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STATUS OF NESTING GOLDEN EAGLES IN BOULDER COUNTY AND
ADJACENT AREAS OF THE FRONT RANGE IN COLORADO

A PRELIMINARY REPORT

By Mike Figgs and Nancy Lederer



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Status of Nesting Golden Eagles in Boulder County and Adjacent Areas
of the Front Range in Colorado - A Preliminary Report

by Mike Figgs and Nancy Lederer ^{1/}

INTRODUCTION

The Golden eagle (Aquila chrysaetos) is regarded as a fairly common raptor in Boulder County (Holitza and Krieg 1981, Boulder County Wildlife Inventory 1982-1985) and in the state of Colorado (Boeker and Ray 1971, Olendorff 1981).

Nesting eagles in the northern Front Range of Colorado have been well documented. From 1883 to 1894, Gale (Henderson 1907) found at least seven nests. In a comprehensive study of the northern Front Range, Jollie (1943) mapped 15 breeding territories, including all seven noted by Gale. D'Ostilio (1954) revisited Jollie's territories, added one more, and conducted a food habit study at five of these sites. Jollie's territories were visited again in 1970 by Rice (unpublished data). Aerial surveys have been conducted by the U.S. Fish and Wildlife Service (Boeker and Ray 1971, L. Crowley pers. comm.) and the Colorado Division of Wildlife (1978). Numerous citizens and amateur ornithologists in Boulder County have also watched nesting eagles, notably Thomas E. VanZandt of Boulder, who has monitored the nest at Lefthand Palisades from 1974 to the present.

Most of these nesting territories, including eleven of Jollie's fifteen sites are within or immediately adjacent to the Front Range Urban Corridor, one of the fastest growing metropolitan areas in the United States. Given the amount of baseline data available, the breeding eagles of the Front Range provide an attractive opportunity to study wildlife adapting to the pressures of human development. Accordingly, this study was initiated to 1) update the status of Jollie's territories, 2) locate the other Golden eagle breeding territories in Boulder County that are not in the lower foothill area covered by Jollie's study, 3) determine productivity of Boulder County territories, 4) monitor the nest sites to document human disturbance, 5) make a determination of territory viability, and 6) integrate the data available from public and private sources to construct as complete a history as possible of the eagle territories.

^{1/} Authors' address: 2216 Bluff St., Boulder, CO 80302

At this time our study is approximately 50% complete. We are issuing this preliminary report for the benefit of land use planners and wildlife managers. We also hope it will stimulate members of the public to participate in the remainder of the study.

STUDY AREA AND METHODS

Jollie (1943) and D'Ostilio (1954) have described their study area, which is a five- to ten-mile wide strip of low foothills and adjacent plains and mesas. It is bordered on the south by the city of Golden in northern Jefferson County, and includes the mountain front north to the Wyoming border in Larimer County (Fig. 1). The present study also includes the remainder of Boulder County west of Jollie's study area. The total area is approximately 1,025 square miles.

