes of participation in these activities are to:

- Review and summarize information on a specific topic or subject area;
- Communicate latest findings with peers;
- Help identify emerging issues and generate new ideas.

This includes presenting results at the annual Boreal Partners in Flight meetings, and the biennial Alaska Bird Conference, and at the Raptor Research Foundation meetings when applicable.

Instructions:

1. The Project Leader for Golden Eagle Vital Sign will maintain membership in *Boreal Partners in Flight* and the *Raptor Research Foundation (RRF)*.
2. In preparing the Annual Work Plan for Golden Eagle Monitoring, the Project Leader will plan and budget for travel to the Annual Meeting of BPIF and the RRF.
3. In preparing the Annual Work Plan for Golden Eagle Monitoring, the Project Leader will plan and budget for travel other workshops, symposia or meetings that will allow the Project Leader to keep current in the field of Golden Eagle monitoring and/or present results from the CAKN vital signs monitoring program.

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Appendix A

Definition of terms and calculating annual monitoring metrics

(December 2007)

This Appendix (Appendix A) includes: 1) definition of terms to describe nest structures and nesting area 2) terms to describe eagles, and 3) calculations for describing occupancy of nesting areas, reproductive success, and production.

Appendix A-1. Definition of terms.

Definition of terms follows Steenhof (1987) and Steenhof et al. (1997).

I. Terms to describe nest structure and nesting areas.

Nest: An individual nest structure originally constructed by Golden Eagle(s).

Nesting area: A group of nests belonging to one pair of Golden Eagles in any given year, and where no more than one pair of Golden Eagles has ever bred in a single breeding season.

Surveyed nesting area: A nesting area that is surveyed in a given year.

Unsurveyed nesting area: A nesting area that was not surveyed in a given year.

Occupied nesting area: A nesting area that is occupied by a territorial pair of Golden Eagles in a given year.

Unoccupied nesting area: A nesting area that is not occupied by a territorial pair of Golden Eagles in a given year. Observations must be made for ≥ 2 hours consecutive hours at a nesting area before categorizing it as unoccupied.

Occupancy unknown: A nesting area that was surveyed, but where occupancy could not be determined in a given year.

Occupied, nesting: A nesting area that contains a nesting pair of Golden Eagles.

Occupied, nesting successful: A nesting area that contained a successful pair of Golden Eagles.

Occupied, nesting unsuccessful: A nesting area that contained an unsuccessful pair of Golden Eagles.

II. Terms to describe eagles.

Adult eagle: A golden eagle with full adult plumage.

Non-adult eagle: A golden eagle with subadult plumage

Territorial pair: A pair of Golden Eagles that defend a nesting area in a given year. Evidence of a territorial pair includes nesting, breeding behavior and territorial defense.

Nesting pair: A territorial pair of Golden Eagles that produced a clutch of eggs. Evidence of nesting includes incubating Golden Eagle, eggs, young, or any other indication that eggs were laid (e.g., fresh eggshell fragments in nest).

Nestling: A Golden Eagle <51 days of age.

Fledgling: For purposes of reporting production and nesting success, a Golden Eagle ≥ 51 days (80% of its age at fledging) is considered a fledgling. This standard was suggested by Steenhof and Kochert (1982) because most young are large enough to count at this stage and mortality after this age is usually minimal.

Successful pair: A pair of Golden Eagles that successfully raises ≥ 1 fledgling in a given year.

Unsuccessful pair: A nesting pair of Golden Eagles that did not raise ≥ 1 fledgling in a given year.

Appendix A-2. Calculations for describing occupancy of nesting areas, reproductive success, and production.

Occupancy rate: The proportion of surveyed nesting areas that are occupied by territorial pairs; calculated by dividing the number of occupied nesting areas by the number of surveyed areas. This rate is calculated using information obtained during the incubation stage.

Nesting rate: The proportion of territorial pairs that are nesting pairs; calculated by dividing the number of nesting pairs by the number of occupied nesting areas.

Success rate: Proportion of nesting pairs that successfully raise at least one fledgling; calculated by dividing the number of successful pairs by the number of nesting pairs.

