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Update
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Greater Yellowstone BALD EAGLE

Management Plan



Greater Yellowstone Bald Eagle Working Group

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Cover Photo: Adult bald eagle colorbanded as a nestling in the Snake Wyoming Bald Eagle Management Unit, now nesting in the same Unit along the Snake River south of Jackson, Wyoming. (photo courtesy Tom Mangelsen)

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EXECUTIVE SUMMARY

A significant nesting population of bald eagles (*Haliaeetus leucocephalus*) occurs in the Greater Yellowstone area of northwestern Wyoming, eastern Idaho and southwestern Montana. The Greater Yellowstone Ecosystem Bald Eagle Working Team, formed in January 1981, established management goals and objectives for the Greater Yellowstone bald eagle population, developed and implemented standard population monitoring procedures, and produced "A Bald Eagle Management Plan for the Greater Yellowstone Ecosystem" in 1983. Advancing knowledge and changing conditions stimulated a need for revision of the plan in the early 1990's to incorporate up to date information, changing priorities and management perspective, and to accommodate the 11 August 1995 federal reclassification of bald eagles from "endangered" to "threatened". The revised Management Plan incorporates recovery and maintenance steps for bald eagle populations outlined in the Recovery Plan for the Pacific Bald Eagle. Pursuant to provisions of the Endangered Species Act, the revised plan can serve as the Conservation and Monitoring Plan in Greater Yellowstone should the bald eagle be delisted.

The bald eagle population in Greater Yellowstone increased exponentially between 1970 and 1995. By 1995, number of known breeding areas had grown to 111. Annual occupancy rate was 91%, average number of young fledged per occupied breeding area was 1.05, and average number of young produced per year was 80.8. Productivity objective of 53 young per year averaged over 5 years as stated in the original plan was reached in 1990.

Three bald eagle Population Units were delineated in the original Plan: the Yellowstone, Snake, and Continental Units. Population Units serve as a basis for continuing management in Greater Yellowstone but were later divided into Management Units.

Bald eagles are sensitive to a variety of human activities. Impacts of human activity that result in eagle avoidance of quality habitat are extremely important to managers. Analysis of cumulative effects of human activity indicated bald eagles tended to nest in river mile segments of high habitat quality with less total



habitat removed by human activity. Continuing development in the flood plain of major rivers and lakes may negatively affect 70% of the nesting bald eagles in Greater Yellowstone. Bald eagles will persist in Greater Yellowstone only if there are enough time and adequate habitat available to avoid humans. Other factors affecting productivity and survival of bald eagles include weather, habitat suitability, environmental contaminants, disease, injury and parasites.

Management objectives for Greater Yellowstone bald eagles are to maintain numbers and distribution of bald eagle pairs that attempt to breed annually at or above 1995 levels, and maintain production of at least 74 young of advanced age per year, averaged over 5 years. If objectives are to be maintained, many problems must be addressed. Problem solving requires monitoring bald eagles and habitat in Greater Yellowstone including breeding populations, seasonal concentrations, environmental contaminants, and habitat quantity and quality. Guidelines for management of breeding areas include application of Nest Site Management Zones. ZONE I is Occupied Nesting Zone, ZONE II is Primary Use Area and ZONE III is all foraging habitat plus a buffer within the home range of breeding eagles. Human activity restrictions are seasonal and are reduced as distance from the occupied nest increases. Site-Specific Management Plans and management of foraging habitat external to Zones are encouraged if conflicts are not resolved or management is inadequate to achieve objectives by application of guidelines. Management of wintering and migration habitat also should be considered.

PRIMARY REFERENCES

Bald eagle research in Greater Yellowstone began in 1978 (Swenson et al. 1986). Nestling banding began in 1979 and continues annually (Harmata 1994). Two intensive, management oriented studies also were conducted; one involving the entire Greater Yellowstone spanned 1986 - 1989 and emphasized bald eagles in Wyoming, the other, from 1989 - 1993, focused on bald eagles in the portion of Greater Yellowstone in Idaho. Results from documents produced by both intensive studies are liberally incorporated throughout this plan. In order to eliminate redundancy, continuous citation of both is avoided. These documents are:

Greater Yellowstone with emphasis in Wyoming;

Harmata, A.R., and B. Oakleaf. 1992. Bald eagles in the Greater Yellowstone Ecosystem: An ecological study with emphasis on the Snake River, Wyoming. Wyoming Game & Fish Dept., Cheyenne. 2 vols., 368 pp.

Greater Yellowstone in Idaho;

Whitfield, M.B. 1993. South Fork Snake River Idaho bald eagle research project. Final report. USDI, Bur. Land Manage., Idaho Falls District, Idaho Falls. 92 pp. plus Appendices.

INTRODUCTION

A significant nesting population of bald eagles (*Haliaeetus leucocephalus*) occurs in northwestern Wyoming, eastern Idaho and southwestern Montana. The region, designated Greater Yellowstone (Fig. 1), is contained in the Pacific Recovery Area for bald eagles [US Fish & Wildlife Service (USFWS) 1986]. Greater Yellowstone includes land administered by 8 governmental agencies with over 20 administrative divisions and encompasses nearly 1.6 million hectares (4 million acres or 6248 mi²).

Management Plan for Greater Yellowstone

The Greater Yellowstone Ecosystem Bald Eagle Working Team (GYEBEWT) was formed in January 1981. Members represented federal and state agencies, conservation groups, universities, local governments, and private industry. Participation was based on management responsibility, commitment, technical expertise and degree of involvement in the recovery of bald eagles. Name was changed to Greater Yellowstone Bald Eagle Working Group (Working Group) in 1994. Objectives of the Working Group were/are to:

1. Establish management goals and objectives for the Greater Yellowstone bald eagle population,
2. Provide a forum for exchange of information on segments of the Greater Yellowstone bald eagle population and habitats and insure that information is compiled for management use (e.g. annual production summaries).
3. Provide technical assistance with planning and management of bald eagle habitat.
4. Identify and interpret bald eagle habitat requirements consistent with current research.
5. Produce a Bald Eagle Management Plan for Greater Yellowstone, and updates as needed.
6. Develop and implement standard population monitoring procedures and insure that adequate records are maintained.
7. Facilitate research on bald eagles in Greater Yellowstone by suggesting research priorities.
8. Coordinate management of Greater Yellowstone bald eagle population.

In 1983, "A Bald Eagle Management Plan for the Greater Yellowstone Ecosystem", was completed by the GYEBEWT. One of the first bald eagle management plans in the nation, it provided impetus and direction for management of the species in Greater

Yellowstone for over a decade. Advancing knowledge and changing conditions stimulated a need for revision of the plan to incorporate up to date information, and changing priorities, population status, and management perspective. In addition, pursuant to the Endangered Species Act (ESA) of 1973 (USC 1531, 1982 Amend.), the bald eagle was reclassified from "endangered" to "threatened" in all of the lower 48 States on 11 August 1995 (50 CFR 17, 60 (133):36000-36010) and this revised Management Plan reflects the reclassification.

The revised Plan is intended to encourage coordinated and effective management of bald eagles in Greater Yellowstone. It includes information pertinent to the management of bald eagles and is intended to guide resource stewards during the land use planning process to promote the conservation of the species and its habitat. The revised Management Plan does not replace the Recovery Plan for the Pacific Bald Eagle (USFWS 1986), rather it is intended to be an extension of the Recovery Plan by identifying potential problems and localizing management recommendations for the Greater Yellowstone population. This revised Management Plan incorporates recovery and maintenance steps for bald eagle populations as outlined by the Recovery Plan and, pursuant to provisions of the ESA, can serve as the Conservation and Monitoring Plan in Greater Yellowstone should the bald eagle be delisted. The impetus for revision of the original plan is strong, as are mandates and legal authorities (Appendix I).

Many changes have occurred in Greater Yellowstone since 1982. Aspects of change pertinent to bald eagle ecology, status and land use are included in following sections.

Population Status and Regional Relationships

Number of bald eagles occupying nest sites in Greater Yellowstone has increased dramatically since 1982 when 49 pairs were known. One hundred eleven breeding areas were recorded in spring 1995 (Fig. 2) and productivity has been well over that considered necessary for population maintenance (n.b. Sprunt et al. 1973). Bald eagles of Greater Yellowstone are no longer a small, isolated population but appear to be part of a large, contiguous population in the northern Rocky Mountains (Fig. 3).

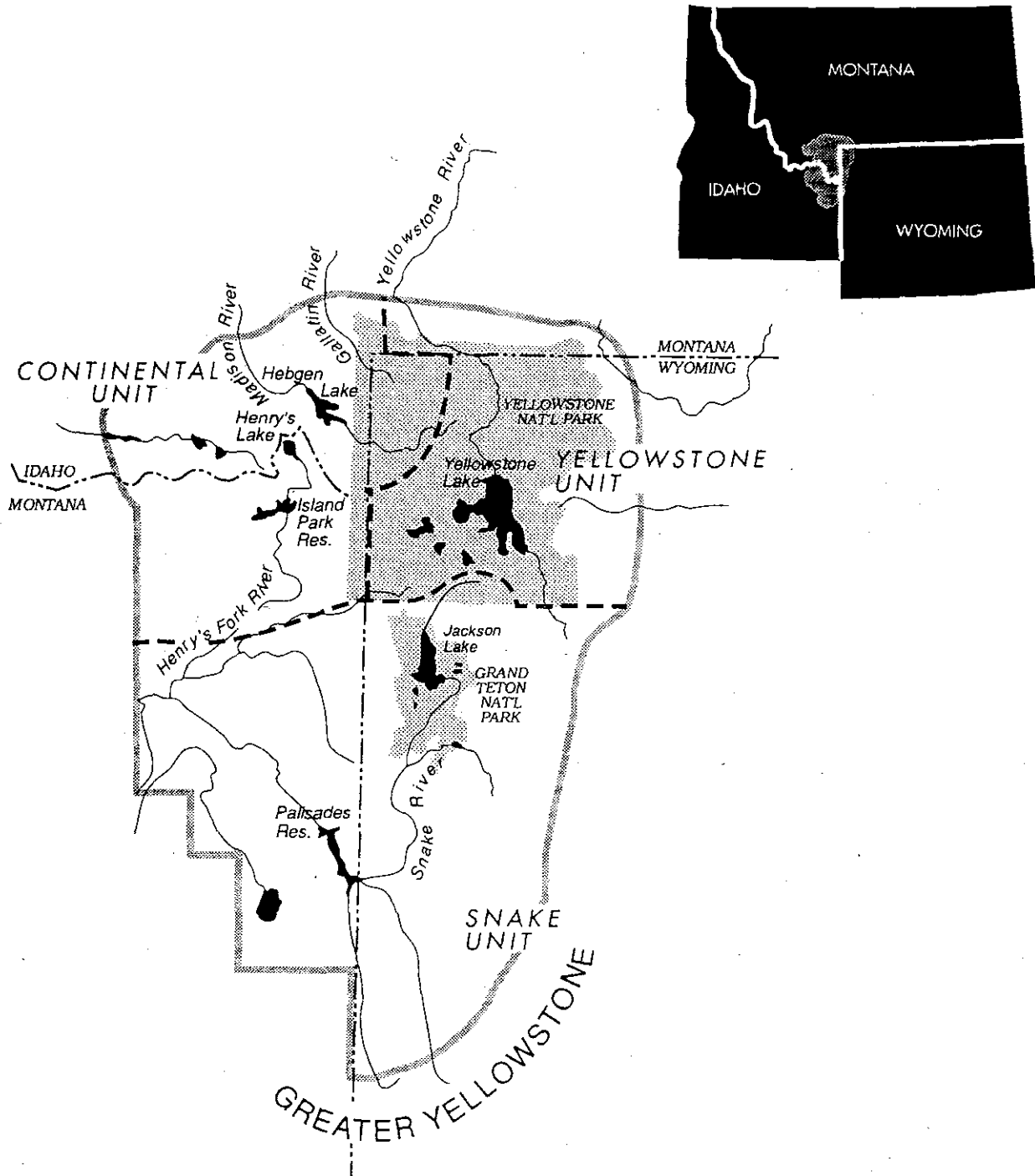


Figure 1. Greater Yellowstone (solid boundary) and inclusive bald eagle Population Units (outer solid and inner dashed boundaries).

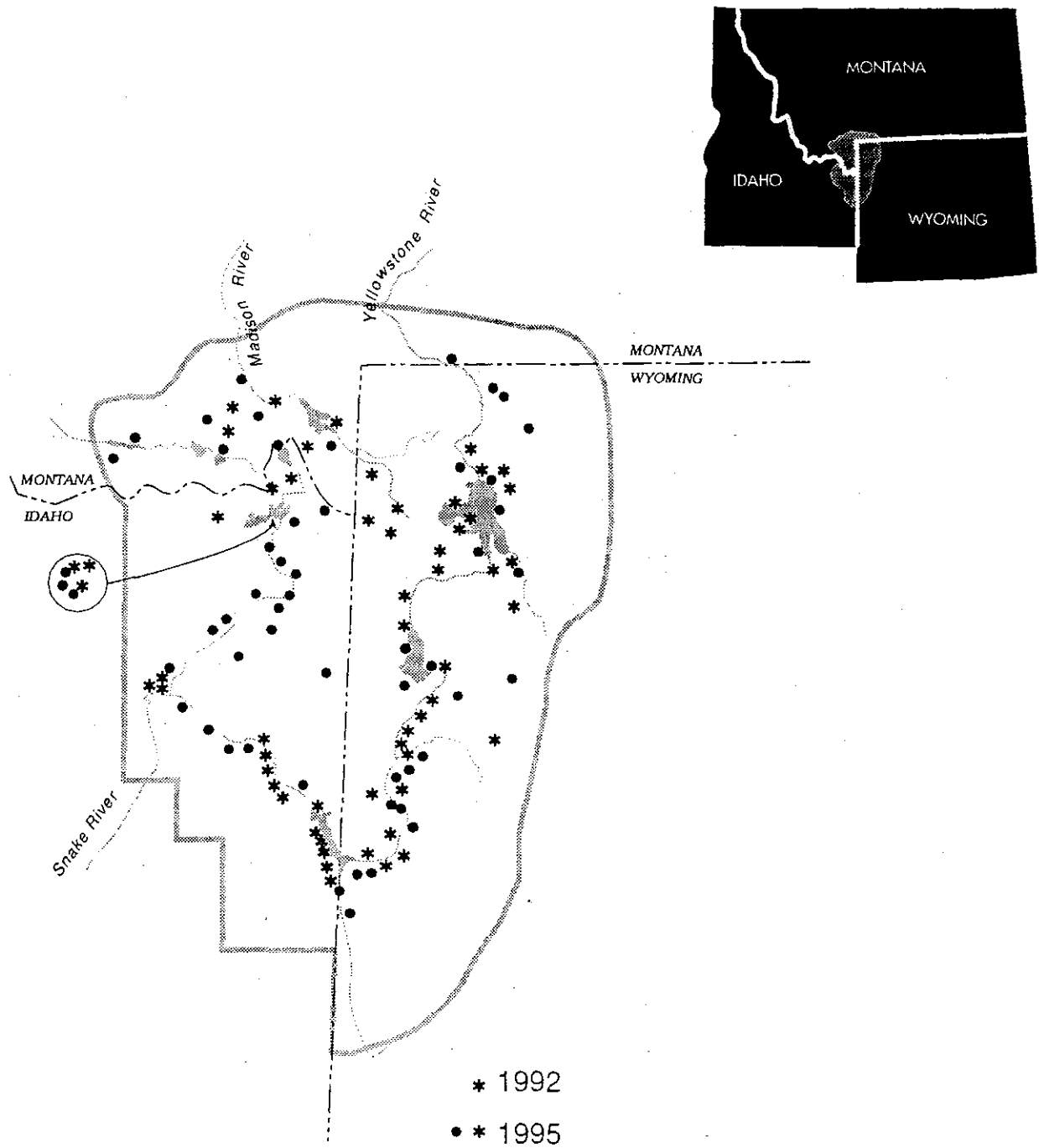


Figure 2. Bald eagle breeding areas in Greater Yellowstone, 1982 (*) and 1995 (* & •)

