WILDLIFE AND WILDLIFE HABITAT LOSS ASSESSMENT AT GREEN PETER--FOSTER PROJECT MIDDLE FORK SANTIAM RIVER, OREGON

FINAL REPORT

By

J. H. Noyes
M. S. Potter
K. L. Bedrossian
Vegetation Analysis by J. B. Glad

Oregon Department of Fish and Wildlife
Environmental Management Section

Prepared For

Jim Meyer, Project Manager

U.S. Department of Energy

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ABSTRACT

A habitat based assessment was conducted of the U.S. Army Corps of Engineers' Green Peter-Foster Dam and Reservoir Project on the Middle Fork Santiam River, Oregon, to determine losses or gains resulting from the development and operation of the hydroelectric related components of the project. Preconstruction, postconstruction, and recent vegetation cover types at the project site were mapped based on aerial photographs from 1955, 1972, and 1979, respectively. Vegetation cover types were identified within the affected area and acreages of each type at each period were determined. Eleven wildlife target species were selected to represent a cross-section of species groups affected by the project. An interagency team evaluated the suitability of the habitat to support the target species at each time period. An evaluation procedure which accounted for both the quantity and quality of habitat was used to aid in assessing impacts resulting from the project. The Green Peter-Foster Project extensively altered or affected 7,873 acres of land and river in the Santiam River drainage. Impacts to wildlife centered around the loss of 1,429 acres of grass-forb vegetation, 768 acres of shrubland, and 717 acres of open conifer forest cover types. Impacts resulting from the Green Peter-Foster Project included the loss of critical winter range for black-tailed deer and Roosevelt elk, and the loss of year-round habitat for deer, upland game birds, river otter, beaver, pileated woodpecker, and many other wildlife species. Bald eagle and osprey were benefited by an increase in foraging habitat. The potential of the affected area to support wildlife was greatly altered as a result of the Green Peter-Foster Project, Losses or gains in the potential of the habitat to support wildlife will exist over the life of the project.

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I. INTRODUCTION

This loss statement addresses the impacts to wildlife resources resulting from the development and operation of the hydroelectric-related components (e.g., dam, reservoir) of the U.S. Army Corps of Engineers' (USACE) Green Peter-Foster Project. The study was funded by Bonneville Power Administration and was designed to meet requirements of Measure 1004(b)(2) 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 the study were to: 1) provide for consultation and coordination with interested parties, 2) identify probable effects of past development and operation of the Green Peter-Foster Project to wildlife and wildlife habitat, and 3) determine the hydroelectric portion of the wildlife resource losses at the Green Peter-Foster Project. A habitat based approach was used to identify effects of the project and to determine losses or gains in the potential of the project area to support wildlife.

II. STUDY AREA

A. Project Description

Green Peter and Foster Reservoirs are located in Linn County, Oregon. Green Peter Dam is located on the Middle Santiam River at river mile 5.5 (USACE 1970). Foster Reregulating Dam is situated at the junction of the Middle and South Santiam Rivers at river mile 38.5 of the South Santiam River (U.S. Fish and Wildlife Service [USFWS] 1963). Foster Dam is 3.5 miles northeast of Sweet Home, Oregon, near the town of Foster. Green Peter Dam is 10.5 miles northeast of Sweet Home. The project is located within the Oregon Department of Fish and Wildlife's (ODFW) Santiam Wildlife Management Unit, and the Salem District of the Bureau of Land Management (BLM).

The Green Peter structure is a concrete gravity dam 385 feet high with a crest length of 1,400 feet (USACE 1982). Power is generated by two turbines with a total capacity of 80,000 kilowatts. The surface area of Green Peter Reservoir is 3,605 acres at full pool (K. Beck, USACE, pers. commun.). The reservoir is 10 miles long, with a maximum width of 1 mile (USACE 1970). Maximum pool elevation is 1,015 feet and minimum pool elevation is 887 feet (USACE 1980). The winter minimum flood control pool exposes approximately 1,650 acres of shoreline (Battelle 1976).

Foster Dam is a gravel and quarried rockfill structure 4,800 feet long and 146 feet high (USACE 1982). Two turbines with a total capacity of 20,000 kilowatts generate power. At full pool, the reservoir surface area is 1,195 acres (K. Beck, USACE, pers. commun.). Foster Reservoir is 5 miles long with an average width of 3/4 mile (USACE 1967a, 1976) Maximum pool elevation is 641 feet, minimum pool elevation is 609 feet. (USACE 1980). Daily fluctuations normally do not exceed 2 feet (USACE 1967a). Approximately 365 acres of shoreline are exposed at minimum pool (Battelle 1976).

Green Peter Dam and Reservoir Project was authorized by the Flood Control Act of 1950. The 1954 Flood Control Act authorized the development of power at the project. Foster Reregulating Dam and Reservoir was authorized by the Flood Control Act of 1960 (USACE 1961). Construction of both dams began in 1961 and flood control commenced in 1967 (USACE 1961, 1967b). The Green Peter-Foster Project was considered complete in 1969 (USACE 1969).

B. Study Area Description

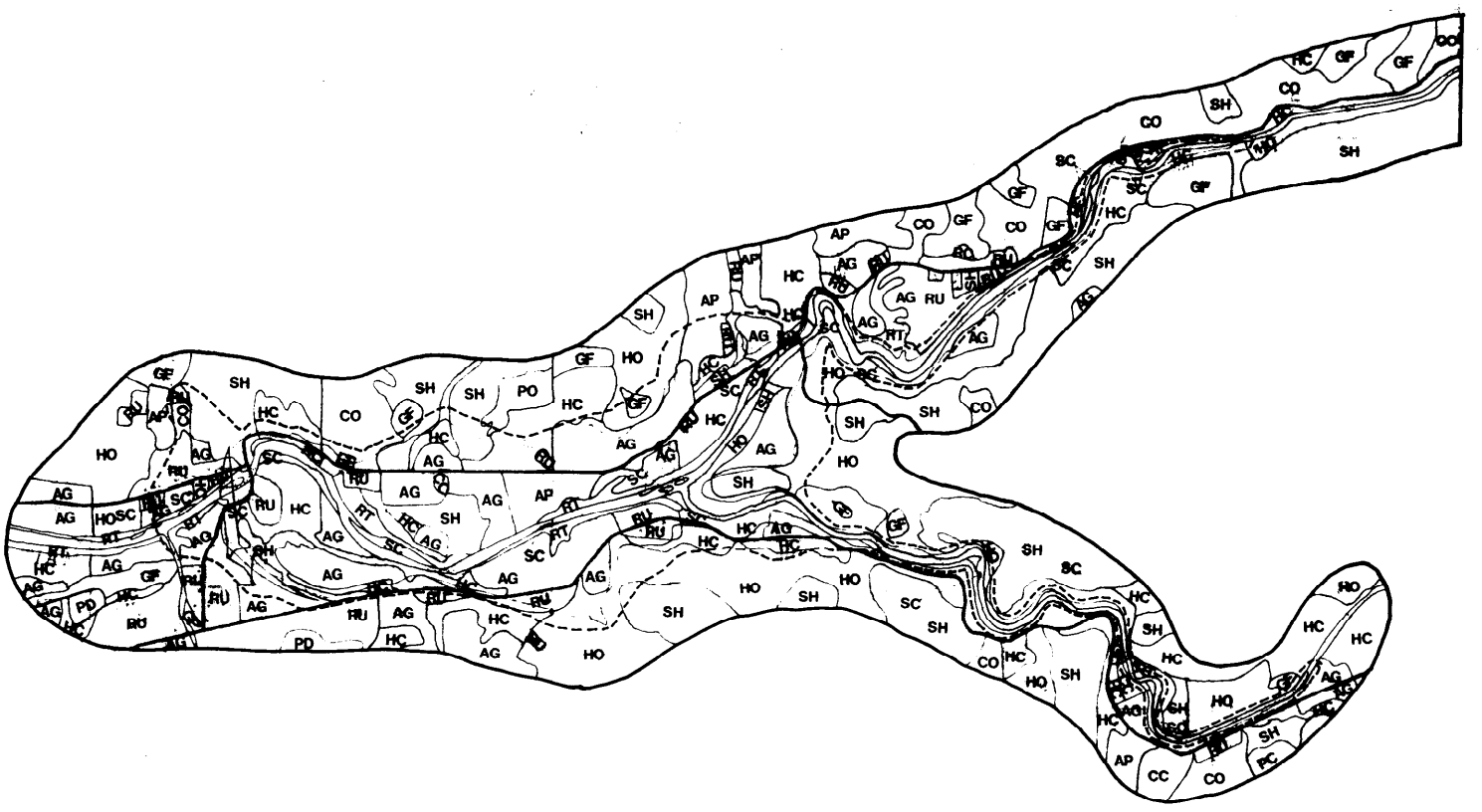
The "affected area" referred to in this report was most intensively studied. It included that area directly affected, by project construction and operation. The affected area encompassed the reservoir, project facilities, staging areas, and relocated roads (Figures 1-6). Areas not directly affected by the project, but within the range of species using the project area, were considered when determining qualitative impacts.

The Green Peter-Foster Project islocated in the Western Hemlock Zone described by Franklin and Dyrness (1973). The Green Peter Reservoir site was characterized by stands of Douglas-fir, western red cedar, and western hemlock. Common understory vegetation included red alder, vine maple, and Pacific dogwood (USFWS 1961). Logged portions of the project area had regrown to a subclimax community of deciduous species, second-growth conifers, and a ground cover of salal, blackberry, bracken fern, and fireweed (USFWS 1961). The upstream portion of the Foster Reservoir site was of Douglas-fir/maple type, with Pacific dogwood, red alder, western hemlock, and a variety of shrubs and grasses. The downstream portion of the Foster impoundment area was of the same general vegetation type interspersed with tracts of agricultural land (USFWS 1963). Forest land adjacent to the Green Peter-Foster Project was cut during the last century and had not regrown to marketable size by the time of construction (USACE 1976). The lands surrounding the project site were generally steep (USFWS 1961). More detailed descriptions of vegetation cover types are provided in Section IV.A.l. of this report.

Black-tailed deer inhabited the project site prior to project construction. Black bear, beaver, mink, raccoon, snowshoe hare, and brush rabbit also inhabited the reservoir areas, as did blue grouse, ruffed grouse, mountain quail, and band-tailed pigeon (USFWS 1961, 1963). Preconstruction information on nongame species was not documented. In addition to those species documented to be present prior to construction, the affected area potentially supported many more wildlife species (Appendix A).

C. Land Ownership

The total acreage of the Green Peter Project is approximately 6,337 acres (K. Beck, USACE, pers. commun.). The project encompasses 2,732 acres above the maximum conservation pool (USACE 1981), Of which 16 acres are necessary for project operations (K. Beck, USACE, pers. commun.),



Vegetation cover types of the Foster Reservoir area: preconstruction, 1955.

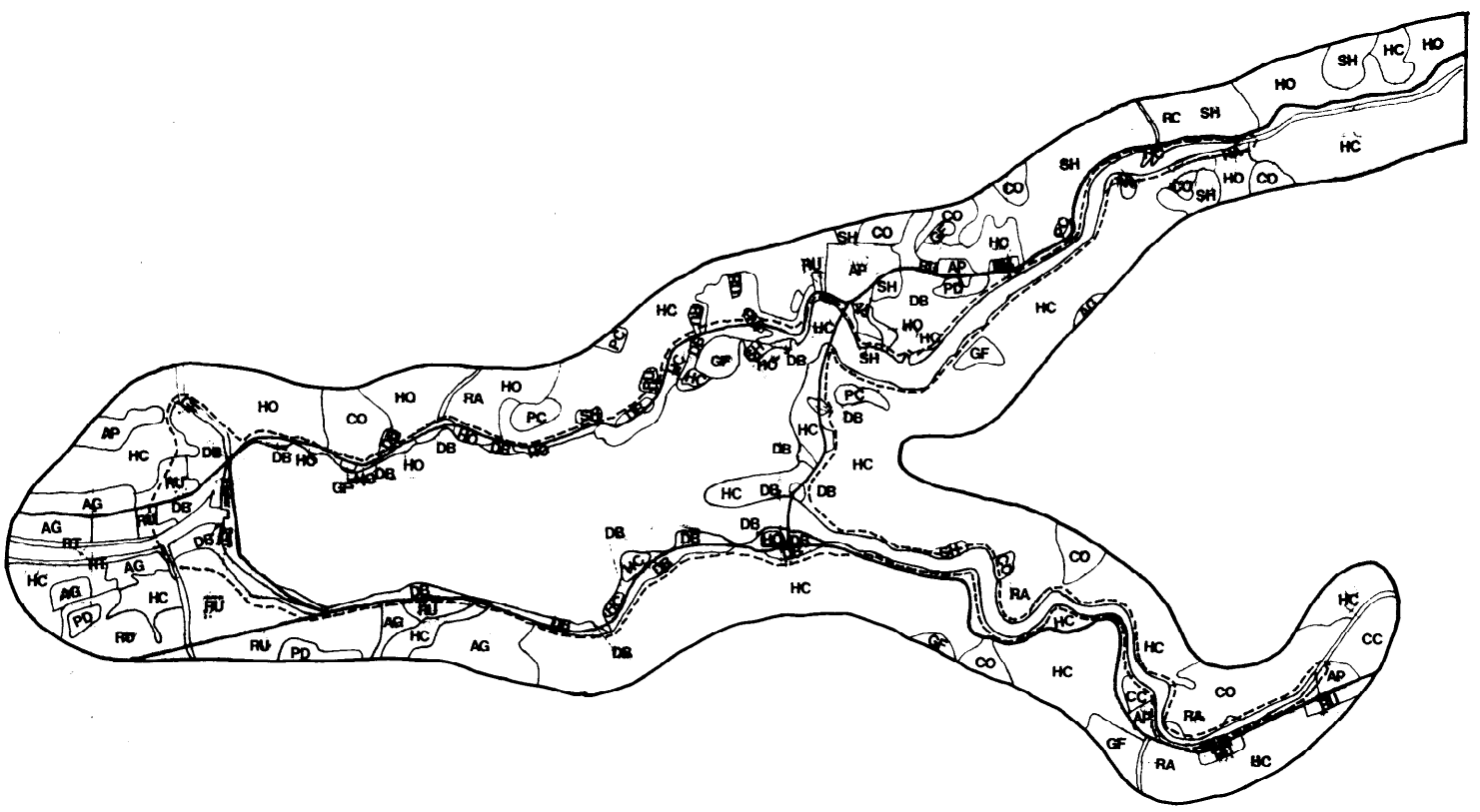
PO Temperate conifer forest, open pole
PC Temperate conifer forest,closed pole
CO Temperate conifer forest, open
CC Temperate conifer forest, closed
HO Conifer-hardwood forest,open
HC Conifer-hardwood forest,closed
RA Red alder
SH Shrubland
GF Grass-forb
HW Herbaceous wetland

RS Riparian shrubs
RT Riparian trees
SC Sand/gravel/cobble
RC Rocky cliffs/talus
RU Residential/urban/industrial
AG Agricultural cropland
AP Agricultural pasture
DB Disturbed/bare
PD Pond
River

----- Affected area

N

Figure 1



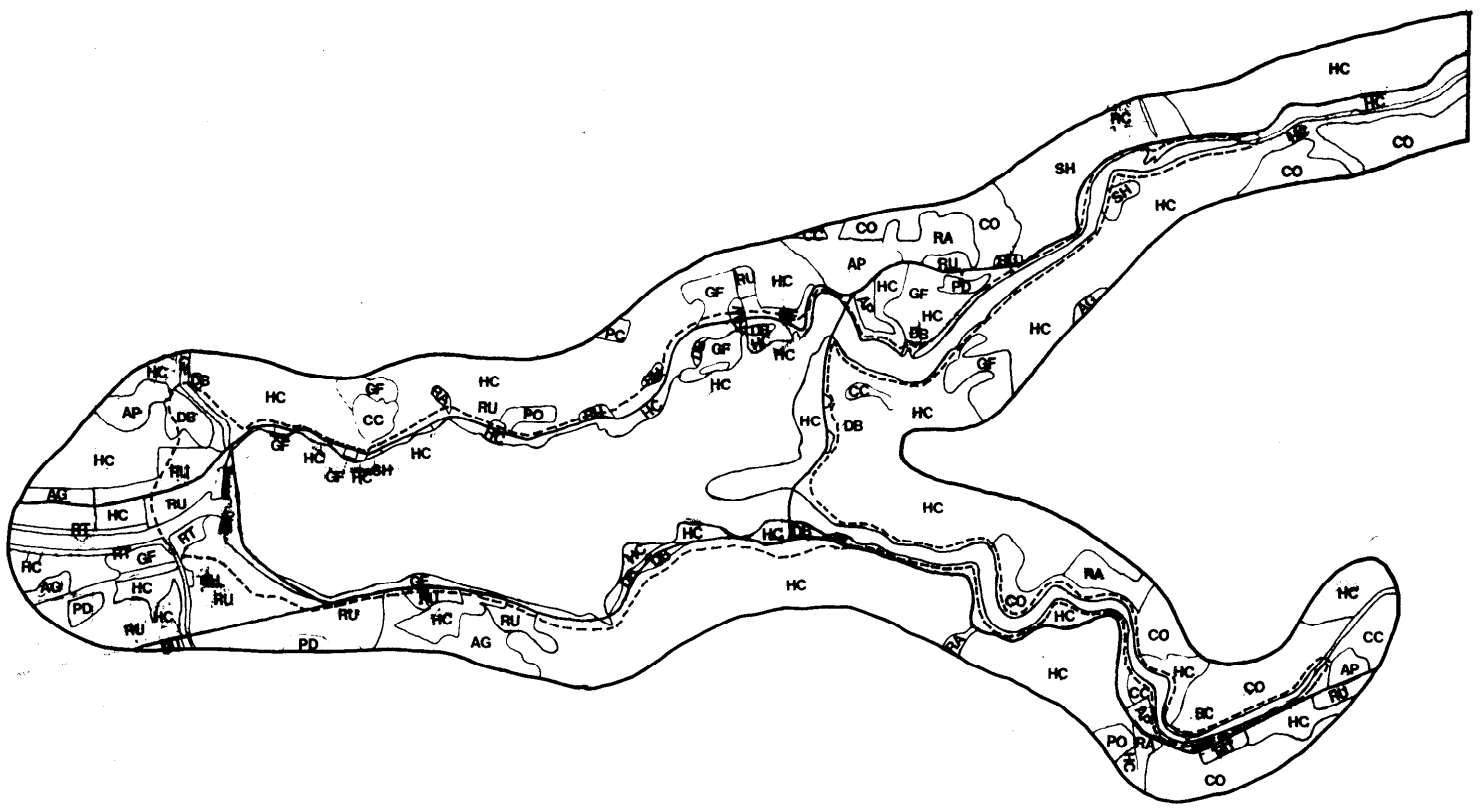
Vegetation cover types of the Foster Reservoir area: postconstruction, 1972.

PO	Temperate conifer forest, open pole	RS	Riparian shrubs
PC	Temperate conifer forest,closed pole	RT	Riparian trees
co	Temperate conifer forest, open	SC	Sand/gravel/cobble
CC	Temperate conifer forest, closed	RC	Rocky cliffs/talus
HO	Conifer-hardwood forest,open	RU	Residential/urban/industrial
HC	Conifer-hardwood forest,closed	AG	Agricultural cropland
RA	Red alder	AP	Agricultural pasture
SH	Shrubland	DB	Disturbed/bare
GF	Grass-forb	PD	Pond
HW	Herbaceous wetland		River

------ Affected area

N

Figure 2



Vegetation cover types of the Foster Reservoir area: recent, 1979.

