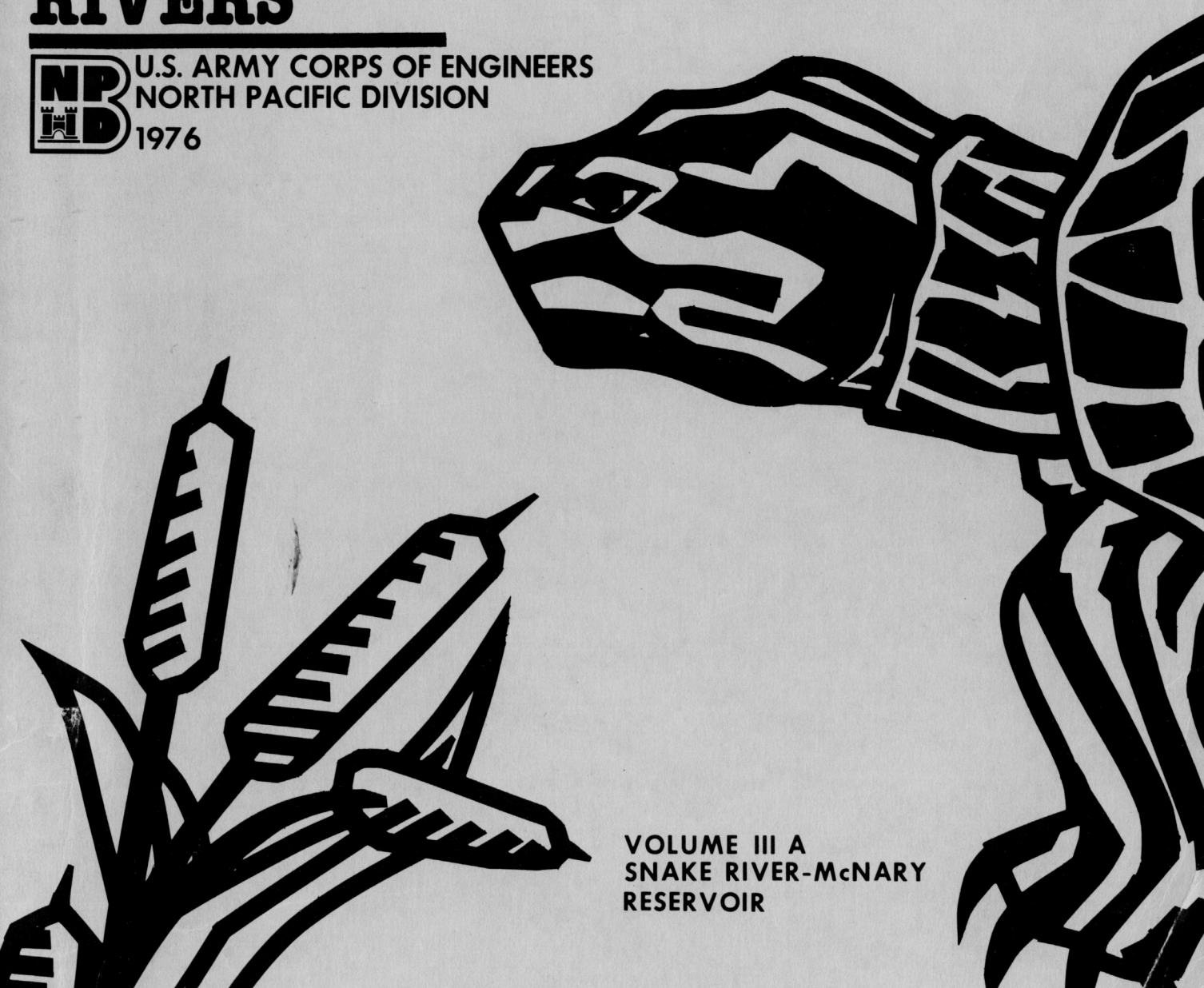
INVENTORY OF RIPARIAN HABITATS AND ASSOCIATED WILDLIFE ALONG COLUMBIA AND SNAKE RIVERS

U.S. ARMY CORPS OF ENGINEERS
NORTH PACIFIC DIVISION
1976



VOLUME III A
SNAKE RIVER-McNARY
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VOLUME 3A

INVENTORY OF RIPARIAN HABITATS AND ASSOCIATED WILDLIFE ALONG THE COLUMBIA AND SNAKE RIVERS

to

U.S. Army Corps of Engineers

Wildlife Work Group

from

Duane A. Asherin

James J. Claar

Idaho Cooperative Wildlife Research Unit

Maurice G. Hornocker, Leader

Elwood G. Bizeau, Assistant Leader

College of Forestry, Wildlife and Range Sciences

University of Idaho

John H. Ehrenreich, Dean

1976

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We are grateful to members of the Wildlife Work Committee for their continued support and review of this project. Past and present members include Dick Norell and Ralph Pehrson, Idaho Department of Fish and Game; Jim Harper and Norm Behrens, Oregon Department of Fish and Wildlife; Gene Dziedzic, Washington Department of Game; Phil Lehenbauer and Dick Giger, U.S. Fish and Wildlife Service; and John McKern, U.S. Army Corps of Engineers. Edward Mains, U.S. Army Corps of Engineers, acted as Advisor to the Wildlife Work Committee and Jack Howerton, Washington Department of Game, was the Study Coordinator. John McKern, Authorized Representative for the U.S. Army Corps of Engineers, was particularly helpful at all stages of the study.

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ABSTRACT

This study was designed to inventory the riparian and upland habitats and their associated wildlife populations along 400 river miles of the Snake and Columbia Rivers. The study area encompassed the Snake River from Westlake Island, just above Brownlee Reservoir, downstream to the confluence of the Snake and Columbia Rivers and the Columbia River from McNary Dam upstream to the USAEC Hanford Reservation boundary. Inventory of vegetation and vertebrates, exclusive of fishes, constituted the primary objectives. Secondary objectives included a preliminary assessment of the impacts of fluctuating water levels due to power peaking operations on the various vegetation types and the wildlife utilizing these vegetation types and a documentation of human use of the wildlife resources in the study area based on existing records and observations during the study.

Eighty sites or stands distributed throughout 8 study area segments were used for the vegetation inventory. Analysis of quantitative vegetation data collected on these sites determined the presence of 25 major vegetation types in the riparian and upland zones. Classification procedures identified 56 plant communities comprising these major vegetation types. Qualitative descriptions for the riparian and upland plant communities are presented along with the corresponding plant species lists and quantitative characteristics of the communities. A key to the vegetation types and plant communities identified in the study area was also developed. Major vegetation types and landforms in the 8 study area segments were delineated on aerial photos and their extensiveness determined on an acreage and shoreline mile basis. Two major riparian plant communities are compared between the lower Salmon River, which is naturally regulated with an annual spring flood and a gradual recession, and the middle Snake River, which is artificially regulated by Hells Canyon Dam and fluctuates daily.

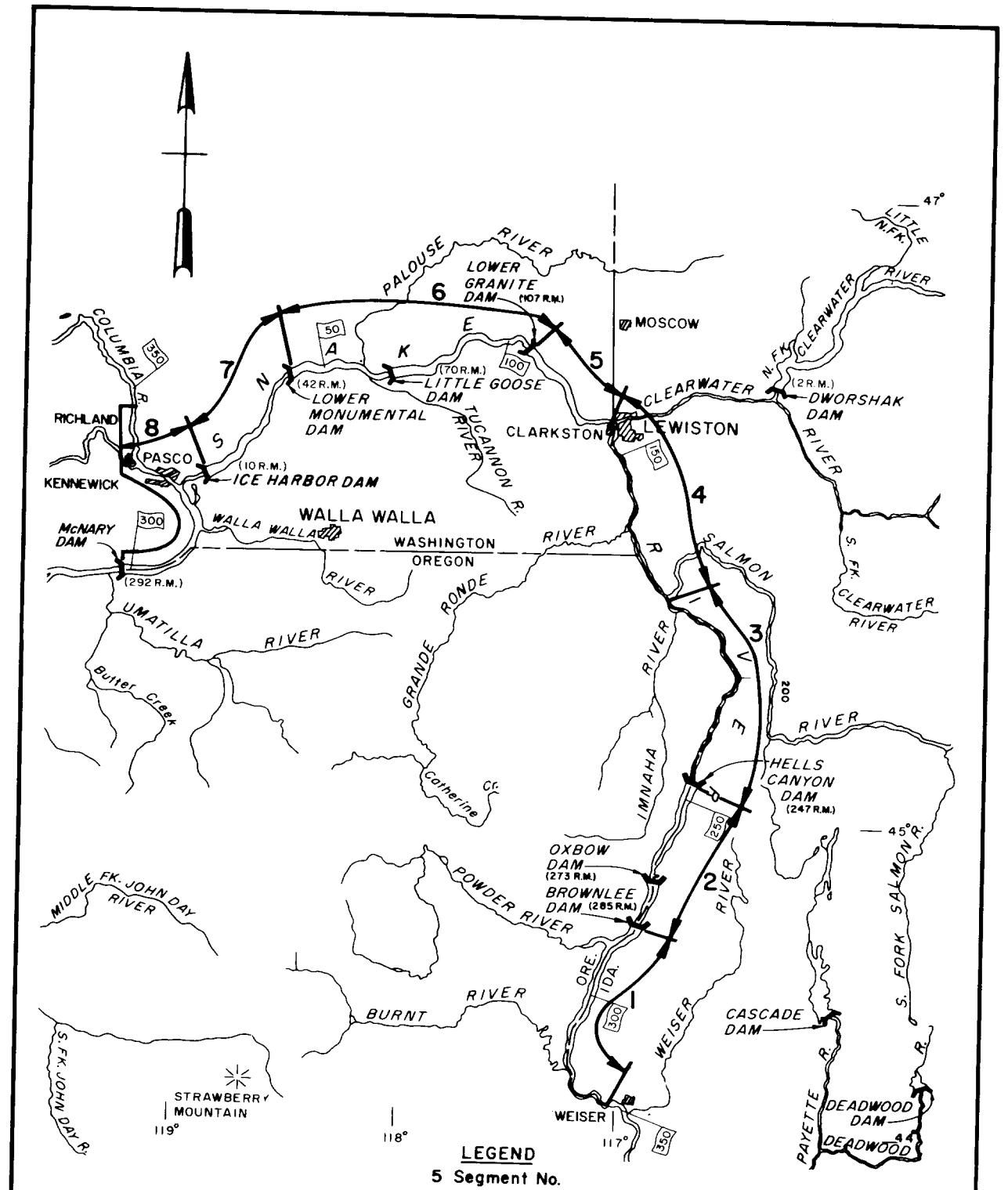
The occurrence, distribution and abundance of vertebrate species are identified in the major vegetation types and/or in the 8 study area segments. Big game, waterfowl, aquatic furbearers, and birds of prey were inventoried throughout the study area while upland game birds and mammals, terrestrial furbearers, other birds (primarily passerines), small mammals, amphibians and reptiles were inventoried on 73 intensive sampling sites located in the major vegetation types represented in the study area segments. An audio census technique was developed for the chukar partridge and used to determine the distribution and relative abundance of this species in the study area.

Human use of wildlife resources in the study area consists primarily of hunting for waterfowl (mostly Canada geese and mallards) and upland game birds (mostly ring-necked pheasants) along McNary Reservoir and for upland game birds (mostly chukars) and big game (mostly mule deer) throughout the lower and middle Snake River. Limited trapping of aquatic furbearers (mostly beaver and muskrats) occurs along McNary Reservoir while in the middle and lower Snake River, primarily terrestrial furbearers (coyotes, bobcats and raccoons) are trapped. Nonconsumptive human uses of wildlife resources include observing and photographing wildlife and educational and research uses. Middle Snake River recreationists, primarily floaters and boaters, apparently select recreational experiences here for the opportunity to observe wildlife and be in an undeveloped area, namely Hells Canyon.

Wave action from wind, boats and barges is causing serious bank erosion or sluffing to occur along vast stretches of shoreline in the study area. Power peaking increases the vertical area of this bank erosion process. Shoreline erosion is most widespread along Brownlee Reservoir and throughout the lower Snake River. Evidence also indicates that sand bars are decreasing in size and numbers in the middle Snake River reaches as a result of being eroded away during high flows in the spring and from wave action caused by power boats. Fluctuations in water levels due to power peaking may be accelerating this process. Formation of new sand bars is limited due to the trapping of sediments by the upstream reservoirs.

Direct impacts to wildlife groups from fluctuating water levels noted during this study and/or aniticipated under future power peaking operations include: big game -- flooding of island fawning and rearing habitat, formation of land bridges to fawning islands during low water levels allowing predator access; upland game birds -- flooding of riparian roosting habitats; waterfowl -- flooding of nest sites, formation of land bridges to nesting islands allowing predator access, decreased accessibility of broods to foraging areas and possible increase in predation due to creation of mudflats during low water levels, decreased waterfowl use of shallow water areas for resting and feeding and corresponding decrease in availability to hunters due to creation of mudflats during low water levels; aquatic furbearers -- flooding of den sites causing drowning of young, benefits from stranding of food items during low water levels; other birds -- flooding of shorebird nest sites, increase in shoreline foraging area during low water levels but decrease in foraging area during high water levels; small mammals -- periodic flooding of riparian habitats causing decrease in available home ranges resulting in decreased numbers; amphibians -- low water levels causing stranding of eggs and subsequent desiccation and loss of reproductive effort; reptiles -- small mammal prey base reduced in riparian habitats, benefits from stranding of small fish and aquatic organisms during low water levels.

Indirect impacts to all wildlife groups inventoried are indicated in the preliminary assessment of effects of fluctuating water levels on wildlife through effects on riparian vegetation. Specific impacts future power peaking operations will have on riparian habitats are unknown, however, and whether effects, if any,will be detrimental, beneficial or both, depending on the particular riparian plant community, is uncertain. Evaluation and identification of effects on riparian habitats is prerequisite to an assessment of final impacts -- short term and long term -- on wildlife species utilizing these habitats.



LEGEND

5 Segment No.

NOT TO SCALE

FISHERIES ENGINEERING RESEARCH PROGRAM

INVENTORY OF RIPARIAN HABITATS 1973 - 1975

UNIVERSITY OF IDAHO

STUDY AREA

SNAKE RIVER

RMO TO RM 344.9

COLUMBIA RIVER

RM 292 TO RM 345.5

U.S ARMY ENGINEER DISTRICT, WALLA WALLA

INTRODUCTION

Plans have been made by the North Pacific Division of the U.S. Army Corps of Engineers to coordinate operation of the dams on the Columbia and middle and lower Snake Rivers to maximize hydroelectric production. As a result, river flows and pool levels will fluctuate on a substantially different daily, weekly, and seasonal regime than at present.

A Wildlife Working Committee,[1/] named to coordinate wildlife research as it relates to water regulation of the Snake and Columbia Rivers, determined that an inventory of riparian habitats and associated wildlife populations is the first research priority. The Committee further wants this inventory information to be used in making preliminary assessments of proposed river regulation impacts upon the riparian and upland habitats and wildlife. This study was designed to accomplish these objectives.

The area of interest as stipulated by the Wildlife Working Committee is the Columbia River from its mouth to the Canadian border and the Snake River upstream to and including Brownlee Reservoir. This is a total distance of approximately 1,100 river miles.

DEFINITION OF STUDY AREA

General Study Area Defined

The primary area of inclusion was the minimum area considered, and included that area of shoreline 10 feet in elevation above highest water levels. Study area boundaries in most cases were located in such a way as to include more than the minimum area. Man-made and natural boundaries (highways, railroads, levees, cliffs, vegetation, etc.) were used for convenience. All portions of islands were included irrespective of relief and vegetation patterns. All Corps of Engineers project lands adjacent to the shoreline were included.

The secondary area of inclusion included those areas, above the primary area of inclusion, that were deemed necessary to include as habitat of a particular vertebrate species or group of species.

Specific Study Area Defined

The Idaho Cooperative Wildlife Research Unit was responsible for studies from the upper end of Brownlee Reservoir (RM 344.9) to the confluence of the Snake and Columbia Rivers and the Columbia River from RM 345.5 downstream to McNary Dam--a distance of approximately 400 miles.

The study area was divided into the following 8 study segments on the basis of geographic location, vegetation similarities, and water levels:

[1/] The Wildlife Working Committee is comprised of representatives of the U.S. Fish and Wildlife Service (Chairman), Washington Dept. of Game, Oregon Dept. of Fish and Wildlife, Idaho Dept. of Fish and Game, and the Corps of Engineers.

(1) Brownlee Reservoir to and including West Lake Island, (2) Oxbow and Hells Canyon Reservoirs, (3) Hells Canyon Dam to the confluence of the Salmon and Snake Rivers, (4) confluence of the Salmon and Snake Rivers to the confluence of the Clearwater and Snake Rivers, (5) confluence of the Clearwater and Snake Rivers to Lower Granite Dam, (6) Little Goose and Lower Monumental Reservoirs, (7) Ice Harbor Reservoir, and (8) Ice Harbor Dam to the confluence of the Snake and Columbia Rivers and McNary Reservoir to the USAEC Hanford Reservation.

Specific study area boundaries used along the 8 study segments are listed in Table 1. Where no specific boundary is listed for a segment of the study area, natural boundaries of relief and riparian vegetation were used. No upper limits were placed on upland vegetation types where these types extended beyond the study area boundary. Upland vegetation types occurring above the study area boundary were identified, however, and the initiation of each type delineated.

OBJECTIVES

1. Identify, delineate, and describe the riparian and associated upland habitats of the study area.
2. Establish indices and make population estimates where possible for wild vertebrates species, exclusive of fish, using these habitats.
3. Make preliminary assessments of proposed river regulation impacts upon these habitats and their associated vertebrate populations within the study area.
4. Gather information pertinent to human use of wildlife resources in the study area.

LITERATURE REVIEW

Geologic History

The study area lies within the Columbia physiographic province and involves certain parts of the Seven Devils and Tristate Upland sections. In the Hells Canyon area, the river has incised a deep gorge which traverses an area of uplifted plateau and rugged mountainous sub-areas. Cook (1954) states a tertiary erosion surface of about 2,000-foot relief was unconformably covered with a thick series of basalt flows in Miocene time. This series is referred to as the Columbia River basalt and was formerly of widespread distribution in this area.

Columbia River basalts have been removed over extensive areas of their former occurrence due to uplift and relatively rapid erosion of the nearby Seven Devils Mountains and plateau area. These processes have exposed some older rocks of the Seven Devils volcanics (Permian and Triassic) and a series of Triassic sedimentary rocks. Wagner (1945) named an exposure of Triassic sedimentary rocks the "Pittsburg formation" located near Pittsburg Landing on the Snake River. Some intrusions of tertiary granitic rocks of the Idaho Batholith are found in the older rocks.

Table 1. Definition of specific study area boundaries.

STUDY AREA PORTION	STUDY AREA BOUNDARIES	
	Right Bank	Left Bank
West Lake Island to Brownlee Dam	Union Pacific Railroad from Porters Island (RM 342) to Steck Park (RM 327.9), Gravel Road from Steck Park (RM 327.9) to Horse Creek (left bank) (RM 319), Gravel Road from Trail Creek (RM 315.0) to Dennett Creek (RM 285.0), Idaho Highway 71 from Brownlee Creek (RM 287.4) to Brownlee Dam (RM 285.0).	US Highway 30 from Porters Flat (RM 341.0) to Farewell Bend State Park (RM 333.0), Snake River Road from Burnt River (RM 327.7) to Soda Creek (RM 307.4).
Oxbow Reservoir	Natural boundaries of relief and riparian vegetation.	Idaho Power paved road from Brownlee Dam (RM 285.0) to Oxbow Dam (RM 273.0)
Hells Canyon Reservoir	Idaho Power paved road from Pine Creek (left bank) (RM 269.7) to Hells Canyon Dam (RM 247.0).	Gravel Road from Hunsaker Creek (RM 269.6) to Copper Creek (RM 261.7).
Hells Canyon Dam to Grande Ronde River	Natural boundaries of relief and riparian vegetation.	Natural boundaries of relief and riparian vegetation.
Grande Ronde River to Lewiston-Clarkston	Natural boundaries of relief and riparian vegetation.	Gravel and paved road from Grande Ronde River (RM 168.7) to Interstate Bridge Clarkston (RM 139.6).
Lewiston-Clarkston to Lower Granite Dam	Camas Prairie Railroad from Clearwater River (RM 139.3) to Lower Granite Dam (RM 107.5).	US Highway 12 from upper end Dry Gulch Island (RM 136.6) to Alpowa (RM 130.9).
Little Goose Reservoir	Camas Prairie Railroad from Lower Granite Dam (RM 107.5) to Little Goose Dam (RM 70.3).	Almota Ferry Road from Casey Creek (RM 101.6) to Lower Granite Dam (RM 107.5).

Table 1. Continued.

STUDY AREA PORTION	STUDY AREA BOUNDARIES	
	Right Bank	Left Bank
Lower Monumental Reservoir	Camas Prairie Railroad from Little Goose Dam (RM 70.3) to Riparia (RM 67.1), Union Pacific Railroad from Riparia (RM 67.1) to Tucannon Railroad Junction (RM 61.8).	Paved Road from Little Goose Dam (RM 70.3) to just above Tucannon River (RM 63.2), Union Pacific Railroad from Perry (RM 56.2) to Lower Monumental Dam (RM 41.6).
Ice Harbor Reservoir	Burlington Northern Railroad from Lower Monumental Dam (RM 41.6) to Ice Harbor Dam (RM 9.7).	Union Pacific Railroad from Lower Monumental Dam (RM 41.6) to Ice Harbor Dam (RM 9.7) (excluding Anchor Canyon Area).
Ice Harbor Dam to confluence of Snake and Columbia River	Burlington Northern Railroad from Ice Harbor Dam (RM 9.7) to the mouth of Snake River (RM 324.3).	Natural boundaries of relief and riparian vegetation.
Confluence of Snake and Columbia Rivers to McNary Dam	Burlington Northern Railroad from Villard Junction (left bank) to McNary Dam.	Burlington Northern Railroad from mouth of Snake River to Union Pacific Railroad Bridge. Union Pacific Railroad from Union Pacific Railroad Bridge to Hat Rock State Park.
Confluence of Snake and Columbia Rivers to USAEC Hanford Reservation	Levee construction from mouth of Snake River to US Highway Bridge, US Highway 12 from Columbia River bridge to Richland, Levee construction from south to north end of Richland.	Levee construction from Sacajawea State Park to opposite the mouth of Yakima River (RM 334.5--right bank).

Near the confluence of the Snake and Grande Ronde Rivers, Savage (1965) reported an occurrence of the Lucille series (late Triassic) sedimentary rocks in the vicinity of Lime Point. Wagner (1945) described the Lucille series as divisible into a lower graphitic schist and calcareous shale member, a middle limestone member, and an upper phyllitic and schistose member in which are some volcanic flows.

In eastern Washington, the Snake River similarly carved through 1700 to 2000 ft of basaltic bedrock of the Columbia Plateau. Canyon sides are typically steep with numerous talus slopes and cut by numerous tributary canyons. In this area, as on the stretch of river on the Idaho-Oregon border, there is little margin for valley bottom and flood plain. Adjacent to the river canyon in eastern Washington lie the rich loess deposits of the Palouse Plateau.

A series of strikingly different formations support the diversity of flora and fauna that occur along the river. These depositions result in formations ranging from transitory and peninsulas to large islands of permanent rock and gravel accumulations. Sandbars and alluvial fans contain various deposits of silt, sand, and gravel. These deposits range in ages from Pleistocene to Recent.

Ross and Savage (1967) classified the major soil type adjacent to the Snake River in the Idaho section of the study area as dark-colored, semi-arid Chestnut soils. On the upper reaches of Brownlee pool, they classified hillside soils as slightly dark-colored, semi-arid Brown soils. Daubenmire (1970) stated that these same major soil groups occur adjacent to the Snake River in Washington, though specific horizon characteristics and development are often different.

To investigate the archaeological history of the lower Snake River Canyon, the Anthropology Department at Washington State University has conducted a summer field school in the Wawawai area since 1955. This work has been financed by the National Park Service and the Army Corps of Engineers. Several "digs" have been made in the Lower Granite Dam area supervised by Dr. Roderick Sprague of WSU. Several interesting artifacts have been discovered, some of which indicate a civilization at least 10,000 years old. These finds in the Granite Point area were of Lind Coulee and Marmes Rockshelter materials. Bones of deer, buffalo, elk, and antelope have been found at some of these sites.

Recent History

Nez Perce Indians inhabited the region prior to white settlement, and the canyons were the wintering areas of these people. Horses were introduced from the Great Plains in the mid-1700s, and large herds grazed in the canyons during the following century or longer.

In 1805, the Lewis and Clark expedition marked the beginning of the best recorded information on the fauna, flora, and other aspects of the Columbia and Snake River country. Specific descriptions of the many species they collected and preserved are summarized by Cutright (1969).

Other expeditions that penetrated deep into Snake River country were in conjunction with beaver trade and exploration. One such expedition led by Messrs. Hunt and Crook killed an "ahsahta" or bighorn sheep in Hells Canyon during a desperate hunt for meat (Irving 190?:241). This was late in the year of 1812. Other sightings of deer, elk, and bear were infrequently mentioned by these explorers who often survived on dog and horse meat. Several other parties (Haines 1971 and Davies 1961) crossed this land and many of the geographic names they coined are used today.

There are many tales of early gold discovery in the Snake River country, but it was not until 1861 that a large discovery by E. D. Pierce on the Clearwater River started the rush (Gulick 1971). Thousands of prospectors explored the Snake River and its tributaries fighting Indians and each other. By the autumn of 1868, the major placer claims "played out" and the few mining operations that remained were tunnels deep into hardrock.

The Snake and lower Salmon River canyon country was opened to white settlers and their livestock about 1879 at the end of the Nez Perce Indian War. Large numbers of cattle heavily grazed the range until the 1920s when they were mainly replaced by sheep (Evans and Tisdale 1972). By the 1940s many ranchers returned to cattle herds due to economic and labor problems in the sheep industry.

Early settlers along the lower Snake River planted orchards of apricots, cherries, and peaches. These crops and others such as tomatoes and melons were transported to market by steamship (Crithfield 1968). Grain crops grown on the fields above the canyon were brought to the river at various points to be loaded on steamships for transport. Feedlots for cattle were also developed along the river. Today, the area economy is mainly dependent on grain and livestock production.

Since the 1940s, an ever increasing demand for electrical power and irrigation water has resulted in dam construction on the Snake River. The lower Snake River lock and dam projects: Ice Harbor, Lower Monumental, Little Goose, and Lower Granite, were authorized to provide slackwater navigation, irrigation water, and hydroelectric power. Lower Granite project, completed in 1975, is also expected to provide flood protection for the Lewiston-Clarkston area. Ice Harbor, Lower Monumental, and Little Goose projects were basically completed in 1961, 1969, and 1970, respectively. McNary Dam on the Columbia River was completed about 1953.

On the middle Snake River, three dams have been constructed by Idaho Power Company. Brownlee, Oxbow, and Hells Canyon dams were completed in 1959, 1961, and 1964, respectively. In late 1975, the U.S. Congress created the Hells Canyon National Recreation Area which deauthorizes any dam construction, at least in the immediate future, in approximately 100 mi of the middle Snake River below Hells Canyon Dam. The U.S. Forest Service is currently involved in a 3-year study to develop a management plan for the newly created Hells Canyon NRA.

Climate

The Snake River canyon is typically hot and dry in summer with mild winters. Winter conditions in the canyon tend to be milder than those of the adjacent uplands (U.S. Depts. of Commerce and Interior 1972). Precipitation falls most heavily in the late fall-winter and spring periods.

The weather station at Kennewick, Washington (elev. 392 ft), recorded an average annual precipitation rate of 7.14 inches over 77 years. The average annual temperature for 65 years was 53.7°F. Maximum temperatures occurred in July, averaging 75.3°F, and minimum temperatures occurred in January, averaging 32.1°F (Bureau of Reclamation 1972).

Comparatively, the weather station at Lewiston, Idaho (elev. 1,413 ft), recorded an average annual precipitation rate of 13.73 inches over 88 years. The average annual temperature for 56 years was 52.7°F. Maximum temperatures occurred in July, averaging 75.1°F, and minimum temperatures occurred in January, averaging 31.8°F (Bureau of Reclamation 1972).

Flora[1/]

Daubenmire (1970) described the climatic climax associations of the steppe vegetation in eastern Washington. The habitat-types discussed cover the study area except for that portion south of the confluence of the Salmon and Snake Rivers. The slopes and narrow bottomlands of the Snake River Canyon in Washington and adjacent Idaho are in the *Artemisia tridentata-Agropyron spicatum* and *Agropyron spicatum-Poa sandbergii* habitat types. Very little of the area is occupied by the climax association that Daubenmire (1970) describes. The vegetation has been disturbed and is presently in a stage of secondary succession. The same plant associations are described by Franklin and Dyrness (1973) as occurring along the Snake River between Oregon and Idaho.

Several descriptions of seral vegetation along the middle Snake River are available. Campbell (1962) described vegetation in the *Agropyron spicatum-Festuca idahoensis* habitat-type which occurs at elevations above the study area. This habitat-type comes closest to the river in the area of Hells Canyon Dam. Hironaka (1954) described vegetation in the *Agropyron-Poa* habitat-type that had been invaded by goatweed (*Hypericum perforatum*). These communities have been changed by the biological control of goatweed. Evans and Tisdale (1972) discuss the distribution and role of red threeawn (*Aristida longiseta*) in the Snake River Canyon between the confluences of the Clearwater River and the Salmon River with the Snake River. Evans and Tisdale (1972) describe communities dominated by red threeawn. While we did not encounter communities dominated by red threeawn, we did find it to be a common component of seral communities.

Several studies have dealt with the riparian vegetation in Washington. Buss and Wing (1966) and Culbertson (1967) intensively described the vegetation on six islands that have since been inundated by Little Goose and Lower Granite Reservoirs. Consequently, their vegetation zones were not encountered on these reservoirs in this study.

[1/] Scientific and common names follow Hitchcock and Cronquist (1973) and Asherin (1973b).

Islands in the Hanford Reservation were cover typed by Hanson and Eberhardt (1971) and their typing is used as part of our vegetation typing. Shoreline and adjacent vegetation in the Hanford Reservation area were studied by Anthony (1968) in conjunction with California quail research.

Clegg (1973) compiled a species list with presence and abundance ratings for the vegetation that was inundated by Lower Granite Reservoir. He points out that 40 percent of the species he encountered were classified as weeds. This is a result of the great degree of disturbance caused by erosion, road building, development, grazing, and introduced seed that is associated with the river shorelines.

Fauna[1/]

Mammal and bird species with ranges which overlap all or part of the study area were determined from the following references: mammals--Burt and Grossenheider (1964), Dalquest (1948), and Larrison (1967); birds--Buss and Wing (1966), Jewett et al. (1953), Larrison et al. (1967), Robbins et al. (1966), and species lists from McNary National Wildlife Refuge and McNary Wildlife Park. A total of 87 species of mammals and 257 species of birds were determined as potentially occurring in the study area.

Vertebrate information, exclusive of fishes, from the middle Snake River region is limited. The U.S. Department of the Interior Report (1968) presents some general population estimates for some wildlife groups in the middle Snake River area from Hells Canyon Dam to near the mouth of the Grande Ronde River. Populations estimates of 4,200 elk (*Cervus canadensis*); 17,300 mule deer (*Odocoileus hemionus*); 41,100 upland game birds including chukars, gray partridges, California and mountain quail; and 350 geese are given. No estimate of the numbers or species of the fur animals that inhabit this area is given but it is pointed out that trapping is of little consequence in this area and is expected to remain that way in the future. This study in this region is essentially an initial inventory from the standpoint of species distribution and population estimates, exclusive of ungulates. Big game census data are available from the Idaho, Oregon, and Washington wildlife agencies. These data are presented later in this report in the big game section.

Of the large ungulates that inhabit the study area, mule deer are the most common. The elk herd referred to above primarily inhabits the Wallowa Mountains of northeastern Oregon and winters on the river breaks. Dalquest (1948) and Ingles (1965) reported that white-tailed deer (*Odocoileus virginianus*) were restricted to the lower Columbia River area and northeastern Washington, although Dalquest (1948) stated this species probably was once more widespread in Washington. White-tailed deer observations have more recently been recorded along the Columbia River in the Hanford Reservation (O'Farrell and Hedlund 1972). These observations support the contention that white-tailed deer are extending or perhaps re-establishing their range into south-central Washington.

[1/] Scientific and common names for vertebrates follow Hall and Kelson (1959), Burt and Grossenheider (1964), and Stebbins (1966). All bird names conform to the A.O.U. Checklist of North American Birds (1957) as amended in 1973.

Two big game transplants have occurred recently in the middle Snake River region. One of these by the Idaho Fish and Game Department, was an introduction of mountain goats (*Oreamnos americanus*) into the Seven Devils Scenic Area in the early 1960s. Bighorn sheep (*Ovis canadensis*), originally present in this area, were re-introduced in 1971 near Hells Canyon Dam by the Oregon Game Commission. No specific information was found on the larger carnivores and/or omnivores such as black bear (*Ursus americanus*), mountain lion (*Felis concolor*), and bobcat (*Lynx rufus*) that inhabit the study area.

The Washington Department of Game estimated furbearer populations in the lower Snake River region based on catches over a period of years. They estimated 1,060 beaver (*Castor canadensis*) from a catch of 212 in 1957, 26,850 muskrats (*Ondatra zibethica*) from a catch of 2,685 between 1960-1965, 2,300 mink (*Mustela vison*) from a catch of 230 between 1960-1965, and 120 river otter (*Lutra canadensis*) from a catch of 12 in 1964. Comparable data for the remainder of the study area were not found.

Rickard (1960) trapped small mammals in undisturbed climax plant associations in eastern Washington and northern Idaho. Four small mammal species: the sagebrush vole (*Lagurus curtatus*), the Great Basin pocket mouse (*Perognathus parvus*), the western harvest mouse (*Reithrodontomys megalotis*), and the deer mouse (*Peromyscus maniculatus*), were trapped in the 2 vegetation zones (*Artemisia-Agropyron* and *Agropyron-Poa*) that occur along the river. Four species trapped only in coniferous forest zones were the yellow pine chipmunk (*Eutamias amoenus*), the boreal or red-backed vole (*Clethrionomys gapperi*), the masked shrew (*Sorex cinereus*), and the dusky shrew (*Sorex obscurus*).

O'Farrell (1972) summarized records of *Lagurus curtatus* in Benton County, Washington, on the Hanford Reservation. Two trap sites immediately adjacent to the river did not produce *Lagurus curtatus*. He concluded that this species was associated with *Artemisia-Agropyron* types rather than the *Artemisia-Poa* types that occur nearer the river in that area. *Perognathus parvus* was the most abundant small mammal at the lower elevations (O'Farrell 1972).

Ranges of 15 bats overlap the study area. Little information is available for any of these species, particularly in the middle Snake River region. Snow (1973) summarized the available information on the spotted bat (*Euderma maculatum*), classified as a threatened species (U.S. Department of the Interior 1973).

Of the several species of upland game birds that occur in the area, research has been conducted on the California quail (Anthony 1968 and Crispens et al. 1960) and gray partridge (Yocom 1943) in southeastern Washington. Ormiston (1966) and Yocom and Harris (1953) described the food habits of mountain quail in the middle Snake River canyon in Idaho (Big Canyon Creek) and eastern Washington, respectively. The historic distribution and recent status of sage grouse (Yocom 1956) and Columbian sharp-tailed grouse (Yocom 1952) have been summarized for the Washington portion of the study area.

Chukar partridge releases in Washington are summarized by Galbreath and Moreland (1953). They delineated the established ranges as of that time along the Columbia River and speculated that extension along the Snake River was

probably from plantings then being conducted. The Idaho Fish and Game Department released game farm reared chukars at several points along the Snake River, from Brownlee to Lewiston, during the 6-year period 1953-1958 following earlier scattered plantings throughout the state (R. Norell, personal communication, 1974). By 1957, the Department felt that viable populations were established in all suitable habitats throughout Idaho and further releases of chukars were reduced to low numbers (Bizeau 1963). Masson (1954) has also summarized the introduction of the chukar in Oregon. Intensive research on the reproductive cycle of the chukar was conducted by Mackie and Buechner (1963) in southeastern Washington.

There has been intensive research on waterfowl on the lower Snake River. Goose populations have been studied by Culbertson (1967) and Buss and Wing (1966). Thus population dynamics data are available for this area and also on the Columbia River at the Hanford Reservation (Hanson and Eberhardt 1971). Yocom (1962) summarized the history of the Great Basin Canada goose in the Pacific northwest and recent changes in the Canada goose population status (Yocom 1961) in Washington. Yocom (1949) also delineated waterfowl breeding areas for eastern Washington. Waterfowl count data are also available from the U.S. Fish and Wildlife Service. These data will be presented later in this report in the waterfowl section.

Further information on the abundance of 22 species of ducks was recorded by Buss and Wing (1966) during 9 fall-winter seasons, 1955-1965. Johnson (1959) studied mallard duck reproduction in southeastern Washington and Yocom et al. (1958) listed the status of 5 species of grebes in eastern Washington.

Research on other species of birds has been conducted in some areas. Johnson (1972) reported on the breeding biology and food habits of the black-billed magpie in southeastern Washington. Parker (1972) has reported on prairie falcon surveys and management in Washington. The lower Snake River and McNary Reservoir area were included in his survey of this species. A pre-impoundment investigation designed to evaluate the impact of Lower Granite Reservoir on vertebrate species utilizing lands that were flooded was conducted by Lewke (1975). Special emphasis was placed on evaluating impacts on birds, particularly songbirds, but some data are also presented for small mammals.

Amphibians and reptiles likely to be encountered along the study area are found in Stebbins (1954, 1966) and Slater (1963, 1964). Life history, habitat preference, and further range information is found in Fichter and Linder (1964), Linder and Fichter (1970), Metter (1960), Owen (1940), Slater (1939, 1941, 1955), Storm (1966a, 1966b, 1971, 1973, 1974). From these published records, we determined that 10 species of amphibians and 21 species of reptiles have ranges overlapping all or part of the study area.

Effects of Water Level Fluctuations

Flora

Very little work has been done on the effects fluctuating water levels have on vegetation. Hall and Smith (1955) report on the survival of woody species on a reservoir in Kentucky that is drawn down during the growing season.

They were not dealing with daily fluctuations but with an annual period of inundation. Wakefield (1966) correlated the lower distribution limits of riparian species to winter and spring flood peaks and to periods of inundation on the middle Snake River. This study also dealt with annual events that affected the plants for a limited period of time. Some of the findings can be used to speculate on the effects of daily fluctuations.

Horton et al. (1960) points out the adverse effects of frequent fluctuations on seedling establishment. Once again he was concerned with fluctuations within flood peaks.

The Stanford Research Institute (1971) pointed out that the area most likely to be affected by the Bonneville Dam fluctuations is the littoral zone between the high and low water marks. They stated that the willow brush community would be expected to increase its distribution due to fluctuations. They also stated that the cattail, reed canarygrass, and horsetail rush communities would also expand but that submergent and aquatic vegetation would be adversely affected. No supportive data were presented.

Fauna

No references were found that dealt with studies on the effects of fluctuating water levels on wildlife which were conducted within our study area. Birds, small mammals, and riparian habitats which were affected by the inundation of Lower Granite Reservoir have been studied by Lewke (1975).

On the lower Columbia River below the Dalles Dam, Claire et al. (1971) concluded that little adverse effects to wildlife would occur with frequent, small fluctuations. However, they stated that major waterfowl losses may result if severe fluctuations follow sustained flows during the nesting and rearing seasons. Species of shore birds which nest near the water edge would be similarly affected. Bird species, especially young waterfowl, that depend on shoreline insect populations for food may be adversely affected during high water levels. They further reported that rapid daily fluctuations that exposed or flooded bank den sites for furbearers would be detrimental during the whelping season. In addition, regarding human use of wildlife, they felt that if water levels were exceedingly high or low during the hunting season adverse impacts on waterfowl hunting would result. Impacts would include decreased access and hunting area as well as stranding during low levels and the loss of aquatic foods during high water levels would reduce hunter opportunity. Trappers would also have access problems. This report also stated that if fluctuating water levels cause decreases in wildlife populations then nonconsumptive uses of wildlife could be expected to decrease.

The Stanford Research Institute (1971) report reached similar conclusions to those of Claire et al. (1971) in the same reach of the lower Columbia River. They estimated the effects of increased water level fluctuations for 95 species of birds and 32 species of mammals. Possible beneficial effects were listed for 6 bird species and 7 mammal species while adverse impacts were listed for 8 bird species and 7 mammal species. The remaining species were not expected to be affected by water level fluctuations. This study by the Stanford Research Institute (1971) has been criticized by the Oregon and Washington State game

agencies regarding the coverage and validity of the conclusions reached by the consultant group. A definite lack of supportive data for conclusions reached was pointed out.

METHODS

The general approach used in conducting the research was to identify the major vegetation types and landform classes occurring within the 8 study area segments and then stratify the sampling of vegetation and wildlife populations on this basis. At least 1 intensive sampling area or site was established in each major vegetation type and landform class occurring within each segment of the study area, except on Lower Granite Reservoir. Construction activities along Lower Granite Reservoir during 1974 made it nearly impossible to maintain intensive sampling areas along the shoreline. On numerous sites all the vegetation was removed where we had previously located sampling transects. Sampling areas were placed in homogeneous stands of vegetation to avoid possible "edge effects" where possible. With certain riparian vegetation types this was not possible, however, due to the occurrence of certain types in narrow bands paralleling the shoreline.