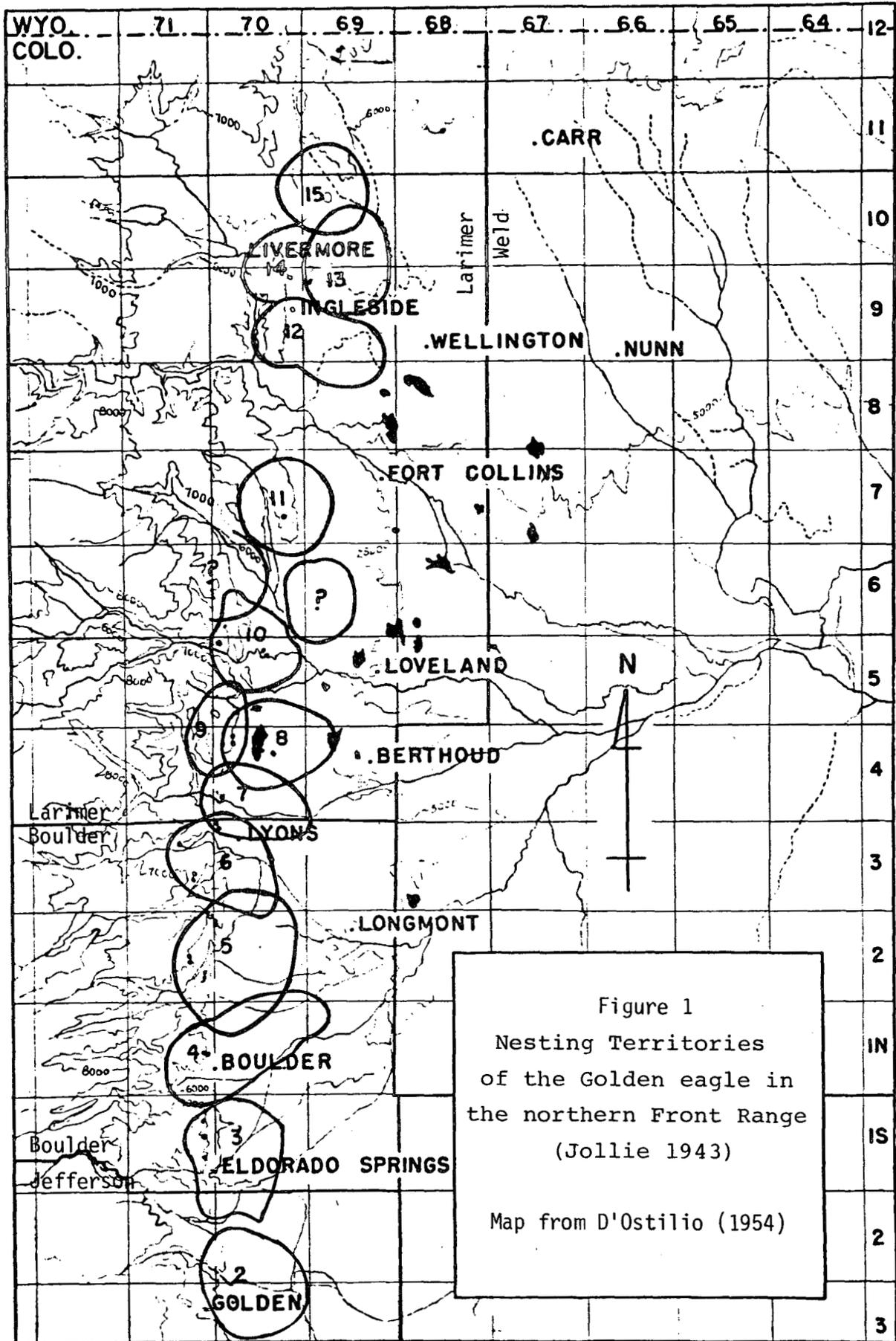
Methods used in this project are essentially the same used by Jollie (1943, pg. 9): "~~The methods of study were fundamentally those of all field workers in ornithology, and consisted mainly of spending all available time in the field observing the birds in their daily activities and correlating these observations with material obtained from the literature.~~"

Nests are located by using the following methods: 1) searching favorable habitat on a trial and error basis, 2) reviewing the literature, 3) following leads provided by private citizens, and 4) reviewing records of public agencies such as the Colorado Division of Wildlife. In many instances, it takes several or all of these techniques working in concert to locate a given nest.

Once a nest is found, a "Raptor Site Inventory" is filled out, describing the general characteristics of the nest and surrounding habitat. Each time a nest is revisited, a "Raptor Nest Monitoring Data Sheet" is completed to record the status of nesting and human disturbance, if any. Examples of both forms are appended.

Flight patterns, locations of territorial defense observations, and hunting grounds are recorded on topographic maps, from which the general boundaries of each territory may be constructed. To map the hunting grounds, nest site visits are supplemented with trips to adjacent areas, where sightings of hunting eagles are recorded.

As breeding and hunting territories are mapped, they are compared to those mapped by Jollie, in order to determine what changes they have undergone.



RESULTS

1. Update of breeding territories mapped by Jollie

To date we have visited nine of the 15 territories. Results are presented in Table 1.

Of these nine territories, we have completed sufficient field work in seven of them to determine their status. Five of these seven territories are still occupied by nesting eagles. Territory #3 has now been found to have two pairs of nesting eagles, so there actually are now six occupied territories in 1985 where Jollie had seven in 1942-43.

