Bald eagles of the San Luis Valley, Colorado : their winter ecology and spring migration
by Alan Robert Harmata

A thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Biological Sciences
Montana State University

Abstract:
Approximately 100-300 bald eagles (Haliaeetus leucocephalus) winter in the San Luis Valley (SLV) of southcentral Colorado. Between January and mid-March 1980-1981, bald eagles were captured, measured, and plumage described. An aging protocol based on plumage, iris, and mandible coloration was developed. A sexing technique was developed based on 4 measurements. Morphological differences were related to resource partitioning between age classes and sexes and also migration differences between sexes of adults. Fifteen adult bald eagles were marked with tail-mounted transmitters to study winter ecology. Over 1300 hours of monitoring showed mean seasonal home range size was 310.7 km^2 . Single day movements typically covered only a small portion of the home range. Mean daily activity was 15.5% of daylight hours and monthly activity was negatively correlated with severe weather. Human activity within 150 m of an eagle perched in a tree or 760 m of an eagle on the ground usually elicited a flush response. Perch trees were usually near irrigation ditches surrounded by agricultural land. Foraging habitat consisted of areas of brushland/cropland interspersion. Habitat use shifted from upland to riparian areas as ice-out on rivers progressed. Roost site suitability appeared dependent on distance from human activity while roost site preference seemed dependent on proximity to food. Primary food was jackrabbit (Lepus spp.) throughout the winter but varying proportions of fish and waterfowl occurred dependent on availability. Use of the SLV by wintering bald eagles is probably relatively recent and coincident with agriculture. Advancing monoculture will probably result in fewer eagles using the SLV in the future. Age ratios in wintering areas are most likely a reflection of food availability and type rather than indicative of population trends. Six eagles were tracked on spring migration. Two eagles were followed to a nesting ground and 2 others found in their summering area, all in northeastern Saskatchewan. Migration routes and wintering areas of adult bald eagles appear to be related to the watershed in which summering grounds are located.

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April 1984

APPROVAL

of a thesis submitted by

Alan Robert Harmata

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

April 4, 1984
Date

Robert S. Eng
Chairperson, Graduate Committee

Approved for the Major Department

4 April 1984
Date

Robert E. Moore
Head, Major Department

Approved for the College of Graduate Studies

May 2, 1984
Date

Henry L. Parsons
Graduate Dean

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Signature 

Date 04-12-84

Recently arrived from her wintering ground in the San Luis Valley, Colorado, an adult bald eagle vocalizes from a perch near her nest in northeastern Saskatchewan.

For the 57,939 who never got the chance...

VITA

Alan Robert Harmata was born 2 June 1945 in Passaic, New Jersey to Howard John and Mabel Beatrice Harmata. He graduated from Rutherford High School, Rutherford, New Jersey in June 1963. He attended Nichols College in Dudley, Massachusetts from September 1963 to June 1964 and subsequently worked in the construction trades. On 26 February 1966 he was inducted into the U.S. Army and served in the infantry with the 1st Bn. 5th Cav, 1st Air Cav Div. in the Republic of Vietnam. He was retired from the U.S. Army on 6 February 1968 due to "disabling" wounds received in action. In September 1969 he enrolled in Fairleigh Dickenson University, Teaneck, New Jersey, transferring to the University of Illinois, Champaign in September 1970 and received a Bachelor of Science degree in Biology in June 1972. He began graduate study in wildlife during January 1973 at Colorado State University, Ft. Collins, and completed required coursework by June 1974. After working in the wildlife consulting field and for the National Audubon Society for several years, he received a Master of Science degree in wildlife biology from Colorado State University in December 1977. He began studies for a Doctor of Philosophy degree in Fish and Wildlife Management at Montana State University in March 1979. He has a daughter, Caryn Jeanne (age 13) and a son, Peter John (age 10) and is sharing life with Elizabeth Bowman Spettigue of Duluth, Minnesota.