Intensive Sampling Areas

Intensive sampling areas used for the sampling of vegetation types and for species of mammals, birds, amphibians, and reptiles that required intensive sampling procedures are listed in Table 2. Vertebrate groups requiring more extensive sampling procedures (e.g., big game, waterfowl, birds of prey, and aquatic furbearing animals) were sampled in a greater number of locations or throughout the study area. Exact locations of the intensive sampling areas or sites are plotted on the aerial photographs used for delineation of vegetation types and landform classes.

Table 2. List of intensive sampling areas by study area segment.

Transect number	Location	Bank	River mile	Transect length	Vegetation type
		Segment 1--Brownlee Reservoir			
1	Porters Island	Island	342.6	500m	Annual Forb
2	Weiser Flat	Right	342.0	500m	Tree Willow
3	Indian Head	Right	341.1	1000m	Medusahead Wildrye
4	Goose Island	Island	340.2	450m	Creeping Wildrye
5	Huffman	Right	335.3	1000m	Annual Forb
6	Weiser Sand Dunes	Right	333.6	500m	Antelope bitterbrush-Big Sagebrush
7	Weiser Sand Dunes	Right	333.6	500m	Shrub Willow
8	Rock Island	Right	330.0	1000m	Rubber Rabbitbrush
9	Fox Creek	Left	315.3	1000m	Big Sagebrush-Bluebunch Wheatgrass
10	Fox Creek	Left	315.3	500m	Shrub Willow
11	Woodhead	Right	287.1	500m	Smooth Sumac
12	Dukes Creek	Right	285.1	1000m	White Alder
		Segment 2--Oxbow and Hells Canyon Reservoirs			
13	Black Canyon	Left	283.4	900m	Douglas Hackberry
14	Eagle Island	Left	280.3	500m	Shrub Willow
15	Jacobs Ladder Creek	Right	279.7	1000m	Antelope Bitterbrush-Bluebunch Wheatgrass
16	Oxbow	Right	270.1	250m	Douglas Hackberry
17	Oxbow	Right	270.3	250m	Ponderosa Pine-Douglas Hackberry
18	Ballard Creek	Left	263.2	1000m	White Alder
19	Ballard Creek	Left	263.3	1000m	Antelope Bitterbrush-Bluebunch Wheatgrass
20	Inca Gulch	Right	262.4	500m	Bittercherry
21	Limepoint Creek to Spring Creek	Right	260.8-258.4	2 mi	Road Fill
22	Eckles Creek	Right	257.1	1000m	Bluebunch Wheatgrass-Sandberg Bluegrass
23	Big Bar	Right	256.5	500m	White Sweet Clover
24	Allison Creek	Right	256.3	170m	Deciduous Tributary Vegetation

Table 2. Continued.

Transect number	Location	Bank	River mile	Transect length	Vegetation type
	Segment 3--Hells Canyon Dam to Salmon-Snake Rivers Confluence				
25	Lamont Springs	Right	245.9	120m	Louisiana Sagebrush
26	Lamont Springs	Right	245.9	210m	Common Reedgrass
27	Warm Springs	Right	241.2	500m	Ponderosa Pine-Douglas Hackberry
28	Wild Sheep Creek	Left	241.4	500m	Douglas Hackberry
31	Johnson Bar	Right	232.0	500m	Bluebunch Wheatgrass-Sandberg Bluegrass
32	Johnson Bar	Right	231.0	500m	Bluebunch Wheatgrass-Sandberg Bluegrass
33	Johnson Bar	Right	230.0	1000m	Douglas Hackberry
34	Sheep Creek	Right	229.6	200m	Louisiana Sagebrush
35	Sheep Creek	Right	229.3	2 stns	Deciduous Tributary Vegetation
37	Pittsburg Landing	Right	216.1	40m	Shrub Willow
38	Pittsburg Landing	Right	216.0	480m	Douglas Hackberry
39	Pittsburg Landing	Right	216.0	700m	Bluebunch Wheatgrass-Sandberg Bluegrass
40	Lower Pittsburg Landing	Right	215.0	350m	Bluebunch Wheatgrass-Sandberg Bluegrass
41	Kurry Creek	Right	214.3	300m	Louisiana Sagebrush
	Segment 4--Salmon-Snake Rivers Confluence to Clearwater-Snake Rivers Confluence				
42	Cottonwood Creek	Right	181.0	2 stns	White Alder
43	Coon Hollow	Left	178.8	500m	Bluebunch Wheatgrass-Sandberg Bluegrass
44	Coon Hollow	Left	178.8	350m	Curlleaf Mountainmahogany
45	Cochran Islands		178.4	Total area	Louisiana Sagebrush
46	Garden Creek	Left	178.0	1000m	Douglas Hackberry
47	Grande Ronde	Right	169.0	900m	Bluebunch Wheatgrass-Sandberg Bluegrass
48	Grande Ronde	Right	168.8	800m	Douglas Hackberry
49	Grande Ronde	Right	168.8	Total area	Louisiana Sagebrush

Table 2. Continued.

Transect number	Location	Bank	River mile	Transect length	Vegetation type
55	Captain John Creek	Right	163.0	Total area	Louisiana Sagebrush
50	Buffalo Rock	Right	162.0	1000m	Douglas Hackberry
52	Asotin	Left	147.0	700m	Tree Willow
53	Asotin	Left	145.5	1000m	Rubber Rabbitbrush
	Segment 5--Clearwater-Snake Rivers Confluence to Lower Granite Dam				
61	Pine Tree Bar	Left	128.0	1000m	Rubber Rabbitbrush
	Segment 6--Little Goose and Lower Monumental Reservoirs				
62	Meadow Creek	Left	82.7	200m	Cattail
63	New York Bar	Left	80.5	1000m	Rubber Rabbitbrush
64	New York Bar	Left	80.5	1000m	Rubber Rabbitbrush
65	New York Bar Island		78.0	1000m	Rubber Rabbitbrush
66	McGuire Range	Left	68.0	3219m	Rock Rip-Rap
67	Riparia	Right	67.5	200m	Cattail
68	Riparia	Right	67.3	50m	Black Locust
69	Tucannon River	Left	62.2	200m	Shrub Willow
70	Steamboat Flat	Left	57.0	1000m	Rubber Rabbitbrush
	Segment 7--Ice Harbor Reservoir				
71	Simmons	Left	25.0	3 stns	Shrub Willow
72	Simmons	Left	25.0	250m	Cattail
73	Simmons	Left	24.8	500m	Rubber Rabbitbrush
74	Big Flat	Right	17.3	500m	Rubber Rabbitbrush
75	Big Flat	Right	17.2	200m	Cattail
76	Big Flat	Right	15.8	500m	Rubber Rabbitbrush
	Segment 8--McNary Reservoir				
77	Sacajawea State Park	Right	1.5	300m	Cattail
78	Sacajawea State Park	Right	1.3	5 stns	Cottonwood-Willow-Russian Olive

Table 2. Continued.

Transect number	Location	Bank	River mile	Transect length	Vegetation type
79	Two Rivers	Left	318.4	5 stns	Shrub Willow
80	Finley-Hover Park	Right	318.0	1000m	Russian Olive
81	Finley-Hover Park	Right	317.9	1000m	Rubber Rabbitbrush
82	Walla Walla River	Left	314.3	5 stns	Tree Willow
83	Hat Rock State Park	Left	299.1	1000m	Antelope Bitterbrush-Big Sagebrush

Inventory of Vegetation and Landforms

Sampling

Vegetation types that were recognizable by changes in life form and major species were delineated on black and white aerial photos (Table 3) by photo interpretation and visual reconnaissance of the study area. The format for the vegetation types was adapted from Poulton (1962) and is listed in Table 4 . Vegetation typing for the islands in the Hanford Reservation was taken from Hanson and Eberhardt (1971). Study sites were subjectively selected to give representations of the major vegetation types. Sixty-seven riparian and adjacent upland sites were sampled during 1974. Data were collected from an additional thirteen sites to supplement the project sites in the analysis of secondary succession. These sites were chosen to represent an array of near climax to low seral communities in the *Agropyron spicatum - Poa sandbergii* habitat type (Daubenmire 1970). These supplemental sites were designated as S1 through S13 and are included in the analysis for a total of 80 sites. Four sites sampled in 1975 are not included in the classification procedures but are described as separate communities in the community descriptions.

Vegetation sampling techniques were designed by the project field supervisor, Dr. Duane A. Asherin, of the Idaho Cooperative Wildlife Research Unit. Vegetation at each site was sampled on two separate 50-foot transects that were located along a longer study site transect used in sampling birds and mammals. The two 50-foot transects were subjectively located in representative areas of the plant community.

A complete species list was recorded for each site. Ground cover, basal herbaceous plant cover, and canopy coverage of low growing shrubs was estimated in twenty 2 x 5 decimeter plots (ten plots at five foot intervals on each fifty-foot transect). Frequency of occurrence was also calculated from this data. Two heavy wire rings, representing one and five percent of the sample plot were used as guides in making the cover estimations. The rings were used to reduce observer variability. One percent was the smallest value recorded for the cover estimations and ninety-nine percent was the largest value. These limitations were employed to accommodate the computer cards used in summarizing the data. The one percent value inflates the cover values of species that seldom occupy over one percent of the plot. This bias must be kept in mind when comparing cover values of less than one percent in the summarized data. Annuals were considered as litter in the ground cover estimations. Only perennials were considered in the live vegetation category.

Line intercept coverage (Canfield 1941) was recorded to the nearest tenth of a foot for shrubs and trees along the two 50-foot transects. Frequency of contact for shrubs and trees was calculated on the basis of interception along twenty 5-foot segments of the 100 feet of line intercept. This measure of distribution is comparable to frequency by plot data (Asherin 1973a).

Table 3. Aerial photo scales, dates, and conversion factors for the University of Idaho study area.

Study Area Segment	Flight Dates	Scale	Inches Per Mile	Acres Per Sq. In.	Dot Equivalent In Acres
Brownlee, Oxbow, and Hells Canyon Reservoirs	23 & 24 June 1970	1:20,000	3.168	63.769	0.996
Hells Canyon Dam to Lower Granite Reservoir	25 March 1973	1:12,000	5.280	22.957	0.358
Lower Granite Reservoir	21 April 1975	1:12,000	5.280	22.957	0.358
Little Goose, Lower Monumental and Ice Harbor Reservoirs	26 February 1973 3 April 1973 18 April 1973	1:12,000	5.280	22.957	0.358
Ice Harbor Dam to Snake-Columbia R. Confluence and McNary Reservoir	4 June 1973	1:24,000	2.640	91.835	1.434

TABLE 4. Vegetation types and landform classes.

Type Number	Type	Scientific Name
	Land Forms	
000.000	Unclassifie	
110	Sand [illegible]es	
141	Rock or Talus	
141.1	Rock Cliffs	
141.2	Cliff - Talus	
142	Gravel	
143	Sand	
143.1	Sand Bar	
143.2	Sand Banks	
144	Mud	
144.1	Mud Flat	
147	Road Fill	
148	Rock Rip-rap	
150	Bare Ground	
211	Ponds	
213	Reservoirs	
214	Embayment Connected to Reservoir	
221	River	
224	Sloughs	
	Annual Grasses	
312.1	Medusahead Wildrye	*Taeniatherum asperum*
312.2	Cheatgrass Brome	*Bromus tectorum*
	Forbs	
313	Annual Forbs	
313.1	Louisiana Sagebrush	*Artemisia ludoviciana*
313.2	White Sweet Clover	*Melilotus alba*
313.3	Absinthe	*Artemisia absinthium*
313.4	Lupine	*Lupinus* spp.
313.5	Northern Buckwheat	*Eriogonum compositum*
313.6	Horsetail	*Equisetum* spp.
	Perennial Grasses	
314	Bunchgrass	
314.1	Bluebunch Wheatgrass-Sandberg Bluegrass	*Agropyron spicatum-Poa sandbergii*
314.2	Thickspike Wheatgrass	*Agropyron dasystachyum*

TABLE 4 (Cont.)

Type Number	Type	Scientific Name
	Perennial Grasses (Cont.)	
314.3	Crested Wheatgrass	*Agropyron cristatum*
314.4	Wildrye	*Elymus* spp.
314.5	Reedgrass	*Phragmites communis* and *Phalaris arundinacea*
	Grasslikes	
316.1	Cattail	*Typha* spp.
316.3	Sedge	*Carex* spp.
316.4	Bulrush	*Scirpus* spp.
316.6	Cattail-Sedge	*Typha* spp.-*Carex* spp.
	Shrubs	
325.1	Big Sagebrush	*Artemisia tridentata*
325.11	Big Sagebrush - Bluebunch Wheatgrass	*Artemisia tridentata* - *Agropyron spicatum*
325.2	Rubber Rabbitbrush	*Chrysothamnus nauseosus*
325.31	Antelope Bitterbrush Bluebunch Wheatgrass	*Purshia tridentata* - *Agropyron spicatum*
325.32	Antelope Bitterbrush - Big Sagebrush	*Purshia tridentata* - *Artemisia tridentata*
325.5	Curlleaf Mountainmahogany	*Cercocarpus ledifolius*
325.6	Douglas Hackberry	*Celtis douglasii*
327.1	Shrub Willow	*Salix* spp.
327.2	Blackberry	*Rubus*-spp.
327.3	Rose	*Rosa* spp.
327.4	Smooth Sumac	*Rhus glabra*
327.5	Black Hawthorn	*Crataegus douglasii*
327.6	Serviceberry	*Amelanchier alnifolia*
327.8	Elderberry	*Sambucus* spp.
327.9	Bitter Cherry	*Prunus emarginata*
329.0	Heterogeneous Shrub Mixture	
	Trees	
342.1	Tree Willow	*Salix* spp.
342.2	Cottonwood	*Populus* spp.
342.3	Russian Olive	*Elaeagnus angustifolia*
342.4	Black Locust	*Robinia pseudo-acacia*
342.6	White Alder	*Alnus rhombifolia*
342.71	Willow-Cottonwood	*Salix* spp.-*Populus* spp.
342.72	Russian Olive-Willow	*Elaeagnus angustifolia-Salix* spp.

TABLE 4 (Cont.)

Type Number	Type	Scientific Name
	Trees (Cont.)	
342.73	Mulberry-Willow	*Morus alba-Salix* spp.
342.87	Willow-Cottonwood-Russian Olive	*Salix* spp.-*Populus* spp. *Elaeagnus angustifolia*
342.9	Deciduous Tributary Vegetation	
343.5	Ponderosa Pine - Douglas Hackberry	*Pinus ponderosa-Celtis douglasii*
343.6	Ponderosa Pine-Elderberry	*Pinus ponderosa-Sambucus* spp.
343.7	Ponderosa Pine-Bluebunch Wheatgrass	*Pinus ponderosa-Agropyron spicatum*
	Artificial Landforms	
510	Field Crops	
540	Fenced Pasture	
560	Idle Lands	
571	Feedlots	
572	Agricultural Buildings	
610	Residential Areas and Summer Homes	
620	Business District	
640	Industrial Area	
651	Railroad	
652	Roads	
654	Airport	
656	Power Facilities and Dams	
661	Gravel Pit	
662	Mine Facilities	
663	Fish Hatchery	
671	Developed Parks	
673	Public Access Areas	
674	Marinas	
674.1	Commercial Outfitter Facility	

Densities of shrubs and trees were recorded by actual count in ten 100-square-foot (5.6 radius) circular plots. These plots were located every twelve feet along the two 50-foot transects. The point-centered quarter method (Curtis 1959) was used to record densities on two sites (site numbers 16 and 20) with sparse woody vegetation. These points were located on the transects the same as the circular density plots. A total count within a 10 x 200 meter belt was also used on two sites (site numbers 13 and 17). All densities were calculated on a per hectare and on a per acre basis.

The mean height of each woody species was obtained to the nearest decimeter at each density plot. These estimates were averaged for the number of plots the species occurred in to obtain the mean height of each species for the site.

Percent slope and aspect were estimated and elevations were determined from topographic maps.

Soils information used in the qualitative descriptions of the vegetation types was derived from field observations and soils maps and descriptions from the following references: Campbell (1962), Daubenmire (1970), Evans (1967), and Soil Conservation Service soil surveys available from S.C.S. offices at Weiser, Idaho; Baker, Oregon; and Colfax and Walla Walla, Washington.

Data were key punched from the field forms and the calculations made by computer. Three computer card formats were used to process the data from each site. The first card format recorded the plot cover data. The tape readings from the line intercept were punched on the second type of computer card. The third format was for the density and mean height data. For each of the three types of data one card contains the information for one species. An example of the field forms and each type of computer card format is given in Appendix I. The three programs are on file with the Computer Services Department, University of Idaho. Some suggestions on the use of the summarization programs are also given in Appendix I.

Plant taxonomic work was done by project personnel and verified against specimens in the herbariums of the Department of Biological Sciences and College of Forestry, Wildlife, and Range Sciences, University of Idaho. Alpha codes and common names were used as listed in the Idaho Range-Plant Symbols Guide (Asherin 1973b). Alpha codes were used to record the species on the field forms and for data processing. The plant collection has been submitted to the herbarium of the University of Idaho's College of Forestry, Wildlife, and Range Sciences.

Classification of Communities

The multivariate analytical techniques used in this study are presented by Orloci (1967), Goldstein and Grigal (1972) and Gauch and Whittacker (1972). More general reviews on the use of multivariate techniques are Goodall (1967), Crovello (1970). Goodall (1970), and Williams (1971).

Presence and absence data were used in a polythetic agglomerative technique to classify the vegetation into communities (recognizable aggregates

of plant species within the vegetation types). A polythetic technique was chosen because monothetic strategies consider only one species at a time. Polythetic techniques have the advantage of considering all the species at the same time. Polythetic strategies group two stands because they share a large number of species (Sokal 1974).

An agglomerative method was used because divisive strategies are, by design, rigidly dichotomous. Once separated, two stands cannot be rejoined. Agglomerative classifications overcome this fault of premature separations (Williams 1971). Agglomerative approaches initially consider the individually sampled stands and then unite them based on their similarities. Stands or groups can be united at any time during the process.

The program used in this classification is Program MIDSP as presented by Goldstein and Grigal (1972). Orloci's (1967) method of the least increase in sums of squares is used in this program to unite the stands. This method has produced good results in several other phytosociological studies (Edwards and Covalli-Sforsa 1965, Allen 1971, Pyott 1972). Presence and absence data simplify the procedure so that the difference in sums of squares is a direct reflection of the difference in the number of species present. The standard distance coefficient (Orloci 1967) is used to assess the difference between stands. Variations in the number of species present from stand to stand, can limit successful analysis, especially in species poor communities. The standard distance coefficient was chosen because of its effectiveness in eliminating this lack of species distortion (Orloci 1967, Allen 1971).

The level at which communities are defined was tentatively set at forty-nine percent difference, subject to observer interpretation because the communities defined by Orloci (1967) were at approximately this level.

Presence and absence data have proven to be adequate for phytosociological work (Williams et al. 1969, Norris and Barkham 1970) and are used in this study to classify and ordinate plant communities. Quantitative data assumes the presence of the species and, therefore, constitute a further description of its presence. Quantitative data may allow for a more detailed breakdown (Pyott 1972), but these subgroups are useless if they cannot be readily identified in the field. Presence is the actual identifying criterion. Quantitative data should be used to further describe the communities.

Classification accuracy is not lost by the elimination of the less common species (Bray and Curtis 1957, Kershaw 1968). This elimination can enhance a classification by eliminating those plants of chance occurrence. It also helps to eliminate the seasonal biases by excluding those small or rare plants that are easily noticed when green or in flower and often missed at other times. This is a major concern considering the logistical problems of trying to sample similar sites at the same time of development over a study area 400 river miles long. The classification process used in this study was based on a partial list of those species that have a frequency of greater than or equal to ten percent. Frequency was used rather than cover because it is more comparable between life forms and consistent between observers. The percent cover data collected are of two types, basal

cover for herbs and canopy cover for shrubs and therefore is not comparable between life forms. The data were collected by four different people. Minor, consistent differences can occur between observers in their percent cover estimations. This leaves percent frequency as the least biased measure of variation between sites in this study. Frequency also allows the inclusion of plants that have small cover values but are consistently observable in the community and may be valuable as indicator species. Ten percent was chosen as the cut off because this meant that the plant occurred in at least two of the 2 x 5 dm plots. The probability that its occurrence was just a random chance is reduced. While this is arbitrary, we felt that those species consistently observable in the community are the ones that are important in classifying the community. Species recognized only to genus or listed as unknowns, were not included on the species lists used as input for the classification and ordination programs.

Plant communities are named for the dominant plant species in each vegetation layer. The three layers considered are trees, shrubs, and herbs. Dominance is a rather ambiguous term, but is strongly related to biomass and conspicuousness. Percent cover data is the better estimate of biomass collected on this project. The initial determination of candidates for the dominant species was made on the basis of highest percent cover.

After picking two or three species with high cover, the following criteria were used to judge the conspicuousness of the species. The tallest species were chosen from the mean height data for shrubs and trees or from knowledge of growth form for the herbs. The most frequent herb or the shrubs and trees with the greatest density were considered to be more dominant. Perennials took precedence over the annuals. In cases where the perennial had less coverage and a frequency of less than twenty percent, the frequency of the annual had to be greater than twice that of the perennial to be considered dominant.

Community names were constructed in the following format using the common or scientific names of the species: Tree species - Shrub species - Herb species. This was shortened to two species when only two layers exist in the community. If only one layer exists the codominant species was used: Dominant herb species - Codominant herb species. A codominant or diagnostic species was also used in several names to differentiate between similar communities. A dichotomous key was developed to identify the communities in the field.

A narrative description was written for each community determined by the classification procedure. It includes the relationship of the plant communities to the original vegetation typing, interpretation and description of the quantitative data, descriptions of observable characteristics such as pattern and growth forms, and general soils information.

Successional Relationships

A habitat-type is defined as the area capable of supporting the same climax plant association (Daubenmire 1970). Secondary succession within a habitat-type is a continuum of vegetation moving toward or away from

climax or shifting back and forth without getting closer to the climax. Within the habitat-type there is greater variability in the seral stages than in the climax association. Therefore, secondary succession can be viewed as a solid cone made of plant communities. The solid cone represents this continual succession in any direction depending on the environmental pressures at work. While secondary succession is a vegetational continuum, it is necessary to recognize communities or stages for practical management. The solid cone of variation must take on the delineations of these communities as in Fig. 1.[1] As the vegetation matures toward climax, its composition is refined until it takes on the identity of the climax association. At the other extreme, a greater amount of variation occurs because different retrogressive factors produce different vegetational compositions. If the retrogressive factor is severe enough, the vegetation is reduced to a single pioneer species and finally to the base level of the cone, bare ground.

Ordinations are a very useful tool to display plant communities so that phytosociological relationships can be interpreted. The stands or communities are positioned in p-dimensional space determined by the number of species. Each species represents a dimension or gradient that helps to establish the position of the stand in respect to the other stands involved. Ordinations are based on the axes or gradients defined by the maximum variation or major changes in community composition. Two or three axes defined by those stands furthest apart gives an accurate picture of stand interrelationships (Bray and Curtis 1957). Many distance coefficients and methods of axis selection have been used. The original Bray and Curtis (1957) method has been discredited because of its subjectivity in reference stand selection and mathematical unsoundness (Anderson 1971). More sophisticated methods such as principal component analysis have since been used in vegetational analysis. While these methods are mathematically correct and more complicated, the same ecological interpretations are derived from both (Beals 1973). The Bray and Curtis method is more consistent in giving interpretable results because it depends on the relative distances involved with each set of data. Principal component analysis gives good results only when dealing with very homogeneous data where correlations are likely to be near linear (Beals 1973).

Gauch and Whittaker (1972) point out that the Bray and Curtis ordination with the index of similarity, retains more information than other coefficients that have less curvilinear distortion. The Bray and Curtis method is also easier to interpret and less computationally involved. The Bray and Curtis method with the index of similarity as presented in Program CEP4 of the Cornell Ecology Series of Computer Programs (Gauch and Dripps 1973) is used in this study.

Three methods of reference point selection were used by Huschle (1975). Only the method developed by Beals (1960) as modified by Huschle (1975) is used in this report.

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[1] Credit for the development of the cone models of secondary succession belongs to Dr. M. Hironaka, College of Forestry, Wildlife, and Range Sciences, University of Idaho, Moscow.

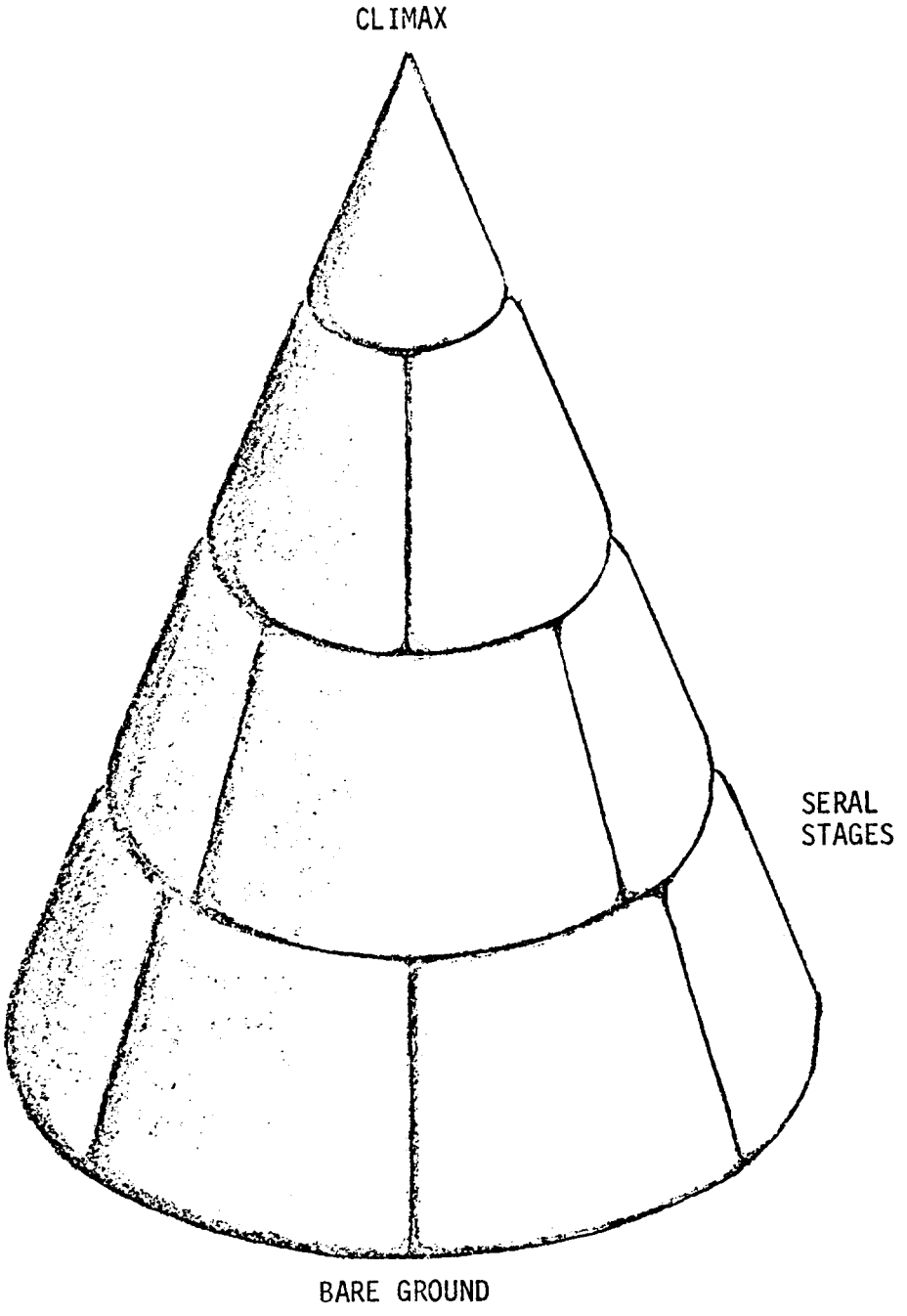

Figure 1. Conceptual model of secondary succession. The continuum of secondary succession is divided into plant communities or stages for practical management (Drawing by William J. Summers).

The ordination is based on the presence and absence of species in 16 communities defined by the objective classification that occurred in the *Agropyron-Poa* habitat-type (Daubenmire 1970). The species lists used in the ordination consist of those species that appear in at least two stands of the community except in cases where the communities were represented by only one site. The species with a frequency of at least 10 percent were used as the species list in the single-site communities.

If the ordination effectively shows the secondary successional relationships of these stands and communities, the most retrogressed stages will be on one end of the major axis and the near climax communities on the other end. Additional ordinations of the second and third dimensions should display the relationships within the cone model.

Inventory of Vertebrates

Big Game

Species included in the category of big game are: elk, (*Cervus canadensis*), mule deer (*Odocoileus hemionus*), white-tailed deer (*O. virginianus*), mountain goats (*Oreamnos americanus*), bighorn sheep (*Ovis canadensis*), black bear (*Ursus americanus*), and mountain lion or cougar (*Felis concolor*).

The occurrence and distribution of big game species on the study area was determined from aerial surveys, additional direct observations of animals, and by the presence of tracks and feces. Pellet group counts were made in each intensive sampling area for estimating relative use of the major vegetation types by ungulates. Ten circular plots of 1/300 acres (6.8 ft radius) were counted along two 50-ft linear transects.

Upland Game Birds and Mammals

Upland game mammals include the rabbits and hares. The occurrence and distribution of species in this group was determined from direct observation of animals and from the presence of sign. No trapping was conducted for species in this group. Scent stations used for sampling terrestrial furbearing animals also provided data on rabbit occurrence in the various vegetation types.

Upland game birds included the grouse, quail, pheasant, and partridge. Techniques used for sampling other birds, which is discussed later, was used for all species except the chukar partridge. Additional, supplemental observations also provided data on species occurrence and distribution throughout the study area. The following methodology for censusing the chukar partridge was developed by Oelklaus (1976).

Chukar Census Technique. Since chukar releases began in this country, census activities have yielded little or no information on populations over broad areas. Population estimates are usually based on one or a combination of 3 methods; waterhole counts, strip transects, and/or hunter harvest information (Nilsson 1956, Christensen 1970). The waterhole count appears to be the

method receiving the greatest use (Moreland 1950, Galbreath and Moreland 1953, Christensen 1970). Nilsson (1956) concludes that "Since seasonal movements of the birds are known and predictable, it follows that census activities can best be held during those periods when they are on water or on their winter range." During the summer-fall drought season, established chukar concentrations and distribution are generally consistent from year to year. The tendency of chukars to flock together during this season reduces dispersion, making it possible to contact a greater proportion of the population with less field effort than at any other season. All prior census methods require direct visual contact with the birds and entail large amounts of field effort for the number of birds seesn (Galbreath and Moreland 1953, Bohl 1957, Christensen 1970). The rough terrain that chukars normally inhabit makes direct visual observation of all birds in an area impossible. Christensen (1970) observes that "In most cases the nature of the terrain makes it extremely difficult to work in chukar habitat, and has been a major factor in handicapping the development of suitable census techniques." Therefore, unless a great deal of effort is expended within a limited area, census estimates will necessarily be low. The inherent limitations in all previous census methods dictated the need to develop a different census technique--one that would be rapid, could contact a greater percentage of the population, and would yield reliable population estimates.

A review of the literature indicated that an audio census technique for chukars might be feasible. Stokes (1961) describes all of the calls that chukars give. From his analysis the "rally call" appears to have the greatest potential as a means of censusing chukars. Bohl (1956) and Williams (1961) both feel that the "rally call" has the most potential for development as a census technique.

The rally call serves as a means of social contact between flock members from mid-summer through winter, when the birds are in flocks (Christensen 1970). The calling of one bird stimulates other chukars to respond (Stokes 1961). The effect that physical and biological factors have on the natural rate of calling was investigated by Williams (1961) and Williams and Stokes (1965). They identified and evaluated many factors affecting the natural rate of calling, but were only able to account for about 50 percent of the variation in calling between days. Temperature, light intensity, wind, and rain were the physical factors exerting significant influence on the chukar's calling rate. Light intensity was not found to be a significant influence other than during those hours near sunrise and sunset.

Bohl (1956 and 1957) describes some of his earlier attempts at stimulating chukar calling in the field. Census efforts at that time were handicapped by fragile, bulky equipment with poor fidelity and inadequate volume. Call counts have been utilized to reveal dispersion and location of chukars (Bohl 1956, Nilsson 1956, Christensen 1970).

Previous census techniques, such as waterhole counts, strip transects, or hunter harvest reports, would not have produced sufficient, statistically sound data to estimate chukar partridge populations along the 400 mi of river within the study area. We decided that the chukar's "rally call" could potentially be used as the census tool to meet the needs of this study. Literature review and field testing strengthened this view.

The summer and fall of 1974 were spent in testing equipment and investigating the feasibility of eliciting responses from chukars. Initially calls were recorded on a Uher 4000 Report L tape recorder. The superior reproductive fidelity of the Uher provided very good recordings. However, this machine's reel-to-reel tape system, bulky size, and weight proved inconvenient for extensive field work. To reduce the size and weight of the recorder for field use a Sony 95-A tape recorder was selected. The previously recorded chukar calls were re-recorded on this machine. The tonal quality of the calls remained good. The Sony's frequency of response, 50-10,000 Hz, more than adequately covers the range of the chukar's rally call (500-4,500 Hz). The Sony 95-A, which operates from 4 self-contained "C" size dry cell batteries, has a cassette tape system which proved convenient to operate in the field.

Neither recorder was found to supply sufficient volume on directionality through its built-in speaker to project the calls an adequate distance for censusing chukar flocks in the wild. A Fannon MV-16S-C megaphone, powered by 8 self-contained dry cell batteries, was added to the system. Installation of a jack into the megaphone allows direct connection with the tape recorder. The addition of the 16-watt megaphone provides a directional speaker with more than ample volume boost. This system is capable of producing chukar rally calls that will carry well over 450 m, the maximum range (Williams 1961) that the chukar's natural call carries under optimal conditions.

To test the feasibility of an audio census technique for chukars, 4 restricted study areas were chosen. These sites were representative of the varied habitats within the entire study area. Lack of year-long access eliminated some otherwise desirable locations. During the summer, fall, and winter of 1974 these sites were sampled repeatedly. Sampling was less intensive on these sites in 1975. Chukar flocks were located by playing the rally call toward an area of suitable habitat. If no response was obtained within 5 minutes the equipment was moved to an adjacent area and the procedure was repeated until a response revealed the chukars' location. The number of chukar responses were counted for 1 minute intervals during the 5 minutes immediately following the playing of the first call which received a response. At the end of this first 5 minutes the rally call was played a second time. Responses were again tabulated for each minute of a second 5-minute time period. During this 10-minute period I attempted to count all birds visually. Following the second 5-minute sample my dog, a German shorthaired pointer, and I worked through the area flushing the chukar flocks. A total count of the number of chukars present was thus obtained to correlate with the number of responses elicited during the sampling period just completed. Five hundred thirty-seven of these samples, felt to be free from unnatural disturbance to the chukars, were subsequently analyzed by regression techniques.

The feasibility of eliciting responses from flocks along other portions of the river was tested during the fall of 1974. These tests were conducted by floating along the river in a rubber raft or canoe playing chukar rally calls continuously. The procedure for counting responses, outlined above, was carried out by either pulling in to shore some distance from the responding birds, or maneuvering the craft into an eddy area. Each flock was then flushed and counted. Periodically, stretches of the river bank just passed were searched with the dog looking for non-responding chukars. The fall concentration period near water was selected as the optimum season to census chukars.

Waterfowl

Aerial Census. Monthly, aerial censuses of ducks and geese using the McNary Reservoir segment of our study area are conducted by the U.S. Fish and Wildlife Service from October-January. The January, winter count is extended up the lower Snake River to Clarkston, Washington. No census flights are conducted by the Idaho Department of Fish and Game, Oregon Department of Fish and Wildlife, or Washington Department of Game for the remainder of the study area. USFWS census data were supplemented with annual fall and winter aerial counts for portions of the study area not covered by the USFWS. In addition, brood surveys were flown in June 1974. Supplemental ground identifications and counts were also conducted during months when aerial flights were not made to document occurrence and species distribution on the study area.

Nesting Surveys. Goose nesting surveys were conducted in 1974 and 1975 on all islands in the study area in cooperation with the IDF&G and WDG. Initial checks were made in early April and followup checks on nesting success were made in mid-July. Duck nesting activity was also noted during these searches. Searches of potential waterfowl nesting habitats along mainland shoreline areas in the lower Snake River were conducted in 1974. No nesting activity was found, however. Nest surveys were therefore restricted to islands in 1975. Each nest located was identified with a numbered wooden stake to facilitate subsequent success checks and data were collected on clutch size, dominant vegetation at nest site, distance from high water mark, and predation, if applicable. All brooding areas observed while conducting the success checks on nests were also noted.

Furbearing Animals

Aquatic Furbearers. Aquatic furbearers are defined to include beaver (*Castor canadensis*), muskrats (*Ondatra zibethicus*), mink (*Mustela vison*), and river otter (*Lutra canadensis*). These mammals were grouped to facilitate inventorying because all are normally associated with water and the immediate shoreline.

Shoreline searches for tracks and other sign (e.g., scat, trails, burrows, feeding areas, and territorial marking areas for beaver and river otter) and direct observations were used to document species occurrence and distribution. Searches were conducted during low water levels to facilitate track identification. Spotlighting was also used to search shoreline areas and obtain direct observations of nocturnal activity.

Harvest reports for counties along the study area and names and addresses of licensed trappers residing adjacent to the study area were obtained from the IDF&G and WDG in order to estimate furbearer harvest in the study area.

Beaver numbers were estimated by determining the number of colonies present on the basis of sign (e.g., trails, cuttings, scent posts, and lodges or bank dens) in an area. Beaver sign should equate closely with colonies in our study area because beaver habitat is discontinuous. In saturated areas or areas of high beaver density in Colorado Hay (1958) found that territorial

boundaries between colonies were not easily discernible by the presence of sign. He also found that the lodge was not necessarily synonymous with the colony. One colony studied maintained 3 different lodges within a small area. While Hay (1958) determined that the overall average number of beavers per colony was 6.3 individuals, the average colony size where willow was the predominant food source was 5.1 individuals. In southeastern Idaho, Leege (1964) found that beaver fetus counts averaged 2.9 and 4.5 in 1963 and 1964, respectively. Placental scar counts indicated the average litter size was 4 individuals. From this literature we assumed the average number of beaver per colony was 5 to 6.

No trapping of aquatic furbearing species was conducted.

Terrestrial Furbearers. All native carnivores in the study area except those considered under big game and aquatic furbearers are included here. These include the coyote (*Canis latrans*), bobcat (*Lynx rufus*), skunks (*Mephitis* spp.), weasels (*Mustela* spp.), raccoon (*Procyon lotor*), badger (*Taxidea taxus*), and red fox (*Vulpes fulva*).

Scent stations similar to those utilized by the USFWS in their coyote index procedure (Linhart and Knowlton 1975) were used to inventory species in this group. Scent stations consisted of circular areas of sifted soil 4 ft in diameter with a commercially prepared food-based, liquid attractant placed in the center on a stake with a piece of sheep skin attached). Tracks of species visiting these stations were recorded for 2 scent stations on 2 consecutive nights for each intensive sampling area during the summer and fall sampling periods. Scent station sampling was conducted concurrent with small mammal trapping. Stations were established near trails or other natural travelways used by carnivores, when possible. Spacing of stations depended on the size of the intensive sampling area but an attempt was made to maintain 200 m intervals.

Supplemental direct observations of animals or their sign were also recorded to assist in documentation of species occurrence and distribution. No trapping was conducted for members in this group.

Birds of Prey

Hawks, eagles, and falcons were censused during the spring nesting season (May) by discharging firearms along cliff faces throughout the study area causing nesting birds to flush. The number of occupied nesting territories by species was determined in this manner and the location of nest sites recorded. Some observations of owl species were also obtained during the surveys.

Further documentation of the occurrence and distribution of species of birds of prey were obtained while conducting sampling for other birds, from supplemental direct observations recorded throughout the study, and for owls by playing tape recorded calls at night in selected areas to elicit responses. Special emphasis was placed on making ground counts of bald and golden eagles wintering in the study area. Counts were conducted at roosting and perching sites identified.

Other Birds

Birds other than the waterfowl and birds of prey are included in this category. All upland game birds, except the chukar partridge, are also included here. Sampling was designed to determine species occurrence and distribution in the major vegetation types occurring in each segment of the study area and to provide an estimate of the relative abundance of birds identified. Sampling was conducted during all 4 seasons of the year to determine seasonal variation in species occurrence and abundance.

Emlen's (1971) Censusing Technique (Modified). In vegetation types dominated by trees and dense shrub understories (e.g., deciduous tributary vegetation, white alder, black locust, Russian olive, cottonwood-willow-Russian olive, and tree and shrub willow) a minimum of three 10-minute observation points were located. Most sites analyzed had 5 observation points located within them but some sites were too small to accommodate this many observation points. All species and their numbers noted by the observer as either audio or visual during the 10-minute observational period were recorded. Sampling points were located to avoid duplication of sampling area and sampling was conducted for 2 consecutive days at each intensive sampling area where this technique was employed.

Modified Sample Count. In shrub and grassland habitats where visibility is not limited excessively, transects varying in length with the habitat size but not exceeding 1000 m were located and staked at 100 m intervals. A 5-minute observation period was conducted at each end of the transect. All birds observed and the sighting distance were recorded while conducting the 2 observation periods and while walking the transect. Sampling was conducted for 2 consecutive days on each transect.

Total Count. Total counts of all bird species observed were conducted in habitats which only occurred in small areas and/or where visibility was essentially unlimited (e.g., rock rip-rap, cattail bands, and Louisiana sagebrush).

