Bald Eagle and American Peregrine Falcon Management Plan

Attachment B

Draft New Bullards Bar Reservoir Fish and Wildlife Management Plan

Yuba River Development Project

FERC Project No. 2246

September 2019

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NEW BULLARDS BAR RESERVOIR

Fish and Wildlife Management Plan

April 11, 2002
(updated with Appendix C)

FORWARD

This draft report has been compiled by the Downieville Ranger District, Tahoe National Forest. Most information was obtained from District records. This is intended to be a living document, and updated as needs arise. Initial formatting is designed so that tables and figures may be easily revised and inserted. Revision dates should be incoporated into sections as appropriate. Individuals participating in the development of the plan, listed alphabetically, are:

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I. Introduction

The Endangered Species Act (ESA) of 1973 (P.L. 93-205), as amended in 1978, 1979, and 1982, directs Federal departments and agencies to ensure that actions authorized, funded, or carried out by them are not likely to jeopardize the continued existence of any threatened or endangered species. The ESA also prohibits "take" of listed species by a federal action without a permit, and it requires all federal agencies to protect and restore threatened or endangered species. Take is defined as "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such event."

The bald eagle was listed as an endangered species in 1973. In 1988, a large stick nest was found on the Garden Valley Peninsula (New Bullards Bar Reservoir). In 1989, the Tahoe National Forest consulted with the U. S. Fish and Wildlife Service (USFWS) under Section 7 of the Endangered Species Act for actions associated with the Skyline Timber Sale. In a letter of concurrence, the USFWS directed the Tahoe National Forest to prepare a management plan for bald eagles at the reservoir. Two subsequent consultations resulted in similar direction from the USFWS: (1) In 1997 for actions at the dam by the Yuba County Water Agency, and (2) In 2000, for actions by the Tahoe National Forest associated with the Pendola Fire Restoration Project.

The need to develop a management plan for bald eagles was the driving force for this plan. However, in 1999 a population of California red-legged frogs, a federally threatened species (USDI Fish and Wildlife Service 1996), was discovered in Little Oregon Creek (New Bullards Bar tributary). Activities that mitigate for potential effects to frogs had the potential to conflict with mitigating effects to bald eagles, and vice versa. Therefore, the scope of this plan was expanded to address the California red-legged frog.

Management actions and activities have the potential to affect many species of fish and wildlife. Most actions to protect wildlife focus around maintaining and enhancing habitat, protecting individuals within key areas (i.e. nests, roosts, feeding and spawning areas) or during critical times (breeding). Sharing information regarding where important habitats occur, understanding historic and present wildlife use areas, existing threats to populations, and selecting places to emphasize wildlife management and human use, can reduce conflicts between people and wildlife.

Standard mitigations commonly employed to reduce adverse effects to one species may be in conflict with mitigations for another, or become so restrictive as to become impractical to apply. For example, prohibiting an activity in the fall and winter to protect one animal, and during the spring and summer to protect another, can leave managers with few choices. Integrating information for all fish and wildlife needing protection allows conflicts to be identified early in the process so that solutions can be sought. This plan is intended to facilitate the ability of decisionmakers to make informed choices that better ensure their management actions comply with existing laws and management direction and work towards achieving goals for recovering federally-protected species at New Bullards Bar Reservoir.

Management Plan Objectives

1. Fulfill the USDA Forest Service (USFS) and Yuba Cunty Water Agency's (YCWA) obligations to the USFWS (as mandated by FERC), which is to protect and manage habitat important to the species survival.

2. Help manage to meet the population goals identified in the Recovery Plans for federally-listed species.

3. Manage for a safe visitor experience while mitigating adverse effects to threatened, endangered, and sensitive species.

4. Restrict human disturbances (walking, driving, mountain biking, boating, camping, operating machinery) within the Management Plans area of interest to protect and sustain existing and potential listed species populations and habitat.

5. Provide land managers with guidance regarding the kinds of actions that may require consultation with the U. S. Fish and Wildlife Service.

National Forest Management Direction

The Tahoe National Forest Land and Resource Management Plan (LRMP) states that habitat management for federally threatened and endangered (T&E) species will focus on increasing populations as identified in species recovery plans. It also says that the Forest will coordinate habitat management with the California Department of Fish and Game (CDFG) and the USFWS are responsible for managing animal populations. The three agencies have cooperatively developed priorities for developing management programs for individual species, with the first priority given to federally threatened and endangered species.

FSM 2670.31 THREATENED AND ENDANGERED SPECIES

1. Place top priority on conservation and recovery of endangered, threatened, and proposed species and their habitats through relevant National Forest System, State and Private Forestry, and Research activities and programs.

2. Establish through the Forest planning process objectives for habitat management and/or recovery of populations, in cooperation with States, the USFWS, and other Federal agencies.

3. Through the biological evaluation process, review actions and programs authorized, funded, or carried out by the USFS to determine their potential for effect on threatened and endangered species and species proposed for listing.

4. Avoid all adverse impacts on threatened and endangered species and their habitat except when it is possible to compensate adverse effect totally through alternatives identified in a biological opinion rendered by the USFWS, or when the USFWS biological opinion recognizes an incidental taking. Avoid

adverse impacts on species proposed for listing during the conference period and while their Federal status is being determined.

5. Initiate consultation or conference with the USFWS when the USFS determines that proposed activities may have an adverse effect on threatened, endangered, or proposed species or when USFS projects are for the specific benefit of a threatened or endangered species.

6. Identify and prescribe measures to prevent adverse modification or destruction of critical habitat and other habitats essential for the conservation of endangered, threatened, and proposed species. Protect individual organisms or populations from harm or harassment as appropriate.

The Biological Opinion issued by the U. S. Fish and Wildlife Service for the Sierra Nevada Forest Plan Amendment Final Envirnmental Impact Statement includes conservation recommendations for listed and unlisted species that have been petitioned for listing pursuant to the Act. Unlisted species that may occur in and around Bullards Bar Reservoir are the California spotted owl and Pacific fisher. These are "discretionary agency activities to implement recovery actions, to help implement recovery plans, to develop information, or other further the purposes of the Act.

FSM 2670.32 SENSITIVE SPECIES

1. Assist States in achieving their goals for conservation of endemic species.

2. As part of the National Environmental Policy Act process, review programs and activities, through a biological evaluation, to determine their potential effect on sensitive species.

3. Avoid or minimize impacts to species whose viability has been identified as a concern.

4. If impacts cannot be avoided, analyze the significance of potential adverse effects on the population or its habitat within the area of concern and on the species as a whole.

5. Establish management objectives in cooperation with the States when a project on National Forest System lands may have a significant effect on sensitive species population numbers or distribution. Establish objectives for Federal candidate species, in cooperation with the USFWS and the States.

Region 5 of the USDA Forest Service maintains a sensitive species list for species found within the national forests whose populations may be at risk. The goal of land managers is to mitigate adverse effects and to manage for sufficient populations of these species, thus avoiding the need to protect them under the Endangered Species Act. Therefore, although bald eagles and Califronia red-legged frogs will be the primary focus of this Management Plan (Figure 1), we will also discuss existing and potential populations and habitat of USFS Sensitive Species in the area of interest (ie., foothill yellow-legged frog and Northwestern pond turtle). This plan is designed so that information regarding additional species of concern and sensitive species may be added at a later date as funding and time allow.

Managing for a full array of wildlife at the reservoir requires baseline information that identifies the type of habitat and species that may be present, as well as surveys to determine species occurrence. Table 1 lists the species that may occur in and near New Bullards Bar Reservoir that have special State or Federal status.

Table 1. Fish and Wildlife species of interest that may be present at New Bullards Bar Reservoir and their State or Federal Status.

Common Name	Scientific Name	Status
Birds		
Bald eagle	*Haliaeetus leucocephalus*	FT, SE
American peregrine falcon	*Falco peregrinus anatum*	FSS, SE
California spotted owl	*Strix occidentalis occidentalis*	FSS, CSC
Northern goshawk	*Accipiter gentilis*	FSS, CSC
Greater sandhill crane	*Grus canadensis tabida*	FSS, ST
Osprey	*Pandion haliaetus*	FSI, CSC
Great Blue Heron	*Ardea herodias*	FSI, CSC
Mammals		
Fisher	*Martes pennanti*	FSS, CSC
Wolverine	*Gulo gulo*	FSS, ST
Pallid bat	*Antrozous pallidus*	FSS, CSC
Townsend's big-eared bat	*Corynorhinus townsendii*	FSS, CSC
Western red bat	*Lasiurus blossevillii*	FSS
Reptiles		
Northwestern pond turtle	*Clemmys marmorata marmorata*	FSS, CSC
Amphibians		
California red-legged frog	*Rana aurora aurora*	FT, CSC
Foothill yellow-legged frog	*Rana boyleii*	FSS, CSC
Fish		
Hardhead	*Mylopharodon conocephalus*	FSS, CSC

CSC = California Species of Special Concern
FSI = Forest Service Special Interest
FSS = Forest Service Sensitive, Region 5
FT = Federally listed, Threatened
SE = State-listed Endangered
ST = State-listed Threatened

(Table updated 4/11/02)

Some of these species are known to occupy key areas of New Bullards Bar Reservoir, while others are less known or assumed to be present because their habitat is present. Thorough systematic surveys for many sensitive species have not been conducted. This makes it difficult to mitigate effects at site-specific locations; and, instead, may result in recommended mitigations that cover broad habitats.

In addition to the species listed in Table 1, a historic migratory route for the Downieville Deer Herd traverses the reservoir, and deer continue to swim this route (California Department of Fish and Game). The increase in shrub forage as a consequence of the 1999 Pendola Fire is expected to attract higher concentrations of deer within the northern portions of the reservoir.

The primary game fish present at New Bullards Bar Reservoir are: Kokanee salmon (*Oncorhynchus nerka*), rainbow trout (*Oncorhynchus mykis*), largemouth bass (*Micropterus salmoides*), small mouth bass (*Micropterus dolomieui*), spotted bass (*Micropterus punctulatus*), and green sunfish (*Lepomis cyanellus*). These species are stocked by the California Department of Fish and Game and private interst groups. Sacramento pike minnow (*Ptychocheilus grandis*) and Sacramento sucker (*Catostomus occidentalis*) are the primary native non-game fish.

The need to manage a variety of resources and activities while protecting threatened, endangered, and sensitive species and other fish and wildlife presents a difficult challenge. Activities such as urban development, timber harvesting, recreation activities, recreational developments, woodcutting, water drafting, road maintenance and development, and reservoir maintenance can adversely affect wildlife. The following briefly summarizes the kinds of effects that humans can have on wildlife.

Direct Effects include activities that disturb, increase stress, reduce fitness, lower reproduction, increase predation, displace, or kill individuals. For example, continuously disturbing individuals from foraging sites increases their energy requirements and reduces feeding opportunities. If this happens at critical times, it and can prevent them from reaching breeding condition, successfully reproducing, or dying from starvation.

Indirect effects include activities that lead to the degradation or removal of breeding, foraging, sheltering, or movement habitat, or activities that reduce food resources. Habitat may be degraded by physically changes to its structure or function, and also by increasing human disturbances so it regularly displaces animals out of it.

Cumulative effects combine the effects from past, present and reasonable foreseeable future activities. When taken individually, no single activity may cause much of an effect, but when combined with other activities over time and place, the increased effects to individuals or populations may be significant.

Yuba County Water Agency's Missions and Goals

A mission and goal stated in the Yuba River Development Project Plan (Yuba County Water Agency 1993) is to maintain habitat for healthy fish and wildlife species. The Federal Energy Regulatory Commission does not stipulate specific plans for protection of threatened and endangered species, but expects the property owner (USFS and YCWA) to fulfill their protection obligations according to the rules of the U. S. Fish and Wildlife Service.

In a letter dated January 21, 1999, the Yuba County Water Agency proposed a Draft Operation and Maintenance Guidelines for the Yuba River Development Project for ESA listed and USFS Species of Concern. This letter addresses their agency goals and proposed implementation of goals. A summary of this letter states:

> Conduct YCWA Yuba River Development Project operation and maintenance activities in a manner that minimizes impacts to species of concern. Implementation would occur through an annual meeting each January with USFS and YCWA staff to review planned projects and activities. Activities of possible concern would be identified, and plans would be developed to avoid or minimize impacts. This meeting would attempt to develop work schedules and approaches that minimize potential impacts that are identified.
>
> Identify known species listed under the state and federal ESA and USFS species of concern. Develop and education program for YCWA and YCWA concessionaire employees to recognize species of concern, their habitat, and critical life stages. When requested by USFS, YCWA will assist USFS by reporting sightings of species of interest.

II. Land Ownership and Management

A variety of public and private interests, within the Management Plan area of interest, own and manage land around New Bullards Bar Reservoir (Figure 1). The majority of the land is National Forest Sytem Lands, managed by two national forests, the Tahoe National Forest on the east, and the Plumas National Forest on the west. The Yuba County Water Agency owns the majority of the private land around the perimeter of the reservoir, with individual private property owners and residential housing occupying the remainder.

The U. S. Forest Service and Yuba County Water Agency manages the majority of the land within the first mile of the water's edge around the Reservoir. Residential development that has occurred in the past 10 years is mostly concentrated outside the first mile, northwest near Moran Cove, south near Moonshine Road, and east around the town of Camptonville. This residential development has resulted in an effort by the U. S. Forest Service to emphasize fuels reduction projects around these communities. Under the Sierra Nevada Forest Plan Amendment (USDA Forest Service 2001), two kinds of fuels reduction zones are delineated around communities: (1) Defense Zones, where the most intensive fuel-reduction efforts occur, and (2) Threat Zones, with less intensive treatments. Figure 1 delineates these land allocations as they occur around New Bullards Bar Reservoir.

III. Vegetative Communities

Figure 2 shows vegetative communities crosswalking Tahoe National Forest vegetation into the State of California WHR vegetation.

IV. Recreation

The Yuba County Water Agency is licensed to manage New Bullards Bar Reservoir and provide hydroelectric power, flood control, domestic and agricultural water, and recreation. The reservoir is a 966,103 acre-foot water storage facility, covering 4,809 water surface acres at a maximum water surface elevation of 1,956 feet above sea level (Yuba County Water Agency 1993). The reservoir is mostly undeveloped, but offers easy road access and is particularly attractive to those seeking motorized boat recreation in a scenic setting of forests and remote canyons.

A permit system is used to manage the number of houseboats and boat access campsite users. A maximum of 74 boat access campsite permits (on the shoreline or on developed sites accessible only by boat) will be issued on any one day. When the reservoir is above 1941 feet, permits will be limited to the 38 developed camp sites only. The number of houseboats occupied at any one time is limited to 60.

Recreational camping use includes boat and car camping (Table 2), and day-use boating and picnicking (Table 3).

Table 2. Total Recreational Visitor Days (RVDs) for camping use (boat and car camping)

Year	RVDs
1988	27,575
1989	40,287
1990	49,797
1991	67,919
1992	61,990
1993	59,369
1994	51,699
1995	54,707
1996	41,537
1997	45,079
1998	54,000
1999	69,077
2000	64,616
2001	62,913

(Table 2 updated 4/11/02)

Table 3. Total Recreational Visitor Days (RVDs) for day use (including boating and picnicking)

Year	RVDs
1985	7,765
1986	14,041
1987	13,299
1988	16,775
1989	19,338
1990	24,711
1991	29,118
1992	32,682
1993	25,110
1994	26,583
1995	27,592
1996	26,171
1997	information not available
1998	30,424
1999	26,208
2000	27,752
2001	33,074

(Table 3 updated 4/11/02)

Figure 3 shows the levels of recreational use that occurs around the reservoir, showing the general areas of low, moderate, and high use areas and administrative sites.

IV. Species Addressed

A. BALD EAGLE

Applicable Laws and Management Direction

The bald eagle was listed as a federally endangered species in 1978. On July 12, 1995, this species was reclassified to Threatened status in the lower 48 states. It was proposed for de-listing on July 6, 1999, but remains protected unless delisting is finalized. Following delisting, the species would be placed on the Region 5 Regional Forester's Sensitive Species List (USDA Forest Service 1999). Monitoring is required as a part of the delisting process.

If delisted, bald eagles will continue to be protected under the Migratory Bird Treaty Act of 1918 and the Bald and Golden Eagle Protection Act. Measures currently being taken to minimize disturbance at nesting sites should be maintained in future management for this species. The bald eagle is also currently protected under the State of California Endangered Species Act, listed as state endangered.

National Forest Management Direction

Once delisted, Region 5 of the USDA Forest Service would place it on the Regional Forester's Sensitive Species List and it would be managed according to Forest Service Manual 2670 direction. The species status as "Sensitive" in Region 5 would be re-evaluated at the end of the five-year monitoring period that is identified in the U. S. Fish and Wildlife Service's Final Rule for delisting the species, as published in the Federal Register; or if there is a change in the species' status under the ESA during this period (for example, if the Fish and Wildlife Service initiated relisting due to information gathered from monitoring).

As stated in the Tahoe National Forest Land and Management Plan (p V-27), the forest will "adopt the Recovery Plan for the Northern Bald Eagle as the guide for management on the Forest," and "manage nesting and wintering habitats for target populations as specified in the species recovery plan." Conservation Recommendations for the bald eagle taken from the Biological Opinion for the Sierra Nevada Forest Plan Amendment (USDA Forest Service 2001) represent the most recent management recommendations. They are as follows:

1. Assist the Service in further implementing recovery actions identified within the Recovery Plan for the bald eagle.

2. Conduct systematic surveys across the landscape to detect additional bald eagle nests and communal night roosts.

3. Monitor bald eagle responses to human generated disturbances, including threats and changes to bald eagle habitat. If the data results indicate bald eagles are exposed and negatively impacted by disturbances, consult with the Service on ways to minimize the impacts.

4. Promote public education regarding the importance and successes of conservation and protection of the bald eagle and other listed species. This can be done using signs in occupied habitat, brochures at ranger stations, and other mediums.

5. Within two years of the signing of the Record of Decision, prepare a bald eagle management plan for every basin or site in the analysis area with occupied bald eagle territories. Each bald eagle management plan should be prepared in consultation with the Service. The objective of a bald eagle management plan should be to perpetuate existing habitat conditions in the nesting, foraging, and wintering areas to maintain nesting pairs of bald eagles and to provide for additional nesting territories, based on the habitat suitability and carrying capacity of the area (as measured using Peterson's (1986) bald eagle habitat suitability index model). Each bald eagle management plan should address the effects of recreation, mining, timber management, residential development, hydroelectric power production, fisheries management, and other effects to bald eagles while offering measures to minimize these effects, including:

   A. Seasonal (January 1 to August 31 or 3 weeks after chicks have fledged) road closures within a quarter mile of bald eagle use areas should be implemented on roads, off-highway vehicle routes, or over snow vehicle routes within a quarter mile of bald eagle nesting, roosting, or wintering areas.

B. Seasonal (January 1 to August 31 or 3 weeks after chicks have fledged) boating restrictions should be implemented within a quarter mile of bald eagle use areas where recreational boating and other water activities pose potential negative impacts to breeding, roosting, or wintering bald eagles.