2. Additional territories in Boulder County

There is a continuing citizen effort to document the natural resources of Boulder County so that these resources are fully considered in the county comprehensive planning process, and so that managers of public lands have up-to-date information. Accordingly, we decided to search for additional Golden eagle territories and nest sites in the remainder of the county not covered by Jollie's study. Four additional pairs of eagles have been found; nests have been located for two of these pairs (Table 2).

3. Productivity

Productivity, as presented herein, is calculated by three methods: 1) average number of young fledged per known nesting attempt (defined as a nest in which at least one egg is laid), 2) average number of young fledged per successful nesting attempt (defined as a nest in which at least one young is fledged), and 3) average number of young produced (fledged) per territorial pair per year.

Most studies of Golden eagle populations determine productivity by either method 1 or 2 or both, and productivity in this study is compared to a representative sample of these studies (Table 3).

One of the most useful statistics for assessing productivity of raptor populations is method 3, because it takes into account the performance of the entire potential breeding population that must replace itself (Newton 1979). This statistic includes pairs of eagles that are occupying a breeding territory, but not necessarily nesting in a given year. Unfortunately, many workers do not report this statistic, perhaps because it is a difficult figure to measure

Table 1. Update of breeding territories mapped by Jollie

| Territory No. ^{a/} and Name | Status | Comments |
|--------------------------------------|-------------------|----------------------------------------------------|
| 2-Golden North | Nesting | Field checked 1985 |
| 3-Eldorado Springs/Boulder | Nesting (2 pairs) | Field checked 1983-85 |
| 4-Boulder North | Inactive | Last active in 1951 ^{b/} |
| 5-Lefthand Palisades | Nesting | Field checked 1974-85 |
| 6-Lyons | Nesting | Field checked 1981-85 |
| 7-Little Thompson | Nesting | Field checked 1982-84 |
| 8-Carter Lake | Inactive | Field checked 1984-85 |
| 9-Blue Mountain | Not determined | Field checked 1985, territory search not completed |
| 10-Big Thompson | Not determined | Field checked 1985, territory search not completed |

^{a/} from Jollie (1943) - see Fig. 1.

^{b/} D'Ostilio (1954) and Van Zandt (pers. comm.).

Table 2. Additional territories in Boulder County

| Territory Name | Status | Comments |
|------------------------------|----------|---------------------------------------------------------|
| Boulder Canyon | Nesting | Field checked 1981-85 |
| North St. Vrain Canyon | Nesting | Field checked 1982-85 |
| South St. Vrain Canyon | Occupied | Field checked 1984-85 Nest not located ^{a/} |
| N. Fork Middle Boulder Creek | Occupied | Field checked 1982-85 Nest not located |

^{a/} may be alternate location for North St. Vrain Canyon.

Table 3. Productivity of Golden eagles in Boulder County compared to other studies

| Source | Location | Average # Young fledged per nesting attempt (eggs laid) | Sample size | Average # young fledged per successful attempt (at least 1 fledged) | Sample size |
|-------------------------------|-----------------------------------|---------------------------------------------------------------------|----------------|------------------------------------------------------------------------------------|----------------|
| Figgs & Lederer | Boulder County, CO | 1.25 | 16 | 1.43 | 14 |
| Beecham & Kochert (1975) | Idaho | 1.10 | 146 | 1.60 | 93 |
| Boeker & Ray (1971) | Colorado, New Mexico & Wyoming | 1.39 | 213 | - | - |
| Brown & Watson (1964) | Scotland | - | - | 1.25 | 97 |
| Hickman (1967) ^{a/} | Idaho & Oregon | 1.30 | 18 | - | - |
| McGahan (1968) | Montana | 1.37 | 51 | 1.56 | 45 |
| Murphy (1973) ^{b/} | Utah | 1.30 | 61 | 1.60 | 50 |
| Reynolds (1969) ^{c/} | Montana | 1.10 | - | - | - |
| Sandeman (1964) ^{d/} | Scotland | - | - | 1.40 | 19 |

^{a/} cited in Boeker and Ray (1971)

^{b/} cited in Newton (1979)

^{c/} cited in Beecham and Kochert (1975)

^{d/} cited in Brown and Watson (1964)

accurately, and requires labor intensive field work.

For Boulder County, we have calculated this figure (average number of young per territorial pair per year) as 1.0, which compares favorably to those studies which have determined this statistic (Newton 1979, pg. 350).

