FINAL REPORT

WILDLIFE IMPACT ASSESSMENT
PALISADES PROJECT, IDAHO
FEBRUARY 1985

U.S. FISH AND WILDLIFE SERVICE
OFFICE OF ECOLOGICAL SERVICES
BOISE, IDAHO

JOHN P. WOLFLIN, FIELD SUPERVISOR

Prepared by

SIGNE SATHER-BLAIR, WILDLIFE BIOLOGIST
SUE PRESTON, WILDLIFE BIOLOGIST

Funded by:

Bonneville Power Administration
Project No. 84-37

Abstract

The Habitat Evaluation Procedures (HEP) was used to evaluate pre- and post-construction habitat conditions of the U.S. Bureau of Reclamation's Palisades Project in eastern Idaho. Eight evaluation species were selected with losses expressed in the number of Habitat Units (HU's). One HU is equivalent to one acre of prime habitat. The evaluation estimated that a loss of 2,454 HU's of mule deer habitat, 2,276 HU's of mink habitat, 2,622 HU's of mallard habitat, 805 HU's of Canada goose habitat, 2,331 HU's of ruffed grouse habitat, 5,941 and 18,565 HU's for breeding and wintering bald eagles, and 1,336 and 704 HU's for forested and scrub-shrub wetland nongame species occurred as a result of the project. The study area currently has 29 active osprey nests located around the reservoir and the mudflats probably provide more feeding habitat for migratory shore birds and waterfowl than was previously available along the river. A comparison of flow conditions on the South Fork of the Snake River below the dam between pre- and post-construction periods also could not substantiate claims that water releases from the dam were causing more Canada goose nest losses than flow in the river prior to construction.

Table of Contents

List of Figures

List of Tables

List of Appendices

Acknowledgements

We would like to thank the following biologists who participated in all or part of the work session held in Idaho Fal Is, Idaho from October 22 to 26: Mike Whitfield, Targhee National Forest; Bob Jones, Bureau of Land Management; Bob Martin and Tracy Trent, Idaho Dept. of Fish and Game; Dave Lockman, Wyoming Dept. of Game and Fish; Bob Adair, U.S. Bureau of Reclamation; Chuck Solomon, Ian McKie, and Dick Giger, U.S. Fish and Wildlife Service. We extend special thanks to Mike Whitfield and Bob Jones who developed the bald eagle model and evaluated the study area using this model after the work session. We extend thanks to Chuck Solomon from the Western Energy Land Use Team whose advise in the use of the Habitat Evaluation Procedures saved us much time and energy. We would also like to thank Jim Munson of the Salt Lake Field Office of the U.S. Fish and Wildlife Service who helped us locate the aerial photography for the pre-construction period. Finally, we express appreciation to Dr. Tom Ore of the Geology Dept. of Idaho State University who was kind enough to loan us the pre-construction aerial photography.

INTRODUCTION

This report presents an analysis of impacts on wildlife and wildlife habitat as a result of the construction and operation of the Bureau of Reclamation's (BR) Palisades Project in eastern Idaho. The study was funded by the Bonneville Power Administration (BPA) under the authority of Section 1000 of the Columbia River Basin Fish and Wildlife Program adopted by the Northwest Power Planning Council pursuant to Section 4(h) of the Northwest Electric Power Planning and Conservation Act of 1980. The objectives of this study were to:

1. Determine the probable impacts of development and operation of the Palisades Project to wildlife and wildlife habitat.

2. Determine the wildlife/wildlife habitat impacts attributable to hydroelectric development and operation.

3. Provide for consultation and coordination with interested agencies and other entities expressing interest in the project.

To achieve these three objectives the study was designed to include interested agencies and other entities in the assessment. One work session was held in Idaho Falls, Idaho from October 22-26, 1984 to evaluate pre- and post-construction wildlife habitat conditions of the project area. The following agencies participated in all or part of the work session: Idaho Dept. of Fish and Game (IDFG), Wyoming Dept. of Game and Fish (WDGF), U.S. Bureau of Land Management (USBLM), U.S. Forest Service (USFS), U.S. Bureau of Reclamation (USBR), and the U.S. Fish and Wildlife Service (USFWS). The information obtained and exchanged at this work session forms the basis of the impact assessment.

PROJECT DESCRIPTION

Palisades Dam and Reservoir are located approximately 50 miles southeast of Idaho Falls, Idaho on the Idaho - Wyoming border (Figure 1). The project was originally authorized in 1940 and reauthorized in 1950 for irrigation, flood control, electric power production, recreation, fish and wildlife (USBR 1978). Construction of the project began in 1951 and the dam and powerplant were completed in 1957 and 1958, respectively. The project created a 15,600 surface-acre reservoir with over 1 million acre-feet of water storage capacity. The storage reservoir provides supplemental water for irrigating approximately 650,000 acres of land in the Snake River Plain as well as for flood control during spring runoff (USBR 1951).

The existing Palisades powerplant has four 28.5 megawatt generating turbines with a total installed capacity of 119 megawatts. The USBR is currently studying the feasibility of enlarging the power facilities at the dam by 110 megawatts, however, this action would not change the current mode of operation (USBR 1978).

Besides the 15,600-acre reservoir, the project also required approximately 500 acres for the dam site, borrow sites, and camp sites located immediately downstream of the dam. The USBR had to relocate U.S. Highway No. 26 around the north side of the reservoir and a 51-mile, 150-foot wide transmission line easement had to be purchased.

Operation of the reservoir results in extreme monthly fluctuations in reservoir surface elevation and water discharge to the South Fork of the Snake River below the dam (Table 1). These data indicate that a 25 to 30 foot vertical drop in reservoir water surface elevation occurs between July and October during most years.

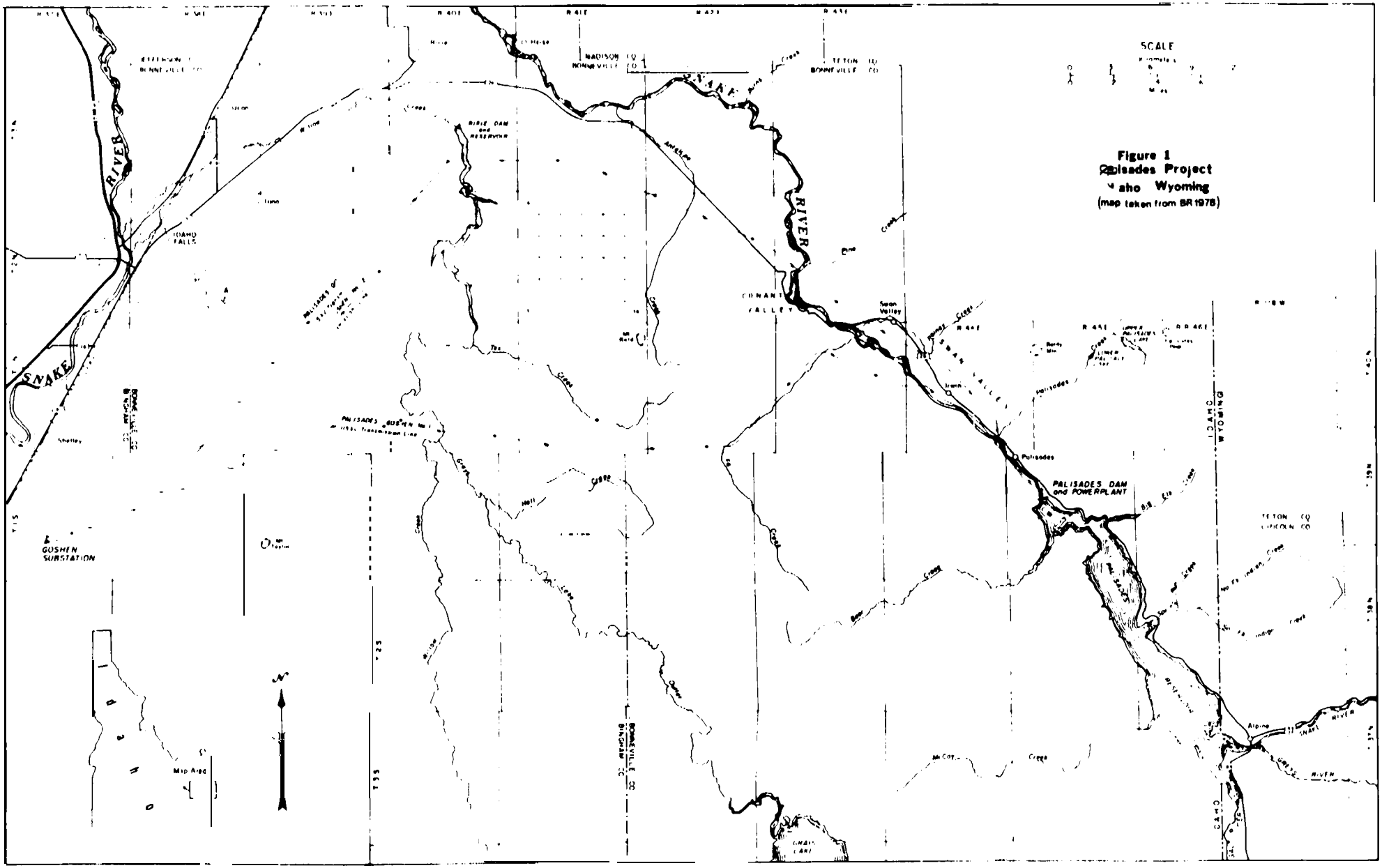

SCALE
Figure 1
Palisades Project
Idaho Wyoming
(map taken from BR 1978)
SNAKE RIVER
IDAHO FALLS
RIRIE DAM and RESERVOIR
SWAN VALLEY
PALISADES DAM and POWERPLANT
GOSHEN SUBSTATION
Alpine
MADISON CO
TETON CO
BONNEVILLE CO
BINGHAM CO
LINCOLN CO
IDAHO
WYOMING

Table 1. Average monthly water releases and head, 1957-1978, Palisades Reservoir (USBR 1978).

Month	Average Release (cfs)	Average Head 1/ (feet)	Month	Average Release (cfs)	Average Head 1/ (feet)
January	2,070	213	July	13,200	232
February	2,330	215	August	9,620	222
March	3,350	215	September	6,820	211
April	6,260	210	October	3,460	203
May	12,100	210	November	2,180	204
June	14,000	226	December	2,030	209

1/ Elevation differential

Reauthorization of the Palisades Project in 1950, included as project features "...facilities for the improvement of fish and wildlife along the headwaters of the Snake River..." and reservation of storage "...not to exceed fifty-five thousand acre-feet of active capacity in Palisades Reservoir for a period ending December 31, 1952 for replacement of Grays Lake storage." (Public Law 81-864). This exchange of water was intended to stabilize water levels at Grays Lake Wildlife Refuge in order to improve the quality of waterfowl habitat. However, the USFWS was unable to resolve land ownership conflicts at Grays Lake or to develop a water exchange plan acceptable to interested parties. As such, no structural measures have been implemented to mitigate for losses of wildlife habitat due to construction and operation of the Palisades Project.

STUDY AREA

For the purposes of this impact assessment the reservoir, dam staging areas, and relocation of U.S. Highway 26 were considered as project features that should be included in the study area. The transmission corridor, while part of the hydroelectric facility, was not included because BPA will be negotiating an agreement with the state "...regarding transmission lines and their effects on wildlife and its habitat" (Northwest Power Planning Council 1984). The 650,000 acres of shrub-steppe vegetation in the Snake River Plain that was converted to farmland, as a result of irrigation development, also was not included as part of the study area. This land use change was not directly attributable to power production at the Palisades Project (although without the power production at Palisades and other hydroelectric facilities irrigation development of the Snake River Plain would be greatly limited).

The study area extended 100 meters from the edge of the reservoir except where Highway 26 is located along the north shoreline. Since relocation of Highway 26 was a project feature the study area included the highway and all land between it and the reservoir. Downstream of the dam the study area extended approximately 1.5 miles and included only those areas that were used as borrow sites and staging areas. There is also discussion on the effect of flow releases from the dam on downstream waterfowl habitat, but this area of concern is not included in the study area.

MATERIALS AND METHODS

Vegetation mapping of the pre-construction period was done using 1954 black-and-white aerial photography (scale 1:20,000) obtained from the Geology Department at Idaho State University in Pocatello. Oblique photographs of the study area before construction were obtained from the USRR and the USFWS to assist in vegetation mapping. Construction at the dam site, rerouting of Highway 26 on the north side of the reservoir, and clearing of vegetation had began in 1954, so the oblique photographs provided information which could not be obtained from the aerial photography.

Vegetation mapping of the post-construction period was done using 1980 color infra-red transparencies. This information was transferred to topographic maps (scale 1:24,000) for measurement.

The national wetland classification system (Cowardin et al. 1979) was used to map the wetland plant communities. Five wetland classes were identified; forested wetland, scrub-shrub wetland, persistent emergent wetland, riverine rock bottom, and lacustrine open water. Five upland vegetation communities could be identified from the aerial photographs. These included agricultural lands, coniferous forest, aspen, sagebrush, and grass/sagebrush. The resolution of the 1954 black and white photography limited any further break down of vegetation communities.

The Habitat Evaluation Procedure (HEPI developed by the USFWS (1980) was used to evaluate the quality of wildlife habitat in the project area under pre- and post-construction conditions. This procedure utilized an interagency team of biologists that selected evaluation species and subsequently evaluated habitat conditions based on selected species models. Usually an evaluation species is

selected because it is a species of special significance in the study area or it is an indicator species used to describe habitat conditions for other species with similar habitat needs. For this impact assessment we selected species models that fit into both of these categories. Because of time constraints, the number of evaluation species was limited to eight.

Through correspondence and at the interagency meeting held in Idaho Falls, Idaho on October 22-26 the following evaluation species were selected by participating biologists.

Species	Reason of Selection
Black-capped chickadee	Indicator species for wildlife associated with forested wetlands.
Yellow warbler	Indicator species for wildlife associated with scrub-shrub wetlands.
Mink	Indicator furbearer species.
Mallard	Indicator waterfowl species.
Mule deer	Indicator big game species.
Ruffed grouse	Indicator upland game species.
Canada goose	Important waterfowl species in the study area.
Bald eagle	Endangered species found in the study area.

The black-capped chickadee, yellow warbler, and mink models have been published and are available from the USFWS (Schroeder 1982, Schroeder 1983, Allen 1984). The mallard, mule deer, and ruffed grouse models are developed but unpublished models. The Canada goose and bald eagle models were developed by evaluation team members specifically for this project. These latter five models are in Appendix 8.

Each species model uses a number of measurable variables that are combined into a simple equation which results in a sample site Habitat Suitability Index (HSI). The average HSI from all sample sites is used as the HSI value for a given evaluation species in the study area. This overall HSI, which is a number between 0 and 1.0, is a quality index or a measure of the capacity of the project area to meet the life requisites of the evaluation species.

To evaluate changes in habitat quality associated with this project using the HEP, two scenarios had to be considered; baseline or pre-construction conditions and future with the project or post-construction conditions. During the October work session, the interagency team of biologists discussed sampling procedures to determine the HSI's for the evaluation species for both conditions. After a review of pre- and post-construction photographs in the vicinity of the study area, one important assumption was accepted at the meeting; the habitat quality of vegetation communities currently in or near the study area are representative of corresponding vegetation communities inundated by the project.

A number of variables had to be measured for the selected evaluation species models. When possible, measurements were taken and sample site HSI's determined using the pre- and post-construction aerial photography. However, some variables such as tree and shrub heights, tree, shrub, and herbaceous canopy cover, and number of snags were measured in the field. Two teams of biologists spent two days taking field measurements. General sampling areas were selected based on their similarity to areas that were inundated by the reservoir or because they were considered representative of vegetation currently in the study area. Three line transects (100 feet) within each sampling area were randomly selected and vegetation measurements were taken along these transects.

The sampling design for determining HSI values varied for each evaluation species. A brief discussion on the sampling design is provided below.

Black-capped Chickadee - It was assumed that the forested wetlands downstream of the project area were representative of those in the project area prior to inundation. Four sampling areas were located in the vicinity of Falls Creek Campground and two sites were located in a narrow band of forested wetland approximately 3 miles downstream of the dam site.

Yellow Warbler - It was assumed that the scrub-shrub wetlands on tributary streams in and adjacent to the study area were representative of those inundated by the project. Two sampling sites were located in the Salt River area, two in the Bear Creek drainage, and one in the Trout Creek drainage.

Mink - The evaluation used a combination of the aerial photography and field measurements taken in the forested and scrub-shrub wetlands. The pre-construction evaluation used sampling locations spaced every mile along the river and its tributaries. A sample site HSI was estimated at each of these sites using the aerial photography and appropriate data collected in the field. The post-construction evaluation used field data, 1977 and 1980 aerial photography, and reservoir operations information. Approximately 70 miles of shoreline were evaluated.

Mule Deer - The evaluation team relied on vegetation field measurements taken near Bear Creek, Indian Creek and McCoy Creek as well as information from the aerial photography. Average monthly snow depths for the reservoir area were obtained from the Soil Conservation Service for the period 1910 to present. This snow depth information was used to adjust HSI values as specified in the model.

Ruffed Grouse - This evaluation species was added after the work session in October at the request of IDFG. Using the field data collected at the work session and the pre-construction aerial photography, sample site HSI's were determined in 1.0 mile intervals along the river for the forested

wetlands. The habitat quality of the aspen communities were evaluated using the field data. The aspen and forested wetland communities currently around the reservoir were assumed to provide similar quality habitat as was inundated by the project.

Mallard - The evaluation team agreed that 100 meters on either side of the river and its tributary should be evaluated as mallard habitat for the pre-construction period. Sample site HSI values were determined at 1.0 mile intervals along the waterways within the study area. The team relied on the pre-construction aerial photography to determine these values. The team also concluded that only certain areas on the reservoir currently provide mallard habitat. These areas were evaluated using the mallard model, and it was assumed that the rest of the reservoir provided no habitat.

Canada Goose - The evaluation procedure was essentially the same as for the mallard. However, since Canada geese use larger water bodies than duck species, only the land adjacent to the South Fork of the Snake River, Grey's River, and Salt River were evaluated for the pre-construction period. The reservoir shoreline was evaluated in a similar manner as was used for the mallard evaluation.

Bald Eagle - The bald eagle model was developed by Mike Whitfield and Bob Jones of the USFS and USBLM, respectively, using the Greater Yellowstone Ecosystem (GYE) Bald Eagle Yanagement Plan (GYE Working Team 1984) for guidance. These two biologists also evaluated pre- and post-construction conditions for bald eagles at 1.0 mile intervals along the river and south side of the reservoir.

The overall HSI, when multiplied by the number of acres of habitat of those cover types needed by each evaluation species, yields the number of Habitat Units (HU's), a measure of the quality and quantity of habitat available to the evaluation species. The difference in HU's for each evaluation species between pre and post-construction periods represents the losses and/or gains of habitat in terms of quantity and quality as a result of the project.