C. Seasonal (January 1 to August 31 or 3 weeks after chicks have fledged) trail restrictions should be implemented within 500 feet of a bald eagle nesting, roosting, or wintering area where hiking and bicycling trails pose potential negative impacts to the bald eagle use area.

D. Non-system and other roads that lead to sensitive bald eagle habitat such as nesting, foraging, or roosting sites should be gated and bermed.

E. Protection and enhancement of fish habitat in occupied bald eagle use areas through the maintenance of streambank stability by restricting activities such as, but not limited to livestock trampling, OHV use, stream crossings, and recreational use.

F. Protection and enhancement of waterfowl habitat in occupied bald eagle use areas through the maintenance of riparian and lake shore vegetation (waterfowl nesting habitat) by restricting activities such as, but not limited to livestock trampling and grazing, OHV use, and recreational use.

G. Seasonal restrictions on logging activities to avoid the bald eagle breeding period (January 1 to August 31 or 3 weeks after chicks have fledged) within one half mile of a nest. This should be increased to one mile for helicopter logging activities. In areas with wintering bald eagles, implement seasonal restrictions on logging activities to avoid the bald eagle wintering period (approximately November 15 to March 15) within one quarter mile of roosts, increase to one half mile for helicopter logging activities.

H. Seasonal restrictions on prescribed burns. Do not implement prescribed burns within one quarter mile of a nest during the breeding season (January 1 to August 31 or 3 weeks after chicks have fledged). If the nest is unoccupied or prescribed burns are to take place outside of the breeding season, maintain the fire at a distance of 500 feet from the nest. Fuels within a 500 foot radius of the nest should be hand thinned. In areas within 500 feet of bald eagle roosts and perches, implement seasonal restrictions on prescribed burns to avoid the bald eagle wintering period (approximately November 15 to March 15).

Yuba County Water Agency's Missions and Goals

The Yuba River Development Project Plan identifies one bald eagle nest near the Garden Point Boat Access Campground. It also identifies the northwest shoreline of the reservoir near the Burnt Bridge Campground as a potential future nesting area, and it states that if any new recreation facilities are planned in known or potential bald eagle nesting or roosting areas, a site specific analysis of the impacts

of such development should be performed. The Burnt Bridge Campground was closed in September 1996, with no plans to reopen.

In their development plan (Yuba County Water Agency 1993) the water agency identifies a number of habitat management objectives and policies as stated in the Tahoe National Forest's Draft Habitat Management Plan for the Bald Eagle (USDA Forest Service 1991) as follows:

> Prepare and implement site specific management plans for all known nest sites. Coordinate with Forest Service and other agency recreation plans, since most key eagle habitat areas coincide with high recreation use areas.
>
> Restrict human disturbances (vehicle, foot, and boat traffic) within 0.25 miles around nest(s) from January 1 to July 15. This buffer should be increased up to 0.50 miles if there is line-of-site vision. Time and distance buffers should be modified according to site-specific conditions.
>
> Coordinate with USFS recreation plans for potential nest areas and winter roost sites.
>
> Avoid clear-cut logging, road building, hiking trails, or boat launch facilities within 0.25 mile of potential nest sites. Other possible sources of disturbance, such as mining operations, campgrounds, boat traffic, etc. should be evaluated on a site-by-site basis.
>
> Restrict buildings closer than 0.25 mile from the shorelines of winter feeding waters.

The Pacific Bald Eagle Recovery Plan (USDI Fish and Wildlife Service 1986)

The Tahoe National Forest lies within Zone 28 (Sierra-Nevada Mountains) of the Pacific Bald Eagle Recovery Area (USDI Fish and Wildlife Service 1986). The Recovery Plan established a population goal for New Bullards Bar Reservoir of three breeding territories.

It calls for the design and implementation of site-specific plans throughout the recovery area that "secure individual nest sites, roosts, and foraging areas" (USDI Fish and Wildlife Service 1986), and that provide wintering habitat for an unspecified number of bald eagles. Local management plans should ensure that long term management: (1) provides suitable nesting and foraging habitat, (2) protects present and future habitat necessary for the well-being and continued existence of this species, and (3) restricts and minimizes human disturbances around critical habitat components.

It also calls for plans to describe the human activities that can be permitted as well as those that must be prohibited; and to describe the steps needed to protect and secure key habitat such as nests, roosting trees, and food resources. Each plan should include a map outlining the important eagle use areas and a list of appropriate methods for protecting suitable nesting, foraging, and roosting habitat over time.

A second component of the Recovery Plan is to "Manage breeding and nonbreeding habitat," which is described at the site-specific level as: "managers should identify and manage for the

specific needs of individual territorial pairs and groups of roosting eagles." (USDI Fish and Wildlife Service 1986).

The bald eagle section of this document is intended to meet the task of developing a site-specific plan at New Bullards Bar Reservoir in accordance with the direction, missions and goals identified by the agencies involved.

The following lists the Pacific Bald Eagle Recovery Plan work items that are applicable to this Management Plan:

1.11 Locate and describe all existing nest sites, communal roosts, foraging areas, and areas used during migration;
1.12 Assess the suitability of habitat not presently used by bald eagles;
1.23 Incorporate eagle habitat guidelines in agency land use plans;
1.31 Manage and improve quantity, quality, and availability of food supplies by:
1.3115 Review programs to control non-sport fish in known eagle foraging areas;
1.3116 Discourage chemical control of aquatic insects in eagle use areas;
1.3118 Maintain and improve habitat for fish by reducing siltation from logging, roads, and overgrazing;
1.3123 Leave avian and mammalian carcasses on site for future use by eagles;
1.3215 Preserve snags in eagle use areas;
1.33 Restrict human disturbance at eagle use areas;
1.331 Establish buffer zones around nest sites;
1.332 Exclude logging, construction, habitat improvement, and other activities during critical periods of eagle use;
1.333 Prohibit building construction near key bald eagle nesting and wintering habitats;
1.334 Prohibit vehicle traffic at sensitive key areas during periods of eagle use;
2.11 Monitor threats and changes to habitat (nesting territories, foraging areas, communal roosts, and associated winter habitat, and habitat for breeding and non-breeding eagles;
2.211 Inventory the breeding population and determine annual productivity;
2.212 Identify and monitor the size and distribution of wintering populations;
4.131 Replace or modify problem power line structures, using accepted designs;
4.132 Restrict power line construction within identified flight lanes near winter roosts;

History of Bald Eagles at New Bullards Bar Reservoir

Little documented historic information of bald eagle nesting is recorded for New Bullards Bar Reservoir. When the bald eagle was listed in 1978, no nesting eagles were known for the Sierra Nevada south of Lake Shasta. The Pacific Bald Eagle Recovery Plan identifies a goal of establishing three breeding territories at New Bullards Bar Reservoir. With only one known territory, this goal has not been achieved.

Bald eagle activity has been documented on New Bullards Bar Reservoir since the early 1970's. Reports that bald eagles were more abundant in the 1970's and 1980's are difficult to validate. The U. S. Forest Service conducted a nest search in 1978, and several possible eagle nests were observed. All the nests

were inactive. Nesting had not been documented at New Bullards Bar Reservoir until 1989, when a nestling was observed in a nest on the Garden Point peninsula. Since 1989 the Forest Service has monitored the Garden Point breeding territory for breeding success (Table 4). The District routinely maintains records of bald eagle sightings that are reported.

Road closures on the Garden Valley Road were implemented shortly after the discovery of the nest in 1989, with a gate preventing year-round vehicular access for 0.5 miles above the nest tree, and a seasonal closure (November 1 through May 31) north of this gate to its intercept with the Baker Ranch Road.

In October 1999, the Pendola Fire burned through the nest territory killing the nest tree on the west side of the peninsula (used 1989 through 1999). The eagles rebuilt their nest in a live tree on the east side of the peninsula near Tractor Cove. The nest failed during the 2000 breeding season, but fledged one young in 2001.

Since 1979, the Forest has conducted annual surveys of winter use around the perimeter of New Bullards Bar Reservoir the second week of January. As needed, monitoring has occurred at specific locations to better determine bald eagle use. Concentrations of sightings occur around the Garden Point area. Smaller clusters of sightings are also recorded at the dam site, Frenchy Point, and over New Bullards Bar Reservoir near Willow and Bridger Creeks.

Table 4. Reproductive success of Garden Point Breeding Territory

Year	No. fledged young	No. fledged/5 years	% success over 5 yrs.
1989	1	--	--
1990	2	--	--
1991	2	--	--
1992	2	--	--
1993	1	1.6	100
1994	2	1.8	100
1995	0	1.4	80
1996	0	1.0	60
1997	0	0.6	40
1998	1	0.6	40
1999	2	0.6	40
2000	0	0.6	40
2001	1	0.8	60

(Table 4 updated 1/15/02)

A second nest, further south and closer to the Garden Point Campground, has been identified on Garden Point Peninsula. Eagles have been observed occasionally in the vicinity, however no nesting activities or nestlings have been documented at this nest site. In October 1999, the Pendola Fire burned through the nesting territory, killing the nest tree and most conifers within a 1000-foot radius. The eagles rebuilt their nest in a live tree on the opposite side of the peninsula near Tractor Cove. The nest failed in 1999.

The Pacific Bald Eagle Recovery Plan goal is to achieve an average reproductive rate of 1.0 fledged young per pair, with an average success rate per occupied site of not less than 65% per 5-year period. New Bullards Bar has not met these criteria since 1995.

Numerous sightings of bald eagles are recorded throughout New Bullards Bar Reservoir during the winter months. The largest concentration of bald eagle use is within 0.5 miles of the dam in the winter. As many as 10 bald eagles, both adult and immature, have been observed perching together. Bald eagles are often observed foraging at this location in the fall, especially when the kokanee congregate at the dam.

Since 1979, annual surveys have been conducted during the National Wildlife Federation Midwinter Bald Eagle Survey (Table 5).

Table 5. New Bullards Bar Reservoir mid-winter bald eagle survey results

Year	Adults	Immature	Unknown
1979	1	9	
1980	1		
1981	no record		
1982	2		
1983	no record		
1984	6		
1985	no record		
1986	4	2	
1987	6	3	
1988	1	1	
1989	2	1	
1990	--	--	
1991	7	3	
1992	4	4	
1993	--	--	
1994	--	--	
1995	2	1	
1996	10	7	
1997	6	2	1
1998	4	1	
1999	4	3	
2000	7	3	
2001	1	1	
2002	3		

(Table 5 updated 1/15/02)

Habitat

New Bullards Bar Reservoir supports a diversity of vegetation typical of montane hardwood-conifer habitats. The most common tree species are Ponderosa pine (*Pinus ponderosa*), sugar pine (*Pinus lambertiana*), Douglas-fir (*Pseudotsuga menziesii*), incense cedar (*Calocedrus decurrens*), California black oak (*Quercus kelloggii*), tan oak (*Lithocarpus densiflorus*), and Pacific madrone (*Arbutus menziesii*).

Bald eagle habitat is discussed similar to that described in the Pit River Interagency Bald Eagle Management Plan (1986), as follows:

1. Nesting Habitat. This habitat is designated immediately around all nest sites existing in the plan area. The size and shape of the designated area varies at each nest territory depending on topography, number of nest sites in the territory, and the known habits of each eagle pair. This designation is the most restrictive with regard to timber management and human activity.

2. Essential Habitat. This designation includes all areas used by bald eagles for nesting, foraging, perching or roosting; it includes the areas designated as nesting habitat. The essential habitat designations are based upon limited field knowledge of eagle use, and the designated areas should be refined in the future. This designation, although not as restrictive as nesting habitat, also imposes limitations on human activity, timber, fisheries management and other activities. In areas where essential habitat is surrounded by expansion habitat, it is hoped that future nesting activity may occur in addition to present foraging use.

3. Expansion Habitat. These are areas presently receiving a low level of bald eagle use, but appear suitable to accommodate an expansion of the bald eagle nesting population. Using Peterson (1986), the Habitat Suitability Index at Bullards is calculated around 0.8. Using the model presented by Peterson (1986), human disturbances are most likely the primary limiting factor to bald eagle nesting at the Reservoir is human activities. The Recovery Plan for the Pacific Bald Eagle requires that the population be managed for expansion, recovery, and eventual delisting of the species. Under the objectives of this plan, expansion habitat also serves as a buffer against a loss of an existing nesting territory in the plan area. At Bullards Bar Reservoir, the Recovery Plan identifies a recovery goal of three breeding eagles. Therefore, for this plan, expanded breeding territories that could potentially serve as this expansion habitat are the following: (1) The area southwest of Moran Cove/Burnt Bridge, and (2) Willow Creek and south, and (3) Long Point. These are displayed in Figure 4. Following recommendations similar to those made in the Pit River Interagency Bald Eagle Management Plan (Lassen National Forest, 1986), the recommendations for expansion habitat should be regarded as equivalent to essential habitat. The two designations vary in the present level of bald eagle use within them. Human activities which occur in expansion habitat should be planned so as not to preclude future eagle use. Should nesting occur in these or any other areas around the Reservoir, the habitat designations will be upgraded as necessary.

Recreation

Disturbance by recreationists can adversely affect bald eagles. The effect of disturbance on eagles varies with the intensity of recreational use, distance to eagle use areas, time of year, and other factors. Nest territories, foraging areas, and roost sites are particularly sensitive to disturbance and require special management. Nearly all common recreational activities, including fishing, boating, hiking, hunting, camping, or birdwatching, can potentially conflict with bald eagle management when they occur in essential habitats. Managing bald eagles seeks to minimize interactions with recreationists in essential habitat whenever possible. The objective of this element is to avoid increased recreation in essential eagle habitats while solving existing recreation conflicts with bald eagles.

Illegal killing of eagles is a problem in northern California, including the shooting of a bald eagle at New Bullards Bar Reservoir in the late 1990s. Land management agencies should educate their personnel and contractors regarding laws that protect eagles, and the appropriateness of publically disclosing specific locations of sensitive areas around New Bullards Bar Reservoir, such as nest and roost (especially winter night roost) locations. Signing administrative closures or interpretive developments should also consider the effects of particular wording of signs.

In 2000, National Forest System Lands within 0.25 to 0.5 miles of the nest were seasonally closed to public access (April 1 through August 31) within 0.25 to 0.5 miles of the nest. The lower mile of the Garden Valley Road is closed to the general public year-round; it is used for administrative purposes which generally includes a few visits to the campground during breeding season for maintenance. Once a new nest was discovered in Tractor Cove (March 2000) a buoy system was installed to close a portion of Tractor Cove (May 2000). Closures to protect breeding sites should cover Janauary 1 to August 31 or three weeks after chicks have fledged (USDI Fish and Wildlife Service, Biological Opinion, 2001).

With the exception of the seasonal closure at Tractor Cove, all shorelines are open to public camping by permit. Trees that die along the shoreline that have a potential to fall within public use areas, and eventually float into the water, both of which create public safety hazards. The USFS and the YCWA have a commitment to provide a safe recreating experience for the public. Felling and removing dead trees that could provide foraging perches for eagles, may remove habitat elements important to eagles. Standards need to be developed to reduce effects to bald eagles while still providing a safe visitor experience, and that assist land managers in understanding what actions necessitate consultation with the U. S. Fish and Wildlife Service.

Floating toilets have variably been placed around New Bullards Bar Reservoir, and they increase human presence around them. In the past, toilets were sometimes placed in the vicinity of the bald eagle nest. Selection of sites to place these facilities should consider the effects this has in increasing boat traffic.

General maintenance at campgrounds and day use facilities includes routine cleaning, trash collection, and pumping of outhouses. In the past, the Garden Point Road was used for truck access to pump the outhouse. Because of the close proximity of the bald eagle nest to the Garden Point Road, pumping should occur in the Fall of each year, to avoid the necessity of spring pumping. Vehicle access to the campground is again needed by July, but this would occur after egg incubation and hatching.

Planned developments to enhance recreational opportunities and experiences need to consider their effect of increasing or changing human activities within essential bald eagle habitats.

There is a need to routinely remove hazard trees around the reservoir and its related facilities. Trees with a high probability of having limbs or entire trees fall on people, vehicles, or structures, present a public safety hazard, especially within frequently used areas of the Reservoir. In the past, trees identified as hazards (generally ones showing signs of decay, or dead and dying trees) are reviewed on an individual basis and subsequently felled. This commonly occurred within and around administrative sites (campgrounds, day use areas). Consultation on this routine activity needs to occur, to incorporate recommendation from the U. S. Fish and Wildlife Service for federally-listed species. Because of the high numbers of hazard trees potentially created by the Pendola Fire, informal consultation for the Pendola Restoration Project (March 1999) allowed for the removal of dead and dying hazard trees along the water's edge. Additional mortality is occurring within these stands, and this may necessitates reviewing appropriate standards for the felling and removing of hazard trees covered under that consultation and the need to pursue additional consultation. Developing guidelines for routinely addressing hazard tree removal and disposal by burning at the Reservoir can clarify the need for additional measures to be incorporated within the burn area.

Trail maintenance activities that incorporate the use of mechanized equipment should apply appropriate limited operating seasons to protect bald eagles. If there are questions regarding the kinds of activities, locations and times of limited operating seasons, a qualified biologist should be consulted. A biologist should be consulted regarding any use of herbicides along trails or within administrative sites.

With the exception of the administrative closure within Tractor Cove, the remainder of the shoreline is open to camping. Steep terrain naturally eliminates portions of the shoreline to high public use, with picknicking and overnight camping being patchily distributed on the shore. Considerations should be made regarding the need to close additional areas to promote bald eagle nesting.

Vegetation Management

In 1989, the Skyline timber sale included several mitigations and management requirements to eliminate disturbances to bald eagles and promote suitable bald eagle habitat. Although different from current mitigations recommended through consultation with USFWS, consultation at the time required the following:

Establish a ¾ mile zone around the bald eagle nest (Garden Valley Peninsula area) and implement silvicultural prescriptions that promote suitable bald eagle habitat.

Maintain a seasonal logging and road closure in the Garden Valley Road area (November 1 through May 31) to protect bald eagle nests.

In 2000, the Pendola Fire Restoration project salvage logged within the breeding territory. Among others, all trees previously used for nest building were retained, whether dead or alive, and all trees greater than 18 inches were retained. Fire-killed hazard trees along the shoreline were removed (trees

within 165 feet of the shoreline within high public use areas). To provide for shoreline perching structures, trees that are immediately adjacent to the shoreline should be felled waist high.

The Sierra Nevada Forest Plan Amendment significantly changed timber management within the Sierra Nevada. Land allocations determine the timber management activities that can occur within them, with the attainment of fuels reduction a primary driving factor for management actions. Site-specifically, land allocations for fuels treatments and wildlife protection are the two greatest variables determining the management standard that is applied in any given place. Figure 1 identifies the fuels allocations (Defense and Threat Zones) for National Forest System lands around the reservoir; and Figure 5 identifies wildlife land allocations that emphasize the maintenance of old forest characteristics (California spotted owl and goshawk Protected Activity Centers, and spotted owl Home Range Core Areas).