In addition to the techniques mentioned above, supplemental observations of bird species observed and the vegetation type in which the observation occurred were recorded throughout the study, except for the obviously common species. These data were used to supplement data obtained during standardized sampling and further document species occurrence and distribution in the study area segments and habitats.

Small Mammals

Included in the category of small mammals are shrews, moles, voles, mice, rats, ground and tree squirrels, gophers, chipmunks, marmots, and porcupine (*Erethizon dorsatum*). Porcupines and marmots were surveyed by direct observations for occurrence and distribution in the study area. Observations of porcupine and marmot sign were also made. All observations of these 2 species were correlated with the vegetation type in which the sighting occurred. Gopher and mole presence was determined by observation of sign (e.g., mounds

and tunnels). Trapping was necessary for the remainder of the small mammal groups because, in general, they are not easily observed nor is their sign.

Trapping. Small mammal trapping was conducted on all intensive sampling areas for 2 consecutive nights during each of 2 sampling periods--summer (June-July) and fall (September-October). Trapping stations were spaced at 33 m intervals (3 per 100 m) along transects used for the bird inventory in sampling areas where size allowed. Ten stations were used on these areas. Numbers of trapping stations were reduced to 5 on some sampling areas of limited size. Each station consisted of 1 baited and 1 unbaited Museum-Special and/or Victor mouse snap trap. In addition, every third station had a baited Victor rat trap, a can or cone trap, and a baited live trap. A minimum of 3 stations per area trapped contained all 5 trap types. Traps were placed within a 5 m radius of each station center and the "best site" set was used in trap placement. A standardized bait recommended for the North American census of small mammals was used (Giles 1969:278).

In addition to transect sampling, some special trapping was conducted in microhabitats not occurring on transects.

Bats. Mist-netting, shooting, and collecting at diurnal roost sites were used to document species occurrence and estimate relative abundance in the study area segments. Mist nets were placed over water and in and over vegetation types where bat feeding activity was noted. Suspected diurnal roost sites searched included mine tunnels, caves, and old buildings. Shooting was conducted under natural light conditions after sunset, with the aid of a spotlight after dark, and at the first signs of light in the morning. Sampling for bats was conducted periodically from July through September 1974.

Amphibians and Reptiles

Intensive sampling areas were sampled to determine species occurrence, distribution, and relative abundance. Transects were visited and/or systematically searched at least once, and occasionally several times, during the study period (May-October 1974). Most importantly these searches were done at the time of day and in weather when lower vertebrates would most likely be encountered. Number of individuals of each species sighted, collected, and/or identified from sign (e.g., shed skins); duration of search; and area covered were recorded as well as time of day and weather conditions. This method of data gathering was selected because as Pianka (1970:706) commented, "this approach maximized the amount of information gathered per unit of time and effort." Relative species abundance for each of the species encountered for each vegetation type sampled was determined from these data (total numbers of individuals of each species/total man hours/total area searched in m^2 x 10,000). We multiplied by 10,000 to facilitate handling the figures on relative abundance. This adjustment (x 10,000) effectively converts relative abundance to numbers/unit time/hectare.

Species occurrence was compiled in part from the systematic searches, in part from more general searches through adjacent areas, and from chance observations by personnel involved in other aspects of the study. Our literature review also identified certain species that should occur in the study area but were not encountered.

Rare, Endangered and Unique Wildlife

The only endangered species listed by the U.S. Department of Interior (1974) that was expected to occur in the study area was the peregrine falcon. Special effort was made to obtain information on sightings of this species. The prairie falcon, previously listed as threatened by the U.S. Department of Interior (1973), is no longer considered threatened. Distribution and nesting status of this species was, nevertheless, given special consideration. Two species of mammals listed as rare by the Washington Department of Game were expected to occur in the study area. Rare species are defined by the WDG as not presently threatened with extinction, but in such small numbers throughout its range that it may be endangered if its environment worsens. Close watch of the status of these species is necessary. For this reason, special emphasis was placed on determining the distribution and abundance of the Ords' kangaroo rat (*Dipodomys ordi*) and the white-tailed jackrabbit (*Lepus townsendii*) in the study area without killing animals. We relied on direct observations of animals and/or their sign for determining distribution and abundance.

Inventory of Human Use of Wildlife Resources

Data for this aspect of the study were sought from state and federal wildlife agencies and included records of hunting, trapping, and nonconsumptive uses of wildlife resources. Project personnel also noted specific activities of people encountered in the study area who were using wildlife resources.

Preliminary Assessment of Water Fluctuation Impacts

Vegetation

No intensive study was conducted to examine the effects of fluctuating water levels on vegetation. We did, however, conduct a comparison between the Salmon River, which is naturally regulated, and the middle Snake River, which is artificially regulated by Hells Canyon Dam. The literature was also examined concerning plant species tolerances to water level fluctuations. Photopoints were established to facilitate future comparisons with the present.

Wildlife

Throughout the field phases of the study, emphasis was placed on observing the effects of fluctuating water levels on the various vertebrates encountered. Habitats with various levels of water fluctuations were examined for mortality, displacement, and/or possible beneficial effects. Indirect effects were assessed primarily with respect to possible changes in habitat. Applicable literature was also sought.

RESULTS AND DISCUSSION

Vegetation Types and Landform Classes

Classification of Communities

Classification results for 80 stands and 345 species are displayed in the dendrogram in Figure 2. The level at which any two stems are united can be read on the vertical scale as percent difference or its complement, percent similarity. The row of numbers across the bottom of the dendrogram contains the individual site numbers. The lines extending down in between the site numbers separate community groups defined at the 30 percent difference level. The name of the community is represented by the alpha codes of the dominant species. Species represented by the alpha codes are listed in Table 5. The three to five digit numbers under the community names correspond with 24 vegetation types.

The objective procedure for defining community groups is to draw a line across the dendrogram at a given percent of difference. All stems which cross the line represent the community groups at that level. The groups defined at the 49 percent difference level are broader than the vegetation types identified in the mapping process. Therefore, the communities included within the vegetation types used in mapping are defined at a lower percent difference. The level at which groups began to break out within vegetation types is 30 percent difference. This level is less than the tentative level because of the large variability or dispersion in the sample universe. The percentage scale used in this classification program is the average within group dispersions expressed as a percent of the average universe dispersion. The more types included in the classification, the larger the universe dispersion, and the lower the percentage level at which the communities are defined.

Thirty percent difference is used as the objective level for community definition. I disagree with only six groupings at this level. In three cases (sites 48 and 50, sites 7 and 71, and sites 34, 41, and 49) the sites should be left together as a community although they are joined at a level slightly higher than 30 percent. I didn't feel that they were sufficiently distinct to be separate communities. The union of sites 48 and 50 is at the 31 percent level. The dominant shrub and grass was the same in each and they occupy similar environmental settings. Sites 7 and 71 join at the 37 percent level. The willow overstory in these two stands was identical in composition and similar in density and frequency. They both had species of sedge (*Carex* spp.) in the understory. The unidentified sedge species were not used in the classification. Their inclusion would make the stands less different than 37 percent. Site 49 joins site 34 and 41 at the 35 percent level. The two dominant grasses and the two dominant forbs were the same in all three stands. The three stands together form a very easily recognizable community.

The other three cases are due to vegetation typing constraints.

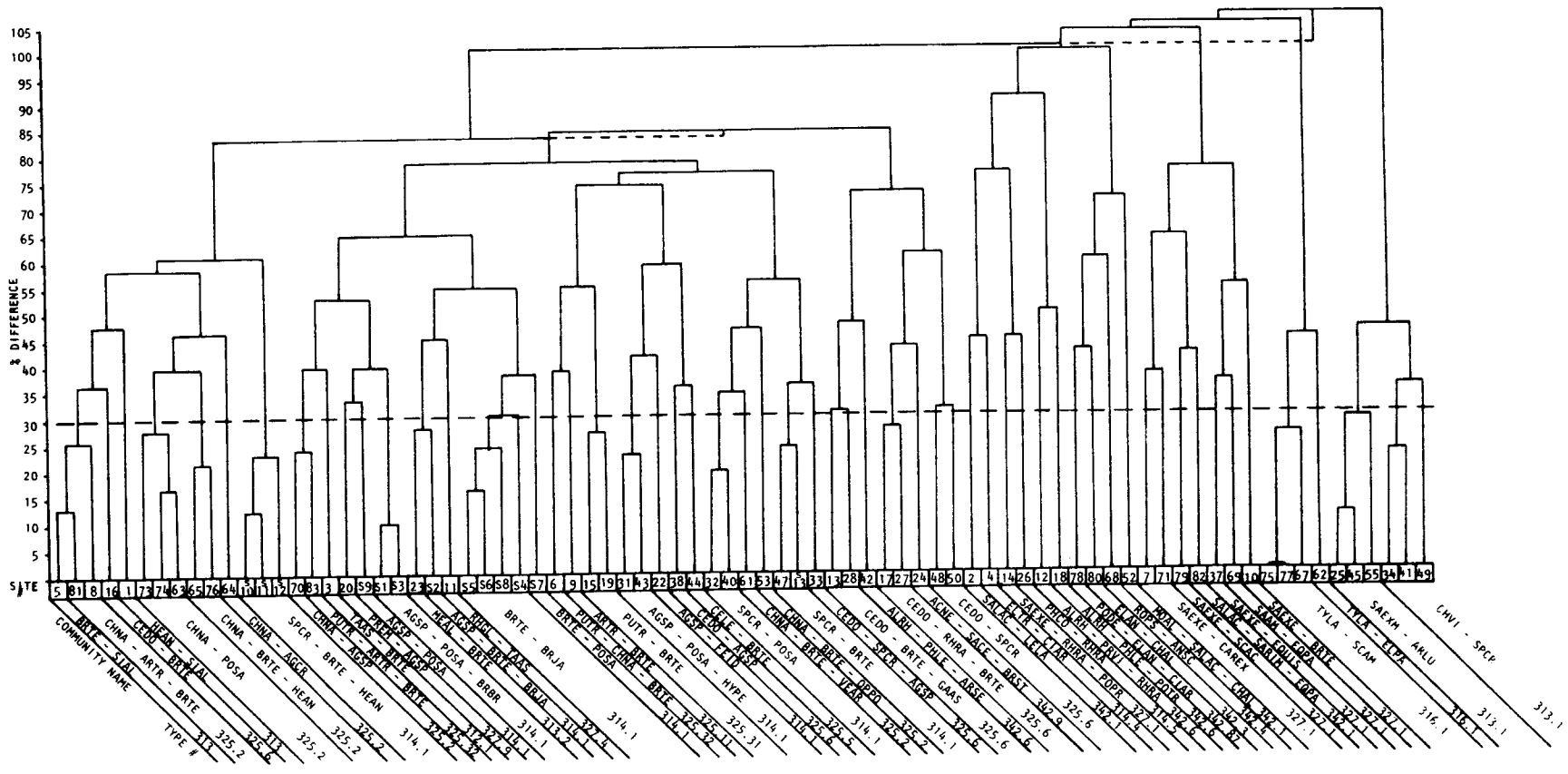

Figure 2. Dendrogram of the classification hierarchy. Classification is of 80 stands by a polythetic agglomerative procedure using standard distance (Orloci 1967). The vertical scale is the percent difference based on the average within group dispersion expressed as a percent. Stand numbers are listed across the bottom of the dendrogram. Communities are defined at the 30% level. Communities are separated by the lines extending down from the site numbers. Alpha codes are given for the names of the communities. A key to the species represented by the alpha codes is presented in Table 5. Numbers following each community name refer to the mapped vegetation type the community occurrs in as listed in Table 4.

TABLE 5. Alpha codes used in Figure 2 and their equivalents. Scientific and common names are from Asherin (1973b).

Alpha Code	Scientific Name	Common Name
ACNE	*Acer negundo*	Boxelder
AGCR	*Agropyron cristatum*	Crested wheatgrass
AGSP	*Agropyron spicatum*	Bluebunch wheatgrass
ALRH	*Alnus rhombifolia*	White alder
ANSC	*Anthriscus scandicina*	Bur chervil
ARLU	*Artemisia ludoviciana*	Louisiana sagebrush
ARSE	*Arenaria serpyllifolia*	Thymeleaf sandwort
ARTR	*Artemisia tridentata*	Big sagebrush
BRBR	*Bromus brizaeformis*	Rattle brome
BRJA	*Bromus japonicus*	Japanese brome
BRST	*Bromus sterilis*	Barren brome
BRTE	*Bromus tectorum*	Cheatgrass brome
CAREX	*Carex* spp.	Sedge
CEDO	*Celtis douglasii*	Douglas hackberry
CELE	*Cercocarpus ledifolius*	Curlleaf mountainmahogany
CHAL	*Chenopodium album*	Lambsquarters
CHNA	*Chrysothamnus nauseosus*	Rubber rabbitbrush
CHVI	*Chrysopsis villosa*	Hairy goldaster
CIAR	*Cirsium arvense*	Canada thistle
ELAN	*Elaeagnus angustifolia*	Russian olive
ELPA	*Eleocharis palustris*	Common spikerush
ELTR	*Elymus triticoides*	Creeping wildrye
EQPA	*Equisetum palustre*	Marsh horsetail
EQUIS	*Equisetum* spp.	Horsetail
FEID	*Festuca idahoensis*	Idaho fescue
GAAS	*Galium asperrimum*	Rough bedstraw
HEAN	*Helianthus annuus*	Common sunflower
HYPE	*Hypericum perforatum*	Goatweed
LELA	*Lepidium latifolium*	Broadleaved peppergrass
MEAL	*Melilotus alba*	White sweet clover
MOAL	*Morus alba*	Mulberry
OPPO	*Opuntia polyacantha*	Plains pricklypear
PHCO	*Phragmites communis*	Common reed
PHLE	*Philadelphus lewisii*	Mockorange
PODE	*Populus deltoides*	Plains cottonwood
POPR	*Poa pratensis*	Kentucky bluegrass
POSA	*Poa sandbergii*	Sandberg bluegrass
POTR	*Poa trivialis*	Roughstalk bluegrass
PREM	*Prunus emarginata*	Bitter cherry
PRVI	*Prunus virginiana*	Common chokecherry
PUTR	*Purshia tridentata*	Antelope bitterbrush
RHGL	*Rhus glabra*	Smooth sumac
RHRA	*Rhus radicans*	Poison ivy
ROPS	*Robinia pseudo-acacia*	Black locust
SAAM	*Salix amygdaloides*	Peachleaf willow
SACE	*Sambucus cerulea*	Blue elderberry
SAEXE	*Salix exigua exigua*	Coyote willow

TABLE 5. (Cont.)

Alpha Code	Scientific Name	Common Name
SAEXM	*Salix exigua melanopsis*	Dusky willow
SALAC	*Salix lasiandra caudata*	Whiplash willow
SARIM	*Salix rigida mackenzieana*	MacKenzie willow
SCAC	*Scirpus acutus*	Tule bulrush
SCAM	*Scirpus americanus*	American bulrush
SIAL	*Sisymbrium altissimum*	Tumblemustard
SPCR	*Sporobolus cryptandrus*	Sand dropseed
TAAS	*Taeniatherum asperum*	Medusahead wildrye
TYLA	*Typha latifolia*	Common cattail
VEAR	*Veronica arvensis*	Common speedwell

The vegetation typing was based primarily on dominant species in the shrub or tree layers. The objective classification was based on the presence and absence of all species, regardless of dominants. Therefore, it is possible to have two sites with very similar vegetation but with different dominant species linked together.

Site 5 is linked to two rubber rabbitbrush (*Chrysothamnus nauseosus*, CHNA) sites, 81 and 8, at less than the 30 percent level. Site 5 was typed as an annual forb type commonly found on gravel railroad fill. Rubber rabbitbrush occurred on the site but not in sufficient quantity as to constitute being a dominant shrub layer. Sites 81 and 8 are on true upland soils with dense stands of rubber rabbitbrush. They were low seral stages in *Artemisia tridentata - Agropyron spicatum* habibat-type (Daubenmire 1970). The major difference between these two communities was the sparse vegetation on site 5 and the definite shrub and grass cover on sites 81 and 8. Site 5 was very characteristic of many areas typed as annual forb and is separated as the Cheatgrass Brome - Tumblemustard (*Bromus tectorum - Sisymbrium altissimum*, BRTE - SIAL) community in the Annual Forb vegetation type.

Sites 70 and 83 are linked together at the 24.2 percent level. The two sites had a high similarity of herbaceous species. However, the shrub overstories were completely different. Site 70 had only rubber rabbitbrush in the shrub layer. This species was lacking in site 83, which had two other major shrub species. The two sites were typed into two different vegetation types. The two sites are separated into communities of the vegetation types they represent.

Sites 23 and S2 (Supplemental Site 2) were representatives of two different vegetation types. The former is located in an old gravel pit with sparse perennial forb vegetation and the latter was a seral upland site with five forbs on its species list used in the classification. All five forbs and two grasses were also present on site 23. These two sites are also separated into distinct communities.

The vegetation types are not isolated as separate stems in the classification. Many of the types occur under several major stems along with other types. The classification makes no distinction between life forms or dominant species. The stands are linked solely on the presence of species. The most similar stands based on species composition do not have to be from the same vegetation type which was based on dominant species and life forms. While the upper hierarchy of the dendrogram does not correspond with the vegetation types, there are some interesting ecological observations that can be made about it.

The first split in the dendrogram (Figure 2) between sites 50 and 2 divides the 80 sites into the upland sites on the left and the riparian sites on the right. The last major group to join the upland sites consists of the Douglas Hackberry type and two tributary vegetation types (sites 13 through 50 across the dendrogram). The understory of these sites was predominantly upland species. Douglas hackberry (*Celtis douglasii*, CEDO) reaches the greatest densities in narrow shoreline belts but is also scattered fairly high above the river in many areas. The Douglas Hackberry type is a transition between riparian and upland communities.

The next split in the upland communities is between sites S12 and 70. Sites 5 to S12 inclusive across the dendrogram were low seral upland types dominated by cheatgrass brome (*Bromus tectorum*, BRTE) and other annuals. Site 16 was representative of the Douglas Hackberry type and at first appears to be out of place. This site has had considerable disturbance and the herbaceous vegetation was very similar to the other stands in the group. The other major divisions on the upland side of the dendrogram have no apparent ecological significance.

On the riparian side of the dendrogram sites 75 to 49 represent very simple communities found below the high water line. Sites 75 to 62 are in the Cattail (*Typhia latifolia*, TYLA) vegetation type. The remaining sites are in the Louisiana Sagebrush type. Louisiana sagebrush (*Artemisia ludoviciana*, ARLU) is characteristic of the cobblestone bars that undergo frequent flooding and severe scouring by strong currents. The other riparian sites (2 through 19 inclusive on the dendrogram) are shrub willow and various tree dominated types that reach their greatest development on the tributaries. These communities are first joined to each other at a high percentage level compared to the other communities as each site is fairly unique. Many additional sites would be necessary to obtain replications within these communities. These communities are probably indicative of their localities rather than of a widespread community. The Douglas Hackberry communities also show locality similarities. The conditions under which the tributary vegetation and shoreline stands of these occur, are greatly different from one end of the study area to another. In the upper segments of the study area between Idaho and Oregon the tributary vegetation, represented by sites 12 and 18, is found in narrow steep side canyons. They are absent on the lower river. Three types on the lower river occur along the shorelines of low river bars. The shrub willow types grow under a variety of conditions from moist boulder strewn areas such as site 37 to sandy river deltas such as 69.

Qualitative Descriptions of Vegetation and Landforms

Vegetation

Plant species identified throughout the study area are listed alphabetically for the 5 basic life forms -- grasses (50 species), grasslike plants (8 species), forbs (247 species), shrubs (47 species) and trees (19 species) -- in Table 6. Occurrence of each plant species is tabulated for the 8 study area segments. Few sites were sampled in segment 5, but the species list for segment 6 is applicable, also. In addition, Clegg (1973) has also compiled an alphabetized checklist of plants for Lower Granite Reservoir or segment 5, prior to inundation.

The vegetation types and plant communities are described in the same order as presented in Table 7. Each description of a vegetation type that was sampled is followed by the descriptions of the sampled plant communities found within that type. This includes the 56 plant communities defined by the objective classification and the four additional communities sampled in 1975. General soils information is included in the vegetation type description.

Table 6. Alphabetized checklist of plant species identified and study area segment occurrence.

Scientific Name	Common Name	Segment Occurrence 1	2	3	4	5	6	7	8
	GRASSES								
Agropyron cristatum	Fairway Crested Wheatgrass						X		
Agropyron dasystachyum	Thickspike Wheatgrass	X							
Agropyron intermedium	Intermediate Wheatgrass						X		
Agropyron repens	Quackgrass				X		X		X
Agropyron smithii	Bluestem Wheatgrass								X
Agropyron spicatum	Bluebunch Wheatgrass	X	X	X	X	X	X	X	
Agrostis alba	Redtop						X		
Agrostis interrupta	Interrupted Apera				X				
Aristida longiseta	Red Threeawn			X	X				
Avena fatua	Wild Oat	X							
Bromus brizaeformis	Rattle Brome	X	X	X	X	X			
Bromus japonicus	Japanese Brome	X	X	X	X	X	X		
Bromus mollis	Soft Brome	X	X	X		X			
Bromus rigidus	Ripgut Brome						X		
Bromus sterilis	Barren Brome		X	X	X				
Bromus tectorum	Cheatgrass Brome	X	X	X	X	X	X	X	X
Distichlis stricta	Alkali Saltgrass	X					X		
Elymus cinereus	Giant Wildrye	X	X	X					
Elymus glaucus	Blue Wildrye		X						
Elymus triticoides	Creeping Wildrye	X							
Eragrostis cilianensis	Stinkgrass		X						
Eragrostis hypnoides	Teal Lovegrass				X				
Festuca arundinacea	Reed or Tall Fescue								X
Festuca bromoides	Six-week Fescue				X				
Festuca idahoensis	Idaho Fescue		X	X			X		
Festuca myuros	Rattail Fescue	X	X	X			X		
Festuca octoflora	Sixweeks Fescue	X		X	X	X			
Festuca pratensis	English Fescue						X		
Festuca rubra	Red Fescue			X					
Festuca scabrella	Rough Fescue	X							
Hordeum jubatum	Foxtail Barley	X	X		X		X	X	
Hordeum murinum	Mouse Barley						X		
Oryzopsis hymenoides	Indian Ricegrass							X	
Panicum scribnerianum	Scribner Panicum		X	X	X		X		
Phalaris arundinacea	Reed Canarygrass			X			X	X	X
Phleum pratense	Timothy			X					
Poa bulbosa	Bulbous Bluegrass	X	X	X					
Poa gracillima	Slender Bluegrass		X	X					
Poa howellii	Howell's Bluegrass								X
Poa nevadensis	Nevada Bluegrass			X					X
Poa palustris	Fowl Bluegrass	X							
Poa pratensis	Kentucky Bluegrass		X					X	
Poa sandbergii	Sandberg Bluegrass	X	X	X	X	X	X	X	X

Table 6. Continued.

Scientific Name	Common Name	Segment Occurrence 1	2	3	4	5	6	7	8
Poa trivialis	Roughstalk Bluegrass		X						
Polypogon monspeliensis	Rabbitfoot Polypogon						X		X
Secale cereale	Rye			X	X				
Spartina pectinata	Prairie Cordgrass			X	X				
Sporobolus cryptandrus	Sand Dropseed			X	X		X		
Stipa comata	Needle-and-Thread							X	
Taeniatherum asperum	Medusahead Wildrye	X	X						
	GRASSLIKE PLANTS								
Carex spp.	Sedge	X		X				X	X
Carex oederi	Green Sedge						X		
Carex raynoldsii	Raynolds Sedge							X	
Carex siccata	Silvertop Sedge		X						
Eleocharis palustris	Common Spikerush		X				X	X	
Juncus spp.	Rush, Wiregrass	X							
Juncus brachyphyllus	Short-leaf Rush		X						
Scirpus acutus	Tule Bulrush						X		X
Scirpus americanus	American Bulrush	X						X	X
Scirpus validus	Softstem Bulrush						X		
	FORBS								
Achillea millefolium	Yarrow	X	X	X	X	X	X	X	
Agastache urticifolia	Nettleleaf Gianthyssop	X							
Allium spp.	Wild Onion			X					
Allium acuminatum	Tapertip Onion		X						
Allium bisceptrum	Palmer Onion	X							
Allium textile	Textile Onion	X							
Alyssum alyssoides	Pale Alyssum			X					
Ambrosia acanthicarpa	Bur Ragweed, Annual Bursage						X		
Ambrosia artemisifolia	Common Ragweed								X
Amsinckia lycopsioides	Tarweed Fiddleneck	X		X	X	X	X		X
Amsinckia menziesii	Menzies Fiddleneck	X	X	X					X
Amsinckia retrorsa	Rigid Fiddleneck								X
Amsinckia tessellata	Tesellate Fiddleneck	X						X	
Anemone piperi	Piper Anemone	X	X						
Anthriscus scandicina	Bur Chervil	X					X		
Apocynum androsaemifolium	Spreading Dogbane		X						
Apocynum cannabinum	Hemp Dogbane	X	X	X	X			X	
Arctium minus	Common Burdock	X							
Arenaria serpyllifolia	Thymeleaf Sandwort		X	X	X	X			
Artemisia ludoviciana	Louisiana Sagebrush	X	X	X	X				
Asclepias fascicularis	Mexican Milkweed	X		X					
Asclepias speciosa	Showy Milkweed	X	X	X	X		X		X

Table 6. Continued.

Scientific Name	Common Name	Segment Occurrence 1	2	3	4	5	6	7	8
Asparagus officinalis	Garden Asparagus	X							X
Asperugo procumbens	Catchweed		X						
Astragalus spp.	Milkvetch, Locoweed				X			X	
Astragalus cusickii	Cusicks Melkvetch			X					
Astragalus inflexus	Hairy Milkvetch			X	X		X		
Astragalus purshii	Pursh Locoweed	X	X						
Astragalus spaldingii	Spaldings Milkvetch						X		
Balsamhorhiza sagittata	Arrowleaf Balsamroot	X	X				X		
Bidens cernua	Nodding Beggarticks								X
Bidens frondosa	Devils Beggarticks						X		
Bidens vulgata	Tall Beggarticks								X
Blepharipappus scaber	Blepharipappus	X	X	X		X			
Brodiaea douglasii	Douglas Brodiea	X	X	X	X	X	X		
Calochortus macrocarpus	Sagebrush Mariposa			X			X	X	
Camassia cusickii	Cusicks Camas		X						
Camelina microcarpa	Littlepod Falseflax		X						
Capsella bursa-pastoris	Shepherdspurse	X							
Carduus acanthoides	Acanthus Thistle			X					
Castilleja applegatei	Applegate Paintbrush		X						
Centaurea solstitialis	Yellow Centaurea								X
Cerastium arvense	Starry Cerastium	X	X	X	X	X	X	X	X
Cerastium viscosum	Sticky Cerastium			X	X	X			
Chaenactis douglasii	Falseyarrow	X	X						
Chenopodium spp.	Goosefoot				X				
Chenopodium album	Lambsquarters				X		X		X
Chenopodium botrys	Jerusalem-Oak				X				
Chenopodium rubrum	Red Goosefoot								X
Chorispora tenella	Chorispora	X		X					
Chrysopsis villosa	Hairy Goldaster			X	X				
Cichorium intybus	Common Chicory		X		X			X	
Cirsium spp.	Thistle				X				X
Cirsium arvense	Canada Thistle	X					X	X	X
Cirsium brevistylum	Thistle							X	
Cirsium subniveum	Thistle	X							
Cirsium undulatum	Wavyleaf Thistle	X	X	X			X		
Cirsium vulgare	Bull Thistle	X			X				
Clematis ligusticifolia	Western Virginsbower	X	X	X	X				
Cleome lutea	Yellow Spiderflower	X						X	
Collinsia grandiflora	Bluelips Collinsia		X						
Collomia linearis	Narrowleaf Collomia		X						
Collomia marcrocalyx	Bristle-flowered Collomia						X		
Conium maculatum	Poison Hemlock	X							X
Convolvulus arvensis	European Morningglory								X
Conyza canadensis	Horseweed						X		
Crepis acuminata	Tapertip Hawksbeard	X	X						
Crepis atrabarba	Slender Hawksbeard						X		
Crepis occidentalis	Western Hawksbeard	X							

Table 6. Continued.

Scientific Name	Common Name	Segment Occurrence 1	2	3	4	5	6	7	8
Cryptantha ambigua	Obscure Cryptantha		X						
Cryptantha intermedia	Common Cryptantha		X	X					
Cryptantha pterocarya	Winged Cryptantha		X						
Cynoglossum officinale	Common Houndstongue	X	X						
Datura stramonium	Jimson Weed					X			
Delphinium bicolor	Little Larkspur		X						
Descurainia pinnata	Pinnate Tansymustard	X		X			X		
Descurainia richardsonii	Mountain Tansymustard							X	
Descurainia sophia	Flixweed Tansymustard	X							
Dicentra cucullaria	Dutchmans Breeches		X						
Dipsacus sylvestris	Teasel		X	X			X	X	X
Dodecatheon conjugens	Slimpod Shootingstar		X						
Draba verna	Spring Draba	X	X	X	X	X	X	X	X
Epilobium angustifolium	Fireweed							X	
Epilobium glaberrimum	Smooth Willowweed						X		
Epilobium paniculatum	Autumn Willowweed	X	X				X		X
Equisetum spp.	Horsetail			X	X			X	
Equisetum arvense	Field Horsetail							X	
Equisetum fluviatile	Water Horsetail			X					
Equisetum hyemale	Western Scouringrush		X		X			X	
Equisetum laevigatum	Smooth Scouringrush							X	X
Equisetum palustre	Marsh Horsetail						X		
Erigeron asperugineus	Daisy				X				
Erigeron divergens	Spreading Fleabane				X				
Erigeron pumilus	Shaggy Fleabane	X						X	
Erigeron speciosus	Showy Fleabane	X	X	X					
Erigeron strigosus	Daisy		X						
Erigeron subtrinervis	Threenerve Fleabane			X					
Eriogonum spp.	Buckwheat		X		X				
Eriogonum compositum	Northern Buckwheat		X						
Eriogonum elatum	Rush Buckwheat	X							
Eriogonum vimineum	Broom Buckwheat		X						
Eriophyllum lanatum	Woolly Eriophyllum		X						
Eriophyllum lanatum	Woolly Eriophyllum				X				
Erodium cicutarium	Storksbill	X	X	X	X	X	X	X	X
Erysimum asperum	Plains Wallflower		X	X					
Euphorbia glyptosperma	Ridgeseed Euphorbia			X	X				
Fritillaria pudica	Yellow Fritillary		X		X		X		
Gaillardia aristata	Gaillardia				X	X			
Galium aparine	Cleavers Bedstraw			X	X	X			
Galium asperrimum	Rough Bedstraw	X	X	X					
Gaura parviflora	Velvet Weed						X		
Geranium bicknellii	Bicknell Geranium			X					
Geranium pusillum	Small Geranium		X		X				
Gilia sinuata	Shy Gilia	X							
Glycyrrhiza lepodota	American Licorice		X	X	X			X	
Gnaphalium chilense	Cottonbatting Cudweed							X	

Table 6. Continued.

Scientific Name	Common Name	Segment Occurrence 1	2	3	4	5	6	7	8
Grindelia nana	Low Gumweed		X						
Haplopappus aberrans	Idaho Goldenweed			X					
Haplopappus carthamoides	Largeflower Goldenweed	X							
Helianthus annuus	Common Sunflower	X	X	X	X	X	X	X	
Heliotropium curassavicum	Salt Heliotrope								X
Heuchera cylindrica	Roundleaf Alumroot				X				
Hieracium albertinum	Western Hawkweed		X						
Hypericum perforatum	Goatweed		X	X	X		X	X	
Iva axillaris	Poverty Sumpweed	X							
Kochia scoparia	Belvedere Summer Cypress						X	X	
Lactuca serriola	Prickly Lettuce	X	X	X	X		X	X	X
Lagophylla ramosissima	Slender Rabbitleaf						X		
Lamium amplexicaule	Henbit Deadnettle		X						
Lathyrus rigidus	Rigid Peavine	X							
Lepidium latifolium	Broadleaved Peppergrass	X	X						X
Lepidium perfoliatum	Clasping Pepperweed	X		X	X		X	X	
Lepidium virginicum	Tall Pepperweed			X		X			
Linaria dalmatica	Butter-and-Eggs	X							
Linum perenne	Perennial Flax							X	
Lithophragma parvilflora	Smallflower Woodlandstar		X	X		X			
Lithospermum arvense	Stoneseed		X				X		
Lithospermum ruderale	Western Gromwell	X	X	X	X		X		
Lomatium spp.	Biscuitroot, Lomatium	X	X		X				
Lomatium canbyi	Canby Biscuitroot			X					
Lomatium dissectum	Carrotleaf Liptotaenia		X	X	X				X
Lomatium grayi	Grays Biscuitroot	X	X				X	X	
Lomatium leptocarpum	Bicolor Biscuitroot		X						
Lomatium salmoniflorum	Salmon River Lomatium		X						
Lomatium triternatum platycarpum			X	X					
Lotus purshianus	Spanishclover		X			X			
Lupinus spp.	Lupine		X						
Lupinus caudatus	Tailcup Lupine		X						
Lupinus laxiflorus calcaratus	Spur Lupine	X							
Lupinus leucophyllus	Velvet Lupine						X		
Lycopus americanus	American Bugleweed			X			X		X
Lycopus asper	Rough Bugleweed							X	
Machaerocarpus californicus	Star Waterplantain	X							
Malacothrix torreyi	Malacothrix	X							
Marrubium vulgare	Common Hoarhound		X	X	X				
Matricaria maritima	Scentless May-weed						X		X
Matricaria matricarioides	Pineapple-Weed				X				
Medicago lupulina	Black Medic			X					
Medicago sativa	Alfalfa		X				X		X
Melilotus alba	White Sweetclover	X	X	X	X		X	X	
Mentha arvensis	Field Mint				X				
Mentha spicata	Spearmint	X							
Mentzelia laevicaulis	Blazingstar mentzelia								X

Table 6. Continued.

Scientific Name	Common Name	Segment Occurrence 1	2	3	4	5	6	7	8
Mertensia ciliata	Broadleaf Bluebells		X						
Mertensia longiflora	Small Bluebells		X						
Microseris linearifolia	Linearleaf Microseris	X							
Microseris nutans	Nodding Microseris			X					
Mimulus guttatus	Common Monkeyflower		X	X			X		X
Mimulus nanus	Dwarf Monkeyflower		X						
Montia arenicola	Sand Montia				X				
Montia cordifolia	Broadleaf Indianlettuce			X					
Montia perfoliata	Minerslettuce		X	X	X				
Moss spp.	Mosses		X	X	X	X		X	
Myosotis laxa	Bay Forget-me-not						X		X
Myosotis micrantha	Smallflower Forget-me-not			X					
Nemophila kirtleyi	Snake River Canyon Nemophila		X						
Oenothera caespitosa	Tufted Eveningprimrose	X	X						
Oenothera pallida pallida								X	
Opuntia polyacantha	Plains Pricklypear			X	X				X
Orobanche fasciculata	Clustered Broomrape			X	X				
Orobanche uniflora	Naked Broomrape		X						
Parietaria pensylvanica	Pennsylvania Pellitory			X					
Penstemon acuminatus	Sharp-leaved Penstemon	X							
Penstemon elegantulus	Lovely Penstemon			X					
Penstemon glandulosus	Stickystem Penstemon	X							
Penstemon wilcoxii	Wilcox Penstemon		X						
Petalostemon orantum	Prairie Clover				X				X
Phacelia hastat	Whiteleaf Phacelia		X						
Phacelia heterophylla	Varileaf Phacelia	X		X	X				
Phacelia linearis	Threadleaf Phacelia		X	X			X		
Phlox colubrina	Snakeriver Phlox			X					
Physalis longifolia	Groundcherry	X		X	X				
Physaria oregana	Oregon Twinpod		X	X					
Plagiobothrys tenellus	Slender Popcornflower			X					
Plantago lanceolata	Buckhorn Plantain	X	X						
Plantago major	Rippleseed Plantain		X						
Plantago patagonica	Indianwheat			X	X		X	X	X
Plectritis macrocera	Longhorn Plectritis			X	X	X			
Polanisia trachysperma	Polanisia		X						
Polygonum aviculare	Prostrate Knotweed						X		
Polygonum coccineum	Bigroot Ladysthumb				X				
Polygonum douglasii	Douglas Knotweed		X						
Polygonum majus	Wiry Knotweed							X	X
Polygonum punctatum	Dotted Smartweed						X		
Potentilla concinna	Early Cinquefoil		X						
Psoralea lancelata	Lanceleaf Scurfpea	X					X		
Ranunculus abortivus	Small Flowered Buttercup								X
Ranunculus glaberrimus	Sagebrush Buttercup		X						
Rudbeckia hirta	Blackeyedsusan						X		
Rumex spp.	Dock, Sorrel					X			

Table 6. Continued.

Scientific Name	Common Name	Segment Occurrence 1	2	3	4	5	6	7	8
Rumex crispus	Curly Dock	X					X	X	
Rumex occidentalis	Western Dock		X	X					X
Rumex salicifolius	Willow Dock						X		
Rumex venosus	Veiny Dock								X
Salsola kali tenuifolia	Russian Thistle	X			X				
Salvia sclarea	Clear Eye	X							
Scleranthus annuus	German Knotweed	X	X						
Scutellaria angustifolia	Narrowleaf Skullcap				X				
Sedum lanceolatum	Lanceleaved Stonecrop			X					
Sedum leibergii	Leiberg Stonecrop			X	X				
Sida hederacea	Alkali Sida	X							
Sisymbrium altissimum	Tumblemustard	X	X	X	X	X	X	X	X
Solanum dulcamara	Bitter Nightshade	X	X		X				X
Solidago canadensis	Canada Goldenrod			X					X
Solidago gigantea	Goldenrod			X			X		X
Solidago missouriensis	Missouri Goldenrod	X					X	X	
Solidago occidentalis	Western Goldenrod						X	X	X
Sonchus oleraceus	Common Sowthistle								X
Sphaeralcea munroana	Munro Globemallow	X			X		X		
Stanleya confertiflora	Biennial Stanleya				X				
Stanleya pinnata	Desert Princesplume			X					
Stellaria media	Chickweed			X	X				
Streptanthella longirostris	Streptanthella			X					
Swainsona salsula	Australian Peavine								X
Taraxacum spp.	Dandelion				X				
Taraxacum officinale	Common Dandelion		X						
Thlaspi arvense	Field Pennycress		X						
Thysanocarpus curvipes	Sand Fringed-Pod		X	X					
Tonella floribunda	Large Flower Tonella		X	X	X				
Tragopogon dubius	Yellow Salsify	X	X	X	X	X	X		
Tragopogon miscellus	Goatsbeard							X	X
Trifolium spp.	Clover		X						
Triodanis perfoliata	Venus'-looking-glass				X				
Typha angustifilia	Narrowleaf Cattail						X		X
Typha latifolia	Common Cattail	X					X	X	X
Urtica dioica	Big Stinging Nettle	X	X	X	X		X		
Vaccaria segetalis	Cow Soapwort		X				X		
Verbascum blattaria	Moth Mullein		X	X					
Verbascum thapsus	Flannel Mullein		X	X					
Verbena bracteata	Bigbracht Verbena						X		
Veronica anagallis-aquatica	Water Speedwell						X		X
Veronica arvensis	Common Speedwell			X	X	X			
Vicia americana	American Vetch				X				
Vicia villosa	Hairy Winter Vetch					X	X		
Viola canadensis	Canada Violet			X					
Viola orbiculata	Darkwoods Violet		X						

Table 6. Continued

Scientific Name	Common Name	Segment Occurrence 1	2	3	4	5	6	7	8
Vitis riparia	Riverbank Grape-vine	X							
Woodsia	Woodsia			X					
Woodsia oregana	Oregon Woodsia		X	X	X				
Xanthium strumarium			X	X	X		X		
Zigadenus paniculatus	Foothill Deathcamas		X	X					
	SHRUBS								
Amelanchier alnifolia	Serviceberry	X	X	X	X				
Artemisia tridentata	Big Sagebrush	X							X
Celtis douglasii	Douglas Hackberry	X	X	X	X	X			
Chrysothamnus nauseosus	Rubber Rabbitbrush	X			X	X	X	X	X
Chrysothamnus viscidiflorus	Tall Green Rabbitbrush	X			X	X	X	X	X
Cornus stolonifera	Red-osier Dogwood			X					
Crataegus columbiana	Columbia Hawthorn		X						
Crataegus douglasii	Black Hawthorn	X		X					
Erigeron filifolius	Threadleaf Fleabane						X	X	
Erigeron linearis	Lineleaf Fleabane	X							
Eriogonum heracleoides	Wyeth Buckwheat		X						
Eriogonum niveum	Snow Eriogonum	X					X	X	X
Gutierrezia sarothrae	Broom Snakeweed	X			X				
Holodiscus discolor	Creambush Oceanspray			X	X				
Humulus lupulus	Hops				X				
Lysium halimifolium	Matrimony Vine				X				
Penstemon deustus	Scabland Penstemon		X						
Penstemon fruticosus	Bush Penstemon			X					
Penstemon triphyllus	Whorled Penstemon			X					
Philadelphus lewisii	Mockorange	X	X	X	X	X			
Phlox longifolia	Longleaf Phlox	X	X		X	X	X		
Prunus emarginata	Bitter Cherry	X	X						
Prunus virginiana	Common Chokecherry	X	X	X					
Purshia tridentata	Antelope Bitterbrush	X	X						X
Rhus glabra	Smooth Sumac	X	X	X	X	X			
Rhus radicans	Poison Ivy	X	X	X	X				
Ribes aureum	Golden Currant		X		X				
Ribes cereum	Wax Currant			X					
Ribes hudsonianum petiolare	Black Currant								X
Ribes irriguum	Idaho Gooseberry		X		X				
Rosa nutkana	Nootka Rose	X		X					
Rosa woodsii	Woods Rose	X	X		X		X		
Rubus bartonianus	Bartonberry			X					
Rubus discolor	Himalayan Blackberry		X	X	X				
Rubus leucodermis	Western Blackcap		X						
Salix amygdaloides	Peachleaf Willow		X	X			X		
Salix exigua melanopsis					X				
Salix exigua exigua	Coyote Willow	X	X	X		X	X	X	X

Table 6. Continued.