Streamflow data from 1945 to present were obtained from the U.S. Geological Service for the Heise gauging station which is downstream of the project. These data were used to compare pre- and post-construction flow conditions in relation to Canada goose production on the South Fork of the Snake River.

VEGETATION COMMUNITIES AND LAND USE

In order to assess losses and/or gains in wildlife habitat as a result of the Palisades Project, vegetation communities and land use of the study area were described. The vegetation mapping was necessarily very general because of the lack of historical data and poor resolution of the pre-construction aerial photography. The early project reports (USFWS 1947, USBR 1951) were of some help but study area descriptions lacked detail.

Eleven cover types (i.e. plant communities or land use features) were identified using the pre- and post-construction photographic data. Definitions in Cowardin et al. (1979) were used to describe wetlands. Each of these cover types is described below.

Forested Wetland - These wetlands occur where moisture is abundant, usually along the river and its tributaries. Woody vegetation is equal to or greater than 6 meters (20 feet) in height. In the study area narrow-leaved cottonwood trees (Populus angustifolia) dominate the overstory with quaking aspen (Populus tremuloides) vine maple (Acer glabrum), willows (Salix spp.), red-osier dogwood (Cornus stoloniferal white alder (Alnus rhombifolia), chokecherry (Prunus virginiana), snowberry (Symphoricarpos spp.), and many other shrubs in the understory.

Scrub-shrub Wetland - These wetlands are generally located where moisture is abundant, usually along the river and its tributaries. Dominant woody vegetation is less than 6 meters (20 feet) in height for this cover type. In the study area willows, red-osier dogwood, white alder, chokecherry, snowberry, young cottonwoods, and aspen are common plants comprising this cover type.

Emergent Wetland - These areas are characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. In the study area cattails (Typha spp.1, bulrushes (Scirpus spp.1, sedges (Carex spp.), and various grasses may dominate, depending on the water regime.

Riverine Rock Bottom - This cover types describes the river channel that was in the project area prior to impoundment. Substrate of the river bottom has 75% or greater cover of stones, boulders, or bedrock.

Lacustrine Open Water - This is the reservoir pool.

Agriculture - In the study area the main crops are wheat and alfalfa hay (USBR 1951). Some grazing lands are also included in this category.

Coniferous Forest - Steele et al. (1983) described several forest habitat types characteristic of the Palisades Reservoir area. Douglas-fir (Psuedotsuga menziesii), subalpine fir (Albies lasiocarpa), and lodgepole pine (Pinus contorta) are the common dominant coniferous trees. The understory associated with these trees is diverse depending on soils, slope, and aspect. Common understory plants include vine maple, Cascade mountain-ash (Sorbus scopulina), chokecherry, serviceberry (Amelanchier alnifolia), and scouler willow (Salix scouleriana).

Aspen - This cover type is dominated by quaking aspen with a variety of associated understory shrubs. Mueggler and Campbell (1982) identified serviceberry and snowberry as the most common shrubs associated with aspen in their survey of southeastern Idaho. Sagebrush (Artemisia tridentata), is also a common understory shrub on some of the drier aspen sites.

Shrub-steppe - This cover type is usually dominated by sagebrush with bitterbrush (Purshia tridentatal, Oregon grape (Berberis repens), ceanothus (Ceanothus velutinus) and snowberry also present. In the study area this cover type is usually present on south facing slopes or on level terrain.

Grass-Sagebrush - This cover type is dominated by grasses (Agropyron spp., Bromus spp., Poa spp.) with scattered sagebrush plants common. This cover type includes some areas used as pastures.

Other - This cover type includes the dam, power facilities, U.S. Highway 26, and the government camp area. Farmhouses and minor roads were not included here but rather were left as part of respective cover type in which they were located.

Pre-construction Conditions

Prior to inundation the study area was known as Grand Valley (map located in Appendix C). The valley floor was wide (1-2 miles across in most places) and sloped gently. The South Fork of the Snake River flowed through the valley with the confluences of the Gray's and Salt Rivers located near the southeastern corner of the project area. Several other small tributaries, notably Indian Creek, Bear Creek, McCoy Creek and Big Elk Creek flow into the South Fork in the study area. Historical accounts also cite several hot springs which were present (USBR 1951). The valley was bordered on the north side by Targhee National Forest and on the south by Caribou National Forest. The principal land use of the valley was farming and grazing.

Comparison of the cover type acreage figures presented in Table 2 with those reported in the early fish and wildlife report (USFWS 1947) reveals some discrepancies. For example, the 1947 USFWS report stated that 4,950 acres of sagebrush were in the reservoir area. Using the presently available data, a lesser amount of shrub-steppe vegetation was identified in this study. The resolution of the 1954 black and white aerial photography limited the ability to distinguish between sagebrush, farmland, grass, and aspen. Therefore, some of the areas classified as sagebrush in 1947 may be classified as grass/sage, aspen, or agriculture in the present study. The USFWS (1947) also identified

1,100 acres of riverbed that would be affected by the project. This study tallied only 900 acres. The 200-acre discrepancy may be due to the earlier inclusion of island areas and to the exclusion of smaller tributary streams in this study. The 1947 report was very general in nature and lacked any description of methods used. Therefore, it is felt that the current measurements probably represent a more accurate estimate of cover type areas within the study area.

Extensive areas of wetlands existed along the project reach of the South Fork and its tributaries prior to project construction (Table 2). Over 2,500 acres of forested and scrub-shrub wetlands were present along the water courses. In some locations large blocks or complexes of these wetlands were present while along other portions of the river there was only a narrow band of vegetation. The Bear Creek drainage had extensive scrub-shrub wetlands along its course as did the Salt River. The USFWS (1947) reported that narrow-leaved pondweed (Potamogeton spp.) was common in slack water areas of the river and that emergent wetlands occurred in the vicinity of the confluence of Sulfur Bar Creek and the South Fork. The river and its tributaries were upper perennial rock bottom riverine systems (Cowardin et al. 1979).

Several islands were present in the project reach prior to dam construction ranging in size from 1 to 24 acres and totaling 100 acres. Most of the islands were composed of a combination of scrub-shrub and grass vegetation. Two notable exceptions to this were the two islands at the dam site which were vegetated with mature cottonwood trees.

Landward of the wetland areas, farming and pastures dominated the landscape of the valley floor. Dryland wheat and irrigated hay were the common crops grown. Large areas near the river were used as pasture due to the high water table and flood frequency in the spring. Human presense was concentrated on the north side of the river; with most of the homes and a major U.S. highway located there. A secondary road and some farming occurred on the south side but the narrowness of the valley on this side limited human disturbances.

Table 2. Cover type areas in the study area for pre- and post-construction periods.

	Forested Wetland	Scrub-shrub Wetland	Emergent Wetland	Riverine Rock Bottom	Lacustrine Open Water	Agriculture	Coniferous Forest	Aspen	Shrub-steppe	Grass/sage	Other [1]	Total
pre-construction conditions	1,715	874	59	900	0	6,800	1,352	2,116	3,284	1,465	0	18,565
pot-c onstruction ond itions	38	42	127	0	15,600	0	740	880	338	590	210	18,565
net gain or loss	-1,677	-832	+68	-900	+15,600	-6,800	-612	-1,236	-2,946	-875	+210	

1 Includes dam, powerhouse, U.S. Highway 26 and government camp

Above the valley floor, coniferous forest, aspen, and shrub-steppe plant communities dominated the landscape depending on slope, soil, and aspect. Early aerial photographs of the study area indicated that a large area of aspens and conifers was present in the vicinity of Bear Creek and Van Point. In some locations these cover types were adjacent to the river or its associated wetland communities.

Post-construction Conditions

The Palisades Project created a 15,600-acre reservoir, as measured from USGS 7.5 minute topographic quadrangles, and inundated most of Grand Valley. All cover types showed a reduction in area except emergent wetlands, lacustrine open water, and the "other" category (Table 2). The forested and scrub-shrub wetlands are present only along tributary streams above the reservoir high water mark. The post-construction increase in area for emergent wetlands is due to the wetland located at the upper end of the reservoir at Alpine. This emergent wetland differs from those that were present prior to the project in that during most years it is only seasonally flooded, dominated by grasses, sedges, and some bulrush; plants that can withstand some degree of exposure without surface water present. The emergent wetlands that were in the study area prior to construction were permanently flooded and dominated by bulrushes and cattails (USFWS 1947).

In many places the land-water interface along the reservoir is characterized by vertical banks of varying height caused by erosion resulting from the seasonal reservoir drawdown and wave action. As indicated in the project description section, an average vertical drawdown of 25 to 30 feet occurs between July and October. This results in large mudflats along the shoreline of the reservoir. In 1977, which was a low water year, over 6,500 acres of the reservoir bottom were exposed creating a large mudflat in late summer, most of which was upstream of the mouth of Indian Creek. In contrast, during recent years because water levels in Jackson Lake Reservoir have been kept low, the water level fluctuations in Palisades Reservoir have been reduced. However, the standard mode of operation with the summer drawdowns is expected to return once Jackson Dam is repaired. Plans for modifying Jackson Lake Dam to ensure structural security are currently ongoing (USBR 1984).

Most of the land around the reservoir is in public ownership under the management of the USFS. The lands around the town of Alpine, Wyoming are in private ownership. U.S. Highway 26 is located next to the reservoir on the north and east side. Several public campgrounds, picnic areas, and private summer homes are located around the reservoir. Land adjacent to the reservoir on the southwest side from Bear Creek to McCoy Creek remains roadless with access available only by foot or boat.

RESULTS

BIG GAME

Big game in the general vicinity of the Palisades Project include mule deer, Rocky Mountain elk, moose, mountain goat, black bear, and mountain lion (Appendix A). Pre-and post-construction population data for these species are limited and very general in nature. The HEP was used with a mule deer model to evaluate and quantify habitat losses (see Appendix B for mule deer model). While this model was developed specifically for mule deer it also measures habitat components important to Rocky Mountain elk. Therefore it was felt that losses for these two important big game species were adequately evaluated and quantified using this model.

Pre-construction Conditions

The 1947 USFWS report indicated that mule deer were "common throughout the south portion of the reservoir area during the entire year, but the heaviest concentrations occur during fall and winter. The carrying capacity is estimated to be at least 20 deer per square mile." Location of the area described in the report is not specified, but in the next sentence the author identifies the Bear Creek drainage as being "nearby." The report also describes range conditions for big game as follows, ". ..browse conditions are good, and the carrying capacity of the range is far above the present big game populations."

The USFS (1981) currently identifies the public land on the north side of the reservoir as deer and elk winter range. If it is assumed that habitat conditions in areas currently adjacent to or near the reservoir are similar to those that were inundated, then the habitat quality in terms of range conditions was excellent. The shrub-steppe, aspen, forested wetland, and scrub-shrub wetland cover types provide abundant food for herbivores. The conifers on the north slopes and the forested wetlands along the river provide adequate thermal cover. However, even with the high quality range conditions, winter snow depths (Table 3) inhibit winter use of the area by mule deer on a consistent annual basis. Loveless (1967) found that snow depths of 24 inches or greater precluded the use of an area in Colorado by mule deer.

Table 3. Average snow depth records for 1936-1982 for station upstream of Palisades Reservoir (elevation: 5720 feet).

	January	February	March	April
Ave. Snow Depth (inches)	22	32	36	32

For this habitat evaluation it was assumed that all of the cover types except farmland, emergent wetland, and riverine were used by mule deer during some portion of the year. This amounted to 10,806 acres of the study area. However, it was further assumed that winter use of the study area was restricted to shrub-steppe and aspen cover types on sloped terrain, where there would be lesser amounts of snow accumulation. A food suitability index of 0.30 and a winter cover index of 0.51 were calculated using the HEP model. As a result, the overall HSI value for mule deer in the study area prior to construction was 0.30 (assuming that winter food is limiting due to movement restrictions). Therefore, based on model calculations the study area had an estimated 3242 HU's (Habitat Units) prior to project construction. This HU value can be interpreted to mean that the 10,806 acres of mule deer habitat that was in the study area prior to construction was equivalent to 3,242 acres of prime mule deer habitat.

The early fish and wildlife report (USFWS 1947) identified a herd of about 100 elk in the Bear Creek drainage but noted that only a few individuals were known to range into the study area. This report goes on to say "...while the reservoir area provides some winter range for elk, the use by this species is not considered sufficient to merit evaluation." This conclusion, however, is questionable based on current elk winter use and personal accounts. One local resident claims that over 150 elk wintered in the project area prior to construction (pers. comm. T. Trent, IDFG). Elk use of the area was limited in the spring, summer, and fall due to the high level of human activity in the valley; winter is obviously the season when the project area was most used.

Like mule deer, southern exposures are critical for elk because of lower snow depths. However, elk can tolerate greater snow depths on winter range than can deer. Snow depths in excess of 24 inches will cause elk to move and depths greater than 28 inches may prohibit elk use of an area (Leege and Hickey 1977, Sweeney and Steinhoff 1976). The snow depths recorded near Palisades Reservoir (Table 3) indicate that elk use of the forested or scrub-shrub wetlands along the river may have been limited in duration. Most of the wintering areas were probably located on the south slopes along some of the tributary streams such as Big Elk and Little Elk Creeks, McCoy Creek, Bear Creek, and Indian Creek.

There was no mention of moose in the early fish and wildlife report (USFWS 1947). However, moose did and still do occur in the general vicinity of the study area (pers. comm. T. Trent, IDFG). While there are no population data available, based on numerous studies it is reasonable to assume that moose foraged in the scrub-shrub communities of Salt River, Bear Creek, and other tributaries as well as the wetland complexes along the Snake River, particularly in the vicinity of Sulfur Bar Creek (Peek 1974, Ritchie 1978).

A few black bear were known to utilize the project area (USFWS 1947). However, because of the farming in the valley their use of the study area was probably restricted to tributary drainages and portions of the valley on the south side of the river. Mountain lions were also in the general vicinity but because of the human presence in the valley their use of the study area prior to construction was considered limited.

Post-construction conditions

The USFWS (1979) reported that mule deer are common around the periphery of the reservoir with approximately 300-450 animals in the summer. They described the winter population as consisting of 150-200 deer. How many of these animals are actually using lands in the study area is unknown since no habitat boundaries or animal densities were provided.

The project inundated 8,158 acres of land used by mule deer and other big game. This study estimated that there are currently 2,628 acres of land providing mule deer habitat in the study area. Assuming that the habitat quality or HSI for mule deer has remained the same over the life of the project the study area is now providing the equivalent of 788 acres of prime mule deer habitat (788 HU's).

The USFWS (1979) also reported that the year-round elk population in the area was 300-500 animals, mostly located on the south side of the reservoir. The area near Van Point on the south side has been identified as an elk calving area (USFS 1981). Moose are commonly found in the vicinity of the Salt River and on the south side of the reservoir. Moose numbers in this general vicinity appear to be increasing with approximately 10 moose currently wintering in the Salt River area (pers. comm. B. Johnson, WDGF). The USFWS (1979) also reported that 20-25 moose occupy the Trout Creek-McCoy Creek area. Since project construction mountain goats have been stocked by IDFG in the Snake River Range north of the reservoir. The population estimate is currently 200 goats with a continuing increase in numbers expected (USFS 1981).

Besides the loss of habitat that occurred as a result of the project, other project features continue to adversely affect current big game populations. There is an elk winter feeding ground at Alpine, Wyoming at the upper end of the reservoir. The WDGF estimate that since the completion of the Palisades Project three to ten elk are lost annually by falling through the ice on the reservoir (pers. comm. B. Johnson, WDGF). The reservoir, which extends for 20 miles on the South Fork of the Snake River, also inhibits big game movement across the river. Animals still cross the reservoir by swimming or crossing the ice, but it must be assumed that movement has been significantly restricted because of the large body of water and open expanse. Rerouting of U.S. Highway 26 on the north side of the reservoir bisected some of the better big game habitat in the study area. The loss of habitat has been accounted for in the HEP analysis but there are several animals killed annually by vehicles as they try to cross the highway (pers. comm. M. Whitfield, USFS).

Impact Assessment

It was estimated that the study area contained over 10,000 acres of big game habitat prior to project construction while it presently contains only a little over 2,700 acres. Winter conditions in the study area reduce the overall quality of big game habitat and as a result, the following impact in terms of mule deer habitat were estimated.

Mule Deer HU's	
3,242	Pre-construction conditions
788	Post-construction conditions
-2,454	change in mule deer HU's

A loss of 2,454 HU's for mule deer resulted from project construction. This habitat loss estimate is also considered representative for Rocky Mountain elk in the study area.

Other project-related losses include the annual loss of animals trying to cross the ice in the winter and those dying as a result of vehicle collisions on Highway 26. Between 10 and 20 deer and elk are annually lost as a result of these two project-related factors. Prior to project construction, Highway 26 traversed through farmland and probably did not result in significant loss of animals due to vehicular collisions.

Assessment of Hydroelectric-Related Losses

Since all of the losses are related to location of the reservoir they are considered consequences of the hydroelectric project purpose.

FURBEARERS

Several furbearers are found in the general vicinity of the Palisades Project (Appendix A). Pre- and post-construction population data for these species are limited and very general in nature. A mink model was used to evaluate and quantify aquatic furbearer habitat losses. While this model was developed specifically for mink, it also measures habitat components important to other furbearers such as muskrat, beaver, and river otter.

Pre-construction Conditions

Mink were identified as being a common furbearer along the river and its tributaries prior to construction of the Palisades Project (USFWS 1947). The area, which consisted of 3,100 acres adjacent to 21 miles of the river and 18 miles of tributary streams were evaluated. These lands were evaluated based on the percent of tree and/or shrub canopy closure within 100 meters of the waterway and the percent of year with surface water present.

Generally, the study area provided excellent habitat for mink prior to construction. There were areas along the river's shoreline where no wetland vegetation existed and these areas lowered the overall HSI for mink somewhat. A computed HSI of 0.86 for pre-construction conditions indicates that the project area provided 2,660 HU's for mink.

Beaver and muskrat were also identified as being common furbearers along the river and its tributaries prior to project construction (USFWS 1947). River otters were also mentioned as being present but their numbers were characterized as few and their presence limited to the south side of the river.

Other furbearers such as bobcat, weasels, red fox, and pine martin are not represented by the mink model. Their presence in the project area prior to construction is assumed though no estimate of numbers or habitat area was made.

Post-construction Conditions

The reservoir currently provides 70 miles of shoreline that may be used by furbearers. The 25 to 30 foot seasonal drawdown of the reservoir results in large expanses of reservoir bottom being exposed along the shoreline from the late summer through fall during most years. The drawdown and wave action on the reservoir preclude establishment of wetland vegetation along its shoreline and much of it currently has vertical banks greater than 3 feet in height.