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ABSTRACT

Approximately 100-300 bald eagles (Haliaeetus leucocephalus) winter in the San Luis Valley (SLV) of southcentral Colorado. Between January and mid-March 1980-1981, bald eagles were captured, measured, and plumage described. An aging protocol based on plumage, iris, and mandible coloration was developed. A sexing technique was developed based on 4 measurements. Morphological differences were related to resource partitioning between age classes and sexes and also migration differences between sexes of adults. Fifteen adult bald eagles were marked with tail-mounted transmitters to study winter ecology. Over 1300 hours of monitoring showed mean seasonal home range size was 310.7 km^2. Single day movements typically covered only a small portion of the home range. Mean daily activity was 15.5% of daylight hours and monthly activity was negatively correlated with severe weather. Human activity within 150 m of an eagle perched in a tree or 760 m of an eagle on the ground usually elicited a flush response. Perch trees were usually near irrigation ditches surrounded by agricultural land. Foraging habitat consisted of areas of brushland/cropland interspersion. Habitat use shifted from upland to riparian areas as ice-out on rivers progressed. Roost site suitability appeared dependent on distance from human activity while roost site preference seemed dependent on proximity to food. Primary food was jackrabbit (Lepus spp.) throughout the winter but varying proportions of fish and waterfowl occurred dependent on availability. Use of the SLV by wintering bald eagles is probably relatively recent and coincident with agriculture. Advancing monoculture will probably result in fewer eagles using the SLV in the future. Age ratios in wintering areas are most likely a reflection of food availability and type rather than indicative of population trends. Six eagles were tracked on spring migration. Two eagles were followed to a nesting ground and 2 others found in their summering area, all in northeastern Saskatchewan. Migration routes and wintering areas of adult bald eagles appear to be related to the watershed in which summering grounds are located.

INTRODUCTION

Considerable public and professional attention has been focused on the bald eagle (Haliaeetus leucocephalus) since the late 1960's, when DDT and its metabolites were associated with poor reproduction and drastic decreases in numbers (Krantz et al. 1970, Wiemeyer et al. 1972). Investigations also revealed that severe losses of winter and summer habitat were contributing to the decline of this species. As a result, in 1978 the bald eagle was classified as endangered (threatened for Alaska, Michigan, Minnesota, Oregon, Washington) in the entire contiguous United States (U.S. Code of Federal Regulations: 43; 6233, 14 February 1978). Implicit in this classification is the need for more complete knowledge of the species and its habitat requirements to insure its survival.

The importance of winter habitat to populations of other avian species has been shown (Eng and Schladweiler 1972, Fredrikson and Drobney 1979). The quantity and quality of winter habitat available may determine the number of migrant birds returning to the summering grounds in breeding condition (Chadbreck 1979). With the reduction of DDT use, winter habitat may become a more critical factor in maintaining future populations of bald eagles. Each year, approximately 3,000-4,000 bald eagles winter in the Rocky Mountain region of the U.S. (Spencer 1976, National Wildlife Federation winter count 1982). Fewer than 110 pairs are known to breed in this region and the

majority of wintering birds are presumed to summer in central and northern Canada. This implies that certain habitats in the lower 48 states are essential to the maintenance of a large percentage of the existing continental population.

Few data are available concerning specific aspects of this bird's winter ecology. Home range size, habitat selection and use, food habit variability, age/sex composition of the population, individual fidelity to wintering areas, roost site choice, and intra- and inter-specific competition are all aspects of the biology of bald eagles that are poorly understood. A better understanding of these factors will be of great value in development of management plans.

Bald eagles wintering in the U.S. seem to be associated with 2 main types of habitat. Some appear to be primarily associated with riparian habitats such as the Mississippi and Missouri River Systems relying heavily on fish and/or waterfowl as food (Fawks 1961, Steenhof et al. 1980, Fisher et al. 1981). In contrast, in southern Colorado (Harmata and Stahlecker 1977), central Utah (Edwards 1969) and eastern Montana (Swenson et al. 1981), eagles are associated with upland habitats characterized by prairie grassland, agricultural valleys, and mountain parks and appear to rely heavily on ungulate carrion and lagomorphs which they kill or take as carrion (Harmata and Stahlecker 1977).

Habitat used by eagles during migration is equally as important as winter and summer habitat. Certain aspects of bald eagle migration have been largely ignored due primarily to the lack of developed techniques and logistical problems. Nestling bald eagles banded and

marked in northcentral Saskatchewan have been recovered or seen in Arizona, New Mexico, Utah, Wyoming, Colorado, and Montana (Gerrard et al. 1978). However, no information is available as to the exact origin of adult eagles wintering in these states. Immatures of several raptor species have been shown to wander considerably prior to selecting a breeding site (Brown 1977, Newton 1979). Thus, the breeding grounds of adult bald eagles wintering in the Rocky Mountains may be entirely different from those indicated by movements of immatures.

From January through March 1977 and 1978, 36 bald eagles were colormarked with yellow patagial wing markers in the San Luis Valley (SLV) of southern Colorado (Harmata and Stahlecker 1977). Although significant data concerning wintering ground fidelity, distribution, sexing and capture techniques, and aging by plumage were gathered, the primary objectives of determining winter home ranges, migration routes, and summering grounds were not realized by the marking program. This was due partially to difficulty of maintaining extended observation of colormarked eagles and researchers in other areas of the west also using yellow patagials. The origin of yellow-marked eagles subsequently sighted outside of the SLV was therefore questionable since the marker letter was usually not recorded. Only 3 sightings outside the SLV were of confirmed origin and none were in an established nesting area or during summer.