Mean brood size: The number of fledglings raised per successful pair (same as number of fledglings raised per successful nest); calculated by dividing the number of fledglings by the number of successful pairs.

Overall population production: The number of fledglings raised per territorial pair (same as number of fledglings raised per occupied nesting areas); calculated by dividing the number of fledglings by the number of occupied nesting areas (or territorial pairs).

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Appendix B

Field data collection forms

(December 2007)

This appendix contains all the field data forms necessary for the occupancy survey, production survey, and nest visits including:

- Table B-1. Golden Eagle occupancy and breeding activity aerial survey form.
- Table B-1a. Codes and definitions for Golden Eagle occupancy and breeding activity aerial survey form.
- Table B-2. Aerial survey times and landing locations form.
- Table B-3. Survey crew, pilot, and survey aircraft form for aerial surveys.
- Table B-4. Observer and pilot information data form for aerial surveys.
- Table B-5. Daily Survey Weather Information form for aerial surveys.
- Table B-6. Field Data Form, Golden Eagle Production Survey.
- Table B-7. Nest characteristics data form.
- Table B-8. Nest visit data form.

All the forms should be printed on Rite-in-the-Rain© paper.

Table B-1. Golden Eagle occupancy and breeding activity aerial survey form.

[illegible]

Table B-1a. Codes and definitions for Golden Eagle occupancy and breeding activity aerial survey form.

CODE	Definition
Nesting area name	Generic name of nesting area
Species	Four character alpha code for species
Surveyed?	Was the nesting area observed? Y = yes, N = no
Occupied?	Was the nesting area occupied? Y = yes, N = no
How?	What was their evidence of occupation? IN = incubation, NB = nest building, TP = territorial pair, TD = territorial defense, CP = copulation
Nest ID	Numeric identification for individual nest structure that was occupied
Passes	Number of passes required to determine occupancy
Flush?	Did the raptor flush when you flew by? Y = yes, N = no
Adult Eagles	How many eagles did you observe?
Non-adult Eagles	What was the age of the eagles? A = adult, SA = subadult, U = unknown
Time	Start and end time of observation (24 hour clock)
Ground observations?	Were observations made from the ground?
Ground time	Start and end time of ground observations
Comments	Any additional comments

Table B-1.1. Notation used for recording observations on survey maps during aerial occupancy surveys.

Notation	Definition
TP	Territorial pair
AD	Adult Golden Eagle
SA	Non-adult Golden Eagle
GOEA	Golden Eagle
GYRF	Gyr Falcon
NB	Nest building
IN	Incubation
EGGS	Eggs in nest
?	Occupancy unknown

Appendix B. Field data sheets for aerial surveys and nest visits

Table B-2. Aerial survey times and landing locations form.

[illegible]

Appendix B. Field data sheets for aerial surveys and nest visits

Table B-3. Survey crew, pilot, and survey aircraft form for aerial surveys.

Date	Primary Observer	2nd Observer	Aircraft Type	Aircraft ID #	Aircraft Company	Pilot

Appendix B. Field data sheets for aerial surveys and nest visits

Table B-4. Observer and pilot information data form for aerial surveys.

Role	Date	Name	OBS_CODE	Affiliation	Address	Previous experience on project

OBS_CODE = First, Middle and Last Initial of observer plus the year of their birth.

Appendix B. Field data sheets for aerial surveys and nest visits

Table B-5. Daily Survey Weather Information form for aerial surveys (collected at start, middle, and end of survey AND when weather conditions suddenly change).

Date	Time	Temp	WS	WD	SC	PP	Comments

WD = wind direction recorded as N, E, S, or W.

Weather Codes:

Wind Speed (WS)	Definition	Sky Conditions (SC)	Definition	Precipitation (PP)	Definition
0	Calm	0	< 10% cloud cover	0	None
1	Slight	1	10 - 50 % cloud cover	1	Fog/smoke
2	Wind felt on face	2	50 – 90% cloud cover	2	Drizzle
3	Leaves in constant motion	3	100% cloud cover	3	Showers
4	Raises dust, small branches move			4	Rain
5	Small trees sway			5	Sleet
6	> 15 mph			6	Snow

Table B-6. Field data form, aerial Golden Eagle production survey.