There is only one nesting site in Boulder County, Lefthand Palisades, for which there are productivity data over a significant length of time (11 years). Data for this site are compared to the remainder of the county in Table 4.

4. Human disturbance (structural and recreational)

Table 5 catalogues structural disturbances (man made developments) to breeding habitat. This type of disturbance affects five of the six nesting territories in the county; three territories are subject to two or more of these disturbance types.

The recreational disturbances documented in this study are: hikers (five territories affected), technical rock climbers (three territories), firearm practice range (one territory), and hunters (two territories). Technical rock climbers probably represent the most significant threat to nesting eagles since they have the ability to come very close to, or even enter nests. A catalogue of disturbances from rock climbers and hikers for one nesting site is summarized in Table 6.

In spite of the amount of human activity in Boulder County, we have not yet been able to clearly document a single eagle mortality due to man.

5. Territory viability

At this time there is not sufficient information to make a definitive statement on viability. A profile of each territory, assessing viability, will be issued in the final report.

6. History of territories

Much information remains to be collected. Partial histories of three territories are shown in Table 7, as an example of what is known at present.

Table 4. Productivity of Lefthand Palisades site compared to remainder of Boulder County sites

| | Period covered | Average # young fledged per nesting attempt ^{a/} (sample size) | Average # young fledged per successful nesting attempt ^{a/} (sample size) | Average # young fledged per territorial pair per year (sample size) |
|---------------------|----------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| Lefthand Palisades | 1974-84 | 1.44 (9) | 1.44 (9) | 1.18 (11) |
| 5 county nest sites | 1981-84 | 1.00 (7) | 1.40 (5) | 0.77 (9) |

^{a/} as defined in Table 3.

Table 5. List of structural disturbances to the six Boulder County Golden eagle nesting territories

| Type of disturbance | Number of nesting territories affected | Distance to nest (miles) |
|-----------------------------------|----------------------------------------|--------------------------|
| Cities | 1 | 1.5 |
| Rural subdivisions | 2 | 0.75 - 1.25 |
| Low density housing ^{a/} | 1 | 0.25 |
| Highways and major arterial roads | 3 | 0.25 |
| Railroads | 1 | 0.25 |
| Gravel mines | 2 | 1.0 - 1.5 |

^{a/} one house or less per 35 acres

Table 6. Record of rock climbers or hikers near eagle nest
in Boulder Mountain Parks

| Year | Number of monitoring visits ^{a/} | Number of incidents of climbers or hikers near nest | | Comments |
|--------------------|----------------------------------------------|--------------------------------------------------------|----------------|----------------------------------------------------------------------------|
| | | Within 100 yd. | Within 300 yd. | |
| 1983 | 9 | 3 | 4 | Adult eagle flew from nest once in response to climber about 800 yd. away. |
| 1984 | 17 | 5 | 6 | Adult eagle flew from nest once in response to climber 150 ft. away. |
| 1985 ^{b/} | 13 | 4 | 7 | Adult eagle flew from nest once in response to climber 20 ft. away. |
| Total | 39 | 12 | 17 | |

^{a/} includes visits made when poor weather or deep snow would have discouraged hikers and climbers. Visits varied from $\frac{1}{4}$ hour to 6 hours in duration, and averaged 2.75 hours.

^{b/} 13 visits made as of mid-May, but observations will continue through June.

Table 7. Histories of three Golden eagle nesting territories in Boulder County

| Territory | Date | Status | Reference | Comments |
|-----------------------------------------------------|---------|----------|--------------------------------|------------------------------------------------|
| Eldorado Springs/ Boulder (Jollie #3, Fig. 1) | 1889 | Occupied | Gale (Henderson 1907) | Subterritory B ^{a/} |
| | 1943 | Nesting | Jollie (1943) | Both subterri- tories occupied by 1 pair |
| | 1954 | Nesting | D'Ostilio (1954) | Subterritory A |
| | 1970 | Nesting | Rice (1970) | Subterritory B |
| | 1977-78 | Nesting | CO Div. Wildlife (1978) | Subterritory A |
| | 1980-81 | Nesting | Roger Briggs (Pers. Comm.) | Subterritory B |
| Subterritory A | 1982 | Occupied | Figgs and Lederer | Nest not located |
| | 1983 | Nesting | " | Eggs laid, nest deserted |
| | 1984 | Nesting | " | Fledging not determined |
| | 1985 | Nesting | " | 1 young on nest as of May |
| Subterritory B | 1983 | Nesting | " | 2 young fledged |
| | 1984 | Nesting | " | 1 young fledged |
| | 1985 | Nesting | " | 2 young on nest as of May |
| Lefthand Palisades | 1886 | Nesting | Gale (Henderson 1907) | |
| | 1889 | Occupied | Gale (Henderson 1907) | |
| | 1943 | Nesting | Jollie (1943) | |
| | 1954 | Nesting | D'Ostilio (1954) | |
| | 1970 | Nesting | Rice (1970) | |
| | 1974-76 | Nesting | T.E. VanZandt (Pers. comm.) | 1 young fledged each year |
| | 1977 | Inactive | " | |