Two activities commonly used in association with fuels reduction treatments are: (1) mechanical vegetation removal by masticating smaller diameter vegetation and (2) prescribed fire. Under the Sierra Nevada Forest Plan Amendment, most areas around the Reservoir lie within the "Threat Zone." The most excessive treatments allow for the removal of trees up to 20 inches in diameter, focusing on removing suppressed and intermediate trees to enhance stand heterogeneity. The treatments vary within zones by the level of canopy cover that may be removed, and the fuels reduction objectives that are met. Application of these standards should promote bald eagle nesting and foraging habitat within National Forest Lands around the Reservoir while decreasing the risk of fire.

Around administrative sites (campgrounds, day-use areas, boat launches), understory vegetation may be removed by hand or chainsaws. This material is often stacked and burned. It is most practical to conduct these activities by administrative personnel outside of the recreation season and fire season. Consultation needs to occur with the U. S. Fish and Wildlife Service to determine whether limited operating seasons need to be implemented for all of these activities; or whether a certain level of burning may be permitted at scattered locations around the Reservoir during the winter.

Residential Development

The majority of land within 0.5 miles of the Reservoir is managed by the Tahoe and Plumas National Forests and the Yuba County Water Agency (Figure 1). The Chy Company, a private timber company, owns several hundred acres of private land just north of Moran Cove. The Pendola Fire intensely burned through this area in 1999, and it was subsequently logged. Although bald eagles may forage along the shoreline, the general lack of suitable nest trees makes it less likely that a breeding territory would become established there. These lands are, however, within 0.75 mile of a winter night roost. Residential development could occur on this land in the future. Within one mile of the Reservoir, most residential development is east of the dam in the vicinity of Moonshine Road. Within two miles of the Reservoir, additional development is occurring east around the town of Camptonville and west around the town of Greenville. Residential development has the potential to affect winter night roosts and reduce nesting opportunities for eagles, but these effects become less likely as distance from the water increases.

Hydroelectric Power Production and Reservoir Maintenance

A list of routine maintenance activities was prepared for the Yuba County Water Agency, and it appears as Appendix A. Most appear have been occurring throughout the years at locations where disturbances have been ongoing. Some have been selected as having a higher potential to affect bald eagles, and should be discussed further in this plan. They are: gathering, stockpiling, and disposing of hazardous wood debris; identifying potential activities that may require consultation; and addressing activities at satellite locations that should be considered in context with this plan.

Dead trees that wash into New Bullards Bar Reservoir when water levels and flows are high, create floating hazards to boaters. Historically, the Yuba County Water Agency has gathered wood debris, contained it in various coves, waited for lowering water levels to land-lock this debris, and subsequently burn it. Optimal sites along the water's edge are places with gradual slope that also provide access by heavy equipment used to pile large pieces of wood for burning. Two places provide the best opportunities: Moran Cove and Tractor Cove. Following the 1999 Pendola Fire, the bald eagles relocated their nest just above Tractor Cove. Because of the bald eagle nest, no additional wood has been stockpiled there. The stockpiling of wood can create a physical barrier that reduces foraging opportunities for eagles. Disturbances from stockpiling wood, operating heavy equipment, and burning piles need to be avoided within essential habitats for bald eagles. Appropriate disposal methods, the timing of activities, and locations of disposal sites need to be selected in consultation with the U. S. Fish and Wildlife Service.

Three alternative coves have been tentatively selected for routinely stockpiling floating wood, based on road access, topography, and balancing threatened species concerns (Figure ___). Although the selected sites are within the bald eagle breeding territory, it appears that practical mitigations can be implemented to alleviate concerns to breeding eagles. Appropriate consultation on this activity needs to be pursued in the very near future with the U. S. Fish and Wildlife Service, and added as an appendix to this plan. Because floods will occur in the future, it would be prudent to establish perameters for identifying overflow sites during "emergencies," and the appropriate consultation procedures for use of these overflow sites.

Cottage Creek Boat Ramp

The dam, adjacent to Cottage Creek Boat Ramp, appears to have the highest concentrated bald eagle use during the winter. Typical mitigations to protect wintering eagles at foraging sites is to limit disturbances approximately between November 15 to March 15 within one quarter mile of roosts (USDI Fish and Wildlife Service 2001). Some years the kokanee begin congregating at the dam earlier, and foraging eagles are present (M. Tierney, personal observation). It is recommended that the limited operating period at the dam begin November 1. Activities that increase noise or disturbances above normal daily background levels such as painting the gates and construction work involving heavy equipment should follow the limited operating periods. Consultation with the U. S. Fish and Wildlife Service should occur if there are questions regarding the kinds and timing of activities. These dates should be better refined with additional monitoring information.

Fisheries Management

The California Department of Fish and Game releases Kokanee fingerlings and Rainbow trout in New Bullard Reservoir yearly (Table 6)

Mining

A search of the Bureau of Land Management data base in February 2002 shows 34 active claims encompassing 680 acres within a two-mile radius of the Reservoir—33 are placer claims, 1 is a lode claim. Active claims are limited to minor exploratory work, with, little to no surface disturbances, storage of equipment, structure building, or extended camping (longer than two weeks), without prior authorization from the U. S. Forest Service. The miner requests authorization by filing a Plan of Operations with the appropriate National Forest. At the present time, no active claims are operating under an approved Plan of Operations. As such, all are limited in scope. Should any expand, the miner would have to submit a Plan of Operation for review and approval by the U. S. Forest Service. At that time, the operation would be evaluated for its compliance with the Endangered Species Act and the National Environmental Policy Act. Any needed consultation with the U. S. Fish and Wildlife Service would occur at that time.

Because the California Department of Fish and Game issues dredging permits, an unidentified number of dredging operations may be present.

Current Site-specific Recommended Mitigations and Action Items

1. In 2000, National Forest System Lands within 0.25 to 0.5 miles of the nest were seasonally closed to public access (April 1 through August 31). The buoy closure remained in place in 2001, with closures officially in effect beginning January 1. Closures should continue to cover the bald eagle breeding season January 1 through August 31 (or three weeks after chicks have fledged), as recommended by the U.S. Fish and Wildlife Service.

2. The use of buoys and signs implementing a seasonal public access closure should continue to be implemented within Tractor Cove. Because this buoy does not prevent access for a full 0.5 miles line-of-sight distance from the Garden point nest tree, a 5m.p.h. speed zone was also signed within the remainder of the cove. Monitoring of the effectiveness of buoys and signs needs to occur in conjunction with monitoring reproductive success at the new nest. Should reproductive success remain below recovery goals, alternative solutions for reducing disturbances need to be considered (i.e. extending buoys to cover 0.5 mile line-of-sight distance, enforcement of 5mph zone).

3. Administrative closures prohibit general public access on land within 0.25 miles of the bald eagle nest during January 1 through August 31, including the Garden Point Road. The upper Garden Point Road gate has been repeatedly vandalized (lock removed) or left open, and the lower gate has been circumvented by motorcycles in previous years. In 1998, installation of new structures effectively closed this area to vehicle access, and monitoring confirmed its effectiveness through 1999 until the Pendola Fire and subsequent timber sale re-opened the landscapes vegetation that once served as barriers to limit vehicle access. The effectiveness of present barriers and gates needs to be diligently monitored in the future.

4. Work in consultation with the U. S. Fish and Wildlife Service to develop guidelines for the removal of hazardous trees along the shoreline and floating wood debris removal.

5. Locate all portable bathrooms > 0.5 miles from nests. These locations should also consider the resulting traffic patterns that may occur from boats accessing these facilities.

6. Identify routine maintenance activities that may/may not need consultation, and prioritize those that do.

Monitoring

Annual bald eagle monitoring (listed in order of priority) should include the following:

Bald eagle nest(s) to determine nesting status and success
Mid-winter survey (should include noting any nests observed and locations of eagles)
Winter night roost use
A spring search (April) for additional nest sites and/or territories (recommended during April)

If sufficient funding is available, monitoring should include:

Search for additional communal winter night roosts; monitor sites located.
Identify additional summer and winter foraging sites.
Search for nests on the North Yuba River between Indian Valley to its mouth

Past funding has been insufficient to support adequate monitoring, including the minimums described above. Funding opportunities should be sought from a variety of sources which may include:

FERC
USFS
YCWA
volunteers

B. CALIFORNIA RED-LEGGED FROG

Applicable laws and management direction

The California red-legged frog, *Rana aurora draytonii*, is listed as federally threatened (USDI Fish and Wildlife Service 1996). Therefore, the California red-legged frog and its associated habitat is protected under the Endangered Species Act of 1973 (ESA). Additionally, the USDI Fish and Wildlife Service (USFWS) identifies other activities that could result in take to include (but not limited to): 1) introduction of exotic species directly into or within dispersal distance of known listed species habitat, 2) unauthorized destruction/alteration of the listed species habitat such as discharge of fill material, draining, ditching, tiling, pond construction, diversion or alteration of stream channels or surface or ground water flow into or out of a wetland, 3) operation of any vehicles within the stream channel, 4) violation of discharge permits, 5) burning, cutting or mowing of wetland or riparian vegetation, 6) pesticide application, discharge, or dumping of toxic chemicals, silt, or other pollutants into waters or riparian and upland habitats supporting listed species (USDI Fish and Wildlife Service 1996).

A Draft Recovery Plan for the California red-legged frog was released for review on May 12, 2000 (USDI Fish and Wildlife Service 2000). The recovery objective is to de-list the California red-legged frog. The recovery strategy includes protecting existing populations by reducing threats, restoring and creating habitat that will be protected and managed in perpetuity, surveying and monitoring populations, conducting research on the biology of the species and threats to the species, re-establishing populations of the species within the historic range, and development of recovery units and core areas that will be the primary focus of recovery actions. The area of interest for this Management Plan falls within the Sierra Nevada Foothills Recovery Unit (Unit 1). The strategy for recovery of the California red-legged frog within Recovery Unit 1 will involve: protecting existing populations by reducing threats, restoring and creating habitat that will be protected and managed in perpetuity, surveying and monitoring populations and conducting research on the biology and threats of the subspecies, and reestablishing populations of the subspecies within its historic range (USDI Fish and Wildlife Service 2000). The Draft Recovery Plan also identified Indian Creek (New Bullards Bar tributary on the Plumas National Forest) as a core area. Recovery action within core areas should include habitat suitability assessments and long-term protection and management to perpetuate existing, or reestablished populations (USDI Fish and Wildlife Service 2000). No critical habitat is designated in the Management Plan area of interest (USDI Fish and Wildlife Service 2001).

History of California red-legged frogs at New Bullards Bar Reservoir and its associated tributaries

Prior to the flooding of New Bullards Bar Reservoir several wetlands existed that could have supported California red-legged frogs. The recent finding (Sept. 15, 2000) of frogs in Little Oregon Creek (tributary to New Bullards Bar Reservoir on the Plumas National Forest) could represent a remnant population from these wetlands. California red-legged frogs have also been observed in Indian Creek (tributary to New Bullards Bar Reservoir on the Plumas National Forest) near the town of Woodleaf from 1973-1983 (Jennings et al. 1992).

Life history patterns and habitat

The California red-legged frog is a highly aquatic species typically found in cold-water ponds and stream pools ≥ 2 feet deep with overhanging, emergent, and/or submergent vegetation (Hayes & Jennings 1988). They are generally found at elevations below 4000 feet, but have been found above this (Martin 1992). They are also generally found in or near water, but do disperse away from water after rain storms (Martin 1992). Optimal breeding habitat of California red-legged frogs is characterized by dense riparian vegetation associated with deep (≥ 2 feet), still or slow-moving water and emergent aquatic vegetation (Jennings 1988, Hayes and Jennings 1988). The California red-legged frog breeds during the months of November through March in most of their current range (USDI Fish and Wildlife Service 1996). Eggs are generally attached to emergent vegetation and hatch within 6 to 14 days of fertilization. The following larval stage usually spans 3.5 to 7 months. Larval development occurs in permanent or nearly permanent pools, and is a critical life stage since less than one percent of larvae reach metamorphosis (Jennings et al. 1992).

Management Plan area of interest

The Tahoe National Forest considers all aquatic habitats that contain water through July 31 (such as lakes, ponds, and water holes, and low gradient (<4%) stream habitats lacking spring flushing flows) located below 5000 feet as suitable breeding habitat for California red-legged frogs. Several studies of California red-legged frogs suggest that dispersal movement can occur over 1.25 miles and up to 2 miles without apparent regard to topography, vegetation type, or riparian corridors (USDI Fish and Wildlife Service 2001). California red-legged frogs may also may make overland excursions through upland habitats during wet weather and travel 300 feet from permanent water during winter to estivate (USDI Fish and Wildlife Service 2000). Based on the frog's mobility throughout the riparian corridor and uplands, we suggest adherence to the Sierra Nevada Forest Plan Amendment (USDA Forest Service 2001) guidelines in developing Riparian Conservation Areas (RCAs) for lentic and lotic waterways within the management area of interest (Figure 3). Management activities within RCA's should not adversely affect California red-legged frog populations or habitat through; fragmentation of breeding and dispersal habitat, degradation of water quality, degradation of habitat, alteration of flow regimes, sedimentation, and proliferation of non-native predators.

The proposed actions in this document apply to Federal land within the area of interest only. Private landowners are encouraged, but not required, to comply with the proposed actions of the Management Plan. The area of interest for this Management Plan is New Bullards Bar Reservoir, and its associated sub-watersheds, and riparian habitat (Figure 3). The steams, lakes, ponds, and riparian areas that make up the area of interest may contain suitable breeding and dispersal habitat and corridors essential for connectivity, expansion, and recovery of California red-legged frog populations. Therefore, this Management Plan will review and suggest management standards and guidelines with regards to current and perceived activities occurring within RCAs of the area of interest (Figure 1). All RCAs within the area of interest are subject to the management standards and guidelines proposed in this document. The primary impetuses for including all RCAs, within the area of interest, in the scope of management standards and guidelines are to perpetuate expansion of existing California red-legged frog populations by sustaining and promoting connectivity among current and historical ranges and quality habitat, and to improve and sustain habitat of foothill yellow-legged frogs (*Rana boylii*) and Northwestern pond turtles

(*Clemmys marmorata marmorata*) which are listed as sensitive on the Region 5 Forester's Sensitive Species List (USDA Forest Service 1998).

Forest Service personnel have observed foothill yellow-legged frogs and Northwestern pond turtles during various aquatic and wildlife surveys (frogs: 2001, 2000, 1999, 1998, turtles: 2001 and 2000) in the area of interest. Foothill yellow-legged frogs have been observed in Brandy Creek, Bridger Creek, and Willow Creek (tributaries to New Bullards Bar Reservoir). Northwestern pond turtles have been observed in Tractor cove and Moran Cove in New Bullard Bar Reservoir. The emphasis on multiple species protection and management at the sub-watershed level reflects recognition of species diversity and habitats associated with New Bullards Bar Reservoir. By developing and implementing management standards and guidelines aimed at restoring and protecting California red-legged frogs, and their associated habitat, we improve the chance of recovery for this species, and promote the sustainability of other species of concern (foothill yellow-legged frog and Northwestern pond turtle) since their range and optimal habitat conditions often overlap with the California red-legged frog.

Objectives

Our main objective is to sustain and perpetuate the California red-legged frog, northwestern pond turtle, and foothill yellow-legged frog populations and their habitats. This objective will be met through suggested management standards and guidelines within RCAs of the area of interest. The type and level of allowable management and maintenance activities will be determined by assessing how current and proposed activities measure against the Riparian Conservation Objectives (RCOs) and their associated standards and guidelines. The RCOs are described in the Sierra Nevada Forest Plan Amendment, which amended the Tahoe and Plumas National Forests Land and Resource Management Plans in January, 2001 (USDA Forest Service 2001).

Sierra Nevada Forest Amendment direction as it applies to this management plan

The following Sierra Nevada Forest Plan Amendment direction specific to the California red-legged frog, and its associated habitat, is taken directly from the Record of Decision, Appendix A (USDA Forest Service 2001).

- The Forest Service will implement recovery plans for listed species; maintain and restore habitat to support viable populations of native riparian dependent species; prevent new introductions of invasive species; work cooperatively with appropriate State and Federal wildlife agencies to reduce impacts of invasive species to native populations; manage Riparian Conservation Areas to maintain or restore the structure and function of aquatic ecosystems.
- Riparian conservation areas overlap all land allocations. The standards and guidelines for riparian conservation areas apply in these areas except in cases where the standards and guidelines of the overlapping land allocation place greater restrictions on management activities. The Riparian Conservation Area (RCA) standards and guidelines include:
- Designate RCA widths:

Perennial Streams	300 feet on each side of the stream, measured from the bank full edge of the stream
Seasonally flowing streams (includes ephemerals with defined stream channel or evidence of scour)	150 feet on each side of the stream, measured from the bank full edge of the stream
Streams in inner gorge (slopes greater than 70% gradient)	Top of inner gorge
Special aquatic features (lakes, meadows, bogs, fens, wetlands, vernal pools, springs) or perennial streams with riparian conditions extending more than 150 feet from edge of streambank or seasonally flowing streams with riparian conditions extending more than 50 feet from edge of streambank	300 feet from edge of feature or riparian vegetation, whichever width is greater
Other hydrological or topographic depressions without a defined channel	RCA width and protection measures determined through project level analysis

- Use a peer review process for vegetation treatments or other activities proposed within RCAs that are likely to significantly affect aquatic resources.
- Where a proposed project encompasses a riparian conservation area, conduct a site-specific project area analysis to determine the appropriate level of management within the RCA.
- Determine the type and level of allowable management activities by assessing how proposed activities measure against the riparian conservation objectives and their associated standards and guidelines.
- Implement other related standards and guidelines (S&Gs) appropriate to the project and include them in documentation of meeting riparian conservation objectives (grazing, road management, mining, vegetation management or other forest plan S&Gs).

The Riparian Conservation Objectives that apply to the New Bullards Bar Management Plan include:

RIPARIAN CONSERVATION OBJECTIVE #1: Ensure that identified beneficial uses for the water body are adequately protected. Identify the specific beneficial uses for the project area, water quality goals from the Regional Basin Plan, and the manner in which the standards and guidelines will protect the beneficial uses.

Standards and Guidelines Associated with RCO #1:

Implement project appropriate Best Management Practices and monitor their effectiveness following protocols outlined in "Investigating Water Quality in the Pacific Southwest Region: Best Management Practices Evaluation Program" (USDA-FS, PSW Region 1992).

For waters designated as "Water Quality Limited" (Clean Water Act Section 303(d)), implement appropriate State mandates for the water body, such as Total Maximum Daily Load (TMDL) protocols.

Conduct project-specific cumulative watershed effects analysis following Regional procedures or other appropriate scientific methodology to meet NEPA requirements.