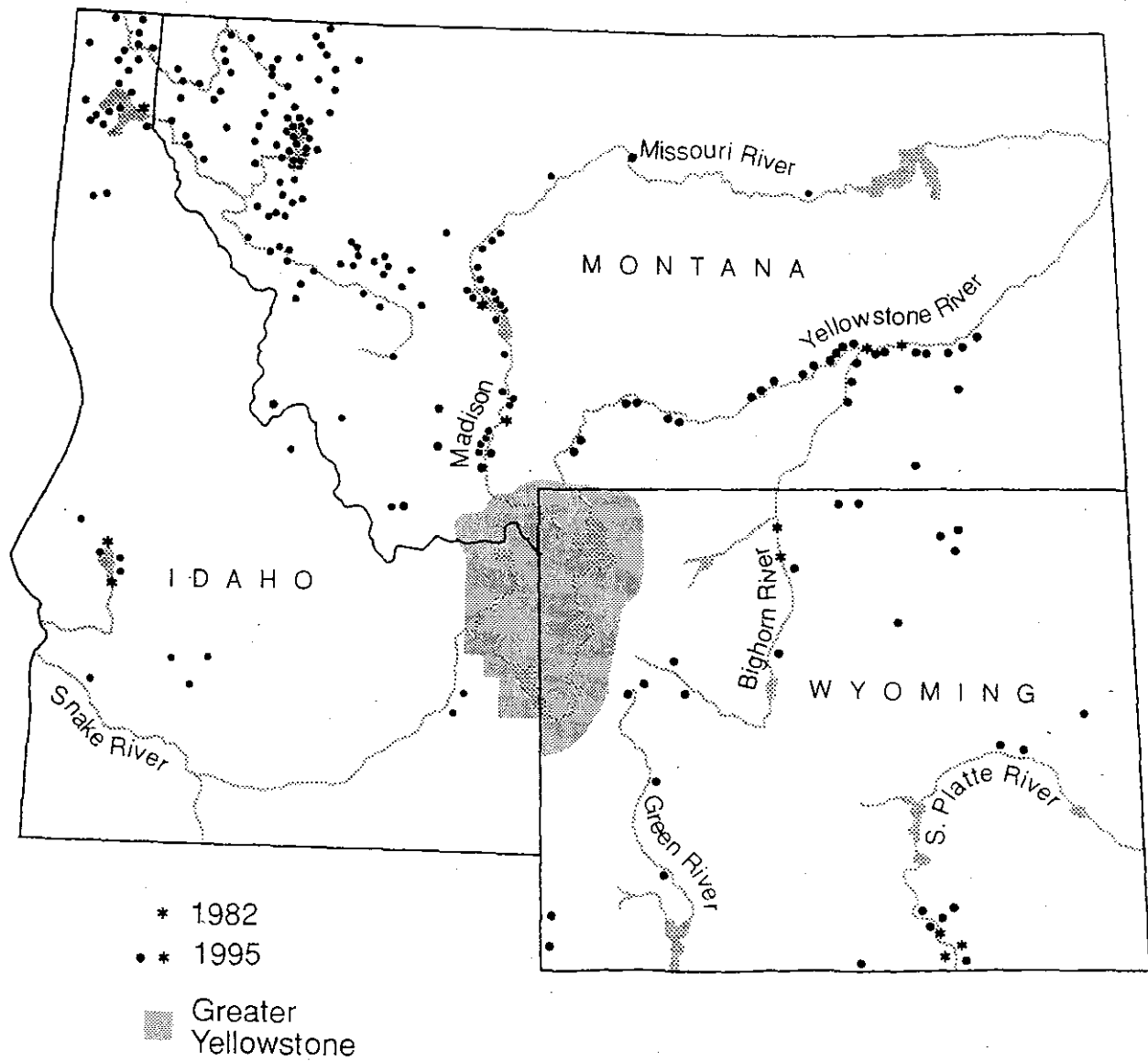


Figure 3. Bald eagle breeding areas in the Northern Rocky Mountains, 1982 and 1995.

Human Pressure and Conflicts

Human populations in Greater Yellowstone have increased dramatically. Teton County, Wyoming grew nearly 13% between 1980 and 1990, from 13,866 to 15,644 people. Total number of building permits issued in Teton County, Wyoming between 1990 and 1995 was 2,164 (Fig. 4). Assuming 90% were residences and an estimated average family size of 3.4 people per household, over 3 times the people were added to the county population in half the time as the decade previous. Similar growth (11.2%) was apparent in Idaho counties included in Greater Yellowstone between 1980 and 1990 (Table 1). Number of new residences between 1990 and 1995 (Table 2) added nearly 6,900 more people in 5 years, twice the rate of the previous decade. Madison County, Montana experienced similar human population growth but most new dwellings were seasonal residences, associated with snowmobile and fishing opportunities.

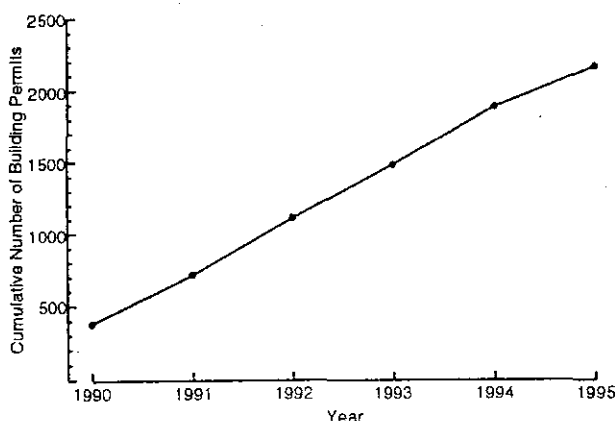


Figure 4. Cumulative number of building permits issued in Teton County, Wyoming, by year from 1990 to 1995.

Table 2. Construction permits issued for human dwellings in counties included in the Idaho portion of Greater Yellowstone, 1990-1995. (Data Sources: Respective County Planning and Zoning offices or County Clerks)

	Census Year						Minimum 5 Year Total
	1990	1991	1992	1993	1994	1995	
Bonneville	107	105	127	114	104	195	752
Fremont	- ¹	-	53	143	222	308	726
Madison	-	-	-	-	-	-	-
Teton	-	-	79	118	187	160	544
Minimum Total	107	105	259	375	513	663	2022

¹No Data

Table 1. Growth of human population in counties within the Idaho portion of Greater Yellowstone.

	Census Year		Percent Increase
	1980 ¹	1990 ²	
Bonneville	65,980	72,207	9.4
Fremont	10,813	10,937	1.1
Madison	19,480	23,674	21.5
Teton	2,897	3,439	18.7
Total	99,170	110,257	11.2

¹U.S. Bureau of Census. 1983. 1980 Census of population. Page 69, in Characteristics of the population. Vol. 1., U.S. Summary. PC80-1-A1. Dept. of Commerce.

²U.S. Bureau of Census. 1991. 1990 census of population and housing. Page 66, in Summary of population and housing characteristics, Idaho. Dept. of Commerce.

In addition to increasing demands on local resources, human population increases resulted in an expanded distribution of people and homes into bald eagle habitat. Few new dwellings were concentrated in urban centers. Rather, recent development scattered activity throughout rural areas at ever increasing densities, reducing the amount or availability of habitat and space for bald eagles and other wildlife. In addition, domestic dogs (*Canis familiaris*) and cats (*Felis domestica*) commonly accompany humans. Unrestrained, these animals are voracious predators that negatively impact native wildlife populations, further reducing quality of diminishing available habitat. Trends appear to be continuing.

Recreational pressure has increased also. Visitation at Grand Teton National Park in 1995 increased 10.5% from 1980 levels (30.5% from 1990 levels) but visitation to Yellowstone National Park increased 55% from 1980 to 1995. Recreational float trips in Grand Teton National Park increased from 6,528 in 1982 to 8,867 in 1995 (35.8%). On the 80 km (50 mi) section of Snake River in Wyoming outside of

Grand Teton National Park, annual recreational float traffic increased to 156,000 people in 1994; 5 fold from 1973 (Fig. 5). However, unregulated (non-outfitted, private) use increased 17% in just one year (1993-94) and an additional 5% from 1994 to 1995 (US Forest Serv., Bridger-Teton Nat. Forest, Jackson Ranger Dist. data). The Snake River and Henry's Fork in Idaho experience similar pressure, but over a longer stretch of river. In 1991 alone, an estimated 151,000 people used 190 km (119 mi) of the Henry's Fork (Pratt 1992). Increasing human presence has required more space for housing developments, support services and recreation, resulting in more conflicts with bald eagles.

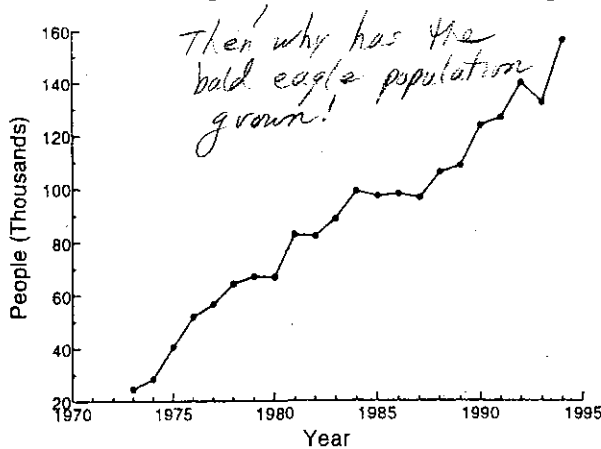


Figure 5. Number of people associated with recreational float trips on the Snake River, Wyoming external to Grand Teton National Park, 1973-1994..

Monitoring Mandates

This revised Management Plan establishes monitoring objectives and recommends methods and timing of surveys. Mandates are consistent with steps for bald eagle recovery outlined in the Recovery Plan for the Pacific Bald Eagle (USFWS 1986) and section 4(g) of ESA. Methods of compilation and evaluation of survey results provide for determination of status, health, and management needs of the Greater Yellowstone bald eagle population.

Habitat Changes

Bald eagle habitat in Greater Yellowstone continues to be lost and rate will undoubtedly increase with burgeoning human populations. Habitat overall is subjected to direct and indirect, short and long-term impacts from various resource development activities (mining, logging, recreation, water development, subdivisions). Vigor of riparian habitats continues to decline throughout Greater Yellowstone (Merigiano 1995). Flow regimes in the Snake River and other tributaries change often in response to various demands (i.e. irrigation, drought, anadromous fish in

the Columbia River system, channelization and levees for flood control). Conflicts that affect quality and quantity of habitat and prey base occur with little predictability (i.e. cottonwood (*Populus spp.*) logging proposals, introduction of whirling disease in rainbow trout (*Onchorynchus mykiss*), lake trout (*Salvelinus namaycush*) infestation of Yellowstone Lake, and management of trumpeter swans (*Olor buccinator*).

Level of Protection

Management of bald eagles in Greater Yellowstone evolved from no protection to maximum protection of nest sites. Current strategy is to protect most productive nests in optimal habitat. Some habitat protection is afforded bald eagles nesting on private lands in Teton County, Wyoming but little is extended to those nesting on private land in Idaho or Montana. Current management strategy strives to avoid excessive restrictions and achieve compatibility of human wants and bald eagle needs. It also embraces the concept that the magnitude of pressures change, temporally and spatially, as does distribution of eagles.

Knowledge of Local Bald Eagles

Managers now know more about bald eagles through long-term research and banding completed during 1980's-90's. Knowledge increases annually with continued emphasis on monitoring population performance, nestling banding, and contaminant analysis. Habitat requirements of bald eagles have become more defined and influence of human impacts on suitability are better understood.

Reaction of Bald Eagles to Human Activity

Anticipated adverse reactions of bald eagles to certain human activities in some areas of Greater Yellowstone have not materialized and management and strategies are vulnerable. Perceptions of disruptive human activities and effects have been modified significantly and incorporated into current management thought (Appendix II).

Funding and Political Support

Following passage of the ESA, public and agency attention on bald eagles increased. Subsequent studies in Greater Yellowstone and the rest of the west answered basic questions needed for effective management. Management attention promoted growth and vigor of bald eagle populations. However, the political climate changed drastically in the mid-1990's. Political support for bald eagles has waned, and funding for research and management has decreased.

BALD EAGLE POPULATIONS IN GREATER YELLOWSTONE

Population Size and Reproductive Performance

No reliable estimates of total population size in Greater Yellowstone were available prior to 1960, but population trend is thought to have followed those throughout the Continent, i.e., declined from 1940 levels. From 1960 to 1995 the population increased exponentially (Fig. 6). In 1982 (first year of comprehensive data), 49 breeding areas were known with 78% occupied by breeding pairs. An average of 0.61 young were fledged per occupied breeding area and 23 young were produced. Number of known breeding areas had grown to 111 by 1995, with a mean annual occupancy rate of 91%, average number of young fledged per occupied breeding area 1.05, and average number of young produced per year of 80.8, over 14 years. Although number of active pairs (pairs that attempted to breed) and number of young they produced per year increased at similar rates, number of young produced annually was more variable (Fig. 7). However, the productivity objective of 53 young per year averaged over 5 years as stated in the original plan was reached in 1990.

The population is expected to increase beyond 1995. Logit regression analysis indicates the population may reach maximum at 209 known pairs by 2045, based strictly on mathematical attributes of historical growth pattern (Fig. 8). Although logistic regression may be used as a prediction model with confidence (Hosmer and Lemeshow 1989), maximum number of known pairs and occupied nests predicted is unrealistic, considering subjective assessment of habitat availability and human activity trends noted by the Working Group (n.b. Human Pressure and Conflicts, page 5). However, number of active nests and young produced predicted by the model are quite realistic and may be representative of saturation levels in Greater Yellowstone.

Population Distribution

Specific aspects of bald eagle natural history, elevation, climate and vegetation that were common among groupings of bald eagle breeding areas in Greater Yellowstone were identified and 3 Population Units delineated.

Ecological attributes of each Unit (i.e., prey use, nesting substrate and phenology) are described in Swenson et al. (1986). Population Units were refined (Fig. 1) and divided into Management Units by the Working Group (Fig. 9). Management Units more precisely define bald eagle breeding areas subject to similar administrative responsibility, habitat condition, impacts, and weather. These similarities are further manifested in nesting phenology, food habits, and productivity of inclusive eagles. Intent of Management Unit delineation was to detail nesting performance, manage specific conflicts, and accommodate administrative authorities.

Snake Unit

The Snake Unit (SU) includes bald eagle breeding areas associated with the Snake River watershed in northwestern Wyoming to 8 km (5 mi) southwest of Idaho Falls, ID (Fig. 1). Most breeding areas in the SU occur in the riparian forest of the Snake River although some occur on lakes, including some at high altitude (Flat Creek Lake, Teton Co. WY). Number of known breeding areas in the SU has grown from 16 in 1960 to 54 in 1995 (Fig. 10).

The SU was divided into the Snake Teton (ST), Snake Wyoming (SW), and Snake Idaho (SI) Management Units. ST includes the Snake River watershed in Yellowstone and Grand Teton National Parks, east to the crest of the Gros Ventre Mountains, south to the border of Grand Teton National Park, and west to the Idaho - Wyoming border. SW includes the



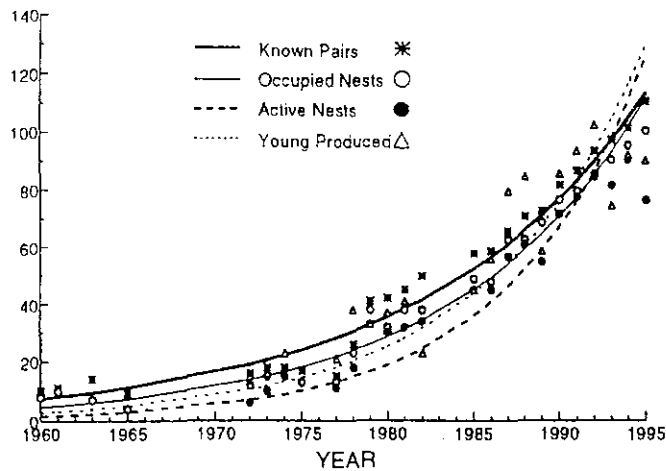


Figure 6. Exponential growth of 4 reproductive parameters for the bald eagle population in Greater Yellowstone, 1960-1995. $R^2 > 0.80$ and $P < 0.01$ for all curves.

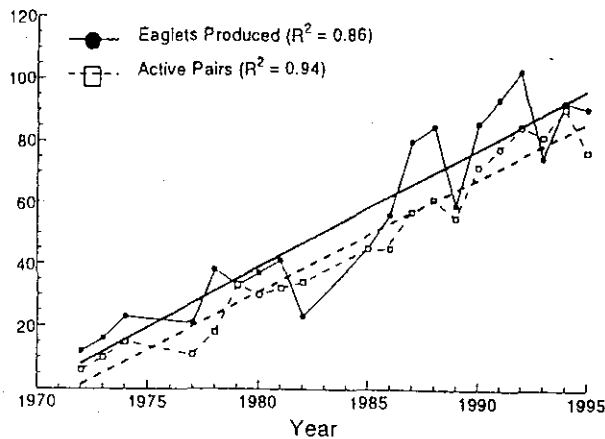


Figure 7. Number of bald eagle pairs that attempted to breed (active pairs) and respective number of eaglets of advanced age produced annually, 1972 - 1995.

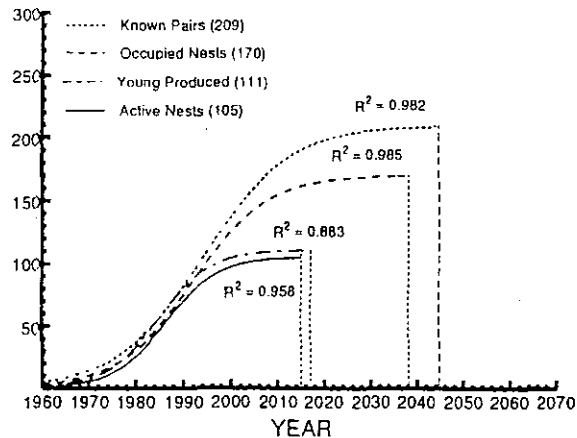


Figure 8. Population growth trends predicted by logistic regression analysis of 4 reproductive parameters of the Greater Yellowstone bald eagle population. $P < 0.01$ for all curves.