^{a/} Jollie, D'Ostilio and Rice all treated this as one territory. In 1983 it was found to have two pairs of nesting eagles. Subterritory A is centered in Eldorado Canyon, Subterritory B on Green Mountain in the Boulder Mountain Parks. There is considerable overlap between the territories. Historical information is referenced to the specific subterritory.

Table 7 (Cont.)

| Territory | Date | Status | Reference | Comments |
|-------------------------------|---------|----------|---------------------------------------------------------|---------------------------|
| Lefthand Palisades (Cont.) | 1978 | Nesting | T.E. VanZandt (Pers. comm.) and CO Div. Wildlife (1978) | 2 young fledged |
| | 1979 | Nesting | T.E. Van Zandt (Pers. comm.) | 2 young fledged |
| | 1980 | Nesting | " | 2 young fledged |
| | 1981 | Nesting | " | 2 young fledged |
| | 1982 | Nesting | " | 1 young fledged |
| | 1983 | Occupied | " | Did not nest |
| | 1984 | Nesting | T.E. VanZandt and Steve Jones (Pers. comm.) | 2 young fledged |
| | 1985 | Nesting | " | 2 young on nest as of May |
| Boulder Canyon | 1876 | Nesting | Weiss (1977) | |
| | 1974-75 | Nesting | Gary Emerson (Pers. comm.) | |
| | 1982 | Nesting | Figgs and Lederer | |
| | 1983 | Occupied | " | Nest not found |
| | 1984 | Nesting | " | 2 young fledged |
| | 1985 | Nesting | " | 1 young on nest as of May |

DISCUSSION

Update of breeding territories mapped by Jollie

Territory #4 (Boulder North) has been inactive since 1951. The nest site is nearly surrounded by a mountain subdivision, and much of the former hunting grounds are now urbanized.

Territory #8 (Carter Lake) has also been inactive since Jollie's study (D'Ostilio 1954). This site has not been urbanized, but there has been some low density home building (less than one house per 35 acres) in the territory, as well as road building and the construction of Carter Lake Reservoir. These types of structural disturbances did not result in abandonment of the other territories in the study. Possible explanations for the abandonment of this territory include the openness of the landscape (nearly treeless) and the lack of a sizeable nesting cliff. Jollie identified three nest sites for this territory; all were on relatively small escarpments (40-60 feet high) that are easily climbed. ~~There are no other cliffs larger in size for eagles to nest on in this area.~~

Interestingly, this feature of small nesting cliffs is shared by territory #4, the only other territory to be abandoned. The active territories in this study all have tall cliffs, 100 feet high or more. Most have sheer walls and large overhangs (Figs. 2 and 3). We suspect that availability of large sheer cliffs may be an important factor for the nesting success of eagles where man is present. We intend to report on this feature in greater detail in the final report.

Productivity

A few words of caution are in order regarding the productivity statistics reported herein. First, our sample size is small (Table 3), and this precludes a confident determination of productivity in Boulder County at this time. Second, the figures in Table 3 are from different studies, conducted by different workers, using different field methods and different statistical methods of reporting productivity.

Although it is encouraging that Golden eagle productivity in the county compares favorably to other locations, additional field work is clearly needed.