Nesting Area Name	Fledglings	Age 1	Age 2	Age 3	Eggs	Adult Eagles	Non Adult Eagles	Comments

Codes:

Fledglings = number of fledglings in the nest; Age 1-3 = estimated ages of fledglings in weeks;

Eggs = number of addled eggs in the nest; Adult Eagles = number of territorial adult eagles detected; Non-adult Eagles = number of territorial non-adult eagles detected; Comments = any comments

Appendix B. Field data sheets for aerial surveys and nest visits

Table B-7. Nest characteristics data form.

Date:	Observer:
	Fill in or circle appropriate answer
Species	
Nesting area name	
Latitude (decimal degrees)	
Longitude (decimal degrees)	
General area	
Elevation above sea level (m)	
Stick nest on cliff	Y N
Ledge nest with no sticks	Y N
Pothole	Y N
Height of cliff (m)	
Height of nest on cliff (m)	
Cliff orientation	N E S W
Nest orientation	N E S W
Nest condition	Occupied Good Remnant
Does the nest have an overhang?	Y N
Distance to human activities (m)	
Is there whitewash near nest?	Y N
Is there orange lichen the nest?	
Is human activity visible from nest?	Y N
Type of human activities	Road Trail Buildings Campsite Aircraft
Method used to find nest	Aerial Vehicle Foot Incidental work
Photo taken, and photo number	
Comments:	

Appendix B. Field data sheets for aerial surveys and nest visits

Table B-8. Nest visit data form.

Bander name:				Area name:				Latitude:		Longitude:	
Date:		Time:									
Band number	Age	Sex	Crop	Mass (g)	Culmen (mm)	Hallux (mm)	Foot pad (mm)	Blood sample #	Feather sample #	COMMENTS	

PREY IN NEST:

PREY COLLECTION #: _____

VEGETATION IN NEST:

PHOTO/MAP INFORMATION:

COMMENTS:

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Appendix C

Collecting feather, egg, and blood samples for analyses.

(December 2006)

This Appendix contains all the protocols for collecting feathers, blood and added eggs for different types of analyses including:

Appendix C-1. Protocols for Collecting Blood and Feather Samples for Genetic Analyses

Table C-1. Blood and feather sample collection form.

Appendix C-2. Protocol for Avian Egg Collection

Table C-2. Avian Egg Contaminants Data Sheet

Appendix C-3. Collecting Feathers for Metals Analysis

Appendix C-1. Protocols for Collecting Blood and Feather Samples for Genetic Analyses

This protocol was developed by Dr. Sandra Talbot, Research Geneticist (Wildlife), USGS/BRD, ALASKA SCIENCE CENTER, MOLECULAR ECOLOGY LABORATORY, Lab 102 and 103, 1011 E. Tudor Rd., Anchorage, AK 99503; (907) 786-3582; Fax (907) 786-3636

Sample Collection Supplies

1. Select the appropriate sample collection box based on the type of sample to be collected.

Sample Type	Collection Box	Short-term Storage
Blood	Blood Buffer	Room Temperature
Blood	Filter Paper in Envelopes	Dry, Room Temperature
Blood quills	Tissue Preservation Buffer	Room Temperature
Bone	Envelopes or Dry Microtubes	Dry, Room Temperature
Egg shell membranes	Envelopes or Dry Microtubes	Dry, Room Temperature
Feathers from museum skins	Envelopes	Dry, Room Temperature
Feathers from nests	Tissue Preservation Buffer	Room Temperature
Feathers from nests	Envelopes	Dry, Room Temperature
Fin Clips	Ethanol	Room Temperature
Fin Clips	Filter Paper, Envelopes or Dry Microtubes	Dry, Room Temperature
Hair	Envelopes or Dry Microtubes	Dry, Room Temperature
Muscle	Tissue Preservation Buffer	Room Temperature

Appendix C. Collecting samples

Scat	Ethanol	Room Temperature
Scat	Silica Beads/Gel	Room Temperature
Teeth	Envelopes or Dry Microtubes	Dry, Room Temperature

2. Check to ensure that your sample collection kit contains numbered microtubes (i.e., 1 to 100), a Sample Collection Form, and a Sharpie marker. Additionally, some kits may contain sampling scissors and forceps.
3. On the Sample Collection Form, record data associated with the respective sample (i.e., species, sample ID or band number, collection location, collection date, sex and age if known, and collector). Additional data may be required, depending upon study.
4. Label the outside of the box (i.e., species, collection location, collection dates, collector name, and contact telephone number).