As a result of the operational characteristics of the reservoir it presently provides limited habitat for mink and other water-related furbearers. Using the mink model for lacustrine systems an HSI value of 0.14 was calculated for 2,783 acres of potential habitat along the shoreline. A total of 390 HU's for mink are currently available in the project area.

Impact Assessment

It was estimated that the study area contained 3,100 acres of water-related furbearer habitat along the river and its tributaries prior to construction while the reservoir currently has 2,783 acres of shoreline habitat. Using the mink model quality of habitat along the river and its tributaries was found to be high while the reservoir currently provides very poor habitat. As a result, the following change in HU's was calculated:

Mink HU's	
2,660	Pre-construction
390	Post-construction
-2,276	change in mink HU's

An estimated loss of 2,276 HU's for mink occurred as a result of the project. This habitat loss is considered representative for other aquatic furbearers such as beaver, muskrat, and river otter.

Other furbearers were also adversely affected by the project. Some of these such as the raccoon can be considered as species semi-dependent on the forested/ scrub-shrub wetlands in the study area. Wildlife losses associated with these wetlands are discussed in the nongame section. Other furbearers such as the bobcat, lynx, and red fox have large home ranges and direct impact to their numbers or habitat would be difficult to ascertain. However, it is assumed that the carrying capacity of the general area for some of these predatory furbearers was reduced as a result of terrestrial habitat losses associated with this project.

Assessment of Hydroelectric - Related Impacts

Since the losses are all related to the location of the reservoir they are considered as consequences of the hydroelectric project purpose.

WATERFOWL

Over 20 waterfowl species occur in the general vicinity of the Palisades Project (Appendix A). Pre- and post-construction population data for these species are limited and general in nature. A mallard model (Appendix B) was used to evaluate and quantify general waterfowl habitat losses. A Canada goose model (Appendix B) was also developed and used to evaluate and quantify habitat losses for this regionally important waterfowl species.

The islands in the South Fork of the Snake River provide very important nesting habitat for Canada geese and other waterfowl. There has been speculation that waterfowl nest losses along the South Fork of the Snake River below the dam have increased since 1958 due to the timing and magnitude of water releases from the reservoir (Bodie 1970, Merrill and Bizeau 1972). Subsequently, several studies were initiated to evaluate the relationship between goose nesting success and flows in the South Fork (Parker 1973, DeShon 1976, DeShon 1977, DeShon 1978). These studies found that water releases from the dam during March through May can affect Canada goose nesting success in two important ways.

1) Low streamflows in the river at times were not adequate to maintain island integrity. Land bridges or shallow water between islands and the mainland provided easy access to the island nesting waterfowl by mammalian predators.

2) Streamflows increased after the incubation period had begun caused significant loss of nests due to flooding. The degree of loss depended on the magnitude and timing of the water releases from the dam.

Parker (1973) found that the number of islands in the South Fork fluctuated widely over the range of streamflows that were in the river during the nesting season. He postulated that the fewer number of islands at low flows (< 5,000 cfs) caused a decrease in the number of nesting attempts on the South Fork. tie also found that 43% of the 77 nest sites on the river were inundated when streamflows were increased to over 18,000 cfs. As a result of his investigation, Parker (1973) recommended that streamflows in the South Fork range from 8,000 to 16,000 cfs during the nesting season (March-May). Later investigations by DeShon (1976, 1977, 1978) substantiated Parker's findings and recommendations.

Pre-construction Conditions

a. Study Area

The riverine ecosystem of the South Fork of the Snake River in the study area provided good aquatic habitat for waterfowl. The USFWS (1947) identified the area around the mouth of Sulfur Bar Creek as being some of the better waterfowl habitat in the study area. This report (USFWS 1947) does not identify which species of ducks nested in the study area, however, based on current information from the general vicinity it can be assumed that mallards, pintails, American wigeon, green-winged teal, gadwalls, goldeneyes, and common merganser were summer residents (USBR 1978, Lockman 1984). Merrill and Bizeau (1972) identified mallards, common mergansers, American goldeneye, and green-winged teal during May along the South Fork just below the project area, with the mallard being the most numerous.

Forested and scrub-shrub wetland complexes which occurred along the river provided good nesting and brood rearing habitat for ducks prior to project construction. The 1954 aerial photographs indicate that portions of the South Fork consisted of braided channels through some of the larger wetland areas. The river was slow moving in these locations with approximately 100 acres of islands that provided nesting refuge for breeding waterfowl.

A 100-meter band along the shoreline of the river and its tributaries as well as the islands in the river were evaluated as waterfowl habitat. This delineation assumed that most of the habitat needs for waterfowl occur in close proximity to water. Published data on nest site locations for the waterfowl species of concern in this assessment generally substantiate the 100-meter boundaries (Bellrose 1976). Food availability, shoreline cover, and wetland interspersion were evaluated within this area using the mallard model.

Using the mallard model it was determined that the pre-construction study area had an HSI value of 0.86 for 3,200 acres of suitable waterfowl habitat. These values indicate that study area provided 2,752 HU's for waterfowl prior to project construction.

Canada geese are an important waterfowl species that nest all along the Snake River in Idaho and Wyoming. They are fairly versatile in their nest site preferences (Bellrose 1976) but along the rivers of the intermountain west they show a strong preference for islands. Studies conducted on the South Fork downstream of the project area found over 85% of goose nests located on islands (Merrill and Bizeau 1972, Parker 1973). The USFWS (1947) reported that the islands in the river in the study area provided nesting habitat for Canada geese prior to construction.

Prior to construction the study area had some areas that provided excellent nesting habitat for Canada geese. These river reaches generally included islands with permanent cover. However, other sections of the study area, where no islands were present, had only marginal nesting habitat for geese. Large grass areas used for grazing along the mid-portions of the study area provided good brood rearing habitat, but the upper and lower river sections provided only marginal habitat.

A Canada goose model was developed for this project using nesting and brood rearing habitat as the evaluation criteria (Appendix B). The evaluation team assumed that geese would nest in close proximity to the shoreline with strong preference to nesting on islands. Because geese tend to limit their nesting to larger water bodies, as compared with ducks, only the river and its two major tributaries, the Greys and Salt Rivers, were evaluated. A 100-meter band along the shorelines of these rivers and the islands were evaluated as nesting and brood rearing habitat. A total of 1948 acres were included as habitat for Canada geese. Using the criteria developed by the evaluation team, a HSI value of 0.48 was calculated for pre-project conditions. This resulted in 935 HU's for Canada geese in the study area.

The South Fork of the Snake River in the study area probably had sections that remained ice free during the winter. Some of these areas were likely areas of rapids or where spring water entered the river system. These latter areas often support abundant aquatic plant life which in turn provides food to wintering waterfowl (Banko 1960). A waterfowl species of considerable importance in

this regard is the trumpeter swan. The mid-continental population of trumpeter swans winter in open water areas of the tri-state region of Idaho, Montana, and Wyoming (Banko 1960). They concentrate on the rivers and lakes of this region where springs maintain open water and food is abundant. Early reports (USBR 1952, USFWS 1947) cite the presence of springs and submerged aquatic plants along the river in the study area, which indicates that winter habitat existed for trumpeter swans and other waterfowl.

b. Downstream Flows - Goose Nesting Success

Streamflow fluctuation in the South Fork of the Snake River below the project area were subject to water releases from Jackson Lake Dam and Reservoir which was built in 1916. The project purposes for the Jackson Lake Project were for irrigation and flood control (USBR 1984) and streamflows in the river downstream were subject to water releases from the dam designed to provide for these purposes. Streamflow data taken at the Heise gauging station indicated that rapid fluctuations were common from 1945 to 1954 in the South Fork (Table 4). A breakdown of flow conditions during the nesting seasons for the lo-year span (Table 4) shows that only in May was the average flow within the 8,000 to 16,000 cfs range recommended by Parker (1973). On the average, 27 days during the month of March had flows less than 5,000 cfs and there were no days during that month where the flows were in excess of 8,000 cfs. These data indicate that island integrity was not being maintained during nest initiation in March during most years. This likely affected the number of nestings attempts as well as the predation rate by mammals (Parker 1973). The mean flow in April was approximately 6,800 cfs and only an average of 7.4 days during this month had flows in the recommended range. The average maximum flow during May is of significance since 22,000 cfs in the South Fork of Snake River at Heise would flood a large portion of the islands that provide nesting habitat for geese (Parker 1973). During this pre-construction period a 4-fold or greater increase in streamflows in the river from March through May was a common occurrence.

Table 4. Pre-construction flow conditions of South Fork of the Snake River below Palisades Dam March-April as measured at Heise gauging station (1945-1954).

	March	April	May
		Flow (cfs.)	
Monthly Mean	3,165	6,792	14,802
Average Monthly Maximum	3,905	12,129	22,500
Average Monthly Minimum	2,580	3,686	8,536
		Average Number of Days	
Average Flow (5,000 cfs	27	11.7	1.2
Average Flow 5,000-7,999 cfs	4	9.4	2.5
Average Flow 8,000-16,000 cfs	0	7.4	14.3
Average Flow > 16,000 cfs	0	1.5	13.0

Post-construction Conditions

a. Study Area

The reservoir currently has 8-10 breeding pairs of Canada geese and unknown number of mallards and common mergansers nesting along its shoreline. At least half of the known pairs of geese nest in the vicinity of the Salt River (pers. comm. M. Whitfield, USFS). It is a large body of open water with 70 miles of shoreline that potentially could provide breeding habitat for waterfowl. The annual drawdown of the reservoir usually occurs after July, subsequently no exposed mudflats are present during most of the breeding season in most years. The drawdown, in combination with wind action, has caused erosion along the reservoir shoreline and precluded establishment of wetland vegetation. Shoreline banks 3 to 5 feet in height or greater are common around much of the reservoir. Only in some of the tributary arms of the reservoir and in the flat peninsula area near Alpine, does the reservoir provide waterfowl breeding habitat. As a result, only these areas were evaluated using the mallard and Canada goose models and the rest of the reservoir was not included. Both evaluations indicated that the reservoir shoreline provides poor habitat for waterfowl; the HSI for both evaluation species being 0.20 for the 650 acres of shoreline evaluated. Current conditions in the study area provide 130 HU's for mallard and Canada geese.

The early fish and wildlife report (USFWS 1947) acknowledged that nesting habitat would be lost as a result of the project but suggested that the reservoir would attract migrating waterfowl, particularly in the upper end. The reservoir near the Salt River and the Alpine peninsula does provide resting habitat for waterfowl during spring and fall migration. Exact numbers are not available but several hundred migrating ducks, geese, and pelicans have been observed in these areas (pers. comm. M. Whitfield, USFS). Waterfowl use of the upper end of the reservoir during fall migration seems to be related to high water levels during that time (pers. comm. D. Lockman, WDGF). However, during most years much of the reservoir is frozen by mid-December and the ice does not melt until into April. This situation and the lack of nearby food sources (agricultural fields) preclude winter waterfowl use of the study area.

Downstream flows-goose nesting success

Data obtained from the Heise gauging station from 1958 to 1984 indicate that flows during the goose nesting season are not optimum for production and large fluctuations in water levels have occurred on the South Fork below the dam since project construction (Table 5). The data also indicate that only an average of 4.6, 9.0, and 18.0 days in March, April, and May, respectively, had flows within the recommended range of 8,000-16,000 cfs (Table 6).

Annual meetings have been held between IDFG and USBR since 1972 to discuss expected water releases from the dam in relation to project needs and optimum flows for downstream goose nesting. The USBR has attempted to provide the desired flows within the constraints of the project's authorized purposes (per. comm. B. Adair, USBR). In an attempt to evaluate the success of this coordination between agencies the last 13 years of data (1972-1984) have been separated from the previous years in Tables 5 and 6. The data suggest that there has been improvement in scheduling flow releases to coincide with those recommended by Parker (1973). In the last 13 years an average of 11.5 days in April had flows between 8,000 and 16,000 cfs whereas the period from 1958-1974 had an average of 6.7 days within the recommended streamflow range. A similar increase occurred during March. Monthly mean flows for the last 13 years are higher by at least 1,000 cfs over the previous period. This difference is likely due to recent wet years as well as the coordinated effort between IDFG and USBR to improve flows for nesting waterfowl.

Table 5. Post-construction flow conditions of the South Fork of the Snake River below Palisades Dam for March-April as measured at Heise gauging station (1958-1984). Monthly mean, maximum and minimum are averaged for the three months.

1958-1984	March	April	May
Monthly mean	4,001	7,486	13,738
Average monthly maximum	6,178	10,283	17,156
Average monthly minimum	2,606	5,015	9,344
1958-1971			
Monthly mean	3,073	5,628	13,003
Average monthly maximum	4,163	8,366	16,379
Average monthly minimum	2,564	3,763	7,576
1972-1984			
Monthly mean	5,000	9,488	14,530
Average monthly maximum	8,348	12,348	17,992
Average monthly minimum	2,652	6,362	11,248

Table 6. Post-construction flow conditions of South Fork of the Snake River below Palisades Dam March-April as measured at Heise gauging station (1958-1974). Average number of days per month under specified flow regimes are listed.

	Average Number of Days		
1958-1984	March	April	May
Flow < 5,000 cfs	22.2	12.9	
Flow 5,000-7,999 cfs	4.1	4.6	2:o
Flow 8,000-16,000 cfs	4.6	9.0	18.0
Flow > 16,000 cfs	0.1	3.5	10.0
1958-1971			
Flow < 5,000 cfs	25.6	18.5	0.7
Flow 5,000-7,999 cfs	2.7	3.0	3.0
Flow 8,000-16,000 cfs	2.4	6.7	20.6
Flow > 16,000 cfs	0.3	1.8	6.7
1972-1984			
Flow < 5,000 cfs	18.5	7.0	1.5
Flow 5,000-7,999 cfs	5.6	6.3	0.9
Flow 8,000-16,000 cfs	6.8	11.5	14.8
Flow > 16,000 cfs	0	5.2	13.8

Impact Assessment

a. Study Area

It was estimated that the study area contained 3,200 acres of suitable waterfowl habitat along the river and its tributaries while the reservoir area currently has only 650 acres suitable for nesting. The quality of habitat along the river for waterfowl was high while the reservoir currently provides poor habitat. As a result, the following impacts were calculated using the mallard model:

Mallard HU's	
2,752	Pre-construction
- 130	Post-construction
-2,622	change in mallard HU's

The project resulted in an estimated loss of 2,622 HU's for mallards. This estimate is considered representative for other resident waterfowl in the study area.

It was also estimated that the study area contained 1,948 acres of suitable Canada goose habitat along the river and its two major tributaries while the reservoir currently has 650 acres. The quality of habitat along the river for Canada geese varied depending on the proximity of islands. The reservoir currently provides some habitat but it is generally considered of poor quality. As a result, the following impacts were calculated:

Canada Goose HU's	
935	Pre-construction conditions
130	Post-construction conditions
-805	change in Canada goose HU's

The project resulted in an estimated loss of 805 Canada goose HU's within the study area.

b. Downstream Flows - Goose Nesting Success

Streamflows for the South Fork below Palisades Dam fluctuate widely during the goose nesting season from March through May. The presented data did not substantiate claims that post-construction streamflow timing and fluctuations were worse for downstream waterfowl nesting conditions than during the pre-construction period. The general trend of recorded streamflow information suggests that monthly flow increased to the benefit of Canada geese and other nesting waterfowl. The monthly mean flows for March were 3,165 cfs and 4,001 cfs for pre- and post-construction periods, respectively. The average maximum flows in May dropped from 22,500 cfs for the pre-construction period to 17,156 for the post-construction period (Table 4 and 5). The data suggest that there has been greater stabilization and restriction in the range of flows during the nesting season since project construction. Improvements are particularly evident since 1972.

Assessment of Hydroelectric - Related Impacts

Since the losses of waterfowl habitat in the study area are related to the location of the reservoir they are considered as consequences of the hydroelectric project purpose. Using the available flow data and criteria developed by Parker (19731 no adverse impacts as a result of this project could be determined for nesting waterfowl on the South Fork downstream of the dam.

UPLAND GAME

Forest grouse, particularly ruffed grouse, are the principal upland game species in the general vicinity of the study area, although sage grouse, mourning doves, and cottontails are also present. A ruffed grouse model was used to assess impact to this important upland game species (Appendix B). The model evaluates factors such as tree density, height of trees, herbaceous canopy cover, distance to openings, distance to scrubland, distance to conifers, and presence of preferred winter food.

Pre-construction Conditions

The early fish and wildlife report (USFWS 1947) identified ruffed grouse as being found along the south side of the river, mainly in the forested bottomlands and aspen areas. The forested wetlands and the aspen communities were evaluated as ruffed grouse habitat. This amounted to 3,831 acres for pre-construction conditions. Generally, the large forested wetlands and aspen communities that were in the study area prior to project construction provided excellent ruffed grouse habitat. Based on field observations in and near the study area these communities provide many of the preferred food plants (Hungerford 1957, Johnsgard 1973) and offer excellent cover conditions for breeding and wintering seasons. The large wetland complexes and aspen communities that were in the vicinity of Van Point area (Appendix C for map) appeared to provide particularly good habitat in the pre-construction period. However, there were small and isolated forested wetlands in the upper end of the study area which were assumed to provide habitat of limited value. These isolated wetlands lowered the overall quality of the study area and as a result, the pre-construction HSI for ruffed grouse in the study area was 0.80 resulting in a total of 3,065 HU's.

Blue grouse were common in the "upper edges of the reservoir site" (USFWS 1947). This report also noted that sage grouse were formerly abundant but they were scarce in 1947. Mourning doves and cottontails were assumed to be common in the study area particularly associated with the wetland communities along the river.

Post-construction Conditions

The reservoir flooded most of the ruffed grouse habitat within the study area; only 918 acres of forested wetland and aspen communities remain. These areas are still providing high quality habitat for ruffed grouse and the HSI is assumed to be the same as for pre-construction conditions. An estimated 734 HU's for ruffed grouse are currently available in the study area.

Blue grouse are currently found around the reservoir in coniferous, shrub-steppe, and aspen communities. No sage grouse are known to be in the vicinity (pers. comm. M. Whitfield, USFS). Mourning doves and cottontails are assumed to be common around the reservoir.

Impact Assessment

It was estimated that the study area contained 3,831 acres of ruffed grouse habitat along the river and in the aspen communities prior to project construction while it currently has 918 acres around the reservoir. Assuming that there has been no appreciable change in habitat quality of the forested wetlands and aspen communities, the following impacts to ruffed grouse were estimated:

Ruffed Grouse HU's	
3,065	Pre-construction
734	Post-construction
-2,331	change in ruffed grouse HU's

It was estimated that the project resulted in a loss of 2,331 HU's for ruffed grouse. There were also habitat losses for blue grouse, sage grouse, mourning doves, and cottontails, although these losses were not quantified.