Implement soil quality standards for soil loss, detrimental soil compaction, and organic matter retention to minimize the risk of sediment delivery to aquatic systems from management activities. Ensure that management-related activities, including roads, skid trails, landings, trails, or other activities, do not result in detrimental soil compaction on more than 5 percent of the RCA or 10 percent of the area in CARs. Measure compaction using the procedures outlined in Appendix F of the FEIS.

Identify existing and potential sources of sediment delivery to aquatic systems. Implement preventive and restoration measures, such as modifying management activities, increasing ground cover, reducing the extent of compacted surfaces, or revegetating disturbed sites to reduce or eliminate sediment delivery from these sources to aquatic systems.

Evaluate new proposed management activities within CARs and RCAs during environmental analysis to determine consistency with the riparian conservation objectives at the project level and the AMS goals for the landscape. Ensure that appropriate mitigation measures are implemented to (1) minimize the risk of activity-related sediment entering aquatic systems, and (2) minimize impacts to habitat for aquatic- or riparian-dependent plant and animal species.

Identify existing uses and activities in CARs and RCAs during landscape analysis. Evaluate existing management activities to determine consistency with RCAs during project-level analysis. Develop and implement actions needed for consistency with RCOs.

Ensure that management activities do not adversely affect water temperatures necessary for local aquatic- and riparian-dependent species assemblages.

Limit pesticide applications to cases where project level analysis indicates that pesticide applications are consistent with riparian conservation objectives. Prohibit application of pesticides to livestock in RCAs and CARs.

Avoid pesticide applications within 500 feet of known occupied sites for the California red-legged frog, Cascade frog, Yosemite toad, foothill yellow-legged frog, mountain yellow-legged frog, and northern leopard frog unless environmental analysis documents that pesticides are needed to restore or enhance habitat for these amphibian species.

Prohibit storage of fuels and other toxic materials within RCAs and CARs except at designated administrative sites. Prohibit refueling within RCAs and CARs unless there are no other alternatives. Ensure that spill plans are reviewed and up-to-date.

RIPARIAN CONSERVATION OBJECTIVE #2: Maintain or restore: (1) the geomorphic and biological characteristics of special aquatic features, including lakes, meadows, bogs, fens, wetlands, vernal pools, springs; (2) streams, including in stream flows; and (3) hydrologic connectivity both within and between watersheds to provide for the habitat needs of aquatic-dependent species.

Standards and Guidelines Associated with RCO #2:

Maintain and restore the hydrologic connectivity of streams, meadows, wetlands, and other special

aquatic features by identifying roads and trails that intercept, divert, or disrupt natural surface and subsurface water flow paths. Implement corrective actions where necessary to restore connectivity.

Ensure that culverts or other stream crossings do not create barriers to upstream or downstream passage for aquatic-dependent species. Locate water drafting sites to avoid adverse effects to in stream flows and depletion of pool habitat. Where possible, maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows, wetlands, and other special aquatic features.

Prior to activities that could affect streams, determine if relevant geomorphic characteristics, including bank angle, channel bank stability, bank full width-to-depth ratio, embeddedness, channel-floodplain connectivity, residual pool depth, or channel substrate, are within the range of natural variability for the reference stream type as described in the Pacific Southwest Region Stream Condition Inventory protocol. If properties are outside the range of natural variability, implement restoration actions that will result in an upward trend.

Prevent disturbance to meadow-associated streambanks and natural lake and pond shorelines caused by resource activities (for example, livestock, off-highway vehicles, and dispersed recreation) from exceeding 20 percent of stream reach or 20 percent of natural lake and pond shorelines. Disturbance includes bank sloughing, chiseling, trampling, and other means of exposing bare soil or cutting plant roots. This standard does not apply to developed recreation sites and designated off-highway vehicle routes.

In stream reaches occupied by, or identified as "essential habitat" in the conservation assessment for, the Lahonton and Paiute cutthroat trout and the Little Kern golden trout, limit streambank disturbance from livestock to 10 percent of the occupied or "essential habitat" stream reach. (Conservation assessments are described in the record of decision.) Cooperate with State and Federal agencies to develop streambank disturbance standards for threatened, endangered, and sensitive species. Use the regional streambank assessment protocol. Implement corrective action where disturbance limits have been exceeded.

Determine if the age class, structural diversity, composition, and cover of riparian vegetation are within the range of natural variability for the vegetative community. If outside the range of natural variability, implement restoration actions that will result in an upward trend. Actions could include restoration of aspen or other riparian vegetation where conifer encroachment is identified as a problem.

Cooperate with Federal, Tribal, State and local governments to secure in stream flows needed to maintain, recover, and restore riparian resources, channel conditions, and aquatic habitat. Maintain in stream flows to protect aquatic systems to which species are uniquely adapted. Minimize the effects of stream diversions or other flow modifications from hydroelectric projects on threatened, endangered, and sensitive species and essential habitat as identified in conservation assessments. (Conservation assessments are described in the record of decision.)

During relicensing of Federal Energy Regulatory Commission (FERC) hydroelectric projects, evaluate modifications by the project to the natural hydrograph. Determine and recommend in stream flow

requirements and habitat conditions that maintain, enhance, or restore all life stages of native aquatic species, and that maintain or restore riparian resources, channel integrity, and fish passage. Provide written and timely license conditions to FERC. Coordinate relicensing projects with the appropriate State and Federal agencies.

For exempt hydroelectric facilities on national forest lands, ensure that special use permit language provides adequate in stream flow requirements to maintain, restore, or recover favorable ecological conditions for local riparian- and aquatic-dependent species.

RIPARIAN CONSERVATION OBJECTIVE #3: Ensure a renewable supply of large down logs that: (1) can reach the stream channel and (2) provide suitable habitat within and adjacent to the RCA.

Standards and Guidelines Associated with RCO #3:

Determine if the level of coarse large woody debris (CWD) is within the range of natural conditions in terms of frequency and distribution and is sufficient to sustain stream channel physical complexity and stability. If CWD levels are deficient, ensure proposed management activities, when appropriate, contribute to the recruitment of CWD. Burning prescriptions should be designed to retain CWD; however short-term reductions below either the soil quality standards or standards in species management plans may result from prescribed burning within strategically placed treatment areas or the urban wildland intermix zone.

In plantations within RCAs or CARs, determine if the plantation will be able to provide a sufficient supply of standing trees suitable for large wood recruitment. If there is not sufficient wood for recruitment, develop a restoration program that will provide standing trees of the appropriate size in the RCA or CAR. In developing the restoration program, ensure that proposed activities are consistent with the riparian conservation objectives.

RIPARIAN CONSERVATION OBJECTIVE #4: Ensure that management activities, including fuels reduction actions, within RCAs and CARs enhance or maintain physical and biological characteristics associated with aquatic- and riparian-dependent species.

Standards and Guidelines Associated with RCO #4:

Within CARs, in occupied habitat or "essential habitat" as identified in conservation assessments for threatened, endangered, or sensitive species, evaluate the appropriate role, timing, and extent of prescribed fire. Avoid direct lighting within riparian vegetation; prescribed fires may back into riparian vegetation areas. Develop mitigation measures to avoid impacts to these species whenever ground-disturbing equipment is used.

Use screening devices for water drafting pumps. (Fire suppression activities are exempt). Use pumps with low entry velocity to minimize removal of aquatic species, including juvenile fish, amphibian egg masses and tadpoles, from aquatic habitats.

Design prescribed fire treatments to minimize disturbance of ground cover and riparian vegetation in RCAs. In burn plans for project areas that include, or are adjacent to RCAs, identify mitigation measures to minimize the spread of fire into riparian vegetation. In determining which mitigation measures to adopt, weigh the potential harm of mitigation measures, for example fire lines, against the risks and

benefits of prescribed fire entering riparian vegetation. Strategies should recognize the role of fire in ecosystem function and identify those instances where fire suppression or fuel management actions could be damaging to habitat or long-term function of the riparian community.

Where catastrophic events, such as drought, fire, flooding, wind, or insect damage, result in degraded stand conditions, allow salvage harvesting and fuelwood cutting in RCAs and CARs consistent with the assessment of the RCOs for the area. Ensure that present and future woody debris needs are met.

Post-wildfire management activities in RCAs and CARs should emphasize enhancing native vegetation cover, stabilizing channels by non-structural means, minimizing adverse effects from the existing road network, and carrying out activities identified in landscape analyses. Post-wildfire operations shall minimize the exposure of bare soil.

Allow mechanical ground disturbing fuels treatments, hazard tree removal, salvage harvest, or commercial fuelwood cutting within RCAs or CARs when the activity is consistent with RCOs. Projects providing for public health and safety, such as the felling of hazard trees or fuel reduction activities within the defense zone of the urban wildland intermix zones, are permitted. Utilize low ground pressure equipment, helicopters, over the snow logging, or other non-ground disturbing actions to operate off of existing roads when needed to achieve RCOs. Prior to removing trees within RCAs or CARs, determine if existing down wood is sufficient to sustain the stream channel physical complexity and stability required to maintain or enhance the aquatic- and riparian-dependent community. Ensure that existing roads, landings, and skid trails meet Best Management Practices. Minimize the construction of new skid trails or roads for access into RCAs for fuel treatments, salvage harvest, commercial fuelwood cutting, or hazard tree removal.

Prior to implementing ground disturbing activities within suitable habitat for the California red-legged frog, foothill yellow-legged frog, mountain yellow-legged frog, and northern leopard frog:

- Assess and document aquatic conditions using the Pacific Southwest Region Stream Condition Inventory protocol, and

- Develop mitigation measures (such as timing of activities, limited operating seasons, avoidance) to avoid impacting these species.

During fire suppression activities, consider impacts to aquatic- and riparian-dependent resources. Where possible, locate incident bases, camps, helibases, staging areas, helispots, and other centers for incident activities outside of RCAs or CARs. During presuppression planning, determine guidelines for suppression activities, including avoidance of potential adverse effects to aquatic- and riparian-dependent species as a goal.

Assess roads, trails, OHV trails and staging areas, developed recreation sites, dispersed campgrounds, special use permits, grazing permits, and day use sites during landscape analysis. Identify conditions that degrade water quality or habitat for aquatic- and riparian-dependent species. At the project level, determine if use is consistent with other standards and guidelines or desired conditions. If inconsistent, modify the use through redesign, rehabilitation, relocation, closure, or re-directing the use to a more suitable location.

Require solid waste facilities (such as waste rock and tailings dumps) to be located outside riparian conservation areas. Where no reasonable alternative to locating these mine waste facilities in riparian conservation areas exists, locate and design them with the goal of ensuring mine waste facility stability and preventing potentially toxic releases. Ensure the following measures are applied: (1) analyze mine waste material using the best conventional sampling methods and analytical techniques to determine its chemical and physical stability characteristics; (2) locate and design mine waste facilities using best conventional techniques to ensure mass stability and prevent acid or toxic material releases; (3) ensure that reclamation and reclamation bonds are sufficient to ensure long-term chemical and physical stability of mine waste facilities; and (4) monitor mine waste facilities after operations have ceased to ensure that chemical and physical conditions are consistent with aquatic management strategy goals.

Allow saleable mineral activities, such as sand and gravel mining and extraction, in riparian conservation areas only if measures that protect the integrity of aquatic, riparian meadow ecosystems are implemented.

RIPARIAN CONSERVATION OBJECTIVE #6: Identify and implement restoration actions to maintain, restore or enhance water quality and maintain, restore, or enhance habitat for riparian and aquatic species.

Recommend and establish priorities for restoration practices in: (1) areas with compaction in excess of soil quality standards, (2) areas with lowered water tables, or (3) areas that are either actively down cutting or that have historic gullies. Identify other management practices, for example, road building, recreational use, grazing, and timber harvests that may be contributing to the observed degradation.

Reclaim abandoned mine sites that are degrading aquatic riparian and meadow ecosystems. First priority is to reclaim sites with hazardous or toxic substances located within CARs and RCAs.

Critical Aquatic Refuges are small subwatersheds that contain known locations of threatened, endangered or sensitive species. The Tahoe currently has two Critical Aquatic Refuges, Upper Independence Creek and Sierra Buttes, neither of which includes known populations of California red-legged frog. As information is gathered through surveys and landscape analysis, additional Critical Aquatic Refuges may be added to this list.

Recreation

Introduction

New Bullards Bar Reservoir is a popular recreation area. Recreational activities include boating, fishing, mountain biking, camping, picnicking, and swimming. The entire riparian corridor surrounding New Bullards Bar is open to public camping and recreation. Disturbance by recreationists can indirectly and directly affect California red-legged frogs. Illegal collecting of frogs is a problem in California, and land management agencies should educate their personnel and contractors regarding laws that protect frogs, and their associated habitat, and the appropriateness of publicly disclosing specific locations of sensitive areas around New Bullards Bar Reservoir.

Existing recreational maintenance activities

1) Trail and road maintenance and use

Suggested activities

a) Vehicular activities and mountain biking should be excluded from riparian and other wetland areas unless adequate stream crossings exist to prevent sedimentation.

b) Maintain and restore the hydrologic connectivity of streams, meadows, wetlands, and other special aquatic features by identifying roads and trails that intercept, divert, or disrupt natural surface and subsurface water flow. Implement corrective actions where necessary to restore connectivity.

c) Forest Service roads within the Little Oregon Creek sub-watershed should be closed, if feasible, during the late winter and spring to prevent the killing of subadult and adult frogs on the roads.

Potential recreational activities that may affect California red-legged frogs

1) Ground disturbing activities such as construction of roads, skid trails, recreational trails, or landings.

Suggested activities

a) Ground disturbing activities within RCAs should only occur after a qualified biologist assesses the site and provides mitigations to minimize effects to threatened or sensitive species.

b) Management related activities should not result in detrimental soil compaction on more than 5 percent of the RCA (USDA Forest Service 2001).

c) Existing and potential sources of sediment delivery should be identified and ameliorated by implementing preventative and restoration measures such as increasing ground cover, reducing the extent of compacted surfaces, or revegetating disturbed sites to reduce or eliminate sediment delivery from these sources to aquatic systems (USDA Forest Service 2001).

2) Introduction of non-native predators to the area of interest

Suggested activities

a) Interpretive signs should be placed at high-use areas to inform the public about laws prohibiting the introduction or use (as bait) of non-native species (such as the bullfrog, warm water fish, or crawfish) in the area of interest.

Vegetation Management

Introduction

Fuels reduction operations and related practices occurring on Forest Service land within watersheds inhabited by California red-legged frogs or that contain suitable habitat may contribute to the degradation of habitat and the decline of the species. The effects that degrade conditions include increased sedimentation of gravels and pools, removal of trees that provide instream and streamside habitat structure and shade, and changed patterns of runoff (USDI Fish and Wildlife Service 1996). Prescribed fire treatments within RCAs of the area of interest should be designed to minimize disturbance of ground cover and riparian vegetation in the RCAs. Retention of large woody debris within RCAs is also critical when designing fire treatments. Large woody debris provides suitable habitat for California red-legged frogs. Ten to twenty tons per acre should be retained (except in defense zones) to provide habitat heterogeneity, decreased soil erosion potential, stream bank stability, shade, and increased pool formation potential (USDA Forest Service 2001).

Existing vegetation management activities

2) Hazard tree removal within RCAs

Suggested activities

a) Projects providing for public safety within the defense zone of the urban wildland intermix zones, (Figure 2) are permitted (USDA Forest Service 2001). However, we suggest that felled hazard trees be left on site within RCAs to provide habitat for the California red-legged frog.

b) Projects providing for public safety outside the defense zone are permitted as long as they are consistent with the RCOs (USDA Forest Service 2001) and the bald eagle management standards and guidelines.

c) Hazard tree removal personnel should consult with qualified Biologists to develop removal procedures that minimize ground disturbance.

Potential vegetation management activities

1) Fuel treatment projects within the area of interest

Suggested activities

a) Fuels planning personnel should consult with qualified Biologists to determine desired conditions for woody debris retention and to establish RCAs in the fuels treatment areas.

b) No ignition, ground disturbing activities, or pile burning should occur in RCAs without approval from a qualified Biologist.

c) RCAs should be established based on average riparian tree height, stream geomorphology, upland slope, and the entire watersheds ability of providing wooding debris to the fuel treatment area.

b) Site assessments should occur prior to fire treatments to determine the presence of California red-legged frogs and their associated habitat, and to develop an optimal fire treatment time. At certain times of the year (winter and spring) fire treatments have the

potential to cause more harm to California red-legged frogs than other times (summer and fall) due to increased activity and mobility (breeding) and estivation.

1) Clearing and disposal of vegetation for trail, road, campground, boat landing, and day use area maintenance.

Suggested activities

a) Burning of brush within RCAs should only occur after the burning site is assessed by a qualified Biologist and a determination of no or minimal effect to California red-legged frogs is made.

b) Chipping of brush piles may be done as an alternative to burning, as long as it confers with the bald eagle management standards and guidelines.

c) Routine recreational site maintenance, such as tree trimming, may occur as long is it confers with the RCOs.

Residential Development

Introduction

Residential development has been implicated as a reason for declining California red-legged frog populations (USDI Fish and Wildlife Service 1996). However, the majority of land within the area of interest is owned by the Tahoe National Forest and The Yuba County Water Agency. Therefore, residential development is not likely to affect California red-legged frogs within the area of interest.

Hydroelectric Power Production and Reservoir Maintenance

Introduction

The Yuba County Water Agency (YCWA) is licensed to manage New Bullards Bar Reservoir. The YCWA provides hydroelectric power, flood control, domestic and agricultural water, and recreation at the reservoir. The YCWA also performs a variety of maintenance activities in and around New Bullards Bar Reservoir that, if done in accordance with the RCOs, are not likely to adversely affect California red-legged frogs or their associated habitat (Appendix 1).

Existing YCWA activities that may affect California red-legged frogs or their associated habitat.

1) Accumulation of woody debris off the reservoir and disposed at coves 1, 2, and 3 (Figure 4).

A) Effects

The proposed burning sites do not provide suitable habitat for California red-legged frogs. Therefore, the accumulation and disposal of woody debris at sites 1, 2, or 3 will have minimal or no effect on California red-legged frogs or their habitat. However, a qualified Biologist should be consulted before initiation of the project to insure that the project

complies with the RCOs. If the burning locations change, the new site should be surveyed for California red-legged frogs and their habitat. If frogs or suitable habitat are found, a qualified Biologist should be consulted to explore possible consultation with the US Fish and Wildlife Service, prior to initiation of the project.

2) Siphoning of water from a storage pond near Cottage Creek

Suggested management activities

a) A two-foot average water depth in this pond should be maintained year round.

b) If an emergency arises whereas the minimum water level must be breached, the pond should be surveyed by a qualified Biologist prior to the breach, using an accepted protocol, to assess the site for California red-legged frogs. If California red-legged frogs are observed, the pond should not be siphoned.

3) New Bullards Bar Reservoir launch ramp improvement scheduled for 2003

A) Effects

a) The effects of this project are unknown because of limited information about the project. However, any activities planned by the YWCA within the area of interest that may affect California red-legged frogs or their associated habitat should be reviewed by a qualified Biologist to assure consistency with the RCOs and assess possible consultation with the U.S. Fish and Wildlife Service.