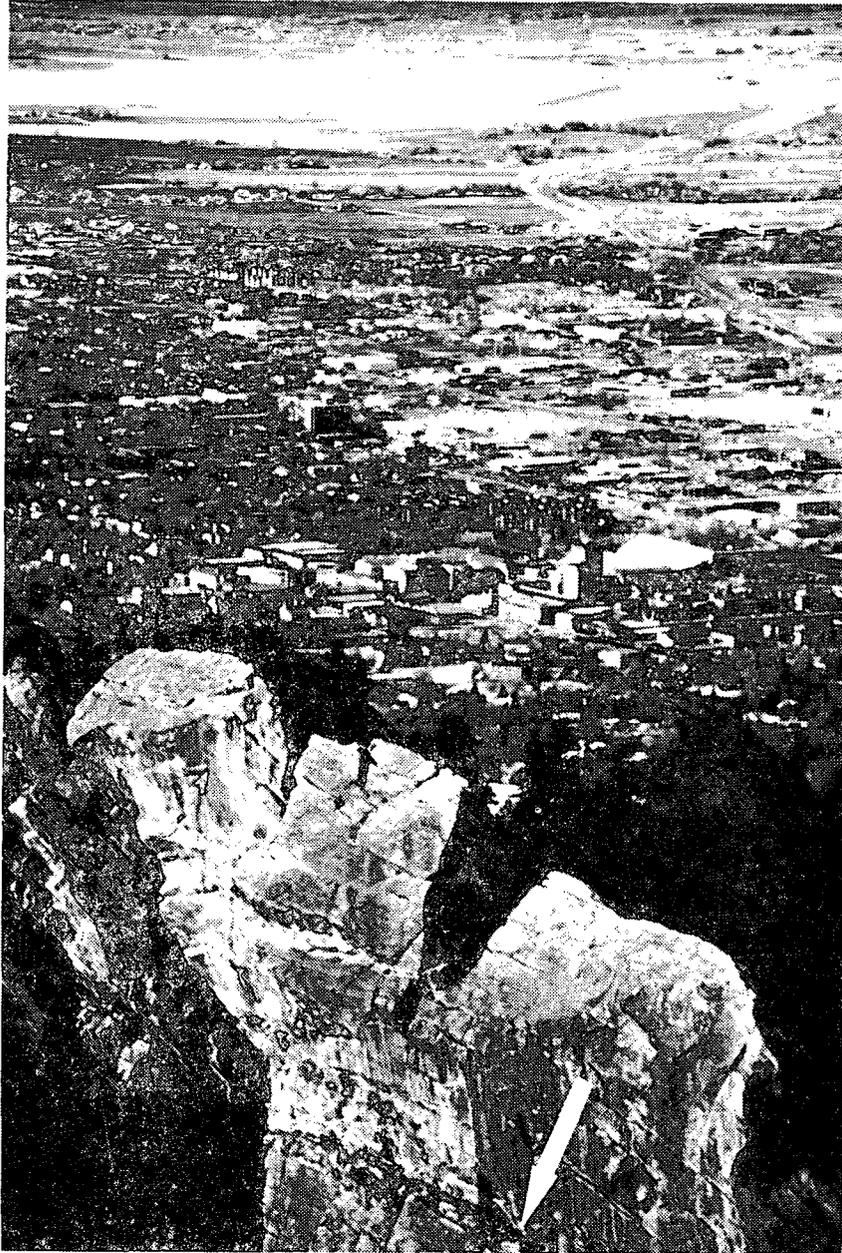


Figure 2. An active Golden eagle nest (white arrow) within $2\frac{1}{2}$ miles of the University of Colorado campus (middle center). This nest fledged young in 1983 and 1984, despite several occurrences of hikers and rock climbers within 100 yards of the nest. One climbing route follows the top of the cliff.



Figure 3. Alternate nest (white arrow) for the site shown in Fig. 2. Table Mesa Drive is in the background. The crack to the left of the nest is an occasionally used climbing route. Recreational pressure on this pair of eagles is steadily increasing.

Human disturbance

With a population in excess of 200,000, Boulder County is highly urbanized, particularly in the eastern two-fifths of the county, which is mostly plains and mesas. This area also provides about half of the hunting habitat for four pairs of nesting eagles. Only one territory, the North St. Vrain Canyon, is not easily accessible by roads. The potential for human disturbance of nesting eagles is high (Figs. 2 and 3).