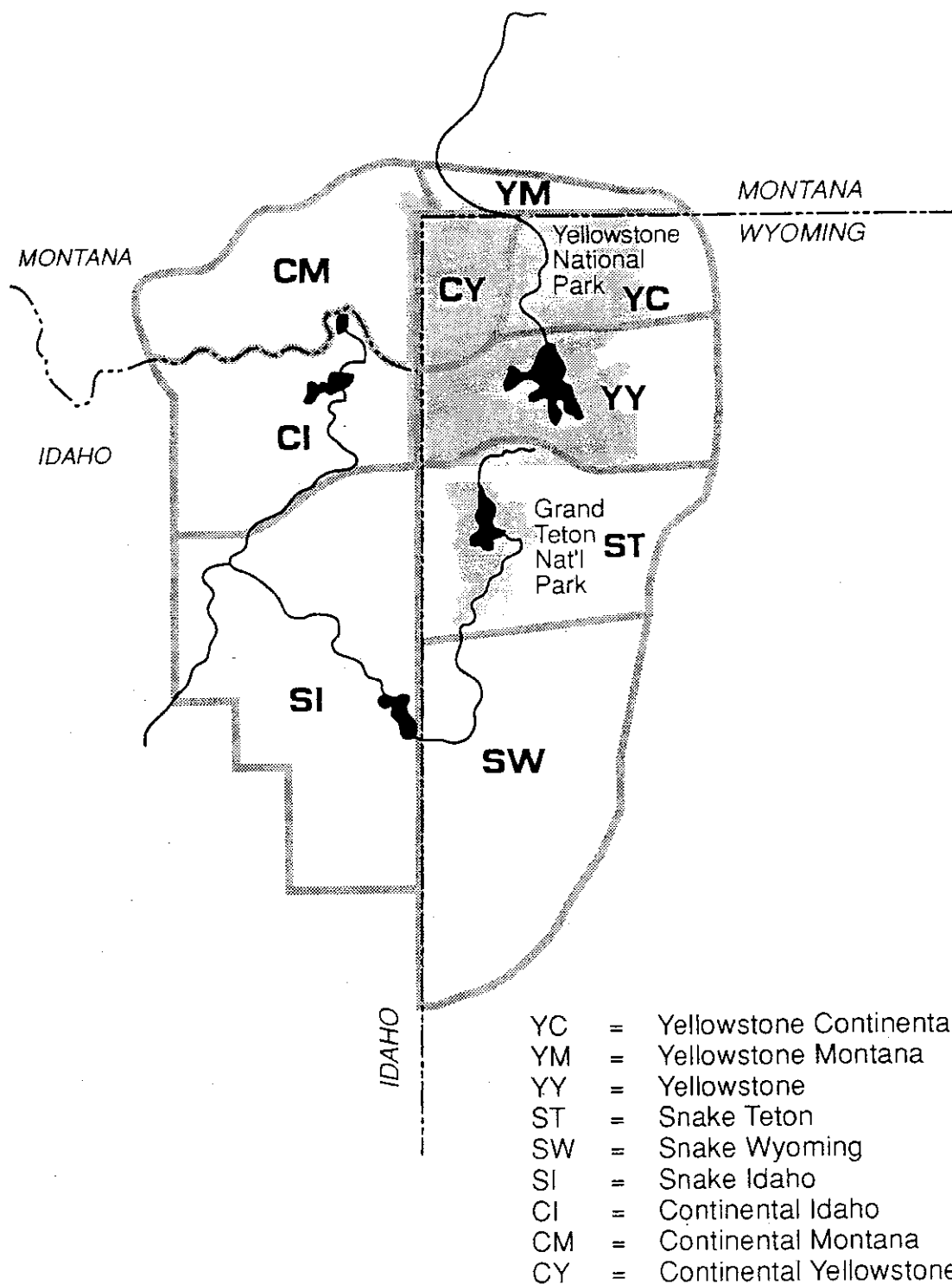


Figure 9. Bald Eagle Management Units within Greater Yellowstone.

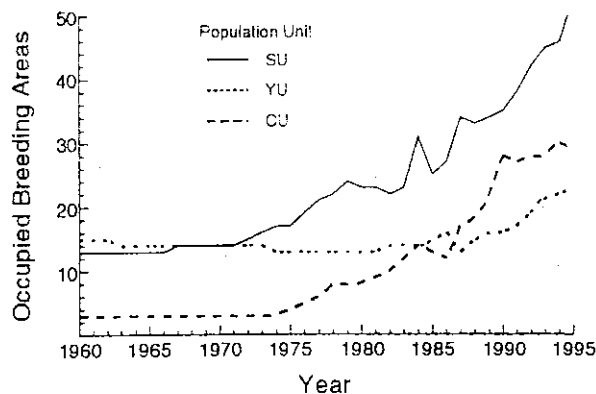


Figure 10. Growth in number of occupied bald eagle breeding areas in Greater Yellowstone, by Population Unit, 1960-1995. SU = Snake Unit, CU = Continental Unit, YU = Yellowstone Unit.

remainder of the Snake River watershed in Wyoming within Greater Yellowstone. The SI includes the Snake River watershed from the Wyoming line downstream to Idaho Falls. Interstate 15 comprises the entire western boundary, the southern boundary is the Bonneville-Bingham County line, and eastern boundary the Idaho - Wyoming line. SI contains portions of the Snake, Henry's Fork, Teton, and Fall Rivers and Grey's Lake Outlet. Major reservoirs are Palisades, Ririe, and Grey's Lake.

Continental Unit

Continental Unit (CU) includes the Madison, Yellowstone, Gallatin, and Red Rock River watersheds in southwestern Montana; Upper Henry's Fork River watershed in northeastern Idaho; and Gibbon, Firehole and Madison River watersheds in Yellowstone National Park. Only 3 bald eagle breeding areas were occupied in CU in 1960. Rate of increase mirrored that of the SU but remained lowest of all Population Units in Greater Yellowstone until 1986 (Fig. 10). Number of breeding areas has since grown to 34 in 1995.

Three Management Units are delineated in the CU (Fig. 10). Continental Montana (CM) contains portions of the Red Rock, Madison, and Gallatin Rivers and associated impoundments (Hebgen, Quake Lakes, Lima Reservoir) plus numerous natural lakes in the Beaverhead National Forest and Centennial Valley (Cliff, Wade, Goose, Elk, Upper and Lower Red Rock Lakes). CM includes portions of Yellowstone National Park with the State boundaries of Montana. The Northern border crosses the Blacktail Divide in Beaverhead County, the Madison River at Indian Creek,

the Gallatin River at Buck Creek, and the Yellowstone River at the mouth of Yankee Jim Canyon. The northern border continues east at that latitude to the Park County line, then south to the Montana - Wyoming border. Continental Idaho (CI) borders the CM to the south. Major aquatic resources include the Henry's Fork and Buffalo Rivers, Henry's Lake, Ashton, Island Park, and Sheridan Reservoirs. The Montana-Idaho border comprises the northern boundary, I-15 from the state line to Dubois, ID the western boundary, Yellowstone National Park the eastern boundary and the latitude of the northern boundary of the city limits of Ashton ID from I-15, east-northeast to the Idaho - Wyoming line the southern boundary. Initially the Management Unit with the fewest nesting pairs, CI now contains 59% of all breeding areas in CU. Continental Yellowstone (CY) includes the Madison, Firehole and Gibbon Rivers and associated tributaries in Yellowstone National Park, Wyoming.

Yellowstone Unit

The Yellowstone Unit includes most of Yellowstone National Park. Major aquatic resources include Yellowstone, Snake, Lamar, and Gardiner Rivers and associated tributaries, and Yellowstone, Lewis, Shoshone and Heart Lakes and tributaries. Until the late 1980's YU had a relatively stable population, intermediate in number of all Population Units in Greater Yellowstone (Fig. 10). Known breeding areas increased from 16 in 1982 to 23 in 1995. YU includes 3 Management Units. The Yellowstone Yellowstone (YY) includes the Yellowstone River watershed from the southern boundary of Yellowstone National Park in the southeast (but including one breeding area near Bridger Lake outside the Park) north to Alum Creek, and west to the Idaho - Wyoming border. YY includes the Lewis River and Yellowstone, Heart, Lewis and Shoshone Lakes and associated tributaries. Yellowstone Lake is the major feature of YY. Yellowstone Montana (YM) includes the Yellowstone River drainage south of Yankee Jim Canyon to Yellowstone National Park. Yellowstone Continental (YC) includes the Yellowstone River downstream from Yellowstone Falls to the Park boundary, including the Lamar River drainage.

Ecological Relationships Among Population Units

Encounters and movements of banded and radio-tagged bald eagles provided proper perspective of relationships among Population and Management

Units in Greater Yellowstone. During population lows of the 1960's and 70's, bald eagles breeding in Yellowstone National Park did not produce a minimum of 0.7 young per pair required to maintain a stable population (Sprunt et al. 1973, Swenson et al. 1986). However, numbers of pairs in the Park remained relatively stable year after year even through the "DDT era", when bald eagle numbers across the continent declined drastically (Fig. 10). Prior to banding and intensive research, the Working Group thought exceptionally high survival of resident adults accounted for stability.

Although encounters of banded eagles were primarily in the Population or Management Unit of natal origin, virtually all eagles radio-tagged as nestlings (n=15) were located in Yellowstone National Park, some over several years and long periods, regardless of Unit of origin (Harmata 1994). Clearly nonbreeding eagles produced in Greater Yellowstone homed to natal Units, but a significant portion of their immature years were spent in pristine habitats in and immediately adjacent to the Park. Recruitment in breeding populations in the Park therefore may be primarily from eagles from more highly productive natal Units outside of the Park. Conversely, habitats within the Park contribute significantly to survival of nonadult bald eagles produced throughout Greater Yellowstone promoting the explosive growth of the population in the 1980's and 1990's.

Expansion Areas

When originally considered, boundaries of bald eagle Population Units were based on contemporary distribution and perceived ecological limits of the Greater Yellowstone. However, boundaries of Greater Yellowstone are in the end, anthropogenic and thus as diverse as the many organizations that attempt to define them. Boundaries delineated by the GYEBEWT in 1983 were understandably more conservative than most. They were defined at a time when number of eagle breeding areas was less than half that of 1995 and range was more restricted. Since then, eagle populations have more than doubled, increasing their range beyond boundaries of Greater Yellowstone as originally defined.

The Working Group recognizes the importance of pairs nesting outside original boundaries. However, in order to maintain consistency in goal and objectives and comparability for data management, original boundaries of the Greater Yellowstone remain intact (Fig. 1). Pairs peripheral to but obviously associated with "core" Greater Yellowstone eagle distribution will be considered and incorporated in Expansion Areas. Expansion Areas will include additional nesting pairs until obvious ecological boundaries or administrative reality dictate limits. Nomenclature of Expansion Areas will be consistent with the most ecologically, spatially, or geographically similar Management Unit (Fig. 10).

EFFECTS OF HUMAN ACTIVITY

Bald eagles are sensitive to a variety of human activities (Mathisen 1968, Grier 1969, Fyfe and Olendorff 1976, Stalmaster and Newman 1978, Fraser 1985, Fraser et al. 1985, Mahaffy and Frenzel 1987, Buehler et al. 1991, McGarigal et al. 1991). Responses of eagles to human activity may vary from ephemeral, temporal and spatial avoidance of activity to total reproductive failure and abandonment of breeding areas. Relationships of human activity and eagle responses are highly complex, difficult to quantify, and often individual or site-specific. Responses vary depending on type, intensity, duration, timing, predictability and location of human activity. The way in which these variables interact depends on age, gender, physiological condition, sensitivity, residency and mated status of affected eagles. Prey base, season, weather, geographic area, topography and vegetation in the vicinity of activities and eagles also influence eagle responses. Although direct impacts occur, frequencies are unexpectedly low in Greater Yellowstone because eagles are modifying activity to avoid direct impacts and are less sensitive than anticipated. However, human activity that results in eagle avoidance of quality habitat is as important to managers as direct impacts.

Bald eagles clearly respond to the proximity of humans. Eagles in Greater Yellowstone flushed (left perches) as humans approached in a variety of manners (autos, boats, bikes, etc.). Grubb and King (1991) found pedestrians most disturbing to eagles in Arizona. In Greater Yellowstone, proportionately fewer eagles in SW flushed when human activity was over 200 m (656 ft) but most did flush when human activity was within 150 m (492 ft). Aerial flaring behavior also may be considered a "flush" response but seldom is distance quantified due to vegetation screening the observer and agent of disturbance. Eagles flying to roost over heavy timber were often observed deviating from their normal direct altitude by flaring, i.e. ascending abruptly and extending the feet as if "backpeddling", either deviating from the flight path or reversing direction completely (Restani and Harmata 1994). In some cases, a lone pedestrian (hunter) or vehicle was eventually detected by the observer.

Some bald eagles were more tolerant of human activity in Greater Yellowstone than others. There were apparently "urban" and "rural" eagles. Mean distance at which resident eagles flushed from human activity was greater when relative exposure to human activity was less. Thus, eagles in the vicinity of continuously

inhabited areas of high human density may become habituated to human presence and tolerant of certain human activities more than their rural counterparts. Urban eagles may be exposed to more human activity at gradually increasing levels, usually within clearly defined spatial limits (towns, villages, roads) while human activity to which rural eagles are exposed is distributed and moving randomly (campgrounds in National Parks, hikers, boats), at varying intensities and often seasonal and abrupt. Whether individual eagles become progressively more tolerant to human activity over time or if areas subjected to excessive human activity are occupied by more tolerant eagles is unknown.

Vehicular traffic (including watercraft) traveling along prescribed routes or within strict spatial limits and at relatively predictable frequencies is least disturbing to bald eagles (Stalmaster 1976, McGarigal et al. 1991, Stangl 1994). Snow machines and all terrain vehicles are especially disturbing, probably due to associated random movement, loud noise and operators are generally exposed (Walter and Garret 1981).

Avoidance of Human Activity

Bald eagles appear to modify activity and movements to avoid encounters with humans. In the SW, bald eagles used perches on one shoreline of the Snake River with much greater frequency and duration than those on the opposite shore, where a heavily used state highway and associated boat ramps, campgrounds, and vehicle pullouts were situated. Preference for perches on the undisturbed shore suggests strong avoidance of vehicular traffic and associated human activity.

Eagles appeared to have avoided construction and reclamation work in Greater Yellowstone. Prior to work on Jackson Lake dam, eagles frequented the vicinity. After initiation of reclamation work, use decreased and centered on areas over 2 km (1½ mi.) away. After reclamation ceased, eagles returned and resumed activity.

Impacts of Urban Development

Urban development affects bald eagle selection of nesting, perching, and foraging sites. Regardless if urban or rural, most eagles in SW avoided the vicinity of isolated, occupied houses for nest sites. Nest sites were significantly farther (4 km; 2½ mi) from occupied, isolated houses than randomly distributed nonuse

Failure +
abandonment
has not
occurred

locations (2.4 km: 1 1/2 mi). Presumably, type, intensity, and bounds of human activity around isolated houses were unpredictable and obvious. Similarly, isolated houses appeared to deter eagles from perching within 453 m (1486 ft) or foraging within 500 m (1640 ft) while nonuse locations were only 267 m (876 ft) and 256 m (840 ft), respectively.

Increasing development has multiplied direct effects of human activity and in some areas, beyond the threshold of tolerance for local breeding eagles. Human activity associated with housing and recreational development contributed to abandonment of 2 nest sites in Yellowstone National Park, and at least 2 along the Snake River; one in Wyoming and one in Idaho. A bald eagle nest site near Fishing Bridge on the Yellowstone River at the outlet of Yellowstone Lake was abandoned in the mid 1970's coincident with campground and satellite recreational facilities development and significant increase in visitor use. No alternate site for the pair has been found and their contribution of young to the population probably has been lost. Also, bald eagles nested on the southeast shore of West Thumb of Yellowstone Lake until the late 1970's when development of extensive visitor dormitories began. No nesting activity occurred there until spring 1996.

Most prime bald eagle habitat in Greater Yellowstone is on rivers and, outside of the National Parks, on private land. Historically, land use was consistent with bald eagle conservation, i.e. low density agricultural and ranch land that provided large undisturbed areas and limited bank/river use by prohibiting public access. Recently however, economic and political incentives and burgeoning human populations have made it financially more profitable to develop these lands into subdivisions and other high density enterprises (shopping malls, stores, manufacturing centers, dude ranches, etc.). A nest site on private land northwest of Jackson Wyoming was consumed by lot 38 of the Solitude subdivision near the southern border of Grand Teton National Park in 1981. A nest in CM was consumed in 1989 by development of Lot 87 of a residential subdivision on the Madison River. The trend is more dramatic along the Snake and Henry's Fork Rivers in Idaho. About 80% of breeding areas in SI are on or adjacent to private land. Subdivisions are increasing rapidly and unmanaged, they will impact 34% of breeding areas in Greater Yellowstone. These breeding areas annually produce about 40% of the young in Greater Yellowstone (Naderman, J., Idaho Fish & Game, pers. comm.). Continuing development in the flood plain of major rivers and lakes in Wyoming and Idaho may

negatively affect 70% of nesting bald eagles in Greater Yellowstone.