Dropping Off Samples

1. Return samples to the Sample Drop Box located in rm. 102 (Molecular Ecology Lab) of the Alaska Science Center, 1011 E. Tudor Rd., Anchorage, AK 99503. Samples may also be returned by regular mail.
2. Record samples in the *Samples Received Log*.
3. Complete *Sample Data Entry Form* for entry into the BIOTA Inventory system.

Collection of Materials for DNA Analysis

Blood (*Blood/1 Vial/Blood Buffer/Room Temperature*)

For birds, blood is the preferred tissue type for nuclear DNA work, but less valuable than muscle for work that includes mtDNA analyses. We have provided 1.5 mL eppendorf tubes with a blood buffer storage solution (Longmire Buffer). The chemicals are not toxic, but this solution should not be ingested. The buffer and any blood/buffer combination can be stored at room temperature until you return from the field, at which point they should be frozen. Only a few drops of blood are needed from each bird, enough to turn the buffer red (usually about 5 drops). Blood can be obtained by pricking the tarsus vein and transferring the drops to the tubes by way of capillary tubes (**DO NOT USE heparinized tubes**). Using a capillary bulb, blood can be blown from the capillary tube into the buffer after collection. If the blood clots inside the capillary tube, break off the tube inside the buffer vial and just leave it there. Blood can also be collected from the brachial or jugular vein with a sterile syringe. Use a new, sterile syringe for each individual.

Blood Quills. (*Blood Quills/1 Vial/Tissue Preservation Buffer/Room Temperature*)

Blood quills are put into tubes containing tissue preservation buffer provided by our lab. Pull two or more blood quills from the bird. We recommend sampling wing coverts rather than emerging primaries and secondaries, which are more critical to flight. We extract DNA from the

bloody “skin end” of the quill, so if the quills will not fit into the tube, trim off the feather tips, leaving the bloody ends (calamus) to put into the tube.

We strongly suggest that latex gloves be used when sampling, and that instruments be cleaned with 10% bleach between sampling. This prevents between-sample contamination and protects the collector from infectious diseases and any preservatives that may have been used in the skin’s preparation.

Tubes can be stored at ambient temperature for shipping.

Egg Shell Membranes (*Egg shell membranes/1 Envelope/Dry/Room Temperature*)

DNA yields from eggshell membranes are very good, provided there is vascularization on the membrane. The easiest field technique is to collect each membrane and place it in a separate plastic bag: placing all membranes in the same bag causes cross contamination of samples. We do not use the hard shell at all, so that portion can be left in the field. Do not store feathers and eggshells from the same nest in the same bag. Give the nest a number, and then label each feather or egg sample with that number (e.g., nest number 100 has feather sample number 100 and membrane sample numbers 100(1), 100(2), etc.).

Feathers from nests. (*Feathers/1 Envelope/Dry/Room temperature*)

We get the best results with contour or tail wing feathers (those with a substantial sheath or rachis) deposited in nests or shed by birds during molt. The DNA is actually in the calamus, so feathers without the calamus cannot be used to extract DNA. We are unable to obtain DNA from down feathers. Please collect as many contour feathers from each nest as possible (we use 5 feathers per DNA extraction from geese and at least that many for passerines, but like to have extra in case it does not work the first time around). Feathers can be removed after the nest has failed or hatched, or when first discovered if you don’t plan to revisit the nest. Keep feathers dry after collection, since moisture can cause decay of feathers and subsequently the DNA. Place feathers in paper envelopes or, if bone dry, in plastic bags. **Store feathers from different nests in separate bags/envelopes.** Feathers do not need to be frozen. Envelopes can be placed in a plastic bag with 2 Tbsp. silica gel to aid in maintaining a dry environment. {See Pearce et al. (1997) for additional considerations when sampling feathers or egg membranes. However, note that chelex extractions are not recommended unless it is anticipated there will be no long-term use of the extracted DNA.}

Chemical Descriptions and Hazards

(For more specific details on each chemical ingredient, see the attached Material Safety Data Sheets.)