PO	Temperate conifer forest, open pole	RS	Riparian shrubs
PC	Temperate conifer forest,closed pole	RT	Riparian trees
co	Temperate conifer forest, open	SC	Sand/gravel/cobble
cc	Temperate conifer forest, closed	RC	Rocky cliffs/talus
HO	Conifer-hardwood forest,open	RU	Residential/urban/industrial
HC	Conifer-hardwood forest,closed	AG	Agricultural cropland
RA	Red alder	AP	Agricultural pasture
SH	Shrubland	De	Disturbed/bare
GF	Grass-forb	PD	Pond
HW	Herbaceous wetland		River

----- Affected area

N

Figure 3

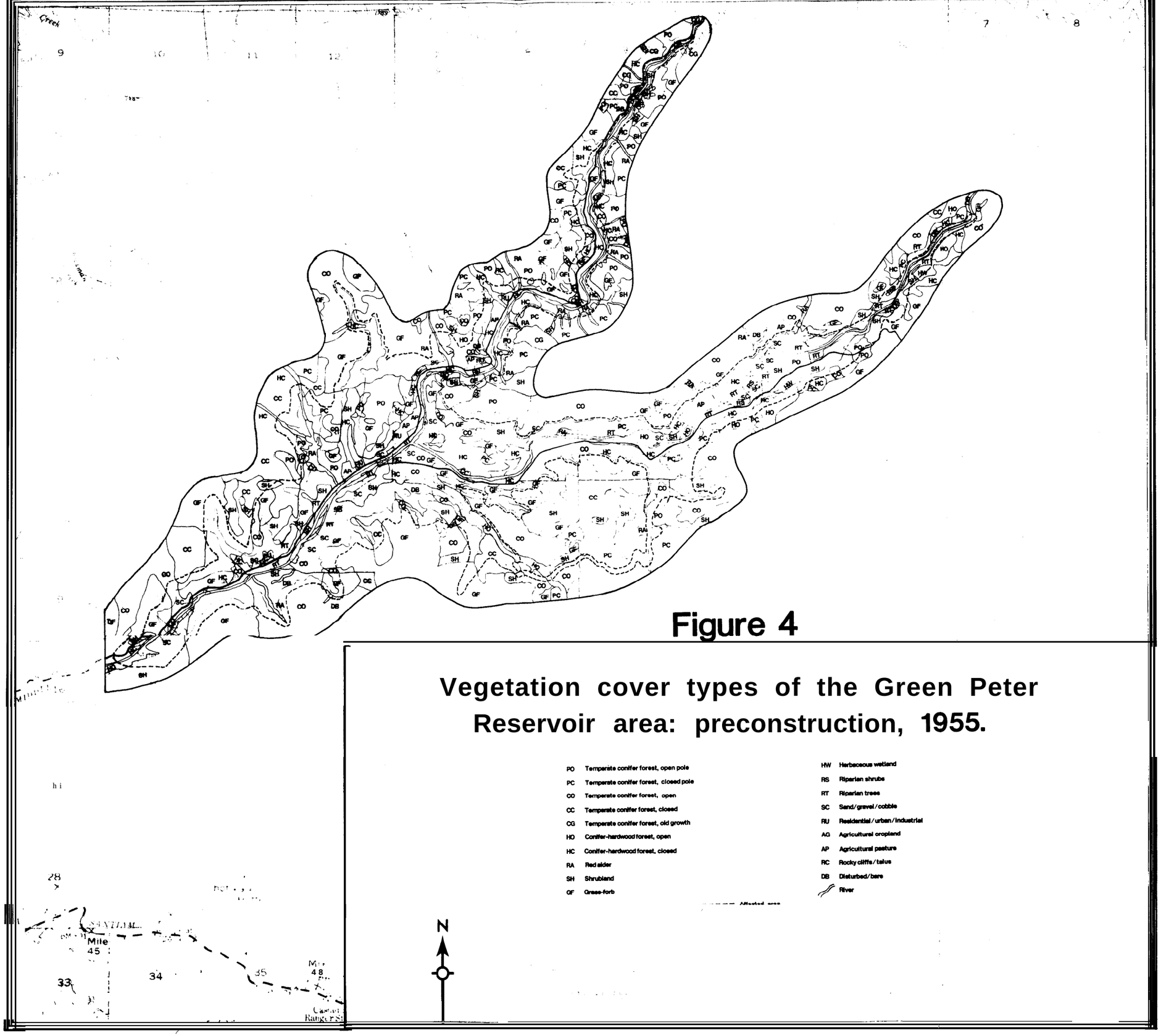


Figure 4

Vegetation cover types of the Green Peter Reservoir area: preconstruction, 1955.

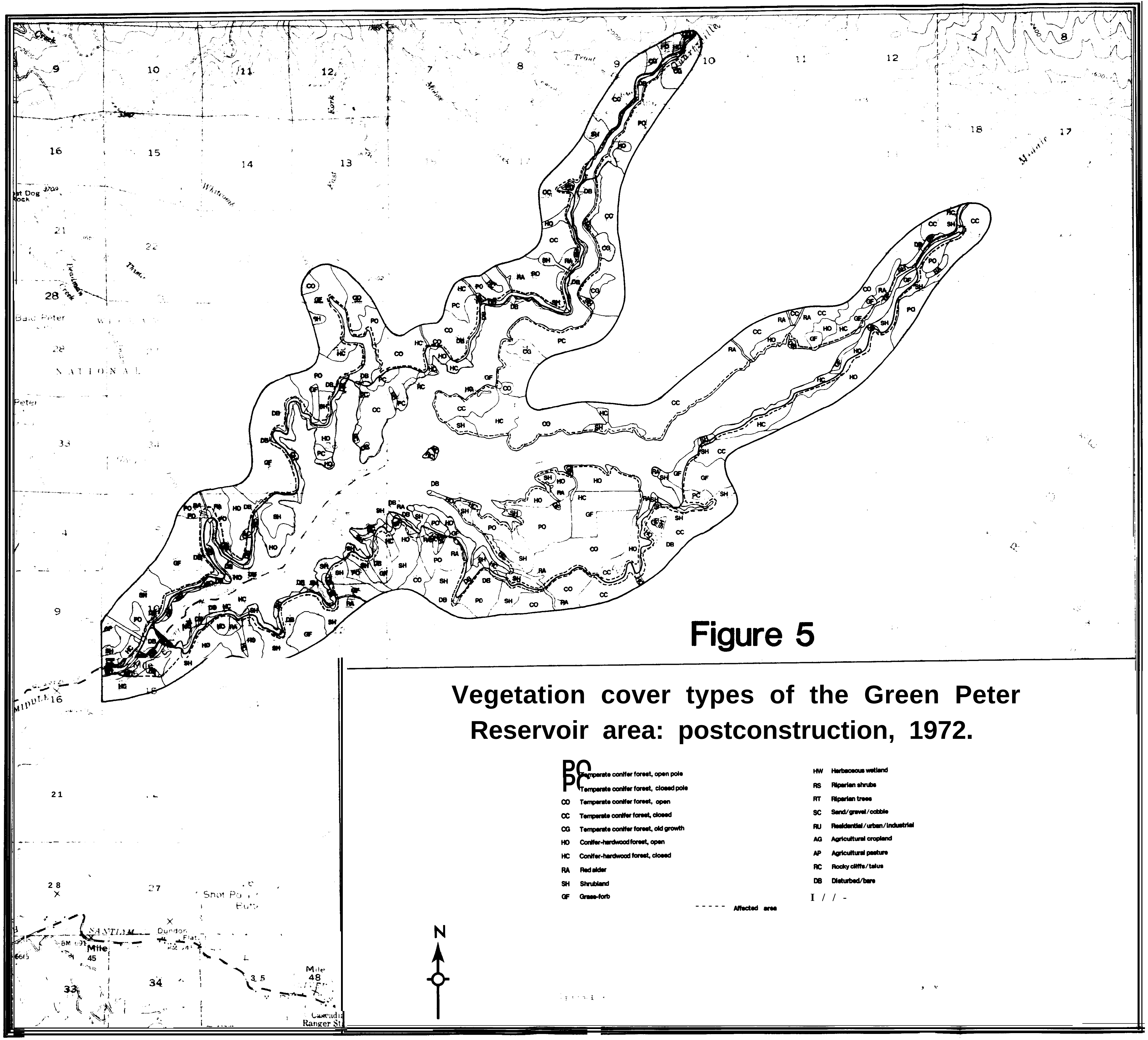


Figure 5

Vegetation cover types of the Green Peter Reservoir area: postconstruction, 1972.

PO	Temperate conifer forest, open pole	HW	Herbaceous wetland
PC	Temperate conifer forest, closed pole	RS	Riparian shrubs
CO	Temperate conifer forest, open	RT	Riparian trees
CC	Temperate conifer forest, closed	SC	Sand/gravel/cobble
CG	Temperate conifer forest, old growth	RU	Residential/urban/industrial
HO	Conifer-hardwood forest, open	AG	Agricultural cropland
HC	Conifer-hardwood forest, closed	AP	Agricultural pasture
RA	Red alder	RC	Rocky cliffs/talus
SH	Shrubland	DB	Disturbed/bare
GF	Grass-forb		I / / -

- - - - - Affected area

N

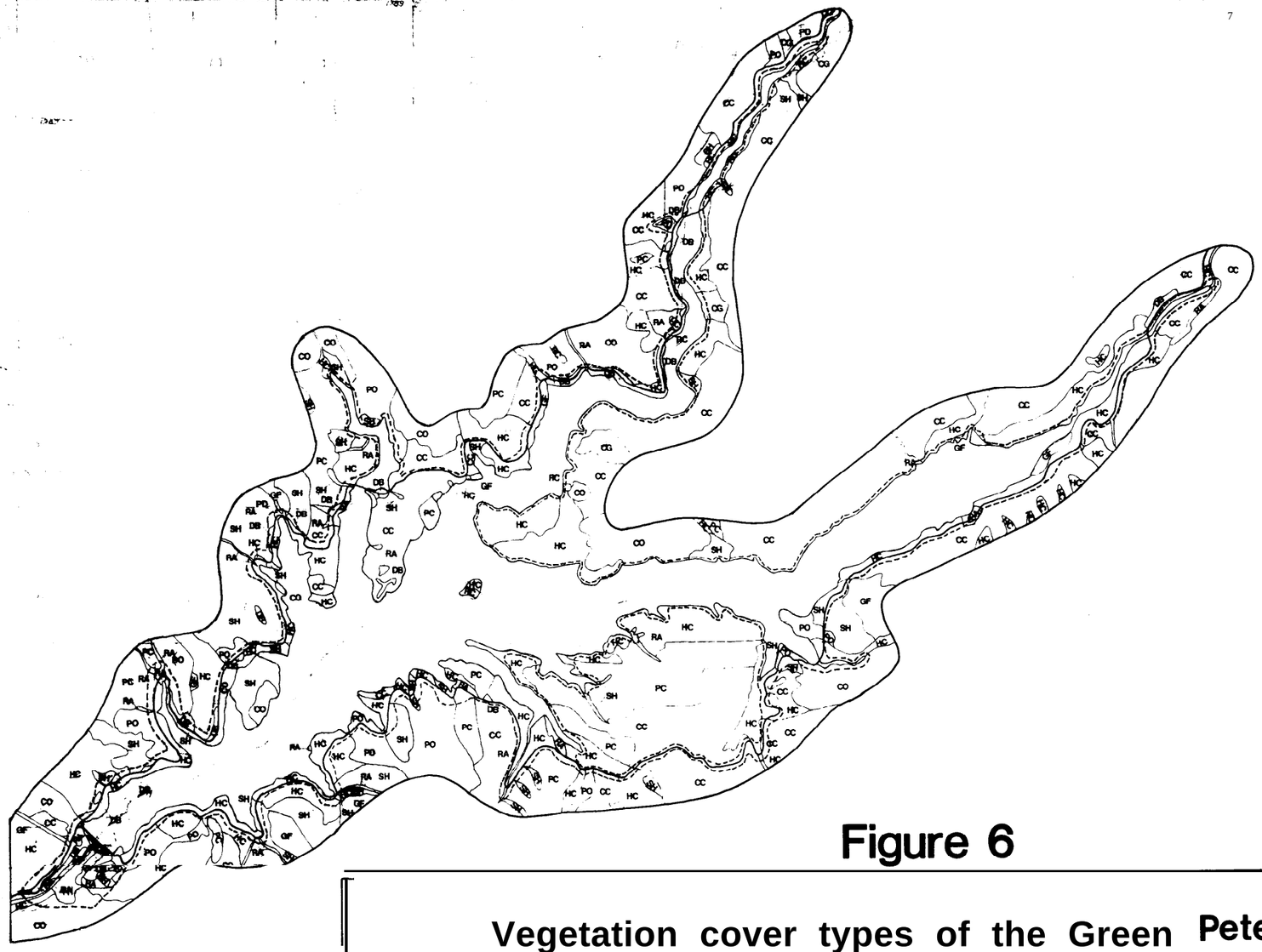


Figure 6

Vegetation cover types of the Green Peter Reservoir area: recent, 1979.

PO Temperate conifer forest, open pole
PC Temperate conifer forest, closed pole
CO Temperate conifer forest, open
CC Temperate conifer forest, closed
CG Temperate conifer forest, old growth
HO Conifer-hardwood forest, open
HC Conifer-hardwood forest, closed
RA Red alder
SH Shrubland
GF Grass-forb

HW Herbaceous wetland
RS Riparian shrubs
RT Riparian trees
SC Sand/gravel/cobble
RU Residential/urban/industrial
AG Agricultural cropland
AP Agricultural pasture
RC Rocky cliffs/talus
DB Disturbed/bare
River

----- Affected area

N

The Foster Project totals approximately 2,111 acres, with 916 acres above maximum conservation pool (USACE 1981). Ninety-one acres are designated for project operations (K. Beck, USACE, pers. commun.).

Lands adjacent to the Green Peter-Foster Project, other than BLM lands, are privately owned and either residential or managed for logging, agriculture, or recreation (BLM 1979).

III. METHODS

A. Consultation and Coordination

A list of agencies and their representatives interested in participating in the consultation/coordination process was developed and updated throughout the study. Parties on this list received correspondence informing them of the project effort and of consultation/coordination meetings. Participating agencies and individuals were contacted by phone or in person repeatedly throughout the study. Meeting minutes, draft species lists, target species lists, vegetation cover type descriptions, acreage tables, habitat rating system descriptions, and sections of the draft report were provided to those agencies and individuals expressing interest in the loss assessment. Study procedures, the species list, target species, vegetation mapping, and report drafts were discussed at meetings and comments were requested and documented. Interested agencies were represented by participants in the habitat rating process (see Section 1II.E.).

B. Vegetation Cover Type Mapping

Preconstruction, postconstruction, and recent vegetation cover types of the Green Peter-Foster Reservoir areas were mapped from 1955, 1956, 1958, 1972, 1976, and 1979 aerial photographs obtained from USACE in Portland. The 1979 photographs were both black and white and color infrared; the remainder were black and white. Scales varied from 1:4,800 to 1:48,000. Most of the mapping was derived from the 1955, 1972, and 1979 aerial photographs, with the 1958 and 1976 photographs used to obtain coverage of areas not included in the other sets. The base map was derived from 1:62,500 USGS quadrangle maps, enlarged to 1:24,000 and screened on mylar film. The area mapped extended l/4 mile from the full reservoir shoreline. Vegetation cover types were based on categories described by Hall et al. (1985) and are described in Section IV.A.l.

The aerial photographs were examined under a stereoscope, and areas of discernibly similar vegetation cover were outlined (polygons) and labeled with a symbol designating cover type. These designations were checked against forest cover type maps obtained from the Salem District of the BLM (where applicable) and photographs taken during an initial site reconnaissance. The polygons on the overlays were then transferred to the base map using a camera lucida and by matching known landmarks, and slope, ridge and valley topography. Some areas along the postconstruction map edge were not covered by aerial photography, so they were mapped by extrapolation from the vegetation observed there on preconstruction and recent aerial photographs.

The recent maps were ground truthed on 5 August 1985. General cover type categories designated on the maps were visually verified and necessary changes were made to the draft recent maps, then to postconstruction and preconstruction maps. All maps were then finalized and traced onto mylar overlays to the base map. A boundary including only the area directly affected by the project was determined from analysis of the aerial photographs and vegetation maps, and was drawn on the base map. Acreages of map categories within the affected area were calculated from blackline reproductions of the three maps, using the known area of the reservoir as a basis for assigning acreages to polygons. A digital planimeter was used to calculate areas of the polygons from which acreages were calculated. Polygon areas among the three maps agreed within 2%, and the area of the reservoir surface differed among the three maps by only 3%, indicating good accuracy had been obtained.

C. Literature Review and Interviews

ODFW, USFWS, and BLM files were examined for wildlife/habitat information relevant to the Green Peter-Foster Project area. An extensive review of journal articles was conducted to locate research findings pertinent to the project area. Much of the available information on the status of wildlife populations during the preconstruction and postconstruction periods was identified in a status report on wildlife mitigation at the Green Peter-Foster Project (Bedrossian et al. 1984). Interviews were conducted with ODFW, USFS, USFWS, and BLM biologists, and other individuals knowledgeable of wildlife/habitat conditions in the project area.

D. Target Species

Wildlife species potentially occurring in the project area (Appendix A) were identified based on a list of wildlife in the Willamette National Forest (USFS undated), BLM Unit Resource Analysis (BLM 1979), and on the Oregon nongame wildlife management plan review draft (Marshall 1984). From these lists, target species were selected based on factors such as threatened or endangered status, priority according to State or Federal programs, recreational or economic importance, or degree of impacts resulting from the project. Target species selected represent a cross-section of species groups (species that have similar habitat requirements) affected by the project and were used to evaluate the losses or gains in the potential of the project area to support wildlife.

E. Impact Analysis

The method used to aid in evaluating the loss or gain of wildlife habitat as a result of the Green Peter-Foster Project was based on the "Habitat evaluation procedure" developed by USFWS (1976, 1980), and "Ecological planning and evaluation procedures" developed by the Joint Federal-State-Private Conservation Organization Committee (1974). Personnel from USFWS, USACE, USFS, and ODFW participated in the development of this analysis method.

The acres of cover types potentially used within the affected area were totaled to determine the acres of habitat available to each target species at preconstruction, postconstruction, and recent time periods. Tables summarizing the cover types and acreages available to each target species were compiled. Habitat rating criteria worksheets providing information on habitat requirements were prepared for each target species and are available from ODFW. The worksheets provided a standard from which ratings were based.

Participating agencies designated individuals with expertise in the project area and/or target species to attend the habitat rating meeting (Appendix B). Each person was provided with habitat rating criteria worksheets, drafts of the background information sections of the loss statement report, and tables of cover type acreages. Cover type maps and aerial photos were available and were consulted frequently during the rating session. The habitat rating group spent one day touring the project area, looking at habitat that was similar to that altered by the project, and discussing preconstruction, postconstruction, and present habitat conditions as well as target species. Acres of habitat available for each target species were agreed upon at the rating session based on cover types, location, and other factors (e.g., forest stand condition) which might indicate whether an area was used as habitat. Once the amount of available habitat was identified, the quality of the habitat at preconstruction, postconstruction, and recent time periods was rated on a scale of 1 to 10 (l=low quality habitat, 5=average quality habitat, lO=optimum habitat) for each target species. Ratings were derived from the site visit, aerial photographs, vegetation maps, habitat requirements of the target species, and biologists' expertise. Reasons for assigning each rating were documented and are discussed in this report. Factors other than hydroelectric development and operation that may have influenced the value of the habitats were considered but did not affect the assigned ratings unless otherwise noted in the text of this report.

The ratings for each target species at each time period were divided by the optimum habitat value (10) to provide a habitat suitability index. The habitat suitability index was then multiplied by the number of acres of habitat available to that species at that time period to determine habitat units (HU's) available. HU's provide a relative index of the importance of the habitat to that particular species. One HU is equal to one acre of optimum quality or prime habitat for that species.

HU's available to each target species prior to project construction were subtracted from available postconstruction HU's to determine the loss or gain in the potential of the habitat to meet the requirements of each target species as a result of project construction. Preconstruction HU's also were subtracted from recent HU's to determine the loss or gain in the potential of the habitat to support the target species 7 years after project construction. When the number of HU's lost or gained at postconstruction was different from the number of HU's lost or gained at the recent time period, the reason for the difference (such as revegetation of an area that was disturbed during construction) was determined and documented. The HU's lost or gained represent the change in the potential of the habitat to support the given species at one

point in time. That potential, however, was lost or gained over the entire life of the project. To simplify the loss statement and loss/gain accounting process, the loss or gain at the recent time period was used in the report summary.

Other factors, such as density estimates, impacts not directly affecting habitat quality, and impacts resulting from other causes, were analyzed when information was available and are discussed in the text of this report. Losses incurred were considered relative to benefits.

IV. RESULTS AND DISCUSSION

A. Vegetation cover Types

1. Descriptions

Nineteen vegetation cover or land use types and 3 aquatic types were identified in the Green Peter-Foster Project area. Acreages within the affected area were calculated for each (Tables 1 and 2). The most abundant vegetation in the preconstruction Green Peter Reservoir area was coniferous forest. It was divided into 5 vegetation cover types: open and closed pole, open and closed sawtimber, and old-growth. The major tree species in all 5 was Douglas-fir. Western hemlock was an important component, and there were various inclusions of western red cedar, bigleaf maple, red alder, and madrone, depending on moisture, slope, aspect, elevation, soils, and past disturbance. Crown closure and trunk diameter were the criteria used in distinguishing among the 5 conifer types.

a. Temperate conifer forest, open pole

Open pole stands, as described by Hall et al. (1985), are those where trees are taller than 10 feet, trunk diameter is less than 9 inches, and canopy cover is less than 60%. In this study, the assignment of this category and that of closed pole was made more on the basis of small trees versus large trees, since it was impossible to know trunk diameter of trees in stands existing in the past. Open stands, where trees were obviously young and appeared to be somewhat larger than tall shrubs, were mapped as open pole stands. Ground cover was sparse and comprised of mostly low shrubs and herbs. Open pole stands accounted for about 4% of the Green Peter-Foster affected area before construction and less than 1% after construction.

b. Temperate conifer forest, closed pole

Stands of closed pole conifer forest had crown closure greater than 60%. Understory vegetation was sparse or lacking due to the closed canopy. Closed pole stands accounted for about 4% of the vegetation of the Green Peter affected area before construction and about 1% after construction.