Significant progress has been made in protecting valuable habitat in the SU. The Jackson Hole Land Trust, The Nature Conservancy, and Teton County Planning Commission have secured easements and encouraged development away from critical areas within the Snake River watershed in the SW. The Jackson Hole Bird Club continues to educate the public about the value of land conservation and appreciation of wildlife in the SW. The Bureau of Land Management (BLM) purchased 648 hectares (1600 acres) of bald eagle habitat along the South Fork of the Snake River (SI) and an additional 121 hectares (300 acres) were purchased by the Idaho Chapter of The Nature Conservancy.

Impacts of Recreation

Recreational impacts may be direct or subtle. Although only 5.8% of encounters between recreating humans and bald eagles observed in SI resulted in a flush response, eagles chose perches insulated from recreational activity along the Snake River by vegetation or extreme distance. Eagles were not observed foraging during periods when they occupied insulated perches indicating they were effectively excluded from prime foraging areas, while these foraging areas were used heavily when recreational activity was absent.

Similarly, movements of breeding eagles on the Snake River in SW indicate an awareness and response to changing human recreation levels on the Snake River. Some pairs' primary use areas were on the most heavily impacted section of the Snake River. Despite continuous and often intensive human use, eagles shifted their activity patterns to periods when their presence would be least obvious to humans: very early morning and evening. Eagles used perches directly over an occupied campground, albeit somewhat clandestinely, as perches would be used only during very early morning before campers arose. These perches were never used after 0600 hrs during summer.

A significant, negative correlation between percent of bald eagle perches within 10 m (33 ft) of the river and mean number of watercraft on the river per hour period occurred in SW. A male bald eagle perched less often within 10 m (33 ft) of the Snake River when number of water craft per hour was greatest, indicating avoidance of the river during periods of peak recreational use. Percent of total perches along the river was low during most of the day until about 1700 hrs. Number of watercraft on the river rose abruptly

Where is control?
What has been impact?

What has been impact?

So what has been impact?

from dawn until 0900-1000 hrs., then declined. Watercraft were virtually absent from the river after 1700 hrs. After young fledged and affinity to the nest site waned, there was an abrupt shift in habitat use by eagles in ST. Use shifted from the Snake River near nest sites to peripheral areas that provided refuge from the continual float traffic on the Snake River. Use of the Snake River resumed after most float activity subsided (late September). Bald eagles nesting on Jackson Lake in ST used the Snake River following the decline of river use by watercraft and anglers after the season closed. Bald eagles will persist only if enough time and adequate habitat are available to avoid humans.

Cumulative Effects of Human Activity

Cumulative effect of human activity on behavior, activity, and habitat use of wildlife species is a relatively new concept in wildlife management. Cumulative effects of many seemingly insignificant or sequential

activities may result in disruption of normal behavior of wildlife. The importance and pertinence to bald eagle behavior cannot be overstated. The concept has been intuitively obvious to many field observers for a long time. Montopoli and Anderson (1991) developed a unique and imaginative approach to assessing cumulative effects of various water associated human activities on the percent habitat available to bald eagles on the Snake River. Amount of foraging and perching habitat available is evaluated based on amount of recreational and other human activity that impacts areas of predetermined size. Analysis of cumulative effects of human activity in SW and ST indicated bald eagles tended to nest in river mile segments of high habitat quality with less total habitat removed by human activity. Eagles tolerated more habitat removed by human activity if quality was high but only to a threshold level. Eagles also used habitat of low quality if little or none was withdrawn by human activity, but to a much lesser extent.

OTHER FACTORS AFFECTING PRODUCTIVITY and SURVIVAL

Weather

Productivity of bald eagles in Greater Yellowstone of Wyoming was inversely correlated with severity of late winter and early spring weather, both seasonally and geographically. Additionally, exceptionally cold and wet (severe) weather in April had a singularly significant depressing affect on productivity regardless of location. In SI, the availability of open water in the vicinity of nest sites during winter was correlated with productivity. During years in which low flows and cold temperatures froze the Snake River, bald eagle productivity the following spring was low (Naderman, J., Idaho Fish & Game Dept., pers. comm.).

Habitat Suitability

Bald eagle productivity in Greater Yellowstone is affected by quality and quantity of habitat. There appears to be a minimum habitat diversity threshold in bald eagle home ranges; below this minimum, productivity declines. In the SW, habitat suitability indexes incorporating variables indirectly relating to prey base abundance and availability (e.g. sinuosity of the river, number of islands, riffles, runs and pools) varied among breeding ranges. These indexes were 2 to 3 times higher for highly productive (high absolute numbers of young) bald eagle breeding areas that were occupied the longest than indexes of breeding areas with low productivity or more recent occupancy. In addition to foraging opportunities, habitat suitability is also influenced by availability of perches, nest trees, security habitat, and amount and type of human activity. Although bald eagles may remain within home ranges exposed to severe habitat degradation and disturbance, consistent low productivity over the long term may indicate habitat suitability has declined.

Environmental Contaminants

Impact of environmental contaminants on bald eagles and other raptors has been well documented (see review, Wiemeyer 1991). Most notorious is DDE, a metabolite of DDT, and its negative affect on thickness and porosity of egg shells, manifested in low productivity. Thickness of egg shell fragments recovered from a nest in ST in 1989 and an egg recovered in CM in 1993 was equivalent or greater to that of pre-DDT era eggs (Kiff, L., World Center for Birds of Prey, Boise, ID, pers. comm.). DDE concentrations in blood of nestling bald eagles sampled

in the late 1980s in Greater Yellowstone were very low (parts per billion). DDT has not been used in Greater Yellowstone since 1964 (Mussehl and Finley 1967) and progressive thickening of recovered egg shells and low blood concentrations reflect a leaching of the chemical from the environment.

Organochlorine concentrations detected recently probably were imported in the prey base because waterfowl and piscivorous birds accumulate and concentrate these compounds (Kieth 1966, Dindahl and Peterle 1968). Regardless, organochlorines appear to no longer affect productivity of bald eagles in Greater Yellowstone.

Organophosphate and carbamate poisons used as rodenticides, insecticides and predicides have caused mortality in bald eagles (Franson et al. 1985, Henny et al. 1987, USFWS 1991, 1993) and there is an increasing trend of such poisonings throughout the west (USFWS 1991, Associated Press 1991 A & B, 1993A & B). The primary mechanism of poisoning is illegal use of registered, legal insecticides (Carbofuran, carbaryl, famphur, fenthion) mixed with ethylene glycol (vehicle anti-freeze) and applied to large ungulate carcasses, ostensibly to kill coyotes. Additional poisonings have resulted when eagles fed on livestock that died subsequent to legitimate treatment with topical insecticides (e.g. Warbex).

Organophosphate or carbamate compounds have induced mortality of at least 2 bald eagles in the SI (Naderman, J., Idaho Fish & Game, Idaho Falls pers. comm.). These compounds are cholinesterase inhibitors and short half lives precludes assignment of cause of death in many instances. Mean blood acetylcholinesterase levels of nestling bald eagles tested in Greater Yellowstone suggest up to 11% were exposed to sublethal doses of anticholinergic compounds. Actual incidence of organophosphate induced mortality may be seasonal (spring), incurred by mostly migrant eagles, and underestimated, due to restricted access to remote lands where poisoning occurs.

Of 146 bald eagles of all age and residency classes tested for heavy metals in Greater Yellowstone, 35% had detectable levels of lead, 91.4% had detectable levels of mercury and 100% had detectable levels of selenium. Some eagles contained high blood levels of lead (≥ 4 ppm) in Greater Yellowstone but most were captured in winter and probably were migrants from Canada. Not all eagles with high lead

levels died or displayed clinical signs of lead toxicosis. However, 6 cases of lead induced mortality have been recorded in Greater Yellowstone. At least one eagle was produced in Greater Yellowstone. The 1991 federal ban on lead shot probably will decrease the incidence of poisoning from lead shot in eagles resident in Greater Yellowstone but increasing fishing pressure may result in increased poisonings from discarded/lost fishing tackle (sinkers, line). Yellowstone National Park wisely imposed lead free fishing tackle restrictions in 1992 with additional restrictions in 1994. Lead induced mortality of eagles originating in Canada will probably continue until 1997 when ban on lead shot becomes national in Canada.

Mercury levels in blood of Greater Yellowstone bald eagles were quite high in breeding adults (2.16 ppm, geometric mean) and in one egg from the CM (2.3 ppm, Kiff, L. World Center for Birds of Prey, Boise ID, pers. comm.). No deaths or debilitation of eagles have been attributed to mercury toxicosis in Greater Yellowstone, possibly due to the mitigative effects of concurrent high levels of selenium. Currently, heavy metal contamination of bald eagles in Greater Yellowstone does not appear to be affecting survival and productivity.

Disease, Parasites, and Injury

A variety of diseases have induced mortality and morbidity in bald eagles (Friend and Laitman 1987,

Redig 1993). During 16 years of nestling banding and 4 years of intensive study in Greater Yellowstone, incidence of disease (e.g. trichomoniasis, avian pox, botulism, cholera, hematozoal infection) and injury (e.g. entanglement with fishing line, leg-hold traps, power line/vehicle collisions) encountered was negligible and somewhat randomly distributed. Accordingly, at past and current levels, these potential population depressing agents appear to have little consequence for the Greater Yellowstone bald eagle population. However, increasing human population in Greater Yellowstone may increase conflicts with vehicles and structures, and incidence should be evaluated periodically.

The frequency of intra-specific territorial encounters among adult bald eagles appears to be increasing. Between 1989 and 1994, 4 encounters resulting in the death of at least one combatant have been noted in Greater Yellowstone (Stevenson, D. WY Game & Fish Dept., Jackson, pers. comm.; Flath, D. Montana Dept. Fish, Wildl. & Parks, pers. comm., Harmata, A., unpubl. banding data). The phenomenon is probably a function of saturation of declining breeding habitat and exceptional productivity and survival of the population. Additional pairs may be attempting to initiate breeding areas within existing territories, stimulating agonistic encounters with greater frequency.

BALD EAGLE MANAGEMENT IN GREATER YELLOWSTONE

Management Goal

The goal of the Working Group and Management Plan is to maintain bald eagle populations in Greater Yellowstone at levels with high probabilities of persistence and in sufficient numbers to provide significance to the ecosystem, academic research, and readily accessible enjoyment by the recreational and residential public.

Objectives

1. Maintain numbers and distribution of bald eagle pairs that attempt to breed annually at or above 1995 levels,
2. Production of at least 74 young of advanced age (at least 7 weeks old) per year, averaged over 5 years.

Objectives by Management Unit are displayed in Table 3.

Table 3. Population objectives for bald eagles in Great Yellowstone, by Management Unit.

Management Unit	No. of Occupied Breeding Areas in 1982	Population Objective ¹
Greater Yellowstone	49	111
Snake Unit (SU)	24	54
Snake Teton (ST)	5	11
Snake Wyoming (SW)	10	18
Snake Idaho (SI)	9	24
Continental Unit (CU)	11	34
Cont. Montana (CM)	6	15
Cont. Idaho (CI)	4	18
Cont. Yellowstone (CY)	1	1
Yellowstone Unit (YU)	14	23
Yellowstone MT (YM)		1
Yellowstone WY (YW)	1	1
Yellowstone (YY)	13	19

¹Number of breeding areas present in 1995.

Management Problems and Solutions

If conservation objectives are to be maintained, some obvious problems will have to be addressed. These problems (numbered and bold faced) are listed, not necessarily in order of priority or severity. Recommendations (solutions) to address problems are indicated by letter. Neither list is exhaustive or all inclusive.

1. Bald eagle use may be precluded from important habitats and population declines may occur unless human activity, resource use and developments are managed appropriately.

- a) Complete management plans specifically as recommended in **Guidelines for Management of Breeding Areas** (pg. 21).
- b) Delineate high priority habitat or Primary Management Parcels (PMPs) (Oakleaf et al. 1994) that have high River Diversity Index (RDI; Harmata and Oakleaf 1992) values.
- c) Develop and implement habitat objectives and management strategies for high priority habitat and PMPs. Evaluate efficacy of management.
- d) Until 1c is completed, Zone II guidelines should be applied to all habitat and PMPs.
- e) Apply Zone II management guidelines to high and medium use perch areas (see methods, pgs. 9-10, Harmata and Oakleaf 1992) of bald eagles using lakes.
- f) Facilitate public awareness of proposed home, recreational, and resource development projects (e.g. subdivisions, float trip permitting, timber sales, hard rock mines, impoundments) that may impact bald eagle habitat and comment on draft Environmental Impact Statements (EIS).

2. Unguided and excessive development of private lands could make it impossible to maintain objectives.

- a) Promote development of an intensive education program involving print & video media and community presentations to inculcate a conservation ethic in the general

public and build a voter base that understands bald eagle requirements.

- b) Private conservation organizations (e.g. Jackson Hole Land Trust) and private landowners have greatly facilitated maintenance of bald eagle habitat on private lands. Resource managers should continue to assist these groups whenever possible.
- b) The most important habitat in terms of RDI ratings and total eagle production in SU is vulnerable. Efforts to secure these habitats by purchase, easement or cooperative agreements with landowners need to be intensified.
- c) Alert county commissions and county planning boards to location and importance of bald eagle habitat (1c, 1d, 2b) to promote proactive management and avoidance of conflicts.

3. Residential, urban, recreational, and resource development in Greater Yellowstone is not being adequately monitored. Available data are not accessible to resource managers for planning or understanding impacts on wildlife.

- a) Describe the problem and develop goals and objectives for a monitoring program.
- b) Obtain funding for monitoring developments and responses of eagles.
- c) Create a readily accessible repository for gathering and compiling data (e.g. Natural Heritage Programs of The Nature Conservancy).
- d) Within 3b, above, develop a Geographic Information System (GIS) monitoring base of human activity centers and creeping development for analysis of regional impacts.

4. Adequate data on recreational use (e.g. number of bank users and floaters) of bald eagle habitat are not being maintained by some resource management agencies. Lack of data will preclude future calculation of ratings generated by Cumulative Effects Model (CEM) developed for bald eagles (Montopoli and Anderson 1991),

monitoring of use trends, and development of strategies and schedules for adequate management of recreational use.

- a) An interagency committee of primary land management agencies and regulatory authorities should develop methods and procedures to compile and periodically update the most recent data (e.g., Pratt 1992) to adequately quantify recreational use as it relates to bald eagles.
- b) A Greater Yellowstone recreational use inventory program should be funded and implemented for all major rivers and lakes in Greater Yellowstone (Snake, Henry's Fork, Madison, Yellowstone Rivers; Henry's, Yellowstone, Jackson, Hebgen, Quake Lakes; Chain of Lakes area in southwestern Montana, and Palisades and Island Park Reservoirs).

5. Increasing recreational use (commercial and noncommercial) will likely reach levels that will preclude bald eagle use, productivity, or occupancy of highly productive bald eagle habitat in Greater Yellowstone (4b). Attempts to limit recreational use will be controversial, need to be well justified and could shift increased human use or problems to other areas.

- a) Interagency programs should be designed to establish objectives for all portions of Greater Yellowstone, determine threshold levels, and implement management actions.
- b) Recreational management plans for impacted rivers and lakes in Greater Yellowstone should be developed and should include public involvement and review.
- c) Interim efforts to prevent or manage conflicts between recreational use and bald eagle requirements should continue in Greater Yellowstone until 5b has been implemented.

6. Recreational development objectives of local governments may be contrary to conservation of bald eagles. Promoting and increasing use generates more funds for local governments. In Idaho, only county governments or state legislation can regulate use of navigable waters. Federal agencies can only regulate access sites.

- a) Diligently pursue recommendations 2a and 2c.

7. Impoundments, especially Palisades Dam but others including Hebgen Lake, Island Park Reservoir, and Jackson Lake, promote vegetative succession and inhibit replacement of decadent cottonwood forests (Merigliano 1995). Stands of cottonwood, used by eagles for nesting, are being lost and rate of replacement with spruce (*Picea spp.*) or Douglas fir (*Pseudotsuga menziesii*) of adequate size for bald eagle nesting structures is lagging and disjunct in distribution.

- a) Work with water management authorities to establish flow regimes that create periodic, manageable flood events at appropriate times to promote deposition of sediment (seed beds) for germination of cottonwood seeds.
- b) Advocate soil management and plantings by volunteer or conservation groups (e.g. Youth Conservation Corps) for creation of cottonwood stands.
- c) Implement recommendations in Merigliano (1995) for creation and maintenance of ecologically sound cottonwood stands.

8. Heavy sediment loads caused largely by the inadequate design of levees, will continue to cause degradation and loss of bald eagle habitat in SW and possibly elsewhere.

- a) Work with the Army Corps of Engineers, Wyoming Game and Fish Department and USFWS to initiate and fund studies to: (1) quantify and characterize the problem; (2) identify specific areas where degradation or loss of habitat may occur in the future, and; (3) recommend and implement projects to address site specific problems (short term) and long term problems within the SU, caused by levees.
- b) Continue to identify and implement habitat improvement projects on feeder streams and wetlands adjacent to portions of the Snake River with levees.