Blood Buffer

Tris/HCL. May cause irritation to skin and mucous membranes on contact. Wash contacted area with plenty of water and contact physician if irritation persists. Ingestion of large doses may cause interior irritation, nausea, weakness and collapse. If ingested, drink copious amounts of water and call a physician.

EDTA. May cause irritation to skin and mucous membranes on contact. Wash contacted area with plenty of water and contact physician if irritation persists. If ingested, drink copious amounts of water and call a physician

NaCl (Sodium chloride). May cause irritation to skin and mucous membranes on contact. Wash contacted area with plenty of water and contact physician if irritation persists. If ingested, drink copious amounts of water and call a physician

SDS (Sodium dodecyl sulfate). May cause irritation to skin and mucous membranes on contact. Wash contacted area with plenty of water and contact physician if irritation persists. If ingested, do not induce vomiting. Drink copious amounts of water and call a physician.

Tissue Buffer

Tris/HCL. See above.

EDTA. See above.

NaCl (Sodium chloride). See above.

N Lauroyl sarcosine. May cause irritation to skin and mucous membranes on contact. Wash contacted area with plenty of water and contact physician if irritation persists. If ingested, do not induce vomiting. Drink copious amounts of water and call a physician.

Urea. May cause irritation to skin or eyes. Wash contacted area with plenty of water and contact physician if irritation persists. If ingested, do not induce vomiting. Drink copious amounts of water and call a physician.

Silica Beads. Silica is an inhalation hazard. Do not breathe silica dust or leave in open areas.

Ethanol. Ethanol is highly flammable; do not place near an open flame. High vapor concentrations or consumption can cause narcotic effects. Do not breathe vapors or consume this ethanol.

Additional Sampling Information

Mundy, N. I., P. Unitt, and D. S. Woodruff. 1997. Skin from feet of museum specimens as a non-destructive source of DNA for avian genotyping. *The Auk* 114(1):126-129.

Pearce, J. M., R. L. Fields, and K. T. Scribner. 1997. Nest materials as a source of genetic data for avian ecological studies. *Journal of Field Ornithology* 68(3):471-481.

Table C-1. Blood and feather sample collection form.

Collection Box Type:	Short-Term Storage:	
Species:	Collection Location:	
Dates of Collection:	Contact Name and Telephone Number:	

Appendix C. Collecting samples

Tube #	Species	Band #	Collection Location	Collection Date	Sex	Age	Notes/Comments
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
23							

Appendix C-2. Protocol for Avian Egg Collection

All collected addled eggs should be sent to :

Dr. Angela Matz, Environmental Contaminants Specialist

U.S. Fish and Wildlife Service

101-12th Ave., Box 19, Room 110

Fairbanks, AK 99701

(907) 456-0442 (907) 456-0208 fax angela_matz@fws.gov

Materials and Equipment

FIELD:

- ☐ permits
- ☐ pencils, pens, permanent markers
- ☐ egg collection boxes (hard-sided container, e.g. Tupperware or tackle box, with foam padding)
- ☐ clean aluminum foil, cut to size (approximately 10 x 15 cm), 1 per egg
- ☐ small ziploc bags
- ☐ labels (with date, species, nest number, nest location, egg number, colony name, lat/long or UTM's, collector's initials, etc.).

Procedures

FIELD:

- ☐ Collect all whole, uncracked, addled eggs from each nest.
- ☐ Wrap the egg in the clean aluminum foil (dull side next to the egg) and twist the ends, as a hard candy is wrapped. The foil should act as a second skin, which keeps the eggshell together and the contents inside should the egg crack in transit.
- ☐ Fill out label. Place label and wrapped egg in small ziploc bag, then into hard container for transport to lab. Use padding to immobilize the egg.
- ☐ Refrigerate eggs until opened, ideally no longer than 48 hrs.
- ☐ Fill out egg data form (Appendix A); use one per egg. The location data (lat/long or UTM's) are very important.