Table 1. Acreages of cover types within the affected area[1] during preconstruction, postconstruction, and recent conditions, Green Peter Reservoir, Oregon.

Vegetation Cover Type/Map Category	Pre Construction (1955)	Post Construction (1972)	Recent (1979)	Loss or gain (-,+) Pre to Post-construction	Pre to Recent
	Acres	Acres	Acres		
Temperate conifer forest, open pole	330	78	149	-252	-181
Temperate conifer forest, closed pole	254	76	88	-178	-166
Temperate conifer forest, open sawtimber	819	60	106	-759	-713
Temperate conifer forest, closed sawtimber	316	255	408	-61	+92
Temperate conifer forest, old-growth	8	8	6	0	-2
Conifer-hardwood forest, open	188	331	0	+143	-188
Conifer-hardwood forest, closed	792	199	717	-593	-75
Red alder	114	67	134	-47	+20
Shrubland	799	372	217	-427	-582
Grass-forb	1,470	147	41	-1,323	-1,429
Herbaceous wetland	12	0	0	-12	-12
Riparian shrub	14	0	0	-14	-14
Riparian hardwood	159	0	0	-159	-159
Sand/gravel/cobble	32	0	0	-32	-32
Residential/urban/ industrial	45	0	0	-45	-45
Agricultural pasture	188	0	0	-188	-188
Rocky cliffs/talus	7	17	10	+10	+3
Disturbed/bare	255	792	527	+537	+272
Ponds	0	8	7	+8	+7
River	227	14	14	-213	-213
Reservoir	0	3,605	3,605	+3,605	+3,m
TOTAL	6,029	6,029	6,029		

1 The "affected area" was the area directly affected by project construction and operation, and included the reservoir, project facilities, staging areas, and relocated roads.

Table 2. Acreages of cover types within the affected area[1] during preconstruction, postconstruction, and recent conditions, Foster Reservoir, Oregon.

Vegetation Cover Type/Map Category	Pre Construction (1955)	Post Construction (1972)	Recent (1979)	Loss or gain (-,+) Pre to Post-construction	Loss or gain (-,+) Pre to Recent
	Acres	Acres	Acres		
Temperate conifer forest, open pole	1	0	0	-1	-1
Temperate conifer forest, open sawtimber	19	10	15	-9	-4
Temperate conifer forest, closed sawtimber	5	2	1	-3	-4
Conifer-hardwood forest, open	259	42	0	-217	-259
Conifer-hardwood forest, closed	282	196	288	-86	+6
Red alder	1	6	0	+5	-1
Shrubland	189	3	3	-186	-186
Grass-forb	28	24	59	-4	+31
Herbaceous wetland	0	2	2	+2	+2
Riparian hardwood	113	0	9	-113	-104
Sand/gravel/cobble	51	0	1	-51	-50
Residential/urban/ industrial	137	43	84	-94	-53
Agricultural cropland	423	7	0	-416	-423
Agricultural pasture	60	3	2	-57	-58
Disturbed/bare	100	294	168	+194	68
River	176	17	17	-159	-159
Reservoir	0	1,195	1,195	+1,195	+1,195
TOTAL	1,844	1,844	1,844		

1 The "affected area" was the area directly affected by project construction and operation, and included the reservoir, project facilities, staging areas, and relocated roads.

c. Temperate conifer forest, open sawtimber

Open temperate conifer stands comprised about 11% of the Green Peter-Foster affected area prior to construction, and less than 1% after construction. They were more abundant than that, however, within the entire study area. Most of the open sawtimber stands within the affected area had well-developed understories, with Oregon grape, vine maple, salal, and seedling trees among the more common understory vegetation. Occasional inclusions of what appeared to be remnants of old-growth timber, most of which consisted of scattered trees standing well above the existing stands, were included in this map category. Large stumps were evidence of past logging. Crown closure was less than 70%.

d. Temperate conifer forest, closed sawtimber

Crown closure in stands of closed sawtimber was greater than 70%, except where inclusions of open sawtimber were too small to map. Understory vegetation consisted of seedling western hemlock, Oregon grape, vine maple, and other shade tolerant species. The Green Peter-Foster affected area consisted of 10% closed sawtimber stands before construction and about 5% after construction.

e. Temperate conifer forest, old-growth

It was evident on 1955 aerial photographs that extensive logging had taken place over a long period throughout both the Green Peter and Foster Reservoir areas. The only old-growth timber remaining within the affected area was in the Green Peter Reservoir area on the Quartzville Creek Arm. Old-growth stands were characterized by decay, numerous snags, canopy openings, and abundant dead and down woody material. Overstory trees were large, usually greater than 21 inches in diameter, and the tree canopy often consisted of 2 or more stories (Hall et al. 1985). Old-growth comprised less than 1% of the Green Peter-Foster Project area both before and after construction.

f. Conifer-hardwood forest, open

Most of the forests in the Foster Reservoir area were mixtures of conifers and hardwoods, with the latter contributing 30-70% of total crown cover. Red alder was the most common hardwood, although bigleaf maple and madrone were also present. Conifer-hardwood forest accounted for 14% of the total vegetation cover within the Foster affected area and 3% within the Green Peter affected area prior to construction, but only 3% and 5X, respectively, immediately after construction.

9. Conifer-hardwood forest, closed

Like the open conifer-hardwood forest, these were stands of mixed hardwoods and conifers. They occurred along steep river and creek shorelines as well as on hillsides. For the most part, they did not appear to be stable communities, but represented a seral stage in the development of conifer forest. Within the study area, red alder apparently competed very well with Douglas-fir in the early stages of regrowth,

particularly on lower river terraces and gently sloping hillsides. Douglas-fir would eventually overtop the red alder, giving a stand the appearance on aerial photographs of being nearly pure conifer. The Foster affected area contained less than 15% closed conifer-hardwood forest before construction and 11% after construction, while the Green Peter affected area was comprised of 13% closed conifer-hardwood forest prior to construction and 3% after construction.

h. Red alder

Scattered stands of red alder were common within the Green Peter-Foster affected area, comprising about 2% of the vegetation before construction and less than 1% after construction. These stands occurred along steep water courses, on the lower river terraces before construction, as well as in areas recovering from disturbance. Red alder stands were distinguished from riparian stands by location in relation to the river or by topography, since riparian hardwood stands were also often dominated by red alder. Hall et al. (1985) distinguished between red alder (dryland) stands and red alder riparian stands by the presence of water. In this study, where red alder occurred adjacent to rivers or on lower reaches of tributary streams where slopes were slight to moderate, it was mapped as riparian; where it occurred along the reservoir, on higher, steeper streambanks, terraces or hillsides, and in narrow steep valleys, it was mapped as red alder. Red alder stands often included Douglas-fir and other conifers, but conifers did not contribute substantially to canopy cover. Bigleaf maple was also a common component of red alder stands, and black cottonwood occurred frequently but not abundantly in these stands. In all cases, however, red alder comprised at least 70% of the canopy.

i. Shrubland

The Green Peter-Foster affected area contained 12% shrubland before construction and less than 5% after construction. Shrub communities had 40% or more woody crown cover, but woody vegetation was less than 15 feet tall (Hall et al. 1985). Most shrub communities were dominated by seedling conifers and were a seral stage in the regeneration of the temperate conifer forest.

j. Grass-forb communities

Most of the grass-forb communities mapped in the Green Peter-Foster study area were regenerating clear-cuts and were the first stage in revegetation of disturbed areas. Those communities downslope of the roads around the reservoir were cleared as part of construction activities and were dominated by weedy species thereafter. Grass-forb communities along transmission line corridors were subject to vegetation management practices which prevented normal successional changes. Woody plant cover was less than 40% (Hall et al. 1985), and tree seedlings were usually present. A few grass-forb communities were in forest clearings or rocky outcrops and generally lacked tree seedlings or shrubs. Most of these were probably stable communities where shallow soil or other environmental factors contributed to maintenance of the grass-forb community. The grass-forb cover type comprised 19% of the

affected area prior to construction, 2% directly after construction, and less than 1% in 1979.

k. Herbaceous wetland

Two herbaceous wetlands were identified on preconstruction aerial photographs of the Green Peter Reservoir area. They appeared to be wet or subirrigated meadows and as such were probably dominated by sedges, rushes, and grasses. One herbaceous wetland apparently developed in a pasture adjacent to the road along the north shore of Foster Reservoir after the reservoir was filled. It did not appear on preconstruction aerial photographs. Herbaceous wetlands comprised less than 1% of the affected area before and after construction.

1. Riparian shrub

This map category was restricted to shrubby areas along the streams and on sand and gravel bars. It comprised less than 1% of the Green Peter-Foster affected area both prior to and after construction. Vegetation consisted of seedling willow, black cottonwood, and red alder, with scattered herbaceous cover. Many of the riparian shrub stands should be considered ephemeral, as they occurred where high water could erode them before they had a chance to develop into tree communities. A few stands might endure to develop into riparian hardwood communities, depending on flood frequency and channel changes.

m. Riparian hardwood

Red alder and conifer-hardwood forest, where they occurred along stream banks, were designated as riparian hardwood communities. Black cottonwood and bigleaf maple were usually present in the Foster Reservoir area, but both were less common in riparian stands within the Green Peter Reservoir area. Before construction, extensive stands of riparian hardwoods were found along both the South Santiam River and Quartzville Creek, accounting for 6% of the vegetation of the Foster affected area and 3% of the Green Peter affected area. After construction, very few stands of riparian hardwoods remained (less than 1% of both affected areas) and those were mostly below Foster Dam.

n. Sand/gravel/cobble

These areas occurred along the river and lower reaches of the larger tributary streams and were probably under water during spring runoff and other periods of high water, They may have supported sparse herbaceous growth, but did not show signs of being heavily vegetated on aerial photographs. Many sand/gravel/cobble bars were too small to map, and their total extent was probably less than 5 acres. They comprised about 1% of the affected area prior to construction and less than 1% after construction.

o. Residential/urban/industrial

This map category includes the town of Foster, rural residences and outbuildings, and industrial areas such as sawmills and log scaling stations.

p. Agricultural croplands

The agricultural lands within the Foster and Green Peter Reservoir areas were generally confined to lower river terraces before the dams were constructed. Some small orchards were mapped with residential or agricultural croplands because they seldom consisted of more than a few trees and were too small to map separately. Agricultural cropland comprised 23% of the Foster affected area before construction, and less than 1% after construction.

Q. Agricultural pasture

Pastures were distinguished from croplands by the presence of trees or shrubs, and the lack of obvious evidences of regular cultivation. They often occurred on steeper slopes than did the cultivated croplands. Pastures accounted for 2% of the Green Peter affected area before construction; none remained after construction.

r. Rocky cliffs/talus

Only a few of the many rocky cliffs within the Foster and Green Peter Reservoir areas are shown on the maps. This is because they are extremely steep and do not show in vertical projection. Talus slopes generally occurred where seasonal runoff cut into steep hillsides, leaving paths free of vegetation, or where wave action had caused slumping of steep banks along the reservoir shoreline.

s. Disturbed/bare areas

This map category included disturbance caused by construction of the Green Peter and Foster Dams and Reservoirs, as well as other areas where human disturbance altered the landscape. Most of the latter were along roads or near developed areas. The Green Peter-Foster affected area contained about 5% of this map category prior to construction, nearly 14% directly after construction, and 9% in 1979.

t. Ponds

Two industrial ponds were located within the town of Foster. A third was at the site of a fish hatchery just upstream of the confluence of the South and Middle Santiam Rivers (it did not appear on preconstruction aerial photographs). Two small ponds resulted from road relocation related to construction of Green Peter Reservoir. One of these, on the Thistl Creek embayment, is apparently filling with sediment and developing into a herbaceous wetland. The other is at the outlet of Moose Creek.

u. River

The area in this category included the South Santiam and Middle Santiam Rivers as well as Quartzville Creek. Other tributaries were too narrow to show up on the map and/or aerial photographs. River comprised over 5% of the Green Peter-Foster affected area prior to construction, but less than 1% after construction.

v. Reservoir

The area mapped as reservoir included the full pool level of each reservoir. During lower water levels at Green Peter, the drawdown zone (with a maximum vertical range of 88 feet) is exposed. Fluctuating water levels at Green Peter have not been conducive to the establishment of vegetation within this zone. Except for 20 acres on the Middle Santiam arm seeded to ryegrass, the drawdown zone is barren during low water levels. Under normal conditions, the daily water level fluctuation range at Foster is 2 feet or less. Green Peter Reservoir makes up 60% of the Green Peter affected area, and Foster Reservoir makes up 65% of the Foster affected area.

2. Changes resulting from the project

Green Peter and Foster Reservoirs inundated 4,800 acres. The actual land base lost was, of course, greater than the reservoir surface acreage. Over 5 miles of the South Santiam River, 7.5 miles of the Middle Santiam River, 6.5 miles of Quartzville Creek, and an undetermined number of miles of tributary streams were inundated (USFWS 1961; USACE 1967a, 1970, 1982). Surrounding land was altered by relocated roads, project facilities, and construction activities. Cover types reduced in acreage were open and closed pole conifer forest, riparian shrub and hardwood, open sawtimber conifer forest, open conifer-hardwood forest, shrubland, sand/gravel/cobble, and river (Tables 1 and 2). Considerably more grass-forb (1,398 acres) was eliminated than any other cover type. Approximately 770 acres of shrubland habitat was lost. Over 80 acres of riparian shrub and hardwood stands were eliminated within the area directly affected by the Green Peter-Foster Project. Riparian vegetation associated with rivers and streams is considered to be of importance by wildlife managers. Riparian habitat is generally thought to provide for higher density and diversity of wildlife than most other habitats. In addition, a reduction of riparian habitat downstream from the project may have occurred as a result of the project and/or effects of the Willamette Reservoir System. The effects of the loss of the previously mentioned cover types within the area directly affected by the project is discussed in greater detail in the Target Species sections of this report.

Cover types which increased within the affected area included the reservoir, disturbed/bare, closed sawtimber conifer forest, and red alder. As a result of natural revegetation and succession during the years following project construction, shrubland, open pole and sawtimber conifer forest, disturbed/bare, and grass-forb cover types developed into open and closed pole, open and closed sawtimber conifer forest, closed conifer-hardwood forest, and red alder on about 964 acres of the area surrounding the reservoir.

Changes have occurred in the Willamette Basin since the time of project construction as a result of increased timber harvest and increased human development. Extensive logging occurred in the project area prior to 1955 and less than 1% of the Green Peter-Foster affected area was old-growth conifer forest. It was not possible to estimate how much of the area directly affected by the project might have been relogged if the

project had not been constructed. The majority of property adjacent to the project is privately owned and lands upstream from Green Peter Reservoir on the Middle Santiam River have been extensively clearcut. BLM land use allocations designate 7,260 acres on the Green Peter peninsula as potential recreation lands (BLM 1983). BLM lands in the Quartzville Creek corridor are withdrawn from harvest as fragile, or designated 100-year rotation, with specific harvest criteria. BLM units on the upper portion of the Quartzville Creek arm of the reservoir are labeled older forest and, as stream buffers, are not programmed for harvest (BLM 1983; W. Logan, BLM, pers. commun.). It is not possible to say how management of the area would have been different without the project. The potential to manage the area for wildlife would still exist if the project had not been constructed. Because the project was constructed, the potential for the inundated area to support many species of wildlife was eliminated.

B. Target Species

1. Roosevelt elk

a. Importance

The Roosevelt elk is a major big game species in western Oregon. Approximately 51,216 hunters participated in seasons for Roosevelt elk in 1983. The Santiam Wildlife Management Unit, in which the project is located, provided 22,153 hunter-days of recreation during the 1983 elk hunting seasons (Ingram 1984). Roosevelt elk require a variety of habitat types for survival, from open areas to old-growth forest (Witmer et al. 1985). The Roosevelt elk was chosen as a target species for this study because of management emphasis, recreational value, loss of critical winter range due to the project, and to represent other species with similar habitat requirements.

b. Habitat requirements

Open areas such as clear-cuts or burned areas, and natural openings found along streams or in old-growth forests provide elk forage such as grasses, forbs, and shrubs (Mace 1956, Swanson 1970, Cleary 1976, Witmer and decalesta 1983). Critical to elk use of open forage areas is the proximity of cover. Elk use of open areas begins to decrease beyond 200 feet, and decreases rapidly beyond 600 feet from cover (Witmer et al. 1985). Forest stands provide escape cover as well as thermal relief from temperature extremes (Mace 1956; Harper 1966, 1971; Witmer and decalesta 1983). Sapling-pole forests provide security during hunting seasons and thermal relief during the warm summer months (Mace 1956, Witmer and decalesta 1983). Old-growth forests provide reduced snow depths and maintenance forage during severe winter weather in addition to escape and thermal cover (Starkey et al. 1982, Witmer and decalesta 1983, Witmer et al. 1985). Snow depths of 18 inches or more can impede elk movement and bury most forage in forest openings, therefore, old-growth stands are particularly important to elk during winter periods of deep snow (Witmer et al. 1985). Riparian habitats characterized by mixed conifer and hardwood vegetation are important foraging, loafing, traveling and watering areas (Starkey et al. 1982, Witmer and decalesta 1983).

Use of plant species for forage varies with the seasons. Green grasses and forbs are heavily used by Roosevelt elk in spring and summer. Browse species are more important in late summer, fall, and winter (Mace 1956; Harper 1966, 1971). Vegetation use depends upon availability, but several species such as huckleberry, vine maple, salal, ceanothus, willow, and blackberry are important food sources for Roosevelt elk (Mace 1956; Harper 1966, 1971; Swanson 1970; R. Jubber, ODFW, E. Harshman, USFS, pers. communs.).

c. History in the project area

Elk were widespread throughout the Willamette Valley during the 1800's. Settlement and unrestricted hunting had decimated the elk population by 1900 (Mace 1956, Starkey et al. 1982). Beginning in 1905, elk hunting was not permitted in Oregon. By the mid-1930's, elk damage complaints indicated some populations of elk could support a limited harvest season, and in 1938 Roosevelt elk were hunted for the first time since the closure (Mace 1956).

Estimates made of the 1932 Oregon elk population indicated 800 animals in the Cascade Range, and 25 elk within Linn County (Oregon State Game Commission [OSGC] 1933). In 1953, OSGC initiated a program to increase the number and distribution of Roosevelt elk in western Oregon (Mace 1971). By 1967, the estimated Roosevelt elk population of the Willamette Basin was 2,000 animals (Aney 1967). In 1980, it was estimated that 900 elk occupied 1,691 square miles of habitat in Linn County. The increase in elk numbers is mostly attributed to the increase in timber harvest in the Willamette Basin.

Information is limited on elk populations in the project area prior to construction because no counts were made. Elk were rarely observed on project lands prior to construction (N. TenEyck, ODFW, pers. commun.). Well-established elk trails were evident and elk sightings occurred on the Middle Santiam River in the vicinity of the project site during the construction period, however, indicating the importance of the project area to elk (N. TenEyck, ODFW, pers. commun.). More recently, a herd of 10-12 elk has been seen regularly on the upper flats at Green Peter following seeding in 1983 (M. Wolfer, ODFW, pers. commun.). Current ODFW records indicate a herd of about 40 elk use the Middle Santiam River at or near Green Peter Reservoir (N. TenEyck, ODFW, pers. commun.). Approximately 10-15 elk occasionally use that portion of the Middle Santiam between Foster Reservoir and Green Peter Dam during winter (Nichols 1983). Approximately 60 elk are located in the Quartzville Creek drainage above Green Peter Reservoir, and a herd of about 18 elk migrate to the reservoir from Parks Creek to the east (N. TenEyck, ODFW, pers. commun.).

d. Assessment of impact

(1) Green Peter

Prior to project construction, 5,463 acres of open and closed pole, open and closed sawtimber, and old-growth conifer forest, open and closed conifer-hardwood forest, riparian shrub and hardwood, shrubland,

grass-forb, red alder, herbaceous wetland and agricultural pasture cover types were available to elk within the Green Peter affected area (Table 3). The affected area was critical big game winter range, providing a good interspersion of forage and thermal cover on south-facing slopes and river bottomlands. The suitability of the elk range was given a rating of 8 (high) by the interagency evaluation group. Following the impact analyses methods described in Section IILE. the rated value of the habitat (8) was divided by the optimum potential value (10) resulting in a habitat suitability index of 0.8. The habitat suitability index was then multiplied by the number of acres of habitat available (5,463), resulting in a habitat unit (HU) value of 4,370. One HU is equivalent to 1 acre of optimum habitat, therefore, the 5,463 acres of elk habitat within the Green Peter affected area prior to construction were equivalent to 4,370 acres of prime elk habitat.