9. Data indicate bald eagles are still accumulating organochlorines and relatively high levels of heavy metals.

They also may be at risk from organophosphate or carbamate pesticides. Contaminants could affect production and survival and preclude maintenance of objectives.

- a) Continue to monitor production and population trends in Greater Yellowstone.
- b) Encourage additional research and compile data from other studies to determine source of heavy metals and other contaminants and possible effects on Greater Yellowstone bald eagles.
- c) Check blood concentrations of heavy metals, organochlorine residues and cholinesterase from a sample of adults and young every 5 years and examine trends.
- d) If eagle population or contaminant data indicate a problem, initiate planning and programs to address it.

10. Small sample size of site specific information obtained from nesting pairs associated with lakes precludes development of guidelines applicable to lake nesting eagles in general.

- a) Develop a CEM rating similar to the approach used by Montopoli and Anderson (1991) for lentic systems.
- b) Based on methods of Harmata and Oakleaf (1992), further develop Lake Diversity Index (LDI) ratings for lake habitat.
- c) Study additional lake nesting eagles in YU and CU intensively (radio-telemetry, colorbanding) to determine if LDI and CEM ratings are useful in explaining or predicting eagle use of lake habitat.
- d) Encourage similar and expanded analysis in studies of lake nesting eagles in Idaho.

11. Applicability of mathematical formulas derived for RDI, CEM and Habitat Suitability Index (HSI: pg. 15, Harmata and Oakleaf 1992) throughout Greater Yellowstone is questionable because data were collected on a relatively small number of eagle pairs (n=8) and were specific to the Snake River, Wyoming.

- a) Work with existing data to improve indexes of nests studied.
- b) Conduct similar analysis on other nests

currently being studied in Greater Yellowstone.

- c) Expand analysis to include nesting pairs associated with other river systems.

12. Few eagles have been banded in some portions of Greater Yellowstone, especially the YU. Additional wintering and subadult habitat not receiving attention may be in need of management.

- a) Continue banding with emphasis on YU, CM and Grand Teton National Park.
- b) Continue review and analysis of band encounters.
- c) Encourage research on seasonal concentrations and movements.

13. Fisheries management projects have conflicted with conservation of bald eagles. Emphasis on creating/maintaining game fisheries has resulted in Rotenone® treatment of some lakes and reservoirs, removing nongame and rough fish, a potentially critical food source for local eagles. Fishing seasons occasionally promote disturbance of local eagles at a critical time (incubation).

- a) Develop fisheries management policy statements and/or recommendations and work with State fisheries biologists to minimize impacts of rough fish eradication programs on eagles.
- b) Consult on fishing season dates and/or local restrictions to minimize conflicts with nesting bald eagles. (The Working Group recognizes that anglers often promote survival and productivity of local bald eagles by providing viscera and carcasses of nongame fish.

14. During cold, dry winters, minimum flows from Palisades Dam facilitate total freezing of the Snake River downstream, reducing availability of both fish and waterfowl to wintering and resident eagles. Subsequent productivity of resident eagles is negatively correlated.

- a) Similar to 7a, work with water management agencies to determine and implement minimum

flow regimes during cold, dry winters to promote flows for open water.

Monitoring Bald Eagles and Habitat in Greater Yellowstone

Adequate monitoring of bald eagle population trends is fundamental to effective management. Emphasis should be placed on surveys designed to monitor size, distribution, and reproductive performance of the breeding population (Appendix III). Other surveys are encouraged if funding and manpower permit. These include those designed to identify and monitor seasonal concentrations of migrant eagles. Periodic monitoring of environmental contaminants is desirable to establish norms and detect problems. In addition, attempts should be made to monitor habitat suitability within and around Greater Yellowstone.

Surveys should be a cooperative effort among federal, state, and private interests to maximize coverage and efficiency and avoid duplication. Repository for information will be a Working Group designee (Appendix III).

Breeding Population Surveys

Monitoring the breeding population should include surveys with the following minimum objectives:

1. detection of incubation by the majority of pairs in the Management Unit,
2. detection of incubation by pairs nesting later than the mode,
3. discovery of new pairs and determination if the breeding area is occupied by adults that do not breed,
4. determination of number of young of advanced age produced or number fledged,
5. determination of pioneering/reoccupancy of potential/historical habitat by breeding pairs.

Timing of surveys (1 - 4) is determined by local phenology of breeding pairs. Surveys for pioneering pairs or reoccupancy of historical habitat (5) should be conducted at least every 5 years.

Seasonal Concentrations

Seasonal surveys should strive to identify location, size and status of concentrations of bald eagles outside the breeding season and identify key foods and habitats. Emphasis should also be placed on identifying communal roost sites and staging areas. All concentrations of 30 eagles or more within a 2.6

km² (1 mi²) area for more than 7 days should be identified. Guidelines for seasonal concentrations include:

1. Encourage, coordinate, and fund seasonal surveys of known concentrations (e.g. Oxbow and inlet of Jackson Lake in Grand Teton National Park (ST), Targhee Creek and Duck Creek (CI), upper Palisades Reservoir (SI), and Snake River in SI).
2. The Working Group may assist in bald eagle mid-winter surveys sponsored by the Raptor Research and Technical Assistance Center, Boise, ID and maintain established routes.
3. Solicit input of agency personnel and other resource oriented organizations and individuals (local Audubon clubs, Greater Yellowstone Coalition, The Nature Conservancy, Universities) to identify locations of seasonal bald eagle concentrations and encourage timely reporting when discovered,
4. Identify seasonal fish concentration and spawning areas within Greater Yellowstone by communication with fishery biologists. These areas may hold potential as bald eagle concentration areas,
5. Inspect suitable habitat during likely concentration periods when possible.

Environmental Contaminants

Henny and Anthony (1989) felt levels of environmental contaminants should be monitored to evaluate effects on survival and productivity. Analysis of blood samples from wild bald eagles at seasonal concentration areas and nestlings at least once every 5 years and controlled experiments relating blood contaminant levels with overall body burdens using nonreleasable eagles should be encouraged to determine incidence, severity, and effect of environmental contaminants on bald eagles in Greater Yellowstone

Habitat

Habitat that remains virtually unaltered and contains or contained breeding bald eagles may be considered *suitable* habitat. Habitat with no history of occupancy by breeding eagles but containing potential to do so may also be suitable. However, evaluation of *potential* for habitat to support nesting bald eagles is difficult because of eclectic choice of structures and habitats selected by the species

throughout the range. Accordingly, potential of an area/habitat to support nesting eagles is unknown but an area that supports nesting eagles is obviously suitable. The composite of habitat characteristics of areas occupied by breeding bald eagles may serve as a paradigm for evaluating suitability of unoccupied areas/habitat. RDI and HSI index values derived for breeding areas of productive eagles in Greater Yellowstone indicate high quality habitat. Other indexes such as macro-habitat characteristics of Wright and Escano (1986) and habitat parameters identified by Jensen (1988) and Montana Bald Eagle Working Group (1994) may further identify suitable habitat. Recently (1995) pioneered nest sites throughout Greater Yellowstone indicate limits of suitability are surpassing those previously thought. Most habitat descriptions of breeding areas (e.g. Wright and Escano 1986, Jensen 1988) focus mostly on structural characteristics of the environment and some human activity parameters without consideration of prey base. Habitat suitability models that do consider prey base incorporate only indirect indicators, mostly abundance of fishes (Peterson 1986, Livingston et al. 1990). However, prey base may be the most important factor in determining density of nesting bald eagles (Dzus and Gerrard 1993), productivity (Hansen 1987) and probably even presence. Evaluation of nesting habitat suitability should therefore, include more emphasis on direct measures of food availability.

Habitat suitability of major rivers and lakes in Greater Yellowstone should be evaluated and suitability indexes updated every 5 years. Guidelines for habitat monitoring include:

1. Incorporation of calculations of RDI, LDI, and human activity by CEM into a HSI for all River Mile Segments or Lake Shoreline Segments of major rivers and lakes in Greater Yellowstone.
2. Employment of GIS for compiling, tracking, and analyzing data on residential and urban sprawl and recreational developments.

Guidelines for Management of Breeding Areas

Management of bald eagle breeding areas will be accomplished by application of one or more of 3 planning options to each nest site/breeding area in Greater Yellowstone: 1) application of Nest Site Management Zone guidelines, 2) development of site-specific management plans and, 3) habitat management plans. Planning options should not be viewed as a stepwise process but rather a "as needed"

basis. Planning option(s) employed will be dictated by actual or potential conflict exposure and management concern within breeding areas. Planning options differ in scope, amount of site-specificity and detail of data input needed to effectively manage conflicts, promote conservation of the species, and achieve/maintain objectives. Resource management agencies need to be familiar with all breeding habitat within their jurisdiction and be vigilant to actual and potential conflicts. Assignment of appropriate option will reflect perceived need and/or effectiveness of previously applied option(s).

Nest Site Management Zones

Nest Site Management Zones (Fig. 11) include areas that are progressively farther from a nest constructed by bald eagles (i.e., 400 m ($\frac{1}{4}$ mi.), 400-800 m ($\frac{1}{4}$ - $\frac{1}{2}$ mi), and 0.8 km - 4.0 km ($\frac{1}{4}$ - $2\frac{1}{2}$ mi). Correspondingly, recommended restrictions decrease as distance from the nest site increases. Zone boundaries may be altered after intensive study of eagle activity and development of site specific management plans.



Definitions of terms used in the zone recommendations:

1. Habitat alterations - Any removal of trees, snags, or under story (includes such activities as timber harvest, firewood cutting of standing snags, or clearing and treatment of vegetation). Habitat alterations also include projects dealing with wetland and aquatic habitats such as levee building, channeling, dredging, gravel removal, or wetland draining. Livestock use that significantly impacts the habitat or occurs at a level that would prevent habitat or prey base objectives being obtained are included in habitat alterations.
2. Suitable habitat - See Guidelines for Habitat Monitoring (page 21).
3. Nesting and Productivity Parameters - See Appendix III.
4. Minimal human activity levels. Essentially no human activity with the following exceptions:
 - a. Existing patterns of ranching and agricultural activities.
 - b. Nesting surveys and banding by biologists experienced with eagles.
 - c. River traffic by boats that continue travel at the rate of the main current and at a frequency which results in no boat traffic for at least 30% of the daylight hours (fishing from boats with such movement rates and frequency is acceptable).
5. Light human activity levels - This level allows for day use and low impact activities such as boating, fishing and hiking but at low densities and frequencies. Activities which are excluded include extended use and activities such as heavy construction, timber harvest, seismic exploration, blasting, concentrated use associated with recreation centers (i.e., picnic areas, boat landings), permanent housing and helicopters or jets within 600 m of the ground.
6. Moderate human activity levels - Low impact (light) activity levels are included, but intensity of such activities are not limited. A limited number of recreation centers designed to avoid eagle conflicts may be considered. Other activities such as construction, seismic exploration, blasting, and timber harvest, also should be designed to specifically avoid disturbance. Designing projects or land uses to avoid eagle conflicts requires sufficient data to formulate a Site-specific Management Plan.

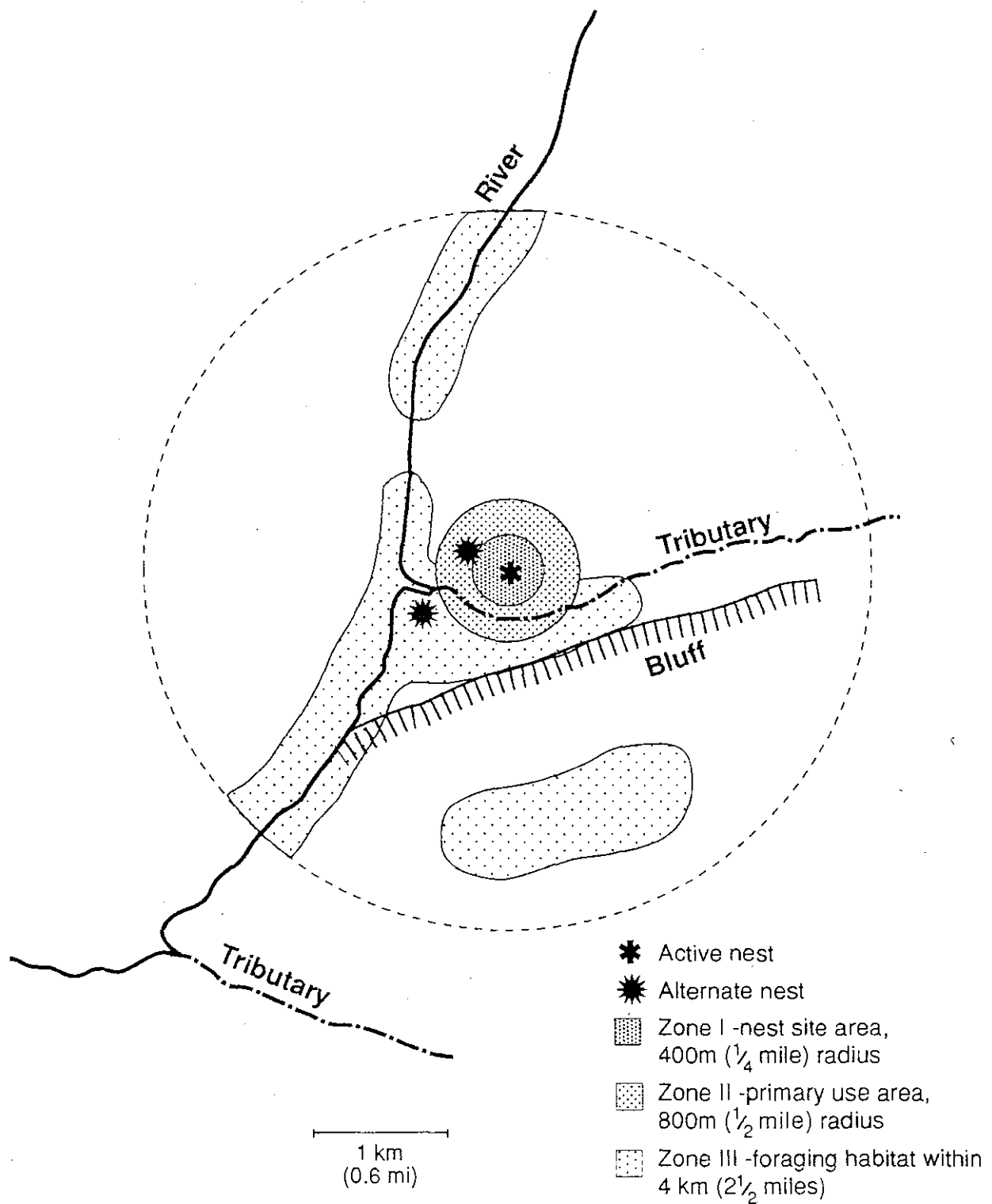


Figure 11. Nest Site Management Zones for management of bald eagle breeding areas in Greater Yellowstone.

ZONE I: Occupied Nesting Zone

Zone I is the area within a 400 m (1312 ft) radius of an occupied nest. Ideally, this zone should be biologically relevant to the tolerance of eagles to human disturbances (i.e., the distance at which the presence of humans first causes significant stress or behavior that results in inattentiveness to young or eggs). Since human activity patterns are easier to control if restrictions do not fluctuate from year to year, it may be desirable that this zone be established for each alternate nest. However, Zone I guidelines for **habitat alterations** should be applied to all alternate nests.

Recommendations:

1. Human activity should not exceed minimal levels during the period from first occupancy of the nest site until two weeks following fledging (approx. 1 February - 15 August). Light human activity levels should not be exceeded during the rest of the year.
2. Habitat alterations should be restricted to projects specifically designed for maintaining or enhancing bald eagle habitat and conducted only during September through January.
3. Human activity restrictions for Zone I may be relaxed during years when a nest is not occupied. However, light human activity levels should not be exceeded and land use patterns should not preclude a return to minimal activity levels.

Justification:

Possible effects of human disturbance on nesting eagles has been previously discussed (pages 12-14). The zone limit of 400 m (1312 ft) was selected primarily for the following reasons. Defense against human intrusion by Greater Yellowstone nesting eagles has been observed up to 400 m (1312 ft), indicating closer approaches to the nest are highly disruptive, at least for some eagles. Defense response to human intrusion occurs up to 300 m (984 ft) in California (Lehman et al. 1980). Attentiveness of nesting eagles to human activity within 400 m (1312 ft) readily occurs in most Greater Yellowstone pairs. In an experimental study designed to measure eagle reaction to human disturbance, Fraser (1985) found that nesting bald eagles flushed from a human approach anywhere from 57 m to 991 m (187 to 3251 ft). Most eagles in Greater Yellowstone flushed when humans approached closer than 200 m.

ZONE II: Primary Use Area

Zone II includes the area within an 800 m (2625 ft) radius of the active nest and of all known alternate nests. Intensive study of a nesting pair for several years

should allow for the boundaries of this zone to be altered to include the area where over 75% of the adults foraging and loafing activity occurs during the nesting season (excluding Zone I). The area could be discontinuous if movement data indicate the need.