Assessment of Hydroelectric-related Impacts

Since the losses are related to the location of the reservoir they are considered as consequences of the hydroelectric project purpose.

RAPTORS

Over 20 species of raptors occur in the general vicinity of the project area over the course of a year (Appendix A). Pre- and post-construction population data for most of these species are limited and very general in nature. The bald eagle, which is a federally listed endangered species, was and is an important resident of the study area. A model (Appendix B) was developed by local biologists using their own knowledge and the Greater Yellowstone Ecosystem (GYE) Bald Eagle Management Plan (GYE Bald Eagle Working Team 1983). Breeding and wintering habitats for bald eagles were evaluated using this model.

Pre-construction Conditions

Historical accounts of residents living in Grand Valley indicate that prior to project construction there were at least four bald eagle nesting sites along the river, and many wintering birds (pers. comm. M. Whitfield, USFS). This evaluation concentrated on bald eagles because of their regional and national importance. The model that was developed recognizes that food availability, nest structure availability, and human activity levels are important components in evaluating breeding habitat.

Several forested wetland areas provided good bald eagle nesting and perch sites in the 18,565 acre study area prior to construction. Those wetlands on the south side of the river provided particularly good sites because of the low level of human activity. The river supported large cutthroat trout (Salmo clarki) and whitefish (Prosopium williamsoni) populations (USFWS 1947) which provided abundant food for the eagles. Sections of the river where the forested wetlands were either narrow in breadth or absent provided lower quality habitat. The overall pre-construction HSI for bald eagle breeding habitat in the study area was 0.72 resulting in 13,367 HU's being available.

Wintering habitat for bald eagles prior to project construction is considered to have been excellent (GYE Bald Eagle Working Team 19831. Based on historical accounts, large sections of the river must have remained ice-free during the winter, providing access to the abundant food source. Big game carrion probably supplemented the fish diet during portions of winter and early spring. The cottonwood trees that lined much of the river provided convenient perch sites for foraging eagles. The wintering bald eagle HSI was considered to be 1.0 which indicates that 18,565 HU's were available prior to project construction.

There was no mention of raptors in the early fish and wildlife report (USFWS 1947), but we can assume that other common breeding raptors probably included the osprey, red-tailed hawk, Swainson's hawk, goshawk, Cooper's hawk, sharp-shinned hawk, northern harrier, kestrel, great horned owl, screech owl, short-eared owl, and long-eared owl. Other species were probably present during the breeding season, but were less common.

Post-construction Conditions

The reservoir inundated the riverine system that was used by bald eagles. Now, the reservoir provides some habitat for eagles on its south side where three active nests are present (GYE Bald Eagle Working Team 1983). Highway 26 on the north side and fairly high human disturbance levels on the reservoir's upstream and downstream ends preclude any use of these areas by breeding eagles (GYE Bald Eagle Working Team 1983). The shallow upstream end of the reservoir produces large numbers of chubs (Gila atraria) and suckers (Catostomus platyrynchus and C. ardens) which are now the main food source of the eagles nesting near that area (pers. comm. M. Whitfield, USFWS). The pair of eagles that nest on Van Point spend much of their foraging time on the river just downstream of the dam.

Proximity to open water during early incubation (March-April) appears to be an important factor in breeding site location (GYE Bald Eagle Working Team 19831. The reservoir is frozen in April during most years which forces the eagles nesting near the reservoir to have large foraging radii during the early incubation period. This need may be affecting the eagles' reproductive success (pers. comm. M. Whitfield, USFS).

Because of the above factors the post-construction project area does not provide as high a quality habitat for breeding bald eagles as prior to construction. Using the developed eagle mode, an HSI of 0.40 was estimated. The study area currently provides 7,426 HU's for breeding bald eagles.

The reservoir is frozen most years from mid-December to mid-April (eprs. comm. M. Whitfield, USFS) retaining open water only in the upstream end where the river and its tributaries enter. No bald eagles winter on the reservoir and the HSI for this season is 0.

Bald eagles will frequently concentrate below reservoirs fishing in the tail waters (Steenhof 1978). The South Fork of the Snake River from Palisades Dam to its confluence with the Henry's Fork winters 20-35 eagles during most years (pers. comm. R. Howard, USFWS). However, only 2-3 birds usually forage in the tailrace area of the Palisades powerplant (pers. comm. M. Whitfield, USFS) indicating that turbine mortality of fish may be low and not an important factor in providing a food source for wintering bald eagles on the South Fork.

During the 1984 summer season, 29 active osprey nests were located on Forest Service lands around the reservoir (pers. comm. M. Whitfield, USFS). All but one of these nests were located on the south side of the reservoir. Ospreys initiate nest building and egg laying in April to May (Zarn 1974) which is later than bald eagles. Therefore, ospreys are more adapted to the icing schedule of the reservoir and are able to take advantage of the abundant fish food early in their reproductive cycle.

Other raptors associated with the forested wetlands and other inundated vegetation communities were displaced and the carrying capacity of these species for the general vicinity was reduced. Some of the species that were most affected by the loss of habitat include the great horned owl, screech owl, red-tailed hawk, and Swainson's hawk. The loss of forested wetlands which adversely affected many of these other raptor species will be discussed in the nongame section.

Impact Assessment

Because the bald eagle forages over large areas, all of the study area was included as eagle habitat. The quality of breeding habitat prior to project construction was high with the river and its associated wetlands providing abundant food and many nest sites. The quality of winter habitat was considered high with much of the river remaining ice free and providing a food source in close proximity to perch sites.

Current conditions for breeding bald eagles are less than optimum. The ice cover on the reservoir during the early nesting season and the human disturbances on three sides of the reservoir limit nesting opportunities. The reservoir provides no wintering habitat.

As a result of these factors the following impacts were estimated:

Bald Eagle HU's	
	breeding season
13,367	Pre-construction
7,426	Post-construction
-5,941	change in bald eagle HU's
	winter season
18,565	Pre-construction
0	Post-construction
-18,565	change in bald eagle AAHU's

It was estimated that project construction resulted in a loss of 5,941 bald eagle HU's for the breeding season and 18,565 bald eagle HU's for the winter season.

Ospreys are the one raptor species that has probably benefited from the project. The reservoir currently supports 29 active osprey nests and it is unlikely the 21+ miles of riverine habitat along the South Fork of the Snake River prior to construction could have supported that many ospreys.

Assessment of Hydroelectric-related Impacts

Since all of the described losses are associated with the location of the reservoir they are considered consequences of the hydroelectric project purpose. Ospreys are the one raptor species that have benefited from the project.

NONGAME WILDLIFE

Many nongame wildlife species, in addition to those already discussed, were affected by the project (Appendix A). These species occur in every vegetation community in the study area and represent an important and large portion of the biota. Many of these species are low on the food chain and are thus themselves important prey for larger predators. Any assessment of this nature must consider nongame species as an integral part of the wildlife community.

Given the number of nongame species which occur in the study area it was not possible to evaluate the habitat quality for all species. Therefore, models were selected to evaluate what are probably the two most important vegetation communities in terms of nongame habitat; forested and scrub-shrub wetlands. The value of these riparian communities for all wildlife, not just nongame species, cannot be overstated. These communities generally have a much higher density and diversity of wildlife then that of surrounding areas (Hubbard 1977, Tubbs 1980). In the Blue Mountains of Oregon, Thomas (1979) found that of the 378 terrestrial species known to occur, 285 were either directly dependent on riparian communities or used them more than any other community.

This analysis used the black-capped chickadee and yellow warbler models to evaluate the habitat quality of the forested and scrub-shrub communities. The black-capped chickadee model evaluates forested wetlands in terms of tree height, canopy closure, and number of snags. The latter criteria is very important for primary and secondary tree cavity dwellers such as bluebirds, nuthatches, wood ducks, and flying squirrels. The yellow warbler model evaluates scrub-shrub wetlands in terms of canopy closure and vegetation height.

Pre-construction Conditions

The study area had an estimated 1,715 acres of forested wetlands located along the river and its tributaries. Some of these wetlands were long, narrow strips of vegetation along the shoreline while others were in as large wetland complexes. It was assumed that grazing occurred in some areas and sampling in downstream

areas reflected this assumption. Large narrow leaved cottonwood trees dominated the overstory with heights usually in excess of 40 feet. Using the black-capped chickadee model, the habitat quality of the forested wetlands were high with an HSI value of 0.81. This value results in a total of 1,389 HU's for black-capped chickadee in the project area.

The black-capped chickadee model evaluates the quality of mature overstory trees but does not take into account the quality of the shrub understory. The yellow warbler model was used to describe the quality of the understory. Again, using the criteria developed in the model and measurements taken in the field, an HSI value of 0.81 was obtained for the understory shrubs in the forested wetlands.

The study area had an estimated 874 acres of scrub-shrub wetlands. Most of these wetlands are dominated by willows with the other species of secondary importance. Generally the scrub-shrub wetlands that were sampled provide excellent habitat for yellow warblers. Based on field measurements, an HSI of 0.86 was calculated for these areas. Using this value it is estimated that the project area had 752 HU's for yellow warbler in the scrub-shrub wetlands prior to inundation.

Sandhill cranes were numerous in the project area prior to construction (pers. comm. T. Trent, IDFG). The agricultural, pasture, and grass/sage areas along the river probably were used during spring and fall migration. However, whether the area provided breeding habitat is unknown.

Post-construction Conditions

The project inundated most of the forested and scrub-shrub wetlands in the project area. Those that remain are located in the tributary drainages just upstream of the reservoir pool. It is estimated that the project area currently has 38 and 42 acres of forested and scrub-shrub wetlands, respectively. Assuming no changes in habitat quality, a total of 31 HU's are currently calculated for black-capped chickadee and yellow warbler for the forested wetlands and 36 HU's for yellow warbler for the scrub-shrub wetlands.

Though difficult to quantify, the reservoir does provide feeding habitat for several hundred shorebirds that migrate through the area in the fall (pers. comm. C. Trost, Idaho State Univ.). These birds congregate on the exposed mudflats at the upper end of the reservoir near Alpine. Sandhill crane use of the reservoir shoreline is currently limited to the emergent wetland and grass areas near Alpine.

Impact Assessment

It is estimated that the project area contained over 2,500 acres of forested and scrub-shrub wetlands while it presently has only 80 acres. It was assumed that the quality of this nongame habitat has not changed and the project resulted in a loss of 1,336 HU's for forested wetland dependent species and 704 HU's for scrub-shrub wetland dependent species (Table 7).

Table 7. HU's for nongame evaluation species for pre- and post-construction periods.

	Forested Wetland		Scrub-shrub Wetland
	Black-capped Chickadee	Yellow Warbler	Yellow Warbler
Pre-construction	1,389	1,389	752
Post-construction	31	31	36
Change in HU's	-1,358	-1,358	-716

The quantity of suitable sandhill crane habitat in the area declined, but the reservoir's mudflats probably do provide more feeding habitat for fall migrating shorebirds than was provided by the river channel before project construction.

Assessment of Hydroelectric-related Losses

Since all of the losses are related to location of the reservoir, they are considered as consequences of the hydroelectric project purpose.

SUMMARY

The Palisades Project affected land use on over 680,000 acres of land. Most of this area was the result of previous irrigation development and not included as part of this assessment. The study area of concern included the reservoir, Highway 26 and lands between it and the reservoir, the dam site, borrow areas, and staging areas immediately downstream of the dam. The study area totaled 18,565 acres.

Eleven cover types were identified in the study area. All were reduced in area after project construction except lacustrine open water and emergent wetland. The project resulted in a loss of 38 miles of riverine habitat. This included 1,677 acres of forested wetland, 832 acres of scrub-shrub wetland, and 900 acres of free-flowing river. Upland areas that were inundated or converted to other uses included 6,800 acres of farmland, 618 acres of coniferous forest, 1,203 acres of aspen, 2,913 acres of shrub-steppe vegetation and 875 acres of grass/ sage.

The HEP was used to evaluate pre- and post-construction wildlife habitat conditions. Evaluation species were selected to represent important species groups or they were species of special concern. Impacts for evaluation species were measured in terms of the difference between pre-and post-construction Habitat Units (HU's), a measure of the quantity (habitat area) and quality (HSI) of available habitat. In simple terms one HU is equivalent to one acre of prime habitat (HSI=1.0).

It was estimated that the study area contained over 10,000 acres of big game habitat prior to project construction while it presently contains approximately 2,700 acres (Table 8). Winter conditions in the study area reduce the overall quality of big game habitat and as a result the HSI for mule deer was 0.30. A loss of 2,454 HU's for mule deer occurred as a result of the project. This loss is also considered representative for Rocky Mountain elk in the study area. Moose, black bear-, and mountain lion were also affected by the project, but no habitat losses were estimated for these big game species.

Table 8. Summary of wildlife/wildlife habitat impacts associated with construction and operation of the Palisades Project, South Fork of the Snake River, Idaho-Wyoming.

Group (evaluation species)	Pre-construction Conditions				Post-construction Conditions				Impact Statement			
	Habitat Area	HSI	HU's	Animal No.	Habitat Area	HSI	HU's	Animal No.	Habitat Area	HU's	Animal No.	Impacts
Big Game												
Mule deer	10,806	.30	3,242		2,648	.10	788		-8,178	-2,454		Loss of winter and seasonal habitat
Elk												Habitat losses assumed same as for mule deer
Moose												Habitat losses assumed same as for mule deer
Black bear												Habitat losses assumed same as for mule deer
Mountain lion												Habitat losses assumed same as for mule deer
Mule deer/elk								10-20			10-20	10-20 mule deer and elk annually lost due to reservoir icing or vehicular accidents
Furbearers												
Mink	3,100	.86	2,666		2,783	.14	390		-317	-2,276		Habitat loss of riverine habitat
Beaver												Habitat losses assumed same as for mink
Muskrat												Habitat losses assumed same as for mink
River otter												Habitat losses assumed same as for mink
Other Furbearers												Habitat losses for furbearers such as bobcat and lynx are assumed though not quantified
Waterfowl												
Mallard	3,200	.86	2,752		650	.20	130	-2,550		-2,622		Loss of habitat
Other resident waterfowl												Habitat losses species assumed same as for mallard
Canada goose	1,948	.48	935	several pairs	650	.20	130	8-10 pairs	-1,298	-805		Loss of habitat
Wintering waterfowl												Loss of winter habitat
Migratory waterfowl								Several hundred				Reservoir may provide more resting habitat for migrating waterfowl than previous riverine system
Upland Game												
Ruffed grouse	3,831	.80	3,065		918	.80	734		-3,097	-2,331		Loss of habitat
Sage and blue grouse												Loss of habitat assumed though not quantified
Other upland game species												Loss of habitat assumed though not quantified
Raptors												
Bald eagle-breeding	18,565	.72	13,367	+4 pairs	18,565	.40	7,426	3 pairs	0	-5,941		Loss of high quality habitat
Bald eagle-wintering	18,565	1.0	18,565	many	18,565	0	0	0	-18,562	-18,562		Loss of high quality habitat
Osprey	18,565				18,565			29 pairs				Population in study area increased with reservoir
Other raptors												Losses for many quantified under nongame group
Nongame Species												
Black-capped chickadee	1,715	.81	1,389		38	.81	31		-1,677	-1,358		Loss of forested wetland habitat for variety of nongame species
Yellow warbler	1,715	.81	1,389		38	.81	31		-1,677	-1,358		Loss of forested wetland habitat for variety of nongame species
Yellow warbler	874	.86	752		42	.86	36		-838	-716		Loss of scrub-shrub wetland habitat for variety of nongame species
Sandhill cranes								few				Loss of habitat during migration season
Shorebirds				many				several hundred				Reservoir probably provides more foraging habitat for migrating shorebirds than previous riverine system

Other project-related losses include the annual winter loss of big game breaking through the ice on the reservoir and those dying as a result of vehicle collisions on Highway 26. Annual losses to the project-related factors are estimated to be between 10 and 20 animals.

It was estimated that the study area contained 3,100 acres of aquatic furbearer habitat prior to construction while the reservoir currently has 2,783 acres along its shoreline. Using the mink model, the pre-construction habitat quality along the river and its tributaries was found to be high while the reservoir currently provides poor quality habitat. A loss of 2,276 HU's was estimated for mink which is also representative for other aquatic furbearers including beaver, muskrat, and river otter.

Prior to project construction the study area contained 3,200 acres of waterfowl breeding habitat along the river and its tributaries while the reservoir area currently has only 650 acres suitable for nesting. The quality of habitat along the river for ducks was high while the reservoir currently provides poor habitat. Using a mallard model an estimated loss of 2,622 HU's for waterfowl occurred as a result of project construction.

The study contained approximately 1,948 acres of suitable Canada goose habitat prior to construction while the reservoir currently has 650 acres. An estimated loss of 805 HU's for Canada geese occurred as a result of the project. A comparison of flow conditions on the South Fork below the dam between pre- and post-construction periods could not substantiate claims that water releases from the dam were causing more Canada goose nest losses than flows in the river prior to construction.

It was estimated that the study area contained 3,831 acres of ruffed grouse habitat prior to project construction while it currently has 918 acres around the reservoir. The habitat quality for ruffed grouse was and currently is high with an HSI of 0.80. An estimated loss of 2,331 HU's for ruffed grouse occurred as a result of project construction. There were also habitat losses for blue grouse, sage grouse, mourning doves, and cottontails, although these losses were not quantified.

The habitat quality for breeding bald eagles in the study area prior to construction was considered moderately high (.72 HSI) while current conditions are considered moderately low (.40 HSI). A loss of an estimated 5,941 HU's for breeding bald eagles occurred as a result of the project. The reservoir currently provides no wintering habitat for bald eagles while the study area prior to the project was considered prime habitat. A loss of 18,565 HU's for wintering bald eagles occurred as a result of the project.

An estimate of 29 osprey nests currently are active around the reservoir. The study currently provides more and better habitat for osprey than was previously along the river.

Forested and scrub-shrub wetland communities provide habitat for a variety of nongame as well as game species. Using the black-capped chickadee and yellow warbler models, estimated losses of 1,336 HU's for forested wetland dependent species and 704 HU's for scrub-shrub dependent species occurred as a result of the project. Sandhill crane habitat declined as a result of the project but the reservoir's mudflats probably provide more feeding habitat for migratory shorebirds than was previously available along the river.

REFERENCES CITED

Allen, A. W. 1984. Habitat suitability index models: mink. FWS/OBS-8200.61 Western Energy Land Use Team, U.S. Fish and Wildlife Service, Fort Collins, Colorado. 19p.

Banko, W. E. 1960. The trumpeter swan; its history, habitat, and population in the United States. North American Fauna. No. 62. U.S. Fish and Wildlife Service. 214p.