Upon completion of the Green Peter Project, 1,593 acres of habitat were available to elk within the affected area (Table 3). The greatest losses were of grass-forb, open sawtimber conifer forest and closed conifer-hardwood cover types. The interagency evaluation group rated the suitability of the postconstruction habitat for elk 1 (low). The habitat that remained was of little value to elk. Shoreline banks were steep, the remaining deciduous vegetation provided inadequate winter thermal cover, and the valuable bottomlands were inundated. Project construction activity and associated disturbance reduced elk use of cover and forage sites at the Green Peter Project. The value of the postconstruction elk habitat in the affected area was 159 HU's, a loss of 4,211 HU's from the preconstruction value.

By 1979, 1,866 acres of habitat were available to elk at Green Peter (Table 3). The increase in habitat was due to natural revegetation and seral advancement in the affected area. The value of the habitat was rated 2 (poor) by the evaluation group. Despite the increase in potential habitat, the value remained low because the affected area was composed of narrow tracts of land sandwiched between roads and reservoir, had little forage remaining, and did not provide adequate thermal cover. The value of the elk habitat was 373 HU's, a loss of 3,997 HU's when compared to the preconstruction value of the affected area.

(2) Foster

The Foster affected area contained 1,380 acres of open pole, open and closed sawtimber conifer forest,open and closed conifer-hardwood forest, riparian hardwood, shrubland, grass-forb, red alder, and agricultural cropland and pasture cover types available for elk use (Table 4). These acres were given a suitability rating of 5 (average) by the interagency evaluation team. The project provided important cover and forage areas during severe winters and the riparian vegetation provided a travel corridor; however, the lack of high quality cover, proximity to the town of Foster, and roads made the site only average habitat for elk. The value of the preconstruction elk habitat at Foster was 690 HU's.

Table 3. Roosevelt elk: Acres of habitat available and lost, habitat ratings, and habitat units at Green Peter Reservoir.

Cover Type	Pre Construction (1955)	Post Construction (1972)	Recent (1979)	Loss or gain (-,+) Pre to Post-construction	Loss or gain (-,+) Preconstruction to recent
	Acres	Acres	Acres		
Temperate conifer forest, open pole	330	78	149	-252	-181
Temperate conifer forest, closed pole	254	76	88	-178	-166
Temperate conifer forest, open sawtimber	819	60	106	-759	-713
Tmperate conifer forest, closed sawtimber	316	255	408	-61	+92
Temperate conifer forest, old-growth	8	8	6	0	-2
Conifer-hardwood forest, open	188	331	0	+143	-188
Conifer-hardwood forest, closed	792	199	717	-593	-75
Riparian shrub	14	0	0	-14	-14
Riparian hardwood	159	0	0	-159	-159
Shrubland	799	372	217	-427	-582
Grass-forb	1,470	147	41	-1,323	-1,429
Red alder	114	67	134	-47	+20
Herbaceous wetland	12	0	0	-12	-12
Agricultural, pasture	188	0	0	-188	-188
TOTAL ACRES	5,463	1,593	1,866	-3,870	-3,597
Habitat Rating	8	1	2		
HABITAT UNITS	4,370	159	373	-4,211	-3,997

Upon completion of Foster Dam and Reservoir, 295 acres of elk habitat remained, a loss of 1,085 acres (Table 4). Little vegetation remained for elk and the site was surrounded by roads, resulting in a rating of 1 (low) and a value of 30 HU's. This represents a loss of 660 HU's from the preconstruction value.

A total of 379 acres were available to elk by 1979 (Table 4) but, because little habitat improvement had occurred for elk, the rating remained at 1. This resulted in an increase of 8 HU's from the postconstruction to the recent period, but the 38 HU's available in 1979 were a loss of 652 HU's from preconstruction conditions.

(3) Summary of impacts

The Green Peter-Foster affected area was an important area for elk prior to construction because it provided important cover and forage areas during severe winters. Over 4,500 acres of elk habitat were inundated and over 4,600 HU's lost as a result of construction of the project. The decline in HU's for Roosevelt elk represents a loss in the potential of the project area to support elk and other wildlife species with similar habitat preferences or requirements.

The relocated roads adjacent to Green Peter and Foster Reservoirs carry logging traffic and provide access to recreationists. In addition to the loss or degradation of habitat, these roads can result in increased incidences of road kills, poaching, or disturbance, resulting in greater energy expenditures, or total avoidance of the area by deer and elk.

2. Black-tailed deer

a. Importance

Black-tailed deer are pursued by more hunters than any other big game species in western Oregon. Deer hunting provided 157,205 hunter-days of recreation in the Santiam Wildlife Management Unit during 1983 (Ingram 1984). Black-tailed deer prefer a variety of habitat types, from open areas to old-growth forest (Witmer et al. 1985). With inundation of the Green Peter-Foster Project site, year-round habitat and important deer winter range was lost (USFWS 1961, 1963). The black-tailed deer was chosen as a target species for this study because of management emphasis, recreational value, loss of winter range due to the project, and to represent other species with similar habitat requirements. The black-tailed deer is a major big game species in Oregon and has different specific habitat requirements and preferences than elk, Therefore, the black-tailed deer was selected as a target species in addition to the Roosevelt elk, even though many basic habitat requirements are similar.

b. Habitat requirements

Black-tailed deer are associated with open areas, such as burns, clear-cuts, and natural openings found along streams or in old-growth forests, as well as brush, and edge habitat (Mace 1953, Aney 1967). These areas produce the grasses, forbs, and shrubs upon which deer forage. The

Table 4. Roosevelt elk: Acres of habitat available and lost, habitat ratings and habitat units at Foster Reservoir.

Cover Type	Pre Construction (1955)	Post Construction (1972)	Recent (1979)	Loss or gain (-,+) Pre to Post-construction	Loss or gain (-,+) Preconstruction to recent
	Acres	Acres	Acres		
Temperate conifer forest, open pole	1	0	0	-1	-1
Temperate conifer forest, open sawtimber	19	10	15	-9	-4
Temperate conifer forest, closed sawtimber	5	2	1	-3	-4
Conifer-hardwood forest, open	259	42	O	-217	-259
Conifer-hardwood forest, closed	282	196	288	-86	+6
Riparian hardwood	113	0	9	-113	-104
Shrubland	189	3	3	-186	-186
Grass-forb	28	24	59	4	+31
Red alder	1	6	0	+5	-1
Herbaceous wetland	0	2	2	+2	+2
Agricultural, cropland	423	7	0	-416	-423
Agricultural, pasture	60	3	2	-57	-58
TOTAL ACRES	1,380	295	379	-1,085	-1,001
Habitat Rating	5	1	1		
HABITAT UNITS	690	30	33	-660	-652

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value of these forage areas for deer is dependent upon the proximity to cover. Black-tailed deer remain near the edge between cover and open areas. Deer use of open forage areas increases from the edge to 200 feet, then gradually decreases beyond 200 feet, and decreases rapidly beyond 600 feet from cover (Wilms 1971, Witmer et al. 1985). Hanley (1983) observed peak deer use of open forage areas approximately 550 feet from cover. Old-growth forest stands are used by deer for hiding cover and during adverse weather conditions because supplemental forage and thermal cover are provided (Lindzey 1943, Witmer et al. 1985). Old-growth stands are, therefore, especially important to deer during periods of deep snow when depths of 18 inches or more may impede deer movement and bury most forage in forest openings (Witmer et al. 1985). Riparian zones provide water, forage, and shade, and are used as travel corridors by black-tailed deer. Riparian habitat receives greater use during fawning periods, dry summer months, and times of heavy snowfall (Witmer et al. 1985).

Forage species used by black-tailed deer vary depending on the season and availability. Wallmo (1981) conducted a study west of Corvallis, Oregon, and found that browse species were most frequently used, forb use increased in spring and summer, and grasses were consumed consistently in winter. Browse species such as trailing blackberry, huckleberry, and salal are important to black-tailed deer in the Coast Range (Lindzey 1943; Brown 1961; Miller 1966, 1968; Hines undated). The primary browse for black-tailed deer in the Cascade Range is ceanothus. The most important species of ceanothus are deerbrush, redstem, and snowbrush (R. Jubber, ODFW, pers. commun.).

c. History in the project area

Information on deer populations in the project area prior to construction is limited. The river bottomlands at the Green Peter site were the wintering range for black-tailed deer on the Middle Fork of the Santiam River (Schneider 1969). OSGC estimated 5 deer per square mile occupied the South Santiam River drainage in 1948 (OSGC and Fish Commission of Oregon 1948). The deer population in the Willamette Basin peaked between 1955 and 1960 (Aney 1967). Spring spotlight counts conducted adjacent to the reservoir site from 1965 to 1967, following clearing of the area, averaged 5.8 deer per linear mile. In 1968, the year following inundation, 3.5 deer per linear mile were counted over the same routes (ODFW files).

In 1967, the estimated black-tailed deer population within the Willamette Basin was 135 000 (Aney 1967) ODFW estimated the 1980 black-tailed deer population in Linn County was 31,600. With approximately 1,999 square miles of deer habitat within the county, the estimated 1980 density was 15.8 deer/square mile of habitat (ODFW files). Approximately 15-20 deer summer along the Middle Santiam River between Foster Reservoir and Green Peter Dam, and an estimated 30-40 deer winter in the same area (Nichols 1983).

d. Assessment of impact

(1) Green Peter

As with elk, it was assumed 5,463 acres of habitat were available to deer at the Green Peter site prior to construction (Table 5). The interagency evaluation team gave the affected area a suitability rating of 8 (high). The basin was prime deer habitat just prior to construction, and deer populations on Quartzville Creek were at a peak (N. TenEyck, ODFW, pers. commun.). The river bottomlands were a key area for deer, and provided critical winter range. The area lacked an old-growth component, which kept the rating below optimum yet provided for 4,370 HU's of black-tailed deer habitat.

In 1972, the Green Peter affected area contained 1,593 acres of deer habitat rated 2 (poor) for a value of 319 HU's, a loss of 4,051 HU's from preconstruction conditions (Table 5). Important lowland areas were inundated, and the deciduous vegetation that remained on the south shore provided no winter thermal cover in the windy drainage. Shoreline vegetation was only a narrow strip, and the reservoir banks were steep.

The suitability of deer habitat at Green Peter in 1979 was also rated 2. Although natural revegetation and seral advancement had increased the acreage to 1,866 (Table 5), the quality of habitat had not improved for deer. The recent (1979) habitat available to black-tailed deer was valued at 373 HU's, a loss of 3,997 HU's from the preconstruction period.

According to USFWS (1961), the site provided up to 40% of critical winter range during severe winters. The reservoir created a physical barrier, restricting wildlife movement between feeding and bedding areas (Battelle 1976). The importance of this winter range was demonstrated immediately following inundation, during the severe winter of 1968-69. ODFW biologists observed approximately 50 deer carcasses along the shoreline or adjacent to the reservoir (H. Sturgis, ODFW, pers. commun.). Drowning was believed to be the cause of death (H. Sturgis, ODFW, pers. commun.). No intensive work was done to determine losses, but the total deer losses were suspected to be much greater than observed (H. Sturgis, ODFW, pers. commun.).

(2) Foster

A total of 1,380 acres of habitat were available to black-tailed deer at the Foster site prior to project construction (Table 6). The interagency evaluation team considered this habitat above average and rated it 7, for a value of 966 HU's. The area had a good diversity of vegetation and the cover:forage ratio was almost optimal. It was considered important winter range, but its value was reduced by the proximity of the town of Foster and associated human development, and the disturbance from the roads.

Following construction of Foster Dam and Reservoir, 1,085 acres of deer habitat were lost, leaving 295 acres available within the affected area (Table 6). The remaining habitat was rated 2 (poor) for deer due

Table 5. Black-tailed deer: Acres of habitat available and lost, habitat ratings, and habitat units at Green Peter Reservoir.

Cover Type	Pre Construction (1955)	Post Construction (1972)	Recent (1979)	Loss or gain (-,+) Pre to Post-construction	Loss or gain (-,+) Preconstruction to recent
	Acres	Acres	Acres		
Temperate conifer forest, open pole	330	78	149	-252	-181
Tmperate conifer forest, closed pole	254	76	88	-178	-166
Temperate conifer forest, open sawtimber	819	60	106	-759	-713
Temperate conifer forest, closed sawtimber	316	255	408	-61	+92
Temperate conifer forest, old-growth	8	8	6	0	-2
Conifer-hardwood forest, open	188	331	0	+143	-188
Conifer-hardwood forest, closed	792	199	717	-593	-75
Riparian shrub	14	0	0	-14	-14
Riparian hardwood	159	0	0	-159	-159
Shrublard	799	372	217	-427	-582
Grass-forb	1,470	147	41	-1,323	-1,429
Red alder	114	67	134	-47	+20
Herbaceous wetland	12	0	0	-12	-12
Agricultural, pasture	188	0	0	-188	-188
TOTAL ACRES	5,463	1,593	1,866	-3,870	-3,597
Habitat Rating	8	2	2		
HABITAT UNITS	4,370	319	373	-4,051	-3,997

to the lack of adequate cover and forage, blockage of local migration, and the roads surrounding the reservoir shoreline. This represented a loss of 907 HU's from the preconstruction period, and left 59 HU's for black-tailed deer at postconstruction.

There was a small increase in available acreage from postconstruction to the recent period. The 379 acres of deer habitat available in 1979 (Table 6) were still considered poor and rated 2 by the evaluation team. Although natural revegetation had improved conditions somewhat, the cover:forage ratio was still poor. The available acreage within the affected area was small and the reservoir banks were steep. Parks had been developed on the north side of the reservoir that resulted in increased recreational disturbance. The 76 HU's available to black-tailed deer in 1979 represented a loss of 890 HU's from preconstruction conditions.

(3) Summary of impacts

The Green Peter-Foster Project area was prime habitat for a deer population at its peak. The affected area provided a key survival area during severe winters. Over 4,800 HU's were lost from the preconstruction (1955) to recent (1979) periods and over 4,500 acres of deer habitat were inundated as a result of construction of the Green Peter-Foster Project. The decline in HU's for black-tailed deer at the Green Peter-Foster Project represents a loss in the potential of the project area to support deer and other wildlife species with similar habitat preferences or requirements.

3. River otter

a. Importance

Furbearers documented as using the reservoir sites prior to project construction included river otter, beaver, mink, raccoon, and muskrat (USFWS 1961, 1963). The river otter was selected as a target species for this study because of its economic and recreational value, dependence on aquatic and riparian habitat, loss of habitat as a result of the Green Peter-Foster Project, and to represent other species with similar habitat requirements.

b. Habitat requirements

The river otter is a semiaquatic mammal dependent upon water and its associated riparian habitat for food, cover, and reproduction (LaDue 1935, Mace 1979, Deems and Pursley 1983). River otters use streams and mountain rivers ranging from 3-33 yards wide (Maser et al. 1981, Melquist and Hornocker 1983). During winter, otters seek fast-flowing streams free of ice (Mace 1979). Mudflats, open marshes and swamps, and backwater sloughs are used more often by otters during summer (Melquist and Hornocker 1983).

River otters use abandoned burrows of other animals as den sites (Mace 1979, Rue 1981, Toweill and Tabor 1982). Beaver houses or dens are used most often, but otters also use muskrat houses and dens, nutria dens,

Table 6. Black-tailed deer: Acres of habitat available and lost, habitat ratings and habitat units at Foster Reservoir.

Cover Type	Pre Construction (1955)	Post Construction (1972)	Recent (1979)	Loss or gain (-,+) Pre to Post-construction	Loss or gain (-,+) Preconstruction to recent
	Acres	Acres	Acres		
Temperateconifer forest, open pole	1	0	0	-1	-1
Terrperateconifer forest, open sawtimber	19	10	15	-9	-4
Temperate conifer forest, closed sawtimber	5	2	1	-3	-4
Conifer-hardwood forest, open	259	42	0	-217	-259
Conifer-hardwood forest, closed	282	1%	288	-86	+6
Ripariannardwood	113	0	9	-113	-104
Shrubland	189	3	3	-186	-186
Grass-forb	28	24	59	-4	+31
Red alder	1	6	0	+5	-1
Herbaceous wetland	0	2	2	+2	+2
Agricultural, cropland	423	7	0	-416	-423
Agricultural, pasture	60	3	2	-57	-58
TOTAL ACRES	1,380	295	379	-1,085	-1,001
Habitat Rating	7	2	2		
HABITAT UNITS	966	59	76	-907	-890

and marmot burrows located near water (Mace 1979, Rue 1981, Toweill and Tabor 1982). Dens selected by river otters may be as far as l/2 mile from water (Maser et al. 1981, USFS 1981a), and they are usually renovated and enlarged by the otter (Ingles 1965, Maser et al. 1981). Parturition may occur in the dens or in cavities among roots of trees, brushpiles, thickets of vegetation, under streambanks, or in hollow stumps or logs (Liers 1951, Mace 1979).

Principal food of the river otter is fish (Rue 1981, Toweill and Tabor 1982, Deems and Pursley 1983). They are opportunistic feeders and select those fish species most abundant and/or easiest to catch (Toweill and Tabor 1982, Melquist and Hornocker 1983). Crayfish are an important year-round item in the otter diet (Maser et al. 1981, Toweill and Tabor 1982, Deems and Pursley 1983). In addition to fish and crayfish, the river otter diet includes amphibians, aquatic insects, small mammals, birds and eggs, and carrion. River otters also eat some vegetation such as berries, tubers, pondweeds, algae, and grasses (Sheldon and Toll 1964, Maser et al. 1981, Rue 1981, Toweill and Tabor 1982).

c. History in the project area

Quantitative information on river otter populations in the project area prior to construction was not available. River otters formerly occupied nearly all permanent streams and lakes in Oregon (Mace 1979). Unregulated trapping was permitted until 1913, at which time the Oregon Legislature enacted comprehensive trapping laws for 5 species of furbearers, including river otter (Mace 1979).

River otters still occupy much of their original range but in lesser numbers due to reduced habitat and increased trapping pressure (Aney 1967, Mace 1979). In 1967, the river otter population in the Willamette Basin was estimated at 500 animals (Aney 1967). In 1980 the estimated otter population in Linn County was 145 animals over 291 linear miles of habitat (291 square miles) (ODFW files). The Middle Santiam River between Foster Reservoir and Green Peter Dam probably receives little otter use due to large fluctuations in river flow; however, 4-6 otters may use the area (Nichols 1983).

d. Assessment of impact

(1) Green Peter

The evaluation team assumed 50% of the open and closed conifer-hardwood, and all of the riparian shrub and hardwood, herbaceous wetland, red alder, sand/gravel/cobble, and river cover types within the affected area at Green Peter were available to river otters, for a total of 1,048 acres of river otter habitat prior to project construction (Table 7). The evaluation team rated the suitability of the affected area 8 (high) for otters due to the availability of prey, and the presence of riparian vegetation for cover and denning. Limited productivity of the river prevented it from being optimum for otters. The river otter habitat was valued at 838 HU's prior to construction.

Table 7. River otter: Acres of habitat available and lost, habitat ratings, and habitat units at Green Peter Reservoir.

Cover Type	Pre Construction (1955)	Post Construction (1972)	Recent (1979)	Loss or gain (-,+) Pre to Post-construction	Loss or gain (-,+) Preconstruction to recent
	Acres	Acres	Acres		
Conifer-hard& forest, open	94	166	0	+72	-94
Conifer-hardwood forest, closed	3%	loo	359	-2%	-37
Riparian shrub	14	0	0	-14	-14
Riparian hardwood	159	0	0	-159	-159
Herbaceous wetland	12	0	0	-12	-12
Red alder	114	67	134	-47	+20
Sand/gravel/cobble	32	0	0	-32	-32
Ponds	0	8	7	+8	+7
River	227	14	14	-213	-213
Reservoir*	0	361	361	+361	+361
TOTAL ACRES	1,048	716	875	-332	-173
Habitat Rating	8	1	3		
HABITAT UNITS	838	72	263	-766	-575

* Represents 10% of the reservoir area.