Recommendations:

1. Light human activity levels should not be exceeded during the nesting season. Moderate levels should not be exceeded during other times in the year.
2. Habitat alterations should be carefully designed and regulated to insure preferred nesting and foraging habitat are not degraded.
3. Developments that may increase human activity levels and use patterns should not be allowed.
4. Structures that have the potential for increasing mortality due to collision should not be constructed (i.e., power and telephone lines). Existing lines posing a potential problem should be modified to minimize collision or electrocution.

Justification:

Territorial defense by bald eagles against conspecifics extends 0.8 km ($\frac{1}{2}$ mi) or greater from the nest (Broley 1957; Mattson 1974; Gerrard et al. 1980; Swenson et al. 1986). Observations of adult movements associated with nesting eagles ($n=13$) along the Snake River in Wyoming indicate that 50% of eagle foraging activity will be within 5.2 km ($3\frac{1}{2}$ mi) of active nests. Fifty percent of perches chosen by breeding adults in Greater Yellowstone were ≤ 540 m (1772 ft) from the most recently active nest site along the Snake River in Wyoming. All these data strongly indicate that habitat suitability and limited disturbances are important within Zone II.

ZONE III: Home Range

Ideally, the home range should be delineated by monitoring eagle movements during nesting and brood rearing for several years. Lacking such data, the zone should include all potential foraging habitat within a 4 km ($2\frac{1}{2}$ mi) radius of the nest. Areas within the 4 km ($2\frac{1}{2}$ mi) radius of the nest that do not include potential foraging habitat may be excluded. However, the zone will include a 400 m (1312 ft) buffer along foraging habitat where the zone has been reduced.

Recommendations:

The primary purposes of this zone are to maintain adequate foraging conditions and aid in maintaining the integrity of Zones I and II. Zone III encompasses

areas that should be protected through purchase, easements, or cooperative agreements. Specific recommendations are:

1. Human activity levels should not exceed moderate.
2. Projects that could potentially alter the habitat of forage species should be carefully designed to insure availability of prey is not degraded. Adequate design of such projects will require data from Site-specific Management Plans.
3. Terrestrial habitat alterations should insure important components are maintained (i.e., perch trees and snags, visual screening from existing or anticipated areas of human activity, and potential nesting habitat). Major habitat alterations should be considered only if Site-specific Management Plans are developed and only if the alterations are compatible with management plans.
4. Permanent developments that are suitable for human occupancy should be avoided.
5. Other developments that may increase human activity levels should be carefully designed to insure objectives will not be exceeded for all 3 management zones.
6. Utility lines should be limited and restricted to locations where the potential for eagle collisions and electrocutions is minimal.
7. Avoid pesticide use within the home range.

Justification:

Studies of the movements of 9 pairs of eagles in the Jackson, Wyoming area indicated extremities of home ranges were up to 10 km (6½ mi) from the nest, and one pair extended its home range up to 14 km (8¾ mi) from the nest. Ninety percent of all foraging attempts of radio-tagged bald eagles in SW (n=13) were within 8.3 km (5.2 mi) of the nest site. A large percentage of food may be obtained with minimal time and energy expenditure near home range extremities. In addition, a foraging situation that is rarely used within a home range may be critically important during short periods of adverse conditions. Both situations can only be identified through intensive study required for site-specific management.

Site-Specific Management Plan

Site-specific Management Plans include precise delineation of Management Zones based on observed movements, habitat use, and responses to human activity exhibited by specific bald eagle breeding pairs

as determined by intensive research (i.e., long-term observation, auxiliary marking). Site-Specific Plans should be completed when required for resolution of potential conflicts. **Site-Specific Plans should be completed only after an intensive research effort designed to determine home range, activity patterns, perch and roost areas, food habits, foraging areas and responses to human activity of specific pairs.** However, preliminary plans may be developed based on knowledge of other pairs and refined as additional data are obtained on the specific pair of concern.

Monitoring procedures and activities for determining site-specific habitat use presented in Appendix IV are applicable to both visual monitoring and radio-tracking. Minimum observation effort needed to adequately describe movements and habitat use is 100 hours with an eagle in sight (Gerrard et al. 1992) or 74 hours of an eagle in sight concentrating on eagles away from the nest (Stangl 1994) depending on situation or technique (telemetry or visual) and number of observers. After data are acquired, a Site-Specific Plan may be prepared following procedure and format guidelines presented in Appendix V.

Habitat Management Plans

Research and management effort often are more efficiently and effectively applied if focused on bald eagle habitat rather than directed at individual breeding pairs or areas. Planning for management of breeding habitat may combine more than one breeding area into a Management Unit, or on the largest scale, an entire Population Unit (i.e. SU, CU, YU). Management Unit boundaries may be determined by spatial relationships, biotic and abiotic habitat similarities, or conflict similarities among breeding areas. In Greater Yellowstone, Management Units have already been delineated and provide a geographical framework to develop Habitat Management Plans.

Habitat Management Plan development should be research-supported and habitat oriented, i.e. directed at describing, evaluating and conserving bald eagle habitat within an entire Management Unit, not just specific breeding areas. A Habitat Management Plan is conceptually similar to a programmatic EIS in that it should attempt to address and manage all potential negative impacts to bald eagles in a Management Unit before they occur. This planning approach is compatible with existing thought on resource management planning emphasizing ecosystem management. **Habitat Management Plans are the preferred alternative for management of bald eagles in Greater Yellowstone.** However, Habitat Management Plans may not be an appropriate option for managing bald eagle pairs nesting ≥ 16 km (10

mi) from the nearest neighboring pair. These pairs may be more effectively managed by application of site-specific plans outlined above. Regardless, the goal of management plans is to maintain suitability of high quality habitat.

Foraging Habitat External to Management Zones

Foraging habitat outside Nest Site Management Zones may be important. Non-breeders are often excluded from preferred foraging areas by resident nesting bald eagles and extensive foraging flights by resident breeding adults may extend well beyond the 4 km (2½ mi) radius of Zone III. Thus, quality and quantity of foraging habitat is essential to the entire population, not just resident breeding eagles. Foraging habitat consists of lakes, rivers, wetlands, and meadows which provide open flight paths, perches, and security from intrusion/disturbance as well as adequate prey. Management of foraging areas includes protection from contaminants and physical hazards, management of prey base and human activity, plus consideration of other factors which would compromise the ability of bald eagles to forage effectively and safely.

Tasks:

1. Identify foraging habitat external to Nest Site Management Zones.
2. Regulate use of poisons and eliminate contamination by toxic elements and chemicals that are detrimental to eagles.
3. Maintain water quality and healthy populations of prey species in foraging habitat.
4. Eliminate or reduce collision and electrocution hazards in foraging habitat.

Guidelines:

1. Encourage investigations to delineate foraging habitat.
2. Work with U.S. Environmental Protection Agency and other agencies to reduce or eliminate contaminants in the aquatic environment. Review environmental documents (Environmental Assessments, EIS) for potential contamination of foraging habitat and submit appropriate responses. Periodically test blood and addled eggs of resident eagles for pesticide residues, heavy metals and indicators of toxic exposure and disease.
3. Provide advice and program review to State Agriculture Departments, U.S. Animal and Plant

Health Inspection Service, BLM, Forest Service, and others regarding the risks of secondary poisoning to bald eagles. Recommend timing restrictions, choice of rodenticides and predacides and application strategies to reduce or eliminate the risks to foraging bald eagles.

4. Encourage efforts to achieve instream flow reservations. Encourage efforts to protect and enhance wetland habitats, water quality and populations of prey species used by bald eagles and encourage mitigation for any negative impacts.
5. Structures that pose a hazard, such as overhead utility lines, should not be constructed. Existing mortality risks should be removed or modified. Seek to route new powerlines away from foraging habitat, and ensure that powerlines are well marked and visible where they cross wetlands. Carcasses of road-killed deer should be removed from rights-of-way to a safe place where eagles can feed without danger of vehicle collision.
6. If conflicts persist, subsequent levels of planning should ensue.

Wintering and Migration Habitat

Management of bald eagle seasonal habitat should focus on 3 habitat components and human disruptions of each (Martell 1992): Presence and abundance of food usually associated with open water, availability and distribution of foraging perches, availability of secure night roost sites and freedom from human harassment. All dictate amount and extent of use of specific wintering grounds and areas used during migration.

Wintering bald eagles tend to congregate near bodies of water and roost communally. Major rivers and large lakes constitute the majority of winter habitats used, although temporary presence of high quality foods may entice eagles to areas far removed from aquatic zones. Wintering eagles are often observed in uplands, foraging on offal and carcasses associated with late ungulate harvests and big game wintering grounds. Eagles may travel several miles to roost sites. Group members are often alerted to small, ephemeral concentrations of eagles associated with calving and lambing operations in January and February.

Roost sites are usually located in stands of mature or old-growth conifers or cottonwoods. For purposes of management, a communal roost is defined as an area usually less than 10 acres in size that contains ≥6 bald eagles on any given night. Critical roost

sites are defined as exhibiting traditional use for ≥ 5 yrs. and contain ≥ 15 eagles per night for ≥ 14 nights per season (USFWS 1983). No critical winter roost sites have been identified in Greater Yellowstone.

A vital roost site is any communal roost that does not meet criteria for critical status but has local or regional significance in terms of public interest, unique features or importance to the local population of bald eagles. For instance, a communal roost containing 10 eagles for one week in an urban, high profile situation may require intensive management attention to appease public concerns. A communal roost located in an area with no other roosting opportunities and geographically isolated from other wintering aggregations may be vitally important to eagles using the site.

Risks to migrant eagles involve exposure to lead poisoning (Pattee and Hennes 1983), secondary poisoning from insect and predator control programs (Henny et al. 1987), collisions and electrocutions associated with power transmission (Olendorff et al. 1981) and loss of perching, foraging and roosting opportunities due to human disturbance (Fraser et al. 1985). Management of migrant bald eagles should focus on elimination or mitigation of these risks. Guidelines follow those of Martell (1992) with some modifications.

Objective:

Identify bald eagle concentrations and flyways during autumn, winter and spring and institute spatial and/or temporal restrictions where human activity is disruptive.

Guideline:

1. Encourage and support research to identify and quantify use and location of seasonal concentrations of bald eagles.
2. Establish buffer zones of 400 m (1312 ft) around high-use foraging areas with temporal restrictions from sunset to 10:00 a.m. in areas of high human use or establish site-specific modifications based on research findings (e.g., Restani and Harmata 1993, 1994).
3. Diurnal perching areas may not always be associated with primary foraging areas. If separate, buffer zones of 200 to 400 m (656 to 1312 ft) around concentrated or high-use perches should be imposed, dependent on existent vegetative screening. Temporal restrictions should be consistent with seasonal residency. Removal of trees, especially snags ≥ 70 cm (2 ft) within 33 m (100 ft) horizontal or

400 m (1312 ft) elevational rise of $>30^\circ$ from shoreline should be discouraged on private land and prohibited on federal and state land. Single trees in upland foraging areas devoid of elevated perch sites should be retained.

4. Promote silvicultural practices that will provide perches of adequate number, location and size in perpetuity.

Objective:

Encourage provision of a safe food base for migrating and wintering eagles.

Guidelines:

1. Carrion is a major source of winter food for eagles. County health standards often require domestic livestock carrion be buried. Frozen ground may preclude burial which is usually unnecessary as there is little hazard of disease and no odor in winter. Where not in conflict with grizzly bear (*Ursus arctos*) or wolf (*Canis lupus*) management, counties should be encouraged to amend regulations to allow livestock producers to leave or place opened, domestic livestock carrion in areas away from human habitation where it may be used safely by eagles and other scavengers. Most carcasses are consumed after only a few days. Livestock expired from ingestion or administration of drugs, sedatives or poisons should not be presented.
2. Spawning runs of trout (*Salmonidae*, *Oncorhynchus* spp.), whitefish (*Prosopium williamsonii*), suckers (*Catostomus* spp.) and other species provide an important food source for migrating eagles. Harvest and other impacts on these populations should be regulated.
3. During spring migration, bald eagles prey on ground squirrels (*Spermophilus* spp.) that have recently emerged from hibernation. Strychnine (now banned for above-ground use) and organophosphate poisons used to control ground squirrels are hazards to eagles. Eagles may succumb to secondary poisoning by feeding on squirrels that have ingested poisons. Rodent control programs using toxicants should be prohibited prior to 30 April, to provide safe passage for migrant eagles.
4. Areas of winter and early spring waterfowl concentrations are important to wintering and migrating eagles. In general, efforts to enhance existing wetlands and development of new ones should be supported.

5. Encourage use of solid point .22 cal. ammunition for varmint shooting. Hollow point projectiles fragment within the animal to a greater extent than solid (Harmata and Restani 1995), posing a lead poisoning threat to eagles (and other wildlife) scavenging carcasses.
6. Require all raptor rehabilitators to report eagles sick or killed by lead poisoning immediately to USFWS and appropriate state wildlife agencies.
7. Provide perch structures within 90 m (300 ft) of shore and plant deciduous trees beside them in areas with few or no natural, elevated perches where eagles congregate. Locate perches unobtrusively to minimize potential for shooting. Such areas may include prairie grasslands, sagebrush (*Artemisia spp.*) steppe, reservoirs or wetland mitigation areas (created wetlands) where winter livestock carrion is available, ground squirrels abound in spring, or fish spawn and waterfowl congregate seasonally.
3. Encourage all hunter safety instructors to include a section on raptor protection in their courses. Educating young hunters about the value of raptors and the fact they are protected by federal and state law may help reduce the incidence of eagle shooting.
4. Encourage use of scent or non-visible baits for predator and furbearer trapping and discourage use of sight baits because eagles are vulnerable to such trap sets. Encourage local trapper's associations to educate their members about the need to use nonvisible baits and check sets daily. Support regulations requiring traps not be placed closer than 8 m (25 ft) from sight baits and be checked frequently. Captured eagles can survive at least one day and quick release will facilitate survival. Encourage release of eagles with toe/foot injuries if they can become airborne. Chances for survival with a foot injury are greater in the wild than at rehabilitation centers where management of the injury is problematic.

Objective:

Minimize the risk of bald eagle injury and mortality during the winter and migration periods.

Guidelines:

1. Remove road-killed animals from road and railway edges. Eagles are attracted to carrion along roadsides during winter months. Eagles are vulnerable to oncoming high-speed traffic, especially when ambient temperatures are well below freezing, wind is calm and eagles are gorged. Carrion should be removed to areas away from public travel where eagles may feed undisturbed and in safety.
2. Identify powerlines and poles which pose an electrocution or collision threat to eagles. A threat exists where lead and/or ground lines are placed so eagles may touch both simultaneously, where transformers are placed in elevated terrain, and where lines cross flight paths. The greatest threat is from distribution lines with less than 69,000 watt capacity. Such poles can be easily modified. Power companies should be contacted and requested to modify the poles in question. Poles near feeding areas are most likely to be used as perch sites and need immediate evaluation. Two main considerations for making powerlines safe for eagles are: (1) modification of existing lines which pose electrocution and collision hazards and (2) proper design of new facilities (Raptor Research Report No. 4, Olendorff et al. 1981).

Objective:

Identify and provide protection for communal roosts.

Guidelines:

1. Encourage research to identify and describe roost site locations, duration and intensity of use (e.g. Kiester and Anthony 1983).
2. Promote confidentiality of roost sites. Photographers, media and public are drawn to sites once revealed.
3. Strive to maintain visual, temporal and spatial integrity of the roost site in order to provide for short- and long-term use by bald eagles. Manage critical and vital roost sites temporally and spatially. Area within 400 m (1/4 mi) of critical and vital roosts should be closed. Human activity beyond 400 m (1/4 mi) may be disruptive if above the roost site (i.e., on a bluff adjacent to the roost). In such cases, methods to provide visual screening from the roost site should be explored and based on onsite inspection and recommendations of Group biologists. Closures for autumn roosts should extend from 1 October to 1 January, for winter roosts from 15 October to 1 April, for vernal roosts from 1 March to 15 April or determined by actual residency patterns of local eagles. Alternative schemes toward these ends should be encouraged to accommodate human values.

4. Encourage silvicultural prescriptions for long-term availability of roost sites in appropriate habitat. However, silvicultural management should be delayed until eagles are seasonally absent.
5. Eliminate negative impacts of logging, prescribed burns (evaluate on a case by case basis), road

building or permanent development within roost management areas at any time.

6. Strive for similar protection of secondary sites because they may evolve into critical or vital roosts through succession, fire, wind or other catastrophe.

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GLOSSARY

(Terms defined here do not necessarily follow traditional or actual definitions, but here are defined to impart the intent of the Greater Yellowstone Bald Eagle Working Group. Italicized words in each definition indicate terms defined elsewhere in the glossary.)

Active (breeding area/pair/nest) - defined by the presence of: 1. an incubating bald eagle(s), eggs, or young, 2. a nest constructed during the current breeding season, 3. fresh nesting material in a previously existing nest. An active *breeding area/nest* also is occupied. Equivalent to *Occupied - Breeding*.

Adult - A bald eagle appearing to possess a predominantly white head and tail (i.e., in adult plumage). Eagles classified as adults at a distance (or unaided eye) may be reclassified as *subadult* upon closer inspection, depending on protocol.

Alternate Nest - a bald eagle nest not used during the current breeding attempt. Alternate nests in the breeding area are extended the same habitat protection as *active nests*.