Bellrose, F. C. 1976. Ducks, geese and swans of North America. Stackpole Books. Harrisburg, Pa. 543p.

Bodie, W. L. 1970. Observations on the Canada goose population of Swan Valley, Idaho. Idaho Dept. of Fish and Game. 17p.

Collie, M. R. 1983. Inventory of the birds of Idaho. Idaho Dept. of Fish and Game, Boise, Idaho. llp.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep water habitats of the United States. FWS/OBS-79/31 U.S. Fish and Wildlife Service, 103p.

DeShon, F. 1976. A survey of Canada goose nesting on the South Fork of the Snake River, Idaho. Idaho Dept. of Fish and Game. 10p.

_____. 1977. A survey of Canada goose nesting on the South Fork of the Snake River, Idaho. Idaho Dept. of Fish and Game. 10 p.

_____. 1978. A survey of Canada goose nesting on the South Fork of the Snake River, Idaho. Idaho Dept. of Fish and Game. 10p.

Greater Yellowstone Ecosystem Bald Eagle Working Team. 1983. A bald eagle management plan for the greater Yellowstone ecosystem. Wyo. Game and Fish Dept. 84p.

Hubbard, J. P. 1977. Importance of riparian ecosystems : biotic considerations. Pages 14-18 in Importance, preservation, and management of riparian habitat: a symposium. Gen. Tech. Rpt. RM-43. U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado

Hungerford, K. E. 1957. Evaluating ruffed grouse foods for habitat improvement. Pages 380-395 in Trans. of the Twenty-second N. Am. Wildl. Confer. Wildl. Manage. Institute, Washington, D.C.

Johnsgard, P. A. 1973. Grouse and quail of North America. Univ. of Nebraska Press, Lincoln, Neb. 553p.

Larrison, E. J. 1981. Mammals of Idaho. Univ. Press of Idaho, Moscow, Idaho. 166p.

Leege, T.A. and W.O. Hickey. 1977. Elk-snow-habitat relationships in the Pete King Drainage, Idaho. Idaho Dept. of Fish and Game, Wildl. Bull. No. 6. 23p.

Lockman, D. C. 1984. Draft waterfowl survey report for Wyoming. Wyo. Game and Fish Dept.

Loveless, C. M. 1967. Ecological characteristics of a mule deer winter range. Colorado Game, Fish, and Parks Dept. Tech. Publ. 10. 124p.

Merrill, L.B. and E.G. Bizeau. 1972. Canada goose production as related to stream flow on the South Fork of the Snake River in Idaho: a preliminary survey . Idaho Cooperative Wildlife Research Unit, U.S. Fish and Wildlife Service, Moscow, Idaho. 39p.

Mueggler, W.F. and R.B. Campbell, Jr. 1982. Aspen community types on the Caribou and Targhee National Forests in southeastern Idaho. Paper INT-294. U.S. Forest Service, Intermountain Forest and Range Experiment Station, Ogden, Utah. 32p.

Northwest Power Planning Council. 1984. Columbia River basin fish and wildlife program as amended October 10, 1984. Portland, Oregon. 138p.

Nussbaum, R.A., E.D. Brodie, Jr. and R.M. Storm. 1983. Amphibians and reptiles of the Pacific Northwest. Univ. Press of Idaho, Moscow, Idaho. 332p.

Parker, T. L. 1973. South Fork Canada goose study. Idaho Dept. of Fish and Game. 31p.

Peek, J. M. 1974. A review of moose food habit studies in North America. Can. Nat. 101: 195-215p.

Ritchie, B. W. 1978. Ecology of moose in Fremont County, Idaho. Wildl. Bull. No. 7, Idaho Dept. of Fish and Game, Boise, Idaho. 33p.

Schroeder, R. L. 1982. Habitat suitability index models: yellow warbler. FWS/OBS-82/10.27. Western Energy Land Use Team, U.S. Fish and Wildlife Service. Fort Collins, Colo. 8p.

Schroeder, R. L. 1983. Habitat suitability index models: black-capped chickadee. FWS/OBS-82/10.37. Western Energy Land Use Team, U.S. Fish and Wildlife Service, Fort Collins, Colo. 12p.

Steenhof, K. 1978. Management of wintering bald eagles. FWS/OBS-78/79. Eastern Energy Land Use Team, U.S. Fish and Wildlife Service. 59p.

Steele, R., S.V. Cooper, D.M. Ondov, D.W. Roberts, and R.D. Pfister. 1983. Forest habitat types of eastern Idaho-western Wyoming. Gen. Tech. Rpt. INT-144. U.S. Forest Service, Intermountain Forest and Range Experiment Station. Ogden, Utah. 122p.

Sweeney, J.M. and H.W. Steinhoff. 1976. Elk movements and calving as related to snow cover. Pages 415-436 in Ecological impacts of snow augmentation in the San Juan Mountains, Colorado, ed. H.D. Steinhoff and 3.0. Ives. Univ. of Colo. Press, Fort Collins, Colo.

Thomas, J. W. 1979. Wildlife habitats in managed forests of the Blue Mountains of Oregon and Washington. Agri. Handbook No. 553, U.S. Forest Service. Pacific Northwest Forest and Range Experiment Station, Portland, Ore. 512p.

Tubbs, A.A. 1980. Riparian bird communities of the Great Plains. Pages 419-433 in Management of western forests and grasslands for nongame birds. Gen. Tech. Rpt. INT-86. U.S. Forest Service, Int. Forest and Range Exp. Station, Ogden, Utah.

U.S. Bureau of Reclamation. 1951. Definate plan report: Palisades Project, Idaho-Wyoming. Boise, Idaho.

_____. 1978. Special report: Palisades Powerplant Enlargement; Idaho. Pacific Northwest Region, Boise, Idaho. 61p.

_____. 1984. Final environmental impact statement: Jackson Lake safety of dams project, Wyoming-Idaho. Pacific Northwest Region, Boise, Idaho.

U.S. Fish and Wildlife Service. 1947. A report of fish and wildlife resources in relation to the proposed Palisades Reservoir Project, Snake River, Idaho-Wyoming. Region One, Portland, Ore. 13p.

_____. 1979. Memoradum: update of fish and wildlife aspects of 90MW addition to the Palisades Powerplant, South Fork of the Snake River, Idaho. Sept. 24, 1979. 20p.

_____. 1980. Habitat evaluation procedures. Ecological Services Manual 102. Division of Ecological Services, Washington, D.C.

_____. 1983. Coordination act report: enlargement of Palisades Dam Powerplant, Minidoka Project, Bonneville County, Idaho-Wyoming. Div. of Ecol. Serv. Boise, Idaho. 19p.

U.S. Forest Service. 1981. Proposed land management plan for Targhee National Forest. Idaho Falls, Idaho.

Wilson, L.O. 1975. Distribution, season of use, and habitat of the mammals, birds, reptiles, amphibians, and fishes of Idaho. Bureau of Land Management, Boise, Idaho. 131p.

Zarn, M. 1974. Habitat management series for unique or endangered species: osprey. Report No. 12, U.S. Bureau of Land Management. Denver, Colo. 41p.

APPENDIX A

LIST OF WILDLIFE SPECIES FOUND IN

GENERAL VICINITY OF THE

PALISADES PROJECT, SOUTH FORK OF THE SNAKE RIVER

Mammals, birds, amphibians, and reptiles found in the vicinity of the Palisades Project area (from Collie 1983, Larrison and Johnson 1981, Nussbaum et al. 1983, Wilson 1975).

CLASS	COMMON NAME	SCIENTIFIC NAME
Mammals	Vagrant Shrew	Sorex vagrans
	Merriam Shrew	Sorex merriami
	Little Brown Bat	Myotis lucifugus
	Yuma Bat	Myotis yumanensis
	Long-eared Brown Bat	Myotis evotis
	Long-legged Brown Bat	Myotis volans
	California Brown Bat	Myotis califronicus
	Big Brown Bat	Eptesicus fuscus
	Western Big-eared Bat	Plecotus townsendii
	Nuttall's Cottontail	Sylvilagus nuttallii
	Snowshoe Hare	Lepus americanus
	White-tailed Jackrabbit	Lepus townsendii
	Least Chipmunk	Eutamias minimus
	Uinta Chipmunk	Eutamias umbrinus
	Yellow-bellied Marmot	Marmota flaviventris
	Golden-mantled Squirrel	Spermophilus lateralis
	Northern Flying Squirrel	Glawcomys gabrinas
	Northern Pocket Gopher	Thomomys talpoides
	Great Basin Pocket Mouse	Perognathus parvus
	Ord's Kangaroo Rat	Dipodomys ordii
	Beaver	Castor canadensis
	Western Harvest Mouse	Reithrodontomys megalotis
	Deer Mouse	Peromyscus maniculatus
	Northern Grasshopper Mouse	Onychomys Leucogaster
	Bushy-tailed Wood Rat	Neotoma cinerea
	Meadow Vole	Microtus pennsylvanicus
	Montane Vole	Microtus montanus
	Long-tailed Vole	Microtus longicaudus
	Richardson Vole	Microtus richardsonii
	Sagebrush Vole	Lagurus curtatus
	Muskrat	Ondatra zibethicus
	House Mouse	Mus musculus
	Western Jumping Mouse	Zapus princips
	Porcupine	Erethizon dorsatum
	Pika	Ochotona princeps
	Coyote	Canis latrans
	Red Fox	Vulpes vulpes
	Black Bear	Ursus americanus
	Grizzly Bear	Ursus horvibilis
	Raccoon	Procyon lotor
	Long-tailed Weasel	Mustela frenata
	Short-tailed Weasel	Mustela erminea
	Mink	Mustela vison
	Pine Marten	Martes americana

CLASS	COMMON NAME	SCIENTIFIC NAME
Mammals cont'd.	Badger	Taxidea taxus
	River Otter	Lutra canadenis
	Spotted Skunk	Spilogale gracilis
	Striped Skunk	Mephitis mephitis
	Mountain Lion	Felis concolor
	Canadian Lynx	Lynx canadensis
	Bobcat	Lynx rufus
	Mule Deer	Odocoileus hemionus
	Elk	Cervus canadensis
	Moose	Alces alces
	Bighorn Sheep	Ovis canadensis
Birds	Common Loon	Gavia immer
	Horned Grebe	Podiceps auritus
	Eared Grebe	Podiceps nigricollis
	Western Grebe	Aechmophorus occidentalis
	Pied-billed Grebe	Podilymbus podiceps
	American White Pelican	Pelecanus erythrorhynchos
	Double-crested Cormorant	Phalacrocorax auritus
	Great Blue Heron	Ardea herodias
	Great Egret	Casmerodius albus
	Snowy Egret	Egretta thula
	Black-crowned Night Heron	Nycticorax nycticorax
	American Bittern	Botaurus lentiginosus
	White-faced Ibis	Plegadis chihi
	Wood Ibis	Mycteria americana
	Tundra Swan	Cygnus columbianus
	Trumpeter Swan	Cygnus buccinator
	Canada Goose	Branta canadensis
	Snow Goose	Chen caerulescens
	Mallard	Anas platyrhynchos
	Gadwall	Anas strepera
	Nothern Pintail	Anas acuta
	Green-winged Teal	Anas crecca
	Blue-winged Teal	Anas discors
	Cinnamon Teal	Anas cyaboptera
	American Wigeon	Anas americana
	Northern Shoveler	Anas clypeata
	Wood Duck	Aix sponsa
	Redhead	Aythya americana
	Ring-necked Duck	Aythya collaris
	Canvasback	Aythya valisineria
	Lesser Scaup	Aythya affinis
	Common Goldeneye	Bucephala clangula
	Barrow's Goldeneye	Bucephala islandica
	Bufflehead	Bucephala al beola
	Ruddy Duck	Oxyura jamaicensis
	Hooded Merganser	Lophodytes cucullatus
	Common Merganser	Mergus merganser

CLASS	COMMON NAME	SCIENTIFIC NAME
Birds cont'd.	Red-breasted Merganser	Mergus serrator
	Turkey Vulture	Cathartes aura
	Northern Goshawk	Accipiter gentilis
	Sharp-skinned Hawk	Accipiter striatus
	Cooper's Hawk	Accipiter cooperii
	Red-tailed Hawk	Buteo jamaicensis
	Swainson's Hawk	Buteo swainsoni
	Rough-legged Hawk	Buteo lagopus
	Ferruginous Hawk	Buteo regalis
	Golden Eagle	Aquila chrysaetos
	Bald Eagle	Haliaeetus leucocephalus
	Northern Harrier	Circus cyaneus
	Osprey	Pandion haliaetus
	Prairie Falcon	Falco mexicanus
	Peregrine Falcon	Falco peregrinus
	Merlin	Falco columbarius
	American Kestrel	Falco sparverius
	Spruce Grouse	Dendragapus canadensis
	Blue Grouse	Dendragapus obsurus
	Ruffed Grouse	Bonasa umbellus
	Sage Grouse	Centrocercus urophasianus
	Sharp-tailed Grouse	Tympanuchus phasicinellus
	Sandhill Crane	Grus canadensis
	Whooping Crane	Grus americanus
	Virgina Rail	Rallus limicola
	Sora	Porzana Carolina
	American Coot	Fulica americana
	Semipalmated Plover	Charadrius semipalmatus
	Killdeer	Charadrius vociferus
	Black-bellied Plover	Pluvialis squatarola
	Ruddy Turnstone	Arenaria interpres
	Common Snipe	Capella gallinago
	Long-billed Curlew	Numenius americanus
	Whimbrel	Numenius phaeopus
	Upland Plover	Bartramia longicauda
	Spotted Sandpiper	Actitus macularia
	Solitary Sandpiper	Tringa solitaria
	Willet	Catoptrophorus semipalmatus
	Greater Yellowlegs	Tringa melanoleuca
	Lesser Yellowlegs	Tringa flavipes
	Baird's Sandpiper	Calidris bairdii
	Least Sandpiper	Calidris minutilla
	Dunlin	Calidris alpina
	Western Sandpiper	Calidris mauri
	Semipalmated Sandpiper	Calidris pusilla
	Sanderling	Calidris alba
	Long-billed Dowitcher	Limondromus scolopaceus
	Marbled Godwit	Limosa fedoa
	American Avocet	Recurvirostra americana
	Black-necked Stilt	Himantopus mexicanus

CLASS	COMMON NAME	SCIENTIFIC NAME
Birds cont'd.	Wilson's Phalarope	Phalaropus tricolor
	Red-necked Phalarope	Phalaropus lobatus
	Herring Gull	Larus argentatus
	California Gull	Larus californicus
	Ring-billed Gull	Larus delawarensis
	Franklin's Gull	Larus pipixcan
	Bonaparte's Gull	Larus philadephia
	Forster's Tern	Sterna forsteri
	Common Tern	Sterna hirundo
	Caspian Tern	Sterna caspia
	Black Tern	Chlidonias niger
	Rock Dove	Columba livia
	Mourning Dove	Zenaidura macroura
	Yellow-billed Cuckoo	Coccyzus americanus
	Black-billed Cuckoo	Coccyzus erythropthalmus
	Common Barn Owl	Tyto alba
	Western Screech-owl	Otus kennicottii
	Flammulated Owl	Otus flammeolus
	Great Horned Owl	Bubo virginianus
	Great Grey Owl	Strix nebulosa
	Long-eared Owl	Asio otus
	Short-eared Owl	Asio flammeus
	Northern Saw-whet Owl	Aegolius acadicus
	Common Poorwill	Phalaenoptilus nuttallii
	Common Nighthawk	Chordeiles minor
	Black-chinned Hummingbird	Archilochus alexandri
	Rufous Hummingbird	Selasphorus rufus
	Calliope Hummingbird	Stellusa calliope
	Belted Kingfisher	Ceryle alcyon
	Northern Flicker	Colaptes auratus
	Pileated Woodpecker	Dryocopus pileatus
	Lewis' Woodpecker	Melanerpes lewis
	Yellow-bellied Sapsucker	Sphyrapicus varius
	Hairy Woodpecker	Picoides villosus
	Downy Woodpecker	Picoides pubescens
	Northern Three-toed Woodpecker	Picoides tridactylus
	Eastern Kingbird	Tyrannus tyrannus
	Western Kingbird	Tyrannus verticalis
	Ash-throated Flycatcher	Myiarchus cinerascens
	Say's Phoebe	Sayornis saya
	Willow Flycatcher	Empidonax traillii
	Hammond's Flycatcher	Empidonax hammondii
	Dusky Flycatcher	Empidonax oberholseri
	Western Flycatcher	Empidonax difficilis
	Olive-sided Flycatcher	Nuttallornis borealis
	Western Wood Pewee	Contopus sordidulus
	Horned Lark	Eremophila alpestris
	Violet-green Swallow	Tachycineta thalassina
	Tree Swallow	Tachycineta bicolor
	Bank Swallow	Riparia riparia

CLASS	COMMON NAME	SCIENTIFIC NAME
Birds cont'd.	Northern Rough-winged Swallow	Stelgidopteryx serripennls
	Barn Swallow-	Hirundo rustica
	Cliff Swallow	Hirundo pyrrhonota
	Gray Jay	Perisoreus canadensis
	Steller's Jay	Cyanocitta stelleri
	Black-billed Magpie	Pica pica
	Common Raven	Corvus corax
	American Crow	Corvus brachyrhynchos
	Clark's Nutcracker	Nacifraga columbiana
	Black-capped Chickadee	Parus atricapillus
	Mountain Chickadee	Parus gambeli
	White-breasted Nuthatch	Sitta carolinensis
	Red-breasted Nuthatch	Sitta canadensis
	Pygmy Nuthatch	Sitta pygmaea
	Brown Creeper	Certhia americana
	House Wren	Troglodytes aedon
	Winter Wren	Troglodytes troglodytes
	Marsh Wren	Cistothorus palustris
	American Dipper	Cinclus mexicanus
	Mockingbird	Mimus polyglottos
	Catbird	Dumetella carolinensis
	Sage Thrasher	Oreoscoptes montamus
	American Robin	Turdus migratorius
	Western Bluebird	Sialia mexicana
	Mountain Bluebird	Sialia currocoides
	Townsend's Solitaire	Myadestes townsendi
	Veery	Catharus fuscescens
	Swainson's Thrush	Catharus ustulatus
	Golden-crowned Kinglet	Regulus satrapa
	Ruby-crowned Kinglet	Regulus calendula
	Water Pipit	Anthus spinoletta
	Bohemian Waxwing	Bombycilla garrulus
	Cedar Waxwing	Bombycilla cedrorum
	Northern Shrike	Lanius excubitor
	Loggerhead Shrike	Lanius lodovicianus
	European Starling	Sturnus vulgaris
	Solitary Vireo	Vireo solitarius
	Warbling Vireo	Vireo gil vus
	Black and White Warbler	Mniotilta varia
	Orange-crowned Warbler	Vermivora celata
	Nashville Warbler	Vermivora ruficapilla
	Yellow Warbler	Dendroica petechia
	Yellow-rumped Warbler	Dendroica coronata
	Black-throated Gray Warbler	Dendroica nigrescens
	Townsend's Warbler	Dendroica townsendi
	Northern Waterthrush	Seiurus noveboracensis
	MacGillivary Warbler	Oporornis tolmiei
	Common Yellowthroat	Geothlypis trichas
	Yellow-breasted Chat	Icteria virens
	Wilson's Warbler	Wilsonia pusilla
	House Sparrow	Paser domesticus
	Bobolink	Dolichonyx oryzivorus