The 716 acres of habitat available to river otters at Green Peter following construction were rated 1 (poor), representing a value of 72 HU's and a loss of 766 HU's from the preconstruction period (Table 7). Ten percent of the reservoir area, used primarily for foraging along the shoreline and in the tributaries, was included for use by otters. The fish prey base had been reduced or eliminated, and the recent disturbance of the shoreline vegetation was still evident.

By 1979, natural revegetation and seral advancement had increased river otter habitat to 875 acres (Table 7). The fish population had become reestablished and provided prey for river otters. Adequate escape cover and denning habitat had become available within the affected area and had recovered well along the tributaries. The recent (1979) river otter habitat was given a rating of 3 (below average) for a value of 263 HU's, a loss of 575 HU's from the preconstruction period.

(2) Foster

The Foster Reservoir site contained 612 acres of river otter habitat within the affected area prior to project construction (Table 8). The evaluation team again reduced the acreage of open and closed conifer-hardwood forest available to river otters by 50% of the total, based on proximity to the river. The habitat was considered above average in suitability and rated 7, for a value of 428 HU's. Anadromous and resident fish were available as prey and cover requirements were met; however, the roads and human development reduced the value.

Following construction of Foster Dam and Reservoir, 264 acres of habitat remained within the affected area for river otters (including 10% of the reservoir area) (Table 8). The fish population was greatly reduced and the disturbed habitat resulted in turbid water conditions. The evaluation team rated the habitat 2 (poor), for a value of 53 HU's and loss of 375 HU's from preconstruction conditions.

The increase in and stabilization of the fish prey base and availability of denning sites resulted in a rating of 3 (below average) for the 293 acres of river otter habitat in 1979 (Table 8). Foster is a shallow, rich reservoir where ODFW rears steelhead; however, the proximity of the town of Foster and recreational disturbance kept the value of the affected area below average. The 88 HU's available to river otters during the recent period were a reduction of 340 HU's from preconstruction conditions.

(3) Summary of impacts

The Green Peter-Foster affected area provided highly suitable escape cover, denning sites, and forage for river otters prior to construction. As a result of construction, 492 acres of river otter habitat and 915 HU's were lost. The decline in HU's for river otters represents a loss in the potential of the project area to support otters and other wildlife species with similar habit requirements.

Table 8. River otter: Acres of habitat available and lost, habitat ratings and habitat units at Foster Reservoir.

Cover Type	Pre Construction (1955)	Post Construction (1972)	Recent (1979)	Loss or gain (-,+) Pre to Post-construction	Loss or gain (-,+) Preconstruction to recent
	Acres	Acres	Acres		
Conifer-hardwod forest, open*	130	21	0	-109	-130
Conifer-harwood forest, cl*osed	141	98	144	-43	+3
Riparian hardwood	113	0	9	-113	-1Q4
Red alder	1	6	0	+5	-1
Herbaceous wetland	0	2	2	+2	+2
Sand/gravel/cobble	51	0	1	-51	-50
River	176	17	17	-159	-159
Reservior**	0	120	120	+120	+120
TOTAL ACRES	612	264	293	-348	-319
Habitat Rating	7	2	3		
HABITAT UNITS	428	53	88	-375	-340

*Represents 50% of total acres present.

**Represents 10% of the reservoir area.

Research conducted in Idaho indicated Cascade Reservoir was virtually unused by river otters because there was insufficient escape cover and resting sites along the exposed shoreline, even though there was a sufficient food source (Melquist and Hornocker 1983). This study also indicated that otters' tolerance of human activity was related to the amount of escape cover and shelter along a lake shoreline. The Idaho study concluded that river otters preferred stream-related habitats to lakes, reservoirs and ponds because of the availability of shelter and escape cover and reduced disturbance.

4. Beaver

a. Importance

Beaver have an important place in Oregon's history, so much so that the species was selected as the state animal. Fur trade attracted the first white men to the Oregon territory, and beaver are still of economic value today. Beaver are dependent upon a relatively stable source of water and its associated riparian habitat for survival, where they create ponds and pools used by many species of fish and wildlife for rearing, feeding, and resting. The beaver was selected as a target species for this assessment because of historic and economic value, dependence upon riparian habitat, loss of habitat due to the project, and to represent other wildlife species with similar habitat requirements.

b. Habitat requirements

Slow-flowing streams, small streams or lakes surrounded by a fairly dense stand of deciduous trees, and some agricultural waterways and wetlands may be selected for colonization by beaver (Aney 1967, Mace 1979, Deems and Pursley 1983). A minimum of 0.5 miles of stream channel or 0.5 square miles of lake or marsh habitat must be available before an area is suitable for beaver colonization (Allen 1982). Beaver need a permanent and relatively stable water source (Allen 1982). Stream gradient, which may be the most significant factor in determining suitability of riverine habitat for beaver, must be less than 15% (Allen 1982). Beaver construct dams to stabilize water depths (Shay 1978, Mace 1979), and to create ponds which fulfill cover, feeding, and reproductive requirements (Rue 1981, Allen 1982, Deems and Pursley 1983).

A deciduous tree and/or shrub canopy closure of 40-60% is an indication of optimum food availability for beaver (Allen 1982). For maximum suitability, the diameter at breast height (dbh) of trees should range from 1-6 inches, and shrubs should be at least 6-1/2 feet tall (Allen 1982). Tree species used include aspen, willow, cottonwood, alder, red osier dogwood, birch, maple, cherry, and poplar (Townsend 1953, Mace 1979, Allen 1982). Beaver feed primarily on the bark and cambium layer of deciduous trees and shrubs, as well as the twigs and leaves. Small quantities of Douglas-fir, western hemlock, and Scotch broom are consumed also (Maser et al. 1981). The majority of foraging occurs within 330 feet of the water's edge, and may extend to distances of 660 feet (Allen 1982). Aquatic vegetation is preferred, and herbaceous

vegetation appears to be preferred over woody vegetation when available (Allen 1982). Sedge and water lily rhizomes are consumed during summer (Seton 1953, Townsend 1953, Allen 1982).

Beaver construct dens which fulfill their cover and reproductive needs (Allen 1982). Three basic forms of dens are constructed by beaver: a standing lodge in open water, a bank lodge with a burrow into the bank, and a burrow into the bank without a lodge (Ingles 1965, Allen 1982).

c. History in the project area

Quantitative information on furbearer populations in the project area prior to construction was not available. The reservoir sites supported beaver, otter, mink, raccoon, and muskrat (USACE 1961, 1963). Small populations of beaver were present in the project area prior to construction (USFWS 1963).

Historical records indicate the Willamette Basin supported large beaver populations when the earliest trappers and explorers arrived in the early 1800's (Aney 1967). Beaver trapping in Oregon was restricted by a statewide closure in 1899 and did not resume until 1951 (Kebbe 1960, Shay 1978). Beaver populations had become seriously depleted due to over-trapping and habitat losses (Kebbe 1960, Shay 1978). In 1932, a program was begun to live-trap beaver from damage sites or areas of healthy populations and transfer them to suitable habitat in an effort to reestablish beaver in their historical habitat (Scheffer 1941, Kebbe 1960). The Willamette Basin beaver population was estimated at 10,000 in 1967 (Aney 1967). In 1980, ODFW estimated for Linn County a beaver population of 4,800 animals on 56 square miles of habitat (ODFW files).

Beaver and muskrat occur at the old fish hatchery wetlands at Green Peter Reservoir. Beaver are also located on USACE lands in the pond at Sunnyside Park adjacent to Foster Reservoir. Five to 6 animals are associated with the Sunnyside Park lodge and 3 beaver dams have been built at the location (J. Sandberg, USACE, pers. commun.). The Middle Santiam River between Foster Reservoir and Green Peter Dam probably receives little beaver use due to large fluctuations in river flow; however, 4-6 beaver may use the area (Nichols 1983).

d. Assessment of impact

(1) Green Peter

Prior to construction of Green Peter Dam and Reservoir, 850 acres of habitat were available to beaver within the affected area (Table 9). Fifty percent of the acreage of open conifer-hardwood and 75% of the closed conifer-hardwood forest was considered available for use by beaver, based on proximity to the river. The total acres of riparian shrub and hardwood, herbaceous wetland, red alder, sand/gravel/cobble, and river cover types were also included as probable beaver habitat at Green Peter. The affected area was considered average for beaver by the evaluation team and the suitability was rated 5 for a value of 425 HU's. Habitat in the numerous tributaries within the affected area was fairly good, with good forage availability. The tributaries were rocky, however, and the rivers were swift during spring.

Table 9. Beaver: Acres of habitat available and lost, habitat ratings, and habitat units at Green Peter Reservoir.

Cover Type	Pre Construction (1955)	Post Construction (1972)	Recent (1979)	Loss or gain (-,+) Pre to Post-construction	Loss or gain (-,+) Preconstruction to recent
	Acres	Acres	Acres		
Conifer-hardwood forest, open	94	166	0	+72	-94
Conifer-hardwood forest, closed	198	50	179	-148	-19
Riparian shrub	14	0	0	-14	-14
Riparian hardwood	159	0	0	-159	-159
Herbaceous wetland	12	0	0	-12	-12
Red alder	114	67	134	-47	+20
Sand/gravel/cobble	32	0	0	-32	-32
Ponds	0	8	7	+8	+7
River	227	14	14	-213	-213
Reservoir*	0	108	108	+108	+108
TOTAL ACRES	850	413	442	-437	-408
Habitat Rating	5	1	1		
HABITAT UNITS	425	41	44	-384	-381

* Represents 3% of the reservoir area.

The 413 acres of habitat available to beaver after construction of the project included 3% of the reservoir area adjacent to the shoreline (Table 9). The habitat was rated 1 (low) due to the lack of riparian vegetation, and because of steep banks, resulting in a value of 41 HU's.

No marked improvements were noted in beaver habitat within the affected area by 1979. Natural revegetation and seral advancement had slightly increased the acreage available to beaver to 442 acres (Table 9), but the quality was unchanged and the evaluation team still rated the suitability 1. The 44 HU's of beaver habitat available within the Green Peter affected area at the recent period was a reduction of 381 HU's from the preconstruction period.

(2) Foster

The Foster Reservoir site contained 477 acres of beaver habitat before construction, comprised of open and closed conifer-hardwood forest, riparian hardwood, red alder, sand/gravel/cobble, and river cover types (Table 10). The evaluation team rated the habitat 6 (above average) because of the abundance of willow along the river and the presence of backwater areas. Minimal bank den sites were available, however, and tributary canyons provided only a narrow fringe of forage species. The affected area had a value of 286 HU's before construction of the project.

Construction of the Foster Project resulted in a loss of 356 acres of beaver habitat (Table 10). The remaining 121 acres included 3% of the reservoir area and were rated 2 (poor) by the evaluation team. Riparian vegetation was lacking throughout the project area except for the upper reservoir arms and the small areas of herbaceous wetlands. The post-construction value of 24 HU's was a loss of 262 HU's from the pre-construction value.

Natural revegetation increased the available beaver habitat within the affected area to 137 acres by 1979 (Table l0), which were rated 3 (below average). Little change had occurred in habitat conditions for beaver from the postconstruction to the recent period. The below average rating resulted in a value of 41 HU's and indicated a loss of 245 HU's from the preconstruction period.

(3) Summary of impacts

The abundance of deciduous trees as forage within the affected area made the Green Peter-Foster Project suitable for beaver. Construction of the projected resulted in the loss of 748 acres of beaver habitat and 626 HU's. The decline in HU's for beaver represents a loss in the potential of the project area to support beaver and other wildlife species with similar habitat requirements or which use ponds and pools created by beaver.

The dam may not have completely blocked beaver dispersal along the river, but it probably inhibited beaver movement along the river. As noted for other lakes and reservoirs (Allen 1982), extreme water level fluctuations rendered much of the habitat unsuitable for beaver. The

Table 10. Beaver: Acres of habitat available and lost, habitat ratings and habitat units at Foster Reservoir.

Cover Type	Pre Construction (1955)	Post Construction (1972)	Recent (1979)	Loss or gain (-,+) Pre to Post-construction	Loss or gain (-,+) Preconstruction to recent
	Acres	Acres	Acres		
Conifer-hardwood forest, open	65	11	0	-54	-65
Conifer-hardwood forest, closed	71	49	72	-22	+1
Riparian hardwood	113	0	9	-113	-104
Red alder	1	6	0	+5	-1
Herbaceous wetland	0	2	2	+2	+2
Sand/gravel/cobble	51	0	1	-51	-50
River	176	17	17	-159	-159
Reservoir*	0	36	36	+1,195	+1,195
TOTAL ACRES	477	121	137	-356	-340
Habitat Rating	6	2	3		
HABITAT UNITS	286	24	41	-262	-245

* Represents 3% of the reservoir area.

major impact of the project was the loss of riparian hardwoods, the major food source of beaver.

5. Ruffed grouse

a. Importance

Upland game birds potentially affected by construction of the Green Peter-Foster Project included ruffed grouse, blue grouse, mountain quail, California quail, and band-tailed pigeon. The ruffed grouse was chosen as a target species because of recreational value, impacts which occurred from the loss of riparian habitat as a result of the Green Peter-Foster Project, and to represent other wildlife species with similar habitat requirements.

b. Habitat requirements

Thickets of alder, hawthorn, birch, maple, and other deciduous trees provide summer and fall habitat for ruffed grouse in Oregon (Masson and Mace 1974). Adjacent conifer stands are used for escape cover and winter shelter.

Spring, summer, and fall diets of ruffed grouse in Oregon consist of a wide variety of leaves, grasses, forbs, berries, and buds (Durbin 1979). The availability of a winter source of birch, alder, hazel, or aspen catkins may be the most important factor influencing the survival of wintering ruffed grouse (Gullion 1966). In Oregon, Durbin (1979) reported that alder buds and catkins are probably the primary winter food. Black cottonwood (buds, twigs, catkins) and buttercup are the primary winter food items of ruffed grouse in western Washington (Brewer 1980).

Ruffed grouse chicks for the first 7-10 days primarily consume invertebrates (Johnsgard 1973), which are most available in mesic conditions such as found in riparian habitat. Ruffed grouse broods use semi-open areas characteristic of early stages of woodland succession (Sharp 1963). Small hardwoods, shrubs, berry bushes, and lush herbs provide habitat preferred by ruffed grouse broods (Bump et al. 1947). Once ruffed grouse chicks reach about 4 months of age, closed-canopy forests are suitable habitat (Chambers and Sharp 1958).

Drumming sites are an important reproductive requirement of ruffed grouse. Drumming habitat may be either deciduous or mixed forest adjacent to fields, clear-cuts, or regrowth areas (Brewer 1980). Adequate nesting habitat is another reproductive requirement of ruffed grouse. Hardwood stands or mixed hardwoods are the most frequently used forest types for nesting (Edminster 1947, Maxson 1978). Nest sites are most often at the base of large trees, but some are located at the base of stumps, logs, or bushes, usually within 50 feet of clearings or fields (Edminster 1947).

c. History in the project area

Grouse populations were "abundant" in the project area prior to project construction (USFWS 1961). Quantitative information on grouse populations in the project area prior to construction was not available. The OSGC estimated 3 grouse per square mile in the South Santiam watershed in 1948. In 1980, ODFW estimated a density of 8,000 ruffed grouse on 2,685 square miles of habitat in Linn County (ODFW files).

d. Assessment of impact

(1) Green Peter

Grass-forb, open sawtimber conifer forest, shrubland, and closed conifer-hardwood forest cover types comprised the majority of the 5,463 acres evaluated as ruffed grouse habitat prior to construction of Green Peter Dam and Reservoir (Table 11). The suitability of this habitat was rated 7 (above average) by the evaluation team for a value of 3,824 HU's. Deciduous hardwoods within the affected area provided cover and forage, but the suitability was limited by the large blocks of grass-forb and agricultural cover types, and the high percentage of conifers.

Construction of Green Peter resulted in the loss of 3,870 acres of ruffed grouse habitat (Table 11). The river bottomlands were inundated and the grouse habitat that remained in the affected area was only a narrow band. Riparian vegetation was eliminated and the reservoir banks were steep. The evaluation team rated the suitability of the post-construction ruffed grouse habitat 2 (poor) for a value of 319 HU's and loss of 3,505 HU's from preconstruction conditions.

Recent (1979) habitat within the Green Peter affected area available to ruffed grouse totaled 1,866 acres, an increase of 273 acres from post-construction due to natural revegetation and seral advancement (Table 11). The habitat was rated 3 (below average) due to a lack of significant improvement in conditions for ruffed grouse. The Green Peter Project resulted in a loss of 3,264 HU's for ruffed grouse from preconstruction to recent conditions.

(2) Foster

The 1,380 acres of ruffed grouse habitat within the Foster affected area before construction had a high interspersion of vegetation types, with blackberries, cottonwoods, red alder, and other riparian hardwoods available as forage sources (Table 12). The large block of agricultural land limited the suitability to a rating of 7 (above average), resulting in a value of 966 HU's.

Ruffed grouse habitat remaining after construction totaled 293 acres and was rated 2 (poor) (Table 12). Brood sites and vegetation edge were greatly reduced, although small pockets of grouse habitat remained in the narrow fringe beside the reservoir, at small wetlands, and on

Table 11. Ruffed grouse: Acres of habitat available and lost, habitat ratings, and habitat units at Green Peter Reservoir.

Cover Type	Pre Construction (1955)	Post Construction (1972)	Recent (1979)	Loss or gain (-,+) Pre to Post-construction	Loss or gain (-,+) Preconstruction to recent
	Acres	Acres	Acres		
Temperate conifer forest, open pole	330	78	149	-252	-181
Temperateconifer forest, closed pole	254	76	88	-178	-166
Temperate conifer forest, open sawtimber	819	60	106	-759	-713
Temperate conifer forest, closed sawtimber	316	255	408	-61	+92
Temperate conifer forest, old-growth	8	8	6	0	-2
Conifer-hardood forest, open	188	331	0	+143	-188
Conifer-hardwood forest, closed	792	199	717	-593	-75
Riparian shrub	14	0	0	-14	-14
Riparianhardwood	159	0	0	-159	-159
Shrubland	799	372	217	-427	-582
Grass-forb	1,470	147	41	-1,323	-1,429
Red alder	114	67	134	-47	+20
Herbaceouswetland	12	0	0	-12	-12
Agricultural, pasture	188	0	0	-188	-188
TOTAL ACRES	5,463	1,593	1,866	-3,870	-3,597
Habitat Rating	7	2	3		
HABITATUNITS	3,824	319	560	-3,505	-3,264

Neuhaus Peninsula. The value of 59 HU's at postconstruction represented a loss of 907 HU's from preconstruction conditions.

By 1979, an additional 84 acres of habitat were available to ruffed grouse within the affected area at Foster for a total of 377 acres (Table 12). An increase in grass-forb cover type created more edge habitat, and some forage was available in the conifer-hardwood cover type. The evaluation team rated the affected area 3 (below average), which represented a value of 113 HU's. A loss of 853 HU's occurred from preconstruction to the recent period at Foster.

(3) Summary of impacts

The interspersion of vegetation types within the Green Peter-Foster affected area provided above average cover and forage for ruffed grouse prior to construction. The project resulted in the loss of 4,600 acres of grouse habitat and 4,117 HU's. The decline in HU's for ruffed grouse represents a loss in the potential of the project area to support grouse and other wildlife species with similar habitat requirements.

6. California quail

a. Importance

The California quail was chosen as a target species at Foster Reservoir because of high recreational value, loss of agricultural habitat resulting from the Foster Project, and to represent wildlife species with similar habitat needs.

b. Habitat requirements

California quail occur in a variety of habitat types in Oregon, but are typically associated with farmlands. California quail diets are composed of herbaceous leafy materials and seeds, with grains and fruits being of lesser importance (Masson and Mace 1974).

California quail nest on the ground in many types of cover, including weeds, grasses, and brushy cover. Trees or low shrubs provide roost sites, and evergreen species are preferred for winter cover (Masson and Mace 1974).

c. History in the project area

Information was not available on California quail populations in the project area prior to construction. California quail can now be found southwest of Foster Dam on USACE project lands (J. Sandberg, USACE. pers. commun.). Based on 1979 and 1980 data, current density estimates for Linn County are approximately 35 California quail per square mile of habitat (ODFW files).

Table 12. Ruffed grouse: Acres of habitat available and lost, habitat ratings and habitat units at Foster Reservoir.