Fisheries and Invasive Species Management

Introduction

The introduction of non-native predatory species such as the bullfrogs, warm water fish, and crawfish (USDI Fish and Wildlife Service 2000) has been implicated as a reason for declining California red-legged frog populations. New Bullards Bar Reservoir is not currently stocked with these predator species. Therefore, the effect of anthropogenic introduction of these species within the area of interest is minimal. However, if areas are identified as having large numbers of non-native predatory species efforts should be made to remove these species, and a predator control plan should be developed.

Mining

A search of the Bureau of Land Management data base in February 2002 shows 34 active claims encompassing 680 acres within a two-mile radius of the Reservoir—33 are placer claims, 1 is a lode claim. Active claims are limited to minor exploratory work, with, little to no surface disturbances, storage of equipment, structure building, or extended camping (longer than two weeks), without prior authorization from the U. S. Forest Service. The miner requests authorization by filing a Plan of Operations with the appropriate National Forest. At the present time, no active claims are operating under an approved Plan of Operations. As such, all are limited in scope. Should any expand, the miner

would have to submit a Plan of Operation for review and approval by the U. S. Forest Service. At that time, the operation would be evaluated for its compliance with the Endangered Species Act and the National Environmental Policy Act. Any needed consultation with the U. S. Fish and Wildlife Service would occur at that time.

Because the California Department of Fish and Game issues dredging permits, an unidentified number of dredging operations may be present.

Monitoring

Annual California red-legged frog monitoring should occur (within available budgets) throughout the area of interest. Suitable habitat should be identified so that it can be protected to increase connectivity and expansion potential of existing populations. All surveys should be done to an accepted California red-legged frog protocol.

Review of Site-specific Recommended Mitigations and Action Items

1) Collection and burning of woody debris in New Bullards Bar Reservoir will be done in accordance with the RCOs and Best Management Practices. A qulified Biologist and Fire chief will be consulted with prior to initiation of the project, and they will be on-site during burning.

2) Vehicular activities and mountain biking should be excluded from riparian and other wetland areas unless adequate stream crossings exist to prevent sedimentation.

3) Maintain and restore the hydrologic connectivity of streams, meadows, wetlands, and other special aquatic features by identifying roads and trails that intercept, divert, or disrupt natural surface and subsurface water flow. Implement corrective actions where necessary to restore connectivity.

4) Forest Service roads within the Little Oregon Creek sub-watershed area of interest should be closed, if feasible, during the late winter and spring to prevent the killing of subadult and adult frogs on the roads.

5) Ground disturbing activities within RCAs should only occur after a qualified biologist assesses the site and provides mitigations to minimize effects to threatened or sensitive species.

6) Management of recreation related activities (trails, campgrounds, boat launches, etc.) should not result in detrimental soil compaction on more than 5 percent of the RCAs (USDA Forest Service 2001).

7) Existing and potential sources of sediment delivery should be identified and ameliorated by implementing preventative and restoration measures such as increasing ground cover, reducing the extent of compacted surfaces, or revegetating disturbed sites to reduce or eliminate

sediment delivery from these sources to aquatic systems (USDA Forest Service 2001).

8) Interpretive signs should be placed at high-use areas to inform the public about laws prohibiting the introduction or use (as bait) of non-native species (such as the bullfrog, warm water fish, or crawfish) in the area of interest.

9) Hazard tree removal personnel should consult with qualified Biologists to develop removal procedures that minimize ground disturbance.

10) Fuels planning personnel should consult with qualified Biologists to determine desired conditions for woody debris retention and to establish RCAs in the fuels treatment areas.

11) No ignition, ground disturbing activities, or pile burning should occur in RCAs, without consultation with a qualified Biologist.

12) Fuels treatment RCAs should be established based on average riparian tree height, stream geomorphology, upland slope, and the entire watersheds ability of providing wooding debris to the fuel treatment area.

13) Site assessments should occur prior to fire treatments to determine the presence of California red-legged frogs and their associated habitat, and to develop an optimal fire treatment time. At certain times of the year (winter and spring) fire treatments have the potential to cause more harm to California red-legged frogs than other times (summer and fall) due to increased activity and mobility (breeding) and estivation.

14) Burning of brush within RCAs should only occur after the burning site is assessed by a qualified Biologist and a determination of no or minimal effect to California red-legged frogs is made.
A) Chipping of brush piles may be done as an alternative to burning, as long as it confers with the bald eagle management standards and guidelines

15) Projects providing for public safety within the defense zone of the urban wildland intermix zones, are permitted (USDA Forest Service 2001). However, we suggest that felled hazard trees be left on site within RCAs to provide habitat for the California red-legged frog.

16) Projects providing for public safety outside the defense zone are permitted as long as they are consistent with the RCOs (USDA Forest Service 2001) and the bald eagle management standards and guidelines.

17) Routine recreational site maintenance, such as tree trimming, may occur as long is it confers with the RCOs.

18) A two-foot average water depth in the Cottage Creek pond should be

maintained year round.

A) If an emergency arises whereas the minimum water level must be breached, the pond should be surveyed by a qualified Biologist prior to the breach, using an accepted California red-legged frog protocol, to assess the site for California red-legged frogs. If California red-legged frogs are observed, the pond should not be siphoned.

19) Any activities planned by the YWCA or USFS within the area of interest that may adversely affect California red-legged frogs or their associated habitat should be reviewed by qualified Biologists to assure consistency with the RCOs and assess possible consultation with the US Fish and Wildlife Service.

20) Ten to twenty tons per acre of large woody debris should be retained (except in defense zones) within RCAs (USDA Forest Service 2001).

Review of potential and existing activities that may require consultation with the US Fish and Wildlife Service

1) Collection and disposal of woody debris from New Bullards Bar Reservoir.

2) Ground disturbing activities within RCAs such as; construction or reconstruction of recreational areas, trails, campgrounds, skid trails, or boat landings, and tree felling.

3) Prescribed burning treatments within the area of interest.

4) Mechanical vegetation harvest and/or disposal within the RCAs.

5) Instream or riparian restoration work such as repair or installation of bridges or culverts.

6) Any activity within RCAs that may affect California red-legged frogs, or their associated habitat, that is not listed in this document should be reviewed by qualified Biologists to determine the applicability of consultation with the US Fish and Wildlife Service.

V. Recommended TES Monitoring Plan and Management Plan Direction

VI. Educational Opportunities:

1. Identify interpretive opportunities in conjunction with the Recreation Plan. Consider interpretive signing at Cottage Creek and Dark Day boat ramps to increase public awareness of wildlife's use of the reservoir and the need for habitat protection. The focus is to educate the visiting public as to the role of the YCWA, USFS, and the public in protecting wildlife and its habitat (what we do, how they can help). Species to emphasize could include bald eagle, osprey, great blue heron, and kokanee salmon. Winter eagle watching opportunites exist at the dam that include barrier-free access while still protecting eagles.

2. Educate reservoir employees in the identification of mature and immature bald eagles, and species of concern and special interest. Report sightings and locations of bald eagles to the Downieville Ranger District Wildlife Biologist.

3. The Pendola Fire offers an opportunity to interpret the role of fire in natural processes, fire history, the benefits and costs of fire, and prescribed burning. Interpretation that meets agency goals include: (1) the role of the USFS in fire management, (2) YCWA goals for maintaining healthy watersheds and waterflow regimes.

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Appendix A

Yuba County Water Agency Routine Operation and Maintenance Duties

Activity by Location	Frequency
Our House Dam	
1. Maintain sluice and fish valves and controls.	Anual
2. Adjust debris boom to divert trash from tunnel trash rack.	Semi-annual
3. Maintain structures and accesses at dam and downstream weir and gaging station.	Semi-annual
4. Remove trash from trash racks	Seasonal
5. Dispose of trash rack debris and grounds accumulations.	Seasonal
6. Maintain road to dam by repairing pot holes, brushing, and removing slides and debris from road.	Seasonal
7. Place and remove tunnel gates. Procure crane and remove or displace gate according to water flow dictates.	Semi-annual
8. Pump and clean portapottie.	Quarterly
Log Cabin Dam	
1. Maintain sluice and fish valves and controls. Grease, replace parts as necessary, block rust and paint.	Semi-annual
2. Maintain structures and accesses at dam and downstream weir. Paint and repair as necessary. Also, maintain access with heavy duty equipment	Semi-annual
3. Remove trash from trash racks.	Seasonal
4. Dispose of trash rack debris and grounds accumulations.	Seasonal
5. Maintain gate and road to dam by repairing pot holes, brushing, and removing slides and debris from road.	Annual
6. Place and remove tunnel gates. Procure crane and remove or displace gate according to water flow dictates.	Semi-annual
7. Pump and clean portapottie	Quarterly
Bullards Bar Dam and Appurtenant Facilities	
1. Maintain lower outlet butterfly and hollow jet valve. Lubricate, charge accumulator with nitrogen and maintain auxiliary equipment	Semi-annual
2. Maintain fish hydro and building. Inspect runner, filter governor oil. Check bearings and clearances, and replace parts as necessary.	Semi-annual
3. Pump and clean portapotties.	Quarterly
4. Maintain 180" butterfly valve and butterfly valve house. Lubricate stuffing box, flush operation valves, and perform annual tests.	Quarterly
5. Maintain access road to bottom of dam.	Seasonal

Clean ditches and maintain asphalt surface.

6. Maintain spillway gates and hoist mechanisms. — Quarterly
   Lubricate and change operating mechanism oil, service Volkswagen engine and functionally test.
7. Maintain Onan emergency generator at Butterfly Valve House. — Semi-annual
   Change oil, check couplings and filters, check battery charging capability, and check all gages and piping (leak check).
8. Maintain fish hydro air compressor. — Annual
   Lubricate, check belts, check pop off valves and other auxiliaries for safe operation.
9. Inspect lower outlet facility once every five years by removing streamline flow section and placing gate. Unwater and physically inspect and then reverse the procedure. — Annual
   Set up crane for gate and streamline section removal and installation. Open man doors, check for oxygen, install rope, inspect, and repair as necessary.
10. Maintain intake crane and intake bulkhead gates and trash rack. — Quarterly
    Replace cable. Lubricate and check crane operation periodically. Change gate positions for temperature mitigation. Keep gates and machinery free of corrosion.
11. Maintain integrity of water line from BFV to water treatment plant. — Semi-annual
    Repair leaks as necessary and coordinate with USFS.
12. Keep top of dam clear of weeds. — Semi-annual
13. Keep groin of dam clear of weeds and vegetation. — Semi-annual
14. Keep inside of dam clear of stalactites, stalagmites, and calcareous accumulations. — Annual
15. Maintain log boom in front of dam. — Quarterly

Cottage Creek Facilities

1. Water Treatment Plant
   a. Maintain integrity of security fence. — Semi-annual
   b. Keep grounds clean and free from accumulated scrap. — Quarterly
   c. Keep portapotties clean and pumped. — Quarterly
   d. Perform preventive maintenance on building, water tanks, and backflow tank and associated facilities. — Semi-annual
      Maintain building integrity including roof and keep tanks maintained with proper painting. Repair any system plumbing defects.
2. Keep garbage cans and parking lot areas clean. — Weekly
3. Maintain parking lot asphalt and drainage. — Annual
4. Maintain traffic lines and parking lanes well defined with paint. — Annual
5. Report need for disposal unit emptying. — Weekly

Bullards Bar Launch Ramp

1. Maintain ramp clear of rocks and other debris. — Monthly
2. Move boarding float to coincide with water levels. — Weekly

3. Patch asphalt as necessary to prevent pot holes.	Semi-annual
4. Maintain boarding float guide cable and anchors.	Semi-annual
5. Maintain signage for handicap, loading zones, and marina parking.	Semi-annual
Move portable signs to coincide with water levels.	Weekly

Bullards Bar YCWA Boat Dock and Access Road

1. Move dock to coincide with water levels	Weekly
2. Maintain access road to dock	Semi-annual
3. Maintain surface and dock bumpers in good repair on main dock and all slips. Cleats should be well anchored at all times.	Quarterly
4. Maintain all boats and motors in serviceable shape at all times.	Weekly
5. Keep boats pumped out especially during inclement weather.	Seasonal

Bullards Bar Warehouse (Hill above the dam)

1. Keep portapottie clean and pumped.	Quarterly
2. Maintain 5000 gallon water tank and enclosure.	
Open and clean annually. Coordinate with USFS.	Annual
3. Keep area clear of Y.C.W.A. trash.	Quarterly
4. Maintain trailers and stored materials in good order inside warehouse.	
5. Maintain air compressor.	Annual
Change oil, lubricate. Check belts and piping, safety guards, pop off valve and auxiliaries.	Annual

Oregon Peak

1. Maintain security fencing and gate.	Annual
2. Maintain yard free of weeds and foreign material.	Annual
3. Maintain interior and exterior of building	Annual
4. Maintain Onan emergency generator.	Semi-annual

Bullards Bar Reservoir

1. Maintain fish spawning buoys at Bridge Creek, Willow Creek, confluence of Little Oregon and Bridger Creek, and Indian Creek.	Annual
2. Maintain buoys at Dark Day and Upper North Fork of Yuba.	Annual
3. Pump floating comfort stations (via boat)	Monthly (6)
4. Pump toilets at Madrone Cove (via boat)	Semi-annual
5. Pump toilets at Garden Point (via truck on Garden Point Road)	Semi-annual
6. Maintaining FCS's.	Semi-annual
7. Dispose of Reservoir debris.	Annual
Boom wood debris to Cove (previously Moran Road Cove).	
Doze into piles for burning.	
Burn debris in coordination with USFS	

Miscellaneous

1. Maintain all security fencing throughout project	Semi-annual
2. Maintain all project roads free of pot holes, etc.	Monthly
3. Maintain weed abatement program at penstock, dams, roads, Oregon Peak and switch yards. Arrange with vendor, after contract prep, for areas to be covered, accompany Vendor on pre-and post emergency and verify applications.	Annual
4. Service and maintain all project gates in good condition and sag free. Provide bracing and paint or repair as required. Repair vandalism.	Annual
5. Keep trash cans throughout the project empty on a periodic basis.	Weekly
6. Maintain all doors (roll up and personnel) in excellent condition at all times.	Weekly
7. Maintain water piping system from Cottage Creek to USFS interface.	Quarterly
8. Facility upkeep.	Monthly

APPENDIX B.

USFS Bullards Bar Routine Maintenance Activity List

Shoreline	Frequency
Remove hazard trees	as needed
Remove mid and lower story fire hazard fuel and vegetation pile and Burn brush, split and stack or remove trunk wood	as needed
Remove and haul away ash and disperse rocks from located fire pits	weekly
Boat in campgrounds	
Remove hazard trees	as needed
Remove mid and lower story fire hazard fuel and vegetation pile and Burn brush, split and stack or remove trunk wood	as needed
Remove or replace broken tables and buildings	annually
Clean and maintain pit toilets and campsites	weekly
Paint or stain tables and buildings	annually
Pump pit toilets	as needed
Drive in campgrounds	
Remove hazard trees	as needed
Remove mid and lower story fire hazard fuel and vegetation pile and Burn brush, split and stack or remove trunk wood	as needed
Remove or replace broken tables and buildings	annually
Clean and maintain pit toilets and campsites	weekly
Paint or stain tables and buildings	annually
Repair or replace septic systems and water lines	as needed

Boat launch facilities

Remove hazard trees	as needed
Remove mid and lower story fire hazard fuel and vegetation pile and Burn brush, split and stack or remove trunk wood	as needed
Clean and remove debris from parking lots	weekly
Seal surface cracks in pavement	as needed
Paint lettering and parking stripes on surface	annually
Paint or stain tables and buildings	annually
Repair or replace septic systems and water lines	as needed
Install and repair regulatory signs	as needed

Trails

Remove hazard trees	as needed
Remove mid and lower story fire hazard fuel and vegetation pile and Burn brush, split and stack or remove trunk wood	as needed
Install and repair drainage devices	as needed
Repair and make minor grade changes and relocation to protect public safety	as needed
Install and repair signs	as needed

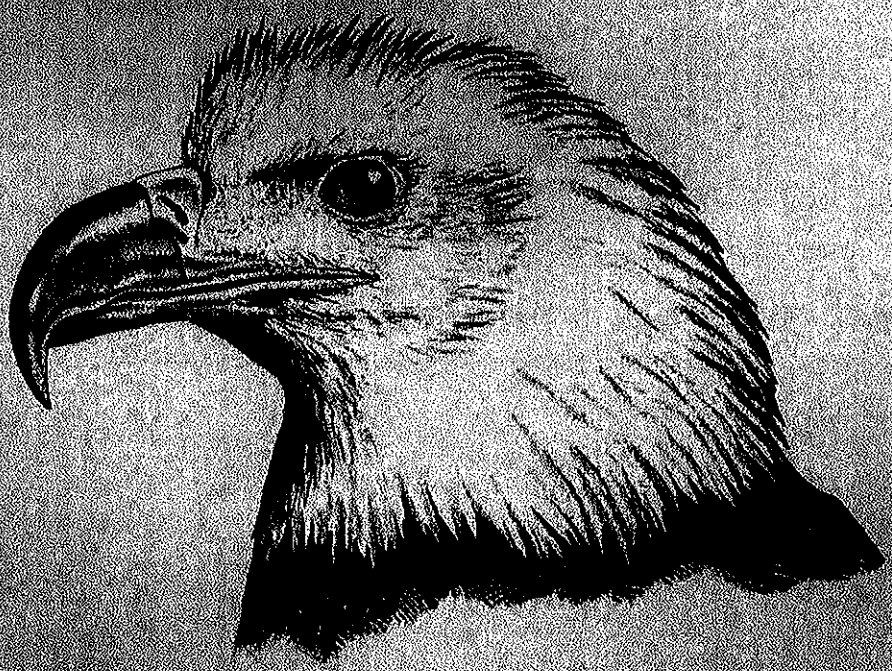
Day use

Remove hazard trees	as needed
Remove mid and lower story fire hazard fuel and vegetation pile and Burn brush, split and stack or remove trunk wood	as needed
Remove or replace broken tables and buildings	annually
Clean and maintain pit toilets and campsites	weekly

Paint or stain tables and buildings	annually
Pump pit toilets	as needed
Repair or replace septic systems and water lines	as needed

BIOLOGICAL REPORT 82(10.126)
OCTOBER 1986

HABITAT SUITABILITY INDEX MODELS: BALD EAGLE (BREEDING SEASON)



...h and Wildlife Service
...S. Department of the Interior

MODEL EVALUATION FORM

Habitat models are designed for a wide variety of planning applications where habitat information is an important consideration in the decision process. However, it is impossible to develop a model that performs equally well in all situations. Assistance from users and researchers is an important part of the model improvement process. Each model is published individually to facilitate updating and reprinting as new information becomes available. User feedback on model performance will assist in improving habitat models for future applications. Please complete this form following application or review of the model. Feel free to include additional information that may be of use to either a model developer or model user. We also would appreciate information on model testing, modification, and application, as well as copies of modified models or test results. Please return this form to:

Habitat Evaluation Procedures Group
U.S. Fish and Wildlife Service
2627 Redwing Road, Creekside One
Fort Collins, CO 80526-2899

Thank you for your assistance.