CLASS	COMMON NAME	SCIENTIFIC NAME
Birds cont'd.	Western Meadow1 ark	Sturnella neglecta
	Yellow-headed Blackbird	Xanthocephalus xanthocephalus
	Red-winged Blackbird	Agelaius phoeniceus
	Northern Oriole	Icterus galbula
	Brewer's Blackbird	Euphagus cyanocephalus
	Brown-headed Cowbird	Molothrus ater
	Western Tanager	Piranga ludoviciana
	Black-headed Grosbeak	Pheucticus melanocephalus
	Lazuli Bunting	Passerina amoena
	Pine Grosbeak	Pinicola enucleator
	Evening Grosbeak	Coccothraustes vespertina
	Cassin's Finch	Carpodacus cassinii
	House Finch	Carpodacus mexicanus
	Rosy Finch	Leucosticte acetoa
	Common Redpoll	Acanthis flammea
	Red Crossbill	Loxia curvirostia
	Pine Siskin	Carduelis pinus
	American Goldfinch	Carduelis tristis
	Rufous-sided Towhee	Piplio erthrophthalmus
	Savannah Sparrow	Passerculus sandwichensis
	Grasshopper Sparrow	Arnmodramus savannarum
	Vesper Sparrow	Pooecetes gramineus
	Lark Sparrow	Chondestes grammacus
	Black-throated Sparrow	Amphispiza bilineata
	Sage Sparrow	Amphispiza belli
	Dark-eyed Junco	Junco hyemalis
	American Tree Sparrow	Spizella arborea
	Chipping Sparrow	Spizella passerina
	Brewer's Sparrow	Spizella breweri
	White-crowned Sparrow	Zonotrichia leucophrys
	Song Sparrow	Melospiza melodia
	Snow Bunting	Plectrophenax nivalis
Amphibians	Tiger Salamander	Ambystoma tigrinum
	Long-toed Salamander	Ambystoma macrodactylum
	Great Basin Spadefoot Toad	Scaphiopus intermontanus
	Western Toad	Bufo boreas
	Woodhouse's Toad	Bufo woodhousei
	Chorus Frog	Pseudacris triseriata
	Pacific Tree Frog	Hyla regilla
	Leopard Frog	Rana pipiens
Reptiles	Sagebrush Lizard	Sceloporus graciosus
	Western Skink	Eumeces skiltonianus
	Rubber Boa	Charina bottae
	Racer	Coluber constrictor
	Gopher Snake	Pituophis melanoleucus
	Western Terrestrial Garter Snake	Thamnophis elegans
	Common Garter Snake	Thamnophis sirtialis
	Western Rattlesnake	Crotalus viridis

APPENDIX B

Unpublished Evaluation Species Models Used In Impact Assessment For the Palisades Project, Idaho

Mallard
Canada Goose
Bald Eagle
Mule Deer
Ruffed Grouse

Mallard

HABITAT EVALUATION CRITERIA

Food - Evaluate food primarily using the criteria listed below. Mallards usually feed in open, shallow water, however grain crops can supplement a natural diet substantially if they occur within close proximity to water, especially in winter. The amount of waste grain available will effect winter food value.

C1= **Summer Food Value** is a function of:

The % of available water that is shallow and open enough to allow a dabbling duck to feed.

a)	75-100%	(0.8-1.0 SI)
b)	25-75%	(0.4-0.7 SI)
c)	25%	(0.1-0.3 SI)

C2= **Winter Food Value** is a function of:

Distance between grain crops and suitable water bodies.

a)	< 8 km	(0.8-1.0 SI)
b)	8-24 km	(0.4-0.7 SI)
c)	24-40 km	(0.1-0.3 SI)

Cover - Evaluate cover primarily using the criteria listed below. Broods are most susceptible to predation when escape cover is lacking. Sufficient amounts of aquatic vegetation supply necessary escape cover.

c3= **Summer Cover Value** is a function of:

% of shoreline dominated by emergent or scrub-shrub vegetation.

a)	50-100%	(0.7-1.0 SI)
b)	15-50%	(0.4-0.6 SI)
c)	0-15%	(0.1-0.3 SI)

Reproduction - Evaluate reproduction primarily using the criteria listed below. The abundance and patchiness of dense nesting cover (DNC) and the suitability of available water will largely influence reproductive value. Suitability of DNC increases with height.

C4= **Reproductive Value** is a function of:

The distance between water bodies suitable for brood rearing and dense herbaceous cover at least 20 cm (8 in) tall.

a)	Immediately adjacent to each other	(0.9-1.0 SI)
b)	10-90 m	(0.6-0.8 SI)
c)	> 90 m	(0.1-0.5 SI)

Interspersion - The mallard utilizes a variety of wetland types for various life functions. Optimal mallard habitat will contain a variety of wetland types and sizes within close proximity. The lack of several wetland types can be compensated for by large water bodies, diverse in physical composition and that contain both shallow and deep sections. Evaluate interspersion value primarily using the criteria listed below.

C5= **Interspersion Value** is a function of:
The number of wetland types (scrub-shrub, forested, emergent, shallow vs. deep, large vs. small, etc.) within a 1.6 km radius.

a) More than3 . . . . . (0.7-1.0 SI)
b) 2-3 . . . . . (0.4-0.6 SI)
c) 1 . . . . . (0.1-0.3 SI)

Model Equation:

$\frac{C_1 + C_2}{2}$ = food suitablity index.

C_3 = summer cover suitability index.

C_4 = reproductive suitability index.

C_5 = interspersion suitability index.

HSI for sample site = $\frac{\text{food SI} + C3 + C4 + C5}{4}$

Canada Goose Model

This model was developed by Dave Lockman, Wyoming Game and Fish Dept; Mike Whitfield, U.S. Forest Service; Bob Jones, Bureau of Land Management; and Chuck Solomon, U.S. Fish and Wildlife Service during the work session in Idaho Falls. It was developed specifically to describe the quality of goose breeding habitat along the Snake River prior to impoundment as well as current conditions at Palisades Reservoir. The model recognizes that the presence of islands, the quality of shoreline habitat, and the accessibility and quality of brood rearing habitat are the most important components determining the quality of Canada goose breeding habitat.

Islands (V_1)	SI Value
Stable islands present; islands have relatively high shoreline/area ratio; cover indicative of stability; ground cover on portions of island 4"-8" high; adjacent water velocity low.	0.8-1.0
Stable islands present; relatively low shoreline/area ratio; cover on island < 4" or > 8"; adjacent water velocity high.	0.5-0.7
No stable islands, or islands with limited or no cover adjacent water velocity high.	0.0-0.4

Shoreline Habitat (V_2)	SI Value
Portions of cover within 10 meters of water; ground cover 4"-8", wetland buffer within 50 meters of shoreline, may include sloughs of open water.	0.5
Portions of shoreline cover within 10 meters of water; over 4"-8"; adjacent wetlands within 50M of shoreline (does not include open water, rather forested or emergent wetlands).	0.3-0.4
No shoreline cover, or shoreline cover taller than 10" and/or very dense; buffer < 50 meters to absent.	0.1-0.2

Brood Rearing Habitat (V_3)	SI Value
Easy accessibility from main river system foraging zones with 10 meters of emergent vegetation or permanent cover ≥ 12" tall; foraging zones (vegetation ≤ 4" tall) average more than an acre in size and total to ≥ 60 acres or more per mile of river; open water wetlands within 25 meters.	0.7-1.0
As above, but no open water wetlands (palustine or lacustrine) near area.	0.4-0.6
Little to no brooding area.	0.0-0.3

Model Equation

$$HSI = \frac{(V_1 \text{ or } V_2) + V_3}{2}$$

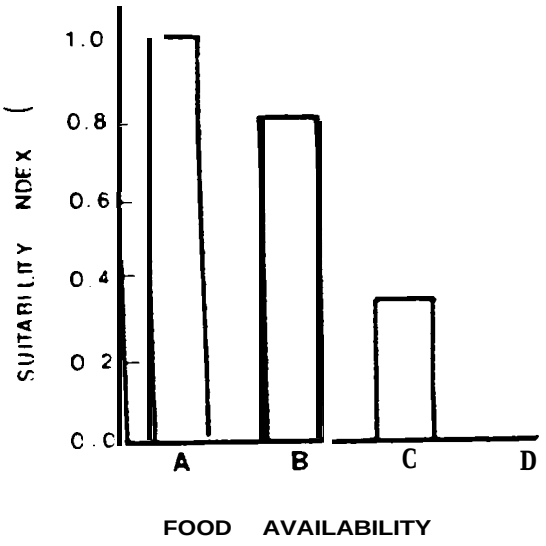
Reproduction value equals V_1 or V_2 whichever one has highest SI value.

Bald Eagle Model

This model was developed by Mike Whitfield and Bob Jones, biologists from the Targhee National Forest and Idaho Falls District of the Bureau of Land Management, respectively. In developing this model these biologists relied heavily on the Greater Yellowstone Ecosystem (GYE) Bald Eagle Management Plan (GYE Bald Eagle Working Group 1983) as well as their own personal knowledge of the bald eagles of the South Fork of the Snake River area.

Habitat Suitability Index (HSI) Model

Variable I_1. Food Requirements



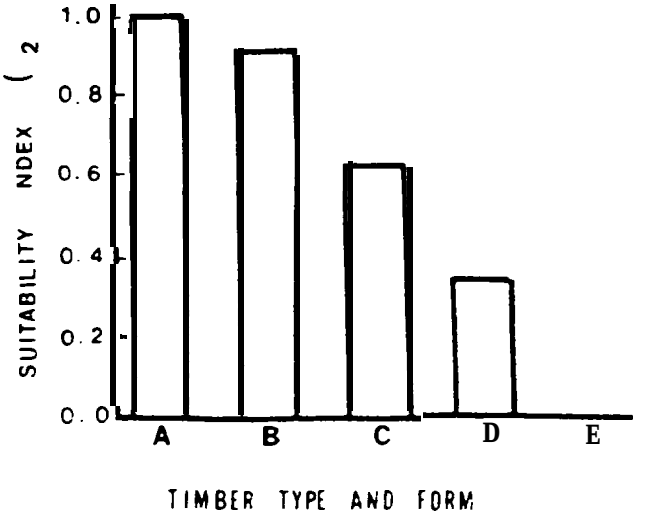
A. Abundant prey base (ungulate carrion, fish of several species, waterfowl, small mammals) available throughout year within 3 miles of potential nest/perch site.

B. Moderate prey availability within 3 miles of potential nest or perch sites. Water sometimes frozen over early in the nesting period, but some ungulate carrion available during that time. Alternative food sources may be within 5 miles of nest or perch.

C. Minimal prey base within 5 miles of potential nest or perch sites. Water frozen over late into nesting cycle without alternative food sources.

D. Insufficient prey base to sustain eagles.

Variable I_2. Nest/Perch Structure-type, form, density



A. Old growth spruce or Douglas fir in coniferous areas; old growth cottonwood in deciduous stands; stands dense and continuous and exceeding 10 acres in size.

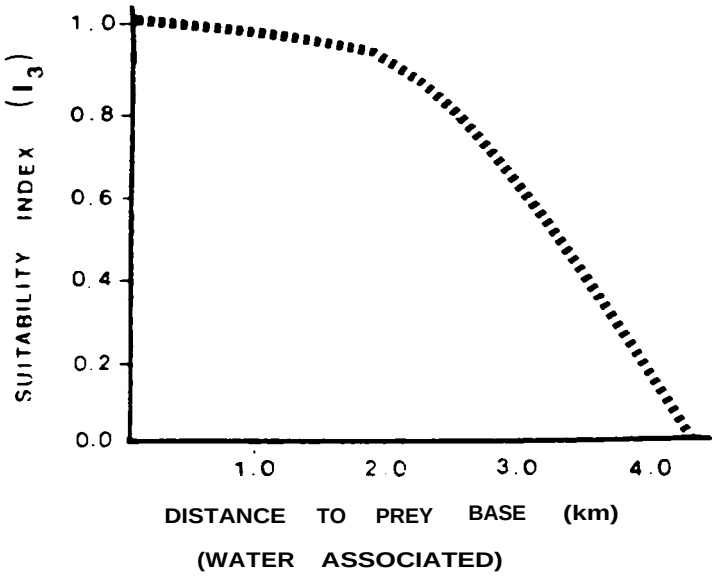
8. Scattered old growth trees in stands of moderate (mature) aged trees (spruce/fir/cottonwoods) exceeding 10 acres in size.

C. Scattered old growth trees (spruce/fir/cottonwoods) in open areas (without screening from younger aged trees).

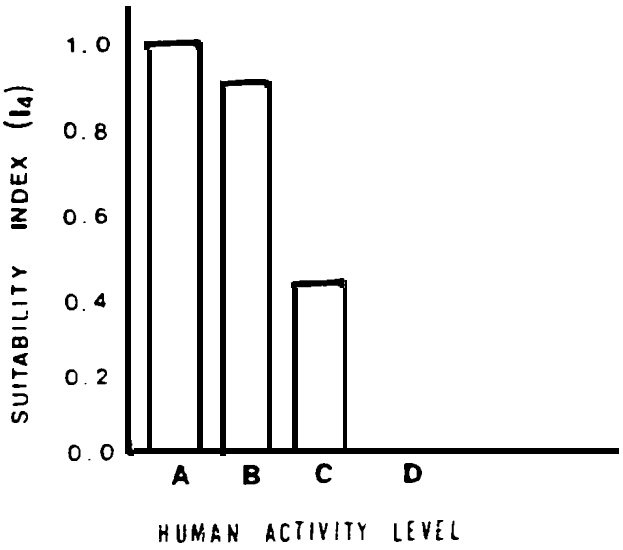
0. Dominant trees available are old growth lodgepole pine or aspen within continuous conifer or deciduous stands respectively..

E. Potential nest or perch structures are shrubs or young trees; no screening present.

Variable I_3. Distance to Water Body with Sufficient Prey Availability.



Variable I_4. Human Activity Level.



A. Natural vegetation dominates area; no permanent developments or human structures; no human activity within the area during the nesting period.

B. Area of farming ground or pastime surrounds site; occasional use of area by predictable humans, such as a farmer or stockman; human activity occurs late in the eagle nesting cycle.

C. Dispersed recreation campsites or trails, or occasionally used boat docks within vicinity of potential nest or perch; activity occurs during brooding period only.

D. Developed sites, e.g. campgrounds, boat launches etc., within vicinity of potential nest or perch; heavy human use of area during incubation period.

Equation:

I_1 = suitability index (SI) for food availability.

I_2 = suitability index (SI) for nest/perch structures.

I_3 = suitability index (S.1) for prey availability.

I_4 = suitability index (SI) for human activity level.

Food SI value - spring/summer/fall = I_1

Food SI value - winter = I_1

Reproductive SI value = $(I_2 \times I_3 \times I_4)^{1/3}$

Winter Perch SI value = I_2

The HSI for wintering bald eagles is equal to $(2(I_1) \times I_2)^{1/3}$.

The HSI for breeding bald eagles is the lowest SI value between the food and reproductive values.

Habitat Suitabilitv Index (HSI) Model for the Mule Deer

General Information

Species Information

Species:	Mule Deer (Gcocoileus hemionus)
Habitat Use Pattern:	Multicover type user
Status:	Resident (seasonal migrant)
Cover Types:	All
Ecoregion:	M3113
Model Type:	Uncalibrated Index Model for Winter Range

Threshold Range Size. Information on the minimum size of suitable babitat that must be present before an area will be occupied by a population of mule oeer was not found in the literature.

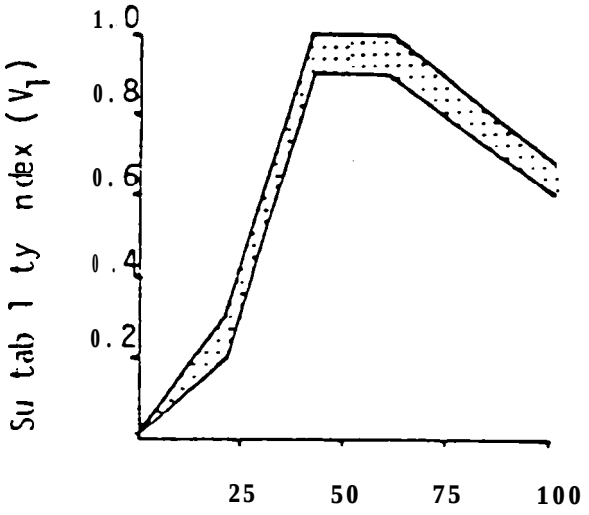
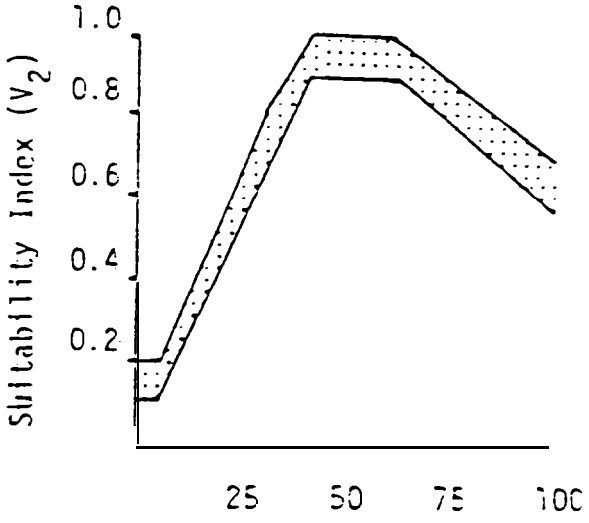
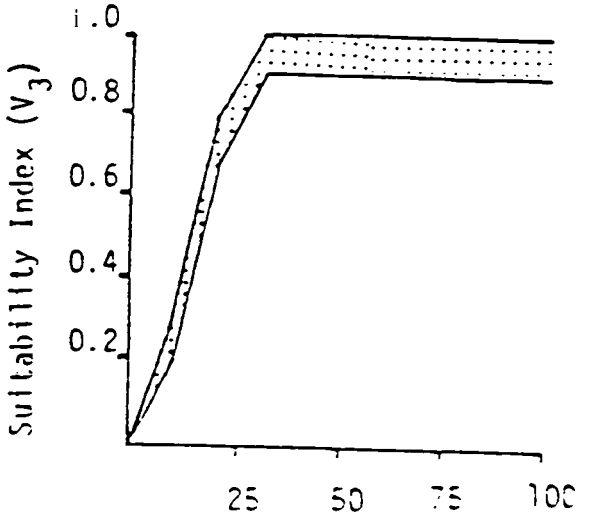
Home Ranoe Data. Winter home range size for mule deer has been estimated to have 2 radius ranging from 0.4 to 1.2 km.