Cover Type	Pre Construction (1955)	Post Construction (1972)	Recent (1979)	Loss or gain (-,+) Pre to Post-construction	Loss or gain (-,+) Preconstruction to recent
	Acres	Acres	Acres		
Temperateconifer forest, open pole	1	0	0	-1	-1
Temperate conifer forest, open sawtimber	19	10	15	-9	-4
Temperateconifer forest, closed sawtimber	5	2	1	-3	-4
Conifer-hardwood forest, open	259	42	0	-217	-259
Conifer-hardwood forest, closed	282	1%	288	-86	+6
Riparian hardwood	113	0	9	-113	-104
Shrubland	189	3	3	-186	-186
Grass-forb	28	24	59	-4	+31
Red alder	1	6	0	+5	-1
Agricultural, cropland	423	7	0	-416	-423
Agricultural, pasture	60	3	2	-57	-58
TOTAL ACRES	1,380	293	377	-1,087	-1,003
Habitat Rating	7	2	3		
HABITAT UNITS	966	59	113	-907	-853

d. Assessment of impact

(1) Green Peter

The California quail was not used as a target species because the evaluation team believed there was inadequate habitat present at the Green Peter site.

(2) Foster

Prior to construction of Foster Dam and Reservoir, 914 acres of riparian hardwood, shrubland, grass-forb, red alder, agricultural cropland and pasture, and disturbed/bare cover types were available to California quail within the affected area (Table 13). The large block of agricultural land limited the amount of available edge habitat and the evaluation team rated the suitability of the affected area as average (5) for quail. The value of preconstruction habitat equaled 457 HU's.

Construction of the Foster Project resulted in a loss of 577 acres of quail habitat for a total of 337 acres in 1972 (Table 13). The remaining habitat was rated 2 (poor), resulting in a value of 67 HU's and loss of 390 HU's from preconstruction conditions. Only small, scattered patches of suitable habitat were available to quail within the affected area. Disturbed/bare areas provided dusting sites and potential sources of weed seeds.

An additional 96 acres of quail habitat were lost between the post-construction and recent period (Table 13). The 241 acres of quail habitat available in 1979 did, however, indicate an increase in grass-forb and riparian hardwood cover types. The evaluation team determined the California quail habitat within the Foster affected area had improved slightly and rated it 3 (below average), resulting in a value of 72 HU's. This represents a loss of 385 HU's from the preconstruction to the recent period. The decline in HU's for California quail represents a loss in the potential of the project area to support quail and other wildlife species with similar habitat requirements.

7. Band-tailed pigeon

a. Importance

The band-tailed pigeon is a migrant species that nests in Oregon. Bandtails are associated with coniferous forests in western Oregon and display a special need for minerals obtained from springs and tidal flats. The band-tailed pigeon was selected as a target species at Green Peter Reservoir because of recreational value and the impact of the project on its habitat.

b. Habitat requirements

Band-tailed pigeons range from southern British Columbia to Baja California and are native to Oregon west of the Cascade Mountains (Masson and Mace 1974, Udvardy 1977). Bandtails that nest in Oregon

Table 13. California quail: Acres of habitat available and lost, habitat ratings and habitat units at Foster Reservoir.

Cover Type	Pre Construction (1955)	Post Construction (1972)	Recent (1979)	Loss or gain (-,+) Pre to Post-construction	Loss or gain (-,+) Preconstruction to recent
	Acres	Acres	Acres		
Riparianhardwood	113	0	9	-113	-104
Shrubland	189	3	3	-186	-186
Grass-forb	28	24	59	-4	+31
Red alder	1	6	0	+5	-1
Agricultural, croplahd	423	7	0	-416	-423
Agricultural, pasture	60	3	2	-57	-58
Disturbed/bare	100	294	168	+194	+68
TOTAL ACRES	914	337	241	-577	-673
Habitat Rating	5	2	3		
HABITAT UNITS	457	67	72	-390	-385

winter in central California (Masson and Mace 1974, ODFW undated), and follow well-defined migration flight lines to appear at the same roosting, feeding, and drinking sites each year (Einarsen 1953). Band-tailed pigeon habitat is predominantly coniferous forests near coastal or in mountainous regions (Masson and Mace 1974, Udvardy 1977). Forest land with a good interspersion of seral stages and openings characterizes good band-tailed pigeon habitat in Oregon and Washington (Jeffrey et al. 1977). Clear-cut areas produce berries and other food sources for bandtails (Morse 1950). Band-tailed pigeons feed on mast, buds, berries, small fruits, seeds, legumes, and acorns (Morse 1949, Masson and Mace 1974, ODFW undated), as well as agricultural fruit, cereal grain, and nut crops (Masson and Mace 1974, ODFW undated).

Band-tailed pigeons perch on dead snags and tree tops near feeding and watering areas (Masson and Mace 1974). Bandtails concentrate at mineral springs and tidal flats during August and September, and make regular daily flights to these areas for water and crystallized salts (Morse 1949, 1950; Einarsen 1953, Masson and Mace 1974). These areas seem to satisfy an apparent mineral need, since bandtails persistently use mineral springs in spite of intensive hunting at these sites (Morse 1950, ODFW undated). Calcium and sodium salts appear to be the attraction of mineral springs to bandtails (Jeffrey et al. 1977).

Bandtails primarily nest in conifers (Gabrielson and Jewett 1940, Aney 1967, ODFW undated). Nests may be anywhere from 8-180 feet above ground, but are typically 15-40 feet high, and are generally crude twig platforms with little or no shaping (Morse 1949, Masson and Mace 1974, Jeffrey et al. 1977.) Bandtails nest at moderate elevations (Aney 1967). Summer resident birds in Washington were concentrated below 1,000 feet (Jeffrey et al. 1977). Bandtails show a preference for nest sites with moderate to steep slopes (Jeffrey et al. 1977). A permanent water source appears to determine the size and spacing of nesting territories (Jeffrey et al. 1977). Nesting occurs from March to October, but peaks in May and June (Morse 1949).

c. History in the project area

Quantitative information on band-tailed pigeon populations in the project area prior to construction was not available. A mineral spring located near Tally Creek was extensively used by bandtails prior to inundation (N. TenEyck, H. Sturgis, ODFW, pers. communs.) and, as a result, the spring was a popular bandtail hunting area (Aney 1967). Use of the spring was not monitored, but a flock of 30 pigeons was documented (N. TenEyck, ODFW, pers. commun.).

Band-tailed pigeon densities range from l-10 pairs per square mile over their range (Jeffrey et al. 1977). Oregon contained an estimated 12,500 square miles of breeding habitat in the mid-1970's (Jeffrey et al. 1977). During the same period, ODFW (undated) estimated a statewide fall population of 600,000 band-tailed pigeons distributed over 15 million acres of habitat. Estimates made for Linn County in 1980 indicated a bandtail population of 12,500 birds on 1,607 square miles of habitat (ODFW files).

d. Assessment of impact

(1) Green Peter

A total of 5,249 acres of habitat were available to band-tailed pigeons within the Green Peter affected area prior to construction (Table 14). Vegetation cover types considered appropriate by the evaluation team for bandtail use included open and closed pole conifer forest, open and closed sawtimber conifer forest, old-growth conifer forest, open and closed conifer-hardwood forest, riparian hardwood, shrubland, grass-forb, and red alder. The suitability of this habitat was rated 7 (above average), for a value of 3,674 HU's. Nesting, foraging, and water requirements were all met within a good mixture of vegetation. There were no other mineral springs near the Tally Creek spring.

A loss of 3,656 acres of band-tailed pigeon habitat occurred as a result of construction of the Green Peter project (Table 14). The mineral spring was inundated and 90% of the grass-forb cover type was lost. The proportion of shrub habitat used for foraging remained about the same, but disturbance from the roads had a negative impact. The evaluation team rated the postconstruction habitat 2 (poor) for a value of 319 HU's, a loss of 3,355 HU's from preconstruction conditions.

The increase of 273 acres of pigeon habitat within the affected area by 1979 (Table 14) did not improve the value, since food sources had not replenished, and the mineral spring, a unique habitat feature, was no longer present. The suitability of the habitat to support bandtails was rated 1 (low) and resulted in a value of 187 HU's. This represents a loss of 3,487 HU's from the preconstruction to the recent period. The decline in HU's for band-tailed pigeons represents a loss in the potential of the project area to support pigeons.

(2) Foster

The band-tailed pigeon was not used as a target species because the evaluation team believed inadequate habitat was present at the Foster site.

8. Waterfowl (wood duck, common merganser)

a. Importance

Two waterfowl species were chosen as target species because of their high recreational value, their dependence on aquatic habitat, and because of the impacts which occurred as a result of the project. A small number of a variety of waterfowl species use the reservoirs during migration (Appendix A). The interagency evaluation team selected the common merganser as a target species at Green Peter and the wood duck as a target species at Foster to represent wildlife species with similar habitat needs.

Table 14. Band-tailed pigeon: Acres of habitat available and lost, habitat ratings, and habitat units at Green Peter Reservoir.

Cover Type	Pre Construction (1955)	Post Construction (1972)	Recent (1979)	Loss or gain (-,+) Pre to Post-construction	Loss or gain (-,+) Preconstruction to recent
	Acres	Acres	Acres		
Temperate conifer forest, open pole	330	78	149	-252	-181
Temperate conifer forest, closed pole	254	76	88	-178	-166
Temperate conifer forest, open sawtimber	819	60	106	-759	-713
Temperate conifer forest, closed sawtimber	316	255	408	-61	+92
Temperateconifer forest, old-growth	8	8	6	0	-2
Conifer-hardwood forest, open	188	331	0	+143	-188
Conifer-hardwood forest, closed	792	199	717	-593	-75
Riparian hardwood	159	0	0	-159	-159
Shrubland	799	372	217	-427	-582
Grass-forb	1,470	147	41	-1,323	-1,429
Red alder	114	67	134	-47	+20
TOTAL ACRES	5,249	1,593	1,866	-3,656	-3,383
Habitat Rating	7	2	1		
HABITAT UN ITS	3,674	319	187	-3,355	-3,487

b. **Habitat requirements**

Wood ducks inhabit creeks, rivers, floodplain lakes, swamps, and beaver ponds characterized by overhanging deciduous trees or shrubs, or flooded woody vegetation (McGilvrey 1968, Bellrose 1976). Bottomland hardwoods provide important nesting habitat. Conifers rarely contain suitable nesting cavities (McGilvrey 1968). Wood ducks prefer nest trees close to suitable brood habitat (McGilvrey 1968). The maximum water current tolerated by breeding wood ducks is about 3 mph, although broods seldom use areas with currents greater than 1 mph (McGilvrey 1968). Optimal brood cover is dense cover (emergent herbaceous vegetation, emergent shrubs, trees, or woody downfall) well interspersed with small, open water channels (Sousa and Farmer 1983). Adult wood ducks are primarily herbivorous, except prior to nesting when they consume invertebrates (Drobney and Fredrickson 1979). Acorns and other mast are important fall and winter foods (Gabrielson and Jewett 1940, Landers et al. 1977). During late summer and early fall, filbert orchards on Willamette Valley foothills provide food for wood ducks (R. Jubber, ODFW, pers. commun.). Aquatic plants, seeds, and occasionally waste grain are also consumed (Gabrielson and Jewett 1940, Landers et al. 1977). Young ducklings require animal foods (primarily insects), and forage where both food and protective cover are present. As they mature, ducklings gradually consume more plant food and by about 6 weeks of age, their diets are similar to those of adults (Hocutt and Dimmick 1971).

Common mergansers typically nest in cavities and prefer deciduous riparian habitat in later forest stages (USFS 1981b). Gabrielson and Jewett (1940) reported that common mergansers nested along swifter streams and shores of larger lakes throughout Oregon. Foods consumed by common mergansers include fish and fish eggs, aquatic invertebrates, frogs, newts, and some aquatic plants (Bellrose 1976, USFS 1981b). Common mergansers forage in clear water l-1/2 to 6 feet deep and eat a wide variety of fishes depending upon the species' availability.

c. **History in the project area**

Quantitative information was not available on waterfowl populations in the project area prior to construction. Small numbers of a variety of waterfowl species occupied the Foster Reservoir area prior to inundation (USFWS 1963). Common mergansers, wood ducks, and mallards are the most common species breeding at Green Peter-Foster (USACE 1981). A total of 50 birds for both reservoirs is considered normal waterfowl use Wolfer, ODFW, pers. commun.). As many as 24 common mergansers have been sighted at one time on the Quartzville arm of Green Peter Reservoir (J. Sandberg, USACE, pers. commun.). Wood ducks are seen year-round at Sunnyside Park adjacent to Foster Reservoir, but are not present on the reservoir during winter (J. Sandberg, USACE, pers. commun.).

d. Assessment of impact

(1) Green Peter

A total of 1,579 acres of common merganser habitat was available within the Green Peter affected area at the preconstruction period (Table 15). The suitability of this habitat was rated 8 (high). Anadromous and resident fish provided a food source, nesting sites were present, and rocks were available for loafing. The lack of adequate nesting cavities and low productivity of the stream limited the value of the habitat to 1,263 HU's.

Construction of Green Peter Dam and Reservoir resulted in the loss of 213 acres of river habitat and 1,037 acres of terrestrial habitat for mergansers (Table 15). The addition of pond and reservoir habitat created a total of 3,942 acres of merganser habitat at the postconstruction period. The evaluation team rated the habitat 2 (poor) due to the decrease in the prey base and reduction of terrestrial habitat used for nesting. The reservoir did provide refuge from predators and served as a winter resting area. The 788 HU's available for mergansers within the affected area at postconstruction was a loss of 475 HU's from preconstruction conditions.

Natural revegetation and seral advancement increased the amount of merganser habitat to 4,140 acres by 1979 (Table 15). The prey base had increased, and both forage and refuge were available in the tributaries. Although most of the reservoir was too deep to be of value to mergansers for foraging, it provided a safe resting area. The evaluation team rated the suitability of the recent (1979) habitat for common mergansers 3 (below average). The 1,242 HU's present at the recent period represent a loss of 21 HU's from preconstruction conditions.

(2) Foster

The evaluation team determined 830 acres of open and closed conifer-hardwood, riparian hardwood, herbaceous wetland, and river cover types were available to wood ducks within the affected area prior to construction of Foster Dam and Reservoir (Table 16). The suitability of the habitat for wood ducks was rated 3 (below average), for a value of 249 HU's. The affected area had little river braiding and only limited backwater areas. Cover and brood rearing sites were also lacking. The river would have been too swift for wood duck use most of the year, although a few farm ponds were probably available.

Immediately following construction, 293 acres of habitat were available to wood ducks (Table 16). This represents a loss of 416 acres of terrestrial habitat and 159 acres of river habitat. Two acres of herbaceous wetland were gained, and the evaluation team estimated 3% of the reservoir area near the shoreline would be used by wood ducks. The lack of adequate wood duck habitat resulted in a suitability rating of 1 (low) and a value of 29 HU's, for a loss of 220 HU's from the preconstruction period.

Table 15. Common merganser: Acres of habitat available and lost, habitat ratings, and habitat units at Green Peter Reservoir.

Cover Type	Pre Construction (1955)	Post Construction (1972)	Recent (1979)	Loss or gain (-,+) Pre to Post-construction	Loss or gain (-,+) Preconstruction to recent
	Acres	Acres	Acres		
Conifer-hardwood forest, open	819	60	106	-759	-713
Conifer-hardwood forest, closed	316	255	408	-61	+92
Riparian shrub	14	0	0	-14	-14
Riparian hardwood	159	0	0	-159	-159
Herbaceous wetland	12	0	0	-12	-12
Sand/gravel/cobble	32	0	0	-32	-32
Ponds	0	8	7	+8	+7
River	227	14	14	-213	-213
Reservoir	0	3,605	3,605	+3,605	+3,605
TOTAL ACRES	1,579	3,942	4,140	+2,363	+2,561
Habitat Rating	8	2	3		
HABITAT UNITS	1,263	788	1,242	-475	-21

Table 16. Wood duck: Acres of habitat available and lost, habitat ratings and habitat units at Foster Reservoir.

Cover Type	Pre Construction (1955)	Post Construction (1972)	Recent (1979)	Loss or gain (-,+) Pre to Post-construction	Loss or gain (-,+) Preconstruction to recent
	Acres	Acres	Acres		
Conifer-hardwood forest, open	259	42	0	-217	-259
Conifer-hardwood forest, closed	282	196	288	-86	+6
Riparian hardwood	113	0	9	-113	-104
Herbaceous wetland	0	2	2	+2	+2
River	176	17	17	-159	-159
Reservoir*	0	36	36	+36	+36
TOTAL ACRES	830	293	352	-537	-478
Habitat Rating	3	1	2		
HABITAT UNITS	249	29	70	-220	-179

* Represents 3% of the reservoir area.

The slight increase in riparian hardwoods and the natural revegetation of edge cover provided some improvement in the suitability of the Foster affected area for wood ducks from the postconstruction to recent period. The habitat was rated 2 (poor) for a value of 70 HU's, a loss of 179 HU's from 1955 to 1979.

9. Pileated woodpecker

a. Importance

The pileated woodpecker is a primary cavity excavator. Vacated woodpecker cavities are used by many birds and mammals for reproduction, roosting, shelter, or hibernation (Bull and Meslow 1977). The pileated woodpecker was chosen as a target species for Green Peter Reservoir because of its preference for old-growth and mature forest habitat, to represent species which use those cover types, and because of impacts which occurred as a result of the project.

b. Habitat requirements

Pileated woodpeckers in western Oregon find optimum habitat for nesting and foraging in old-growth Douglas-fir forests (Meslow et al. 1981). Pileated woodpeckers also nest in true fir and deciduous trees (Bent 1964, Conner et al. 1975). Critical habitat components are large snags, large trees, diseased trees, dense forest stands, and high snag densities (Bull 1975). Pileated woodpeckers prefer to nest in 2-storied stands with a crown closure of approximately 70% and in trees or snags with a dbh greater than 20 inches (Bull 1975, Bull and Meslow 1977, Schroeder 1983).

Foraging habitats of pileated woodpeckers contain high densities of logs and snags, dense canopies, and tall shrub cover. Carpenter ants and their larvae, and other wood-boring insects are the primary food items of pileated woodpeckers (Bull 1975).

c. History in the project area

Quantitative information was not available on pileated woodpecker populations in the project area prior to construction. One pair is known to occur on the Green Peter peninsula outside the affected area, and 3 pairs occur up Quartzville Creek (W. Logan, BLM, pers. commun.).

d. Assessment of impact

(1) Green Peter

The Green Peter Project area contained 2,980 acres of available pileated woodpecker habitat before construction (Table 17). Open pole and sawtimber conifer forest and closed conifer-hardwood forest cover types accounted for 58% of the total, while only 8 acres of old-growth conifer forest were located within the affected area. Preconstruction conditions were not typical of pileated woodpecker habitat, but the area did contain scattered old trees and old stumps with good height for foraging. Because the affected area had a low proportion of mature

Table 17. Pileated woodpecker: Acres of habitat available and lost, habitat ratings, and habitat units at Green Peter Reservoir.

Cover Type	Pre Construction (1955)	Post Construction (1972)	Recent (1979)	Loss or gain (-,+) Pre to Post-construction	Loss or gain (-,+) Preconstruction to recent
	Acres	Acres	Acres		
Temperate conifer forest, open pole	330	78	149	-252	-181
Temperate conifer forest, closed pole	254	76	88	-178	-166
Temperateconifer forest, open sawtimber	819	60	106	-759	-713
Tanperate conifer forest, closed sawtimber	316	255	408	-61	+92
Temperate conifer forest, old-growth	8	8	6	0	-2
Conifer-hardwood forest, open	188	331	0	+143	-188
Conifer-hardwood forest, closed	792	199	717	-593	-75
Riparianhardwood	159	0	0	-159	-159
Red alder	114	67	134	-47	+20
TOTAL ACRES	2,980	1,074	1,608	-1,906	-1,372
Habitat Rating	4	3	3		
HABITAT UNITS	1,192	322	482	-870	-710

forest, it was rated 4 (below average) by the evaluation team, with a value of 1,192 HU's.

Construction of Green Peter Dam and Reservoir resulted in the loss of 1,906 acres of pileated woodpecker habitat (Table 17). The suitability of the remaining 1,074 acres was rated 3 (below average) for a value of 322 HU's, a loss of 870 HU's from preconstruction conditions. Habitat components important to pileated woodpeckers had changed little as a result of construction, although almost 600 acres of closed conifer-hardwood forest were lost.

An increase of 534 acres of pileated woodpecker habitat occurred within the affected area between the postconstruction (1972) and recent (1979) periods due to natural revegetation (Table 17). No additional forage areas were present due to the lack of recruitment of large, dead and down woody material. The evaluation team rated the suitability of the recent habitat 3 (below average), indicating a loss of 710 HU's from the preconstruction to the recent period. A total of 482 HU's of pileated woodpecker habitat were present at the recent period. The decline in HU's for pileated woodpeckers represents a loss in the potential of the project area to support woodpeckers and other wildlife species with similar habitat requirements.