Scientific Name	Common Name	Segment Occurrence 1	2	3	4	5	6	7	8
Salix lasiandra lasiandra	Red Willow			X					
Salix lasiandra caudata	Whiplash Willow	X			X		X		X
Salix rigida mackenzieana	MacKenzie Willow	X	X		X		X	X	X
Sambucus cerulea	Blue Elderberry	X	X	X	X				
Sarcobatus vermiculatus	Black Greasewood	X							
Symphoricarpos albus	Common Snowberry		X						
Tamarix pentandra	Tamarisk	X							
Vitis riparia	Riverbank Grapevine		X	X					
Vitis vinifera	European Grapevine	X	X	X	X				
	TREES								
Acer saccharinum	Silver Maple	X			X		X		
Acer negundo	Boxelder		X		X				
Ailanthus altissima	Tree of Heaven				X	X	X		
Alnus rhombifolia	White Alder	X	X	X		X	X	X	X
Betula occidentalis	Water Birch		X	X					
Elaeagnus angustifolia	Russian Olive	X					X	X	X
Fraxinus pennsylvanica	Green Ash	X	X	X	X				
Juglans nigra	Black Walnut			X	X				
Juglans regia	English Walnut			X	X				
Malus pumila	Apple	X	X	X	X				
Morus alba	White Mulberry		X		X				
Pinus ponderosa	Ponderosa Pine		X	X	X	X			
Populus deltoides	Great Plains Cottonwood								X
Populus trichocarpa	Black Cottonwood	X	X		X		X		
Prunus armeniaca	Apricot		X	X					X
Prunus avium	Bird Cherry			X	X				
Prunus cerasifera	Cherry Plum	X	X	X	X				
Prunus spinosa	Blackthorn			X					
Robinia pseudo-acacia	Blact Locust, False Acacia	X				X	X		X

Table 7. Index to Vegetation Types and Plant Communities.

Table 7. Continued.

Vegetation Type	Community	Site Numbers Included	Page
WILDRYE			64
	Creeping Wildrye-Canada Thistle	4	64
REEDGRASS			65
	Common Reed-Poison Ivy	26	65
CATTAIL			65
	Common Cattail-American Bulrush	67,75,77	66
	Common Cattail-Common Spikerush	62	66
SEDGE			67
BULRUSH			67
CATTAIL-SEDGE			67
BIG SAGEBRUSH			67
BIG SAGEBRUSH-BLUEBUNCH WHEATGRASS			67
	Big Sagebrush-Cheatgrass Brome	9	68
RUBBER RABBITBRUSH			68
	Rubber Rabbitbrush-Big Sagebrush-Cheatgrass Brome	8,81	68
	Rubber Rabbitbrush-Bluebunch Wheatgrass	70	69
	Rubber Rabbitbrush-Sandberg Bluegrass	63,73,74	69
	Rubber Rabbitbrush-Crested Wheatgrass	64	70
	Rubber Rabbitbrush-Cheatgrass Brome-Common Sunflower	65,76	70
	Rubber Rabbitbrush-Cheatgrass Brome-Plains Prickly Pear	53	70
	Rubber Rabbitbrush-Cheatgrass Brome-Common Speedwell	61	71
ANTELOPE BITTERBRUSH-BLUEBUNCH WHEATGRASS			71
	Antelope Bitterbrush-Cheatgrass Brome	15,19	72
ANTELOPE BITTERBRUSH-BIG SAGEBRUSH			72
	Antelope Bitterbrush-Big Sagebrush-Cheatgrass Brome	83	72
	Antelope Bitterbrush-Rubber Rabbitbrush-Cheatgrass Brome	6	73
CURLLEAF MOUNTAINMAHOGANY			73
	Curlleaf Mountainmahogany-Cheatgrass Brome	44	73

Table 7. Continued.

Table 7. Continued.

MEDUSAHEAD WILDRYE VEGETATION TYPE

This is a seral annual grassland type found in the *Artemisia tridentata - Agropyron spicatum* habitat-type of southern Idaho. Medusahead wildrye *(Taeniatherum asperum)* is the dominant annual grass. Several annual bromes are also present in varying amounts. The presence of many annual forbs indicates that past disturbance has eliminated the climax vegetation.

The Medusahead Wildrye type is limited on the study area to sites near Brownlee Reservoir. Traces of medusahead wildrye were found as far downstream as the Palouse River confluence in Washington but always in a subordinate role to cheatgrass brome.

Medusahead Wildrye - Cheatgrass Brome Community

This annual grassland is dominated by medusahead wildrye with cheatgrass brome occurring in varying amounts. The only remnant species of climax vegetation is Sandberg bluegrass (*Poa sandbergii*), suggesting a past heavy use by livestock (Daubenmire 1970). The community has only a trace of rubber rabbitbrush (*Chrysothamnus nauseosus*) present.

The scabland sites found in areas occupied by the Medusahead Wildrye-Cheatgrass Brome community are dominated by a distinct stiff sagebrush (*Artemisia rigida*) community. This scabland community has been described by Daubenmire (1970) as the *Artemisia rigida - Poa sandbergii* habitat-type.

CHEATGRASS BROME VEGETATION TYPE

Some overgrazed upland areas are dominated by a nearly pure stand of cheatgrass brome (*Bromus tectorum*). Annual forbs are sparse to abundant. The annuals contribute to a fairly high ground cover of litter.

The type is part of the cheatgrass brome phase of the *Agropyron - Poa* habitat-type and occurs primarily on flat benches. Small fenced areas are not included in this type. They have been typed as pastures.

ANNUAL FORB VEGETATION TYPE

This type of vegetation is found on severely disturbed sites such as abandoned fields and railroad and road right of ways. It is characterized by varying densities of annual forbs. The drier sites with coarse gravelly soils support a low sparse growth of such species as tumblemustard *(Sisymbrium altissimum)*, Russian thistle *(Salsola kali)* and cheatgrass brome *(Bromus tectorum)*. The Cheatgrass Brome - Tumblemustard community is an example of this dry type of community.

The more mesic communities support a dense tall growth of annuals such as common sunflower *(Helianthus annuus)*, thistles *(Cirsium spp.)*, prickly lettuce *(Lactuca seriola)*, and horseweed *(Conyza canadensis)*. This type of

forb community was found on sandy river bars and islands that were abandoned agricultural lands. The Common Sunflower - Tumblemustard community, the Prickly Lettuce - Cheatgrass Brome community and the Horseweed - Prickly Lettuce community are examples of the abandoned field forb type.

The Cheatgrass Brome - Tumblemustard community is a low seral stage of primary succession on areas of gravel fill. This gravelly soil will prohibit the development of a grassland for quite some time. A higher stage in this sequence of primary succession would be the perennial White Sweet Clover vegetation type. The Cheatgrass Brome - Tumblemustard community could mature into a similar perennial type if disturbances such as spraying, burning, and mowing that are commonly used along road right of ways were discontinued.

Abandoned fields should mature into grasslands or shrub steppes of the habitat-type in which they occur. For most sites this would be the *Agropyron spicatum - Poa sandbergii* and *Artemisia tridentata - Agropyron spicatum* habitat-types.

The Annual Forb vegetation type is found extensively throughout the study area.

Cheatgrass Brome - Tumblemustard Community

The Cheatgrass Brome - Tumblemustard community is characterized by a sparse growth of annuals. This sporadically vegetated plant community grows on dry disturbed sites such as road fills. Many of these communities are not permitted to develop into the more mature perennial communities due to periodic disturbances such as burning, mowing, and spraying. Cheatgrass brome, tumblemustard and Russian thistle are the most abundant species. These species have a sparse to spotty distribution leaving approximately 20 percent of the ground bare.

Common Sunflower - Tumblemustard Community

Dense stands of common sunflower are found growing on abandoned fields located on benches and islands just above the high water line. Common sunflower reaches a height of over 2 meters in this mesic forb community. The next most abundant species is tumblemustard. Many other forbs such as thistles and western gromwell *(Lithospermum ruderale)* are scattered throughout the community but are not very conspicuous due to the dense, tall stand of common sunflower. Ground cover in these dense stands of annuals approaches 100 percent litter.

Prickly Lettuce - Cheatgrass Brome Community

This community is a very homogeneous stand of prickly lettuce. Very few other annual species are found in this community due to the dense, 2 meters tall, growth of prickly lettuce. Cheatgrass brome has a high frequency of occurrence but is very sparse. The high cover value of 1.8

percent for cheatgrass brome is inflated due to the fact that the lowest value recorded is 1 percent. This community was found on an abandoned field on a river bar along Little Goose Reservoir. Ecologically it is equivalent to the Common Sunflower - Tumblemustard community found on the upper segments of the study area.

Horseweed - Prickly Lettuce Community

The Horseweed - Prickly Lettuce community is a mesic band of shoreline vegetation bordering the Prickly Lettuce - Cheatgrass Brome community. The horseweed community is much more diverse than the other forb communities with a definite understory beneath the tall horseweeds, prickly lettuce, and common sunflowers. The understory consists of such mesic plants as American bugleweed *(Lycopus americanus)*, willowdock *(Rumex salicifolius)* and cocklebur *(Xanthium strumarium)*. The tall growing forbs are not as dense as in the Prickly Lettuce - Cheatgrass Brome community. The understory forbs are very dense producing a nearly 100 percent cover of litter.

HORSETAIL VEGETATION TYPE

The horsetail type is found in moist areas above the high waterline. This type is limited to a few areas where the proper environmental conditions are maintained. On a few steep north exposures the type occurs as a wide ecotone between the shoreline vegetation and the adjacent upland vegetation. In other areas without such steep relief, the community is a narrow belt of shoreline vegetation.

This type takes on characteristics of the adjacent upland type. In one area on Oxbow Reservoir the codominant is bluebunch wheatgrass *(Agropyron spicatum)*. In most other areas the codominant is cheatgrass brome *(Bromus tectorum)*.

Smooth Scouringrush - Cheatgrass Brome Community

This community is found as a belt about 15 meters wide between the shoreline vegetation and the adjacent upland. Smooth scouringrush *(Equisetum laevigatum)* is the dominant plant in the community. It forms a dense uniform stand with 86 percent litter cover from old stalks. Coyote willow *(Salix exigua exigua)* and rubber rabbitbrush *(Chrysothamnus nauseosus)* are scattered on the area. Coyote willow could become a dominant shrub layer on some area if beaver did not feed upon this species.

On some areas the Smooth Scouringrush - Cheatgrass Brome community is found as a narrow belt of shoreline vegetation. On Ice Harbor Reservoir this narrow belt of vegetation has an occasional young white alder *(Alnus rhombifolia)* growing in it.

LOUISIANA SAGEBRUSH VEGETATION TYPE

The scouring of strong currents during spring runoff creates the cobblestone bars below the high water line where this vegetation type is found. The current carries away sand, silt, and litter leaving rounded rocks with small pockets of sand between them. The vegetation is very sparse but fairly diverse. Louisiana sagebrush *(Artemisia ludoviciana)* and hairy goldaster *(Chrysopsis villosa)* are the most consistently observed species in the type.

Vegetation reaches maximum development late in the year due to June-July flooding. Storksbill *(Erodium cicutarium)* was observed growing as early as January 29. Plants were very large at this time due to the abundant moisture and lack of competition. Most of the grass species such as sand dropseed *(Sporobolus cryptandrus)* and red threeawn *(Aristida longiseta)* begin growing long before the spring runoff. After flooding the grasses were observed to recover rapidly but most forbs recovered slowly.

The Louisiana Sagebrush type is limited to the free flowing stretch of the Snake River between Hells Canyon Dam and the Clearwater River confluence. This vegetation type is the most likely to be affected by artificial water fluctuations on the free flowing stretch of the Snake River.

The two communities within the Louisiana Sagebrush vegetation type formed a very unique stem in the classification hierarchy. They were the last communities to be joined to the other riparian communities. This is due to the low number of abundant species and because several species *(Chrysopsis villosa,* hairy goldaster, and *Salix exigua melanopsis)* are unique to the type.

The dominant species of this type, *Artemisia ludoviciana,* has possibly been identified by other researchers (Wakefield 1966, Horton 1972) as *Artemisia lindleyana.* Although *Artemisia lindleyana* is described as occurring below the high water mark, we felt that the characteristics of *Artemisia ludoviciana* more closely fit those of the plant specimens we observed.

Salix exigua melanopsis - Louisiana Sagebrush Community

Willow *(Salix exigua melanopsis)* in this community is very sparse and short, creating a bare appearance that is characteristic of the type. This willow subspecies was only found between the Grande Ronde and Clearwater River confluences with the Snake River. Louisiana sagebrush and hairy goldaster are found sparingly in the forb layer. Several other forbs and shrubs are found as incidentals in the community. Small individuals of sand dropseed can be found quite regularly growing in the sand pockets between the rocks. This community is located closer to the low water line and subjected to stronger currents than the Hairy Goldaster - Sand Dropseed community.

Hairy Goldaster - Sand Dropseed Community

The Hairy Goldaster - Sand Dropseed Community has larger sand deposits and more diverse vegetation than the other Louisiana Sagebrush community. Although no shrub layer exists, an occasional stunted Douglas hackberry *(Celtis douglasii)* may be found. Several annual grasses *(Bromus tectorum, Bromus japonicus,* and *Festuca octoflora)* are found in addition to the major perennial grass, sand dropseed. Hairy goldaster is the dominant forb but Louisiana sagebrush, common sunflower *(Helianthus annuus),* and goatweed *(Hypericum perforatum)* are also consistent members in this sparse community.

ABSINTHE VEGETATION TYPE

The Louisiana Sagebrush type is replaced on the Columbia River by the Absinthe, Lupine and Northern Buckwheat vegetation types. These three type designations are used by Hanson and Eberhardt (1971) for the plant communities occurring on cobblestone islands in the upper end of McNary Reservoir.

The Absinthe type occupies the highest elevation zone on these cobblestone islands. A sparse stand of absinthe (*Artemisia absinthium*) dominates the type. Very few species other than absinthe occur. Thickspike Wheatgrass and Wildrye communities grow above this type on the sandy soils.

LUPINE VEGETATION TYPE

Cobblestone islands on the upper end of McNary Reservoir, including the Snake River up to Ice Harbor Dam, have a zone of vegetation dominated by lupine (*Lupinus spp.*). This zone occurs in between the Absinthe type and the Northern Buckwheat type.

A sparse growth of lupine dominates this type. It is essentially the only species found in the type. Rock and gravel comprise nearly 100 percent of the ground cover.

NORTHERN BUCKWHEAT VEGETATION TYPE

The lowest zone of forbs on the cobblestone islands of upper McNary Reservoir is dominated by northern buckwheat (*Eriogonum compositum*). The Lupine type occurs above this type. Occasionally communities of the Shrub Willow type exist below this type.

Northern buckwheat is very sparse in the type. Individual clumps are fairly large creating some ground cover of live vegetation, but rock and gravel cover most of the ground.

WHITE SWEET CLOVER VEGETATION TYPE

This type occurs on disturbed coarse soils such as old gravel pits and road right of ways that are not subjected to continued disturbance. Perennial forbs and grasses have become established on these areas. Succession to a more mature grassland type will be slow due to the lack of fine textured soils. This type is found in small areas throughout the study area. In addition to the following community very small pockets of white sweet clover *(Melilotus alba)* can be found in more mesic areas with a dense forb understory.

White Sweet Clover - Cheatgrass Brome Community

White sweet clover is the dominant forb in this community. The annual grasses, Japanese brome *(Bromus japonicus)*, *Bromus sterilis*, cheatgrass brome *(Bromus tectorum)* and medusahead wildrye *(Taeniatherum asperum)* form a sparse but continuous ground cover. More important are the perennial species that have become established on the area. In addition to white sweet clover, these are giant wildrye *(Elymus cinereus)*, foxtail barley *(Hordeum jubatum)*, Scribner panicum *(Panicum scribnerianum)*, yarrow *(Achillea millefolium)*, tapertip hawksbeard *(Crepis acuminata)*, nineleaf lomatium *(Lomatium triternatum)*, alfalfa *(Medicago sativa)* and curly dock *(Rumex crispus)*. Most of these species occur sparsely scattered throughout the community.

This community had a high similarity to the seral Bluebunch Wheatgrass - Cheatgrass Brome - Japanese Brome community in the objective classification, but it is not a grassland as is the bluebunch wheatgrass community. The seral grassland community had many of the same forbs and annual grasses as the White Sweet Clover - Cheatgrass Brome community. This similarity is due in part to their close proximity.

BUNCHGRASS VEGETATION TYPE

This type was used as a temporary designation in the initial vegetation typing. Upland areas in which the dominant species of bunchgrass was unknown were included in this type. After identifying the dominant species the areas were typed as one of the other perennial grass types.

BLUEBUNCH WHEATGRASS - SANDBERG BLUEGRASS VEGETATION TYPE

This vegetation type represents the pure grassland communities in the *Agropyron spicatum - Poa sandbergii* habitat-type (Daubenmire 1970). Shrubs such as rubber rabbitbrush *(Chrysothamnus nauseosus)* may be present in these communities but not in sufficient densities to constitute a true shrub layer. Seral communities of this habitat-type, where rubber rabbitbrush is a dominant, are listed under the Rubber Rabbitbrush vegetation type.

Daubenmire (1970) described the climax vegetation as consisting of the two caespitose grasses for which the habitat-type is named and very little else, although a few widely scattered individuals of rubber rabbitbrush are characteristic. The seral communities sampled on this project have varying amounts, including the total absence, of these two grasses depending upon the degree of past disturbance. This array of *Agropyron - Poa* plant communities was ordinated to show their secondary successional relationships to each other. These relationships will be brought out in the individual community descriptions.

Three successional phases were identified in these communities. The cheatgrass brome *(Bromus tectorum)* phase is characteristic of the seral communities found along the Snake River in Washington. The phase is found on deep sandy to silt loam soils without a clay loam substrate. Other annual bromes are absent and often a definite rubber rabbitbrush layer is present in the seral communities. This phase is further described under the Rubber Rabbitbrush vegetation type.

The sand dropseed *(Sporobolus cryptandrus)* phase is found on sandy alluvial benches between Hells Canyon Dam and Wawawai, Washington (Daubenmire 1970). It is characterized by the dominant status of sand dropseed. Sandberg bluegrass *(Poa sandbergii)* is usually abundant in the higher successional communities but can be absent on severely disturbed sites. Bluebunch wheatgrass *(Agropyron spicatum)* is present on many of the less disturbed areas.

The third phase is recognized by the presence of the more mesic brome species such as Japanese brome *(Bromus japonicus)*, rattle brome *(Bromus brizaeformis)* and soft brome *(Bromus mollis)*. Japanese brome is the most abundant and widespread of these and the phase is named the Japanese brome phase. This phase is found on residual, stony silt loams of the steeper areas of the Snake River Canyon upstream from the Clearwater River confluence.

The *Agropyron - Poa* habitat-type comprised of the Bluebunch Wheatgrass - Sandberg Bluegrass and Rubber Rabbitbrush vegetation types is the most extensive of the upland habitat-types found on the study area. The Bluebunch Wheatgrass - Sandberg Bluegrass type begins near the middle of Brownlee Reservoir where it integrates with communities of the *Artemisia tridentata - Agropyron spicatum* habitat-type. It extends as the major upland type all the way down to the Grande Ronde River confluence. From this point, down river, it is found on the steeper slopes interspersed with the Rubber Rabbitbrush communities of the *Agropyron - Poa* habitat-type. In the area of Ice Harbor Dam the upland types change back to communities of the *Artemisia tridentata - Agropyron spicatum* habitat-type.

Bluebunch Wheatgrass - Idaho Fescue Community

The *Agropyron spicatum - Festuca idahoensis* habitat-type has a cooler and more mesic climate than the *Agropyron - Poa* habitat-type (Daubenmire 1970) and is found above the *Agropyron - Poa* zone in the Snake River Canyon. The *Agropyron - Festuca* habitat-type was sampled in the steep grassland area of Hells Canyon Reservoir where this habitat-type comes closest to the river.

It has been included in the Bluebunch Wheatgrass - Sandberg Bluegrass vegetation type because it is not readily discernable as a separate type by

the methods used in vegetation typing. The community sampled was a lush grassland with high basal cover of bluebunch wheatgrass (19 percent) and Idaho fescue *(Festuca idahoensis)* (14 percent). The bluebunch wheatgrass has slightly higher cover and a greater frequency of occurrence. Cheatgrass brome, Japanese brome, and Sandberg bluegrass are also consistent members in the community.

The unique species of this community are Idaho fescue, and western hawkweed *(Hieracium albertinum)*. Pursh locoweed *(Astragulus purshii)* and Douglas brodiea *(Brodiaea douglasii)* occur in higher proportions in this community than in other communities in which they occur. Live vegetation and litter equally comprise 90 percent of the ground cover.

Bluebunch Wheatgrass - Sandberg Bluegrass Community

The Bluebunch Wheatgrass - Sandberg Bluegrass community is the climax vegetation for the *Agropyron - Poa* habitat-type. Bluebunch wheatgrass and Sandberg bluegrass are the principal species. Annual grasses are nearly absent and few forb species occur in the community. Bluebunch wheatgrass is a tall dominant bunchgrass with approximately 70 percent frequency of occurrence. Sandberg bluegrass has a frequency of 95 percent, covering much of the ground in between the bluebunch wheatgrass. Rock and erosion pavement make up about 30 percent of the ground cover. Litter and live vegetation complete the ground cover leaving no bare ground.

It should be pointed out that this example of climax vegetation is from the Japanese brome phase found on steep residual soils. The climax vegetation described by Daubenmire (1970) is from the cheatgrass brome phase and there are slight differences in ground cover, frequency of occurrence and relative amounts of grass cover between the two phases. Daubenmire lists nearly 100 percent frequency of occurrence for both grass species and states that the ground cover is almost entirely live vegetation and cryptograms. The cover data are not comparable because Daubenmire used canopy coverage, and our data are for basal cover. Both sets of data show no bare ground present. Land managers should take note of the fact that a habitat-type does not produce a completely homogeneous type of vegetation over its entire range. There is variation within the climax vegetation between extreme ends of a habitat-type.

Bluebunch Wheatgrass - Sandberg Bluegrass - Goatweed Community

This community of the *Agropyron - Poa* habitat type has a high similarity to the Bluebunch Wheatgrass - Idaho Fescue community. The two communities were linked at the 41 percent difference level or at 59 percent similarity in the objective classification. Idaho fescue was found in the north facing pockets of one of the stands (site 43) sampled in this community. The Bluebunch Wheatgrass - Sandberg Bluegrass - Goatweed community represents a seral community in the mesic end of the *Agropyron - Poa* habitat-type which has a high similarity to the xeric end of the *Agropyron - Festuca* habitat-type.

The Bluebunch Wheatgrass - Sandberg Bluegrass - Goatweed community is

a dense grassland on moderate to steep slopes where moisture and temperature conditions near that of the *Agropyron - Festuca* habitat-type. Goatweed *(Hypericum perforatum)* was unique to this community in the upland sites that were sampled. Other indicators of this mesic community are *Chorispora tenella*, broadleaf Indianlettuce *(Montia cordifolia)*, miners lettuce *(Montia perfoliata)*, and Oregon woodsia *(Woodsia oregana)*. There is also a high frequency of occurrence of thymeleaf sandwort *(Arenaria serpyllifolia)*, storksbill *(Erodium cicutarium)*, cleavers bedstraw *(Galium aparine)*, and species of moss.

Bluebunch wheatgrass and Sandberg bluegrass are the dominant grasses. The community has been subjected to heavy grazing but the effects are not as obvious as in some of the drier communities. Japanese brome and rattle brome are well represented in addition to cheatgrass brome.

Bluebunch Wheatgrass - Sandberg Bluegrass - Rattle Brome Community

This grassland community is near climax as bluebunch wheatgrass and Sandberg bluegrass are very dense and still the dominant grasses. It is in the Japanese brome phase although this community is characterized by the absence of Japanese brome and the abundance of rattle brome. The forb layer is not well developed but two important forbs in the community are arrowleaf balsamroot *(Balsamorhiza sagittata)* and hemp dogbane *(Apocynum cannabinum)*, This community is found on steep, rocky slopes which helps protect it from heavy grazing.

Bluebunch Wheatgrass - Cheatgrass Brome - Japanese Brome Community

This is a typical widespread community of the Japanese brome phase. While cheatgrass brome is the codominant annual grass, Japanese brome is also well represented. Rattle brome is only found in small isolated clumps. Bluebunch wheatgrass is very dense but Sandberg bluegrass is not as abundant as in the Bluebunch Wheatgrass - Sandberg Bluegrass - Rattle Brome community, to which it is very similar in appearance and successional standing.

The only conspicuous forb is spreading dogbane *(Apocynum androsaemifolium)*. The high ground cover of litter, rock, and live vegetation leaves only about 5 percent of the ground bare.

Cheatgrass Brome - Sandberg Bluegrass Community

This grassland community is found on moderate, bottom slopes where grazing has had a considerable effect. Bluebunch wheatgrass has been eliminated from the community and Sandberg bluegrass is poorly represented. Cheatgrass brome is the dominant species. Small amounts of rattle brome are present to identify this community as a member of the Japanese brome phase. The "weedy" appearance of the community is produced by the presence

of autumn willowweed *(Epilobium paniculatum)*, three species of buckwheat *(Eriogonum compositum, Eriogonum umbellatum* and *Eriogonum strictum)*, thistle *(Cirsium spp.)* and tumblemustard *(Sisymbrium altissimum)*.

Cheatgrass Brome - Japanese Brome Community

This community is intermediate in successional sequence between the Bluebunch Wheatgrass - Cheatgrass Brome - Japanese Brome community and the Cheatgrass Brome - Sandberg Bluegrass Community. This annual grassland still retains a noticeable amount of bluebunch wheatgrass which makes it different from the Cheatgrass Brome - Sandberg Bluegrass community. Bluebunch wheatgrass has a cover value of less than 1 percent in this community while it has a value greater than 2 percent in the Bluebunch Wheatgrass - Cheatgrass Brome - Japanese Brome community. There is approximately 20 percent bare ground and about 2 percent erosion pavement in the ground cover of this community.

Cheatgrass brome is dominant and Japanese brome is a close codominant. Sandberg bluegrass and rattle brome are fairly abundant. Medusahead wildrye *(Taeniatherum asperum)* can be present in this community in the area of Oxbow Reservoir where medusahead wildrye begins to become the dominant annual grass on certain soil types.

Sand Dropseed - Sandberg Bluegrass Community

This is a near climax bunchgrass community with about 18 percent live vegetation cover. Sand dropseed and Sandberg bluegrass comprise the bulk of the perennial grasses but large amounts of bluebunch wheatgrass may be conspicuously present. There is also a high cover of annual grasses contributing to the 70 percent litter cover.

This community resembles the *Sporobolus - Poa* zootic climax discussed by Daubenmire (1970). Replacement of *Sporobolus - Poa* communities by a true *Agropyron - Poa* climax community would probably take a long time even if grazing were discontinued. Bluebunch wheatgrass apparently has a hard time replacing sand dropseed. Grazing management of the sand dropseed phase should be aimed at producing a Sand Dropseed - Sandberg Bluegrass community and not a Bluebunch Wheatgrass - Sandberg Bluegrass community.

Sand Dropseed - Cheatgrass Brome Community

This seral community in the sand dropseed phase has only a trace of bluebunch wheatgrass present. There is still a readily observable amount of Sandberg bluegrass in the community. Sand dropseed is the dominant bunchgrass and cheatgrass brome is the codominant. This community, like the other communities of this phase, is found on sandy alluvial benches that have had a long history of grazing (Daubenmire 1970). Forbs that are consistently observable in the community are hairy milkvetch *(Astragulus inflexus)*, storksbill *(Erodium cicutarium)*, Indianwheat *(Plantago patagonica)*,

and tumblemustard *(Sisymbrium altissimum)*. There is nearly 30 percent bare ground due to the continued grazing disturbance.

Sand Dropseed - Cheatgrass Brome - Common Sunflower Community

This is the lowest seral community that was sampled in the successional sequence of the sand dropseed phase. Bluebunch wheatgrass and Sandberg bluegrass have been eliminated by heavy concentrations of livestock on the parts of the alluvial benches where this community is found. Even the sand dropseed plants are small and nearly overtaken by the annual bromes. Forbs such as storksbill, common sunflower *(Helianthus annuus)*, alfalfa *(Medicago sativa)*, indianwheat, tumblemustard and common speedwell *(Veronica arvensis)* are very abundant. The annuals are very dense, comprising an 85 percent litter cover and leaving very little bare ground.

THICKSPIKE WHEATGRASS VEGETATION TYPE

Thickspike wheatgrass (*Agropyron dasytachyum*) is the dominant species above the high water line on some islands in McNary Reservoir. Forbs are fairly abundant in the type. The type occurs above the Absinthe vegetation type on sandy soils.

CRESTED WHEATGRASS VEGETATION TYPE

Crested wheatgrass (*Agroypron cristatum*) is an introduced species used in reseeding upland areas that have been seriously disturbed. It was seeded on New York Bar and New York Bar Island on Little Goose Reservoir with limited success. Tall wheatgrass (*Agropyron elongatum*) was seeded along with the crested wheatgrass on these sites with little or no success. The soils are possibly too sandy to provide adequate moisture. The areas mentioned above were initially placed in this type anticipating the establishment of the crested wheatgrass. After the areas were sampled they were retyped into the Rubber Rabbitbrush vegetation type.

WILDRYE VEGETATION TYPE

The Wildrye vegetation type is a tall bunchgrass grassland that grows on river flats. The soils are silt loams to loamy sands. The bunchgrass is primarily one of two species of wildrye. Creeping wildrye (*Elymus triticoides*) was the dominant grass on the islands at the upper end of Brownlee Reservoir. Giant wildrye (*Elymus cinereus*) was also found on the islands mentioned above and was the dominant grass on the river flats at the mouth of the Palouse River. The type receives heavy cattle use due to the level topography and proximity to water.

Creeping Wildrye - Canada Thistle Community

This dense community of tall bunchgrass is found on river flats and flat sandy islands just above the high water line. The creeping wildrye does not form a continuous cover over the area. There are scattered patches dominated by forbs such as Canada thistle (*Cirsium arvense*), *Lepidium latifolium*, and by stinging nettle (*Urtica dioica*) interspersed with the wildrye. Although it is not apparent in the quantitative data, cheatgrass brome (*Bromus tectorum*) is the primary species occurring in the understory of the community on some scattered patches.

REEDGRASS VEGETATION TYPE

The Reedgrass type is found as a fringe around marshes and ponds. Common reed (*Phragmites communis*) and reed canarygrass (*Phalaris arundinacea*) grow in dense stands to heights of over 2 meters tall making this type readily identifiable.

The type is found on wet silty to sandy loams around springs and seeps on the upper end of the study area. On the McNary Wildlife Recreation Area the type becomes an important constituent of the marsh and pond complex that has been developed.

Where both grasses occur in the same community one or the other is usually clearly dominant. The understory is quite different from area to area.

Common Reed - Poison Ivy Community

Poison ivy (*Rhus radicans*) is found extensively along the shoreline above the Clearwater River confluence with the Snake River. It grows in almost every moist shaded area. Tall dense stands of common reed create the proper environment for a very dense understory of poison ivy. The major grass in this community is a 2.5 meter growth of common reed. Reed canarygrass is also present in small amounts. The shorter prairie cordgrass (*Spartina pectinata*) may occur infrequently. Site 26 was the only place where it was observed on the study area.

While poison ivy makes up a continuous understory layer, several other forbs of varying heights are also evenly distributed. These forbs are hemp dogbane (*Apocynum cannabinum*), horsetail (*Equisetum fluviatile*), and goldenrod (*Solidago gigantea*). This is an early community in the primary succession of moist, flat areas along the river.

CATTAIL VEGETATION TYPE

The emergent Cattail vegetation type is very restricted in distribution on the reservoirs due to their recent formation. The textured surface horizon, composed of mineral soil and decomposed organic matter, characteristic of poorly drained mucks which cattails usually grow on is poorly

developed. Only on McNary Reservoir and some tributary deltas are the communities extensive and old enough to have developed this characteristic muck soil. On the other reservoirs, cattail plants are sparse and found only in shallow bays. The cattail type will undoubtedly never be widespread on these reservoirs, except at the mouths of tributary streams, due to the steep, rocky shorelines.

The communities are very simple with common cattail (*Typha latifolia*) and species of rush as the only abundant species. A few other forbs have a spotty distribution along the waters edge depending on the steepness of the bank.

The cattail type is well defined in the objective classification. The type is represented by a single stem at the 45 percent difference level and does not unite with the other riparian communities until the 103 percent level is reached.

Common Cattail - American Bulrush Community

This rather simple community is composed primarily of the emergent species, common cattail and American bulrush (*Scirpus americanus*). The stalks of these plants grow to about 2 meters tall and vary in density over the area. Common cattail is much more abundant than American bulrush. Willow (*Salix spp.*) occurs occasionally in the community but they are usually hidden by the cattail. Forbs, including western dock (*Rumex occidentalis*), western goldenrod (*Solidago occidentalis*) and water speedwell (*Veronica anagallis-aquatica*) are scattered along the shoreline side of the cattail stand.

Cattail communities are found along shallow reservoir shorelines, embayments, sloughs and ponds. Plants growing in recently inundated reservoirs are currently rooted in upland soils that are gradually being converted to mucks. This cattail community is an early pioneer in the primary succession of the river bank.

Common Cattail - Common Spikerush Community

This marsh community was sampled on a tributary delta. The area is very wet but not actually submerged. The soil is basically a silt loam with a strongly textured surface horizon. Common cattail is the tall dominant plant in the community. Narrowleaf cattail (*Typha angustifolia*) is also present in its typical sparse distribution. Common spikerush (*Eleocharis palustris*) and redtop (*Agrostis alba*) are evenly dispersed in the understory. Willows are slightly more abundant than in the Common Cattail - American Bulrush community. The Common Cattail - Common Spikerush community is more advanced than the other cattail community in the primary successional sequence.

SEDGE VEGETATION TYPE

Moist areas around springs or on tributary deltas support dense stands of sedge (*Carex spp.*). These areas are extremely limited in size and distribution on the study area. No communities of this type were sampled.

BULRUSH VEGETATON TYPE

Stands of bulrush (*Scirpus spp.*) are abundant on the McNary Wildlife Recreation Area. The type occurs as small pockets of dense, emergent vegetation along the edges of ponds. The bulrushes obtain heights of over 2 meters tall. The type has a very limited distribution on the rest of the study area.

CATTAIL - SEDGE VEGETATION TYPE

An overstory of cattail (*Typha latifolia* and *T. angustifolia*) dominates this vegetation type. The understory consists of sedge (*Carex spp.*) and a few forb species. This is a mature cattail community on tributary deltas and other moist areas. This type was not encountered very frequently.

BIG SAGEBRUSH VEGETATION TYPE

This type was used as a preliminary designation for stands of big sagebrush (*Artemisia tridentata*) that did not have an easily distinguished dominant in the herbaceous layer. It was also used as the vegetation type for disturbed big sagebrush stands and stands occurring on sandy soils that had little herbaceous development.

BIG SAGEBRUSH - BLUEBUNCH WHEATGRASS VEGETATION TYPE

Seral plant communities of the *Artemisia tridentata* - *Agropyron spicatum* habitat-type that have retained a dominant shrub layer of big sagebrush (*Artemisia tridentata*) are included in this type. Bluebunch wheatgrass (*Agropyron spicatum*) is the dominant grass under the big sagebrush shrub layer in the climax communities. Heavy grazing during the growing season eliminates the bluebunch wheatgrass allowing the annual invader, cheatgrass brome (*Bromus tectorum*) to become dominant in the herbaceous layer. When relieved from grazing pressure, bluebunch wheatgrass is very slow in re-invading the cheatgrass communities (Daubenmire 1970).

The *Artemisia* - *Agropyron* habitat-type is found on sandy, silt loams at opposite ends of the study area. The habitat-type is found on the upper end of the study area above the middle of Brownlee Reservoir. It occurs

again on the lower end of the study area below Ice Harbor Dam.

The more common cheatgrass brome dominated community is described below. Communities in this habitat-type in which rubber rabbitbrush has replaced the big sagebrush are described under the Rubber Rabbitbrush vegetation type.

Big Sagebrush - Cheatgrass Brome Community

A broken shrub layer of big sagebrush dominates this shrub steppe community. Rubber rabbitbrush (*Chrysothamnus nauseosus*) and broom snakeweed (*Gutierrezia sarothrae*) are also present in a lesser role. Cheatgrass brome is dominant in the herbaceous layer. Bluebunch wheatgrass has been eliminated and only a trace of Sandberg bluegrass (*Poa sandbergii*) remains. Forbs are poorly represented. The Big Sagebrush - Cheatgrass Brome community is a seral community produced by over grazing the Big Sagebrush - Bluebunch Wheatgrass climax community.

RUBBER RABBITBRUSH VEGETATION TYPE

Seral communities from two habitat-types comprise this vegetation type where rubber rabbitbrush *(Chrysothamnus nauseosus)* has developed into a dominant shrub layer. Rubber Rabbitbrush communities can be found in the *Artemisia tridentata - Agropyron spicatum* habitat-type and are usually recognizable by the presence of a few remnant plants of big sagebrush *(Artemisia tridentata)*.

Most of the area occupied by this vegetation type falls within the *Agropyron spicatum - Poa sandbergii* habitat-type. A few scattered plants of rubber rabbitbrush are found even in the climax grassland community of this habitat-type. The shrub steppe Rubber Rabbitbrush type has a shrub density of 1,000 to 5,000 plants per hectare which average about 5 decimeters tall.

In the *Agropyron - Poa* habitat-type, the Rubber Rabbitbrush communities are common seral stages in the cheatgrass brome phase that has been discussed in the ordination section and under the Bluebunch Wheatgrass - Sandberg Bluegrass vegetation type. The cheatgrass brome phase is found on deep sandy to silty loam soils without clay loam substrates. Along the Snake River this phase is found between the Grande Ronde River and Ice Harbor Dam. The gentle slopes of this phase are occupied by the Rubber Rabbitbrush vegetation type.

Rubber Rabbitbrush - Big Sagebrush - Cheatgrass Brome Community

This community is a seral stage in the *Artemisia - Agropyron* habitat-type. Big sagebrush is present only in trace amounts but it is valuable as an indicator of the habitat-type. Cheatgrass brome is dominant in the herbaceous layer. Bluebunch wheatgrass and Sandberg bluegrass have been nearly eliminated.

The two samples of this community are on opposite ends of the study area. One of the sites (Site 8) had been subjected to very heavy grazing and the other site (Site 81) was abandoned crop land. Each had a high forb diversity but only two of the species were common to both sites. The more abundant forbs are storksbill *(Erodium cicutarium)*, tumblemustard *(Sisymbrium altissimum)*, starry cerastium *(Cerastium arvense)* and rush buckwheat *(Eriogonum elatum)*. The community is grouped by the objective classification with Annual Forb communities and then with other Rubber Rabbitbrush communities.

Rubber Rabbitbrush - Bluebunch Wheatgrass Community

This community, represented by Site 70, is the highest seral stage in the cheatgrass brome phase that was sampled in this study. Its high perennial grass cover makes it more similar to sites dominated by bluebunch wheatgrass (*Agropyron spicatum*) than to other rubber rabbitbrush sites.

This area was historically used as winter range for sheep. The site has been protected from grazing for at least 6 years. Bluebunch wheatgrass is the dominant grass with over 5 percent basal cover. The cover of Sandberg bluegrass *(Poa sandbergii)* is exceptionally high (15 percent) due to past grazing. The ground has a complete cover of these two grasses, moss, and litter. Only trace amounts of forbs occur.

Most of the mature rubber rabbitbrush plants on the site were dead or dying. The density of rubber rabbitbrush is very high (38,320 per hectare) due to the many seedlings. The reason for the mortality of the rubber rabbitbrush plants was undetermined but may be the result of disease, parasites, spraying, or competition with grasses.

This community is not very common along the river. Most of the uplands along the river have a history of overgrazing due to the close proximity of water which concentrates the livestock. This results in communities that are lower seral stages than this community.

Rubber Rabbitbrush - Sandberg Bluegrass Community

Heavy grazing created this common seral community. Rubber rabbitbrush has increased to 4,000 plants per hectare and changed a climax grassland into a shrub steppe. Bluebunch wheatgrass has decreased to a minor role. Sandberg bluegrass is more resistant to grazing and has increased to dominant status in the herbaceous layer. The annual invader, cheatgrass brome, is very abundant. A variety of forbs occur in the community but they are of minor importance. The more consistently observed forb species are yarrow *(Achillea millefolium)*, tessellate fiddleneck *(Amsinckia tessellata)*, spring draba *(Draba verna)*, starry cerastium, sagebrush mariposa *(Calochortus macrocarpus)*, prickly lettuce, Indianwheat *(Plantago patagonica)* and tumblemustard.

This community is intermediate in its secondary successional development. It falls in between the Rubber Rabbitbrush - Bluebunch Wheatgrass community and the other low seral cheatgrass brome phase communities.