Breeding Area - the geographic area used by a pair of bald eagles during the breeding season. Breeding areas must include some evidence of past reproduction or attempted reproduction but may not include an existing *territory* or *nest* of bald eagles. Size may vary over time. Breeding areas may be *suitable* or *unsuitable*, *occupied* or *unoccupied*, *active*, *successful* or *historical*, or combinations thereof.

Communal Roost - an area where ≥ 6 eagles spend the night within 100 m (328 ft) of each other.

DDT - 1,1,1-trichloro-2,2-bis (*p*-chlorodiphenyl) ethane. A persistent organochlorine pesticide used extensively through out the world since 1945. Use was banned in the U.S. 1972, but production and export to third world country continues.

DDE - 1,1-dichloro-2,2-bis(*p*-chlorophenyl) ethylene. Biotoxic metabolite of DDT responsible for species wide reproductive failures of birds during 1950's - 1970's. Toxicity manifested in thin egg shells, embryonic mortality, impaired reproductive behavior, and direct mortality at increasing concentrations.

Delist - the formal process of removing a species from the list of federally *endangered* and *threatened* species, pursuant to the Endangered Species Act of 1973.

Disturbance - any human elicited response that induces a behavioral or physiological change in a bald eagle contradictory to those that facilitate survival and reproduction. Disturbance may include elevated heart or respiratory rate, flushing from a perch or events that cause a bald eagle to avoid an area or *nest site*.

Downlist - the formal process of reclassification of a federally *endangered species* to threatened species status, pursuant to the Endangered Species Act of 1973.

Ecosystem - any area of nature that includes living organisms and nonliving substances interacting to produce an exchange of materials between the living and nonliving parts. Commonly considered regional in size (millions of hectares) and containing common attributes such as elevation, vegetation, animal communities, weather patterns, soil, geology, hydrology and topography.

Endangered Species - a species that is in danger of becoming extinct in the foreseeable future in all or a significant portion of its range, as stipulated in the Endangered Species Act of 1973.

Fledgling - a *juvenile* bald eagle, mostly over 13 weeks of age, that has taken at least one flight away from the natal *nest site* but is not necessarily absent from the *nest* or *nest site*. Fledglings may be capable of sustained flight but are still dependent on adults for sufficient food. Fledglings often return to and use the natal *nest* as a *perch* and *roost site* and feeding platform.

Habitat - the naturally associated environment in which an animal lives and contains all requisites for survival, health, reproduction, and persistence. Habitat for bald eagles may be considered *suitable* or *unsuitable*, *occupied* or *unoccupied*, or combinations of both.

Historical (habitat/breeding area/nest) - that which has some record of use or occupancy by bald eagles.

Home Range - geographic area defined by movements and locations of a bald eagle or bald eagles. Area may be defined annually, seasonally, daily or any part thereof.

Immature - a bald eagle appearing not to possess *adult* plumage. Immature eagles may be associated with an *occupied, active or successful territory, breeding area or nest*. Often used to indicate any nonadult bald eagle but more strictly defined as one between 1 1/2 and 2 1/2 years old. Plumage is often distinctive, exhibiting a white, speckled belly and white inverted triangle on the back. Beak is mostly black but containing streaks of yellow.

Management Unit - Management Unit boundaries may be determined by spatial or administrative relationships, biotic and abiotic habitat similarities, or conflict similarities among breeding areas within.

Monitor(ing) - regular, systematic, and long term effort to examine specifically identified categories of data acquired from surveys to determine the status, health and management needs of the Greater Yellowstone bald eagle population. Monitoring may or may not include research.

Nest - any platform within the *breeding area* that may have been built or used by a bald eagle, usually as a focus for reproductive behavior and activity. Bald eagle nests are usually built by mated pairs, are made of sticks and are situated in trees. Nests may be constructed by single eagles or other species and composed exclusively or in part of grass, forbs or man-made material and situated on cliffs, man-made structures (windmills, utility poles) or the ground.

Nestling - a bald eagle between hatching and leaving the *nest* for the first time under its own volition.

Nest Site - the geographic point location or structure supporting the *nest*.

Nest Site Management Zone(s) - local geographic areas surrounding *active* and *alternate* bald eagle nests in which human activities are likely to disrupt normal breeding activity. Zones involve application of spatial and temporal human activity restrictions, progressively less restrictive with increasing distance from the nest site.

Occupied (habitat/breeding area/nest) - *Habitat/breeding area/territory/nest* defined by the presence of a pair of bald eagles during the breeding season. Equivalent to Occupied - Non-breeding, Occupied - Breeding, or Occupied - Breeding Status Unknown.

Perch Site - any location where an eagle stands, usually during daylight hours (c.f., *Roost Site*, below).

Population Unit - an area smaller than traditionally defined *ecosystems*, usually associated with one or more rivers, lakes or watersheds, including an

aggregation of 2 or more bald eagle *breeding areas* with continuous/contiguous distribution where local bald eagles exhibit significant similarities in habitat associations, nesting substrate and phenology, food, population dynamics, movements, wintering areas, responses to human activity or other life history characteristics. Larger than *Management Units*.

Potential (habitat/breeding area/nest) - that which may support nesting bald eagles in the future. Potential may be more precisely assigned by the confirmed presence of at least one adult bald eagle during the breeding season in an area known not to previously contain a breeding pair.

Productivity - number of young eagles raised to advanced age by a pair of bald eagles, within a *breeding area* or by a population or part thereof, per unit time. Progeny of breeding pairs that have attained advanced age are no less than 7 weeks old. Productivity may be expressed as young per *occupied, active, or successful breeding area/pair/nest or population unit*.

Recovered - the designation upon which a species may be removed from the federal list of *endangered and threatened species* and no longer require protection under the Endangered Species Act of 1973.

Recovery - Efforts needed to remove the bald eagle from the list of *endangered and threatened species* pursuant to the Endangered Species Act of 1973.

Riparian Habitat - associated with rivers and streams; commonly considered within the 100 year flood plain and including features characterized by biotic and abiotic associations typical of aquatic or mesic terrestrial environments.

Roost/Roost Site - any *perch site* location where an eagle spends the night.

Subadult - a bald eagle appearing not to possess full *adult* plumage. More strictly defined as one appearing mostly adult in plumage and further by being between 2 1/2 and 3 1/2 years old. Plumage may possess a dark eye line and dark terminal tail band. Beak is mostly yellow but may be streaked with brown.

Successful (breeding area/pair/nest) - site or pair that has produced at least 1 young eagle to an advanced age. Progeny that have attained an advanced age are no less than 7 weeks old. Equivalent to Occupied - Successful.

Survey(ing) - activity to identify and record predetermined variables on a selected route or area at specific times. These include aerial or ground based

efforts to quantify location, number and reproductive performance of bald eagles.

Suitable (habitat/breeding area/nest) - term indicating *unoccupied* sites that may support nesting bald eagles in the future. Suitable may be applied to *breeding area/nest* or habitat with a history of use and/or contains characteristics within normal range of those currently *occupied*.

Territory - the portion the *breeding area* defended by bald eagles against other bald eagles and species, not limited to the breeding season. Territory size and location may vary with time. *Breeding area* is

preferred over territory in relation to productivity surveys because some breeding eagles may not exhibit territorial behavior or defend any portion of the breeding range while others may defend areas not associated with breeding activity (i.e. winter ranges). Equivalent to Breeding/Nesting Territory.

Threatened Species - a species that is likely to become *endangered* in the foreseeable future.

Unoccupied (habitat/breeding area/nest) - Habitat that which exhibits no evidence of the presence of bald eagles during the breeding season.

APPENDIX I

Agency Mandates and Legal Authorities

Agency Mandates

This plan does not supersede existing agreements or modify any agency responsibility. For additional management perspective in the portion of Greater Yellowstone included in Montana, the management plan developed by the Montana Bald Eagle Working Group should be consulted (Montana Bald Eagle Working Group 1994). When considering delisting or reclassification of the Bald Eagle in Greater Yellowstone, guidelines contained in the Recovery Plan (USFWS 1986) should be followed. However, pursuant to amendments of the Endangered Species Act (ESA), this Bald Eagle Management Plan will serve as the Conservation and Monitoring Plan for bald eagles in Greater Yellowstone should the species be delisted (removed from list of threatened and endangered species).

Resource managers are encouraged to use this plan as a tool to address obligations under the ESA. Sections 2(c) and 7 (a, 1 & 2) of ESA stipulate that all federal agencies have an affirmative responsibility to promote conservation of endangered and threatened species. Additionally, the National Forest Management Act charges the US Forest Service (USFS) with maintaining viable populations of all species that occur on lands under its jurisdiction.

Legal Authorities

Persecution of bald eagles, mostly in Alaska and livestock producing areas of the west, prompted protection under the Bald Eagle Protection Act of 1940 (16 USC 668). Further protection was afforded in 1972 with inclusion of raptors under the Migratory Bird Treaty Act (16 USC 703, 1916). As a result of severe population declines (Sprunt et al. 1976) induced by pesticide residues mid century (Krantz et al. 1970, Wiemeyer et al. 1972), further protection was afforded under the Endangered Species Act (ESA) of 1973 (16 USC 1531, 1982 ammend.) for the then classified southern subspecies (*H. l. leucocephalus*) that did not occur in Greater Yellowstone. Federal protection as an endangered species was not extended to bald eagles in states of Greater Yellowstone until 14 February 1978 (43 CFR 6233) when the then classified northern subspecies (*H. l. alascanus*) was included. Currently, subspecies are not legally recognized. In states included in Greater Yellowstone, Idaho and Wyoming statutes afford endangered status to bald eagles but in Montana, the bald eagle is neither endangered nor threatened but a "Species of Special Interest or Concern" (Flath 1984).

APPENDIX II

Human Activity: Considerations for Management in Bald Eagle Habitat

Several behavioral/biological phenomena are important to consider when developing strategies for management of human activity in bald eagle habitat. Partial lists of *generally applicable* concepts are presented below.

General Behavioral Considerations

1. Responses of eagles to human activity vary by individual, population, sex, age, breeding status, time of year, condition, locale, weather and probably many other variables humans don't recognize much less understand.
2. The cumulative effects of successive or concurrent human activities are important when considering disturbance potential/effects. Cumulative effects of several activities may be synergistic in disruptive potential while each individually has no effect.
3. Sensitivity of nesting bald eagles to human activity generally diminishes in the following temporal order: nest site selection > nest building > egg laying > incubation > brooding > fledging.
4. Sound, not associated by human activity in the eagles' line-of sight (LOS) is usually well-tolerated.
5. Human activity in LOS in association with loud noise is tolerated less than activity alone.
6. Sensitivity to human activity increases with proximity.
7. Visual buffers (vegetative and/or topographical) mitigate the effects of human activity. Eagles often tolerate higher activity levels in closer proximity when not in LOS of individuals or nest proper.
8. Eagles raised under conditions associated with high human activity levels may be more likely to tolerate human activity.
9. Human activity above an eagle nest is more likely to elicit a disturbance response than activity below the nest.
10. Constant, predictable human activity within strict spatial and temporal bounds will be tolerated at higher levels of intensity and closer proximity than intermittent random human activity.
11. Eagles know when they are being observed. Direct stares at an eagle are more disruptive at greater distances than indirect glances at closer distances.

12. Eagles will be more tolerant of approach by humans in the following order: on horseback > in a vehicle > on foot.
13. Eagles will tolerate closer human approach when completed in a zig-zag fashion.
14. Eagles come to recognize individual humans and vehicles through repeated non-disruptive exposure and often tolerate closer approach than by those unfamiliar.
15. Adult eagles often cover eggs with nest material when left unattended. Eggs may be left unattended up to 1 hr.
16. Adult nest attendance drops significantly 3 weeks after hatching. Adults are more likely to supply shade to nestlings over a greater portion of the nestling period than they will provide shelter from rain, wind and snow.
17. Once departed the natal breeding area, the younger the eagle, the more intolerant to human approach. Males seem less tolerant than females to human activity but more tolerant of handling. Females are more aggressive at nest defense.

General Biological Considerations

1. Nesting Chronology:
 - Pair Formation - ?
 - Courtship - Year Round
 - Nest Site Selection - Year Round
 - Nest Building - October through April (autumn nest repair in established breeding areas).
 - Egg Laying - 28 February through 10 April
 - Incubation - 35 day duration
 - Nestling - 10 to 13 weeks duration
 - Fledging - 15 June through 15 August
 - Post Fledging* - 2 weeks to 3 months duration but usually not beyond 15 October in the Greater Yellowstone (Harmata & Oakleaf 1992). (* Period that young remain in adult range.)
2. Eggs and eaglets are more sensitive to overheating than cooling. Adult attendance should be maintained if, in absence, eggs/young will be in the direct sun. If flushed during monitoring observer should depart immediately.

3. Brood reduction is mostly a result of lack of food or severe weather, but seldom fratricide.
4. Nestling eagles begin to thermoregulate after 2 weeks of age.
5. Adult bald eagles hunt mostly from perches and many perches within the home range are used habitually. Preferred perches may be indicative of location of abundant and/or available/high quality food source and should be protected as fervently as nest sites
6. Access to a diversity of habitats and prey is important to maintain productivity and occupancy of the breeding area long term.

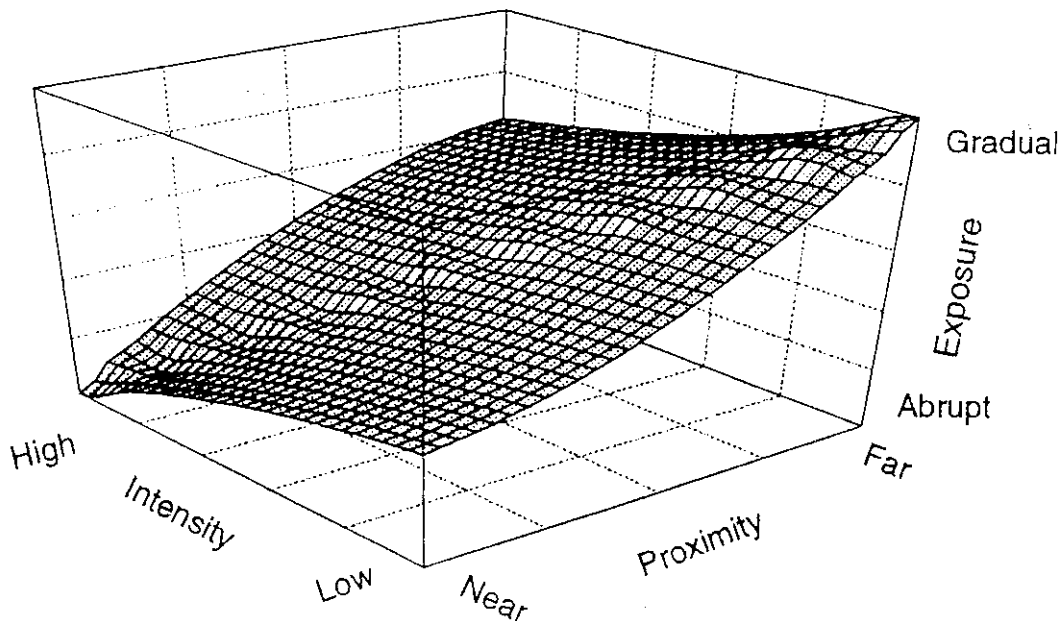
Thresholds

In the context of the above, it is important to note that eagles tolerate increasing levels of human activity to threshold levels that are poorly understood. Regardless, after many hours of observing bald eagles in the wild, several researchers have intuitively, if not

objectively, discovered tenets of the bald eagle response spectrum, constant in premise if not in magnitude.

Human activity variables that affect eagle response may be categorized as: 1) intensity (including type & frequency), 2) proximity and 3) duration. Responses to these variables may range from indifference, to passive awareness, agitation, flushing, reduced productivity, to abandonment of nest sites and breeding areas. Actual threshold levels and interactive effects for each are virtually unknown and determining just when an eagle is "disturbed" is problematic. Accordingly, human activities should be managed conservatively.

A theoretical response surface model of interactive variables, an effect on threshold level of bald eagles is shown in Appendix Figure 1. Variables probably interact in a similar manner for all levels of response in a hierarchical manner, i.e. thresholds will be higher as effect on eagles is more severe.



Appendix Figure 1. Response surface model for threshold of interactive variables that affect bald eagle reactions to human activity. Events with coordinates above the surface cause most severe response.

APPENDIX III

Greater Yellowstone Bald Eagle Population Data Management

Bald eagle reproductive performance in Greater Yellowstone will be recorded by cooperating individuals and agencies annually. The Greater Yellowstone Bald Eagle Working Group will compile, report in a consistent manner (e.g., Appendix Tables 1 & 2), and store population and productivity data. Repository for data will be designated by the Working Group, currently Russ McFarling, BLM, Idaho Falls District, Idaho Falls ID.

Definitions and terms used in productivity monitoring are as follows:

Breeding Area (or Territory) - the local geographic area used by a pair of bald eagles during the breeding season. Breeding areas must include some evidence of past reproduction or attempted reproduction but may not necessarily still contain an existing territory or nest of bald eagles.