In 1978, radio-tracking colormarked individuals provided more unique information, but inadequate funding and manpower problems prevented complete description of home ranges and ecology of wintering

eagles. However, 1 adult female eagle that was radio-tagged left the SLV on 28 February 1978 and was subsequently tracked for 2 days and over 300 km of her northward migration. This effort established the feasibility of an expanded project designed to determine breeding areas and migration routes of the population.

Between 1 January and 30 April 1980 and 1981, research was conducted on bald eagles in the SLV. Objectives of this study were to: (1) document the ecology of adult bald eagles wintering in an upland area in Colorado and to describe habitats used within that area, (2) determine the exact breeding grounds of adult bald eagles from a distinct wintering population in the Rocky Mountain region, and (3) gather information regarding migration routes, duration, stopover habitats used, and other factors affecting the successful completion of migration. Information concerning ecology and movements obtained during this period was further supported by sightings and encounters of eagles banded and marked in 1977 and 1978 and reported between January 1977 and February 1983.

STUDY AREA

Geography and Hydrology

The San Luis Valley (Fig. 1) located in southcentral Colorado is the largest of 4 large intermountain basins in Colorado. The periphery of the valley floor is approximately 2,440 meters (m) above MSL and at its longest and widest extent is about 161 and 130 kilometers (km), respectively. The SLV encompasses approximately 6,475 km^2, approximately the size of the state of Delaware. It is bounded on the west by the San Juan Mountains and on the east by the Sangre de Cristo Range. These 2 ranges meet at the northern end of the valley and exceed 3,050 m in elevation. Nine peaks over 4,250 m are visible from the central valley. Mean elevation of the nearly level valley is 2,286 m.

The SLV is geologically young and is an intermountain basin filled with alluvium, volcanic debris, and tuffs of Oligocene to Holocene origin (Larsen and Cross 1956). Most of the area was occupied by an extensive lake in the early Pleistocene. Many peripheral streams flowing from the surrounding mountains filled the valley with deposits of up to 910 m deep (Gaca and Karig 1966). This left the valley floor level after the lake outlet at the south end became so deep that the lake was drained (Ramaley 1942).

Two major rivers now flow through the SLV. The Rio Grande emanates in the San Juan Mountains to the west, enters about mid-valley, and