Rubber Rabbitbrush - Crested Wheatgrass Community

Crested wheatgrass (*Agropyron cristatum*) was seeded in the fall of 1972 on the site where this community was sampled. A fair amount of rubber rabbitbrush has established itself on the area as there is an estimated 2,000 plants per hectare.

Crested wheatgrass is beginning to become very evident although cheatgrass brome is an abundant codominant in the herbaceous layer. Many annual forb species are abundant due to disturbance by seeding equipment. The only other Rubber Rabbitbrush community in which forbs are as abundant is the Rubber Rabbitbrush - Cheatgrass Brome - Common Sunflower community. The more important forbs are starry cerastium, autumn willowweed *(Epilobium paniculatum)*, slender rabbitleaf *(Lagophylla ramosissima)*, prickly lettuce *(Lactuca seriola)*, clasping pepperweed *(Lepidium perfoliatum)*, tumblemustard, and hairy winter vetch *(Vicia villosa)*.

The community at this site (Site 64) has been receiving considerable grazing pressure due to poor fencing. If the grazing were discontinued the crested wheatgrass could be expected to displace the annuals more rapidly. The soils may be too sandy, however, for crested wheatgrass to become well established. Tall wheatgrass (*Agropyron elongatum*) was also seeded at the same time as crested wheatgrass. This species was not found growing on the area and apparently is not adapted to the dry, sandy soils.

Rubber Rabbitbrush - Cheatgrass Brome - Common Sunflower Community

The Rubber Rabbitbrush - Crested Wheatgrass community is ecologically similar to this community. One of the sites (Site 65) in this community was also seeded to crested wheatgrass. The crested wheatgrass is not doing well and only a trace amount was in the sample. This seeded site is on an island and it is possible that the soil is too sandy for crested wheatgrass.

The other site (Site 76) in this community is on an area that was heavily overgrazed in the past. Forbs are abundant in the herbaceous layer as they are in the Rubber Rabbitbrush - Crested Wheatgrass community. Common sunflower *(Helianthus annuus)* is one of the more abundant and conspicuous forbs in this community and is absent in the other Rubber Rabbitbrush - Cheatgrass Brome communities.

For management purposes, the Rubber Rabbitbrush - Crested Wheatgrass community and the Rubber Rabbitbrush - Cheatgrass Brome - Common Sunflower community should be considered together as a very low seral community with an abundant assortment of forbs. The two communities are not joined in the objective classification until the 46 percent difference level due to the large number of forb species that the communities do not have in common.

Rubber Rabbitbrush - Cheatgrass Brome - Plains Pricklypear Community

This community is one of the lowest seral stages in the cheatgrass brome phase. The perennial grasses, bluebunch wheatgrass and Sandberg

bluegrass, occur only in trace amounts. Cheatgrass brome is essentially the only grass in the herbaceous layer. The unique feature of this Rubber Rabbitbrush community is the abundance of plains pricklypear *(Opuntia polyacantha)* which also indicates overgrazing. Plains pricklypear was also present on several of the sand dropseed phase sites but not on any of the other cheatgrass brome phase sites. Another species unique to this community is ridgeseed euphorbia *(Euphorbia glyptosperma)*. Other forbs that are abundant in the community are sticky cerastium *(Cerastium viscosum)*, storksbill, carrotleaf leptotaenia *(Lomatium dissectum)*, and Indianwheat.

Rubber Rabbitbrush - Cheatgrass Brome - Common Speedwell Community

North facing exposures in the Rubber Rabbitbrush type are occupied by this community. Cheatgreass brome is the dominant annual grass but Japanese brome *(Bromus japonicus)* and soft brome *(Bromus mollis)* are present in small amounts indicating its position in the continuum between the more mesic Japanese brome phase and the cheatgrass brome phase of the *Agropyron - Poa* habitat-type. Several forbs found on this site also indicate a link with the more mesic areas further upstream. These are common speedwell *(Veronica arvensis)*, Spanish clover *(Lotus purshianus)* and *Blepharipappus scaber*. Rubber rabbitbrush has an exceptionally high density with approximately 18,000 plants per hectare. This community is low seral. Perennial climax grass species occur only in trace amounts.

ANTELOPE BITTERBRUSH - BLUEBUNCH WHEATGRASS VEGETATION TYPE

The *Purshia tridentata - Agropyron spicatum* habitat-type discussed by Daubenmire (1970) is similar to this vegetation type. It is found on moderately steep slopes of rocky, loam soils in the area of Oxbow and Hells Canyon Reservoir.

The shrub layer is a highly variable, open stand of antelope bitterbrush (*Purshia tridentata*). The herbaceous layer of a climax stand would be similar to the *Agropyron - Poa* climax community. Only seral sites of this type were sampled. Cheatgrass brome (*Bromus tectorum*) is the dominant species in the understory of these communities. Bluebunch wheatgrass (*Agropyron spicatum*) and Sandberg bluegrass (*Poa sandbergii*) occur in varying amounts. Idaho fescue (*Festuca idahoensis*), which would indicate a *Purshia - Festuca* habitat-type, is absent.

Daubenmire (1970) states that it is the rock and gravel debris which increases the moisture equivalent of the soil sufficiently to support the edaphic Purshia - Festuca climax community. The rocky soils in Hells Canyon are capable of supporting antelope bitterbrush at lower elevations than Idaho fescue probably because the temperatures at this low elevation are not cool enough to support Idaho fescue.

The Smooth Sumac and Bittercherry vegetation types are interspersed in the more extensive Antelope Bitterbrush - Bluebunch Wheatgrass vegetation type. The Smooth Sumac type is found on south facing knolls of deep loamy soil and the Bittercherry type is found on north and east facing slopes.

Antelope Bitterbrush - Cheatgrass Brome Community

Antelope bitterbrush forms an open, dispersed shrub layer in this community. Its density is approximately 1,000 individuals per hectare. Blue elderberry (*Sambucus cerulea*) and smooth sumac (*Rhus glabra*) are also found in the shrub layer. The antelope bitterbrush and blue elderberry are 1 to 2 meters tall.

Cheatgrass brome is the dominant herb. Bluebunch wheatgrass and Sandberg bluegrass are present in minor amounts indicating the potential climax community. The mesic brome species (*Bromus japonicus* and *Bromus brizaeformis*) are also present. The forb layer is very rich with nearly 40 species recorded on two sites. Indicative species of this community are arrowleaf balsamroot (*Balsamorhiza sagittata*), nineleaf lomatium (*Nemophila triternatum*), miners lettuce (*Montia perfoliata*), nemophila (*Nemophila kirtleyi*), narrowleaf skullcap (*Scutellaria angustifolia*) and darkwoods violet (*Viola orbiculata*).

ANTELOPE BITTERBRUSH - BIG SAGEBRUSH VEGETATION TYPE

Antelope bitterbrush (*Purshia tridentata*) is the major constituent in the highly variable shrub layer of this vegetation type. The role of big sagebrush (*Artemisia tridentata*) varies from a minor member of the open shrub layer to an equal codominant with antelope bitterbrush.

Rubber Rabbitbrush (*Chrysothamnus nauseosus*) can be an abundant codominant or totally absent. Tall green rabbitbrush (*Chrysothamnus viscidiflorus*) is consistently found in small amounts.

The herbaceous layer is not well developed. Sandberg bluegrass (*Poa sandbergii*) is the only perennial grass found in the type. A few forb species occur sparsely in the herbaceous layer.

This vegetation type occurs on immature sandy soils. The communities may be still evolving in a primary succession of active sand dunes. The vegetation does not readily fit into any previously defined habitat-type. If these communities are a sere in a primary successional sequence, the end point is probably an *Artemisia tridentata* - *Agropyron spicatum* climax community.

Farewell Bend on Brownlee Reservoir is one area where this vegetation type was found. A more extensive area is the south side of the Columbia River in the vicinity of Hat Rock State Park.

Antelope Bitterbrush - Big Sagebrush - Cheatgrass Brome Community

Antelope bitterbrush and big sagebrush are codominants in this shrub steppe community found near Hat Rock State Park on the Columbia River. Each species has an approximate density of 1,000 plants per hectare. These two species average 1 to 1.5 meters tall. The shrub layer is very open with some tall green rabbitbrush plants present. Cheatgrass brome is dominant in the herbaceous layer. Sandberg bluegrass occurs only as a trace. A few small forbs are present. Over 30 percent of the ground is bare leaving the appearance of a recently active sand dune.

Antelope Bitterbrush - Rubber Rabbitbrush - Cheatgrass Brome Community

Antelope bitterbrush is the dominant shrub in this open community. It has a density of about 1,000 plants per hectare and grows to about 1 meter tall. Rubber rabbitbrush and tall green rabbitbrush are very abundant in the interspaces of the antelope bitterbrush. A few big sagebrush plants are also scattered in the community.

The herbaceous layer is sparse. Cheatgrass brome and a few forb species are scattered throughout. Over 80 percent of the ground is bare. Active sand dunes are nearby and the community appears to be an early stabilizer of these dunes.

CURLLEAF MOUNTAINMAHOGANY VEGETATION TYPE

The Curlleaf Mountainmahogany type is dominated by an open to nearly closed tall shrub layer of curlleaf mountainmahogany (*Cerococarpus ledifolius*). The understory varies from a grassland on the open gentle slopes to a low shrub complex on rock outcroppings.

The type is restricted to limestone outcroppings and toeslopes beneath these outcroppings. The toeslopes support the nearly closed canopy and grassland combination of this vegetation type. The rock outcroppings support an open, tall shrub layer and a sparse low shrub layer. The low shrub layer is usually dominated by greenbush (*Glossopetalon nevadense*) and species of buckwheat (*Eriogonum spp.*). Isolated patches of bluebunch wheatgrass (*Agropyron spicatum*) also occur in the understory.

The shallow soils of limestone outcroppings and toeslopes occur sparingly along the Snake River from the Grande Ronde River confluence upstream to the middle of Brownlee Reservoir. Curlleaf mountainmahogany becomes increasingly less common downstream, and an isolated patch on the west river bank between Asotin and the Grande Ronde River appears to mark its northern limit.

Curlleaf Mountainmahogany - Cheatgrass Brome Community

This toeslope community supports a dense stand of curlleaf mountainmahogany. The shrub layer also contains a few scattered Douglas hackberry (*Celtis douglasii*) shrubs. The density of the mountainmahogany is approximately 1,000 plants per hectare and it grows to an average height of 3 meters. The density of the shrub layer varies from a broken canopy over most of the area to small pockets with a completely closed canopy. The broken canopy has a cheatgrass brome (*Bromus tectorum*) understory. The understory of the closed pockets consists of cheatgrass brome and mesic forbs such as small geranium (*Geranium pusillum*), Indian lettuce (*Montia arenicola*), miners lettuce(*Montia perfoliata*), Lieberg stonecrop (*Sedum liebergii*) and chickweed (*Stellaria media*).

The Curlleaf Mountainmahogany - Cheatgrass Brome community has the same physiognomy as the dense shoreline stands of the Douglas Hackberry

type. This community is more lush than the curlleaf mountainmahogany stands found on the limestone outcroppings. The grassland understory is capable of supporting a climax community of bluebunch wheatgrass and Sandberg bluegrass (*Poa sandbergii*).

DOUGLAS HACKBERRY VEGETATION TYPE

Rocky shoreline escarpments and alluvial fans give rise to the Douglas Hackberry type. The most extensive development of this type occurs between Brownlee Dam and the Clearwater River confluence with the Snake River, where narrow bands of the type line the riverbanks above the high water mark. Small isolated stands and scattered individuals are also found on adjacent segments of the study area. On Oxbow and Hells Canyon Reservoirs the type occurs only at the upper end of each reservoir where current pool level does not reach the old natural river high water mark.

Douglas Hackberry (*Celtis douglasii*) is dominant in a broken to nearly closed, tall shrub layer. The average height of Douglas hackberry is 2 meters tall and the density varies from 100 to 2500 plants per hectare. In the Oxbow and Hells Canyon Reservoir area, Blue elderberry (*Sambucus cerulea*) is also an important constituent of the tall shrub layer.

On steep shoreline escarpments, the type is characterized by a dense, nearly closed canopy. These communities have basically a cheatgrass brome (*Bromus tectorum*) and mixed forb understory. On the gentle shoreline slopes and alluvial fans the type takes on the appearance of an open savanna.

The herbaceous layer of these communities is essentially a seral grassland community of the *Agropyron spicatum - Poa sandbergii* habitat-type. The soils of the shoreline communities are rocky, sandy loams that are often boulder strewn. The alluvial fans have well drained gravelly loams with gravel and sand substrates.

The Douglas hackberry type is a high seral community in the primary succession of the river bank. However, the understories of these communities are in different stages of secondary succession due to grazing.

Douglas Hackberry - Cheatgrass Brome - Rough Bedstraw Community

The two stands that were classified into this community were physiognomically different. Although Site 13 was a dense shoreline stand of Douglas hackberry and Site 28 was an open savanna, three things were unique to these two stands. First, they were the only two Douglas hackberry stands that were sampled on the west bank of the river. Second, rough bedstraw (*Galium asperrimum*) was abundant in both stands. Third, woods rose (*Rosa woodsii*) was present in both stands. Rough bedstraw, which is usually abundant in moist areas, was present in three other Douglas hackberry stands but only in trace amounts. It has a frequency of over 20 percent and a cover of 1 percent in this community. Woods rose is an indicator of mesic areas in dry habitats (Hitchcock and Cronquist 1973). It was found on both sites representing this community and not in any of the other Douglas Hackberry communities.

The southeast aspect and additional shade that these two stands gain by being on the west side of the river apparently produces a more

mesic environment. This community should not be considered as an absolute entity that is characteristic on the west side of the river. It is only a suggestion as to what communities are there from a very limited sample. A larger sample from the west side of the river is needed to investigate these mesic communities.

Douglas Hackberry - Cheatgrass Brome Community

The understory of this very open savanna community has been subjected to heavy concentrations of cattle. Cheatgrass brome is the dominant grass. The abundance of several forb species gives a weedy appearance to the understory. The most common forb species are Menzies fiddleneck (*Amsinckia menziesii*), catchweed (*Asperugo procumbens*), storksbill (*Erodium cicutarium*), horseweed (*Conyza canadensis*), and tumblemustard (*Sisymbrium altissimum*). Of the savanna-like Douglas Hackberry communities, this community has the lowest seral understory with respect to secondary succession.

Douglas Hackberry - Bluebunch Wheatgrass Community

Douglas hackberry and serviceberry (*Amelanchier alnifolia*) create a fairly open savanna over a bunchgrass dominated grassland. Serviceberry shrubs are scattered among the dominant Douglas hackberry.

Bluebunch wheatgrass (*Agropyron spicatum*), sand dropseed (*Sporobolus cryptandrus*) and red threeawn (*Aristida longiseta*) contribute to the grassland appearance of the understory. Annual grasses are also well represented. While forbs are an inconspicuous constituent of this community several are well distributed throughout the understory. These are cleavers bedstraw (*Galium aparine*), Bicknells geranium (*Geranium bicknellii*) and chickweed (*Stellaria media*).

This community constitutes a fairly high stage in both the primary and secondary successional scheme.

Douglas Hackberry - Sand Dropseed - Bluebunch Wheatgrass Community

Douglas hackberry is the dominant shrub in this open savanna. Serviceberry and mockorange (*Philadelphus lewisii*) are also present in the shrub layer.

The understory is a grassland characteristic of very sandy soils. It consists of sand dropseed, bluebunch wheatgrass, and red threeawn. The sparse forb layer consists primarily of starry cerastium (*Cerastium arvense*), storksbill, cleavers bedstraw, goatweed (*Hypericum perforatum*) and Indianwheat (*Plantago patagonica*).

The soils of this community are coarse and immature indicating a lower primary successional standing than that of the Douglas Hackberry - Bluebunch Wheatgrass community. The understory has probably never been much more developed than its present state.

Douglas Hackberry - Sand Dropseed Community

Douglas hackberry creates a nearly closed canopy in this dense shoreline community. Mulberry (*Morus alba*) and Pacific willow (*Salix lasiandra caudata*) are occasional contributors to the overstory.

Sand dropseed, cheatgrass brome, and red threeawn are the major colonizers of these rocky, sandy soils. Giant wildrye (*Elymus cinereus*), Scribners panicum (*Panicum scribnerianum*) and *Bromus sterilus* also occur. A wide variety of forb species is conspicuous in the herbaceous layer. The more common species are starry cerastium, western scouringrush (*Equisetum hyemale*), American licorice (*Glycyrrhiza lepidota*), common sunflower (*Helianthus annuus*), common hoarhound (*Marrubium vulgare*) and cocklebur (*Xanthium strumarium*). Poison ivy (*Rhus radicans*) is a highly variable constituent of the understory, varying from dense patches to absent.

This dense shoreline community represents a lower primary successional stage than the open savannas. As the soils develop into loams this community can be expected to develop grassland understories.

SHRUB WILLOW VEGETATION TYPE

The dominant plants in this vegetation type are a combination of several species of willow. Shrubby species that occur on the study area are peachleaf willow (*Salix amygdaloides*), coyote willow (*Salix exigua exigua*), *Salix exigua melanopsis*, *Salix rigida mackenzieana* and *Salix lasiandra lasiandra* In addition to these, *Salix lasiandra caudata* is usually a small tree but also occurs as a shrub.

Understory vegetation varies considerably from a dense sward of grasses and grasslike plants to a sparse stand of forbs. A herbaceous layer similar to the adjacent upland is encountered in some areas along the reservoirs.

This vegetation type is found throughout the study area and occurs primarily between the high water and low water lines. It is flooded almost annually. Willow shrubs reach maximum development on level areas just above and below the high water line.

Several soil types support this vegetation type. The soils of tributary deltas and meadow edges occupied by shrub willow vegetation are silt loams or loamy sands. Boulder strewn sands along free flowing stretches of the Snake River support willow development. It also occurs on upland sandy loam soils along shores of the reservoirs.

Peachleaf Willow - Marsh Horsetail Community

Peachleaf willow and coyote willow dominate the dense shrub layer of this community which is found along the mouths of tributaries. Approximately 4,000 shrubs per hectare reach an average height of 3 meters in the community. A few young white alder (*Alnus rhombifolia*) and black cottonwood (*Populus trichocarpa*) trees are scattered in the

community. Their presence may indicate that this community is a stage in the primary successional development of a community in the White Alder vegetation type.

The understory is dominated by dense patches of forbs under the canopy openings such as marsh horsetail (*Equisetum palustre*) and goldenrod (*Solidago gigantea*). Rabbitfoot polypogon (*Polypogon monspeliensis*) is the most abundant grass and is found along the edges and more open areas of the community. About 70 percent of the ground is bare due to silt deposition and litter removal by annual flood waters.

Coyote Willow - Horsetail Community

The shrub layer of this community is a moderate growth of coyote willow. The community occurs as a narrow band of vegetation near the low water line on boulder strewn river banks.

The only understory in this simple community consists of dense patches of horsetail (*Equisetum spp.*) on the larger, moist sand deposits.

Coyote Willow - Sedge Community

Coyote willow and *Salix rigida mackenzieana* comprise the 2-3 meter tall shrub layer of this community. Coyote willow and *Salix rigida mackenzieana* have approximate densities of 8,000 and 4,000 plants per hectare, respectively.

The understory is a complex, lush growth of grasslikes, grasses and forbs. A dense growth of sedge (*Carex spp.*) is evenly distributed in the herbaceous layer. This is accompanied by a patch distribution of reed canarygrass (*Phalaris arundinacea*), Missouri goldenrod (*Solidago missouriensis*), common cattail (*Typha latifolia*), thistle (*Cirsium brevistylum*), and field horsetail (*Equisetum arvense*).

This is a well developed shoreline community growing on flat moist areas. It is the most mature willow shrub community sampled in the primary succession of the river banks.

Coyote Willow - Tule Bulrush Community

A well developed, dense shrub layer of coyote willow characterizes this shoreline community. Coyote willow has a density of 12,000 individuals per hectare and an average height of 1.5 meters. *Salix lasiandra caudata* is also found in the shrub layer.

A tall herbaceous layer exists and is dominated by tule bulrush (*Scirpus acutus*), reed canarygrass, and teasel (*Dipsacus sylvestris*). These three species grow to a height of 2 meters and contribute to the dense overstory of vertical stems. The understory consists of a scattered distribution of forbs such as American bugleweed (*Lycopus americanus*) and bay forget-me-not (*Myosotis laxa*).

The community occurs on very low, silt loam river banks. The water table is at the ground surface during most of the year. This community is often bordered by Bulrush or Cattail communities along the shoreline.

Coyote Willow - Poison Ivy - Kentucky Bluegrass Community

The Coyote Willow - Poison Ivy - Kentucky Bluegrass community has a dense shrub layer of coyote willow. An occasional Douglas hackberry (*Celtis douglasii*), Woods rose, blue elderberry (*Sambucus cerulea*) and *Salix rigida mackenzieana* are also present. Patches of poison ivy create a low shrub understory in parts of the community. The herbaceous layer consists of Kentucky bluegrass (*Poa pratensis*) and annual grasses such as soft brome (*Bromus mollis*) and medusahead wildrye (*Taeniatherum asperum*).

The Coyote Willow - Cheatgrass Brome community is ecologically similar to this community. Both communities occur at the high water line on alluvial fans. The surface soil horizon of this community maintains enough moisture to support Kentucky bluegrass, whereas the Coyote Willow - Cheatgrass Brome community only has cheatgrass brome in the herbaceous layer.

This community was sampled on Oxbow Reservoir which fluctuates very little. The Coyote Willow - Cheatgrass Brome community was sampled on Brownlee Reservoir which is drawn down during the summer. It is possible that the draw down on Brownlee Reservoir allows the soil above the high water line to dry out so that it cannot support Kentucky bluegrass, while the stable level of Oxbow Reservoir maintains sufficient adjacent surface moisture to support this species.

Coyote Willow - Cheatgrass Brome Community

A coyote willow shrub layer approximately 2 meters tall dominates this community. Woods rose (*Rosa woodsii*) and poison ivy (*Rhus radicans*) also occur in the shrub layer.

The community occurs at the high water line on alluvial fans where the surface horizon dries out early in the year but subsurface moisture is maintained. The dry surface horizon gives rise to seral upland vegetation dominated by cheatgrass brome (*Bromus tectorum*). A few mesic forbs such as nettleleaf gianthyssop (*Agastache urticifolia*), low dogbane (*Apocynum cannabinum*) and common burdock (*Arctium minus*) occur in the understory. The community has about 95 percent of the ground covered with litter.

BLACKBERRY VEGETATION TYPE

Patches of blackberry (*Rhus discolor*) occur scattered along the Snake River above the Clearwater River confluence. These dense, impenetrable

thickets do not alow the development of a herbaceous layer. They are found in moist spots at the base of cliffs or near waterseeps.

ROSE VEGETATION TYPE

Dense patches of rose (*Rosa spp.*) are occasionally encountered throughout the study area. Most of the patches occur in moist spots where native species have found ideal growing conditions. Several patches of domestic rose species exist on McNary Reservoir in areas of past habitation.

SMOOTH SUMAC VEGETATION TYPE

Daubenmire (1970) lists three habitat-types of sandy or stony soils that are encompassed by this vegetation type. The habitat-types are *Rhus glabra - Agropyron spicatum*, *Rhus glabra - Sporobolus cryptandrus* and *Rhus glabra - Aristida longiseta*. Edaphic climax vegetation of these habitat-types consists of an open smooth sumac (*Rhus glabra*) shrub layer and one of the above perennial grasses. Most sites are disturbed and have an annual grass herbaceous layer dominated by cheatgrass brome (*Bromus tectorum*) or medusahead wildrye (*Taeniatherum asperum*). Smooth sumac is often severely browsed by wintering deer and livestock.

Patches of the vegetation type are distributed in the upland grasslands throughout the study area. A Smooth Sumac - Medusahead Wildrye community occurs above Brownlee Dam. Below this point the seral community is Smooth Sumac - Cheatgrass Brome.

Smooth Sumac - Medusahead Wildrye Community

Smooth Sumac has an approximate density of 14,600 per hectare in the open shrub layer of this community. An occasional small Douglas hackberry (*Celtis douglasii*) is present.

The herbaceous layer consists of a continuous cover of annual grasses. Medusahead wildrye, Japanese brome (*Bromus japonicus*), and cheatgrass brome are the most abundant. A trace amount of bluebunch wheatgrass (*Agropyron spicatum*) and Sandberg bluegrass (*Poa sandbergii*) occur, indicating that this community is a seral stage in the *Rhus glabra - Agropyron spicatum* habitat-type. Forbs are sparse and inconspicuous.

BLACK HAWTHORN VEGETATION TYPE

This vegetation type occurs on Brownlee, Oxbow, and Hells Canyon Reservoirs. It is physiognomically similar to the Douglas Hackberry vegetation type, but not nearly as common. It consists of dense shoreline and open savanna communities. Black hawthorn (*Crataegus douglasii*) is

the dominant shrub. The herbaceous layer is usually composed of annuals. Columbia hawthorn (*Crataegus columbiana*) also occurs on the study area but not in sufficient densities to be classed as a dominant.

SERVICEBERRY VEGETATION TYPE

Serviceberry (*Amelanchier alnifolia*) usually occurs as scattered individuals in other shrub communities. Occasionally a rocky slope was encountered in which serviceberry was the principal species. These areas are located above the Clearwater River confluence with the Snake River and were designated as the Serviceberry vegetation type.

ELDERBERRY VEGETATION TYPE

Two species of elderberry occur on the study area. Only a few individuals of European elderberry (*Sambucus racemosa*) were encountered. Blue elderberry (*Sambucus cerulea*) is much more abundant and commonly a member of the Douglas Hackberry communities. Occasionally blue elderberry is dense enough to be considered the dominant species of a community. These stands are restricted to Oxbow and Hells Canyon Reservoirs and were placed in the Elderberry Vegetation Type.

BITTER CHERRY VEGETATION TYPE

On some north exposures of the Antelope Bitterbrush - Bluebunch Wheatgrass vegetation type, bitter cherry (*Prunus emarginata*) replaces antelope bitterbrush (*Purshia tridentata*). The vegetation is probably an edaphic climax and has a patchy distribution along the reservoirs above Hells Canyon Dam.

The climax vegetation consists of an evenly dispersed stand of bitter cherry over a lush bluebunch wheatgrass (*Agropyron spicatum*) understory. The low seral communities have an annual grass understory of cheatgrass brome (*Bromus tectorum*) and Japanese brome (*Bromus japonicus*).

Bitter Cherry - Bluebunch Wheatgrass Community

Bitter cherry attains a height of 3 meters and a density of over 300 shrubs per hectare in this shrub steppe community. It forms an open shrub layer evenly dispersed over a lush grassland. Bluebunch wheatgrass has a basal cover of approximately 18 percent. Sandberg bluegrass and cheatgrass brome form a luxuriant growth in between the bluebunch wheatgrass. Several forbs also contribute to the herbaceous layer. The most abundant are rough bedstraw (*Galium asperrimum*), large flower tonella (*Tonella floribunda*), thymeleaf sandwort (*Arenaria serpyllifolia*), starry cerastium (*Cerastium arvense*) and cryptantha (*Cryptantha salmonensis*).

HETEROGENEOUS SHRUB MIXTURE VEGETATION TYPE

Small rocky slopes throughout the study area support a stand of shrubs with no one species clearly dominant. These areas may represent a stage of primary succession in which a dominant has not become established. Shrub species occurring in this type are serviceberry (*Amelanchier alnifolia*), Douglas hackberry (*Celtis douglasii*), black hawthorn (*Crataegus douglasii*), mock orange (*Philadelphus lewisii*), common chokecherry (*Prunus virginiana*), smooth sumac (*Rhus glabra*), rose (*Rosa spp.*), currant (*Ribes spp.*), blue elderberry (*Sambucus cerulea*) and common snowberry (*Symphoricarpus albus*).

TREE WILLOW VEGETATION TYPE

Salix lasiandra caudata, although often a shrub, is capable of growing into a tree reaching a height of over 8 meters and a diameter of over 30 centimeters. The Tree Willow type consists of those communities in which *Salix lasiandra caudata* has matured into a dominant tree overstory. Tree canopy coverage in this type varies from about 10 to 50 percent. White alder (*Alnus rhombifolia*), black cottonwood (*Populus trichocarpa*), white mulberry (*Morus alba*) and American elm (*Ulmus americana*) are also present in the tree layer.

The shrub layer of the type is highly variable. It is a dense growth of shrub willows in some communities and nearly non-existent in other communities. Common shrub species are coyote willow (*Salix exigua exigua*), *Salix rigida mackenzieana*, Douglas hackberry (*Celtis douglasii*), Russian olive (*Elaeagnus angustifolia*), golden currant (*Ribes aureum*) and Nootka rose (*Rosa nutkana*).

The herbaceous layer is a variable growth of forbs. More mesic communities have a dense growth of tall forbs. Drier sites have a sparse growth of forb species.

Tree willow vegetation is situated on the edges of low river terraces and tributary deltas. The soils are a fine, loamy sand. The type occurs sporadically the entire length of the study area.

Salix lasiandra caudata - *Salix rigida mackenzieana* - Marsh Horsetail Community

Salix lasiandra caudata forms a very open canopy with only 10 percent coverage over a dense stand of *Salix rigida mackenzieana* and coyote willow. The willow shrub layer creates a continuous cover over the mesic forb herbaceous layer.

Tall reed canarygrass (*Phalaris arundinacea*) is scattered in the community, but primarily the herbaceous layer consists of forb species such as marsh horsetail (*Equisetum palustre*), nodding beggarticks (*Bidens cernua*), Canada thistle (*Cirsium arvense*), mayweed (*Matricaria maritima*), buttercup (*Ranunculus arbortivus*), bitter nightshade (*Solanum dulcamara*) and goldenrod (*Solidago gigantea*).

Black cottonwood trees occur in this community which will probably mature into a Willow - Cottonwood or Willow - Cottonwood - Russian Olive type. These types were found adjacent to this community on drier sites.

White Mulberry - *Salix lasiandra caudata* - Goosefoot Community

The tree canopy in this community varies from a closed canopy of white mulberry and *Salix lasiandra caudata* to a more open canopy primarily of *Salix lasiandra caudata*. Trees average 6 meters tall and have a combined density of about 500 per hectare.

This is the driest tree willow community and has a sparse forb understory. Goosefoot (*Chenopodium spp.*), American licorice (*Glycyrrhiza lepidota*) and cocklebur (*Xanthium strumarium*) are sparsely scattered throughout the community. They are slightly more abundant under the canopy openings.

Salix lasiandra caudata - *Lepidium latifolium* Community

This community has a nearly closed canopy of *Salix lasiandra caudata* The trees are 6-7 meters tall and have a density of over 500 per hectare. Nootka rose has a density of over 500 per hectare creating an open shrub layer. Individuals of Russian olive are also present.

The herbaceous layer consists of a continuous dense stand of *Lepidium latifolium*. Few other forb species exist in the herbaceous layer. Similar communities may occur in which the dominant forb species is horsewood (*Conyza canadensis*) or goldenrod (*Solidago spp.*).

COTTONWOOD VEGETATION TYPE

A few small areas are found on the study area in which cottonwoods (*Populus deltoides* and *P. trichocarpa*) are the dominant tree species. These stands have no other abundant tree species in them. The understory usually consists of a sparse shrub layer and a forb layer. The type occurs along river banks and on tributaries.

RUSSIAN OLIVE VEGETATION TYPE

Russian olive (*Elaeagnus angustifolia*) occurs in several other vegetation types in moderate to sparse densities. This species was planted as windbreaks in many open areas of the river canyon and windbreaks characterize this vegetation type. Russian olive achieves a density of up to 2500 individuals per hectare. The canopy varies from nearly closed to a very dense, closed canopy.

The understory consists of forb species whose abundance and composition depends upon the density of the canopy. Grasses are a minor

constituent of the herbaceous layer.

The vegetation type is scattered throughout the study area. Its occurrence is primarily tied to cultivated areas or old places of habitation although it is a naturally occurring type in some instances.

Russian Olive - Lambsquarters Community

Russian olive creates a dense closed canopy prohibiting the penetration of much light. Very few species survive in the herbaceous layer. Lambsquarters (*Chenopodium album*) and thistle (*Cirsium spp.*) occur sparingly. The ground is nearly covered with leaf litter.

This community has the densest canopy and most barren understory of the Russian Olive type. It may have originated from a shoreline windbreak but it is now a spreading, self perpetuating community.

BLACK LOCUST VEGETATION TYPE

Black locust (*Robinia pseudo-acacia*) is an ornamental tree that has escaped and grows well on flat terraces along the river. It is usually found in areas of habitation.

Vigorous seedlings and saplings can be found along the edges of black locust stands. Mature trees form a nearly closed canopy and can attain a height of 25 meters. The understory consists of annual grasses and forbs.

Since black locust grows well along the river it may be valuable as a planted species on recreation development areas.

Black Locust - Bur Chervil Community

A nearly closed canopy of black locust dominates this community. The numerous saplings inflate the density to 4,600 per hectare. The density of mature trees is much less.

Several forb species are abundant in the herbaceous layer. These species are bur chervil (*Anthriscus scandicina*), lambsquarters (*Chenopodium album*), Canada thistle (*Cirsium arvense*) and belvedere summer cypress (*Kochia scoparia*). Cheatgrass brome (*Bromus tectorum*) is also abundant.

WHITE ALDER VEGETATION TYPE

A closed tree canopy of white alder (*Alnus rhombifolia*), a well developed complex of shrubs and a poorly developed herbaceous layer characterizes this vegetation type. The type occurs in the bottoms of narrow side canyons that have water flowing during the entire year. Daubenmire (1970) describes this vegetation as the *Alnus rhombifolia*

habitat-type. An intensive study[1] of this type is currently in progress.

The closed tree layer consists primarily of white alder and an occasional black cottonwood (*Populus trichocarpa*) and white mulberry (*Morus alba*). The moist, subtropical climate of these side canyons is reflected by the numerous exotic species that flourish such as English walnut, black walnut, black locust, apple, apricot, plum, boxelder, grape and ash. This is further accented by the abundance of lianas such as bitter nightshade (*Solanum dulcamara*) and western virginsbower (*Clematis ligusticifolia*).

The shrub layer is a complex association. The layer is dense and has an average height of about 3 meters. This vegetation type usually abuts the Douglas Hackberry type at the mouth of tributaries. The White Alder type was sampled near the river and consequently Douglas hackberry (*Celtis douglasii*) is a major constituent of the White Alder shrub layer.

The herb layer is a sparse growth of mesic forbs. Stream flooding and lack of sunlight probably account for the scant herbaceous development.

Another phase of the White Alder type occurs along the shores of the lower reservoirs on the Snake River. White alder forms a narrow belt of vegetation on the river bank with an understory of smooth scouringrush (*Equisetum laevigatum*). A shrub layer is absent in these communities. This type appears to be spreading as young, isolated white alder were found scattered along the shore. Streambank erosion due to wave action is widespread on the reservoirs. This erosion undermines the white alder trees causing them to tip over into the water. White alder does help to protect these banks from erosion, however, and could be planted on the lower reservoirs for this purpose.

White Alder - Mockorange - Roughstalk Bluegrass Community

White alder has a density of 300 per hectare and creates a closed canopy along with a few white mulberry and black cottonwood trees. The tree canopy has an average height of 11 meters tall.

The shrub layer is relatively sparse for the type. Mockorange (*Philadelphus lewisii*) is dominant with fewer than 100 individuals per hectare. Poison ivy (*Rhus radicans*) is sporadically abundant.

Abnormally warm temperatures coupled with heavy rains and snowmelt caused flooding in January 1973. This flooding literally removed nearly all of the herbaceous understory in many of the major tributaries above Hells Canyon Dam. Few plants occurred on the rock rubble which remained and covered over 40 percent of the ground.

[1] Miller, Thomas B. Master's Thesis in preparation. College of Forestry, Wildlife and Range Sciences, University of Idaho, Moscow.

White Alder - Mockorange - Thymeleaf Sandwort Community

This is a typical community of the White Alder vegetation type. White alder forms a closed canopy over a dense shrub layer. The shrub layer consists of mockorange, Douglas hackberry, blue elderberry (*Sambucus cerulea*), and golden currant (*Ribes aureum*). The shrubs have a total density of about 2400 individuals per hectare and a combined canopy cover of approximately 80 percent. Mockorange and Douglas hackberry comprise about 90 percent of the total shrub cover.

Thymeleaf sandwort (*Arenaria serpyllifolia*) is the only abundant plant species in the sparse herbaceous layer.

White Alder - Common Chokecherry - Poison Ivy Community

Wider side canyons that are not very steep give rise to this lush community. White alder and black cottonwood equally comprise the nearly closed tree canopy.

Both a tall and low shrub layer exist. The tall shrub layer is dominated by a 60 percent canopy cover of common chokecherry (*Prunus virginiana*). Other species in the layer include mockorange, bittercherry (*Prunus emarginata*), blue elderberry, coyote willow (*Salix exigua exigua*), serviceberry (*Amelanchier alnifolia*), and black hawthorn (*Crataegus douglasii*).

Poison ivy and common snowberry (*Symphoricarpos albus*) equally comprise about 65 percent low shrub cover. Woods rose is also a component in this layer.

The herbaceous layer is also well developed in this community. It consists of forbs such as bur chervil (*Anthriscus scandicina*), common burdock (*Arctium minus*), rough bedstraw (*Galium asperimum*), Piper anemone (*Anemone piperi*) and western virginsbower (*Clematis ligusticifolia*).

WILLOW - COTTONWOOD VEGETATION TYPE

A vegetation complex that consists of cottonwood (*Populus deltoides* and *P. trichocarpa*), tree willow (*Salix spp.*) and Russian olive (*Eleaegnus angustifolia*) occurs between the mouths of the Snake and Walla Walla Rivers on McNary Reservoir. Some stands lack Russian olive. The other two tree species are equally dominant. These areas are placed in this type. The understory is usually a stand of shrub willow and forbs.

RUSSIAN OLIVE - WILLOW VEGETATION TYPE

This type is part of the vegetation complex referred to in the Willow - Cottonwood type description. In this type cottonwood is absent. Russian olive and tree willow are equally dominant. The understory consists of shrub willows and forbs. This type is possibly a lower seral stage in this primary succession. Cottonwood seedlings were observed in several stands of this type.

WHITE MULBERRY - WILLOW VEGETATION TYPE

White mulberry (*Morus alba*) is an introduced tree that is fairly abundant above the Clearwater River confluence with the Snake River. It is usually a member of another vegetation type such as the Tree Willow or Douglas Hackberry types. A few stands were observed, however, where mulberry was the dominant tree creating a nearly closed canopy. Tree willow is also present in this vegetation type. The understory consists of a sparse forb layer.

WILLOW - COTTONWOOD - RUSSIAN OLIVE VEGETATION TYPE

A variable mixture of tree willow (*Salix lasiandra caudata*), black and plains cottonwood (*Populus trichocarpa*, *P. deltoides*) and Russian olive (*Elaeagnus angustifolia*) comprises the overstory of this vegetation type. No species is consistently dominant.

A shrub layer of willows (*Salix spp.*) has a spotty distribution in the type. The more moist areas support dense patches of willow while the drier sites have only a sparse stand.

The herbaceous layer consists of tall forb species such as goldenrod (*Solidago spp.*), thistle (*Cirsium spp.*) and Australian peavine (*Swainsona salsula*).

The Willow - Cottonwood - Russian Olive type is found on low alluvial benches. The soils of these moist benches are deep, loamy, fine sands with a coarse sand or gravel substrate.

Plains Cottonwood - Russian Olive - Canada Thistle Community

Plains cottonwood creates a closed tree canopy in this woodland community. The average height of the trees is 11 meters. Plains cottonwood saplings, Russian olive, coyote willow (*Salix exigua exigua*) and *Salix rigida mackenzieana* contribute to the moderately dense shrub layer. A total of 300 stems per hectare are found in this tall shrub layer.

The herbaceous layer is dominated by Canada thistle (*Cirsium arvense*). Western goldenrod (*Solidago occidentalis*), Canada goldenrod (*Solidago canadensis*) and Austrian peavine are fairly abundant.

DECIDUOUS TRIBUTARY VEGETATION TYPE

The vegetation of many small tributaries above the Clearwater-Snake River confluence has no clearly dominant species, but consists of numerous individuals of many species. A detailed sample is needed to determine dominance. Tributary vegetation that was not easily typed by a dominant tree or shrub was placed in this vegetation type.

The tree layer is usually an open canopy of several of the following species: white alder (*Alnus rhombifolia*), black cottonwood (*Populus*

trichocarpa), boxelder (*Acer negundo*) and water birch (*Betula occidentalis*).

A dense shrub layer is similarly comprised of several species. Species encountered commonly include Rocky Mountain maple (*Acer glabrum*), serviceberry (*Amelanchier alnifolia*), Douglas hackberry (*Celtis douglasii*), Columbia hawthorn (*Crataegus columbiana*), black hawthorn (*Crataegus douglasii*), red-osier dogwood (*Cornus stolonifera*), mockorange (*Philadelphus lewisii*), common chokecherry (*Prunus virginiana*), cascara (*Rhamnus purshiana*), smooth sumac (*Rhus glabra*), poison ivy (*Rhus radicans*), Woods rose (*Rosa woodsii*), western blackcap (*Rubus leucodermis*), blue elderberry (*Sambucus cerulea*) and common snowberry (*Symphoricarpos albus*).

The herbaceous layer is usually dominated by annual grasses of the genus *Bromus*.

The communities in this type are not repetitive in the field. Each stand consists of a different aggregate of species and a different combination of dominants. Many of the communities are primary successional stages that have not developed a dominant species. Other tributaries have been disturbed by man and have numerous planted and escaped species such as apple, apricot, plum, walnut, boxelder, and grape.