Species _____ Geographic Location _____

Habitat or Cover Type(s) _____

Type of Application: Impact Analysis ____ Management Action Analysis ____
Baseline ____ Other _____

Variables Measured or Evaluated _____
_____
_____
_____

Was the species information useful and accurate? Yes ____ No ____

If not, what corrections or improvements are needed?_____
_____
_____
_____

Were the variables and curves clearly defined and useful? Yes ____ No ____

If not, how were or could they be improved? _____

_____

_____

_____

Were the techniques suggested for collection of field data:

Appropriate? Yes ____ No ____

Clearly defined? Yes ____ No ____

Easily applied? Yes ____ No ____

If not, what other data collection techniques are needed? _____

_____

_____

_____

Were the model equations logical? Yes ____ No ____

Appropriate? Yes ____ No ____

How were or could they be improved? _____

_____

_____

_____

Other suggestions for modification or improvement (attach curves, equations, graphs, or other appropriate information) _____

_____

_____

_____

Additional references or information that should be included in the model:

_____

_____

_____

_____

_____

Model Evaluator or Reviewer _____ Date _____

Agency _____

Address _____

_____

_____

Telephone Number Comm: _____ FTS _____

Biological Report 82(10.126)
October 1986

HABITAT SUITABILITY INDEX MODELS: BALD EAGLE (BREEDING SEASON)

by

Allen Peterson
New York State Electric and Gas Corporation
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Project Officer

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2627 Redwing Road
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Performed for
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Division of Wildlife and Contaminant Research
Fish and Wildlife Service
U.S. Department of the Interior
Washington, DC 20240

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PREFACE

This model was developed by the author as a result of his interest in, and experience with, the bald eagle. The U.S. Fish and Wildlife Service provided quality control, content reviews, and publication costs, but the fact that the model was completed is due primarily to the persistence and interest of the author.

This document is part of the Habitat Suitability Index (HSI) Model Series [Biological Report 82(10)], which provides habitat information useful for impact assessment and habitat management. Several types of habitat information are provided. The Habitat Use Information section is largely constrained to those data that can be used to derive quantitative relationships between key environmental variables and habitat suitability. This information provides the foundation for the HSI model and may be useful in the development of other models more appropriate to specific assessment or evaluation needs.

The HSI Model section documents the habitat model and includes information pertinent to its application. The model synthesizes the habitat use information into a framework appropriate for field application and is scaled to produce an index value between 0.0 (unsuitable habitat) and 1.0 (optimum habitat). The HSI Model section includes information about the geographic range and seasonal application of the model, its current verification status, and a list of the model variables with recommended measurement techniques for each variable.

The model is a formalized synthesis of biological and habitat information published in the scientific literature and may include unpublished information reflecting the opinions of identified experts. Habitat information about wildlife species frequently is represented by scattered data sets collected during different seasons and years and from different sites throughout the range of a species. The model presents this broad data base in a formal, logical, and simplified manner. The assumptions necessary for organizing and synthesizing the species-habitat information into the model are discussed. The model should be regarded as a hypothesis of species-habitat relationships and not as a statement of proven cause and effect relationships. The model may have merit in planning wildlife habitat research studies about a species, as well as in providing an estimate of the relative suitability of habitat for that species. User feedback concerning model improvements and other suggestions that may increase the utility and effectiveness of this habitat-based approach to fish and wildlife planning are encouraged. Please send suggestions to:

Habitat Evaluation Procedures Group
National Ecology Center
U.S. Fish and Wildlife Service
2627 Redwing Road
Ft. Collins, CO 80526-2899

CONTENTS

ACKNOWLEDGMENTS

Earlier drafts of this model were reviewed and commented on by Denis Case (Ohio Department of Natural Resources, Columbus, OH), Stanley Wiemeyer (U.S. Fish and Wildlife Service, Laurel, MD), and Keith Cline and Brian Millsap (Raptor Information Center, Washington, DC). They also provided additional data and literature on the bald eagle. Many people provided literature and unpublished data on different populations of the bald eagle: Jack Hodges (U.S. Fish and Wildlife Service, Juneau, AK), Mark Jenkins (Pacific Gas and Electric Co., San Ramon, CA), Jim Morash and Gary Strawn (West Virginia Department of Natural Resources, Elkins, WV), Peter Nye (New York State Department of Environmental Conservation, Delmar, NY), Dale Sheffer (Pennsylvania Game Commission, Harrisburg, PA), Gary Taylor (Maryland Wildlife Administration, Wye Mills, MD), Sylvia Taylor (Michigan Department of Natural Resources, Lansing, MI), and W. H. Taylor (Virginia Commission of Game and Inland Fisheries, Richmond, VA).

A later draft of this model was reviewed and commented upon by Dr. Robert Anthony (Oregon Cooperative Wildlife Research Unit, Corvallis, OR), Dr. Daniel James (U.S. Fish and Wildlife Service, Arlington, VA), John Mathisen (U.S. Forest Service, Cass Lake, MN), and Karen Steenhof (Bureau of Land Management, Boise, ID). Dr. Anthony, Mr. Mathisen, and Ms. Steenhof also provided additional literature. Much information on the measurement of lake productivity was provided by Richard A. Ryder (Ontario Ministry of Natural Resources, Thunder Bay, Ontario) and Dr. David Green (Cornell University, Biological Field Station, Bridgeport, NY). The generous and valuable assistance of these people is gratefully acknowledged.

The cover of this document was illustrated by Jennifer Shoemaker. Word processing was provided by Dora Ibarra, Elizabeth Barstow, and Patricia Gillis. Kay Lindgren assisted with literature search and acquisition.

BALD EAGLE (Haliaeetus leucocephalus)

HABITAT USE INFORMATION

General

The bald eagle (Haliaeetus leucocephalus) is a large predatory raptor that occurs "...primarily near seacoasts, rivers and large lakes, breeding in tall trees or on cliffs" (American Ornithologists' Union 1983:106). It is a common breeder throughout southeastern coastal Alaska (Robards and Hodges 1977) and is found in lesser numbers throughout Canada and the United States (DeGraaf et al. 1980). It winters primarily "...from southern Alaska and southern Canada southward" (American Ornithologists' Union 1983:106) near large, ice-free bodies of water (Steenhof 1978). After suffering precipitous declines over much of its range, the bald eagle population has recently exhibited signs of recovery (Hamerstrom et al. 1975; Grier 1982).

Food

The preferred foraging habitats of the bald eagle are rivers, lakes, and estuaries (DeGraaf et al. 1980). Primary feeding areas are large bodies of open water. It is rarely associated with smaller streams or ponds (Leighton et al. 1979). In the Greater Yellowstone Ecosystem, "[a] stable food source, which was available from early spring, appeared to be the most important factor in breeding area selection" (Swenson et al. 1986:5). Swenson et al. (1986:43) further stated that "[d]ifferences in movements, breeding success, nest site selection, and nesting chronology among [the Yellowstone, Continental, and Snake] units were primarily due to differences in the amount and timing of food availability."

The bald eagle consumes a wide range of food items, from pied-billed grebes (Podilymbus podiceps) (Cline and Clark 1981) to bullheads (Ictalurus spp.) (Dunstan and Harper 1975) to sea otter (Enhydra lutris) pups (Sherrod et al. 1975). Bald eagles at Chesapeake Bay have been found to prey upon or take as carrion 45 species of birds, 11 species of mammals, 12 species of fish, and 5 species of turtles (Cline and Clark 1981). Bald eagles in Maine preyed upon or took as carrion at least 34 species of birds, 18 species of fish, 11 species of mammals, and 2 species of invertebrates (Todd et al. 1982). In Oregon, bald eagles fed on 16 species of fish, 46 species of birds, 20 species of mammals, and 2 invertebrate species (Frenzel 1984).

Although the staple of the bald eagle diet is fish (DeGraaf et al. 1980), their prey may be classified into three main types: live fish, live sea or water birds, and carrion. Fish composed 77% of the food item remains collected at bald eagle nests in interior Maine (Todd et al. 1982). Bald eagles nesting on offshore coastal islands fed primarily on seabirds and waterfowl. In northcentral Minnesota, the diet of breeding eagles was 90% fish (Dunstan and Harper 1975). Studies in Ohio showed that nesting bald eagles fed primarily on fish (Herrick 1924). At San Juan Island, Washington, fish composed 51% of the breeding season diet (Retfalvi 1970). Fish were also the most frequent prey of bald eagles in Chesapeake Bay (LeFranc and Cline 1983) and in Oregon (Frenzel 1984). In southeast New York, wintering bald eagles fed almost entirely on dead and dying alewives (Alosa pseudoharengus) that had passed through the turbines of hydroelectric generating stations (Nye and Suring 1978). In contrast, wintering eagles in Missouri fed primarily on dead and crippled Canada geese (Branta canadensis) (Griffin et al. 1982).

Bald eagle prey selection is determined largely by availability. Birds accounted for 68% and 47% of the diet of bald eagles in the Yellowstone and Continental Units, respectively, of the Greater Yellowstone Ecosystem, but fish made up 67% of the diet in the Snake Unit, in response to habitat differences and prey availability (Swenson et al. 1986). In Maine, eagles focused on the chain pickerel (Esox niger) spawning run in April, then on the sucker (Catostomus spp.) spawning run in May (Todd et al. 1982). Bald eagles in Missouri abandoned their primary prey, dead or crippled waterfowl, in favor of fish during years of heavy fish kill (Griffin et al. 1982). In Oregon, bald eagle diets varied both seasonally and geographically (Frenzel 1984). Wintering bald eagles in southeast New York readily fed upon deer (Odocoileus virginianus) carcasses on frozen reservoirs (A. Peterson, N.Y. State Department Environmental Conservation, Albany; unpubl.). In Washington, eagles fed heavily on road-killed animals (Retfalvi 1970).

Bald eagle nesting densities depend, in part, on total prey availability. At Besnard Lake, Saskatchewan, nesting densities were higher in areas of higher lake productivity (Gerrard et al. 1983), and eagle nesting densities in central Saskatchewan were significantly correlated with the commercial fish catch per hectare of surface water (Whitfield and Gerrard 1985). In California, there also appears to be a positive relationship between bald eagle nesting densities and lake or reservoir productivity (Detrich 1985).

Total prey availability is a function not only of foraging habitat productivity but also the size of the foraging habitat (i.e., total available prey = prey biomass/ha x size of foraging habitat). This is exemplified by the bald eagle's preference for large areas of open water for foraging. Bald eagles nesting in marine environs in New Brunswick were more successful than those occupying lake or river sites (Stocek and Pearce 1981). Lake habitats were also clearly preferred over river habitats. At the Pit River hydroelectric complex in California, bald eagles nested exclusively along reservoirs, although riverine habitats were available (BSAI 1985). Leighton et al. (1979) concluded that lakes <11 km in circumference did not constitute primary breeding habitat. Whitfield et al. (1974) concluded that lakes with <11.3 km of shoreline did not provide primary breeding habitat. The surface

area of lakes with a circumference of 11 km varies with shoreline configuration, but cannot exceed 9.6 km² (for a circular lake). The smallest body of water reported to support one nesting pair of bald eagles is 8 ha (J. Mathisen, Chippewa National Forest, Cass Lake, MN; pers. comm.). It should be noted that bald eagles nesting on smaller water bodies may require other nearby lakes for additional foraging areas.

Although larger bodies of water appear to provide superior habitat to smaller ones (Whitfield et al. 1974; Leighton et al. 1979; Stoceck and Pearce 1981), increasing surface area beyond the 9.6 km² threshold does not appear to affect habitat suitability. For example, Lake Britton in northern California is a long and narrow reservoir with only 5.2 km² of surface area (BSAI 1985); however, it supports the highest density of nesting bald eagles in that state (if it were not so narrow, i.e., had a larger surface area, the same shoreline length could be more effectively used and might support an even greater density) (BSAI 1985; Detrich 1985). Also, in New York State, historical bald eagle nesting densities along Oneida Lake (207 km²) were at least as great as along the eastern shore of Lake Ontario (>15,000 km²) (Nye and Peterson 1980). Therefore, lakes with surface areas >10 km² (rounded from 9.6) appear to be of optimal size.

Water

No information pertaining to dietary water needs of the bald eagle was found in the literature.

Cover

Wintering bald eagles depend on suitable night and severe weather roosts in sheltered timber stands (Steenhof 1976). Although proximity to food sources is an important attribute (Keister and Anthony 1983), these roosts need not be close to water (Steenhof 1978). Roosts appear to be selected for protection from the wind (Steenhof 1978; Keister et al. 1985). However, the literature does not mention a dependence on cover during the breeding season. Cover requirements during the breeding season are assumed to be identical to reproduction requirements.

Reproduction

Although bald eagles will nest on the ground on isolated, treeless islands (Troyer and Hensel 1965) and occasionally on cliffs (Bull 1974; Brazil 1985), they prefer larger, dominant trees of a variety of species (Murphy 1965; Jaffee 1980; Lehman et al. 1980; Anthony and Isaacs 1981; Mosher and Andrew 1981; Mathisen 1983). The bald eagle prefers to nest in areas that are primarily mature or old-growth timber (Lehman et al. 1980; Anthony and Isaacs 1981; Anthony et al. 1982). Most nests in southeast Alaska were in old-growth forest where the average nest tree height was 29.4 m; no nests were found in second-growth trees (Robards and Hodges 1977). A mature vegetation structure was considered to be an important component of bald eagle breeding habitat in Maryland (Mosher and Andrew 1981). There, the average nest tree height was

29 m. The average nest tree height in Virginia was 30.1 m (Jaffee 1980). Nest trees were of an open, stable form providing easy access; the form was more important than the tree species in nest site selection.

Bald eagles in the Greater Yellowstone Ecosystem were flexible in their selection of nest sites, as long as a dependable food source was available in early spring (Swenson et al. 1986). Once this criterion was met, the eagles "... would nest...near either lakes or rivers, in either large, strong trees ...or small, weak trees..." (Swenson et al. 1986:41), although they tended to select the most desirable trees available. In comparison to surrounding trees, 38%, 44%, and 19% of the nest trees were categorized as larger (in diameter or height) in the Yellowstone, Continental, and Snake Units, respectively (Swenson et al. 1986). Sixty-two percent, 56%, and 71% of the nest trees were categorized as similar to surrounding trees in the three Units, respectively. Only 2 of the 56 nest trees were categorized as smaller than the surrounding trees.

Second-growth forest with a remnant (5% to 10%) old-growth component also may provide breeding areas. In Minnesota, State forestry laws of 1902 and 1908 required that 5% to 10% of the trees in the original forest stands be retained as seed trees (Juenemann and Frenzel 1972). These retained trees currently provide canopy discontinuity from the surrounding second-growth hardwoods and are strongly selected for by breeding bald eagles (Juenemann and Frenzel 1972; Mathisen 1983).

Some deforestation may occur without apparently affecting bald eagle densities. For example, in southern British Columbia, 21% of the study area had no old-growth trees, yet eagle density was not reduced from levels in northern British Columbia where 10% of the study area lacked old-growth (Hodges et al. 1984). Eagle densities in both areas matched those of undisturbed southeast Alaska. Although nesting density was greatly reduced in those plots of the study area without old-growth trees, densities in areas with at least some old-growth trees were higher than expected.

One of the most important characteristics of bald eagle nesting habitat is an open forest structure (Lehman et al. 1980; Anthony and Isaacs 1981; Mosher and Andrew 1981; Anthony et al. 1982). The average percent canopy closure at nests in Maryland was 61% (Mosher and Andrew 1981). In California, the canopy closure of the timber stand associated with the nest was usually <40% (Lehman 1979) and often <20% (Lehman et al. 1980). Bald eagles in the Pacific Northwest also nested in fairly open forests (Anthony et al. 1982) where the mean crown closure was <50% (Anthony and Isaacs 1981).

Bald eagles are primarily shoreline nesters (Hensel and Troyer 1964; Robards and King 1966; King et al. 1972; Gerrard et al. 1975; Grier 1977; Lehman et al. 1980; Hodges 1982; Mathisen 1983; Barber et al. 1985; Brazil 1985; Koonz 1985; Stocek 1985). Murphy (1965) listed proximity to water as the first requirement of an area as nesting habitat. The mean distance from water, however, varies between populations, from 36 m on Admiralty Island, Alaska (Robards and Hodges 1977), to over 707 m in Virginia (Jaffee 1980) to over 1.2 km in Oregon (Anthony and Isaacs 1981). Whitfield et al. (1974)

found that over 90% of all nests in their Manitoba and Saskatchewan study areas were within 182 m of a lake or river. Very few nests were found over 728 m from water. In this study and in Alaska (Robards and Hodges 1977), the number of nests dropped off sharply beyond 46 m from water. Bald eagles nested an average of 97.5 m, 199.8 m, and 552.5 m from water in the Yellowstone, Snake, and Continental Units, respectively, of the Greater Yellowstone Ecosystem (Swenson et al. 1986). In Maryland, Taylor and Therres (1981) did not consider land over 1.6 km from water to be suitable nesting habitat. Over 90% of all Maryland bald eagle nests were within 1.5 km of water. None of these studies, however, established a mean distance of land to water. Therefore, nest site preference may have been confounded with land and water distribution.

Bald eagles may show some reluctance to nest right at the shoreline. Even in relatively undisturbed areas of Alaska, the average distance of nest to water was 36 m (Robards and Hodges 1977). In addition, nests within 10 m of shore had a tendency to be used less than those nests over 10 m from shore. Both Robards and Hodges (1977) and Dixon (1909 cited by Bent 1937) suggested that protection from storms may be a reason for this avoidance of the immediate shoreline.

Special Considerations

Although the level of human disturbance often has no effect on the productivity of bald eagles at existing nest sites (Mathisen 1968; Grier 1969; Jaffee 1980; Stocek and Pearce 1981), eagles clearly prefer to nest in areas with little or no human disturbance (Fraser 1985). For example, bald eagle populations are densest in areas without significant human disturbance, such as southeast Alaska (Robards and Hodges 1977), and there they did not use areas of heavy human use. In Manitoba, there were significant numbers of nesting bald eagles on Lakes Winnipeg and Manitoba, except near extensive cottage development (Hatch 1985). Bald eagle densities on Besnard Lake, Saskatchewan, decreased in areas opened to recreational activity (Gerrard et al. 1985). The distance to a water body from bald eagle nests in the Greater Yellowstone Ecosystem tended to increase as the recreational use of the water body increased (Swenson et al. 1986). In Minnesota, human disturbance was related to lowered nest occupancy and productivity (Juenemann and Frenzel 1972). In coastal British Columbia, bald eagles were abundant except in heavily disturbed areas (Hodges et al. 1984). Bald eagles tended to nest away from human residential areas in Maryland (Taylor and Therres 1981). There, only two of 123 nests had residential development as the primary land use within 0.6 km of the nest. Taylor and Therres (1981) suggested that nesting bald eagles will tolerate low-density residential disturbance at distances greater than 1.2 km and medium- to high-density residential disturbances at greater than 1.8 km. A tendency of bald eagles to nest away from human activity was also noted in another quantitative study of bald eagle nesting habitat in Maryland (Mosher and Andrew 1981). Successful nest sites were located in more dense forest stands set back further from open water and forest openings than unsuccessful nests. All the bald eagle nests on Yellowstone Lake, Wyoming, were on the roadless south shore (Murphy 1965). The north shore is paralleled by a heavily traveled highway that permits access for a wide range of human recreational activities. The majority of

bald eagle nests in Virginia were located in areas of light human use (Jaffee 1980). Jaffee (1980) suggested that bald eagles were relocating their nests in Virginia to avoid human disturbance associated with shorelines. Lehman et al. (1980) made a similar suggestion about bald eagles in California. These studies indicated that, although nesting bald eagles were not affected by low degrees of human disturbance, habitat suitability decreased as human disturbance increased. There were few reported instances of bald eagles nesting in medium- to high-density human residential areas, and the greatest densities were always reported in areas of minimal human activity.