On the other hand, these pressures upon breeding eagles are being countered by some positive factors, perhaps the most important being the ability of the eagles to adapt to various disturbances. If given the opportunity to gradually habituate to structural disturbances, eagles obviously can tolerate some amount of roads, homes, and mining in their breeding territories. At what point disturbance becomes intolerable is unknown; perhaps the clues are to be found in the abandoned territories.

Recreational pressures upon nest sites are likely to increase, especially given the popularity of technical rock climbing in the Boulder area. Climbers pose a serious threat to nesting eagles since their presence may flush adult eagles off the nest. Eggs that are exposed for prolonged periods may addle, and young up to the age of two weeks cannot thermoregulate, and may easily die of hypothermia or overheating. Young eagles that are not quite ready to fledge may also flush in the presence of climbers, and this premature fledging may cause wing and bone damage and result in death to the young birds. (Call 1978). The climbing community must respect the needs of nesting eagles and give the nests a wide berth. At this time we are recommending that climbing routes which are within 100 yards of active nests be closed to climbers during the nesting season (January 1 to July 1).

SUMMARY

A study of a Golden eagle breeding population in the Colorado Front Range is being conducted to: 1) compare the current population to historical levels; 2) locate additional nesting eagles in adjacent areas of concern; 3) determine breeding productivity of the population; 4) document human disturbance at nest sites; 5) determine viability of the breeding territories; and 6) construct histories of each territory.

Results to date are: 1) the number of breeding territories in the study area has declined slightly, probably due to human impacts; 2) four additional territories have been located; 3) productivity compares favorably to other populations, but a larger census is required in order to determine whether the population is stable, increasing, or decreasing; 4) nesting eagles are subject to a wide variety of human disturbances, but are generally adapting to these alterations to their breeding territories. Technical rock climbers are identified as a primary threat to the nesting eagles. 5) and 6) Partial histories of the breeding territories have been constructed. The study is continuing to gather information on history and viability of territories.

ACKNOWLEDGEMENTS

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Site name, # _____

Date of observation _____ Time _____ to _____ Observer(s) _____

Stick nest / scrape / perch (Circle one)

Location _____

Alternate nests at site _____

Distance from observer(s) _____ Elevation _____

Location photos taken # _____

Close-up photos # _____

Species observed using site: Currently _____ In past _____

Total # birds _____ Adults _____ Female _____ Male _____ Young _____ Fledged _____

Nest characteristics:

Tree nest: Tree species _____ Tree dead/alive; Tree height _____

Cliff nest: On ledge with overhang/On ledge without overhang/In pothole or crevice

Other _____

Height above ground _____ Height above valley bottom _____

Aspect _____ Slope _____

Whitewash/lichens present. Stick nest dimensions (estimate) _____

Adjacent habitat: Distance to water _____ Type _____

Vegetation type: Pond. pine / Doug-fir / Montane meadow / Foothills shrub

Plains grassland / Other _____

Cliff: Rock type / formation _____

Status: Active now / Inactive / Unknown. History _____

Reference reports _____

Potential disturbances _____

How close can people get to site without aids _____

Behavior of birds while being observed _____

Other notes _____

Attach additional sheets if needed.

^{d/} Form modified from form used by Resource Managers in Denali Nat'l. Park, Alaska.

Appendix 2
RAPTOR NEST MONITORING DATA SHEET ^{a/}

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Date _____ Observer(s) _____ Time _____ to _____
Site name, # _____ Species _____ Dist. to nest _____
Weather: Temp. _____ Wind _____
Cloud cover _____ Precip. _____ Snow Cover: _____
Status of nesting activity (courtship, incubating, etc.) _____
Birds present, activity _____

Birds' reaction to observers _____
Other notes _____

HUMAN ACTIVITY INFORMATION:

A. Number people in party _____ Number dogs _____
Activity (rock-climbing, hiking, etc.) _____
Time spent within 100 m of nest _____
Time spent within 300 m of nest _____
Closest distance to nest & position (above, below, etc.) _____
Time spent there & activity _____
Noise _____
Behavior of birds _____

Other notes _____

B. Number people in party _____ Number dogs _____
Activity _____
Time spent within 100 m of nest _____
Time spent within 300 m of nest _____
Closest distance to nest & position _____
Time spent there & activity _____
Noise _____
Behavior of birds _____

Other notes _____

Attach additional sheets if needed.

^{a/} Form modified from form used by Resource Managers in Denali Nat'l. Park, Alaska.