Boxelder - Blue Elderberry - *Bromus sterilis* Community

Boxelder has 80 percent canopy coverage in this community. The shrub layer is open with both tall and low growing species. The tall shrub layer is dominated by blue elderberry with about 10 percent cover. Columbia hawthorn is also present. The low shrub layer consists primarily of poison ivy and common snowberry which have a total of about 6 percent cover.

The most abundant species in the herbaceous layer are *Bromus sterilis*, bulbous bluegrass (*Poa bulbosa*) and slender bluegrass (*Poa gracillima*). Forbs are not abundant.

Water Birch - Common Chokecherry Community

The open tree canopy of this community is comprised of water birch and white alder. The trees have approximately 40 percent canopy cover and an average height of 7 meters.

The shrub layer is dense with a combined canopy cover of about 90 percent. The most abundant shrub species are common chokecherry, mockorange, and Douglas hackberry. The herbaceous layer is not well developed although cheatgrass brome is fairly abundant.

PONDEROSA PINE - DOUGLAS HACKBERRY VEGETATION TYPE

The open tree layer of ponderosa pine (*Pinus ponderosa*) varies from just a few individuals to a sparse woodland in this vegetation type. A moderate density (100 per hectare) of Douglas hackberry (*Celtis douglasii*)

dominates the shrub layer. Poison ivy (*Rhus radicans*) is also abundant. The herbaceous layer is primarily grasses.

This type occurs on moist rocky areas well above the high water line. The type is limited to the upper end of Hells Canyon and Hells Canyon and Oxbow Reservoirs. Ponderosa Pine grows on the North and East facing slopes in this area and extends down to the river on steep rocky slopes.

Douglas Hackberry - Poison Ivy - Cheatgrass Brome Community

This mesic community has approximately 6 individuals of ponderosa pine per hectare. The shrub layer consists of Douglas hackberry with 4 percent canopy cover and scattered individuals of other tall shrub species. Poison ivy is abundant.

The herbaceous layer is dominated by cheatgrass brome. Several other annual grasses are also well represented. Bluebunch wheatgrass (*Agropyron spicatum*), bulbous bluegrass (*Poa bulbosa*), Sandberg bluegrass (*Poa sandbergii*) and Idaho fescue (*Festuca idahoensis*) are perennial grasses present in the community.

Forbs are represented by a sparse growth of numerous species. Species indicative of this community are thymeleaf sandwort (*Arenaria serpyllifolia*) and rough bedstraw (*Galium asperrimum*).

Ponderosa pine was absent in one sample (Site 17) included in this community, although it did occur in the same stand of Douglas hackberry several hundred meters upstream. The understory is fairly similar between the two sites. There are also a large number of different forb species but most of them require a mesic environment like the two forb species mentioned above. Both sites sampled occurred on moist rocky soils.

PONDEROSA PINE - ELDERBERRY VEGETATION TYPE

This type occurs in the bottoms of a few side canyons on Hells Canyon Reservoir and along the Snake River for a few miles below Hells Canyon Dam. Ponderosa pine (*Pinus ponderosa*) comes down to the river in the side canyons of this area. A dense stand of shrubs dominated by blue elderberry (*Sambucus cerulea*) forms the understory in the bottoms of these canyons.

PONDEROSA PINE - BLUEBUNCH WHEATGRASS VEGETATION TYPE

Daubenmire and Daubenmire (1968) describe the *Pinus ponderosa* - *Festuca idahoensis* habitat-type. This habitat-type extends down to the Snake River on north facing slopes in the area of Hells Canyon Reservoir and below Hells Canyon Dam. On these slopes ponderosa pine creates an

open tree canopy. The herbaceous layer is dominated by a lush grassland of bluebunch wheatgrass (*Agropyron spicatum*) and Idaho fescue (*Festuca idahoensis*).

The Ponderosa Pine - Elderberry vegetation type is found in the bottoms of these north slopes. The Ponderosa Pine - Douglas Hackberry type also occurs along the river in this area.

Landforms

Most of the landform and artificial landform designations are self explanatory. Only a few need further description.

The Cliff-Talus category was used for areas of the canyon that had a mixture of cliffs and talus that were too small to map separately. These usually have small pockets of bluebunch wheatgrass interspersed.

Small fenced areas, irrigated pastures, and corrals were mapped as Fenced Pastures.

Areas denuded of vegetaton by construction or farming that were not presently being used were designated as Idle Lands. This category does not include crop land that was in summer fallow.

Agricultural Buildings not only includes farm and ranch headquarters but also includes hay storage sheds and grain elevators scattered along the river.

Landform classes as a whole comprise very little of the Snake River Shoreline. Vegetation covers 40-90 percent of the shoreline in most segments. Most of the landform designations comprise less than 5 percent of the shoreline, however, there are a few exceptions to this. Ten percent of the shoreline of Oxbow Reservoir and over 40 percent of Hells Canyon Reservoir is Roadfill due to the close proximity of the road that runs the entire length of these two reservoirs. In the rugged segment of Hells Canyon between Hells Canyon Dam and Pittsburg Landing over 10 percent of the shoreline is Cliff-Talus. From the Grande Ronde River to the Clearwater River over 7 percent of the shoreline is Sand Bar. This is probably due to the influx of sand from the Salmon and Grande Ronde Rivers and the slowing down of the current.

Rock Rip-Rap on the Reservoirs below the Clearwater River confluence with the Snake River comprises 20 to 40 percent of the shoreline miles. This is mostly a result of the railroad that follows the lower Snake River. Most of the embayments on these lower reservoirs also have a large percentage of Rock Rip-Rap because they are formed by the railroad.

Successional Relationships

The *Agropyron-Poa* habitat-type is the most extensive upland type occurring on the study area. This habitat-type was the only one from which an adequate sample was obtained to facilitate a detailed analysis of secondary succession. Twenty-eight stands were subjectively placed in the *Agropyron-Poa* habitat-type on the basis of location and species composition. These 28 stands were classified into 16 communities and these communities were used in the ordination procedure. Stand 22, which was a near climax stand in the more mesic *Agropyron spicatum - Festuca idahoensis* habitat-type (Daubenmire 1970), was included with these 28 stands to see how it would behave in the ordination of the *Agropyron-Poa* succession.

Three definite successional phases of the *Agropyron-Poa* habitat-type were identified while working in the field. The first phase is characterized by the presence of sand dropseed (*Sporobolus cryptandrus*) which is indicative of sandy alluvial soils. This phase was found primarily on alluvial soils between Hells Canyon Dam and Wawawai, Washington (Daubenmire 1970). Sand dropseed is considered to be a member of its own climax plant association of the *Sporobolus cryptandrus - Poa sandbergii* habitat-type on very sandy soils. It is also considered to be a long lasting seral stage of the *Agropyron-Poa* habitat-type on more loamy soils (Daubenmire 1970). The presence of abundant Sandberg bluegrass (*Poa sandbergii*) and remnant bunches of bluebunch wheatgrass (*Agropyron spicatum*) indicate that the sand dropseed stand is of the *Agropyron-Poa* habitat-type.[2] All of the sand dropseed stands except two had Sandberg bluegrass present. It was readily apparent in the field that these two sites had been subjected to heavy concentrations of livestock. Several of the other sites had bluebunch wheatgrass present. All of the sites occupied similar level benches above the river. For these reasons, the sand dropseed stands sampled on this study were considered to be seral stages of the *Agropyron-Poa* habitat-type.

The second phase is a dry alluvial soil phase characteristic of the Snake River Canyon in Washington. The seral vegetation in this area is predominated by cheatgrass brome and is referred to as the cheatgrass brome phase.

The third phase occurs on the residual soils in the steeper parts of the Snake River canyon between Idaho and Oregon. The more mesic brome species such as rattle brome (*Bromus brizaeformis*), Japanese brome (*Bromus japonicus*) and soft brome (*Bromus mollis*) occur here in addition to cheatgrass brome. The most abundant and widespread of the mesic bromes is the Japanese brome which will be used as the name of this phase.

The successional sequence in each of the three phases should be fairly distinct within the overall *Agropyron-Poa* succession. In order to test this, the identity of each of the three phases is maintained in the three-dimensional drawing presented in Figure 3 to illustrate the results of the ordination. The three phases are identified by the different symbols appearing in the three-dimensional drawing. The triangles represent the sand dropseed phase. The squares represent communities of the cheatgrass brome phase and the circles represent the more mesic Japanese brome phase. In all three phases the communities were divided into low seral - represented by the largest sized symbols, seral - represented by the medium sized figures and climax - represented by the smallest circles. Only two Japanese brome communities were classified as climax. Stand S9 was considered to be the best example of *Agropyron-Poa* climax of the 28 stands. Stand 22 was the *Agropyron-Festuca* climax stand and was also represented by a small circle. The stands were divided into these three categories on the basis of their species composition and relative appearance.

The climax point of the ordination is in the upper right hand corner. The seral end is across the bottom of the drawing.

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[2]Personal communication during July 1975 from Dr. E. W. Tisdale, College of Forestry, Wildlife and Range Sciences, University of Idaho, Moscow.

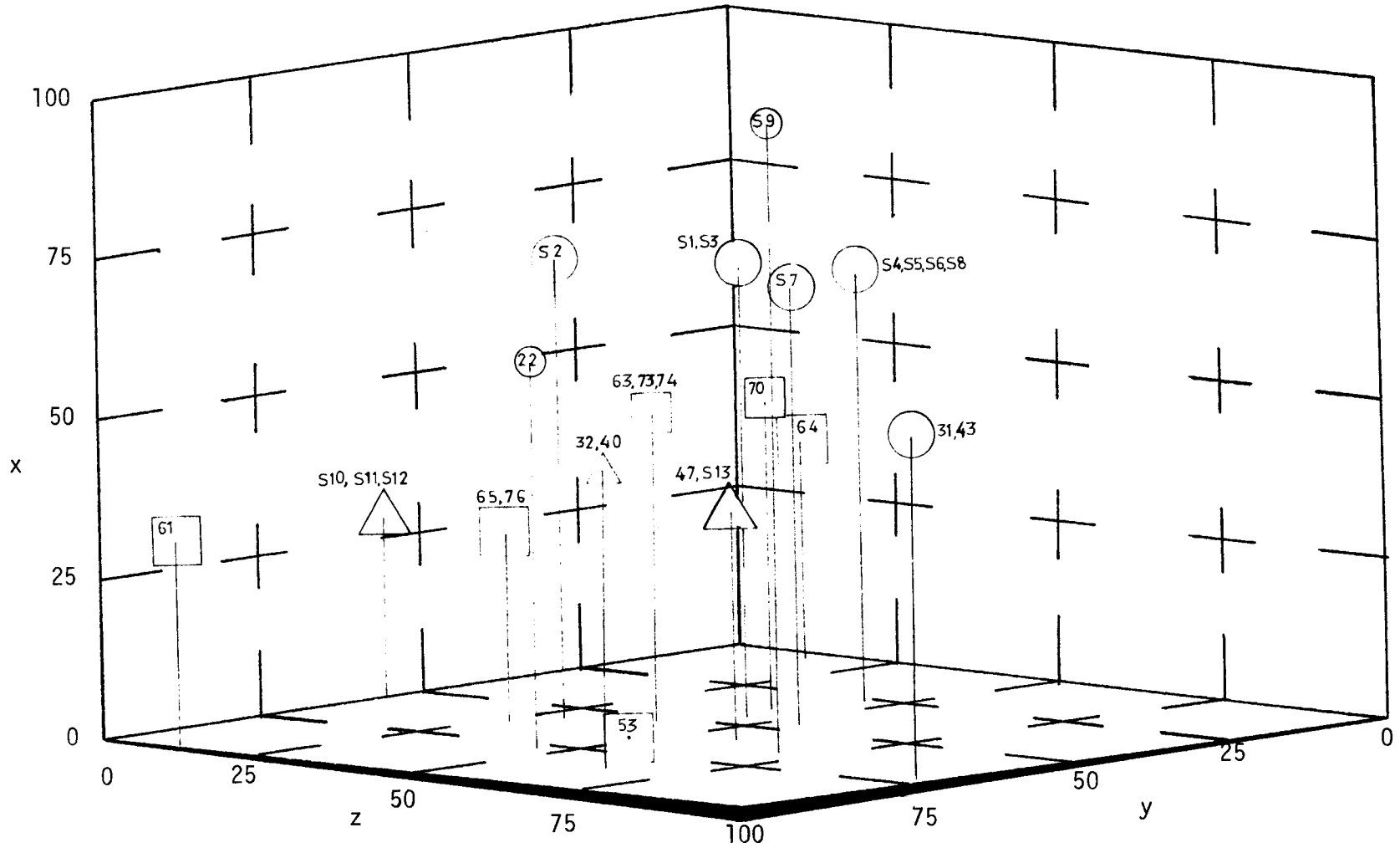

Figure 3. Three-dimensional drawing of an ordination of communities based on Beal's (1960) method of reference point selection. The middle center point of the drawing is the lowest value for all 3 axes. Axes are oriented to position the climax stands at the top of the drawing. The sixteen communities represent three phases of the *Agropyron-Poa* habitat-type. The triangles represent sand dropseed phase communities, squares represent the cheatgrass brome phase, and circles represent communities of the Japanese brome phase. Large sized symbols represent the lowest seral stages, medium sized symbols represent seral stages nearer to climax, and the smallest symbols represent climax stands.

In comparing the ordination to the cone model it is easy to see the wide seral base across the bottom of the drawing. The large symbols are the lowest in the drawing. The medium symbols are above the large ones, and the two small circles are located near the top. The successional sequence for each of the three phases is fairly well grouped on the basal plane in the ordination.

The cone models are still a simplification of the real world. The real environment may distort or never produce all parts of the cone. The data used in this study have shown the model to be accurate, however, and it is a valuable working model for conceptualizing the processes that take place in secondary succession.

The habitat-types defined by Daubenmire (1970) are a broad classification of climax vegetation. The phases and stages of secondary succession within the habitat-types are not accounted for. Management practices for the different phases at different stages of successional development are apt to be quite different. The techniques and models used in this study should make the identification of stages within habitat-type phases possible for the land manager.

Key to Vegetation Types and Plant Communities

As a result of the vegetation analysis, we developed a key to vegetation types and plant communities. The key should prove useful to land managers in identifying plant communities within their area of management jurisdiction.

All of the communities that exist are not listed in the key, but we trust this effort will stimulate further research and discussion and eventually lead to a refined key. The key appears in Appendix 2.

Rare and Uncommon Plants

As interest has recently grown in rare and endangered plants, we felt it desirable to include such a list as part of our vegetation analysis for the study segments (Table 8). The criteria used for compiling the list were taken from Johnson and Steele (1974). *Endemic* refers to plant populations of limited geographic distribution. *Disjunct* refers to small natural populations within the study area with larger populations elsewhere. *Escaped* species are also disjunct, but escaped is used to specifically designate domestic plant species which were introduced by man (e.g., homesteaders) and which to some extent are now naturally reproducing. *New* refers to a plant species never listed as occurring within the geographical area, but which has now been documented as occurring there. *Rare* and *uncommon* are quantitative terms used to describe the number of individuals (abundance), with rare applying to lower abundance than uncommon. *Endangered* and *threatened* apply to survival status. Any taxon considered likely to become extinct within the geographical area during the next 10 years under present trends is considered endangered. Any taxon whose population is likely to be reduced sufficiently within the next 10 years to become an endangered species is considered threatened. *Special interest* status refers to those taxa listed only by Dyrness et al. (1975); these taxa were not evaluated as to being rare or uncommon and endangered or threatened.

Table 8. Rare and uncommon plants known or suspected to occur within the study area.

Scientific Name	Common Name	Study Segment	Endemic, Disjunct or Escaped	Status	Source
Trees					
Acer saccharinum	Silver Maple	1,4,6	Escaped	New, Rare	Miller 1976
Shrubs					
Humulus lupulus	Hops	4	Escaped	Uncommon	Miller 1976
Ribes cereum var. colubrinum	Wax Currant	3	Endemic	Special Interest	Dyrness et al 1975
Ribes irriguum	Idaho Gooseberry	2,4	Endemic	Special Interest	Dyrness et al 1975
Ribes velutinum var. gooddingii	Gooding's Gooseberry	-	Endemic	Rare	Henderson 1974
Rubus bartonianus	Bartonberry	3	Endemic	Rare, Endangered	Henderson 1974 Johnson and Steele 1974 Dyrness et al 1975
Vitis riparia	Riverbank Grapevine	2,3	Escaped	New, Rare	Miller 1976
Forbs					
Arabis crucisetosa	Cross-haired Rockcress	-	Endemic	Rare	Henderson 1974 Johnson & Steele 1974
Astragalus cusickii	Cusick's Milk-vetch	3	Endemic	Rare Uncommon	Henderson 1974 Johnson and Steele 1974 Dyrness et al 1975
Astragalus purshii var. ophigenes	Pursh Locoweed	1,2		Rare, Endangered	Smithsonian Inst. 1975
Astragalus vallaris	Snake Canyon Milk-vetch		Endemic	Rare	Johnson and Steele 1974 Dyrness et al 1975
Camassia cusickii	Cusick's Camas	2	Escaped	Rare	Miller 1976 Dyrness et al 1975
Erigeron disparipilus	Snake River Daisy	-	Endemic	Special Interest	Dyrness et al 1975
Hackelia hispida	Rough Stickseed	-	Endemic	Rare	Johnson and Steele 1974 Dyrness et al 1975
Haplopappus aberrans	Idaho Goldenweed	3	Endemic	Uncommon, Threatened	Smithsonian Inst. 1975

Table 8. Continued.

Scientific Name	Common Name	Study Segment	Endemic, Disjunct or Escaped	Status	Source
Haplopappus radiatus	Snake River Goldenweed	-	Endemic	Special Interest	Dyrness et al 1975
Lomatium rollinsii	Rollin's Lomatium	-	Endemic	Rare, Endangered	Johnson and Steele 1974
					Dyrness et al 1975
Lomatium serpentinum	Snake Canyon Lomatium	-	Endemic	Rare	Johnson and Steele 1974
					Dyrness et al 1975
Nemophila kertleyi		2	Endemic	Uncommon	Johnson and Steele 1974
					Dyrness et al 1975
Phlox colubrina	Snake River Phlox	3	Endemic	Rare	Henderson 1974
					Johnson and Steele 1974
					Dyrness et al 1975
Sedum leibergii	Leiberg Stonecrop	3,4	Endemic	Rare	Henderson 1974
Tonella floribunda	Large Flower Tonella	2,3,4	Endemic	Special Interest	Dyrness et al 1975
Viola canadensis	Canada Violet	3	Disjunct	New, Rare	Miller 1976
					Dyrness et al 1975
Grasses					
Spartina pectinata	Prairie Cordgrass	3,4	-	Rare	Miller 1976

Quantitative Descriptions of Vegetation and Landforms

Summarized Site and Community Data

Data from each sample site are summarized in Appendix IV. The tables are presented in numerical order and contain the average percent cover and average percent frequency of occurrence for each species and ground cover category. The tables also contain the average density and mean height for each woody species. Location and environmental data are also presented at the top of each table. These tables are combined by community to form the plant community data tables which contain the averaged quantitative values for the 56 plant communities defined by the objective classification and the additional 4 communities sampled in 1975 (Appendix III).

Vegetation Types and Landforms per Segment

Several potential error factors became apparent while calculating acreages for the major vegetation types and landform classes on aerial photographs using a dot grid. These include: (1) the edge effect or "in-out" error associated with counting dots within the long, narrow shapes characteristic of many delineated areas; (2) the increased area of small, delineated types due to line placement on the aerial photographs; and (3) the scale variance on the aerial photographs due to changes in topography and flight elevation. We calculated a correction factor for McNary Reservoir (aerial photo scale 1:24,000) when we discovered that known acreages were being overestimated 20 to 60 percent. Error on other study area segments (aerial photo scale 1:12,000 or 1:20,000) checked was 10 percent or less and therefore no correction was applied. In addition, only alternate dots lying on delineated type borders were counted to compensate for "in-out" error.

We also calculated a shoreline distance for each vegetation type and landform class delineated as an index of their extensiveness. This minimizes and/or eliminates the errors mentioned above and is faster and easier to calculate. Vegetation types and landform classes were classified as primary or secondary. Secondary types are vegetation types and/or landform classes that occur between the upper study area boundary and shoreline vegetation types or landform classes--the latter then being the primary type. Table 3 lists the conversion factors used in shoreline distance and acreage computations for the various aerial photo scales.

Vegetation types and landform classes were originally delineated on aerial photos in 1973. During the study we updated photos as landform changes occurred such as inundation of Lower Granite Reservoir and the associated development of parks and marinas. Vegetation types can also change in areas such as the mouths of the Walla Walla, Tucannon and Palouse Rivers, in particular. These alterations can occur due to plant succession as well as excessive spring runoff which may deposit silt or wash out established vegetation. For these reasons, subsequent utilization of aerial photo delineations will bear out such changes.

The amount of shoreline covered by each vegetation type and landform

is summarized for each study area segment in Tables 9-25. Vegetation comprises about 90 percent of the shoreline cover above the Clearwater River confluence with the Snake River. Such upland types as Bluebunch Wheatgrass-Sandberg Bluegrass, Big Sagebrush-Bluebunch Wheatgrass, and Antelope Bitterbrush-Bluebunch Wheatgrass cover most of this area. Douglas Hackberry is also very extensive in the area below Hells Canyon Dam. The riparian vegetation type with the most shoreline coverage is Shrub Willow. Road Fill and Cliff-Talus have 40 and 10 percent coverage, respectively, along Hells Canyon Reservoir. Sand Bars have their greatest coverage between the Grande Ronde River and the Clearwater River confluence, with 7.5 percent.

Below the Clearwater River confluence, Rock Rip-Rap covers as much as 47 percent of the reservoir shoreline miles. This large amount of rip-rap is a result of the railroad that follows the lower Snake River. Upland vegetation comprises the majority of remaining shoreline miles but riparian types are more extensive than on the middle Snake River. Shrub Willow is the most abundant riparian type.

Table 9. Miles of shoreline and acres of vegetation and landform types on Brownlee Reservoir.

Type	Shoreline Miles	% Shoreline Miles	Acres
Riverbank			
Road Fill	7.1	4.9	44.8
Medusahead Wildrye	2.8	1.9	-
Bluebunch Wheatgrass-Sandberg Bluegrass	7.4	5.1	-
Forbs	6.7(0.5)*	4.6	93.6
Big Sagebrush-Bluebunch Wheatgrass	70.8(3.8)	48.6	1,039.8
Rubber Rabbitbrush	9.4	6.4	-
Antelope Bitterbrush-Bluebunch Wheatgrass	15.0	10.3	-
Curlleaf Mountainmahogany	0.9	0.6	-
Douglas Hackberry	2.4	1.6	-
Shrub Willow	15.1	10.4	102.5
Tree Willow	3.1	2.1	5.1
White Alder	0.1	0.1	-
Deciduous Tributary Vegetation	0.7	0.5	-
Willow-Cottonwood-Russian Olive	0.1	0.1	0.6
Field Crops	1.1	0.8	19.9
Fenced Pasture	0.1	0.1	24.9
Agricultural Buildings	0.1	0.1	6.8
Power Facilities and Dams	0.1	0.1	17.9
Developed Parks	2.2	1.5	77.7
Public Access Areas	0.2	0.1	1.0
Residential Areas	0.2	0.1	0.5
Total	145.6	100.0	1,435.1
Island			
Rock	0.3	2.6	1.0
Forbs	- (2.4)	-	80.8
Bluebunch Wheatgrass-Sandberg Bluegrass	0.3	2.6	3.9
Wildrye	- (1.1)	-	13.9
Big Sagebrush	-	-	2.4
Shrub Willow	8.7	75.7	43.9
Tree Willow	2.2	19.1	16.9
Field Crops	- (2.1)	-	57.8
Total	11.5	100.0	220.6
Embayment			
Sand Dunes	1.0	38.5	-
Rock Rip-rap	0.9	34.6	-
Rubber Rabbitbrush	0.3	11.5	-
Antelope Bitterbrush-Bluebunch Wheatgrass	0.4	15.4	-
Total	2.6	100.0	

* Secondary Type

Table 10. Miles of shoreline and acres of vegetation and landform types on Powder River extension of Brownlee Reservoir.

Type	Shoreline Miles	% Shoreline Miles	Acres
Riverbank			
Cattail	0.2	1.3	3.0
Shrub Willow	2.0	12.6	19.9
Willow-Cottonwood	0.1	0.6	-
Big Sagebrush-Bluebunch Wheatgrass	10.9	68.5	-
Deciduous Tributary Vegetation	Tr	Tr	Tr
Field Crops	2.3	14.5	-
Developed Parks	0.4	2.5	7.0
Total	15.9	100.0	29.9

Table 11. Miles of shoreline and acres of vegetation and landform types on Oxbow Reservoir.

Type	Shoreline Miles	% Shoreline Miles	Acres
Riverbank			
Road Fill	2.5	9.9	10.0
Cheatgrass Brome	0.8	3.1	3.8
Horsetail	0.1	0.4	2.0
Antelope Bitterbrush-Bluebunch Wheatgrass	11.0	43.5	-
Douglas Hackberry	5.5(1.3)*	21.7	29.8
Shrub Willow	1.0	4.0	3.1
Elderberry	1.7	6.7	6.3
White Alder	0.1	0.4	-
Deciduous Tributary Vegetation	0.1	0.4	-
Ponderosa Pine-Bluebunch Wheatgrass	0.4	1.6	4.6
Fenced Pasture	0.2	0.8	4.4
Residential Area	0.1	0.4	3.0
Power Facilities and Dams	1.4	5.5	44.8
Developed Parks	0.2	0.8	6.3
Public Access Area	0.2	0.8	6.0
Total	25.3	100.0	124.1
Island			
Rock	Tr	Tr	Tr
Blackberry	0.1	100.0	0.5
Total	0.1	100.0	0.5

* Secondary Type

Table 12. Miles of shoreline and acres of vegetation and landform types on Hells Canyon Reservoir.

Type	Shoreline Miles	% Shoreline Miles	Acres
Riverbank			
Rock	0.6	1.2	6.3
Rock Cliffs	0.9	1.7	24.4
Cliff-Talus	5.4	10.4	-
Road Fill	22.0	42.4	151.9
Cheatgrass Brome	0.3	0.6	20.6
White Sweetclover	2.4	4.6	34.4
Bluebunch Wheatgrass-Sandberg Bluegrass	6.4	12.3	23.8
Antelope Bitterbrush-Bluebunch Wheatgrass	3.5	6.8	5.6
Curlleaf Mountainmahogany	0.9	1.7	-
Douglas Hackberry	1.9	3.7	21.9
Shrub Willow	0.2	0.4	1.9
Blackberry	0.1	0.2	0.6
Elderberry	0.3	0.6	3.1
Bittercherry	0.2	0.4	20.0
White Alder	0.8	1.5	8.8
Deciduous Tributary Vegetation	0.2	0.4	4.4
Ponderosa Pine-Douglas Hackberry	2.2	4.2	20.0
Ponderosa Pine-Elderberry	0.7	1.4	15.6
Fenced Pasture	0.6	1.2	20.0
Residential Areas	0.3	0.6	5.0
Power Facilities	0.8	1.5	23.9
Mine Facilities	0.3	0.6	4.0
Fish Hatchery	0.2	0.4	3.0
Developed Parks	0.6	1.2	23.8
Total	51.8	100.0	443.0
Island			
Rock	0.1	10.0	2.0
Bluebunch Wheatgrass-Sandberg Bluegrass	0.9	90.0	25.9
Total	1.0	100.0	27.9

Table 13. Miles of shoreline and acres of vegetation and landform types from Hells Canyon Dam to Pittsburg Landing.

Type	Shoreline Miles	% Shoreline Miles	Acres
	Riverbank		
Rock Cliffs	0.9	1.3	-
Sand	0.1	0.2	1.5
Sand Bars	0.6	0.9	7.4
Louisiana Sage	3.8	5.6	26.4
Reedgrass	- (0.2)*	-	1.8
Bluebunch Wheatgrass-Sandberg Bluegrass	1.4	2.1	-
Douglas Hackberry	56.8	83.0	354.8
Shrub Willow	0.5	0.7	1.1
Ponderosa Pine-Douglas Hackberry	3.9	5.7	46.2
White Alder	0.2	0.3	0.2
Power Facilities	0.1	0.2	0.5
Public Access Areas	0.1	0.2	0.8
Commercial Outfitter Facility	-	-	0.4
Total	68.4	100.2	441.1

* Secondary Type

Table 14. Miles of shoreline and acres of vegetation and landform types from Pittsburg Landing to confluence of Salmon-Snake Rivers.

Type	Shoreline Miles	% Shoreline Miles	Acres
Riverbank			
Gravel	Tr	-	0.5
Sand Bars	0.5	0.8	-
Sand Banks	0.1	0.2	0.6
Louisiana Sagebrush	1.6	2.6	20.5
Bluebunch Wheatgrass-Sandberg Bluegrass	18.3	29.7	-
Curlleaf Mountainmahogany	Tr	-	25.2
Douglas Hackberry	37.7	61.2	235.6
Shrub Willow	0.2	.3	-
Smooth Sumac	Tr	-	3.2
Serviceberry	3.1	5.0	242.0
White Alder	- (0.1)	-	0.6
Deciduous Tributary Vegetation	Tr	-	2.5
Ponderosa Pine-Douglas Hackberry	- (0.2)	-	3.0
Agricultural Buildings	Tr	-	5.9
Public Access Areas	0.1	0.2	0.8
Commercial Outfitter Facility	Tr	-	1.1
	61.6	100.0	541.5
Island			
Louisiana Sagebrush	0.2	66.7	1.4
Shrub Willow	0.1	33.3	0.4
	0.3	100.0	1.8

Table 15. Miles of shoreline and acres of vegetation and landform types from the confluence of Salmon-Snake Rivers to the confluence of Grande Ronde-Snake Rivers.

Type	Shoreline Miles	% Shoreline Miles	Acres
	Riverbank		
Sand Bars	5.0	11.2	34.0
Louisiana Sage	0.2	0.5	1.7
Bluebunch Wheatgrass-Sandberg Bluegrass	20.1	45.2	-
Curlleaf Mountainmahogany	0.3	0.7	15.0
Douglas Hackberry	1.1(17.3)*	2.5	176.7
Shrub Willow	17.1	38.4	80.9
Deciduous Tributary Vegetation	0.1	0.2	-
Ponderosa Pine-Douglas Hackberry	0.6	1.3	4.5
Total	44.5	100.0	312.8
	Island		
Rock	0.2	12.5	1.0
Louisiana Sagebrush	0.5	31.3	5.8
Willow (shrub)	0.8	50.0	3.8
Douglas Hackberry	0.1	6.3	0.4
Total	1.6	100.1	11.0

* Secondary Type

Table 16. Miles of shoreline and acres of vegetation and landform types from the confluence of Grande Ronde-Snake Rivers to Lower Granite Reservoir.

Type	Shoreline Miles	% Shoreline Miles	Acres
	Riverbank		
Rock Cliffs	0.2	0.4	2.6
Sand Bars	3.9	7.5	33.6
Slough	-	-	3.8
Cheatgrass Brome	- (0.7)*	-	8.3
Louisiana Sagebrush	- (2.4)	-	41.6
Bluebunch Wheatgrass-Sandberg Bluegrass	0.5	1.0	2.2
Rubber Rabbitbrush	- (2.5)	-	15.0
Douglas Hackberry	0.4	0.8	155.1
Shrub Willow	45.6	87.4	261.2
Blackberry	0.4	0.8	3.6
Black Hawthorn	- (0.1)	-	0.4
White Alder	-	-	0.5
White Mulberry/Willow	0.3	0.6	45.4
Deciduous Tributary Vegetation	- (17.6)	-	26.4
Fenced Pasture	0.3(4.8)	0.6	80.6
Feedlots	- (0.3)	-	10.0
Agricultural Buildings	0.1(0.6)	0.2	13.3
Residential Area	-	-	3.3
Public Access Area	0.4	0.8	7.9
Marinas	0.1	0.2	0.5
Total	52.2	100.3	715.3
	Island		
Louisiana Sagebrush	0.3	20.0	9.3
Shrub Willow	1.2	80.0	14.2
Total	1.5	100.0	23.5

* Secondary Type

Table 17. Miles of shoreline and acres of vegetation and landform types on Lower Granite Reservoir.

Type	Shoreline Miles	% Shoreline Miles	Acres
	Riverbank		
Rock or Talus	0.4	0.5	2.9
Rock Cliffs	3.4	3.9	31.5
Gravel	0.2(0.6)*	0.2	10.5
Sand	0.1	0.1	0.3
Road Fill	4.5	5.1	9.6
Rock Rip-rap	37.1	42.1	31.1
Bare Ground	Tr	-	-
Cheatgrass Brome	1.5	1.7	14.4
Forbs	11.2	12.7	142.5
Bluebunch Wheatgrass-Sandberg Bluegrass	9.8	11.1	1.7
Rubber Rabbitbrush	6.5	7.4	4.7
Douglas Hackberry	0.9	1.0	8.2
Shrub Willow	1.2	1.4	4.4
Smooth Sumac	1.2	1.4	23.7
Serviceberry	0.2	0.2	-
Heterogeneous Shrub Mixture	1.3	1.5	16.4
Cottonwood	0.2	0.2	-
White Alder	0.1	0.1	1.6
White Mulberry-Willow	0.2	0.2	1.5
Deciduous Tributary Vegetation	0.3	0.3	3.3
Industrial Area	0.1	0.1	-
Power Facilities and Dams	0.9	1.0	0.5
Developed Parks	1.1	1.2	13.4
Public Access Areas	2.5	2.8	50.7
Marinas	3.2	3.6	53.0
Total	88.1	99.8	425.9
	Embayment and Pond		
Rock or Talus	0.5	6.1	7.4
Gravel	0.1	1.2	-
Road Fill	3.8	46.3	1.3
Rock Rip-rap	1.6	19.5	-
Forbs	0.2	2.4	0.2
Bluebunch Wheatgrass-Sandberg Bluegrass	1.3	15.9	-
Rubber Rabbitbrush	0.3	3.7	-
Douglas Hackberry	Tr	-	-
White Mulberry-Willow	0.2	2.4	0.5
Deciduous Tributary Vegetation	0.2	2.4	1.4
Total	8.2	99.9	10.8

Table 17. Continued.

Type	Shoreline Miles	% Shoreline Miles	Acres
	Island		
Rock or Talus	0.1	2.2	-
Gravel	0.6	13.3	6.9
Sand	0.2	4.4	2.8
Rock Rip-rap	0.5	11.1	-
Forbs	2.3	51.1	119.9
Public Access Areas	0.8	17.8	15.3
Total	4.5	99.9	144.9

* Secondary Type

Table 18. Miles of shoreline and acres of vegetation and landform types on Little Goose Reservoir.

Type	Shoreline Miles	% Shoreline Miles	Acres
	Riverbank		
Sand Dunes	-	-	10.5
Road Fill	1.9	2.3	113.6
Rock Rip-rap	23.9	29.5	47.5
Bare Ground	1.3	1.6	30.9
Cheatgrass Brome	8.2(2.1)*	10.1	211.2
Forbs	13.3	16.4	348.6
Bluebunch Wheatgrass-Sandberg Bluegrass	13.4	16.6	1.8
Bunchgrass	0.2	0.2	3.4
Crested Wheatgrass	0.4	0.5	90.6
Rubber Rabbitbrush	8.2	10.1	107.6
Douglas Hackberry	0.1	0.1	7.8
Serviceberry	0.4	0.5	1.6
Black Locust	0.1	0.1	-
Deciduous Tributary Vegetation	0.1	0.1	10.6
Fenced Pasture	3.1	3.8	123.6
Agricultural Buildings	1.0	1.2	46.9
Airport	- (0.7)	-	-
Power Facilities and Dams	0.4	0.5	25.4
Developed Parks	4.3	5.3	104.2
Public Access Areas	0.4	0.5	1.5
Marinas	0.3	0.4	3.2
Total	81.0	99.8	1,290.5
	Island		
Rubber Rabbitbrush	0.4	26.7	32.8
Crested Wheatgrass	1.0	66.7	14.9
Cattail	0.1	6.7	0.2
Total	1.5	100.1	47.9
	Embayment		
Rock Rip-rap	2.9	29.3	5.4
Cheatgrass Brome	0.1	1.0	-
Bluebunch Wheatgrass-Sandberg Bluegrass	5.4	54.6	-
Cattail	0.1	1.0	1.8
Sedge	0.1	1.0	4.3
Rubber Rabbitbrush	1.3	13.1	2.3
Total	9.9	100.0	13.8

* Secondary Type

Table 19. Miles of shoreline and acres of vegetation and landform types on Lower Monumental Reservoir.

Type	Shoreline Miles	% Shoreline Miles	Acres
	Riverbank		
Rock	0.1	0.1	5.9
Rock Cliffs	4.5	6.3	28.8
Gravel	0.4	0.6	149.5
Road Fill	0.8	1.1	107.2
Rock Rip-rap	18.9	26.6	162.9
Bare Ground	2.8	3.9	25.4
Cheatgrass Brome	1.9(1.2) *	2.7	140.7
Forbs	3.3	4.6	115.2
Bluebunch Wheatgrass-Sandberg Bluegrass	9.9	13.9	-
Cattail	0.7	1.0	3.2
Cattail-Sedge	1.6	2.2	30.8
Rubber Rabbitbrush	23.6(1.5)	33.1	278.7
Shrub Willow	Tr	Tr	0.7
Black Locust	0.4	0.6	11.4
Field Crops	- (1.4)	-	-
Pasture	1.5	2.1	-
Agricultural Buildings	-	-	7.1
Developed Parks	0.1	0.1	32.9
Power Facilities and Dams	0.2(0.2)	0.3	16.1
Public Access Areas	0.2	0.3	7.1
Marinas	0.3	0.4	10.7
Total	71.2	99.9	1,134.3
	Island		
Forbs	0.6	46.2	3.9
Bluebunch Wheatgrass-Sandberg	0.2	15.4	0.5
Wildrye	0.2	15.4	1.0
Rabbitbrush	0.3	23.1	1.0
Total	1.3	100.1	6.4
	Embayment		
Rock Cliffs	Tr	-	-
Road Fill	0.3	7.5	1.4
Rock Rip-rap	0.8	20.0	13.3
Forbs	0.2	5.0	0.7
Bluebunch Wheatgrass-Sandberg Bluegrass	0.4	10.0	-
Cattail	0.2	5.0	1.9
Rubber Rabbitbrush	1.8	45.0	-
Public Access Areas	0.3	7.5	9.7
Total	4.0	100.0	27.0

* Secondary Type

Table 20. Miles of shoreline and acres of vegetation and landform types on Ice Harbor Reservoir.

Type	Shoreline Miles	% Shoreline Miles	Acres
	Riverbank		
Rock Cliffs	2.5	3.3	25.8
Sand Bars	0.3	0.4	0.8
Road Fill	1.3	1.7	128.4
Rock Rip-rap	35.1(0.4)*	46.8	252.7
Bare Ground	- (0.8)	-	23.6
Horsetail	0.2	0.3	1.1
Bluebunch Wheatgrass-Sandberg Bluegrass	2.9	3.9	40.9
Cattail	1.5	2.0	2.4
Rubber Rabbitbrush	21.1	28.1	1,972.1
Antelope Bitterbrush-Bluebunch Wheatgrass	0.3	0.4	32.7
Shrub Willow	3.2	4.3	16.7
Russian Olive	-	-	1.0
White Alder	3.7	4.9	22.1
Agricultural Buildings	0.1	0.1	8.4
Power Facilities and Dams	0.3	0.4	11.7
Developed Parks	2.3	3.1	86.7
Public Access Areas	0.2	0.3	0.7
Total	75.0	100.0	2,627.8
	Island		
Forbs	0.1	100.0	0.7
Total	0.1	100.0	0.7
	Embayment		
Rock Rip-rap	3.1	37.4	11.8
Cattail	0.9	10.8	8.2
Rubber Rabbitbrush	4.2	50.6	-
Shrub Willow	0.1	1.2	2.5
Total	8.3	100.0	22.5

* Secondary Type

Table 21. Miles of shoreline and acres of vegetation and landform types from Ice Harbor Dam to Columbia River.

Type	Shoreline Miles	% Shoreline Miles	Acres
	Riverbank		
Road Fill	0.5	2.4	2.5
Rock Rip-rap	1.0	4.9	5.9
Bare Gound	1.3	6.3	32.1
Big Sagebrush	0.5	2.4	-
Rubber Rabbitbrush	3.4	16.5	286.8
Shrub Willow	8.3	40.3	46.9
Russian Olive	0.2	1.0	2.2
Black Locust	0.2	1.0	2.2
Willow-Cottonwood-Russian Olive	2.1	10.2	11.9
Industrial Area	1.1	5.3	31.2
Power Facilities and Dams	0.8	3.9	18.6
Developed Parks	0.3(0.4)*	1.4	46.5
Public Access Areas	0.9	4.4	9.0
Total	20.6	100.0	495.8
	Island		
Gravel	0.6	10.3	1.0
Forbs	0.3	5.2	1.1
Absinthe	0.6	10.3	6.1
Lupine	0.1	1.7	3.9
Shrub Willow	3.6	62.1	44.1
Big Sagebrush	0.4	6.9	45.5
Cottonwood	0.2	3.4	15.8
Total	5.8	99.9	117.5

* Secondary Type

Table 22. Miles of shoreline and acres of vegetation and landform types on Palouse River extension of Lower Monumental Reservoir.