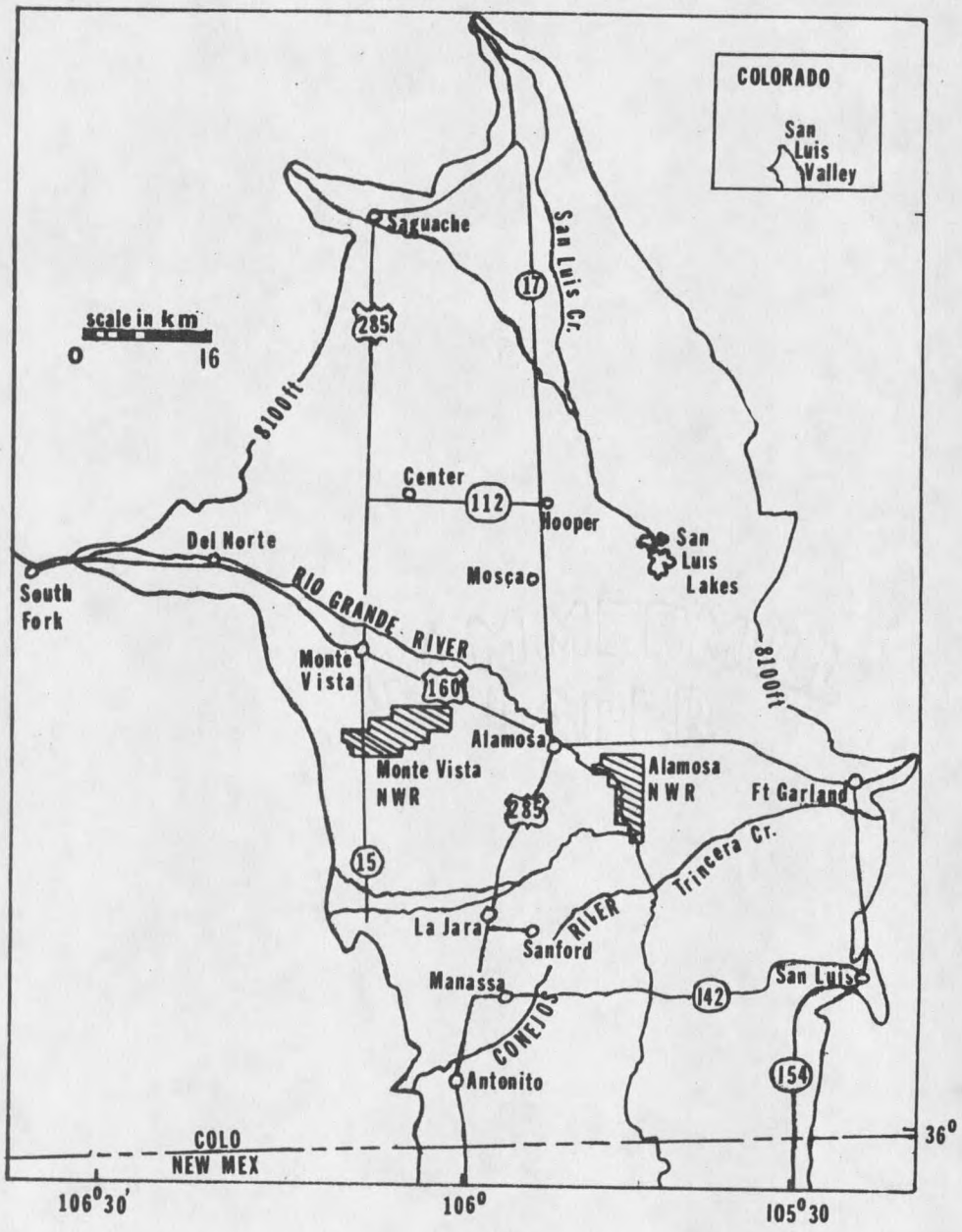

Figure 1. Locator and political map of the San Luis Valley, CO.

flows generally east then south. The Conejos River also begins in the San Juans but enters the valley farther south and flows northeast to the confluence with the Rio Grande River (Fig. 1). The total annual water supply to the SLV averages 2.5 million acre-feet. About 60% is streamflow, collected from about 12,200 km^2 of surrounding mountain watershed. Precipitation on the valley floor contributes the remainder (Emery 1972). About 80% of the annual water supply is lost primarily through evapotranspiration of phreatophytes such as greasewood (Sarcobatus spp.) rabbitbrush (Chrysothamus spp.), and salt grass (Distichlis spp.) (Emery 1972).

Ground water is derived from unconfined and confined aquifers. The depth to water in the early 1970's averaged less than 3.6 m and the unconfined aquifer extended from 0 to 60 m below the surface. Recharge to the unconfined aquifer comes primarily from infiltration of peripheral streams, leakage from ditches and canals, applied irrigation water, and seepage from the confined aquifer. All streams flowing into the northern half of the valley are emptied by percolation into beds of sand at the edge of the valley floor (Fenneman 1931) where a deeper clay layer is absent. Water drains towards the valley center and is trapped under the layer of clay recharging the confined aquifer. The only outlet is through artesian wells (Hopper et al. 1975). Between 1910 and the 1970's irrigation water from the major rivers raised the level of the unconfined aquifer between 1 and 2.5 m (Ramaley 1942, Dillon 1981). There is a daily fluctuation in the water table of between 2.5 and 20 centimeters (cm), reaching its lowest stage at 1800 to 1900 hours (hrs) MDT then rising until 0900. The amount and

timing of the fluctuation presumably depends on evapotranspiration of plants and evaporation from the soil.

Climate

Classified as cold desert (Lantis 1949) the SLV has cool dry summers and cold winters. Mean annual temperature is 5.5 centigrade (C). Nighttime temperatures in January commonly reach -30 C and occasionally lower than -45 C. Precipitation averages less than 30 cm per year and is lowest in the central valley (Ramaley 1942). Snow depths seldom exceed 15 cm, with average annual snowfall about 63.5 cm (Colorado State Planning Division 1964). Humidity is low, and evaporation high. Ramaley (1942) reported a summer average humidity of 41% and an average per annum evaporation of 126.8 cm, the highest of all Colorado recording stations. Winds prevail from the southwest and are strongest in late March and early April, when entire days with 40 km per hour (km/hr) winds are common. Sunny weather predominates and seldom are there more than 5 days per month with cloud cover of 75% or more.

Vegetation

The valley floor is approximately 70% brushland. The vegetation of the northern valley, with a high water table and alkaline soils is primarily black greasewood (Sarcobatus vermiculatus) also known as chico, and inland saltgrass (Distichlis stricta). In the southern valley, with a lower water table rabbitbrush (Chrysothamnus spp.) predominates (Costello 1954). Big sagebrush (Artemisia tridentata) is common on well drained margins of the peripheral valley.