Logging operations can be very intensive, and this degree of human activity may lower nesting productivity (Anthony and Isaacs 1981). Carefully controlled selective timber harvest, however, need not lower habitat suitability (Lehman et al. 1980). Selective logging during the fall and winter was considered a necessary and appropriate bald eagle management tool in California because eagles there preferred to nest in ponderosa pine (Pinus ponderosa), a shade intolerant species (Lehman et al. 1980; Burke 1983).

Bald eagles may be more prone to nest desertion early in the nesting cycle than late in the cycle (Mathisen 1968) and will react differently to different types of disturbance. For example, existing cropland was considered an acceptable component of bald eagle nesting habitat in Maryland (Taylor and Therres 1981). However, the authors noted that cropland itself is unsuitable bald eagle nesting habitat. Intensive agriculture in Ohio was not thought to disturb some nesting bald eagles (D. Case, Ohio Department of Natural Resources, Columbus, Ohio; pers. comm.). In addition, disturbances that eagles may not directly recognize as human, such as railroads, planes, and unused buildings, may be tolerated.

HABITAT SUITABILITY INDEX (HSI) MODEL

Model Applicability

Purpose. This model differs from the standard HSI model. Most HSI models are designed to quantify the impacts of development projects for mitigation planning or to predict benefits of various habitat management programs. The bald eagle HSI model may be used for assessment of impacts, but will be of little use in mitigation or management studies due to the model variables. Variables used in this model to assess habitat suitability either are not likely to change due to management (e.g., area of water body, morphoedaphic index), or are likely to change slowly over time as a result of management (e.g., the amount of mature forest available for nest sites). Management of bald eagle nesting habitat currently consists primarily of nest site protection. For example, the management strategy for the bald eagle at Chippewa National Forest in Minnesota is primarily land-use restrictions in the vicinity of nests, along with biological monitoring (Mathisen et al. 1977). Therefore, the primary uses of this model may differ from those of other HSI models. This model may be most useful in comparing the suitability of many different areas at one point in time for site protection, or as a tool in recovery planning to locate optimum areas for bald eagle reintroduction or protection.

Geographic area. This HSI model has been developed for application to habitats in that portion of North America north of the 37th parallel, which runs from Norfolk, Virginia, to San Jose, California (Figure 1). Because the bald eagle nests across the continent in a variety of ecoregions, and is so mobile, no attempt was made to delineate a discrete breeding range within this area.

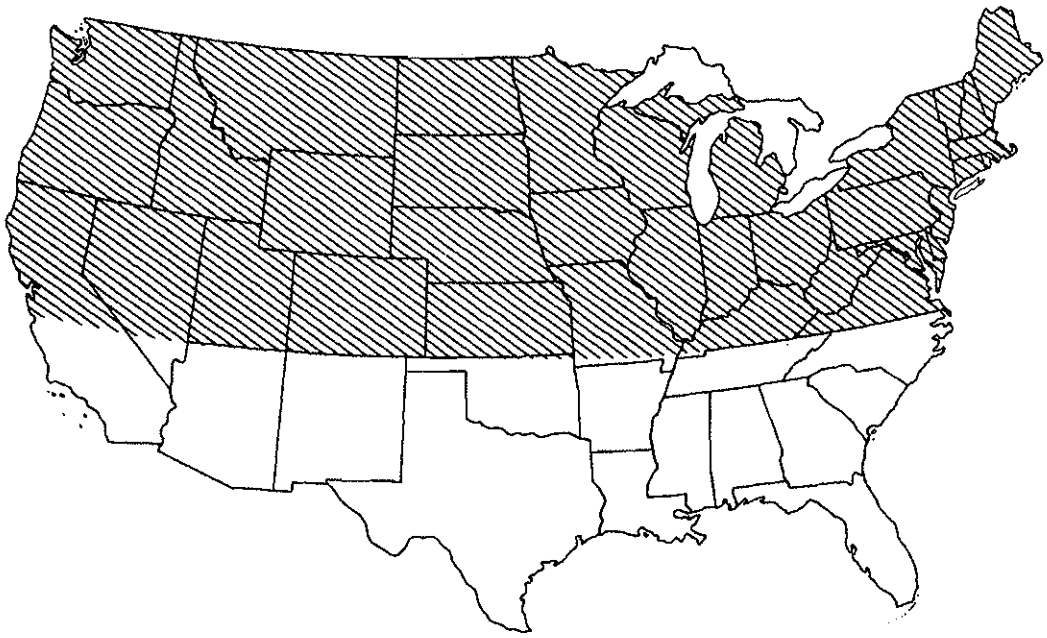


Figure 1. Geographic applicability of the bald eagle HSI model.

Season. This model was developed to evaluate the potential quality of nesting habitat for the bald eagle. It is not intended to assess the quality of fall and winter habitat.

Cover types. This model was developed to evaluate habitat in the Lacustrine (L) and Estuarine (E) cover types (terminology follows that of U.S. Fish and Wildlife Service 1981). These cover types include a 1.5-km strip of land that borders the open water or adjoining emergent or scrub-shrub wetlands. This model does not provide a means of evaluating riverine and marine cover types because data on the morphoedaphic index (a major factor in determining food suitability with this model) was not found for these cover types.

Minimum habitat area. Minimum habitat area is defined as the minimum amount of contiguous habitat that is required before an area will be occupied by a species. The smallest body of water occupied by one pair of nesting bald

eagles is 8 ha. Therefore, the minimum size of an evaluation area is assumed to be a body of water with a surface area of 8 ha surrounded by a 1.5-km strip of land.

Verification level. Earlier drafts of this model were reviewed by the following individuals:

Dr. Robert Anthony, Oregon Cooperative Wildlife Research Unit, Corvallis, OR

Mr. Denis Case, Ohio Department of Natural Resources, Columbus, OH

Mr. Keith Cline, Raptor Information Center, Washington, DC

Dr. Daniel James, U.S. Fish and Wildlife Service, Arlington, VA

Mr. John Mathisen, U.S. Forest Service, Cass Lake, MN

Mr. Brian Millsap, Raptor Information Center, Washington, DC

Ms. Karen Steenhof, U.S. Bureau of Land Management, Boise, ID

Mr. Stanley Wiemeyer, U.S. Fish and Wildlife Service, Laurel, MD

Comments by the reviewers were incorporated into the model and resulted in several significant improvements. The current model has not been field tested and empirical relationships between model outputs and measures of bald eagle habitat suitability are unknown.

Model Description

Overview. The breeding season HSI model for the bald eagle considers food, reproduction, and human disturbance as the primary components of breeding habitat. The HSI value considers the quality and availability of nesting sites and the availability of prey. Because eagle prey is primarily derived from aquatic systems, total prey availability is assumed to depend upon the size and productivity of the associated water body. Optimal nesting habitat is assumed to be characterized by: (1) a large foraging area with high fish production, (2) the presence of mature trees for nest sites, and (3) minimal human disturbance. Cover requirements during the breeding season are assumed to be adequately evaluated by the criteria used to evaluate reproductive requirements.

The following sections describe the logic used and the assumptions made to translate the habitat information for the bald eagle to the variables and equations used in the model. The suitability levels of variables and relationships between variables are also described.

Food component. Bald eagle breeding habitat suitability is strongly influenced by the availability of live or carrion prey, primarily fish or aquatic birds. Specifically, the amount of open water in the evaluation area and its productivity are of major importance in determining the total amount of food available to a population of eagles.

Since nesting bald eagles prey largely on aquatic or aquaphilic species, habitat suitability generally increases with the amount of open water. It was noted previously that areas with <8 ha (0.08 km^2) of open water are not known to constitute bald eagle habitat. Habitat suitability increases from zero below this size to optimal for bodies of water with surface areas ≥10 km^2 (Figure 2a). For estuarine cover types, the suitability index (SIV1) is assumed to be optimal (=1.0) for the amount of foraging habitat.

For the purposes of this model, emergent and scrub-shrub wetlands adjacent to open water also should be considered foraging habitat (as opposed to nesting habitat) due to documented eagle use of these habitats. Foraging in emergent or scrub-shrub wetlands, however, is apparently coincidental to the primary feeding strategies of fishing and shoreline scavenging, because bald eagles have not been observed hunting in emergent or scrub-shrub wetlands that are located far from large, open water bodies. Therefore, emergent or scrub-shrub wetlands that are not associated with open water should not be considered foraging habitat.

The productivity of the water body is the second aspect that is of importance in determining food availability. Specifically, food availability and, hence, habitat suitability, increase with productivity. A reasonable measure of the productivity of lentic aquatic systems can be obtained from the morphoedaphic index (Ryder 1965, 1978, 1980; Jenkins 1982) in terms of fish biomass density or potential fish yield (lbs/acre). The morphoedaphic index (MEI), where

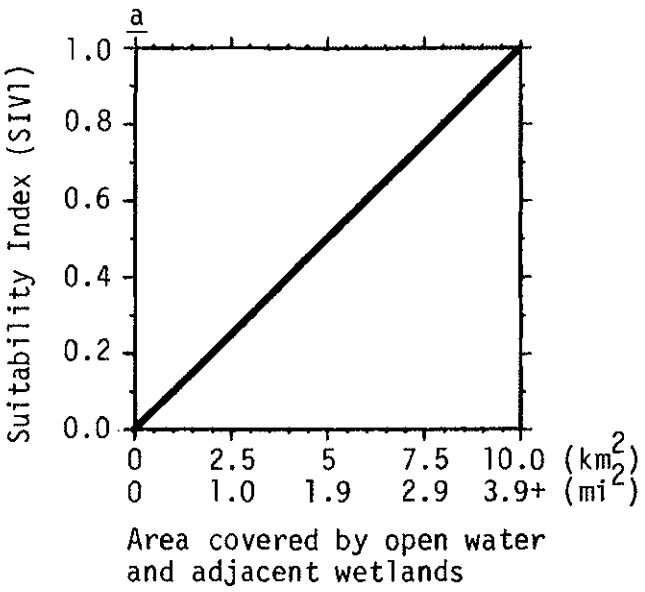
$$MEI = \frac{\text{total dissolved solids (ppm)}}{\text{mean depth (feet)}}$$

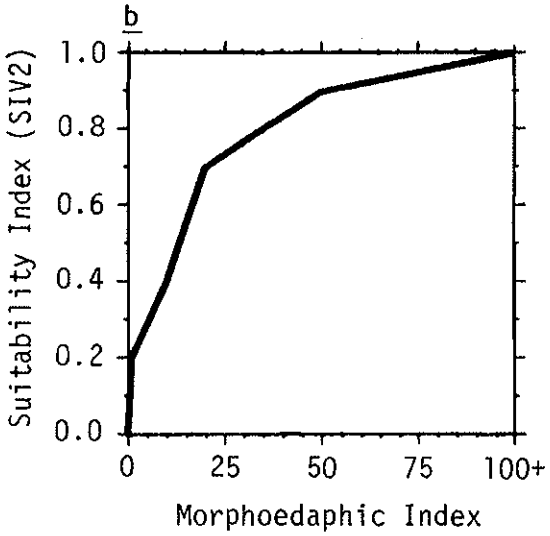
has been used to explain differences in bald eagle nesting densities (Gerrard et al. 1983; Detrich 1985). Detrich (1985) used a modified form where

$$MEI = \frac{\text{conductivity (micromhos)}}{\text{mean depth (cm)}}$$

Fish biomass density and, hence, habitat suitability are assumed to increase with the MEI as a function of the data curves generated by Ryder (1965) and Jenkins (1982) and as described by Ryder (R. A. Ryder, Ontario Ministry of Natural Resources, Thunder Bay, Ontario; pers. comm.) (Figure 2b).

Ryder et al. (1974) note that certain conditions may cause the MEI to yield misleading results. Very shallow lakes, with a mean depth <3 m, may contain lowered fish biomass because of winterkill. Also, lakes with very high TDS levels often have limited fish populations, although the precise reason for this is unclear (Schlesinger and Regier 1982). It is often thought,





Coordinates

X	Y
0.0	0.0
1.0	0.2
10.0	0.4
20.0	0.7
50.0	0.9
100.0	1.0

Figure 2. Relationships between variables used to evaluate suitability of water bodies as bald eagle habitat and suitability indices for the variables.

however, that highly productive systems have marginal habitat for some fish species because of anoxic hypolimnions or reduction of "liebensraum" (Ryder, pers. comm.). Ryder states that fish crops increase rapidly with the MEI to about 40, and show little improvement between MEI's of 40 and 100. Beyond an MEI of 100, Ryder states that the MEI-fish crop relationship often breaks down because of the conditions noted above.

Provided that all criteria for use are heeded, the MEI can be applied to freshwater or brackish ecosystems (Ryder, pers. comm.). However, in this model, comparisons of HSI between the two types may not be made because the salinity of estuaries and, therefore, TDS differs from that of lake water.

The suitability of the food component (SIF) is assumed to be best represented by the geometric mean of the two variables used to evaluate this component, as in Equation 1. This is intended to reflect the compensatory nature between lake size and lake productivity. Specifically, it is assumed that the food resources in lakes from 0.08 - 10 km^2 are not most efficiently used by eagles due to their territorial requirements. It is assumed, following the discussion of Detrich (1985), that smaller lakes often have opposing shorelines <0.5 km apart and that the presence of a pair of eagles on one shore may preclude use of the other shore by other eagles. On larger lakes (>10 km^2), it is assumed that lake geometry does not affect habitat use and that the SI is primarily determined by the MEI. Equation 1 yields a food suitability index of 0.0 for lakes ≤8 ha. For lakes >8 ha, the food suitability index determined by Equation 1 is a function both of area and MEI, but the index will be closer to the lower of the two inputs (i.e., SIV1 and SIV2). Note that the area of foraging habitat in estuarine cover types is assumed to be optimal (i.e., SIV1 = 1.0).

$$SIF = (SIV1 \times SIV2)^{1/2} \quad (1)$$

Reproduction component. Although individual pairs or remnant populations of bald eagles will nest in second-growth timber or largely deforested areas, the species clearly prefers, and reaches its greatest densities in, large areas of undisturbed, mature or old-growth timber, with an open and discontinuous canopy. This habitat type provides an abundance of the eagle's preferred nesting sites, i.e., tall, dominant trees, regardless of species, with an open structure and stable limbs allowing easy approach from the air. Second-growth forests, with a remnant (5% to 10%) old-growth component intermixed, also can provide for nesting requirements. Dense stands of even-aged, small, second-growth timber without a remnant old-growth component do not provide the relatively open canopy structure bald eagles need. The species rarely nests in this seral stage. Productivity of more exposed nests may be affected by increased vulnerability to storm damage. Susceptibility to human disturbance also may increase with visibility or accessibility of the nest.

Suitable bald eagle nesting habitat within lacustrine or estuarine habitats is assumed to be a function of the amount of mature, open canopy forest cover within the evaluation area. Because the majority of bald eagle nests of all populations are within 1.5 km of shore, the evaluation area for this component is the land area within 1.5 km of the edge of the water or associated herbaceous or shrub wetland. Optimum conditions for reproduction are assumed to occur when mature timber exceeds 75% of the land area. Smith (1974) defined undisturbed (i.e., mature) temperate forest generally as uneven aged, having a discontinuous canopy >20 m high. However, the height and structure of mature forests will vary with the forest type. Hence, the user should establish a definition of maturity for the forest cover in the evaluation area. The silvicultural definition of rotation age maturity is not appropriate for the purposes of this model, because it refers to the concepts of financial maturity and return on investment (Smith 1962). Habitats where mature forest cover is <75% of the land area are assumed to be suboptimal (Figure 3). Because bald eagles are territorial, with widely spaced nests even under optimum conditions, it is assumed that some deforestation within an evaluation area may occur without reducing the suitability index for the reproduction component. In this model, the suitability index for bald eagle reproduction (SIR) is estimated by only one variable, the proportion of potential nesting area in mature timber, and is equal, therefore, to SIV3 (from Figure 3).

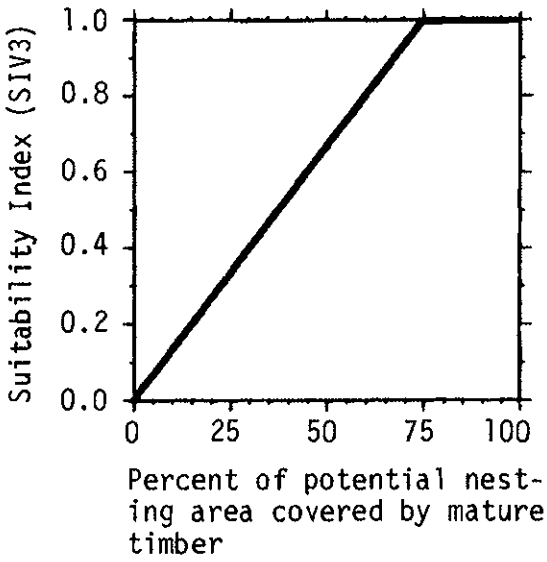


Figure 3. The assumed relationship between the amount of mature timber within 1.5 km of a shoreline and suitability of the habitat for bald eagle nesting.

Human disturbance component. Bald eagle populations reach their greatest densities in areas of minimal human activity. They are found in reduced densities in areas of moderate human use and are not found at all in areas of heavy human use. They prefer to nest at least 1.0 km from human residences and will nest farther from shore to avoid shoreline disturbances. Where human disturbance is severe, nesting success may be affected, and the area may be abandoned entirely. Although remnant populations often are not affected by existing levels of human disturbance, the potential carrying capacity of their habitat has been reduced through human presence and activities. The precise effect of human disturbance on bald eagle carrying capacity is not known and is, therefore, difficult to evaluate.