Habitat Composition.. Habitat composition information for species which are multicover type users is most useful when presented in terms of life requisite needs. Optimal iife requisite composition may be determined by consioerino the composition cf the habitat in terms of cover types and by considering what life requisites are provided by each cover type. The following percentages were estimated based on the assumption that food shuld be available over a larger area than cover to provide optimal wi nter habitat.

Life Reouisite	Optimal Percentage Estimate
Food	60%
Water	Assumed not to be limiting on winter range.
Cover	40%

Evaluation Criteria

Wi nter Food Value. Browse often furnishes 75% or more of the mule deer's winter diet. Forbs and grasses are supplemental winter foods and their availabl' i'ty will resuit in an increased fool value for muie deer.

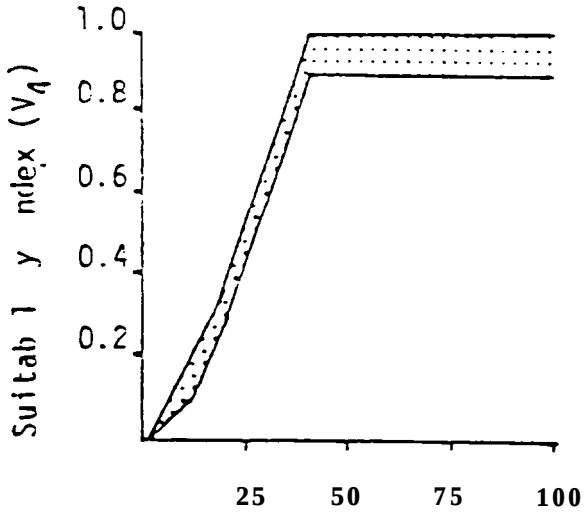
Variable		Suitability Index Curve
$[V_1]$	% shrub crown cover < 1.5 m (5 ft) in height. (bo not consider small conifers as shrubs.)	
$[V_2]$	% shrub crown cover of preferred shrubs < 1.5 m (5 ft) in height. (Preferred shrubs i ncl ude, but are not 1 i mi ted to, antel ope bi tterbrush, mountai n mahogany , ceanothus, chokecherry, and servi ceberry.)	
$[V_3]$	% herbaceous canopy cover.	

Winter Food Value in all cover types is a function of V_1, V_2, and V_3. V_1 and V_2 are interactive variables and compensations exist between them. The abundance of shrubs and the availability of preferred shrubs are the most important components of the food value for winter range and have been weighted accordingly. The suggested function is:

$$\frac{3(V_1 \times V_2)^{1/2} + V_3}{4}^*$$

*When evaluating food on winter range the average snow conditions for the area must be taken into consideration. If the average depth of snow on the ground exceeds 60.9 cm (24 in) for extended periods of time, the life requisite value for food should equal zero. If persistent snow cover ranges from 3C.4 cm (12 in) to 60.9 cm (24 in), the life requisite value should be adjusted downward. In determining winter snow conditions consider snowfall records, slope, aspect, wind, and vegetative cover.

Cover Value. Excellent winter habitat for mule deer has been characterized as being comprised of approximately one-half shrub cover types and one-half timbered cover types.

Variable		Suitability index Curve
$[V_4]$	% canopy cover of evergreen woody vegetation > 3.0m (10 ft) in height.	

[V_5] Topographic diversity (consider entire project area).

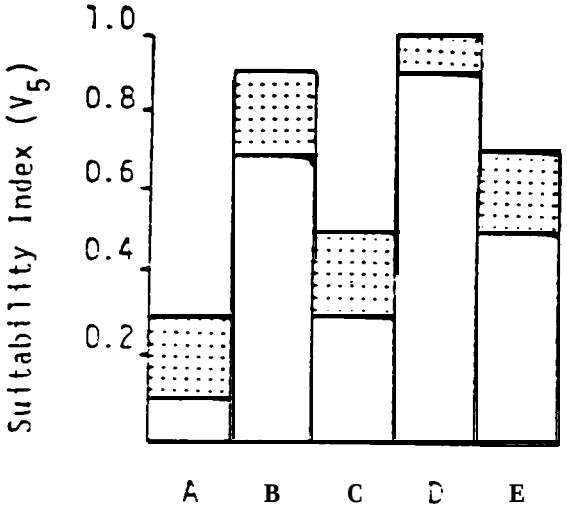
A) level terrain (0-5% slope), flat or nearly so, little to no physical diversity.

B) Level terrain (0-5% slope), area broken by drainages.

C) Rolling terrain (5-25% slope).

D) Rolling terrain (5-25% slope), ridges, rims and/or drainages present.

E) Mountainous (> 25% siope).



Cover Value in all cover types is a function of V_4 and V_5. V_4 and V_5 are interactive and compensations exist between them. The life requisite value will be zero only if both variables are equal to *zero*. The suggested function is:

$$\frac{2V_4 + V_5}{3}$$

HSI Determination for Multicover Type Users. The following is an abbreviated step by step discussion of HSI determination for multicover type species.

Step 1 - Determine Suitability indices for each variable based on field data.

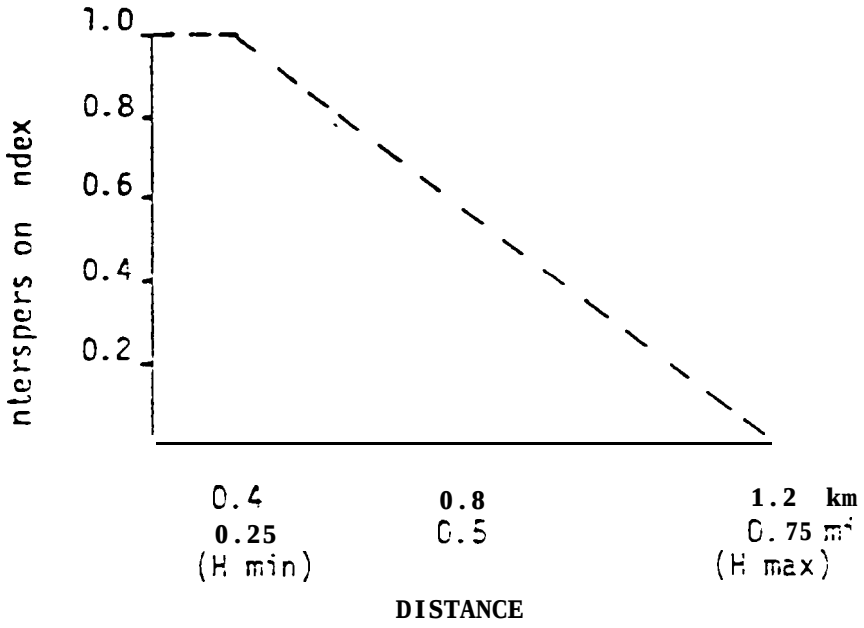
Step 2 - Compute Life Requisite Values for the indicated cover types using the suggested functions provided in the model.

Step 3 - Getermine if all life requisites can be provided considering all cover types within the studv area. If anv life requisites are missing, the HSI will dqual zero and no further evaluation is necessary.

Step 4 - Using the life requisite values computed in Step 2, the next step is to determine the spatial relationship cf cover types providing various life requisites. Life requisite values may need tc be adjusted to varying degrees depending on the distances separating them and how the *distances* compare with the species minimum and maximum home ranges. This step is accomplished as follows:

a) Determine the mean distance (measured from randomly selected points) from each cover type missing a life requisite to the edge of the next nearest cover type that provides the missing life requisite(s).

b) Incorporate the mean distance measurements from Step 4a into the x-axis of the home range-interspersion graph presented below. Determine where the mean distance measurement intercepts the graph and obtain the interspersion index by reading the corresponding value from the y-axis.



c) Multiply the interspersion index for each cover type determined in Step 4b by the life reqiosote vaues determined in Step 2. The products are the modified life requisite values.

Step 5 - Determine the reiative abundance (in percent) of cover types used by the species within the study area, as follows:

$$\text{Relative Area for Cover Type A} = \frac{\text{Area of Cover Type A}}{\text{Total Area of all Cover Types used by the Species}} \times 100$$

Be certain that you consider oniv those cover types used by the speci es in determining **relative** area cf cover types.

Step 6 - Determine the percent life requisite support provided by the available habitat as follows:

a) For each life requisite within each cover type, multiply the modif ied iife requisite value(s) (Step 4c) by the relative area of that cover type (Step 5). The products equal the percent life requisite wupport provided by each cover type.

b.) Sum the products from Step 6a for each life requisite The total equals the percent life requisite support provided by the available habitat.

Step 7 - For each life requisite, divide the percent life requisite support (Step 6b) by the optimal percent life requisite estimate provided in the General Information section of the HSI Model (use the lower percentage where a range of percents are given as estimates for optimal life requisite percent). This yields the overall life requisite values for the entire study area.

Step 8 - The Habitat Suitability Index (HSI) is the lowest of the overall life requisite values.

Model Assupmtions and Limitations. It is assumed in this model that the availability of free water wiii not be limiting on mule deer winter range. It is also assumed that average annual snowfall data will be available for the area (or immediate geographic region) under evaluation and that the influence of snow conditions can be directly related to the value calculated for food. It is assumed that the food value for the mule deer can be estimated without a precise volume measurement or assessing vegetative productivity, by estimating the approximate standing crop of veoetation. A further assumption is that the home range data can be used to assess spatial relationships of food to cover.

The major limitation in this model is that optimal life requisite composition values and the interspersion Graph are best estimates derived from literature reviews. The estimates presented may not be valid in every situation.

HABITAT SUITABILITY INDEX

Ruffed Grouse in Tree-dominated Wetland

Ecoregion 2410

food Value $(X_1) = I_7$

Cover Value (X2) = $(I_1 \times I_2 \times I_5 \times 16)^{1/4}$

Reproductive Value - Drumming (X3) = $(I_1 \times I_4)^{1/2}$

Reproductive Value - Brood $(X_4) = (I_3 \times I_5)^{1/2}$

Interspersion Value $(X_5) = I_5$

Where: I_1 = Suitability Index (SI) of tree density.

I_2 = SI of height of lowest overstory trees.

I_3 = SI of percent herbaceous canopy cover.

I_4 = SI of distance to opening.

I_5 = SI of distance to scrubland.

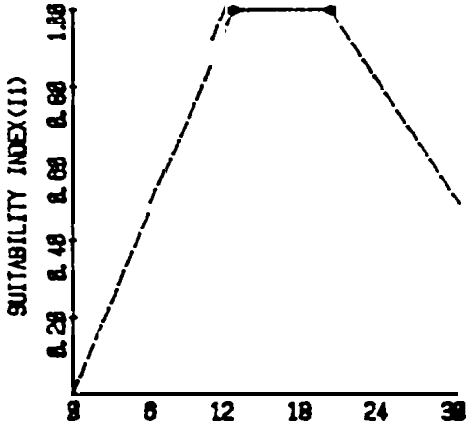
I_6 = SI of distance to conifer tangles or thickets.

I_7 = SI of presence of preferred winter foods.

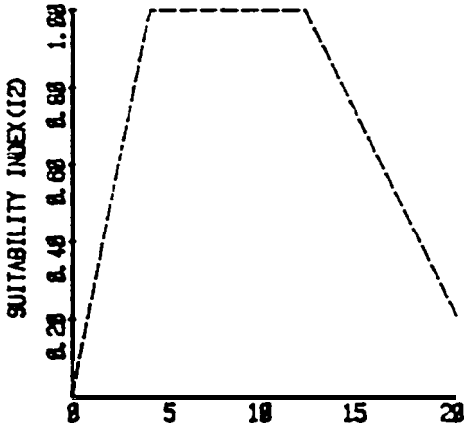
The Habitat Suitability Index is the lowest X_n value.

RUFFED GROUSE

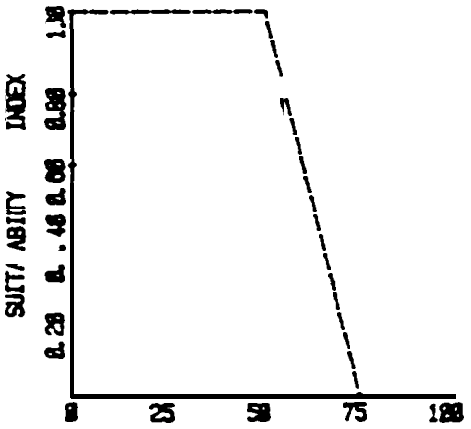
TREE-DOMINATED WETLAND



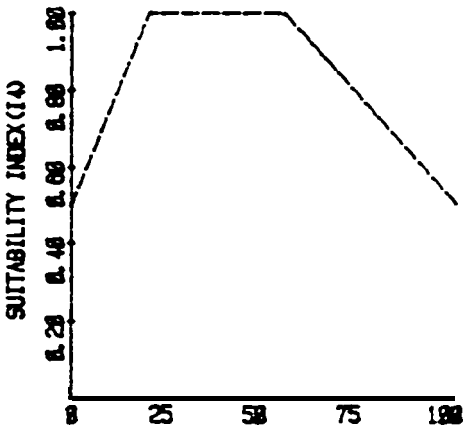
TREE DENSITY (THOUSANDS/HA)



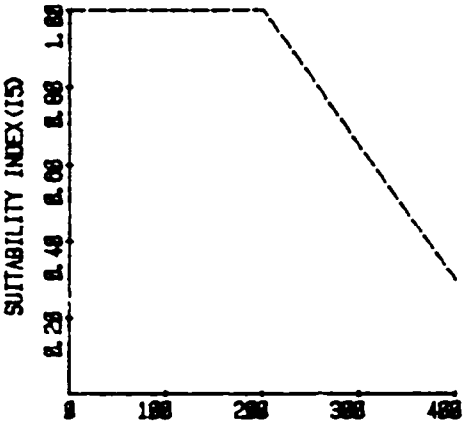
HEIGHT OF LOWEST OVERSTORY TREES
00



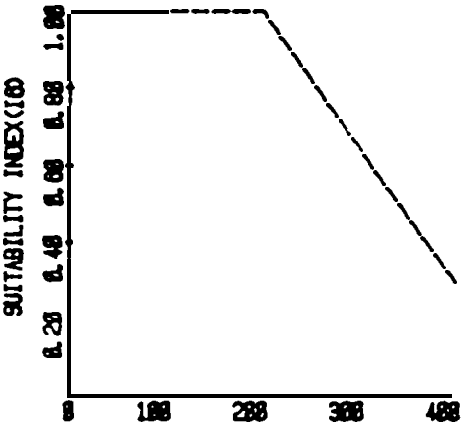
HERBACEOUS CANOPY COVER CO



DISTANCE TO OPENING 00



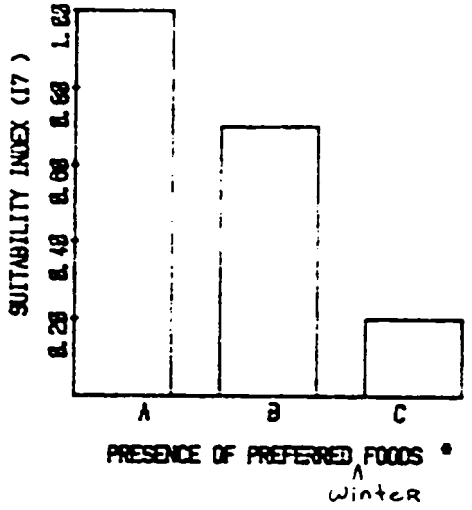
DISTANCE TO SCRUBLAND 00



DISTANCE TO CONIFER TANGLES OR
THICKETS 00

RUFFED GROUSE

TREE-DOMINATED WETLAND



A. 3 TO 4 PREFERRED FOODS PRESENT
B. 1 TO 2 PREFERRED FOODS PRESENT
C. NO PREFERRED FOODS PRESENT

* REFER TO TEXT FOR PREFERRED WINTER FOODS

Appendix C

Pre-construction conditions in study area - Palisades Project, South Fork of the Snake River

Plate A - Dam site and Bear Creek drainage (includes some of Van Point area).

Plate B - Big Elk and Little Creek drainages.

Plate C - Van Point to Indian Creek (includes Sulfur Bar Creek area).

Plate D - Williams Creek to Trout Creek (includes McCoy Creek area).

Plate E - Alpine peninsula, Salt River, and Grey's River.