Artesian wells and high water table have created many wetlands. Vegetation in natural lakes, ponds, marshes, and wet meadows consists primarily of spike sedge (Eleocharis spp.), baltic rush (Juncus balticus), and sedges [Carex spp., (Hopper et al. 1975)].

River bottom forest/shrub communities consist mostly of cottonwood (Populus angustifolia) and willows (Salix spp.), with rabbitbrush, roses (Rosa spp.), currants and gooseberries (Ribes spp.). Common grasses include wheatgrass (Agropyron spp.), blue grama (Bouteloua gracilis), smooth brome (Bromus inermis), muhly (Muhlenbergia spp.), bluegrass (Poa spp.), and dropseed (Sporobolus spp.). In more mesic riparian areas, Smilacina spp. and meadow rue (Thalictrum spp.) are common.

Human History and Ecology

The Folsom points which many SLV residents own are mute testimony that humans inhabited the valley more than 10,000 years ago. Folsom culture is thought to have come to the SLV via the eastern plains, as nomadic hunters wandered down the front range of the Rocky Mountains and into the valley in pursuit of game (Roberts 1948).

On 8 September 1598, Don Juan de Oñate of Spain and governor of New Mexico, established the first permanent European settlements in the New World after St. Augustine. These settlements were on the southern tip of the SLV in present day New Mexico (Simmons 1980). The first European to set foot in Colorado was actually Juan de Archuleta in 1664. He entered the SLV while chasing runaway Indian slaves from Taos (Hafen 1948).

By 1807 when the first Americans entered the SLV, a road on the eastern side of the valley was "well worn" (Jackson 1966). This road was used by the Spanish as a supply route from Taos to forts just east of the Sangre de Cristos on the Arkansas and Huerfano Rivers.

Thomas Jefferson charged Lt. Zebulon Montgomery Pike to explore the Louisiana Territory, and on 28 January 1807 Pike entered the SLV from the east. He spent most of the winter along the Conejos River. Other surveys entered the SLV in the mid 1800's to map railroad routes and document geography and natural history. The Hayden Survey looked for a railroad route and documented natural history in 1873 and 1874 (Toll 1929). The Wheeler Survey was the first to map the SLV in June 1875 (Bartlett 1962).

Today the SLV supports a population of over 36,000 people, most of whom live in 3 central valley counties: Alamosa, Rio Grande, and Conejos. Major population centers are Alamosa, Monte Vista, Center, Del Norte, and LaJara (Fig. 1). The remaining population is somewhat evenly distributed throughout the remaining 2 counties of Sagauche and Costilla. The economy is based on irrigated crop production and commercial livestock enterprise. The SLV is noted for its potato industry and the production of high quality barley, the latter used primarily for ingredients in Coors beer. Approximately 25% of the valley (128,600 hectares) is cultivated (Dillon 1981). Crops in descending order of planted hectares (ha) are: alfalfa, barley, grass hay, potatoes, spring wheat, and oats. Sheep operations seem to outnumber cattle ranches, especially in the central valley.

Flood and subirrigation were the primary means of irrigation prior to the late 1960's. Water for irrigation was derived at the time from the major rivers (Rio Grande and Conejos) and mountain streams (Alamosa, Saguache, Trinchera, and LaJara creeks) in addition to existing artesian and shallow wells. Many large canals were built between 1880-90 to irrigate the eastern and central part of the valley and many new cottonwood stands were established as a result. Intensive irrigation early in the century artificially raised the water table rendering originally valuable cropland useless by 1920. The water-soaked condition of previously tillable land increased the soil salinity and some soils now have a pH of 9.0. These areas, long since left fallow have returned or are returning to their native condition of greasewood, rabbitbrush, native grasses, and herbs (Ramaley 1942).

Since 1975 the use of center pivot irrigation systems has proliferated. These systems are much more efficient than flood irrigation often increasing yields by 120%. Center pivots require flat unobstructed fields, averaging 0.6 km^2 but often as large as 2.59 km^2. These systems do not normally utilize ditch or river water, but well water derived from artesian or drilled wells. Consequently, the number of large capacity wells (>1300 liters per minute) has increased dramatically since 1975, depleting the water resource in the shallow (unconfined) aquifer. Wetlands which existed prior to the arrival of European man in the SLV are drying up because the aquifer is not being recharged. As of January 1982, 1,724 center pivots were operational in the SLV (Fig. 2) and the number increases an estimated 10% per year. A moritorium on new wells has been imposed in some areas of the valley.