Type	Shoreline Miles	% Shoreline Miles	Acres
	Riverbank		
Rock Cliffs	0.3	2.1	7.2
Cliff-Talus	1.3	9.0	6.9
Rock Rip-rap	1.6	11.0	3.8
Bluebunch Wheatgrass-Sandberg Bluegrass	4.4	30.3	-
Wildrye	1.4	9.7	16.8
Cattail	1.7	11.7	25.4
Big Sagebrush	1.2	8.3	-
Rubber Rabbitbrush	1.9	13.1	-
Shrub Willow	0.1	0.7	0.5
Developed Parks	0.6	4.1	18.3
Total	14.5	100.0	78.9
	Island		
Cattail	0.6	75.0	1.8
Big Sagebrush	0.1	12.5	0.3
Rubber Rabbitbrush	0.1	12.5	0.3
Total	0.8	100.0	2.4
	Embayment		
Rock Rip-rap	0.4	57.1	1.8
Rubber Rabbitbrush	0.3	42.9	-
Total	0.7	100.0	1.8

Table 23. Miles of shoreline and acres of vegetation and landform types from the confluence of Snake-Columbia Rivers to McNary Dam.

Type	Shoreline Miles	% Shoreline Miles	Acres
	Riverbank		
Gravel	0.1	0.1	1.1
Rock Rip-rap	37.9	47.7	60.2
Sloughs	-	-	8.1
Reedgrass	0.5	0.6	7.5
Forbs	2.5	3.1	64.6
Cattail	0.2	0.3	119.5
Bulrush	1.2	1.5	15.4
Big Sagebrush	0.6	0.8	3.2
Rubber Rabbitbrush	1.2	1.5	163.5
Antelope Bitterbrush-Big Sagebrush	4.1	5.2	-
Shrub Willow	6.0	7.5	42.9
Cottonwood	-	-	11.8
Russian Olive	1.0	1.3	15.3
Black Locust	0.1	Tr	1.4
White Alder	1.0	1.3	8.6
Willow-Cottonwood	3.0	3.8	24.8
Willow-Cottonwood-Russian Olive	12.3	15.5	219.3
Field Crops	- (10.2)	-	117.5
Fenced Pasture	0.1	Tr	2.5
Agriculture Buildings	1.1	1.4	31.9
Industrical Area	3.0	3.8	79.3
Power Facilities and Dams	0.2	0.3	10.0
Developed Parks	1.6	2.0	10.0
Public Access Areas	1.6	2.0	15.8
Marinas	0.2	0.3	5.0
Total	79.5	100.0	1,039.2
	Island		
Reedgrass	0.2	2.6	1.0
Bulrush	0.1	1.3	0.7
Big Sagebrush	1.3	16.7	14.7
Rubber Rabbitbrush	0.5	6.4	8.3
Antelope Bitterbrush-Big Sagebrush	0.4	5.1	20.4
Shrub Willow	0.5	6.4	7.3
Russian Olive	1.0	12.8	7.2
Willow-Cottonwood	2.4	30.8	28.7
Willow-Cottonwood-Russian Olive	1.4	17.9	10.8
Total	7.8	100.0	99.1

Table 23. Continued.

Type	Shoreline Miles	% Shoreline Miles	Acres
	Embayment and Pond		
Rock or Talus	0.1	0.6	-
Mud Flat	0.2	1.2	2.2
Rock Rip-rap	6.8	40.5	7.0
Forb	0.8	4.8	3.8
Cattail	2.7	16.1	4.3
Shrub Willow	3.1	18.4	24.1
Willow-Cottonwood	1.2	7.1	18.3
Willow-Cottonwood-Russian Olive	1.9	11.3	40.2
Total	16.8	100.0	99.9

Table 24. Miles of shoreline and acres of vegetation and landform types on the Walla Walla River extension of McNary Reservoir.

Type	Shoreline Miles	% Shoreline Miles	Acres
Riverbank			
Forbs	Tr	-	17.9
Cattail	0.7	4.8	3.9
Big Sagebrush	0.6	4.1	-
Rubber Rabbitbrush	0.1	0.7	-
Antelope Bitterbrush-Big Sagebrush	1.3	8.9	18.7
Shrub Willow	2.2	15.1	19.0
Willow-Cottonwood	1.5	10.3	16.9
Willow-Cottonwood-Russian Olive	7.9	54.1	342.2
Field Crops	0.3	2.1	-
Developed Parks	Tr	-	-
Total	14.6	100.1	418.6
Island			
Shrub Willow	0.2	100.0	0.6
Total	0.2	100.0	0.6

Table 25. Miles of shoreline and acres of vegetation and landform types from the confluence of Snake-Columbia Rivers to USAEC Hanford boundary.

Type	Shoreline Miles	% Shoreline Miles	Acres
Riverbank			
Rock Rip-rap	8.4	14.4	96.4
Bare Ground	0.4	0.7	4.0
Cheatgrass Brome	1.7	2.9	118.4
Cattail	- (0.6)*	-	-
Rubber Rabbitbrush	- (0.8)	-	30.1
Shrub Willow	29.5	50.7	282.0
Willow-Cottonwood-Russian Olive	7.9	13.6	522.7
Industrial Area	2.6	4.5	11.1
Business District	1.1	1.9	170.7
Developed Parks	5.9(0.8)	10.1	385.5
Marinas	0.7	1.2	9.0
Total	58.2	100.0	1,629.9
Island			
Gravel	16.7	56.6	96.4
Forbs	0.2	0.7	14.3
Absinthe	3.9(2.5)	13.2	130.0
Lupine	- (4.4)	-	46.1
Cushion Buckwheat	- (3.3)	-	73.3
Thickspike Wheatgrass	- (5.9)	-	110.4
Shrub Willow	4.6(4.2)	15.6	101.4
Willow-Cottonwood-Russian Olive	4.1	13.9	128.5
Total	29.5	100.0	700.4
Embayment			
Rock Rip-rap	0.6	46.2	2.0
Shrub Willow	0.7	53.8	7.0
Total	1.3	100.0	9.0

* Secondary Type

Wildlife

Big Game

Species Occurrence by Study Area Segment

The distribution of big game species within segments of the study area is shown in Table 26. Species occurrence within segments was documented from aerial surveys, pellet group counts, terrestrial furbearer scent stations, and supplemental observations. Mule deer (*Odocoileus hemionus*) are the most widely distributed of the large ungulates that inhabit the study area and were found in all 8 segments. White-tailed deer (*Odocoileus virginianus*) were found in 5 of the 8 segments but in significantly lower numbers compared to mule deer. Elk (*Cervus canadensis*) and black bear (*Ursus americanus*) were restricted in distribution to the 2 middle Snake River segments and to the 2 segments above Hells Canyon Dam. These 2 species are further restricted in segment 1 to the northern part of the segment or that area near Brownlee Dam. Mountain lions or cougar (*Felis concolor*) are only associated with the 3 segments comprising the remote canyon country of the middle Snake River. The bighorn sheep (*Ovis canadensis*) and mountain goat (*Oreamnos americanus*) populations found in segment 3 are the results of transplants conducted by the Idaho Department of Fish and Game and the Oregon Department of Fish and Wildlife. Mountain goats are currently restricted to Idaho and particularly to the Seven Devils Mountains area.

Table 26. Distribution of big game species by study area segment.

SPECIES	STUDY SEGMENT							
	1	2	3	4	5	6	7	8
Elk	X	X	X	X				
Mule Deer	X	X	X	X	X	X	X	X
White-Tailed Deer		X	X	X	X	X		X
Bighorn Sheep			X					
Mountain Goat			X					
Black Bear	X	X	X	X				
Cougar		X	X	X				

Big Game Surveys

Attempted big game counts conducted in portions of the middle Snake River in January 1974, with fixed-wing aircraft, proved unsatisfactory from the viewpoint of number of animals observed. Rugged topography, numerous side canyons and associated exposures, and a lack of snow background made total coverage of the area and detection of animals nearly impossible. Using helicopter instead of fixed-wing aircraft and timing the counts to coincide with

spring "green-up" of herbaceous vegetation, normally about mid-April, was determined to be the most feasible method, unless deep snow conditions persist on the area and concentrate big game at lower elevations on south- and west-facing exposures.

Aerial surveys were flown with a Hiller 12E helicopter along the middle Snake River (segments 3 and 4) in April 1975 in cooperation with the Idaho Department of Fish and Game (IDF&G). These counts were generally flown on elevational contours beginning along the Snake River and increasing in elevation to and slightly above the upper limits of observed animal distribution. The area covered on this survey includes: Idaho--from the Snake-Salmon Rivers junction (RM 188.2) upstream to Granite Creek (RM 239.7), Washington--from the Grande Ronde River (RM 168.7) upstream to the Oregon-Washington state line (RM 176.0), and Oregon--from the Oregon-Washington state line upstream to Saddle Creek (RM 236.2). Census results are summarized in Tables 27 and 28. River elevations vary from about 815 ft (msl) at the mouth of the Grande Ronde River to approximately 1300 ft at Saddle Creek. Counting conditions were good to excellent throughout the survey with bright sunny weather prevailing. Most animals were observed feeding and bedded on open slopes and benches, primarily in the bluebunch wheatgrass vegetation type. Elk concentration areas identified include: Idaho--Klopton and Trail Creeks, Washington--upper end of the Grande Ronde Range, and Oregon--Cache Creek to Jim Creek, Cherry Creek, Mountain Sheep Creek, Salt Creek, and Rush Creek to Saddle Creek. Smaller bands of elk were also noted in Granite Creek in Idaho and in Dug, Deep, and Roland Creeks in Oregon. In late March 1974, IDF&G personnel counted 58 elk in the upper reaches of Klopton and Corral Creeks (Pehrson 1974:19). No deer concentration areas were noted in Washington or Oregon. In Idaho, mule deer were concentrated in Thorn to Dry Creeks, Wolf Creek, Kurry to Big Canyon Creeks, Trail Creek, Corral Creek, Sheep Creek, and Bernard to Granite Creeks. Why so few mule deer were observed in Oregon is not known. Observers may have keyed on elk groups which were generally located at slightly higher elevations (Table 28) than the deer and in this manner, perhaps, covered the lower elevation slopes in Oregon less intensively than on the Idaho side of the river. The 3 cougar observed were in Corral Creek and consisted of an assumed female and 2 of the previous years kittens. The mountain goats and bighorn sheep observed on this count are discussed in the transplant section.

Further information on ungulate numbers and distributions in the middle Snake River canyon have been obtained from the IDF&G and the Oregon Department of Fish and Wildlife (ODF&W). Pehrson (1974) has compiled survey results conducted by IDF&G personnel in 1974 in Management Units 22 and 31 which correspond to portions of study segments 1, 2, and 3. Survey information pertinent to the study area is here presented from this report. All survey work was flown with a Bell 47G3B helicopter.

In Management Unit 22, a survey was conducted from Brownlee Creek (RM 228.3) to Granite Creek (RM 239.7) during the period 15-20 February 1974. A summary of the results of this count and a comparison with the findings of a 1970 survey are shown in Table 29. A total of 2,304 deer, primarily mule deer, were counted in 1974 compared to 2,818 deer in 1970. The only white-tailed deer observed, in 1974, was a doe in Blue Creek. This represents an 18 percent decrease since 1970. Poor recruitment and moderately severe winters were cited as the reasons for this decline. Of note is the difference

Table 27. Aerial big game counts along Middle Snake River, 29-30 April 1975.

	STUDY AREA PORTION							
	Idaho				Oregon			Washington
SPECIES	Granite Cr. to Sheep Cr.	Sheep Cr. to Kurry Cr.	Kurry Cr. to Wolf Cr.	Wolf Cr. to DivideCr.	Saddle Cr. to Pittsburg Cr.	Copper Cr. to Dug Bar	Eureka Cr. to WA-OR Line	Grande Ronde R. to WA-OR Line
Elk	4	13	0	1	371	64	189	46
Mule Deer	225	256	90	130	9	12	18	11
White-tailed Deer	0	21	3	0	0	0	0	0
Bighorn Sheep	9	0	0	0	0	0	0	0
Mountain Goat	17	0	0	0	0	0	0	0
Black Bear	1	1	0	0	0	0	0	0
Cougar	0	3	0	0	0	0	0	0
Coyote	0	1	1	3	0	0	0	1

Table 28. Elevational distribution of big game species observed on aerial counts along Middle Snake River, 29-30 April 1975.

Elevation (feet)	STUDY AREA PORTION: Idaho — Granite Cr. to Sheep Cr.				Sheep Cr. to Kurry Cr.				Kurry Cr. to Wolf Cr.		Wolf Cr. to DivideCr.		Oregon — Saddle Cr. to Pittsburg Cr.		Copper Cr. to Dug Bar		Eureka Cr. to WA-OR Line		Washington — Grande Ronde R. to WA-OR Line	
Species	E	MD	MG	BS	E	MD	WT	C	MD	WT	E	MD	E	MD	E	MD	E	MD	E	MD
<1500																				
1501-2000		23							4											
2001-2500		12	1			33			4		1	24			25	11			32	5
2501-3000		32							33			36			4		53	8	14	6
3001-3500		71				3			21			22		3	20		156	10		
3501-4000		44				100		3	15			48	242	1	15	1				
4001-4500		37	8			90	3		13											
4501-5000	4	6	4	9	13	30	18			3			129	5						
5001-5500			4																	
>5500																				
Totals	4	225	17	9	13	256	21	3	90	3	1	130	371	9	64	12	189	18	46	11

E = Elk, MD = Mule Deer, WT = White-tailed Deer, MG = Mountain Goat, BS = Bighorn Sheep, C = Cougar

Table 29. Aerial big game survey along Brownlee, Oxbow and Hells Canyon Reservoirs and upper portion of middle Snake River in Idaho, IDF&G data.

STUDY AREA PORTION	Number of Animals Observed			
	1974		1970	
	Deer	Elk	Deer	Elk
Brownlee Creek	192	0	370	0
Brownlee Creek to Wildhorse River	111	0	86	0
Wildhorse River, south side	178	1	75	0
Wildhorse River, north side	377	0	198	0
Wildhorse River to Salt Creek	239	0	313	0
Salt Creek to Indian Creek	91	0	33	0
Indian Creek	180	13	177	0
Blue Creek to Kinney Creek	651	0	1,272	0
Kinney Creek to Deep Creek	193	0	202	0
Deep Creek to Granite Creek	92	3	92	0
TOTALS	2,304	17	2,818	0

Note: Survey dates are 19-22 March 1970 and 15-20 February 1974.

in the 2 counts in the Blue Creek to Kinney Creek subsegment. The drop here from 1,272 deer in 1970 to 651 in 1974 more than accounts for the total decline. Also of note is that no elk were observed in 1970 but 17 were observed in 1974. Elk tracks were also observed in Crooked River during the 1974 flight but no elk were seen. Counting conditions in 1974 were reported as marginal due to weather and because several flights were made during mid-day when some animals were bedded. No flights were made when visibility was poor, however. Deer were generally stratified with approximately 65 percent found between 2,500-3,500 ft (msl) although some deer were found from river grade on up to 5,000 ft plus.

In Management Unit 31, the IDF&G has conducted 6 surveys from the West Fork of Brownlee Creek (RM 288.3) to Dennett Creek (RM 310.7) since 1962. A summary of the numbers of mule deer and elk counted on these surveys is shown in Table 30. The 1974 count was conducted between 20-24 February with marginal conditions prevailing for the same reasons mentioned above compared to reported ideal conditions for the 1972 survey. A total of 1,522 mule deer were counted in 1974, the same number counted in the 1972 survey. Deer numbers averaged 857 animals for the 4 previous trend surveys conducted between 1962-1970. Elk were not observed until 1970 when 3 animals were counted. In 1972 and 1974, 13 and 9 elk, respectively, were counted in the West Fork of Brownlee Creek. Although the hunting season for elk has been closed since 1968 in Unit 31, there is no indication the population has increased substantially. During both the 1972 and 1974 surveys, several thousand domestic sheep were noted between Cottonwood and Sturgill Creeks. In only 1 instance were deer observed in close proximity to sheep. In 1974, 70 percent of the deer were located above 3,800 ft while domestic sheep were reported occupying the range between 2,600-3,700 ft. In contrast, over 90 percent of the deer observed between the West Fork of Brownlee Creek and Cottonwood Creek were found between 3,000-4,000 ft elevation.

In Oregon, IDF&G personnel conservatively estimated 250-300 elk wintering on the open slopes and benches from approximately 2 mi above Oxbow Dam to the mouth of Granite Creek (about 33 river miles) from a helicopter on 3 March 1975 (P. Hanna, personal communication, 1975). This was not an intensive census flight, but incidental to other work being conducted. The largest group counted consisted of 64 elk. We also counted a group or band of 48 elk along Hells Canyon Reservoir in Oregon on 21 January 1974.

The ODF&W has surveyed elk in the middle Snake River since 1970. Summaries of the results of surveys conducted by ODF&W personnel from 1970-1975 are shown in Tables 31 and 32 (V. Coggins, personal communication, 1975). Table 31 covers essentially the breaks area from Hells Canyon Dam to the Imnaha River or the Snake River Unit while Table 32 covers from the Imnaha River to the Oregon-Washington state line or the Chesnimnus Unit. Survey flight dates are noted on the tables. These tables identify the traditional elk concentration areas during winter and early spring in greater detail than Table 27, from our 1975 survey. No elevational distributions of counted animals were given.

Additional aerial surveys were conducted by IDF&G personnel for relative numbers and winter distribution in the lower portion of the middle Snake River (segment 4) in 1974 and 1975. These counts encompassed the Snake River breaks

Table 30. Aerial big game surveys along Brownlee Reservoir in Idaho, 1962-1974, IDF&G data.

STUDY AREA PORTION	Number Animals Observed											
	1962		1966		1968		1970		1972		1974	
	Deer	Elk	Deer	Elk	Deer	Elk	Deer	Elk	Deer	Elk	Deer	Elk
West Fork Brownlee Creek to Cottonwood Creek	393	0	393	0	344	0	283	0	593	13	587	9
Cottonwood Creek to Sturgill Creek	546	0	411	0	366	0	469	3	514	0	488	0
Sturgill Creek to Dennett Creek	-	-	-	-	224	0	-	-	415	0	447	0
TOTALS	939	0	804	0	934	0	752	3	1,522	13	1,522	9

Note: Survey dates are 29 March-4 April 1966, 15-16 March 1972 and 20-24 February 1974. No dates found for 1962, 1968 or 1970.

Table 31. Aerial census of elk in Oregon along middle Snake River (Snake River Unit), 1970-1975, ODF&W data.

STUDY AREA PORTION	1970	1971	1972	1973	1974	1975
Summit R. - W. of Fingerboards	67	30	42	71	66	30
Deep Creek - Teaser Ridge	129	138	146	186	119	239
Tryon Creek - Somers Creek	*	*	43	30	160	2
Somers Rt. R. to Salt Creek	7	23	19	46	89	74
Temperance Creek	25	58	36	26	22	0
Sand Creek	11	20	*	-	221	112
Rush Cr. - Sluice Cr.	52	77	111	108	124	79
Saddle Cr. bench (breaks)	145	228	210	164	15	202*
S. Saddle Cr. - Wild Sheep Creek	79	99	77	43	7	13
Battle Cr. drainage	25	*	25	28	59	53
Barton Heights to 32 Point Cr.	76	91	52	35	67	25
TOTALS	616	764	761	737	949	829

* Indicates that counts for these areas are included in the figure shown for the area immediately above.

Note: Survey dates are 27 February - 19 March 1970; 16-21 March 1971; 7-17 March 1972; 2-15 March 1973; 3-5 January, 6-7 February 1974; and 28 January, 15-23 February 1975.

Table 32. Aerial census of elk in Oregon along middle Snake River (Chesnimnus Unit), 1970-1975, ODF&W data.

STUDY AREA PORTION	1970	1971	1972	1973	1974	1975
Cemetery Ridge	61	75	131	43	98	28
Deadhorse Ridge	93	173	162	173	258	247
West Cook Creek to Dry Creek	72	136	101	79	13	0
Dry Creek Drainage	*	*	62	176	27	43
Downey Creek	147	106	144	18	111	137
Jim Creek	156	78	104	106	136	73
Jim Creek Butte to Cache Cr.	*	47	163	99	264	282
Stateline to Rogersburg	47	-	116	43	-	122
Mt. Wilson	14	1	*	52	283	125
TOTALS	590	616	983	789	1,190	1,057

* Indicates that counts for these areas are included in the figure shown for the area immediately above.

Note: Survey dates are 9 March - 4 April 1970; 22 March - 13 April 1971; 18-27 March 1972; 18 March - 7 April 1973; 8-20 February 1974; and 8-28 March 1975.

from Captain John Creek (RM 162.5) to the Snake-Salmon Rivers junction. Weather conditions were reported as good for counting purposes both survey years and all counts were made using a Hiller 12E helicopter. The results of the 1974 and 1975 surveys are summarized in Table 33 (Pehrson 1974, Thiessen 1975). Emphasis on these surveys was to evaluate the status of the mule deer population on the breaks of the Snake River. The major white-tailed deer wintering areas, which are outside this area, were not flown. IDF&G personnel familiar with this area feel that mule deer numbers have declined since about 1970. No hunting seasons were allowed in this Management Unit (No. 11) in 1974 or 1975. Even though significantly fewer hours were flown in 1975 compared to 1974, mule deer numbers were up 29.8 percent and elk numbers were up 12.3 percent. Dashes in columns in Table 33 indicate drainages or areas not flown intensively for that species. No elevational distributions were noted in 1974. In the 1975 survey, all deer were observed between 1,400-4,500 ft (msl) and 75 percent were located between 2,100-3,500 ft. Elk were distributed between 2,300-4,500 ft with 69 percent located between 3,600-4,500 ft.

Table 33. Aerial big game surveys in Idaho along the lower portion of the middle Snake River, March 1974 and 1975, IDF&G data.

Location	Elk		Mule deer		White-tailed deer	
	1974	1975	1974	1975	1974	1975
Captain John Creek (S. Fork)	94	93	45	89	3	1
Billy Creek	0	4	3	46	1	-
Chimney Creek	0	28	30	-	0	-
Middle Creek	0	1	7	-	0	-
Middle Creek to Corral Creek	0	0	46	-	0	-
Corral Creek	0	0	13	85	0	6
Garden Creek	0	22	2	29	0	0
Cave Gulch	12	4	17	28	0	0
Cave Gulch to Cottonwood Creek	0	0	22	9	0	0
Cottonwood Creek	1	0	4	14	0	0
Cottonwood Creek to Lone Pine Creek	0	0	18	-	0	-
Lone Pine Creek to Frenchy Creek	0	0	12	26	0	0
Frenchy Creek to Salmon River	0	10	10	-	0	-
TOTALS	107	122	229	326	4	7

In the lower Snake River, we flew an aerial survey with a Cessna 180 in April 1975, coinciding with spring green-up. Fixed wing aircraft were considered adequate here because of the open topography and less need for maneuverability. This survey covered both sides of the reservoirs from Clarkston, Washington (RM 139.3) to Lyons Ferry (RM 58.7). Results of this survey are summarized in Table 34. A total of 49 mule deer and 6 white-tailed deer were counted along the right or north bank and a calculated total

Table 34. Aerial big game counts along lower Snake River, 21 April 1975.

SPECIES	STUDY AREA PORTION		
	Clarkston to Lower Granite Dam	Little Goose Reservoir	Little Goose Dam to Lyons Ferry
Mule Deer			
Right Bank	33	11	5
Left Bank	29[a]	74[a]	0
Total	62	85	5
White-tailed Deer			
Right Bank	0	6	0
Left Bank	0	0	0
Total	0	6	0
Coyote			
Right Bank	1	0	0
Left Bank	4[a]	0	0
Total	5	0	0

[a]Due to a shortage of fuel, approximately 25 percent of the available habitat was not censused. Actual numbers observed were therefore increased by 25 percent. In Little Goose Reservoir the only counts affected were those from Lower Granite Dam to Almota.

of 103 mule deer were recorded along the left or south bank. Although visibility was excellent during the flight, most animals were observed bedded. Therefore, it is probable that we missed animals, particularly in the small shrub stands and creek bottoms which occur primarily from Clarkston to Central Ferry Bridge (RM 83.2). Ninety percent of the deer were distributed between 800-2,000 ft (msl) in elevation. P. Fowler (personal communication, 1975), Washington Department of Game, also informed us of the results of an aerial big game survey he made on 14 February 1975 from the Palouse River (RM 59.5) to Clarkston, Washington along the north bank only. His count totaled 70 mule deer and 3 white-tailed deer. This is 21 mule deer higher but 3 white-tailed deer less than our count 2 months later (see Table 34). Several explanations exist for the difference in the 2 counts including observer error, date of count, area covered, possible deer movements across the river and/or inland, and different aircraft used. One interesting point in the 2 counts is that Mr. Fowler reported observing few to no deer from Lower Granite Dam (RM 107.5) to Clarkston when he flew in February while we observed 33 mule deer in the same area in April. Apparently a movement of deer occurred during the interim of the 2 flights either upstream from Little Goose Reservoir or downstream from the lower Clearwater River in Idaho, across the Snake River, or a combination of both.

No aerial surveys for big game were flown in Ice Harbor or McNary Reservoirs. Mule deer were observed in the upper half of Ice Harbor Reservoir on the south side, however, and mule deer and white-tailed deer were observed at the mouth of the Walla Walla River and above Richland, Washington on McNary Reservoir. Mule deer were also observed at Hat Rock State Park in Oregon and are known to inhabit the McNary Reservoir breaks from Hat Rock State Park to the mouth of the Walla Walla River.

Mule Deer Production--Middle Snake River

Recent declines in mule deer numbers is generally acknowledged throughout most of the western United States. Causes offered for this apparent decline vary widely but include such answers as over-harvesting, predation losses, severe winter conditions, poor range conditions, and changes in weather patterns. We do not propose to have the answer(s) to any apparent decline in the middle Snake River but recent data collected by the Oregon Department of Fish and Wildlife may shed some light on this issue in this area.

V. Coggins (personal communication, 1975) has provided us with data obtained on a boat survey conducted on 14 December 1975 from the Oregon-Washington state line to Temperance Creek (RM 223.8). Mule deer classified on this survey include 153 does, 43 fawns, and 20 bucks from Temperance Creek to the mouth of the Imnaha River (RM 191.7) and 82 does, 16 fawns, and 3 bucks from the Imnaha River to the state line. Foot surveys were also conducted in Sluice and Rush Creeks with 24 does, 10 fawns, and 2 bucks classified and in the Sand Creek-Dry Gulch-Quartz Creek area with 34 does, 20 fawns, and 6 bucks classified. A total of 413 mule deer were classified--293 does, 89 fawns, and 31 bucks. This is a combined post-season fawn/doe ratio of 30.4 fawns per 100 does. Fawns comprised 20.5 percent of the total mule deer counted. The buck/doe ratio is 10.5 bucks per 100 does.

Mackie (1973) has documented mule deer population trends on the Missouri River Breaks in Montana for 13 years, 1961-1973. Findings from this study concluded that increases in this deer population occurred only when fawns made up more than 33 percent of the herd. Mackie (1973:17) states "In most years this required more than 55 fawns per 100 does. Populations decreased or changed only slightly in years when 55 fawns or less were produced per 100 does and 30 percent or less of the population was fawns." He found that drought, especially spring drought, and severe winter conditions strongly decreased fawn production and survival through the first winter. These findings indicate that fawn survival may be affecting mule deer numbers in the middle Snake River as witnessed by the low fawn/doe ratio found above and the low percentage of fawns in the population assuming this classification count was representative of the total population.

Bighorn Sheep and Mountain Goat Transplants

Three big game transplants have occurred recently in the middle Snake River region. One of these transplants by the Idaho Department of Fish and Game (IDF&G) was an introduction of mountain goats into the Seven Devils Scenic Area in the early 1960s. Two separate plants provided the nucleus for this mountain goat introduction: 8 mountain goats, including 4 females and 4 males, were released at the Seven Devils Guard Station on 28 June 1962 and 9 mountain goats, 7 females and 2 males, were released just west of Basin Lake near the Hibb's Cow Camp on 11 July 1964 (Shaw 1965). No evidence was found to indicate that mountain goats historically occurred in Hells Canyon. Mountain goats are now commonly observed around Dry Diggins Lookout from this successful transplant. In late March 1974, IDF&G personnel observed 21 mountain goats (14 adults and 7 kids) on an aerial survey (Pehrson, 1974:19). These animals were located between Little Granite Creek and Three Creeks at an elevation range of 4,000-6,300 ft (Snake River elevation there is approximately 1350 ft). We observed 17 mountain goats in this same area during an aerial count conducted 29 April 1975. All animals on this count were observed between 2,000-5,500 ft. This count did not cover the entire area occupied by mountain goats.

Two transplants of bighorn sheep have taken place in Hells Canyon in an effort to re-introduce them to their former range. The first of these re-introductions was made by the Oregon Game Commission on 3 April 1971. Twenty bighorns (8 young rams, 10 adult ewes, and 2 yearling ewes) from Jasper National Park were released near Hells Canyon Dam. Thirteen bighorn sheep were counted in Steamboat Creek canyon (RM 248.1) in the spring of 1973 (V. Coggins, personal communication, 1974) and we observed the tracks of from 3-6 animals at the mouth of Hells Canyon Creek (RM 246.8) in January 1975. The status of this transplant is uncertain at this time. Some of these animals have been observed on the Idaho side of the canyon since the transplant (D. Norell and P. Hanna, personal communication, 1973 and 1975, respectively) which means they are swimming the river, crossing Hells Canyon Dam on the road, or both.

The second attempt to re-introduce bighorn sheep into Hells Canyon was made by the IDF&G on 31 January 1975. Thirteen bighorns including 3 rams (1 adult and 2 lambs) and 10 ewes that were trapped in Panther Creek on the

Salmon River were released in Granite Creek (RM 239.7). Subsequent monitoring of this transplant by IDF&G personnel indicates that 4 adult ewes died and the 6 remaining ewes (1 of which was a yearling which probably did not conceive) produced 3 lambs in 1975 (P. Hanna, personal communication, 1975). The IDF&G plans to supplement the 1975 transplant with additional animals from Panther Creek in 1976.

Habitat and Seasonal Use Patterns

Major elk and deer wintering and spring use areas were identified in the section concerning big game surveys. These data and that presented for bighorn sheep and mountain goat transplants provide relatively good documentation on the distribution of elk, deer, and other big game species in the study area segments and on their relative abundance. These data do not indicate the relative importance of the various habitats or vegetation types in the study segments nor are the summer or fall seasons covered. The best answers to questions concerning habitat preferences and seasonal use patterns could have been obtained by radiotracking several individuals of the various species occurring in the study area segments, but this was beyond the scope of this study.

An attempt was made to evaluate relative use by big game species of the vegetation types in the 8 study segments using pellet group counts. Concurrent with the collection of quantitative vegetation data, pellet group counts were made in all intensive sampling areas where feasible. Counts were not made in plant communities where high water had either removed pellet groups or covered them with debris or soil. The purpose was to quantify the relative importance of the various plant communities to big game but too few pellet groups were encountered to make valid comparisons. These data and supplemental observations indicate that big game numbers utilizing the riparian zone and the upland plant communities immediately above this zone during the winter of 1973-74 were low. The data are undoubtedly more indicative of winter severity than of actual big game numbers in these areas and/or their dependence on these areas. For example, deer and elk were observed wintering in similar upland vegetation types as those occurring along the reservoirs and river but at much higher elevations than the location of the intensive sampling areas. This was especially true in the free-flowing middle Snake River (segments 3 and 4). During more severe winter snow conditions, the lower elevation winter ranges become more important.

Table 35 summarizes the occurrence of big game species in the various landform and vegetation types on the study area. Occurrence was determined by combining the pellet group and direct observation data on the intensive sampling areas, the supplemental observations made elsewhere in the study area, and the tracks data recorded at scent stations used for sampling terrestrial furbearers.

In segment 1 or along Brownlee Reservoir, mule deer utilized the following types: rock or talus, sand bar, annual forb, bluebunch wheatgrass-sandberg bluegrass, big sagebrush-bluebunch wheatgrass, antelope bitterbrush-bluebunch wheatgrass, smooth sumac, tree willow, and douglas hackberry type. Although pellet groups were noted on nearly all sampling sites, only the

Table 35. Habitats (vegetation and landform types) utilized by big game species on the study area.

SPECIES	VEGETATION & LANDFORM TYPES																														
	Rock or Talus	Rock Cliffs	Gravel	Sand Bar	Mud Flat	Rock Rip-rap	Road Fill	Reservoir	River	Cheatgrass Brome	Annual Forb	White Sweet Clover	Bluebunch Wheatgrass-Sandberg Bluegrass	Big Sagebrush	Big Sagebrush-Bluebunch Wheatgrass	Rubber Rabbitbrush	Antelope Bitterbrush-Bluebunch Wheatgrass	Antelope Bitterbrush-Big Sagebrush	Curlleaf Mountainmahogany	Douglas Hackberry	Shrub Willow	Smooth Sumac	Serviceberry	Bitter Cherry	Tree Willow	Deciduous Tributary Vegetation	Ponderosa Pine-Douglas Hackberry	Roads	Developed Parks
Elk													X							X									
Mule Deer	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
White-tailed Deer													X					X			X					X				
Mountain Goat		X											X						X											
Bighorn Sheep		X											X							X								X		
Black Bear																				X						X				
Cougar													X																	
Feral Goat		X											X																	

smooth sumac type had significant numbers present. Total mule deer pellet groups present here calculated to 2,178 pellet groups (PG) per acre. However, the bitterbrush type was not counted here as it was in segment 2. Observers in segments 1 and 2 counted total pellet groups present and not just those from the previous winter and spring as was done in segments 3-8.

In segment 2, only mule deer and black bear were noted in the immediate sampling area. Types where mule deer use was noted and pellet groups per acre counted include: rock cliffs, road fill, reservoir, white sweet clover (1,307 PG/acre) annual forb, big sagebrush-bluebunch wheatgrass, antelope bitterbrush-bluebunch wheatgrass (14,810 PG/acre on one site and 25,265 PG/acre on another), curlleaf mountainmahogany, bitter cherry (14,810 PG/acre) and deciduous tributary vegetation. No pellet group counts were obtained in the mountainmahogany type, but general observations indicate that use here would be as high as in the bitterbrush type. Even though total counts of pellet groups were obtained and may seem unrealistic compared to past seasons only, it is obvious that the antelope bitterbrush-bluebunch wheatgrass and bitter cherry types are preferred mule deer wintering types. Tracks at scent stations in summer also indicate that resident mule deer also use the bitterbrush type as well as the deciduous tributary vegetation. This bitterbrush type is most prevalent on Oxbow and Hells Canyon Reservoirs in the lower elevations with curlleaf mountainmahogany occurring at higher elevations and generally associated with limestone outcroppings on Hells Canyon Reservoir. Mule deer use was also noted in developed parks along this segment. Black bear use was noted in the Douglas hackberry and deciduous tributary vegetation types. Black bear are infrequently observed here in early spring on the open bunchgrass slopes and in the ponderosa pine stands and in the late summer and fall when berry crops are abundant. Elk winter in this segment at higher elevations than the immediate study area and prefer the open bluebunch wheatgrass slopes and benches bordered by stands of ponderosa pine.

Segment 3, the upper reaches of the middle Snake River or Hells Canyon, contains the highest diversity of big game species of any of the study segments. Elk, which normally winter at higher elevations than along the immediate river, were found in the bluebunch wheatgrass-Sandberg bluegrass and Douglas hackberry (4,792 PG/acre) vegetation types. Pellet group documentation was made at Wild Sheep Creek in Oregon. Mule deer were noted in the following types: sandbar, river, bluebunch wheatgrass-Sandberg bluegrass (436 PG/acre), Douglas hackberry (1,742 PG/acre and 436 PG/acre), deciduous tributary vegetation, and ponderosa pine-Douglas hackberry (871 PG/acre). White-tailed deer were only noted adjacent to the river at Pittsburg Landing. Tracks at scent stations in the Louisiana sagebrush type in summer were verified by direct observation of a doe and fawn in the bluebunch wheatgrass-Sandberg bluegrass type. Mountain goats and bighorn sheep, discussed also in the transplant section, occur primarily in cliff-talus areas at higher elevations. Vegetation types the mountain goats utilize vary from the ponderosa pine-bluebunch wheatgrass and curlleaf mountainmahogany types on the breaks to the sub-alpine meadows and timber types in the Seven Devils Mountains. Three mountain goats were noted within 100 m of the Snake River at Granite Creek on an open bluebunch wheatgrass slope in the summer of 1975. Bighorn sheep, in both Oregon and Idaho, utilize the open bluebunch-wheatgrass slopes and the stands of ponderosa pine-douglas-fir which "finger" down the slopes. Cliff-talus habitats exist throughout the area these animals occupy. Black

bear and cougar were only noted in the ponderosa pine-bluebunch wheatgrass type. Feral goats are also present in this segment from Wild Sheep Rapids to Hells Canyon Dam in Idaho. Several individuals were noted during the study in rock cliff-talus areas interspersed with the bluebunch wheatgrass-Sandberg bluegrass vegetation type. Feral goats were frequently observed across the river, in the cliffs, at the end of the road below Hells Canyon Dam.

In segment 4, the lower portion of the middle Snake River, mule deer utilized the bluebunch wheatgrass-Sandberg bluegrass, serviceberry, and curl-leaf mountainmahogany (2,613 PG/acre) vegetation types. Mule deer were also sighted on gravel bars along the river. Tracks at scent stations in the Douglas hackberry and bluebunch wheatgrass types and direct observations of individuals and family groups in these types and in the curlleaf mountain-mahogany type sampled at Coon Hollow documented summer and fall use by resident mule deer adjacent to the river. Elk were also observed to utilize the bluebunch wheatgrass type in the upper elevations in this segment.

Mule deer primarily utilized the rubber rabbitbrush vegetation type in segments 5, 6, and 7 but mainly because this is the most extensive vegetation type along the reservoirs in these segments--namely Lower Granite, Little Goose, Lower Monumental, and Ice Harbor Reservoirs. Additional observations of mule deer were made in rock cliffs and talus, mud flats, roads, cheatgrass brome, shrub willow, and deciduous tributary vegetation. Deer tracks at scent stations in the shrub willow type at the mouth of the Tucannon River and 1 mule deer observed swimming Little Goose Reservoir near New York Bar indicate that some deer remain adjacent to the reservoirs during the summer. A mule deer doe was observed in a cave-like area on a cliff in the Palouse River canyon on 6 June 1973 and was assumed to either have fawned there or was preparing to fawn. Most deer in these segments, however, apparently move up the major tributary canyons and/or to the higher elevations by late spring and do not return to the immediate reservoir breaks until early winter.

Along McNary Reservoir and along the Columbia River above McNary to the AEC boundary, mule deer were noted to utilize the antelope bitterbrush-big sagebrush, shrub willow, and tree willow vegetation types. Resident mule deer were observed throughout the study at Hat Rock State Park in the bitterbrush-big sagebrush and shrub willow habitats and at the mouth of the Walla Walla River in the dense, tree willow and bitterbrush-big sagebrush habitats available. White-tailed deer were observed near the mouth of the Walla Walla River in an antelope bitterbrush-big sagebrush type which is adjacent to the tree willow river bottoms and above Richland in shrub willow habitats adjacent to the river. Battelle personnel have also documented white-tailed deer occurrence along the Columbia River in the Hanford Reservation (O'Farrell and Hedlund 1972). Mule deer tagging studies being conducted by Battelle personnel since 1969 have demonstrated a marked preference for the islands in the Columbia River as fawning areas (Hedlund et al. 1973). Undoubtedly, this is selection of areas void of mammalian predators, such as the coyote. Tag returns indicate that some of these mule deer move up to 20 mi from their original fawning grounds.

Upland Game Birds and Mammals

Species Occurrence by Study Area Segment

The distribution of mammalian and avian upland game species is shown in Table 36 for the 8 study area segments. Blue grouse were anticipated to occur in segments 1, 2, 3, and 4 and are known to occur at higher elevations in these segments but we were unable to document their occurrence in the immediate study area. Mountain quail were also suspected to occur in segments 3 and 4 but no sightings were made during the study nor were any harvested birds of this species brought to our attention. Mountain quail numbers have apparently declined quite drastically in recent years in the middle Snake River and elsewhere where this species was normally sighted and harvested during the hunting season. Mixed bags of chukars and mountain quail in the middle Snake River in Idaho were reported to us as late as the early 1970s. Wild turkeys also inhabit the higher elevation ranges along the Salmon-Snake Rivers divide in Idaho, segments 3 and 4, but no turkeys were observed in the study area.

Table 36. Distribution of upland game species by study area segment.

SPECIES	STUDY SEGMENT							
	1	2	3	4	5	6	7	8
Birds								
Chukar	X	X	X	X	X	X	X	X
California Quail	X	X		X	X	X	X	X
Ring-Necked Pheasant	X			X	X	X	X	X
Gray Partridge	X	X	X	X	X	X		
Ruffed Grouse	X			X				
Mourning Dove	X	X	X	X	X	X	X	X
Mammals								
Nuttall's Cottontail Rabbit	X	X	X	X	X	X	X	X
Black-Tailed Jackrabbit							X	X
White-Tailed Jackrabbit								X

Mammals

Nuttall's (mountain) cottontail rabbit (*Sylvilagus nuttalli*) was abundant throughout the study area. This species was most abundant in the following vegetation types though sign or sightings were noted in nearly all vegetation types available: annual forb, white sweet clover, big sagebrush-bluebunch wheatgrass, rubber rabbitbrush, antelope bitterbrush-bluebunch wheatgrass, antelope bitterbrush-big sagebrush, Douglas hackberry (dense stands), shrub and tree willow, and deciduous tributary vegetation. Densities

were high where desert shrub species--rubber rabbitbrush, big sagebrush, antelope bitterbrush--occurred adjacent to shrub and tree willow habitats and/or deciduous tributary vegetation. Examples of this include the mouth of the Walla Walla River, McNary Wildlife Recreation Area, Badger and Locust Grove Islands, Sacajawea State Park, and Finley-Hover Park area on McNary Reservoir; Charbonneau and Big Flat Recreation Area and Simmons area on Ice Harbor Reservoir; the mouth of the Tucannon River and Riparia area on Lower Monumental Reservoir; the Asotin area on the upper end of Lower Granite Reservoir; and the Fox Creek and Weiser sand dune area and above on Brownlee Reservoir. Cottontails in the middle Snake River were often associated with dense Douglas hackberry, rock outcroppings, and deciduous tributary vegetation. Annual forb stands where associated with escape cover such as rock outcroppings or desert shrub species were also preferred habitats. These habitats frequently occurred along railroad tracks in upper Brownlee Reservoir and throughout the 4 lower Snake River projects.