PLATE A

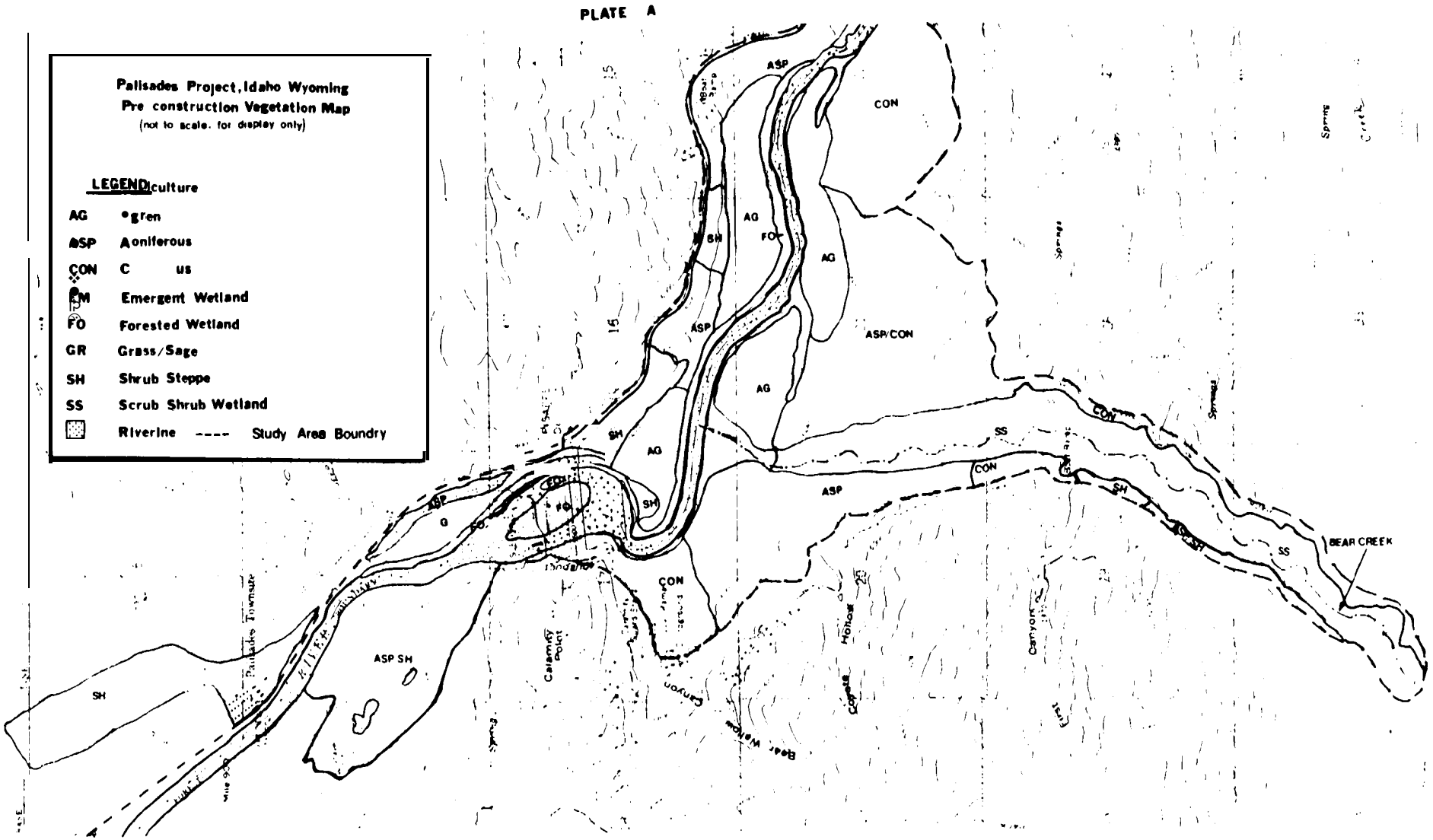
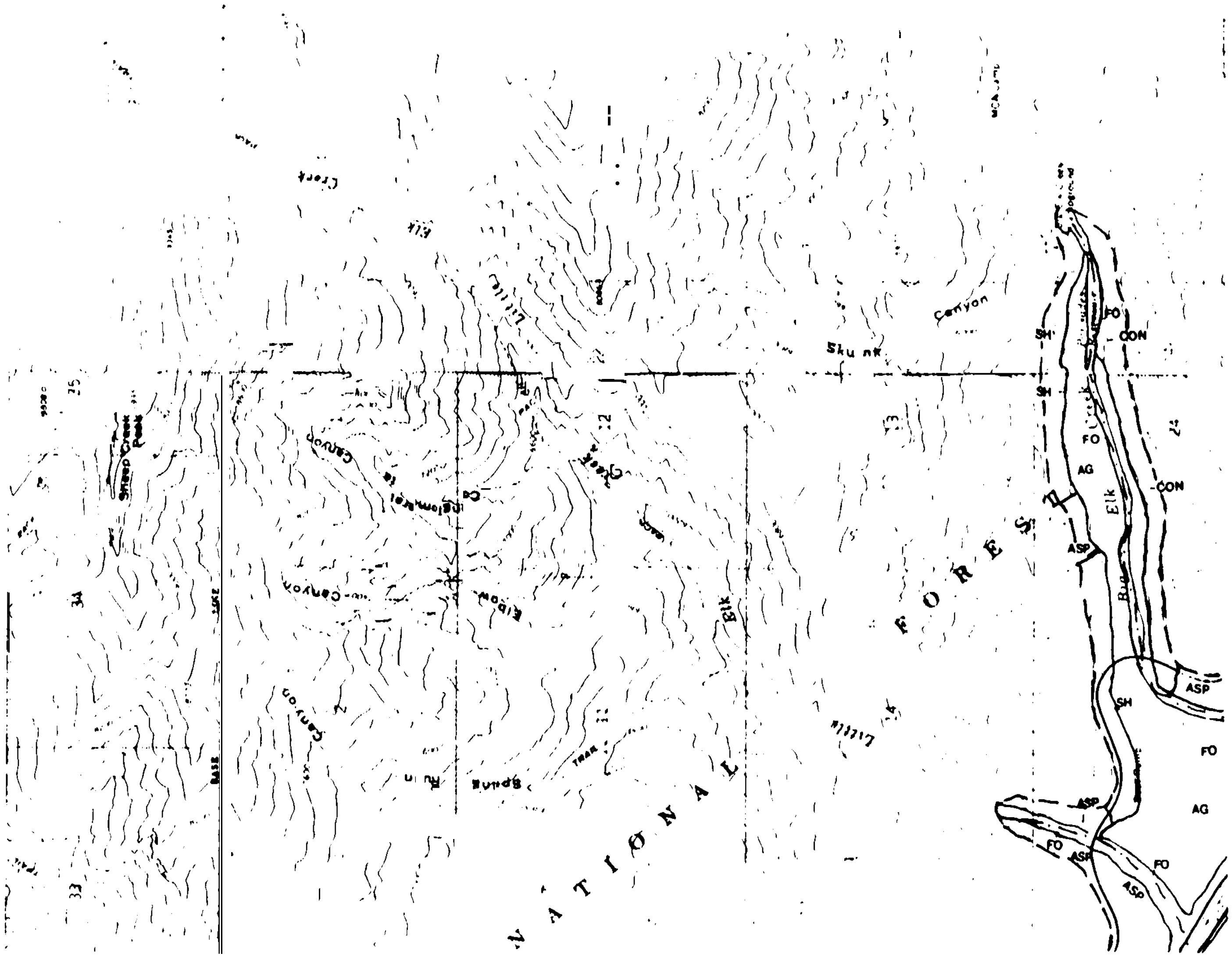

Palisades Project, Idaho Wyoming
Pre construction Vegetation Map
(not to scale. for display only)
LEGEND
AG
ASP
CON
EM
FO
GR
SH
SS
Riverine
Study Area Boundry
ASP/CON
ASP SH
BEAR CREEK

PLATE B



Skunk
Canyon
Little
Elk
Creek
Elk
Canyon
Conglomerate
Elbow
Spring
Ruin
Little
NATIONAL
FOREST
Sheep Creek Peak
Big
SH
FO
CON
AG
ASP

PLATE C

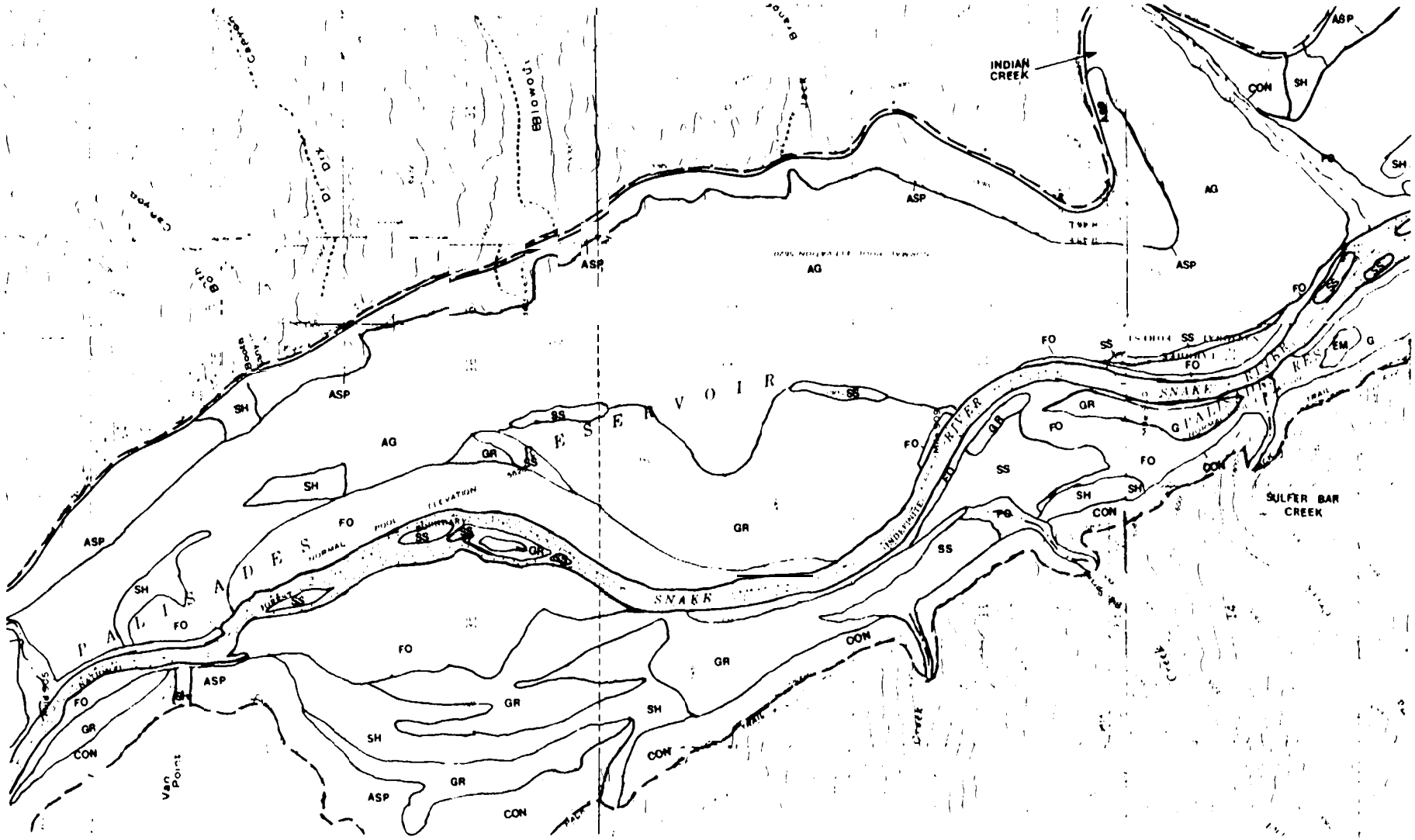

INDIAN CREEK
ASP
CON
SH
AG
FO
SS
GR
PG
EM
G
RESERVOIR
SNAKE RIVER
PALISADES
NORMAL POOL ELEVATION
SULFER BAR CREEK
Van Point

PLATE D

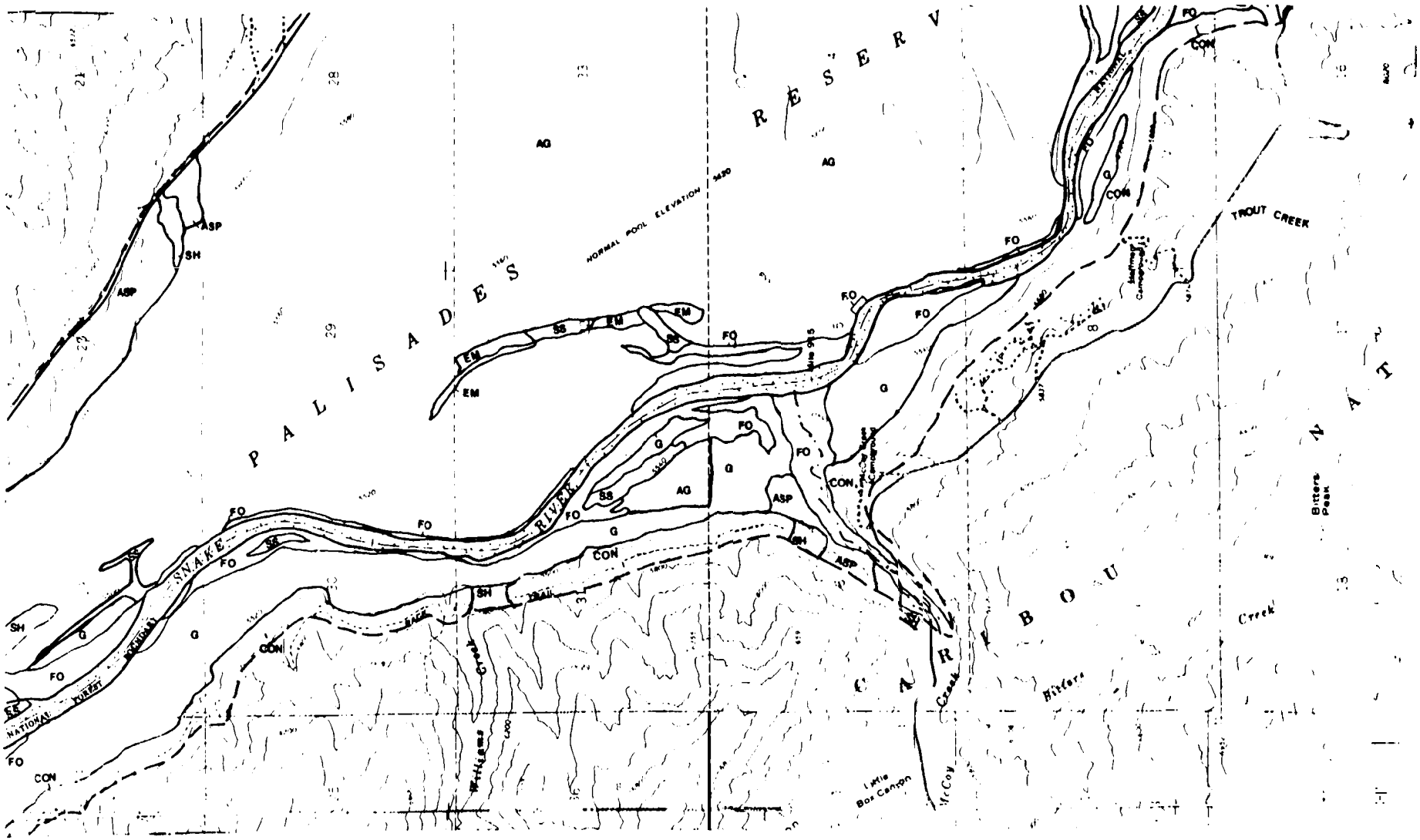
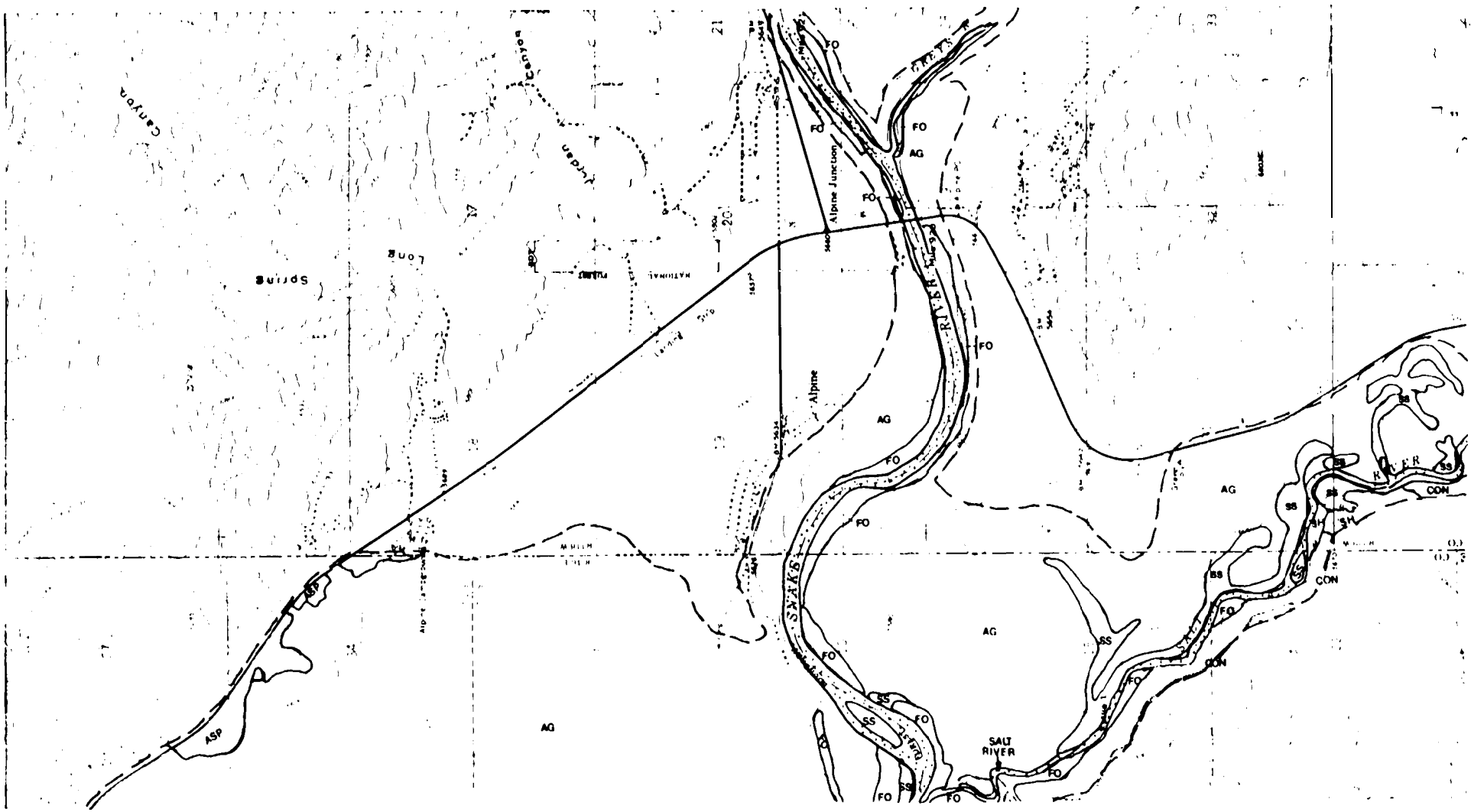

PALISADES RESERVOIR
NORMAL POOL ELEVATION 5450
SNAKE RIVER
TROUT CREEK
Bitters Peak
Bitters Creek
Little Box Canyon
Wilkens Creek
NATIONAL FOREST
AG
ASP
SH
EM
SS
FO
G
CON

PLATE E



United States
Department of the Interior

Fish and Wildlife Service
Lloyd 500 Building, Suite 1692
500 N.E. Multnomah Street
Portland, Oregon 97232

In Reply Refer To: Your Reference:

May 2, 1985

Director
Division of Fish & Wildlife PJ
Attention: James Meyer
Bonneville Power Administration
P. 0. Box 3621
Portland, Oregon 97208

Dear Mr. Meyer:

This responds to your request to parties for formal comments on the report "Wildlife Impact Assessment, Palisades Project" prepared by our agency under contract to you.

We have no recommendations for changes in the technical content or conclusions of the study, The identification of substantial, unaddressed habitat losses resulting from construction of the Palisades Project indicates that wildlife planning and mitigation are important future needs, We urge your early consideration of these activities for the Palisades Project,

Thank you for the opportunity to comment on the report.

Sincerely yours,

David F. Riley

Assistant Regional Director
Habitat Resources