Human presence in bald eagle nesting habitat falls primarily into four categories: (1) agriculture, (2) urbanization, (3) recreational development, and (4) logging. Most agricultural operations are not human intensive and their effect on carrying capacity most likely is felt via attendant deforestation, not via the human presence per se. For this reason, agriculture is considered to be an impact upon the reproduction component. Urbanization and recreational development can both be measured by the density of houses, buildings, or campsites. Medium- and high-density residential areas are defined as areas where lot frontage is ≤33 m (New York State 1974). Medium-density residential areas along a lakeshore would then have buildings at a density of 30 per kilometer of shoreline (Figure 4). This corresponds to 20 buildings per square kilometer of the reproduction area. Habitat suitability is assumed to be optimal where there are no buildings or campsites and unsuitable where there are >20 buildings or campsites per square kilometer of upland (Figure 4).

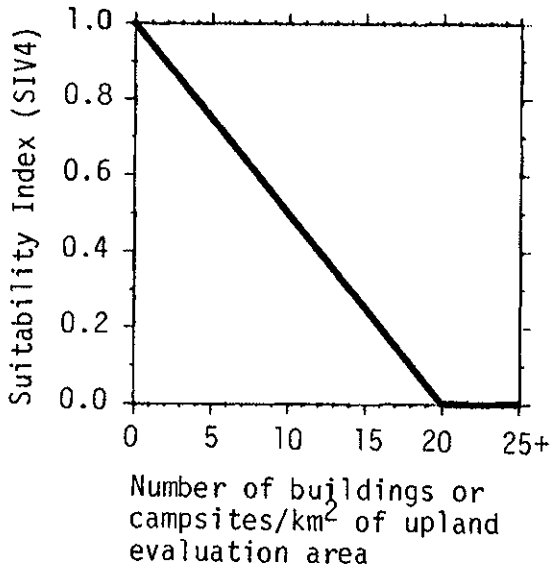


Figure 4. Assumed relationship between housing or campsite density and habitat suitability for the bald eagle.

The distribution and uses of the buildings or campsites, as well as the season of use, will affect the amount of their disturbance. If all the buildings or campsites are distributed evenly along the shoreline, so as to preempt the most desired nesting and perching sites, their impact will be greater than if they are tightly clustered and removed from the shoreline.

The human presence associated with logging may be significant and could cause large reductions in habitat suitability. However, this form of human disturbance has been studied only with respect to impacts upon productivity at individual nest sites. Because productivity varies between and within eagle populations, regardless of nesting density, productivity data alone cannot be used to reliably support habitat suitability models that are based upon nesting density. No information was located in the literature that documented a correlation between logging intensity over a large area (i.e., more than a single nest site) and nesting density in the same area. For this reason, the human disturbance associated with logging operations, although important, cannot be reliably included in this model and must be considered as a separate process.

The overall suitability index for the human disturbance (SIHD) component is estimated by the suitability index determined for building or campsite density (i.e., SIHD = SIV4).

Building density may not be the most precise indicator of human disturbance under certain conditions (e.g., heavy boat traffic only). To be a useful habitat assessment tool, however, the model variables must be easily measurable and applicable to the range of conditions within the model's geographic area of applicability. Building density, therefore, is used as a surrogate measure of human disturbance, because it is an easily measured indicator of long-term human land use.

HSI determination. The overall habitat suitability index is a function of the food, reproductive, and human disturbance components. Any of the components may be the most limiting factor in a given situation. Under pristine conditions, where the reproductive and human disturbance components are optimum, the overall habitat suitability will be determined by the food component which is, in turn, a function of the foraging area and the MEI. Under other conditions, the potential food base may be capable of supporting a higher density of bald eagles than is actually realized, as a result of less than optimum conditions for nesting sites and disturbance potential. It is assumed that the food component is of greater importance alone than either of the other components alone, unless one of the other components is 0.0. The reproductive and human disturbance components are combined via a geometric mean which yields a combined suitability value of 0.0 if either of the inputs is 0.0, and a value closer to the lower of the input values if both are >0.0. The resulting suitability value is multiplied by the food suitability index to yield the overall habitat suitability index (Equation 2). This relationship is based on the assumption that the food suitability value defines the upper level of potential suitability that will be realized only when the reproductive and human disturbance components are optimum. Values less than optimum for the reproductive and human disturbance components will lower the overall value

from the maximum set by the food component suitability. In the extreme situation, none of the potential food will be used by eagles when either or both of the reproductive or human disturbance components equals 0.0. It should be noted that the product resulting from Equation 2 will be lower than any individual input if the combined reproductive/disturbance input and the food input are <1.0, because decimals are being multiplied. This is intended and follows the logic that the combined reproductive/disturbance component is a modifier of the maximum suitability determined by the food component.

$$HSI = (SIR \times SIHD)^{1/2} \times (SIF) \qquad (2)$$

Because the HSI equation is geometric, and uses values <1.0, the HSI score will generally be <1.0, and will often be <0.5. This will be particularly true when cold, oligotrophic lakes are evaluated. The assignment of an HSI value <0.5 to a wilderness lake with perhaps a healthy eagle population may seem illogical. However, it should be remembered that the HSI is designed to reflect habitat suitability by the density of eagles along the shoreline. Oligotrophic, wilderness lakes may have quite healthy populations of eagles, but at lower densities than can be expected around more productive lakes.

Application of the Model

Summary of model variables. This model provides criteria to evaluate the suitability of bald eagle nesting habitat in lacustrine or estuarine cover types. The relationships of the habitat variables to an HSI are shown in Figure 5. Definitions of habitat variables and suggested measurement techniques (Hays et al. 1981, unless noted otherwise) are shown in Figure 6.

The presumed relationship between each habitat variable and habitat suitability has been described and documented. This provides some insights that can be used to tailor the model to fit study constraints and local bald eagle breeding characteristics. Due to the large breeding range of the bald eagle, it is expected that model alterations will be necessary.

Because many of the data used in applying this model are derived from remote sensing, it is essential that the user visit the evaluation area to ensure that all remote sensing data are accurate. This is necessary to properly define the occurrence and limits of mature forest and to accurately record the type and intensity of human disturbance. This model should not be applied solely on the basis of remote sensing data, no matter how recently collected.

Model assumptions. A number of significant assumptions were made in the development of this HSI model for the bald eagle. The major assumptions are as follows:

1. Mature forested stands with minimal human disturbance are required for nesting by bald eagles. However, optimal nesting conditions can exist as long as >75% of potential nesting area is in mature timber.

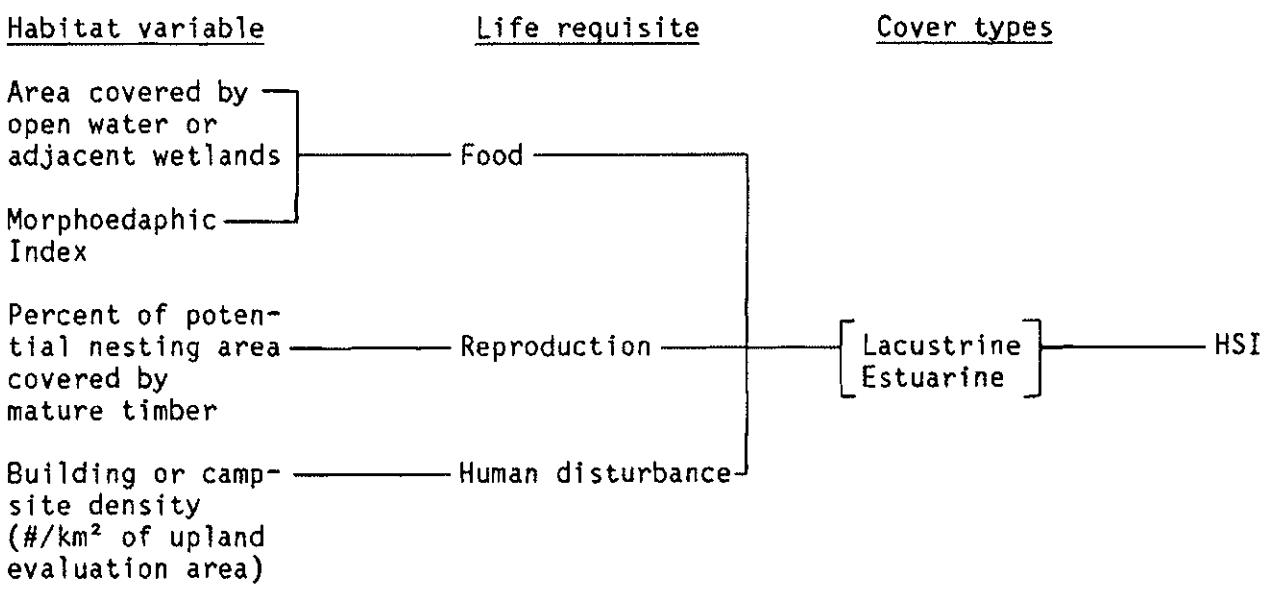


Figure 5. Relationships of habitat variables, life requisites, and cover types in the bald eagle HSI model.

2. Mature forest stands within 1.5 km of a body of water ≥8 ha provide optimal nesting conditions regardless of stand composition.

3. Immature forest stands provide no nesting habitat.

4. The extent and influence of human disturbance can be estimated by an estimate of building or campsite density.

The first assumption will probably be valid in most applications of this model. Under certain conditions, however, bald eagles will nest on the ground or on cliffs. This typically occurs on isolated, uninhabited islands where trees are scarce or absent. Under these circumstances, the model should be modified to include potential cliff or ground nests.

The second and third assumptions also should be valid in most applications of this model. However, certain monotypic stands may not provide optimal nesting conditions at maturity, if the tree species' terminal branching structure is too fine or fragile to support eagle nests. Some immature forest stands that are approaching maturity may contain scattered individual trees that, due to site advantage, possess size and form suitable for nesting. If either circumstance occurs, the model should be modified to reflect the relative presence or absence of nesting sites.

Variable (definition)	Cover types	Suggested technique
Area covered by open water or adjacent wetlands (the absolute area being evaluated that consists of open water plus the herbaceous and shrub wetlands that are immediately adjacent to open water; herbaceous and shrub wetlands that are not adjacent to open water should not be included in determination of area for this variable.)	L	Remote sensing, topographic map, dot grid, published data.
Morphoedaphic Index [A ratio relating the productivity of a water body as measured by total dissolved solids to the mean depth of that water body using the following formula: Morphoedaphic Index (MEI) = $\frac{\text{total dissolved solids}}{\text{mean depth}}$ where total dissolved solids (TDS) is measured in parts per million and mean depth is measured in feet].	L,E	TDS meter, conductivity meter, laboratory analysis, soundings, published data, (Hamilton and Bergersen, n.d.). (NOTE: Conductivity measurements must be converted to TDS before determination of MEI.)
Percent of potential nesting area covered by mature timber (an estimate of the proportion of a 1.5 km wide band of land, surrounding the cover type being evaluated, that is covered by mature forest; characteristics defining mature forest, such as height and density of trees, must be defined by the model user).	L,E	Remote sensing, direct observation, dot grid, topographic map.

Figure 6. Definitions of habitat variables and suggested measurement techniques.

Variable (definition)	Cover types	Suggested technique
Building or campsite density (the number of campsites, houses, or other permanent dwellings per km^2 of upland evaluation area based on the 1.5 km wide strip of land surrounding the aquatic cover type being evaluated).	L,E	Remote sensing.

Figure 6. (Concluded)

The fourth assumption is perhaps the assumption that will most often be invalid. The impact of humans on nesting bald eagles involves many types and intensities of disturbances. The use of building or campsite density as the single estimator of the impact of human disturbance obviously simplifies a very complex problem. Other means of assessing human disturbance on a local basis may be preferable to building or campsite density.

There are factors other than habitat that affect the carrying capacity of an area for bald eagles, including climate and environmental contaminants. These factors should be considered as possible sources of variation when model outputs are compared to populations in different habitats in widely separated areas.

Climate affects virtually all living organisms. As the mean temperature decreases, breeding seasons become shortened and energetics becomes an increasingly important factor. Wetmore and Gillespie (1976) found a significant correlation between mean April temperature and osprey (Pandion haliaetus) productivity in Labrador and northeastern Quebec. Leighton et al. (1979) found a significant correlation between April temperature and bald eagle nesting density in Saskatchewan. Their data indicated that, whereas local climatic and geographic features may cause variation, in general, bald eagle reproduction becomes difficult, if not impossible, where the mean April temperature is <-7 °C. Where mean April temperature is >10 °C, bald eagles begin nesting earlier to avoid extreme summer temperatures; this behavior is exhibited by bald eagles nesting in the southeastern United States (Bent 1937).

Climate also affects bald eagle prey availability. Total annual fish production is positively correlated with annual temperature on a global basis (Schlesinger and Regier 1982). Although climate was not a significant factor

in fish production within the north-temperate climatic region (Matuszek 1978), there can be large differences in annual fish production between north-temperate and south-temperate lakes with similar morphoedaphic indices (Schlesinger and Regier 1982).

Persistent environmental contaminants are another factor, but are not included as a habitat component in this model for two reasons. First, the contaminant burden in eagle populations is a function of wintering habitat as well as breeding habitat and cannot be accurately measured by analysis of breeding habitat alone. Second, the effect of persistent environmental contaminants on eagles has been measured by its effect upon nesting productivity, not directly on nesting density. However, nesting density has been affected where contamination was severe for prolonged periods (S. N. Wiemeyer, Patuxtent Wildlife Research Center, Laurel, MD; pers. comm.). In these cases, reproduction was inadequate to maintain stable populations and contaminants caused direct mortality to eagles. For the same reasons discussed earlier concerning logging impacts, the impact of persistent environmental contaminants upon habitat suitability cannot be reliably included in this model and must be considered as a separate process. Persistent environmental contaminants, however, have had marked effects on many raptor populations (Hickey 1969; Porter and Wiemeyer 1969; Redig 1979), including the bald eagle (Hamerstrom et al. 1975; Wiemeyer et al. 1984). Thus, the level of environmental contaminants in the nesting area should be considered in conjunction with any habitat analysis. Few controlled studies of the relationships between dietary levels of contaminants and reproductive success have been conducted. However, a very general pattern has been observed regarding dietary concentrations of DDE, which is now the most frequent source of chemically-induced reproductive disruptions (Wiemeyer, pers. comm.). This pattern can be used as a preliminary guide to suggest effects on productivity. When the wet weight dietary concentration of DDE in prey tissue is <0.1 ppm, no effect on raptor productivity is expected. Between 0.1 and 0.5 ppm, there may be some residue accumulation and minor effects. Between 0.5 and 3 ppm, there may be some eggshell thinning and reproductive problems. When DDE concentrations in prey tissues are consistently above 3 ppm, there may be occasional adult mortality and a severe reduction or complete failure in productivity. Other persistent contaminants also may cause adverse effects on bald eagle populations (Wiemeyer, pers. comm.). Contaminant ecologists should be consulted when such contaminants are detected in prey items. The potential effects of nonpersistent but moderately to highly toxic contaminants should not be overlooked.

SOURCES OF OTHER MODELS

Two HSI models have been developed for Alaska (Steenhof, in press). Both models rely on subjective characterization of habitat types and appear to measure the suitability of individual nest sites, rather than larger areas of habitat.

Taylor and Therres (1981) used the physical characteristics of known bald eagle nesting habitat in Maryland to construct a computer-generated prediction

of suitable habitat in Maryland. They evaluated land use, cover type, disturbance, and distance to feeding areas. Their system measured many different areas at a single point in time. The biological data used in their model supports this HSI model and was used to document some of the assumptions contained herein.

Two additional HSI models are currently being developed for use in Montana (Steenhof, in press).

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A review and synthesis of existing information were used to develop a Habitat Suitability Index (HSI) model for the bald eagle (Haliaeetus leucocephalus). The model consolidates habitat use information into a framework appropriate for field application, and is scaled to produce an index between 0.0 (unsuitable habitat) and 1.0 (optimum habitat). HSI models are designed to be used with Habitat Evaluation Procedures previously developed by the U.S. Fish and Wildlife Service.

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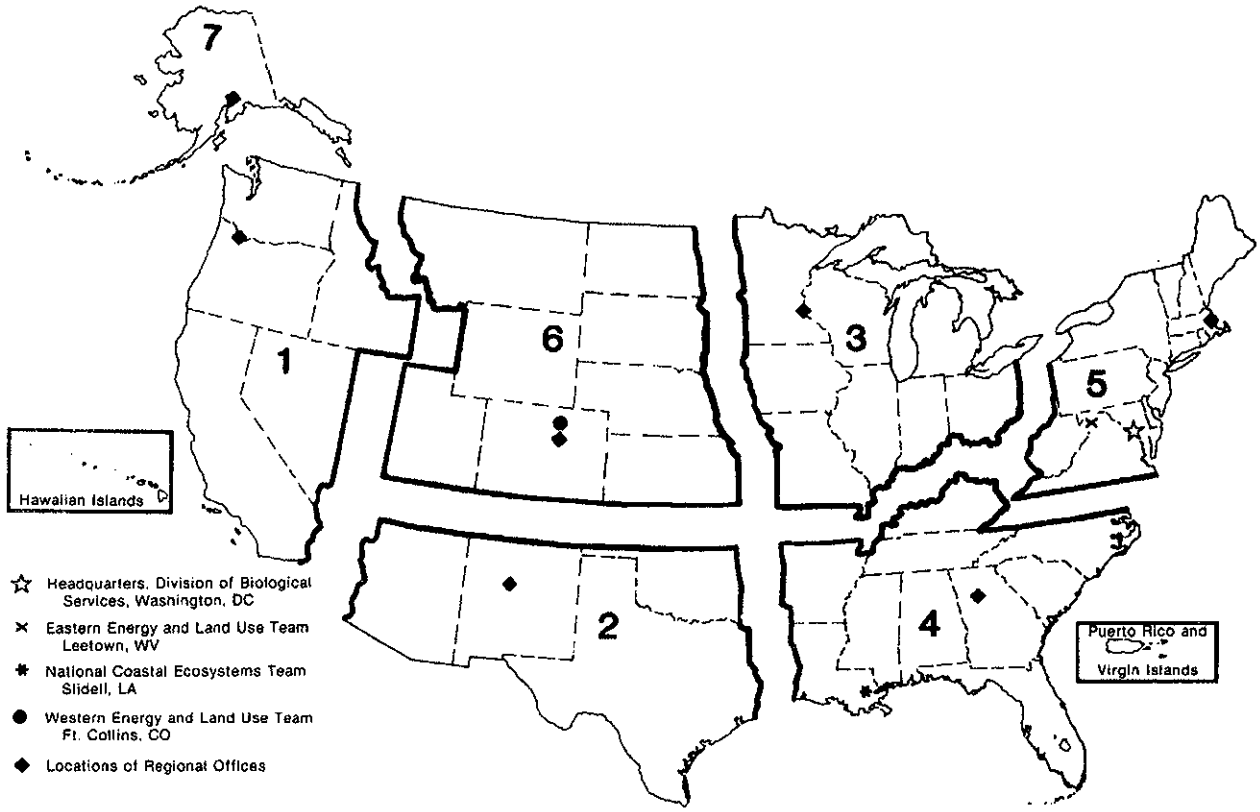

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