Occupied Breeding Area - Breeding area containing a pair of bald eagles during the breeding season. Evidence for occupancy includes presence of: a) nestling eagles, b) eggs or egg shell fragments, c) one adult eagle in incubation posture during normal incubation period, d) two adult eagles at an empty nest after 15 April (migrant eagles may investigate unoccupied nest sites during vernal migration),

or e) one adult eagle in frequent association with a subadult eagle between 15 April and 1 August.

Annual reproductive status of resident eagles surveyed will fall into 6 categories:

1. **Pairs which bred (laid eggs)** - Observations of a) - c), above.
2. **Pairs which did not breed** - Pairs occupying breeding areas where no incubation or eggs were observed during several checks during the early breeding season so failure or late breeding may be eliminated.
3. **Pairs whose breeding status is uncertain** - Pairs in occupied breeding areas in which frequency of surveys or survey effort was not sufficient to identify early failures or late breeding attempts.
4. **Breeding areas occupied by a single adult** - Classification of breeding areas is contingent on sufficient survey effort and determination of absence of a mate.
5. **Unoccupied breeding areas** - No evidence of adult eagles, eggs, or young.
6. **Successful pair/breeding area/nest** - Breeding area where at least one eaglet was raised to advance age or known to fledge.

Appendix Table 1. Bald eagle productivity in Greater Yellowstone for all Population Units. Data for 1983 and 1984 were incomplete.

	1982	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	TOTAL	AVERAGE
Territories checked	49	58	59	66	71	74	82	87	94	98	102	111	951	86.5
Territ. not checked	0	2	1	0	0	1	0	0	0	1	1	0	6	0.5
Unoccupied	11	10	8	3	5	3	5	7	7	7	6	9	81	7.4
Unoccupied/1 adult	2	0	3	0	1	1	0	0	1	0	0	0	8	0.7
Nests occupied	38	49	48	63	63	70	77	80	86	91	96	101	862	78.4
Number Active	34	45	45	57	61	55	72	78	85	82	91	77	782	71.1
Number Successful	14	28	35	43	48	38	52	59	61	51	61	59	549	49.9
Number Unsuccessful	17	17	10	16	13	21	18	19	24	39	33	26	253	23.0
Outcome unknown	3	1	1	0	0	3	2	0	0	1	0	1	12	1.1
Number young fledged	23	45	56	80	85	58	86	94	103	75	93	91	889	80.8
Number new territories	3	3	1	10	5	6	6	5	6	5	4	9	63	5.7
% Occupancy	78%	84%	81%	95%	89%	95%	94%	92%	91%	93%	94%	91%	91%	91%
% Active	89%	92%	94%	90%	97%	79%	94%	98%	99%	90%	95%	76%	91%	91%
% Successful/Occupied	37%	57%	73%	68%	76%	54%	68%	74%	71%	56%	64%	58%	64%	64%
% Successful/Active	41%	62%	78%	75%	79%	69%	72%	76%	72%	62%	67%	77%	70%	70%
Brood size (yg./succ.)	1.64	1.61	1.60	1.86	1.77	1.53	1.65	1.59	1.69	1.47	1.52	1.54	1.62	1.64
Young/occupied	0.61	0.92	1.17	1.27	1.35	0.83	1.12	1.18	1.20	0.82	0.97	0.90	1.03	1.05
Young/active	0.68	1.00	1.24	1.40	1.39	1.05	1.19	1.21	1.21	0.91	1.02	1.18	1.14	1.13

Appendix Table 2. Bald eagle productivity in Greater Yellowstone by Management Unit, for 1995.

	SW	ST	SY	SI	CY	CM	CI	YY	YM	YW	1995
Territories checked	18	11	1	24	1	15	18	21	1	1	111
Territ. not checked	0	0	0	0	0	0	0	0	0	0	0
Unoccupied	0	0	0	1	0	4	1	3	0	0	9
Unoccupied/1 adult	0	0	0	0	0	0	0	0	0	0	0
Nests occupied	18	11	1	23	1	11	17	17	1	1	101
Number Active	15	4	1	20	11	1	8	16	0	1	77
Number Successful	12	4	1	15	1	9	7	10	0	0	59
Number Unsuccessful	3	7	0	5	0	2	2	6	0	1	26
Outcome unknown	0	0	0	0	0	0	0	0	1	0	1
Number young fledged	19	5	1	29	1	13	10	13	0	0	91
Number new territories	3	1	0	2	0	1	1	1	0	0	9
% Occupancy	100%	100%	100%	96%	100%	73%	94%	81%	100%	100%	91%
% Active	83%	36%	100%	87%	100%	100%	47%	94%	0%	100%	76%
% Succ./Occ.	67%	36%	100%	65%	100%	82%	41%	59%	0%	0%	58%
% Succ./Active	80%	100%	100%	75%	100%	82%	88%	63%	0%	0%	77%
Brood size (yg./suc.)	1.58	1.25	0.00	1.93	1.00	1.44	1.43	1.30	0.00	0.00	1.54
Young fledge/occ.	1.06	0.45	1.00	1.26	1.00	1.18	0.59	0.76	0.00	0.00	0.90
Young fledge/active	1.27	1.25	1.00	1.45	1.00	1.18	1.25	0.81	0.00	0.00	1.18

APPENDIX IV

Monitoring Bald Eagle Breeding Areas to Determine Site-Specific Habitat Use

(Adapted from: Yates, R.E. 1989. Bald eagle nesting ecology and habitat use: Lake McDonald, Glacier National Park, Montana. M.S. Thesis. Univ. of Montana, Missoula. 102 pp.)

- 1) Monitoring should begin prior to egg laying (February or March) to determine limits of defended territories, and late-winter/early spring food habits and foraging areas. Look for eagles at areas of open water (should be fairly limited in late-winter in most areas). Observers should find an observation point away from inlets, river forks, or confluences 1/2 mile or more from the nest site.
- 2) Concentrate observations in the a.m. to determine important forage sites, but also cover all daylight hours (each week or so) to determine other forage sites, feeding sites, loafing areas, human disturbance, and roost sites. Follow birds to foraging sites as often as possible when they leave the nest area.
- 3) Identify all perches, roost sites, and consistently used flight paths. Plot on daily field maps. Code (alpha,#) frequently used perches, plot on a master perch map, and use the alpha code on the data sheets. A perch on the ground is still a perch but may be further coded to indicate such. UTM's for specified perches can be added fairly easily in a data base manager. Calculate UTM's and add to the database daily.
- 4) Plot all prey captures and attempted prey captures. Calculate UTM's and add to the database daily. Use different codes for each.
- 5) Record all feeding bouts; bird, time, length, and location.
- 6) All disturbance, forage, prey capture, or roost sites can be plotted using GIS by creating separate data base files for each area of interest. Maps can also be produced for specific time periods if needed.

Use of the Bald Eagle Activities Form

The Bald Eagle Activities form (Appendix Table 2) is designed to expedite and simplify collection and analysis of bald eagle nesting, foraging, roosting, and behavioral data. It standardizes collection of weather information. The form is used for data collection during

periods of continuous observations, such as at a nest or foraging site. Observation periods can vary in length, but periods of 2 or 4 hours (or more) tend to provide optimum information, especially at an active nest site.

Directions For Use

The top row of the form is for recording the date (Year and [Julian] Day), breeding area (Loc.), observation period (Begin Obs.[24-hour clock], End Obs., Total Obs.[minutes]), observer location (Obs. Loc), weather information (Temp. [Celsius], Precip. [rain or snow], Cloud [% cover], Wind Sp. [speed, estimated MPH], Wind Dir. [direction the wind is coming from], and data form number (Form) for that observation period. A new form should be started for each observation period.

The columns beneath the top row are for recording specific activities information, such as an adult male bringing food to the nest, feeding of young, perching, etc. Separate rows are used for each activity of interest. Events (or activities) should be recorded chronologically to the nearest minute. There may be long periods when activity is slow, i.e. an eagle perching on the same branch for hours. Or, there may be periods when many activities occur within a minute or less, i.e. an eagle leaves a perch, catches a fish, returns to a perch, flies to the nest, and feeds young. It is important to record these events on the data form in the order that they happened, even though the same time is used for the "Begin Time." Explanations follow.

Begin Time - the minute (ex. 0545) an activity begins. If an observation period begins at 0530 and an eagle is already perched at that time, then the Begin Time for perching would be 0530 as well.

Individual - which eagle is performing the activity? Adult (A), Male (M), Female (F), Nestling #1 (N1), etc.

Main Act.(ivity) - the main activities performed by the eagles of interest. Perching (PER), prey capture (PCAP), adult feeding bout (AFB), adult feeding young (IFFY), nest visit (NV), young

feeding bout (YFB), night roost (RST), disturbance (DIST), and territorial defense (TD) are most of the main activities.

Location - where did the main activity occur? Alpha-numeric codes can be used to identify specific perches. Alpha designation may be a cue to location, e.g. "JL" for Jackson Lake. Perches need to be mapped and described as the **eagles use** them. New perches should be coded sequentially, but not recoded once used (e.g. JL1, JL2, SR3, CP4, JL2, SR4, SR3, etc.). UTM's can be digitized later from the master map. Perches at the nest can be described simply as "nest".

Con. Act. (concurrent activity) - is an activity that is of interest but it occurs as a result of a previous activity. For example, the adult male may fly to the nest with dried grass and then copulate with the female. The Main Act. would be a NV (nest visit), but the concurrent activities would be a NMD (nest material delivery) and a COP (copulation). Or, an adult may be perched at a forage site and then flushed by a passing F-16 fighter jet. The Main Act. is a PER (perch) and the Con. Act. is a DIST (disturbance). In this case, a DIST should also be noted in the next row as a Main Act. since it is an important event and DIST is considered a main activity. Besides main activities, concurrent activities include; NMD, COP, PD (prey delivery), BW (bill wipe), DRNK (drink), BATH (bathe), DEF (defecating),

NT (nest tending) and PRN (preening). These activities are interesting but not essential to mapping habitat.

Capt. Succ. (capture success) - is used to denote if an activity results in a successful prey capture (yes, no, unk.).

Prey species (Sp) or class (C) - is used to note prey type if it is **identifiable**; i.e. mallard (S), fish (C), ground squirrel (C), etc.

End Time - used to document when an activity ceases. For example, the time when an eagle leaves a perch or finished feeding young.

Total Time - the number of minutes an activity has occurred; determined by subtracting "Begin Time" from "End Time." For example, an AFB may have occurred from 0615 until 0626; the Total Time is 11 minutes. or, an adult might be perched at the nest (NV) from 0730 until 1122; the Total Time in this case is 232 minutes.

Comments - is for noting other activities or observations that may be important or useful at a later time. For example, if an eagle is flushed from a perch (DIST) by a nearby bulldozer breaking rocks, it would be useful to record the type and distance to this disturbance stimuli from the perch site.

At the bottom of the data sheet is an area to record other Wildlife Observations including time, species, number, and location. These observations also may be useful at a later date.

BALD EAGLE ACTIVITIES FORM

Year	Day	Begin Obs	End Obs	Total Obs	Obs Loc.	Temp	Precip	Cloud	Wind Sp	Wind Dir	Form
Begin Time	Individ.	Main Act.	Location	Con. Act.	Cap. Suc.	Prey	End Time	Total Time	Comments		
Wildlife Observations				Time	Species	No.	Location				

APPENDIX V

Recommended Procedure for Developing Site-specific Bald Eagle Management Plans

Recommended Steps	Management Concerns
1. Document historical use of area by eagles.	<ul style="list-style-type: none"> a. Past nest and roosting sites b. Feeding areas c. Winter use
2. Document habitat conditions of historical breeding territories.	<ul style="list-style-type: none"> a. Other resource uses b. Vegetative succession c. Prey base d. Changes in waterways e. Pesticide use f. Urban development
3. Determine site-specific nesting chronology and productivity.	<ul style="list-style-type: none"> a. Previous surveys b. Working Group files
4. Delineate breeding area boundaries based upon site-specific habitat use patterns by telemetry or intensive observation.	<ul style="list-style-type: none"> a. Current nest and roosting sites b. Feeding areas by season c. Winter areas
5. Characterize existing and potential nest sites.	<ul style="list-style-type: none"> a. Breeding area and nest site measurements
6. Characterize pair behavior.	<ul style="list-style-type: none"> a. Response to disturbance
7. Evaluate prey availability.	<ul style="list-style-type: none"> a. Identify fish concentration areas and population trends b. Map big game winter ranges c. Map waterfowl habitat d. Seasonal availability of prey e. Provide site-specific recommendations for protection and enhancement of prey habitat
8. Identify landowners and include them in all management considerations.	<ul style="list-style-type: none"> a. Solicit landowner cooperation and protection and provide information
9. Provide direction and coordination with appropriate resource managers or landowners to accommodate bald eagle needs.	<ul style="list-style-type: none"> a. Identify temporal limits on activities b. Spatial limits
10. Examine the silvics of trees within existing and potential breeding territories. Consult with professional forester.	<ul style="list-style-type: none"> a. Nest trees b. Shading c. Perches d. Roosts
11. Plan and schedule silvicultural treatments if manipulation is necessary to provide adequate tree size, growth type, and density, in consultation with a professional forester.	<ul style="list-style-type: none"> a. Potential nest tree b. Stand thinning c. Stand regeneration d. Species preference or conversion

12. Provide for alternate stands should disease or fire eliminate the primary stand.
 - a. Protection of tree stands from fire and disease
 - b. Identification of potential, replacement, or alternate stands within 800 m (1624 ft)
13. Identify factors which influence productivity and attempt to reduce their limiting effect.
 - a. Quality of habitat
14. Inventory recreation use levels at sites within and adjacent to occupied and potential breeding territories.
 - a. Developed recreation sites, campgrounds, special uses.
 - b. Dispersed recreation, land based: landings and campsites.
 - c. Dispersed recreation, water based: landings, campsites, boat dock, and boater use patterns.
15. Provide direction to recreation managers necessary for the protection of bald eagles.
 - a. Fishing and floating regulations
 - b. Location of access and development
 - c. Necessary closures
16. Identify existing and potential developments within breeding areas.
 - a. Subdivisions, developments, roads, and associated increases in human activities.
17. Identify special hazards.
 - a. Powerlines and pesticides.
18. Review site-specific nesting plans with the Working Group.
 - a. The working group will review plans for adequacy and interpretation of data.
 - b. Management recommendations will be evaluated.
19. Priorities for selection.
 - a. High hazard rating from surveys
 - b. Poor nesting success
 - c. High potential conflict ratings.
 - d. Any new activities in nest site and primary use areas.

Format Guideline

Bald Eagle Breeding Area Site-specific Management Plan¹

I. Background Information.

A. Basic Information.

1. Pertinent literature (recovery plan, species biology, management, landowner options, plan examples, and case histories).
2. List of additional knowledgeable contacts not directly involved with the site(s) in question.

B. Site-specific information.

1. Up-to-date map(s) and photo(s) showing nest location(s) ownership(s), and potential sources of human disturbance.
2. Precise directions to the nest site and to a nondisturbing viewpoint.
3. Geographic, topographic, and ecological description.
4. Land use - historic, current, and proposed.
5. All available history of bald eagle use of the area (i.e., productivity, nesting chronology, perch and roost trees, feeding areas and types of prey, pair behavior, etc.).
6. Forest stand and understory description.
7. Nest tree species, size, prominence, form, and condition (longevity?) for all nest trees.
8. Nest description and location in the tree for all nests.
9. List other considerations (i.e., winter use).
10. Estimate how long current condition will persist.

II. Management recommendations.

A. Designed to best maintain or improve current condition of the nest site and food source based on eagle biology and other background information.

1. Delineate Nest Site Management Zone boundaries using eagle behavior, landform, etc., as guides.
2. Consider and define restrictions on human activities by area (i.e., permanent road closures, pesticide use, etc.).
3. Consider and define restriction on human activities by time (i.e., seasonal road closures, seasonal logging restrictions, etc.).

4. List and prioritize information needs (i.e., prey base, perch sites, etc.).

5. List and prioritize hazards and conflicts (i.e., land development, logging etc.).

B. Designs to ensure equal or enhanced nesting and feeding opportunities when conditions change.

1. Identify and plan for alternate nest sites.
2. Discuss forest management needs (i.e., artificial nest structures or perches, silvicultural treatments to maintain or improve habitat quality, fuel management, etc.).
3. Anticipate and discuss land use changes.
4. Discuss feeding area/prey base management needs (i.e., artificial perches, plantings for future natural perches, prey base enhancement, etc.).
5. List additional information needs.
6. List other considerations (i.e., will modifications affect winter use?).

III. Compliance and review.

A. Coordinating body to compile a plan agreeable to all participants.

B. All participants to receive a copy of the plan.

C. Implementation schedule.

D. Tie monitoring and further action to land use permitting agencies in a way that keeps all participants involved (i.e., contact all participants when land use changes are proposed).

E. Tie monitoring and further action to annual reviews conducted in conjunction with annual surveys in a way that keeps all participants involved (i.e., annual letters).

F. Update the plan when necessary because of:

1. Changes in the habits of the eagles.
2. Land use changes.
3. New knowledge.
4. Changes in the attitude/interest of the landowner(s).
5. Other considerations

¹ Courtesy Washington-Oregon Bald Eagle Working Group.