(2) Foster

The pileated woodpecker was not used as a target species because the evaluation team believed there was inadequate habitat present at the Foster site.

10. Bald eagle

a. Importance

The bald eagle is classified by ODFW and USFWS as "threatened" in Oregon. The Pacific States Bald Eagle Recovery Team (1982) set recovery goals for bald eagle populations in Oregon and identified Green Peter and Foster Reservoirs as potential nesting areas. Potential nesting areas were determined by historical nest records, occasional sightings of adult eagles, and/or presence of old-growth forests within 1 mile of a water body possessing a good supply of fish and/or waterfowl. The bald eagle was chosen as a target species because of its threatened status, management emphasis within Oregon and specifically at Green Peter and Foster Reservoirs, and because bald eagles may have benefited from the construction of the Green Peter-Foster Project.

b. Habitat requirements

Bald eagles find optimum nesting and roosting habitat in old-growth forests (Meslow et al. 1981). In western Oregon, Douglas-fir is the most frequently used tree species for nesting (Anthony et al. 1982). Tree structure and uneven-aged forest stands appear to be more important, however, than tree species in the selection of nest trees. Nest trees are typically the largest tree in the stand and are usually located within 1 mile of large bodies of water (Anthony et al. 1982).

Winter roosting sites are characterized by a protected microclimate, stout perches high above the ground, a clear view of surrounding terrain, and freedom from human activity (Hansen et al. in Stalmaster et al. 1985). Bald eagles use both deciduous roosts in riparian habitat and coniferous roosts for protection from adverse weather (Stalmaster and Newman 1979). Bald eagles use mature or old-growth roost trees that are larger than the average size of surrounding trees (Hansen et al. 1980, Keister 1981, Anthony et al. 1982).

Bald eagles forage in open areas usually associated with rivers, lakes, or coastal shorelines (Stalmaster et al. 1985). The Pacific States Bald Eagle Recovery Team (1982) stated that food supply is probably the most critical component of bald eagle wintering habitat in the Pacific Region. The most common foods of eagles in this region include fish, waterfowl, and carrion. Anadromous fish, trout, whitefish, squawfish, carp, suckers, and tui chubs are used by eagles (Pacific States Bald Eagle Recovery Team 1982). Waterfowl are an important food item for eagles in the Klamath Basin (Keister 1981) and at some reservoirs on the Columbia River (Fielder 1982). Studies in Washington (Servheen 1975, Stalmaster 1976) identified mammalian carrion as an important alternate food source. Because the young are less tolerant of food deprivation than adults, a constant food supply is most important during the nesting season (Stalmaster et al. 1985).

Perching sites are another important feature of bald eagle habitat. Proximity to food is the primary factor governing selection of perching sites (Steenhof et al. 1980). Preferred perching sites are on the edge of stands and include the tallest trees with strong, lateral branches high in the crown (Stalmaster et al. 1985). Perches may also be used as "sentry" sites by breeding adults for defending the nest. Snags are preferred perching sites in winter and, when near the nest tree, are preferred perching locations during the nesting season (Stalmaster and Newman 1979, Forbis et al. cited in Stalmaster et al. 1985).

c. History in the project area

Information is not available on the status of bald eagle populations in the project area prior to construction. No nests have been located in Linn County (Isaacs and Anthony 1983), although Green Peter and Foster Reservoirs are listed as potential nesting areas. Bald eagles are seen frequently in the winter on or within 1 mile of Green Peter Reservoir (J. Sandberg, USACE, pers. commun.) Bald eagles perch on snags located on Neuhaus Peninsula at Foster Reservoir, and they have been observed roosting in decadent maple trees and old-growth conifers adjacent to Green Peter Reservoir, as well as in cottonwood trees below Foster Dam (W. Logan, BLM, pers. commun.). Green Peter Reservoir has 2 potential nest sites designated, and Foster Reservoir has 1 potential nest site (Pacific States Bald Eagle Recovery Team 1982).

d. Assessment of impact

(1) Green Peter

Prior to construction of Green Peter Dam and Reservoir, the affected area contained 2,541 acres of bald eagle habitat (Table 18). Most of this acreage was in open sawtimber conifer forest and closed conifer-hardwood forest, which provided potential nesting and perch sites. The suitability of the habitat was rated 5 (average) because food was available in the form of anadromous fish runs, but not on a year-round basis. It is doubtful that young eagles were reared in the affected area. The value of the habitat was 1,271 HU's.

Following construction, the affected area contained 4,472 acres of bald eagle habitat comprised of 3,605 acres of reservoir and 853 acres of terrestrial habitat (Table 18). The evaluation team rated the remaining habitat 1 (low) because of the lack of a prey base. The 477 HU's available to bald eagles at the postconstruction period represented a loss of 824 HU's from preconstruction conditions.

An increase of 384 acres occurred between the postconstruction and recent (1979) periods due to natural revegetation and seral advancement (Table 18). The 4,856 acres of bald eagle habitat within the affected area were rated 7 (above average) and resulted in a value of 3,399 HU's, a gain of 2,128 HU's from preconstruction to recent conditions. Anadromous fish runs had become reestablished and new runs initiated which provided a source of food almost year-round. Perch sites were located on the reservoir arms and peninsula, and numerous potential nest sites occurred just outside the affected area. Recreational disturbance had increased, but human access was limited at Green Peter. Fluctuating reservoir levels prevent the site from providing optimum bald eagle habitat.

(2) Foster

The Foster affected area contained 905 acres of bald eagle habitat at the preconstruction period (Table 19). Open and closed conifer-hardwood forest cover types comprised most of the acreage, which also included riparian hardwood, open and closed sawtimber conifer forest, sand/gravel/cobble, and river cover types. Although anadromous and resident fish were available for food, the habitat was marginal. Protected perch sites with high visibility were available for roosting, but the area lacked large trees typically used by bald eagles for nesting. The evaluation team determined the suitability of the habitat within the affected area was below average for bald eagles and rated it 4, for a value of 362 HU's.

Construction of Foster Dam and Reservoir created 1,195 acres of reservoir and resulted in the loss of 479 acres of terrestrial habitat for bald eagles. The affected area was rated 2 (poor) due to the lack of a prey base. The fish and waterfowl populations had not yet become reestablished, indicating the eagle's main food sources were not yet available. The 292 HU's available at postconstruction represented a loss of 70 HU's for bald eagles.

Table 18. Bald eagle: Acres of habitat available and lost, habitat ratings, and habitat units at Green Peter Reservoir.

Cover Type	Pre Construction (1955)	Post Construction (1972)	Recent (1979)	Loss or gain (-,+) Pre to Post-construction	Loss or gain (-,+) Preconstruction to recent
	Acres	Acres	Acres		
Temperate conifer forest, open sawtimber	819	60	106	-759	-713
Temperate conifer forest, closed sawtimber	316	255	408	-61	+92
Temperate conifer forest, old-growth	8	8	6	0	-2
Conifer-hardwood forest, open	188	331	0	+143	-188
Conifer-hardwood forest, closed	792	199	717	-593	-75
Riparian hardwood	159	0	0	-159	-159
Sand/gravel/cobble	32	0	0	-32	-32
River	227	14	14	-213	-213
Reservoir	0	3,605	3,605	+3,605	+3,605
TOTAL ACRES	2,541	4,472	4,856	+1,931	+2,315
Habitat Rating	5	1	7		
HABITAT UNITS	1,271	447	3,399	-824	+2,128

By 1979, an additional 64 acres within the Foster affected area was available as bald eagle habitat, for a total of 1,526 acres (Table 19). The vegetation had not changed appreciably, roost sites had not yet developed around the reservoir, and no suitable nesting sites were located within the affected area. The prey base had increased over the 7-year period since postconstruction. Eagles wintering along the Middle Santiam River between Foster and Green Peter Dams fed on fish in the tailrace of Green Peter Dam. The evaluation team rated the suitability of the Foster affected area 5 (average) for bald eagles in 1979, which resulted in a value of 763 HU's at the recent period and indicated a gain of 401 HU's from preconstruction conditions.

(3) Summary of impacts

Construction of the Green Peter-Foster Project resulted in an increase of 2,936 acres of bald eagle habitat with a value of 2,529 HU's. This gain was primarily in foraging habitat, and represented a gain in the potential of the project area to support bald eagles and other wildlife species with similar habitat requirements.

11. Osprey

a. Importance

The osprey is included on the USFWS list of national species of special emphasis (USFWS 1982) and was chosen as a target species because of management interest within Oregon, and because this species may have benefited from construction of the Green Peter-Foster Project.

b. Habitat requirements

Ospreys inhabit mid to late-stage forests near lakes or large rivers. Nests are usually located within a mile of water (Koplin 1971), and are most commonly on the top of partially or completely dead trees ranging in height from 50-250 feet (French and Koplin 1972). Lind (1976) reported an average height of 120 feet and average dbh of 43 inches for osprey nest trees adjacent to Crane Prairie Reservoir, Oregon. In addition to the nest tree, at least one other large tree within 150 yards of the nest is regularly used by the nesting pair and fledglings for sunning, protection from wind, and as a "lookout" perch and feeding post (Lind 1976, Zarn undated). Ospreys require open and clear water for foraging. Their diet is almost exclusively fish, generally 6-12 inches in length (Lind 1976).

c. History in the project area

Information on osprey populations during the preconstruction period was not available. In 1976, Henny et al. (1978) identified 1 nesting pair each at Green Peter and Foster Reservoirs. There are currently 9 osprey nests in the vicinity of Green Peter Reservoir, 4 of which are known to be active (W. Logan, BLM; C. Bruce, ODFW; J. Sandberg, USACE, pers. communs.). Three of the nests are situated just outside the Green Peter affected area. Eight of the nests are located on the peninsula between

Table 19. Bald eagle: Acres of habitat available and lost, habitat ratings and habitat units at Foster Reservoir.

Cover Type	Pre Construction (1955)	Post Construction (1972)	Recent (1979)	Loss or gain (-,+) Pre to Post-construction	Loss or gain (-,+) Preconstruction to recent
	Acres	Acres	Acres		
Temperate conifer forest, open sawtimber	19	10	15	-9	-4
Temperate conifer forest, closed sawtimber	5	2	1	-3	-4
Conifer-hardwood forest, open	259	42	0	-217	-259
Conifer-hardwood forest, closed	282	196	288	-86	+6
Riparian hardwood	113	0	9	-113	-104
Sand/gravel/cobble	51	0	1	-51	-50
River	176	17	17	-159	-159
Reservoir	0	1,195	1,195	+1,195	+1,195
TOTAL ACRES	905	1,462	1,526	+557	+621
Habitat Rating	4	2	5		
HABITAT UNITS	362	292	763	-70	+401

the Middle Santiam River and Quartzville Creek. The ninth nest is near Trout Creek at the upper end of the Quartzville Creek arm of the reservoir. An additional 5 osprey nest sites have been located within 1/2 mile of Foster Reservoir (C. Bruce, ODFW, pers. commun.).

d. Assessment of impact

(1) Green Peter

Osprey habitat within the Green Peter affected area before construction consisted of open and closed sawtimber conifer forest, old-growth conifer forest, open and closed conifer-hardwood forest, riparian hardwood, sand/gravel/cobble, and river cover types for a total of 2,541 acres (Table 20). The fish prey base was ample; however, the narrow width of the stream may have restricted osprey use. The availability of old-growth conifers typically used for nesting by ospreys was limited. The evaluation team rated the suitability of the habitat for ospreys 5 (average), for a value of 1,271 HU's.

As with bald eagles, construction of Green Peter Dam and Reservoir resulted *in* the loss of 1,461 acres of terrestrial habitat for ospreys and the creation of 3,605 acres of reservoir (Table 20). The 4,472 acres of osprey habitat available at postconstruction was a gain of 1,931 acres from preconstruction. The vegetation above the inundated area was much the same as that present at preconstruction and primarily provided perch sites. The 159 acres of riparian hardwood cover type were lost, but a few old-growth conifers remained available. The prey base had been eliminated and had not yet recovered, resulting in a rating of 2 (poor) for the affected area at postconstruction. The value of 894 HU's was a loss of 377 HU's from preconstruction conditions.

The evaluation team considered the 4,856 acres of habitat within the affected area (Table 20) to be highly suitable for ospreys by 1979 and rated it 8 (high), for a total of 3,885 HU's. The prey base had recovered, although the productivity of the stream system was less than optimum, and several nests were located on the peninsula. The Green Peter Project resulted in a gain of 2,614 HU's from preconstruction to the recent period.

(2) Foster

The Foster affected area contained 905 acres of osprey habitat prior to construction, most of which was open and closed conifer-hardwood forests (Table 21). The evaluation team rated the suitability of the habitat 6 (above average), for a value of 543 HU's. The affected area had a good prey base, but few nest sites.

Construction of the Foster Project resulted in the loss of 479 acres of terrestrial habitat and the creation of a 1,195 acre reservoir (Table 21). The 1,462 acres of osprey habitat at postconstruction was rated 3 (below average), equal to 439 HU's. The few nest sites available before construction had been inundated, and the prey base was greatly reduced.

Table 20. Osprey: Acres of habitat available and lost, habitat ratings, and habitat units at Green Peter Reservoir.

Cover Type	Pre Construction (1955)	Post Construction (1972)	Recent (1979)	Loss or gain (-,+) Pre to Post-construction	Loss or gain (-,+) Preconstruction to recent
	Acres	Acres	Acres		
Temperate conifer forest, open sawtinber	819	60	106	-759	-713
Temperate conifer forest, closed sawtimber	316	255	408	-61	+92
Temperate conifer forest, old-growth	8	8	6	0	-2
Conifer-hardwood forest, open	188	331	0	+143	-188
Conifer-hardwood forest, closed	792	199	717	-593	-75
Riparian hardwood	159	0	0	-159	-159
Sand/gravel/cobble	32	0	0	-32	-32
River	227	14	14	-213	-213
Reservoir	0	3,605	3,605	+3,605	+3,605
TOTAL ACRES	2,541	4,472	4,856	+1,931	+2,315
Habitat Rating	5	2	8		
HABITAT UNITS	1,271	894	3,885	-377	+2,614

Natural revegetation and succession had increased the osprey habitat within the affected area to 1,526 acres by 1979 (Table 21). No nesting occurred within the affected area, but there were at least 5 nest sites in the vicinity of Foster. Ospreys will nest in isolated sites of older-age trees, and perch on young trees. The prey base had increased and ospreys used Foster Reservoir for foraging. The evaluation team rated the suitability of the habitat 7 (above average) for ospreys, resulting in a value of 1,068 HU's at the recent period, an increase of 525 HU's from preconstruction conditions.

(3) Summary of impacts

Construction of the Green Peter-Foster Project resulted in an increase of 2,936 acres of osprey habitat with a value of 3,139 HU's. This gain was primarily in foraging habitat, and represented a gain in the potential of the project area to support ospreys and other wildlife species with similar habitat requirements.

V. SUMMARY

The Green Peter-Foster Project inundated, extensively altered, or affected 7,873 acres of land and river in the Santiam River drainage. Impacts to wildlife centered around the loss of 1,429 acres of grass-forb vegetation, 768 acres of shrubland, and 717 acres of open sawtimber conifer forest at Green Peter-Foster. Nineteen cover types were directly affected by construction and operation of the hydroelectric-related components of the project. Acreages of each cover type were calculated for 3 time periods: prior to project construction (1955), directly after construction (1972), and more recently (1979).

Project impacts were evaluated for 11 wildlife species or species groups selected from a list of species likely to occur in the project area (Appendix A). A habitat-based evaluation system was used to assess the suitability of preconstruction, postconstruction, and recent habitat for the target species or species groups. Losses or gains to these species as a result of the hydroelectric-related components of the Green Peter-Foster Project were calculated and are summarized in Tables 22 and 23. Impacts resulting from the Green Peter-Foster Project included the loss of critical winter range for black-tailed deer and Roosevelt elk, and the loss of year-round habitat for deer, upland game birds, river otter, beaver, pileated woodpecker, and many other wildlife species. Bald eagle and osprey were benefitted by an increase in foraging habitat.

Impacts to target species were measured by determining the difference between habitat units (HU's) prior to construction and after construction. HU's are a measure of the quantity (habitat area) and quality (suitability) of available habitat. One HU is equivalent to 1 acre of optimum habitat. In most cases the losses in HU's were greater immediately following project construction than when measured 7 years after completion of the project because of natural revegetation in the portion of the affected area which was not inundated. These differences are discussed in the target species sections of the report. To simplify the summary table, however, only losses and gains which occurred from

Table 21. Osprey: Acres of habitat available and lost, habitat ratings and habitat units at Foster Reservoir.

Cover Type	Pre Construction (1955)	Post Construction (1972)	Recent (1979)	Loss or gain (-,+) Pre to Post-construction	Loss or gain (-,+) Preconstruction to recent
	Acres	Acres	Acres		
Temperate conifer forest, open sawtimber	19	10	15	-9	-4
Temperate conifer forest, closed sawtimber	5	2	1	-3	-4
Conifer-hardwood forest, open	259	42	0	-217	-259
Conifer-hardwood forest, closed	282	1%	288	-86	-6
Riparian hardwood	113	0	9	-113	-104
Sand/gravel/cobble	51	0	1	-51	-50
River	176	17	17	-159	-159
Reservoir	0	1,195	1,195	+1,195	+1,195
TOTAL ACRES	905	1,462	1,526	657	+621
Habitat Rating	6	3	7		
HABITAT UNITS	543	439	1,068	-104	+525

preconstruction to the more recent condition were addressed. The habitat units lost or gained (Tables 22 and 23) represent the change in the potential of the habitat to support the given species at one point in time. That potential, however, was lost over the entire life of the project, a point which should be remembered when planning mitigation. It should also be noted that HU's lost or gained are not totaled among species. Each species was evaluated separately. When mitigation, enhancement, or protection measures are conducted, a single activity may improve the habitat for more than one species and would be credited for doing so. If it is not possible to mitigate in-kind (for the same species which experienced losses), out-of-kind mitigation, and hence trade-off mitigation, may have to be negotiated. Benefits to bald eagles and ospreys, for example, may be credited against losses to other species during the process of establishing trade-off mitigation levels.

It was not practical or possible to estimate the number of animals lost or gained as a result of the project. Site specific wildlife population estimates prior to construction were not available. Density estimates by OSGC were available for the South Santiam River drainage in 1948 (OSCG) for deer and grouse, but these figures were generalized and not representative of the actual losses which occurred at the Green Peter-Foster Project site. Density estimates for deer do not reflect the level of use the project area might have received during severe winter conditions and, thus, its long term importance to the deer population in the drainage. The technique used in 1948 to estimate deer and grouse densities was not documented and these estimates were made 13 years prior to initiation of project construction. Possibly the factor which most complicates the attempt to estimate the number of animals lost or gained as a result of the Green Peter-Foster Project is the considerable change in conditions for wildlife in the Willamette Basin caused by timber harvesting and increased human use. The number of animals using the site at a given time does not adequately reflect the level of project impact because population fluctuations have occurred as a result of other factors. The potential of the affected area to support wildlife was altered as a result of the project, and that change can be quantified in terms of HU's.

Impacts considered in this report were limited to effects of construction and operation of the hydroelectric-related components of the Green Peter-Foster Project, unless otherwise stated. These impacts would have occurred even if the project was not used for flood control or other nonhydroelectric purposes. Quantitative impacts considered were limited to the area directly affected by the project. Cumulative or system-wide impacts were not quantitatively assessed. Losses of wildlife and wildlife habitat resulting from increased human development as a result of the Willamette Reservoir System were not addressed. Indirect impacts such as degredation of habitat adjacent to the project site as a result of increased human development, recreational use, or blockage of anadromous fish passage were not measured.

No documentation was found nor were resource agency personnel aware of any mitigation, enhancement, or protection measures implemented by USACE at the Green Peter-Foster Project to directly offset impacts to wildlife resulting from construction or operation of the project (Bedrossian et al. 1984).

Table 22. Summary of impacts (preconstruction to recent) to target species as a result of the hydroelectric-related components of the Green Peter Project, Middle Fork Santiam River, Oregon.

Species (group)	Acres of habitat lost or gained[a]	Habitat Units lost or gained[ab]	Estimated No. animals lost or gained[b]	Impacts
BIG GAME				
Roosevelt elk	-3,597	-3,997	Unknown	Loss of winter habitat. Migration and movement inhibited or blocked. Increased disturbance.
Black-tailed deer	-3,597	-3,997	Unknown	Loss of critical winter and year-round habitat. Migration and movement inhibited or blocked. Increased disturbance.
FURBEARERS				
River otter	-173	-575	Unknown	Loss of year-round habitat. Movement inhibited or blocked.
Beaver	-408	-381	Unknown	Loss of year-round habitat. Movement inhibited or blocked.
UPLAND GAME				
Ruffed grouse	-3,597	-3,264	Unknown	Loss of riparian habitat.
Band-tailed pigeon	-3,383	-3,487	Unknown	Loss of nesting and feeding habitat. Loss of mineral springs.