Table C-2. Avian Egg Contaminants Data Sheet

Name: _____

Species: _____

Date Collected: _____ Date Processed: _____

Nest location (latitude and
longitude): _____

Egg Number or description: _____

Nest status at time of collection: _____
(nesting, incubating, abandoned, with chicks - how many, post-fledging, etc.)

Appendix C-3. Collecting Feathers for Metals Analysis

Objective: Provide a standard collection protocol to ensure accurate and precise analysis of metallic contaminants in feathers of nestling raptors.

Materials:

- Permit(s)
- Writing utensil
- Labels
- Teflon or paper collection bags
- Clean stainless steel scissors

Methods

- Nestlings must be old enough to have some emergent feathers. Down can be sampled, but contaminant concentrations in down are more difficult to interpret.
- Sample the largest nestling in each nest (unless sampling multiple nestlings, which is generally not needed).
- Remove up to the distal 1.5 cm of the 4th secondary, from one side of the bird only, using clean stainless steel scissors.
- DO NOT CUT THE FOLLICLE, which is vascularized and prone to bleeding.
- Store the cut feather in a Teflon or paper envelope.
- Label the envelope with your name, date, nest description (including lat/long or UTM), band number of the nestling if banded, estimated age and sex of the nestling, and whether the sample was taken from the right or left side.

Appendix D. Database tables.

IV. Database tables. The narrative field descriptions will be completed at a later date.

Table: tbl_data_locations

Field name	Field description	Field type	Field width
Data_Location_ID		Replication I	16
Site_ID		Replication ID	16
GIS_Location_ID		Replication ID	16
Meta_MID		Replication ID	16
X_Coord		Double	8
Y_Coord		Double	8
Coord_Units		Text	50
Coord_System		Text	50
UTM_Zone		Text	50
Datum		Text	5
Est_H_Error		Single	4
Accuracy_Notes		Text	255
Unit_Code		Text	12
Loc_Name		Text	100
Loc_Type		Text	25
Updated_Date		Text	50
Loc_Notes		Memo	-
Date		Date/Time	8
Obs_Site_Name		Text	50

Table: tbl_Db_Meta

Field name	Field description	Field type	Field width
Db_Meta_ID		Replication ID	16
Db_Desc		Memo	-
Meta_MID		Replication ID	16
DSC_GUID		Replication ID	16

Table: tbl_ED_Bird_Activities

Field name	Field description	Field type	Field width
Event_ID		Replication ID	16
Data_ID		Replication ID	16
Activities		Text	24
Event_Notes		Memo	-

Table: tbl_Event_Group

Field name	Field description	Field type	Field width
Event_Group_ID		Replication ID	16
Start_Date		Date/Time	8
End_Date		Date/Time	8
Event_Group_Name		Text	100
Event_Group_Desc		Text	255
Event_Group_Notes		Memo	-
Event_Group_Report		Text	255
Park_Code		Text	50
Location		Text	100
Primary_Observer		Text	50
Secondary_Observer		Text	50
Access_Method		Text	24
Pilot		Text	50
Aircraft		Text	50
Flight_Time		Long Integer	4
Fuel_Use		Long Integer	4
Start_Time		Date/Time	8
End_Time		Date/Time	8

Table: tbl_Events

Field name	Field description	Field type	Field width
Event_ID		Replication ID	16
Site_ID		Replication ID	16
Event_Group_ID		Replication ID	16
Site_Name		Text	50
Protocol_Name		Text	15
Start_Date		Date/Time	8
Start_Time		Date/Time	8
End_Time		Date/Time	8
Survey_Protocol		Text	15
Passes		Long Integer	4
Ground observations?		Yes/No	1
Temperature		Text	4
Wind_Speed		Text	4
Wind_Direction		Text	4
Clouds		Text	50
Precipitation		Text	50

Appendix D. Database tables

Turbulence		Text	50
Snow_Present		Yes/No	1
Data_Entry_Name		Text	24
Data_Entry_Date		Date/Time	8
Comments		Text	250

Table: tbl_FD_Birds

Field name	Field description	Field type	Field width
Event_ID		Replication ID	16
Data_ID		Replication ID	16
Site_Name		Text	50
Date		Date/Time	8
Number_of_Birds		Long Integer	4
Species		Text	4
Age_Class		Text	50
Gender		Text	5
Flush		Yes/No	1
Comments		Text	250

Table: tbl_FD_Nest_Visit

Field name	Field description	Field type	Field width
Event_ID		Replication ID	16
Location_ID		Replication ID	16
NEST_Name		Text	25
Date		Date/Time	8
BAND_NUMBER		Long Integer	4
FWS_BAND_LEG		Text	50
CULMEN_MM		Double	8
HALLUS_MM		Double	8
WING_CHORD_MM		Double	8
FOOT_PAD_MM		Double	8
SEX		Text	50
WEIGHT_GRAMS		Double	8
BLOOD_SAMPLE		Yes/No	1
BLOOD_SAMPLE_ID		Text	50
FEATHER_SAMPLE		Yes/No	1
FEATHER_COLLECTION_ID		Text	50
ADDITIONAL_MARKERS		Text	50
RADIO_TAG_TYPE		Text	50
RADIO_TAG_ID		Text	50

Appendix D. Database tables

RADIO_FREQUENCY		Text	50
PREY_COLLECTION_ID		Text	50
PREY_IN_NEST		Text	250
VEG_IN_NEST		Text	250
RECAPTURE		Yes/No	1
COMMENTS		Text	250

Table: tbl_FD_Nests

Field name	Field description	Field type	Field width
Event_ID		Replication ID	16
Location_ID		Replication ID	16
Site_Name		Text	50
Nest_Name		Text	25
Date		Date/Time	8
Species		Text	4
Nest_Building		Yes/No	1
Hatchable_Eggs		Long Integer	4
Non_Viable_Eggs		Long Integer	4
Number_of_Nestlings		Long Integer	4
Age_Estimate		Text	20
Age_Method		Text	50
Nest_Visit		Yes/No	1
Fledged		Yes/No	1
Comments		Text	250

Table: tbl_FD_Recapture

Field name	Field description	Field type	Field width
BAND_NUMBER		Long Integer	4
NEST_ID		Text	8
DATE		Date/Time	8
LAT		Double	8
LON		Long Integer	4
LOCATION		Text	50
HOW		Text	50
WHO		Text	50
CONDITION		Text	50
COMMENTS		Text	250

Table: tbl_FD_Territory_Occupancy

Field name	Field description	Field type	Field width
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Appendix D. Database tables

Event_ID		Replication ID	16
Site_Name		Text	50
Date		Date/Time	8
Occupied		Text	3
Species		Text	4
Occupancy_Evidence		Text	50
Nest_in_Use		Yes/No	1
Comments		Text	250

Table: tbl_Locations

Field name	Field description	Field type	Field width
Location_ID		Replication ID	16
Site_ID		Replication ID	16
GIS_Location_ID		Replication ID	16
Meta_MID		Replication ID	16
X_Coord		Double	8
Y_Coord		Double	8
Z_Coord		Double	8
Coord_Units		Text	50
Coord_System		Text	50
UTM_Zone		Text	50
Datum		Text	5
Est_H_Error		Single	4
Accuracy_Notes		Text	255
Unit_Code		Text	12
Loc_Name		Text	25
Loc_Type		Text	25
NEST_TERRITORY_NAME		Text	75
GOEA_Site_Name		Text	50
FINDER		Text	50
FIND_DATE		Date/Time	8
FIND_METHOD		Text	50
MONITORING_SITE		Yes/No	1
MAP_NAME		Text	50
DRAINAGE_NAME		Text	50
Species1		Text	5
Species2		Text	5
NEST_BUILDER		Text	4
NEST_SUBSTRATE		Text	50
TYPE_OF_NEST		Text	50