Table 22. (continued) Summary of impacts (preconstrucion to recent) to target species as a result of the hydroelectric-related components of the Green Peter Project, Middle Fork Santiam River, Oregon.

Species (group)	Acres of habitat lost or gained[a]	Habitat Units lost or gained[ab]	No. animals lost or gained[b]	Impacts
WATERFOWL				
Common merganser	+2,561	-21	Unknown	Loss of breeding habitat. Additional migratory resting habitat provided.
NONGAME SPECIES				
Pileated woodpecker	-1,372	-710	Unknown	Loss of year-round habitat. Increased disturbance.
Bald eagle	+2,315	+2,128	Unknown	Loss of nesting and roosting habitat. Increased disturbance. Foraging habitat increased.
Osprey	+2,315	+2,614	Unknown	Loss of nesting and perching habitat. Increased disturbance. Foraging habitat increased.

[a] From preconstruction (1955) to recent (1979).
[b] This number represents losses or gains at one point in time, not over the life of the project.

Table 23. Summary of impacts (preconstruction to recent) to target species as a result of the hydroelectric-related components of the Foster Project, Middle Fork Santiam River, Oregon.

Species (group)	Acres of habitat lost or gained[a]	Habitat Units lost or gained[ab]	Estimated No. animals lost or gained[b]	Impacts
BIG GAME				
Roosevelt elk	-1,001	-652	Unknown	Loss of winter habitat. Migration and movement inhibited or blocked. Increased disturbance.
Black-tailed deer	-1,001	-890	Unknown	Loss of winter/summer habitat. Migration and movement inhibited or blocked. Increased disturbance.
FURBEARERS				
River otter	-319	-340	Unknown	Loss of year-round habitat. Movement inhibited or blocked.
Beaver	-340	-245	Unknown	Loss of year-round habitat. Movement inhibited or blocked.
UPLAND GAME				
Ruffed grouse	-1,003	-853	Unknown	Loss of riparian habitat.
California quail	-673	-385	Unknown	Loss of year-round habitat.

Table 23. (continued) Summary of impacts (preconstrucion to recent) to target species as a result of the hydroelectric-related components of the Foster Project, Middle Fork Santiam River, Oregon.

Species (group)	Acres of habitat lost or gained[a]	Habitat Units lost or gained[ab]	No. animals lost or gained[b]	Impacts
WATERFOWL				
Wood duck	-478	-179	Unknown	Loss of breeding and preferred forage habitat.
NONGAME SPECIES				
Bald eagle	+621	+401	Unknown	Loss of nesting and roosting habitat. Increased disturbance. Foraging habitat increased.
Osprey	+621	+525	Unknown	Loss of nesting and perching habitat. Increased disturbance. Foraging habitat increased.

[a] From preconstruction (1955) to recent (1979).
[b] This number represents losses or gains at one point in time, not over the life of the project.

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APPENDIX A

WILDLIFE SPECIES POTENTIALLY OCCURING IN THE GREEN PETER - FOSTER DAM AND RESERVOIR PROJECT AREA 1 (PRECONSTRUCTION AND/OR POSTCONSTRUCTION)

Herptiles

Northwestern salamander
Long-toed salamander
Cope's giant salamander
Pacific giant salamander
Olympic salamander
Clouded salamander
Oregon slender salamander
Ensatina
Dunn's salamander
Larch mountain salamander
Western redback salamander
Roughskin newt
Western toad
Pacific tree frog
Tailed frog
Red-legged frog
Foothill yellow-legged frog
Cascade frog
Bullfrog
Spotted frog
Western pond turtle
Northern alligator lizard
Short-horned lizard
Western fence lizard
Western skink
Rubber boa
Racer
Sharptail snake
Ringneck snake
Gopher snake
Western terrestrial garter snake
Northwestern garter snake
Common garter snake
Western rattlesnake

Birds

Common loon
Pied-billed grebe
Horned grebe
Red-necked grebe
Eared grebe
Western grebe
Double-crested cormorant
American bittern
Great blue heron
Great egret
Green-backed heron
Greater white-fronted goose
Canada goose
Wood duck
Green-winged teal
Mallard
Northern pintail
Blue-winged teal
Cinnamon teal
Northern shoveler
Gadwall
American wigeon
Canvasback
Redhead
Ring-necked duck
Greater scaup
Lesser scaup
Harlequin duck
Common goldeneye
Barrow's goldeneye
Bufflehead
Hooded merganser
Common merganser
Ruddy duck
Turkey vulture
Osprey
Bald eagle
Northern harrier
Sharp-shinned hawk
Cooper's hawk
Northern goshawk
Red-tailed hawk
Golden eagle
American kestrel

1 Based on species list for reproductive habitat, Willamette National Forest, BLM Unit Resource Analysis, and Oregon Nongame Wildlife Management Plan, review draft.

Birds (Continued)

Merlin
Peregrine falcon
Prairie falcon
Ring-necked pheasant
Blue grouse
Ruffed grouse
California quail
Mountain quail
Virginia rail
Sora
American coot
Sandhill crane
Killdeer
Greater yellowlegs
Solitary sandpiper
Spotted sandpiper
Western sandpiper
Least sandpiper
Baird's sandpiper
Dunlin
Long-billed dowitcher
Common snipe
Wilson's phalarope
Ring-billed gull
Western gull
Black tern
Rock dove
Band-tailed pigeon
Mourning dove
Barn owl
Western screech owl
Great horned owl
Northern pygmy owl
Spotted owl
Barred owl
Great gray owl
Long-eared owl
Northern saw-whet owl
Common nighthawk
Black swift
Vaux's swift
Calliope hummingbird
Rufous hummingbird
Allen's hummingbird
Belted kingfisher
Lewis' woodpecker
Red-breasted sapsucker
Williamson's sapsucker
Downy woodpecker
Hairy woodpecker
White-headed woodpecker
Three-toed woodpecker
Black-backed woodpecker
Northern flicker
Pileated woodpecker
Olive-sided flycatcher
Western wood pewee
Willow flycatcher
Hammond's flycatcher
Dusky flycatcher
Western flycatcher
Western kingbird
Horned lark
Purple martin
Tree swallow
Violet-green swallow
Northern rough-winged swallow
Bank swallow
Cliff swallow
Barn swallow
Gray jay
Steller's jay
Scrub jay
Clark's nutcracker
American crow
Common raven
Black-capped chickadee
Mountain chickadee
Chestnut-backed chickadee
Bushtit
Red-breasted nuthatch
White-breasted nuthatch
Pygmy nuthatch
Brown creeper
Rock wren
Canyon wren
Bewick's wren
House wren
Winter wren
Marsh wren
American dipper
Golden-crowned kinglet
Ruby-crowned kinglet
Western bluebird
Mountain bluebird
Townsend's solitaire
Swainson's thrush
Hermit thrush
American robin
Varied thrush
Wrentit
Water pipit
Bohemian waxwing
Cedar waxwing

Birds (Continued)

European starling
Solitary vireo
Hutton's vireo
Warbling vireo
Red-eyed vireo
Tennessee warbler
Orange-crowned warbler
Nashville warbler
Yellow warbler
Black-throated blue warbler
Yellow-rumped warbler
Black-throated gray warbler
Townsend's warbler
Hermit warbler
American redstart
MacGillivray's warbler
Common yellowthroat
Wilson's warbler
Yellow-breasted chat
Western tanager
Black-headed grosbeak
Lazuli bunting
Green-tailed towhee
Rufous-sided towhee
Brown towhee
Chipping sparrow
Brewer's sparrow
Vesper sparrow
Savannah sparrow
Fox sparrow
Song sparrow
Lincoln's sparrow
Golden-crowned sparrow
White-crowned sparrow
Harris' sparrow
Dark-eyed junco
Red-winged blackbird
Western meadowlark
Brewer's blackbird
Brown-headed cowbird
Northern oriole
Rosy finch
Pine grosbeak
Purple finch
Cassin's finch
House finch
Red crossbill
White-winged crossbill
Pine siskin
Lesser goldfinch
American goldfinch
Evening grosbeak
House sparrow

Mammals

Virginia opossum
Vagrant shrew
Dusky shrew
Pacific shrew
Water shrew
Pacific water or Marsh shrew
Trowbridge's shrew
Shrew-mole
Townsend's mole
Coast mole
Little brown myotis
Yuma myotis
Long-eared myotis
Fringed myotis
Long-legged myotis
California myotis
Silver-haired bat
Big brown bat
Hoary bat
Townsend's big-eared bat
Pallid bat
Pika
Brush rabbit
Snowshoe hare
Mountain beaver
Yellow-pine chipmunk
Townsend's chipmunk
Siskiyou chipmunk
Yellow-bellied marmot
California ground squirrel
Golden-mantled ground squirrel
Western gray squirrel
Douglas' squirrel
Northern flying squirrel
Botta's pocket gopher
Western pocket gopher
Beaver
Deer mouse
Dusky-footed woodrat
Bushy-tailed woodrat
Western red-backed vole
Heather vole
White-footed vole
Red tree vole
Townsend's vole
Long-tailed vole
Creeping vole
Water vole
Muskrat
House mouse
Pacific jumping mouse
Porcupine

Mamnals (Continued)

Nutria
Coyote
Red fox
Gray fox
Black bear
Raccoon
Marten
Fisher
Ermine
Long-tailed weasel
Mink
Wolverine
Badger
Western spotted skunk
Striped skunk
River otter
Mountain lion
Lynx
Bobcat
Roosevelt elk
Mule deer
Black-tailed deer

APPENDIX B

Interagency Habitat Evaluation Group
Green Peter - Foster Project

Name	Agency
Geoff Dorsey	USACE
Larry Gangle	USFS
Wayne Logan	BLM
Jim Noyes	ODFW
Mary Potter	ODFW
John Sandberg	USACE
Neil TenEyck	ODFW
Pat Wright	USFWS

APPENDIX C

Comments

(1) State agency (ODFW)

To be included in the final report.

(2) Federal agencies (USFWS and BLM)

No comments were received from BLM.

(3) Tribes

No tribes are involved with the actions taken at the Green Peter-Foster Project.

(4) Facility operator (USACE)

BPA requested comments on the November 1985 Green Peter-Foster report by 31 December 1985. USACE had not submitted comments by 20 February 1986 when the final report was typed; therefore, USACE comments could not be incorporated into the report.

(5) Other (PNUCC)

PNUCC submitted comments on the Detroit/Big Cliff report only. It was assumed PNUCC's comments on the Detroit/Big Cliff report also applied to the Green Peter-Foster report; therefore, the comment letter is included in this report.

ODFW Comments:

Explanations or Modifications:

VICTOR ATIYEH
GOVERNOR

Department of Fish and Wildlife
506 S.W. MILL STREET. P.O. BOX 3503. PORTLAND. OREGON 97208

December 9, 1985

Mr. James R. Meyer
Division of Fish and Wildlife
Bonneville Power Administration
PO Box 3621
Portland, OR 97208

Dear Mr. Meyer:

The following comments respond to your request, dated 22 November 1985, to review the Loss Assessment Report for the Green Peter-Foster Project.

The Green Peter-Foster Loss Assessment presents an analysis of the impacts to wildlife and wildlffe habitat resulting from the construction and operation of the hydroelectric-related components of the project. The Green Peter-Foster Project inundated, extensively altered, or directly affected 7,873 acres of land and river in the Santiam River drainage. impacts to wildlife centered around the loss of 1,398 acres of grass-forb vegetation and 768 acres of shrubland. Important Roosevelt elk winter range was lost, as was year-round habitat for black-tailed deer, upland game birds, forbearers, pileated woodpeckers, and many other wildlife species. Impacts of the project included: blockage or inhibition of animal migration or movement; loss of thermal and/or hiding cover; alteration of open area and cover interspersion; loss of breeding, parturition and/or rearing habitat; fragmentation of contiguous habitat; loss or alteration of available forage; loss of nesting, perching and/or roosting sites; and avoidance of the project area by wildlife during construction.

The Green Peter-Foster Loss Assessment clearly shows the potential of the area to support wildlife was altered as a result of the project. That change was quantified in terms of Habitat Units. In this study, the tiabitat Units lost or gained represent the change in the potential of the habitat to support the given species, at one point in time. That potential, it should be emphasized, was lost over the entire life of the project. Habitat Units also may serve as a guide toward developing mitigation plans, as well as provide a method of measuring the success of mitigation implementation.

The Oregon Department of Fish and Wildlife has a legal mandate "To maintain all species of wildlife at optimum levels and prevent the serious depletion of any indigenous species," and "To develop and manage the lands and waters of this state in a manner that will enhance the production and public enjoyment of wildlife." In accordance with this mandate, the Oregon Department of Fish and Wildlife has a policy to request mitigation when losses to animal populations and habitat result from project construction and operation. These

No explanations or report modifications necessary.

ODFW Comments (cont.):

policies are consistent with the Northwest Power Planning Act and Wildlife Program purpose "to protect, mitigate, and enhance fish and wildlife to the extent affected by the development and operation of any hydroelectric project of the Columbia River and its tributaries..."

In order to "protect, mitigate, and enhance" wildlife resources affected by hydroelectric generating facilities, it is necessary to develop and implement mitigation plans. The Green Peter-Foster Loss Assessment represents the beginning of the process to achieve mitigation for the impacts to the wildlife resource resulting from construction of the project. The next step in the Council's Wildlife Program is the preparation of mitigation plans. I strongly urge the participating agencies to move forward in implementing the Wildlife Program of the Northwest Power Planning Council. The Oregon Department of Fish and Wildlife is ready to take the lead in developing a mitigation plan for the Willamette Basin. Consultation and coordination with the appropriate agencies involved in the project will be an integral part of the process. The Northwest Power Planning Act and the Power Council's Fish and Wildlife Program have provided the opportunity to correct past misunderstanding and shortsightedness regarding wildlife resources affected by the development and operation of hydroelectric power in the Columbia River Basin. The Oregon Department of Fish and Wildlife wants to-see that opportunity realized to the fullest degree possible in a timely, effective, and cost-efficient manner.

I appreciate your assistance in this program and look forward to working with you in a cooperative way to achieve our mutual objectives.

Sincerely,,

John R. Donaldson, PhD
Director

D16-9
EMS Projects Misc.

Explanations or Modifications (cont.):

No explanations or report modifications necessary.

USFWS Comments:

Explanations or Modifications:

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Portland Field Office
727 N. E. 24th Avenue
Portland, Oregon 97232

Reference, PW:mm

January 23, 1986

Mr. John Palensky, Director
Division of Fish and Wildlife
Attn: James Meyer
Bonneville Power Administration
P. 0. Box 3621
Portland, Oregon 97208

Dear Mr. Palensky:

We have reviewed the draft loss statement reports for Green Peter/Foster and Detroit/Big Cliff hydroelectric projects. The following comments are being provided for inclusion in each of the final loss statements.

In our opinion, the reports are well written and adequately describe the on-site wildlife impacts of each project. A comprehensive evaluation, based on habitat supported by population data when available, was conducted by a diverse team of wildlife biologists familiar with the area's wildlife resources. Our agency actively participated in each evaluation and we believe the methods employed to identify the wildlife impacts at each project resulted in a fair and accurate analysis of project impacts.

7 It is important to note that during each of the evaluations, the impacts were identified on a concensus basis by the evaluation team. This format provided for a thorough discussion of impacts, both beneficial and adverse, and provided a forum for resolving differences in a manner mutually acceptable to each agency's team representative. To the best of our knowledge, the impacts identified in the loss statements-accurately reflect both the discussions and decisions of the evaluation teams.

The evaluations did not address cumulative impacts that these and the other major Willamette Valley hydroelectric projects may have had on wildlife. we believe the extensive development that has occurred along the Willamette River's floodplains has significantly reduced a variety of wildlife habitats and related resources. In our opinion, that development and resultant wildlife losses would have been considerably less without the construction and operation of the aforementioned hydroelectric projects. Accordingly,

No explanations or report modifications necessary.

USFWS Comments (cont.):

the Power Council, BPA, and the Corps of Engineers, together with the wildljfe management agencies should address the cumulative impacts of the major Willamette Basin hydroelectric projects on wildlife.

In conclusion, we believe the magnitude of on-site wildlife losses identified in the loss statements for the Green Peter/Foster and Detroit/ Big Cliff hydroelectric projects warrants that mitigation planning be initiated as *early* as possible as provided for in the Power Council's Fish and Wildlife Program. We are eager to assist in these efforts and look forward to the day when on-the-ground mitigation can be implemented.

Sincerely,

Roger E Forderstrasse

for Russell D. Peterson
Field Supervisor

cc:
Jim Noyes, ODFW
ARD-HR, Dick Giger

Explanations or Modifications (cont.):

No explanations or report modifications necessary.

PNUCC Comments:

PNUCC

PACIFIC NORTHWEST UTILITIES CONFERENCE COMMITTEE

December 27, 1985

Mr. James Meyer PJS
Fish & Wildlife Division
Bonneville Power Administration
1002 N.E. Holladay
P.O. Box 3621
Portland, Oregon 97208-3621

Dear Jim:

The Pacific Northwest Utilities Conference Committee (PNUCC) submits this letter in response to your request for comments on the Oregon Department of Fish and Wildlife draft Wildlife and Wildlife Habitat Loss Assessment at Detroit/Big Cliff Dam and Reservoir Project, North Santiam River, Oregon.

This loss assessment does not differ technically from the previous loss assessments for the other Willamette Basin federal projects. The comments in our earlier review letter, dated July 29, 1985, therefore, also apply to this document. The following points highlight our major concerns.

The data and information included in the report are insufficient to evaluate the validity of the results. The information is presented within the context of abstract indices and the models and data relating the indices to the conditions at the project are absent. For example, we were not able to determine from the report the site-specific ecological difference between a habitat suitability index, "HSI," of 5 and one of 6, or even between one of 8 and one of 2. The changes in "HSI" reported as resulting from the hydroelectric proportion of the projects may be legitimate, but we were not able to verify these results.

2. The results of the losses evaluation are presented as though they are based on quantified data, although the data and sampling schemes are not reported. Input during the consultations indicated that much of the information is quite subjective. We recognize that the time constraints during this assessment precluded a detailed quantification of the "losses" and question whether such a quantification would be possible even under ideal time and funding conditions. Our concern is not with the subjectivity, but rather with presenting the results as if they were rigorously quantified when, in fact, they are qualitative and subjective. The available information may accomodate a qualitative evaluation of "low," "moderate," and "high" impacts. However. we feel that further detail is inappropriate unless rigorous

Explanations or Modifications

Habitat suitability indexes were derived from site visits, aerial photographs, vegetation maps, and biologists knowledge of species habitat requirements. Group discussions and averaging agency representatives ratings yielded habitat suitability indexes ranging from low to "optimum", expressed on a scale of 1-10. See Section III.E. for discussion of methods and rating criteria. Tha numeric rating system and resulting Habitat Units provide a method to credit mitigation, protection, or enhancement activities against project impacts.

PNUCC Comments (cont.):

3. No population data is included to support the "losses" reported in the document. We have found documentation* of increases in Willamette Basin populations for several of the "impacted" species during the 1950s and 1960s, the decades of and following construction of these dams. Black-tailed deer and Roosevelt elk were reported in 1969-15 years after completion of Detroit--as being at their highest populations since the 1930s. Several other target species populations were reported as "satisfactory" or "unaffected by development." The conflicting information between the "HEP" analysis in this report and the population trends is a serious concern.

PNUCC does not believe that the Willamette projects loss assessments provide information that justifies a major wildlife mitigation program in the basin. We continue to support the "good stewardship" protection policies of the project operator, the Army Corps of Engineers. Our position remains unchanged from that stated in our letter of August 14, 1985. Thank you for this opportunity to comment.

Sincerely,

Kathryn Kostow

Kathryn Kostow
Fish & Wildlife Analyst

*Pacific Northwest River Basins Commission - Willamette Basin Task Force. (1969) Willamette Basin: Comprehensive Study of Water and Related Land Resources. Ap. D: Fish and Wildlife.

KK:lp: 1631

cc John Palensky - BPA
Pam Barrow - PNUCC
Martin Montgomery - NWPPC
Jim Noyes - ODFW
Mary Potter - ODFW

Explanations or Modifications (cont.):

Site-specific wildlife population estimates prior to construction were not available. Wildlife population fluctuations in the Willamette Basin have occurred as a result of several factors. Because density estimates can often be misleading indicators of habitat quality, we evaluated the changes in habitat potential. The potential of the Detroit Project affected area to support wildlife has been altered, and it will remain so for the life of the project.