Appendix D. Database tables

Nest_Placement		Text	15
HT_of_Object		Long Integer	4
HT_of_Nest		Long Integer	4
TREE_NEST_SPECIES		Text	50
CLIFF_LENGTH_M		Long Integer	4
CLIFF_ASPECT		Long Integer	4
OVERHANG		Text	50
NEST_HEIGHT_M		Long Integer	4
NEST_ASPECT		Long Integer	4
NEST_ACCESS_HUMANS		Text	50
HUMAN_ACTIVITY_3KM		Text	50
DISTANCE_HUMAN_ACTIVITY		Long Integer	4
HUMAN_ACTIVITY_VISIBLE		Yes/No	1
TYPE_HUM_ACT_VISIBLE		Text	50
CURRENT_NEST_CONDITION		Text	50
Updated_Date		Text	50
Loc_Notes		Memo	-

Table: tbl_Sites

Field name	Field description	Field type	Field width
Site_ID		Replication ID	16
GIS_Location_ID		Replication ID	16
Site_Name		Text	100
Site_Desc		Text	255
Unit_Code		Text	12
Site_Notes		Memo	-
X_Coord		Double	8
Y_Coord		Double	8
Occupied		Text	2
Breeding		Text	2
Prev_year		Text	4

Table: tlu_Activities

Field name	Field description	Field type	Field width
Type		Text	50

Table: tlu_Age_Adults

Field name	Field description	Field type	Field width
AGE		Text	50

Table: tlu_Age_Method

Field name	Field description	Field type	Field width
AGING_CRITERIA_CODE		Text	50
DESCRIPTION_AGING_CODE		Text	50

Table: tlu_Age_Nestlings

Field name	Field description	Field type	Field width
Age		Text	50

Table: tlu_Aircraft_Type

Field name	Field description	Field type	Field width
DESCRIPTION_MODEL		Text	50

Table:

tlu_Base_Cardinal_Direction

Field name	Field description	Field type	Field width
cardinal_direction		Text	4
cardinal_description		Text	50
cardinal_order		Long Integer	4

Table: tlu_Cond_Cloud_Cover

Field name	Field description	Field type	Field width
cloud_cover_code		Text	20
cloud_cover_min_percent		Integer	2
cloud_cover_max_percent		Integer	2
cloud_cover_desc		Text	100

Table: tlu_Cond_Precipitation

Field name	Field description	Field type	Field width
precipitation_code		Text	20
precipitation_desc		Text	100

Table: tlu_Cond_Temperature

Field name	Field description	Field type	Field width
temperature_code		Text	20
temperature_min_degf		Integer	2
temperature_max_degf		Integer	2
temperature_desc		Text	100

Table: tlu_Cond_Wind_Speed

Appendix D. Database tables

Field name	Field description	Field type	Field width
wind_speed_code		Text	20
wind_speed_min_mph		Integer	2
wind_speed_max_mph		Integer	2
wind_speed_desc		Text	100

Table: tlu_Contacts

Field name	Field description	Field type	Field width
Contact_ID		Replication ID	16
Initials		Text	5
Last_Name		Text	50
First_Name		Text	50
Middle_Init		Text	4
Organization		Text	50
Position_Title		Text	50
Address_Type		Text	50
Address		Text	50
Address2		Text	50
City		Text	50
State_Code		Text	8
Zip_Code		Text	50
Country		Text	50
Email_Address		Text	50
Work_Phone		Text	50
Work_Extension		Text	50
Contact_Notes		Memo	-

Table: tlu_MFU

Field name	Field description	Field type	Field width
MFU		Text	1

Table: tlu_Occupancy_Evidence

Field name	Field description	Field type	Field width
Observation		Text	50

Table: tlu_Raptor_Species

Field name	Field description	Field type	Field width
SPECIES_CODE		Text	255
AOU#		Long Integer	4
Common_Name		Text	255

Appendix D. Database tables

Sci_Name		Text	255
TSN		Double	8

Table: tlu_Survey_Method

Field name	Field description	Field type	Field width
SURVEY_METHOD		Text	50

Table: tlu_Survey_Type

Field name	Field description	Field type	Field width
Type		Text	50

Table: tlu_Territories

Field name	Field description	Field type	Field width
Name		Text	50

Table: tlu_Turbulence

Field name	Field description	Field type	Field width
Description		Text	10

Table: tlu_YNU

Field name	Field description	Field type	Field width
YNU		Text	1