Rabbit use, primarily Nuttall's cottontail, constituted 28 instances of use (18.7 percent) out of a total of 150 instances of wild mammal use at scent stations. Seven of the 28 instances of use occurred in early summer while 21 instances of use occurred during the fall sampling. The increase in fall use apparently resulted from higher fall populations due to the annual increment. During the summer sampling, rabbit use was documented at intensive sampling site numbers 68, 71, 72, 73, 80, and 82. In the fall, rabbit use was noted at intensive sampling site numbers 5, 6, 7, 11, 14, 15, 17, 20, 23, 24, 68, 69, 73, and 82. Rabbit tracks at scent stations were recorded most frequently in shrub and tree willow habitats (6 of 16 sites visited). In addition to the vegetation types mentioned above, rabbit use at scent stations was also documented in the smooth sumac, bittercherry, black locust, and Russian olive types.

White-tailed jackrabbits (*Lepus townsendi*) were only observed on Goose Island (RM 8.5) just below Ice Harbor Dam. Two individuals were sighted on the island on 17 May 1974 while conducting goose nesting surveys. How these individuals reached the island is a matter of conjecture but river currents around this island are strong which would make it difficult for this species to swim to the island. No individuals were sighted during the 1975 surveys. Ingles (1965:138) shows a range distribution for white-tailed hares to include the entire lower Snake River area but this is the only sighting of this species in the study area. The Washington Department of Game considers this species as rare in Washington.

Black-tailed jackrabbits (*Lepus californicus*) were abundant only at Hat Rock State Park on McNary Reservoir on segment 8. Numerous sightings of this species were made in the antelope bitterbrush-big sagebrush vegetation type which is so prevalent here. A few additional sightings of this species were made in rubber rabbitbrush habitats between Hat Rock State Park and the mouth of the Walla Walla River. In addition to McNary Reservoir, black-tailed jackrabbits were only noted on Ice Harbor Reservoir even though Ingles (1965:138) also shows a range distribution for this species throughout the entire Snake River basin in Oregon and Washington. On Ice Harbor Reservoir, we observed 2 individuals at the Charbonneau Recreation Area in a rubber rabbitbrush habitat on 16 May 1974.

No pygmy rabbits (*Sylvilagus idanoensis*) were noted in the study area. This species was suspected to occur in the sagebrush zone at the upper end of Brownlee Reservoir (Ingles 1965:142).

Birds

No intensive sampling was conducted specifically for the various upland game bird species, except for chukar partridge. Chukar sampling is discussed in depth in the following section. Sampling for the other upland game bird species--California quail, ring-necked pheasants, gray partridge, ruffed grouse, and mourning doves--was incorporated in the sampling for songbirds. Relative abundance estimates for these species are listed in the section on other birds for the 4 seasons.

Ring-necked pheasants were not observed along Oxbow or Hells Canyon Reservoirs (segment 2) nor along the upper, middle Snake River (segment 3). On Brownlee Reservoir numerous pheasants were noted from the upper end of the study area (RM 345.6) down to the Powder River (RM 295.7). Highest densities of pheasants were associated with the annual forb, big sagebrush-bluebunch wheatgrass, and shrub and tree willow habitats at the upper end of Brownlee pool which are adjacent to agricultural lands. In segment 4, pheasants are low in numbers and occur only from the Grande Ronde River area downstream to Lower Granite Reservoir. Pheasants were found throughout segments 5, 6, and 7 on the lower Snake River. While conducting raptor surveys in May 1974, crowing cocks were heard in nearly all tributary draws and on most bars along these segments. In these segments pheasants were common during all seasons in the cattail, cattail-sedge, willow shrub, and rubber rabbitbrush habitats. The highest densities of pheasants on the study area occur along McNary Reservoir or segment 8. High numbers of pheasants are found on the McNary National Wildlife Refuge, the McNary Wildlife Recreation Area, and at Sacajawea State Park. Pheasants here appear to have adapted well to urbanization, industrialization, and irrigation farming practices. Along McNary Reservoir, pheasants were lowest in numbers where strictly upland vegetation types occurred and highest where riparian types occurred between the reservoir and either the upland habitats or agricultural lands. For example, few pheasants were noted below the mouth of the Walla Walla River on either side of the pool where upland, shrub habitats, namely rubber rabbitbrush and antelope bitterbrush-big sagebrush, continue to the water's edge.

California quail were noted in all segments except segment 3, the upper portion of the middle Snake River. This species was only locally abundant and generally associated with dense riparian and/or upland habitats. On the upper 3 reservoirs, segments 1 and 2, California quail were common and were found in big sagebrush- and antelope bitterbrush-bluebunch wheatgrass and Douglas hackberry upland habitats and in deciduous tributary, white alder, and shrub and tree willow riparian habitats. In segment 4, this species was commonly associated with tree willow and dense Douglas hackberry. Birds were also observed here in the Louisiana sagebrush, rubber rabbitbrush, and curlleaf mountainmahogany types. California quail were uncommon in segments 5, 6, and 7. In segment 8, high densities were noted in the Russian olive and willow-cottonwood-Russian olive habitats which occur in the Finley area, at the mouth of the Yakima River, in Columbia and Sacajawea State Parks, and on the McNary

Wildlife Recreation area. Smaller numbers were also noted at Hat Rock State Park in the antelope bitterbrush-big sagebrush vegetation type, especially where this type was adjacent to riparian vegetation.

Gray partridge or "huns" were also only locally abundant and were only recorded in segments 1-6. No gray partridge were observed along Ice Harbor and McNary Reservoirs although low numbers are expected to occur in the adjacent upland habitats. Brownlee, Oxbow, and Hells Canyon Reservoirs had the highest numbers present. The medusahead wildrye annual grass type found quite extensively along upper Brownlee pool had high densities compared to other vegetation types examined. Birds were also found here in the antelope bitterbrush- and big sagebrush-bluebunch wheatgrass habitats as well as in white sweet clover, annual forb, and shrub willow types. In segments 3-6 or in the middle Snake River and along Lower Granite, Little Goose, and Lower Monumental Reservoirs, this species was only found in the bluebunch wheatgrass-Sandberg bluegrass, and rubber rabbitbrush vegetation types in addition to agricultural lands. Although numbers were low in areas sampled adjacent to the river, this species may be more abundant at slightly higher elevations in the same habitats. This is undoubtedly true along the lower Snake River projects where agricultural lands, primarily wheat and peas, come up to the canyon rim.

Ruffed grouse were noted in segments 1 and 4 only. In both segments, single birds were observed in white alder habitats which occur along tributaries. One observation occurred in the fall and the other in the winter indicating the birds may have been young birds pioneering new range and undoubtedly came from the higher elevation habitats. Ruffed grouse are known to be abundant in various tree and mixed shrub habitats at higher elevations in segments 1-4.

Mourning doves were common throughout the study area for all seasons except winter. A few doves do remain in the study area during the winter, however. Along Brownlee Reservoir or segment 1, the big sagebrush-bluebunch wheatgrass, rubber rabbitbrush, tree willow, and white alder habitats contained the highest numbers; though doves were also recorded in annual grass and forb, shrub willow, and smooth sumac types. In segments 2-4, the ponderosa pine-Douglas hackberry, Douglas hackberry, tree willow, and deciduous tributary habitats were most important. Douglas hackberry stands in the middle Snake River seemed especially important as shade cover to this species during the hot summer months, as it does with chukars. In segments 5-7, most mourning doves were observed in the rubber rabbitbrush type, the most prevalent upland vegetation type in these segments. Where shrub willow or trees, e.g., black locust at Riparia, were found, mourning doves also occurred. On McNary Reservoir, mourning doves were found associated in highest numbers with the Russian olive, willow-cottonwood-Russian olive, and shrub and tree willow habitats. Lower numbers of birds were also observed in the antelope bitterbrush-big sagebrush and rubber rabbitbrush vegetation types. Agricultural fields appeared to be important feeding areas throughout the study area but they were not sampled.

Chukars

The most widely distributed and abundant upland game bird on the study area is the chukar partridge. For this reason an intensive effort was conducted to develop and evaluate a reliable chukar census technique and to use this technique in defining chukar distribution and relative abundance on the study area. The following is a discussion of the results of this effort conducted by Mr. W. F. Oelklaus as partial fulfillment of requirements for his Master of Science degree in wildlife management at the University of Idaho. See also Oelklaus (1976).

Constraints on the Chukar Census Technique

Physical.--Use of the recorded rally calls was found to elicit responses from chukars under a wide variety of conditions in the field. Several influences causing significant variation in the number of responses were identified. The reliability of responses primarily varied with prevailing weather conditions, time of day, and whether or not the birds had been disturbed prior to playing the call. Analysis of 537 time periods, counting the number of responses received per minute for 5 minutes following the playing of a rally call to a flock of birds (Figure 4) demonstrated that the following constraints must be considered in conducting this audio census. During the fall, in early morning and late evening, chukars are normally active as they are leaving or entering night roosts, feeding, or moving to and from water sources. During these portions of the day, the natural rate of calling and responses to recorded calls are greatest, but vary considerably for any given number of birds (Table 37). Census activities must therefore be limited to mid-day hours in order to avoid the early morning and late evening periods of high variability in responses.

Table 37. Variability of regression estimates of chukar flock size from responses elicited by the audio-census technique during 3 daily periods, 1974-1975.

Sample period	Number of 5 minute time periods	Correlation coefficient
Sunrise to 1000 hr	87	0.597
1000 hr to 1500 hr	350	0.932
1500 hr to sunset	100	0.675

The reliability of eliciting responses during and after periods of rainfall and heavy winds was very poor. During some inclement weather entire flocks remained non-responsive. In strong winds, either the recorded calls were not heard by the birds, their responses were rendered inaudible, or no response was elicited. Even though the louder responses were sometimes heard over the wind, those birds responding with a call of lower intensity would be missed. Proportionally low estimates of flock size resulted or the entire

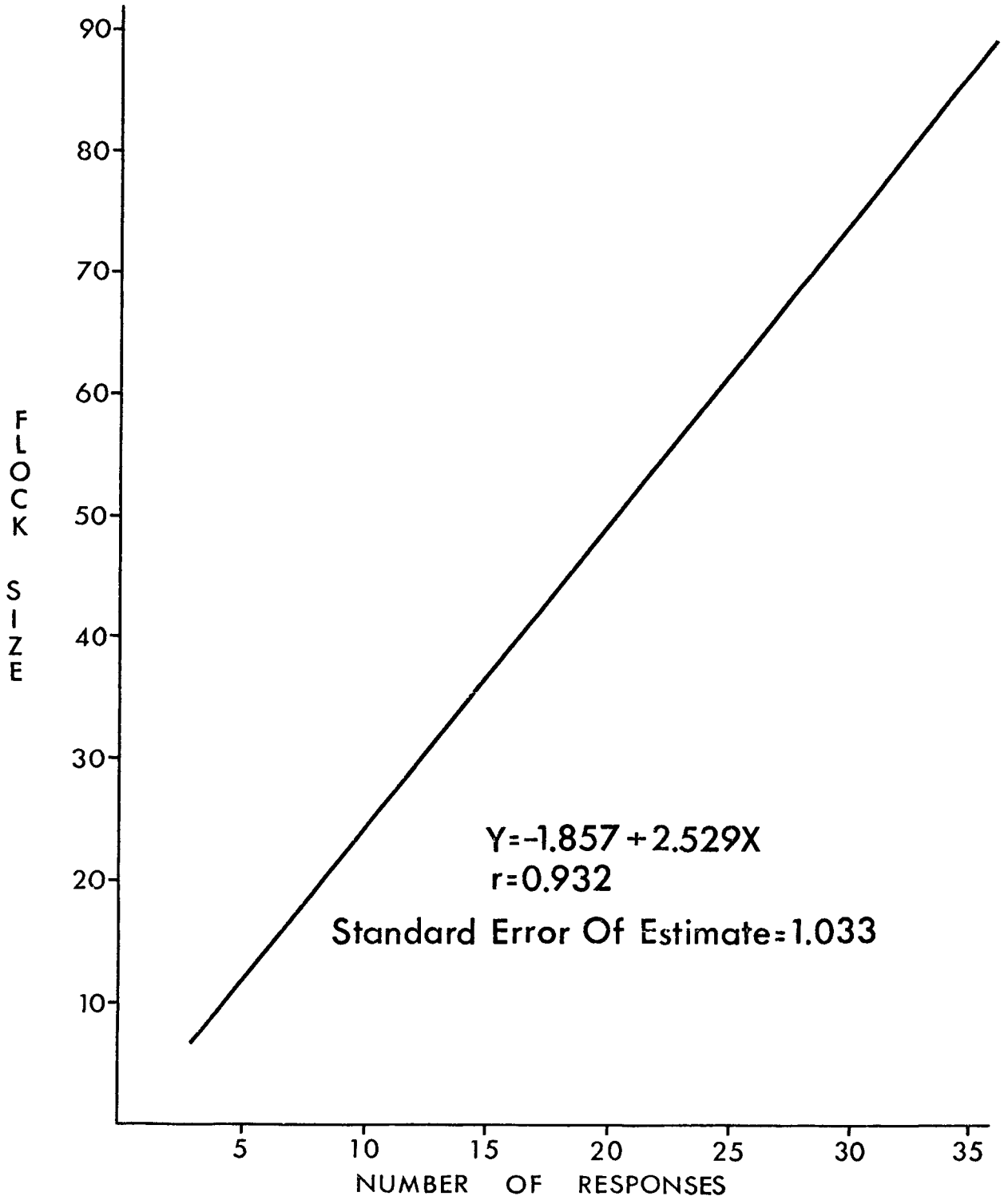

Fig. 4. Regression of chukar flock size on the total number of responses by flock members to a recorded rally call played at the start and middle of a 10-minute sampling period.

flock was missed. Light rain varied in its effect on the birds' responses. Some flocks responded within expected ranges for the number of birds present while other flocks decreased their responses or were completely suppressed by the light rain. Moderate to heavy rainfall almost entirely prohibited chukars from responding. Other factors, such as associated wind, or temperature, may have contributed to the variability during rainstorms. Responses shortly after a heavy rain were frequently more numerous than normally found. Census activity during these times would grossly overestimate chukar numbers.

Birds would generally not respond to calls played to them shortly after being disturbed. Flocks in the proximity of roads suppressed their responses, or declined to respond, for several minutes following the passage of a vehicle; a 5 minute wait was found sufficient to again obtain accurate census estimates from responses. The same relationship existed where flocks along the river were disturbed by the passage of power boats. Non-powered craft floating down river 15-20 m off shore had little effect on the responses as long as the floaters remained silent and minimized their movements. Census efforts afoot required that an even greater distance be maintained from the chukars to obtain reliable response rates. Chukar flocks were found least disturbed by an observer on the ground when cautiously approached from above. But the birds' wary nature enables them to detect intrusion from any direction. When responses are suppressed by such disturbance, abnormally low population estimates would occur.

Biological.--Census activities were also curtailed by the presence of predators. Avian predators represented by a wide variety of hawks, owls, eagles, and osprey were seen most frequently. Upon sighting an avian predator, a low "whirring" call was given by the chukars and all other calling ceased. If the raptor was near, the birds crouched, remaining motionless and silent until the danger passed. After the raptor moved out of the vicinity, the chukars would resume their previous activity. Census attempts again yielded reliable information after waiting 5 minutes from the time chukars resumed activity.

Coyotes were the only ground predator, other than man, observed near chukars. In 2 instances a single coyote was observed stalking along a contour toward chukars feeding in open, grass-covered terrain. The birds began to move uphill when the coyotes were detected. Both flocks flushed as the coyotes continued their approaches. In neither case did the coyote get within 20 m of the birds. These encounters with coyotes apparently disturbed the birds more than the presence of avian predators. A wait of about one-half hour was necessary before the flocks flushed by coyotes gave responses reliable enough for census estimates to be made. The necessary waiting period following disturbance is in part due to the high rate of natural calling as dispersed flock members attempt to regroup their numbers.

Testing during the winter and spring seasons of 1974-75 revealed several problems that prevented censusing chukars during those seasons. With the coming of the precipitation of early winter in 1974, the chukar concentrations quickly dispersed. In the Hells Canyon region, some chukars moved uphill to the snow line, several hundred meters above the river. All along the river early winter green-up resulted in the dispersion of chukars. Large flocks broke up distributing themselves over a much greater area. Many flocks which

were dependent on the river for water earlier in the year now maintained themselves completely independent of the river. The recorded rally call proved a valuable aid in locating these dispersed flocks, with a considerable savings over the time and effort which would have been required for a thorough ground search. The deep snows of mid-winter concentrated chukars on a smaller portion of their range, similar to the concentrations near water during the drought season, but this was not a consistent phenomena and it occurred on only a portion of the study area. Due to the variability of the weather and the uncertain concentration pattern of the chukars during the winter, we felt that accurate census information could not be obtained during that season.

The late summer-fall distribution of chukars in 1974 conformed to the expected behavior pattern, i.e., concentrating near water. The birds left their roost areas in the morning and fed slowly down toward the river. They were normally in the vicinity of the river by mid-morning (0900 to 1000 hours). Flocks which used the river as a source of drinking water generally utilized night roosts one-half to 2 mi from the river. Those occupying the most distant roosts invariably availed themselves of day roosts closer to the river. Where vegetation affording adequate shade occurred in conjunction with the water, as in the case of Douglas hackberry (*Celtis douglasii*) stands along the middle Snake River, the chukars remained in those shaded areas through mid-day. In the late afternoon, often as early as 1600 hours, the chukars would begin walking back up the hill, feeding on their way to night roosts. Where vegetation did not provide shaded areas in close proximity to water, chukars sought shelter from the sun in shade provided by topography, usually along east-west ridges. Often, though, chukar flocks would have to return to cliff areas some distance from the water to find shade.

Reliability of the Technique

The audio census technique proved capable of contacting a very high percentage of the chukar flocks directly associated with the river system. A total of 142 chukar flocks were located while canoeing or rafting along portions of the Snake River during the summer and fall of 1974. The audio census technique failed to elicit responses from 15 of these flocks. The actions of 6 of these flocks indicated they were disturbed by our presence, either by attempting to conceal themselves or retreating from the river. Only 9 (6.34 percent) flocks, apparently undisturbed, failed to respond to the recorded rally calls. To insure reliable responses from flocks associated with the river, field census efforts must be conducted with minimal movement and noise and an adequate distance must be maintained from the shoreline (15-20 m). Based on the results obtained with the recorded rally call, we felt that reliable estimates of the number of chukars associated with the river system would be possible in the fall of 1975. Plans were made to conduct the census throughout the study area at that time. Further testing of the audio census technique continued during the winter, spring, and early summer months of 1974-75.

Effect of Weather on Chukar Distribution

The summer and fall of 1975 proved to be far wetter and cooler than 1974 (Table 38). Due to this unusually cool, wet summer and fall the chukars exhibited behavior patterns distinctly different from that observed in 1974. This cool, wet summer weather of 1975 allowed the chukars to dissociate themselves from the river and utilize a much greater portion of their range than is normally utilized by them during the summer and fall. This was primarily due to the increased availability of water. Many seeps and springs along the Snake River breaks which were dry in 1974 had standing water during the summer and fall of 1975. Coupled with the increased water availability there was a decrease in the chukars' requirement for drinking water for two reasons: (1) the lower temperatures which persisted throughout the season, and (2) the prolonged availability of succulent, green vegetation for food. Grasses on all parts of the study area maintained their green leaves through August, and most forbs remained succulent and growing much later in 1975 than in 1974.

In the summer of 1975 the prolonged availability of green vegetation, cool weather, and dispersion of water sources allowed chukar partridge to continue utilizing most of their spring range. Chukars were frequently seen up to 5 mi from the nearest available water as late as 1 September 1975. Published accounts of fall dispersion by chukars indicate 1 mi to be about the greatest distance flocks normally move from their water source during hot, dry seasons (Christensen 1970, Harper et al. 1958). The cool, moist weather continued throughout the summer and fall, blocking census activities. Figure 5 shows a comparison of summer-fall chukar numbers on the four intensive study sites for 1974 and 1975. On the three sites supporting largest aggregations of chukars, the number of birds present greatly diminished in 1975. This was in part attributed to the differences in dispersion between the 2 years.

Effect of Weather on Chukar Production

Chukar production was poor and late in 1975. The first brood seen along the river was in early July, although back dating of broods seen later indicated some broods hatched in June. Mackie and Buechner (1963) found the peak hatch in southeastern Washington to occur from mid-May to late June. Also in Washington, during 1950 and 1951, Galbreath and Moreland (1953) ". . . found that the peak of the hatching season was reached during the first 10 days of June." Eleven broods seen in 1975, all under 4 weeks old when counted, averaged just over 5 chicks per brood. Christensen (1970) in Nevada found average brood sizes of 8.5 to 12.4 chicks between 1960 and 1969. Galbreath and Moreland (1953) found brood sizes to average about 14 chicks during their 2 year study. Mackie and Buechner (1963) found an average of 15.5 eggs in the 4 active chukar nests they located. Most flocks encountered in the fall of 1975 appeared composed predominantly of adult birds.

Not only were chukar populations lower in 1975 but they were also spread over a much greater portion of the study area. As it became apparent that dispersion was considerably different in 1975 from that found in 1974 we gathered some supplemental information (Figure 6). This was envisioned as additional to the actual census that was to be conducted when the summer-fall drought period arrived. However, the weather did not change and the

Table 38. Comparisons of monthly average temperatures and total monthly precipitation along portions of the Columbia and Snake Rivers.

Location	Year	Temperature*					Precipitation				
		Jun	Jul	Aug	Sep	Avg	Jun	Jul	Aug	Sep	4-month total
McNary Dam	1974	69.3	73.2	74.7	66.6	70.9	.09	.23	.01	.01	.34
	1975	64.4	74.6	70.2	65.7	68.7	.08	.09	.49	none	.66
Ice Harbor Dam	1974	69.0	72.1	73.4	66.7	70.3	.11	.30	none	.01	.42
	1975	64.7	76.7	70.5	65.1	69.3	.38	1.60	1.06	.01	3.05
Lower Monumental Dam	1974	69.3	74.2	75.2	69.5	72.1	.05	.31	none	.03	.39
	1975	64.6	77.3	70.9	68.5	70.3	.67	1.19	1.07	none	2.93
Little Goose Dam	1974	71.6	74.4	75.6	68.6	72.6	.36	.50	none	none	.86
	1975	65.5	78.7	71.8	66.9	70.7	.84	.41	.84	none	2.09
Lower Granite Dam	1974	70.1	74.6	75.1	70.1	72.5	1.17	1.61	.32	.06	3.16
	1975	64.0	77.0	71.5	69.0	70.4	.65	.31	1.38	.21	2.55
Lewiston Idaho	1974	71.2	74.0	73.7	66.3	71.3	.50	.40	.01	.10	1.01
	1975	63.6	77.7	70.4	66.2	69.5	1.29	.68	1.09	trace	3.06
Brownlee Dam	1974	74.8	77.3	76.8	70.5	74.9	.73	.80	.47	none	2.00
	1975	66.0	81.4	72.4	69.0	72.2	1.49	.61	2.26	none	4.36
Weiser Idaho	1974	69.6	71.1	69.0	60.6	67.6	.22	.79	.14	none	1.15
	1975	63.5	76.3	68.0	62.2	67.5	1.07	.04	1.02	none	2.06
Study area averages	1974	70.6	73.9	74.2	67.4	71.5	.40	.62	.12	.03	1.17
	1975	64.5	77.5	70.7	66.6	69.8	.81	.61	1.22	.03	2.60

*Some averages computed from incomplete records.

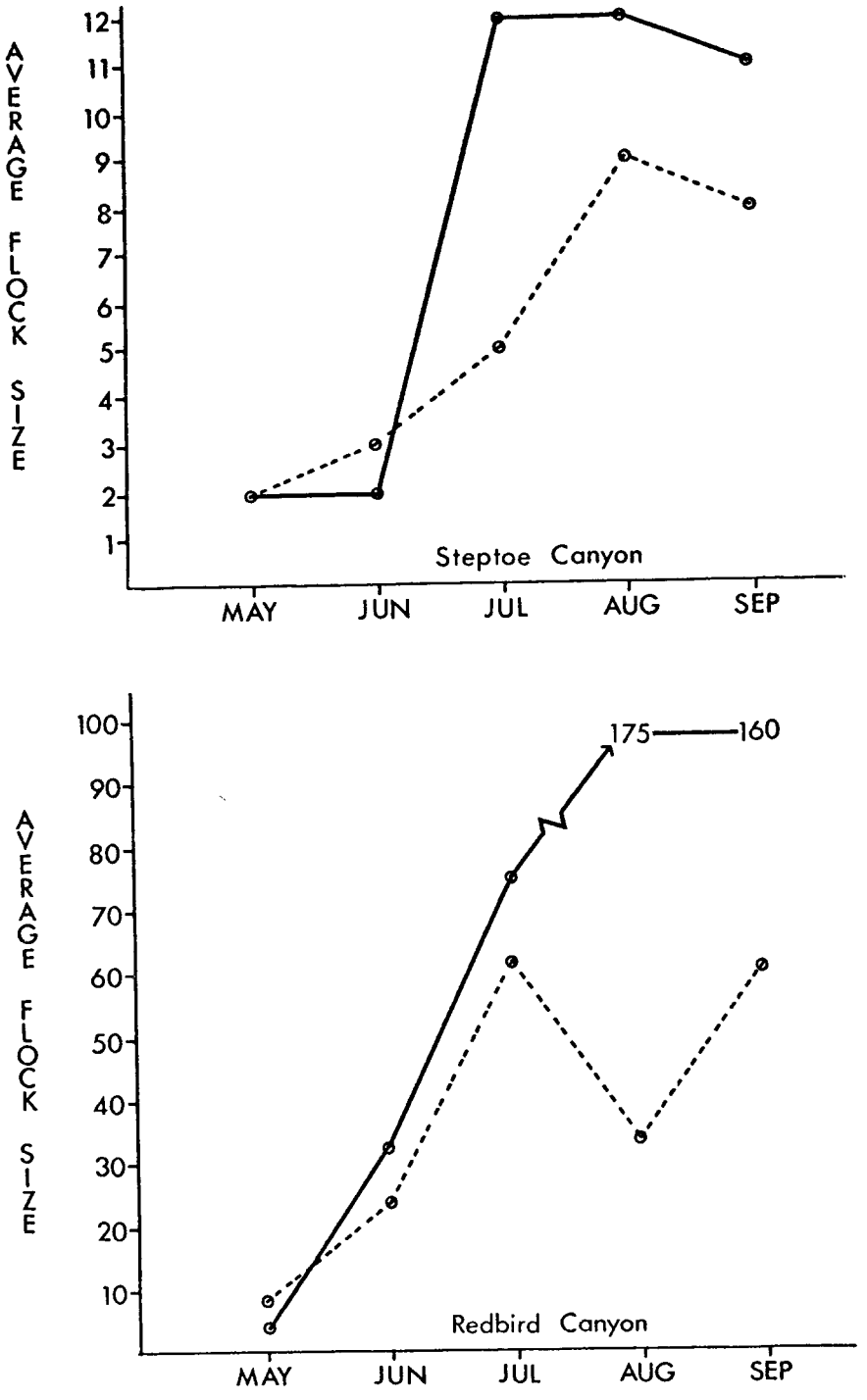

Fig. 5.--A comparison of average flock sizes between 1974 and 1975 on selected sites along the middle and lower Snake River. (———— 1974; - - - - - - - - - - - 1975)

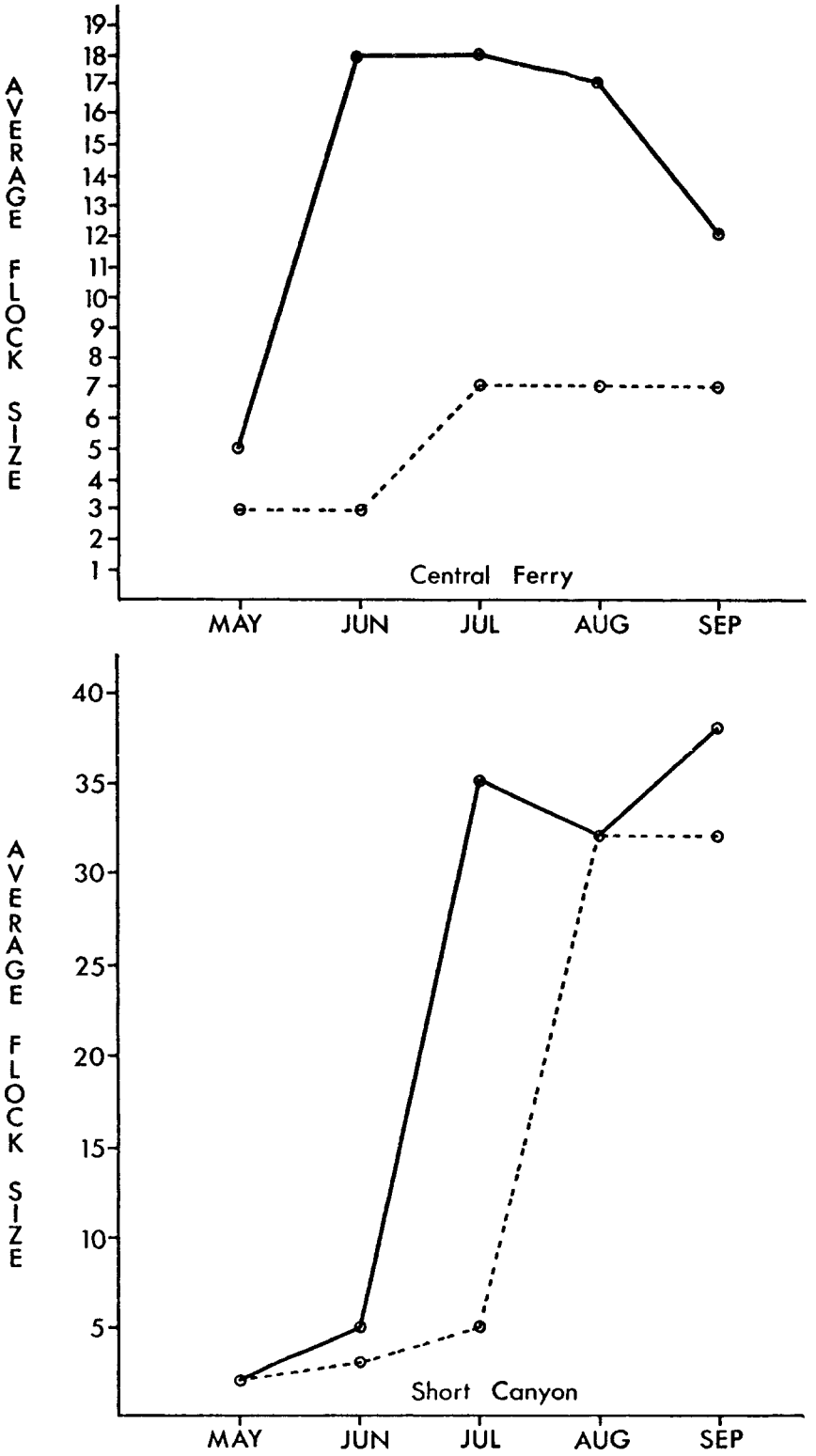

Fig. 5.--Continued.

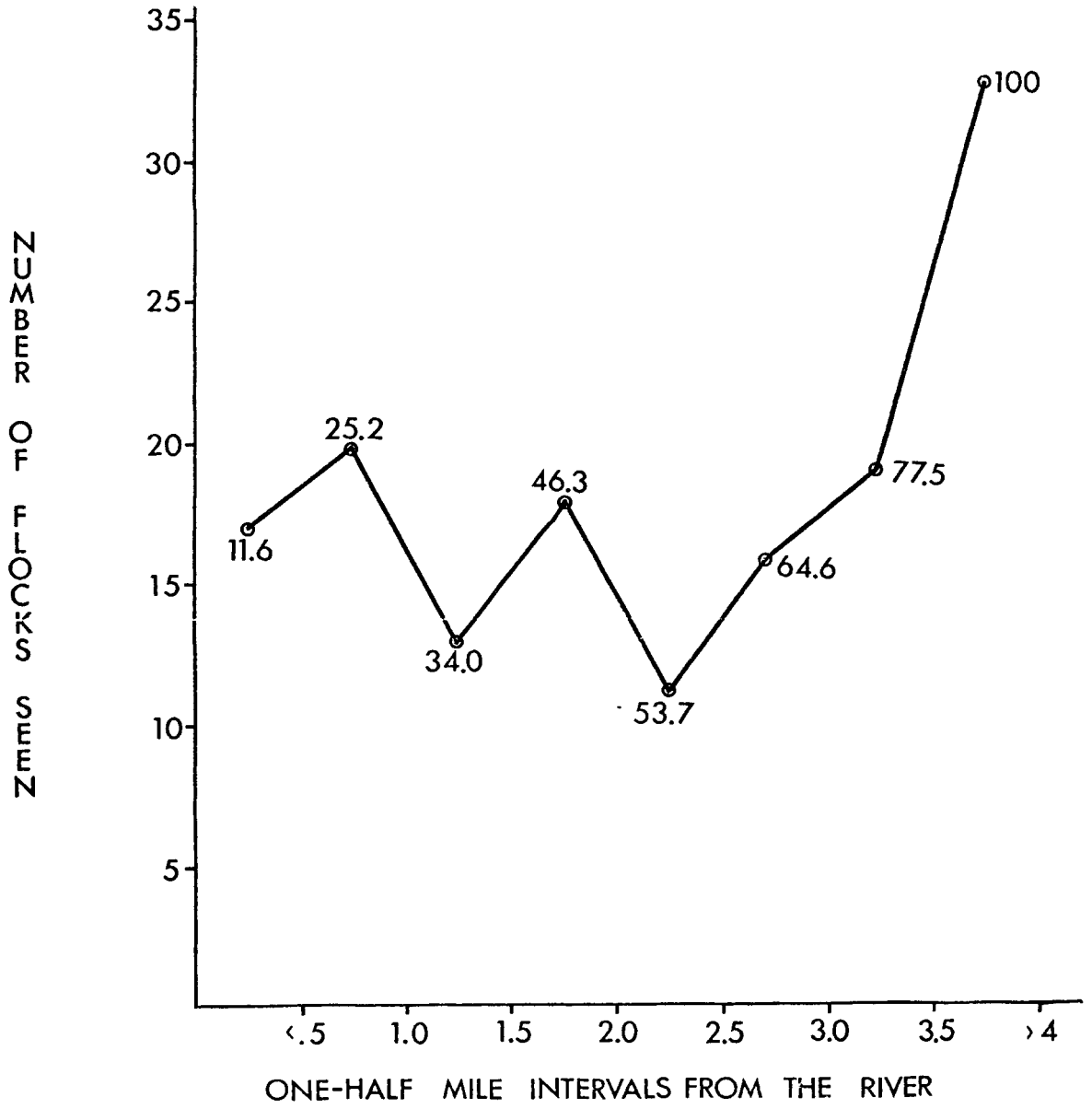

Fig. 6.--Chukar flock distribution (slope distance) in August and September 1975 determined through 67 transects run perpendicularly from points along the middle and lower Snake River. Accumulative percentages of total flocks shown.

summer-fall of 1975 had no drought period. Consequently, most of the chukar flocks along the Snake River utilized the river only sparingly. With the chukars dispersed up to 5 mi on either side of the river it was not possible to use the census technique developed in 1974, and no reliable census of the chukar partridge populations along the river was possible in 1975.

Chukar Habitat Use

General.--Chukars were located in all segments of the study area. This wide distribution was not unexpected. The essential elements of chukar habitat occur extensively throughout the entire study area. The Snake and Columbia River canyons offer ideal chukar habitat conditions. Their steeply rising canyon walls provide a vast area with the geologic landforms and vegetation types required by chukars in close proximity to a yearlong water supply. Lying within a region of suitable climate, these canyons provide an extended belt of habitable terrain for chukars along most of their course. Spring emigration, primarily of breeding pairs, has resulted in occupancy by chukars throughout the middle and lower Snake River system from the scattered releases of the 1940s and 1950s.

Habitat use by chukars is generally consistent throughout the study area. They utilize most of the habitats available to them. Being highly mobile, chukars may pass through many more habitat types than they actually use during a day. Steep topography with rock outcroppings or cliff-tallus areas provide chukars roost sites and escape cover during all seasons of the year. These areas and the extensive expanses of grass dominated slopes constitute the nucleus of chukar habitat year long. Within this broad range, weather, availability of water, type of food, and human disturbance dictate the particular areas of use.

Rock outcroppings; vegetation, generally Douglas hackberry, smooth sumac (*Rhus glabra*), or poison ivy *(Rhus radicans);* and occasionally east-west oriented ridges serve as loafing areas during the day. The shade provided by these areas is primarily important during the summer and fall, when temperatures are highest and drought conditions generally prevail. These same areas also provide protection from predators and inclement weather all year. Chukars remained in shaded areas, sleeping and loafing, for most of the day during the late summer and early fall. When weather conditions were more moderate the periods of chukar activity were greatly extended.

Those tree-shrub habitats most heavily utilized in the fall provide a dense overstory canopy close to the ground, which results in a sparse understory of herbaceous cover. This allows good visibility and unencumbered movement beneath the canopy. Smooth sumac stands and low growing hackberry trees were the vegetation most often found providing these conditions. Where these plants occur close to a water source, they almost always showed signs of chukar use throughout the drought season. Douglas hackberry, in particular, occurs much more extensively along the free-flowing portion of the Snake River than around the reservoir areas. These hackberry and sumac stands near water sources serve as valuable resting areas in the summer and fall. During these seasons in 1974, chukars remained in these shaded sites, sleeping and loafing throughout mid-day. In 1975, the birds were much less dependent on this shelter, primarily because of the cooler temperatures.

Influence of Weather.--The seasonal variations in chukar habitat use patterns generally relate to precipitation. Precipitation directly influences vegetation phenology and provides a wider dispersion of drinking water. Within suitable habitat, both of these conditions influence chukar distribution. Moist seasons, or periods of available green vegetation, allow widely scattered flocks of generally smaller numbers. Dry seasons find fewer, larger flocks concentrated on a much smaller portion of the range. During dry seasons dried, cured grasses and forbs provide little succulent forage.

Winter snow accumulations preclude chukar use of the higher portions of their range, although flocks can frequently be found just at the lower fringe of the snowline, moving up or down the slope as the snow level recedes or advances. Chukars frequently utilize exposed areas above snowline, such as south and west aspects and ridges which are free of snow accumulations. Abnormally heavy snowfalls may force large numbers of chukars to concentrate on an extremely restricted range until the snow level returns to more normal elevations. With the coming of spring, flock structure breaks down and pairs of birds begin courtship and nesting activities. Chukar dispersal is greatest at this time with pairs of birds scattering throughout all suitable habitat. Often several miles from water sources, chukars space themselves throughout the upland vegetation types during this season. As nesting begins, males regroup, generally in small flocks of 2-5 birds. Wide dispersion of these groups still occurs because of the scattered availability of food and water. Nests are also widely scattered, but generally are located 200-400 m from a water source in dense vegetation (Galbreath and Moreland 1953, Harper et al. 1958). As spring progresses into summer, unsuccessful hens join the male flocks and the older broods begin to aggregate. The typical summer heat and drought conditions draw these smaller groups together about the remaining available water. It is during this period that the greatest number of chukars are closely associated with the river and its riparian habitats. With the late fall-winter rains chukar flocks disperse, increasing the range utilized. This is particularly true as the fall green-up of grasses and forbs occurs. The presence of succulent vegetation enables the birds to go extended periods without drinking water (Harper et al. 1958, Christensen 1970). Free from a close association with a water source, the birds disperse somewhat from their constricted summer range. With these dispersions the flock sizes usually decrease, serving to spread the birds more evenly across their range.

Chukar Distribution and Relative Abundance

McNary Reservoir.--Chukars were found in the Wallula Gap region on this study segment. Flocks were located from near the water edge to the cliff tops and were present on both banks of the river. One flock of 13 chukars, in August 1975, was found utilizing a slight cliff area between Highway 395-730 and the railroad tracks just below, a space not more than 20 m wide. The birds were apparently unconcerned by the traffic passing above them. Chukar flocks were found along a greater stretch of the north bank than the south. This difference can undoubtedly be directly attributed to the presence of more rock outcroppings and cliffs on the north bank.

Above and below the Wallula Gap area, rock outcroppings diminish. These gentler slopes do not supply the steep topography that chukars require. The

intense industrial and urban use of much of this study segment further restricts use by chukars. No intensive searching for chukars was therefore conducted on this study segment upstream from Columbia River mile (RM) 315. Chukars were not incidentally observed in reconnaissance of the area, nor recorded on regularly sampled transects for other birds along this portion of the Columbia River. The chukar distribution on this study segment was the most restricted of the 8 segments on the study area.

Ice Harbor Reservoir.--The chukars found on Ice Harbor Reservoir were concentrated on its upriver end. Upstream from the mouth of the Snake River the river banks rise gently. These low, flat areas are heavily developed through urbanization and irrigated farming. These developments, and the lack of sufficiently steep topography with rock outcroppings, preclude chukars from establishing on downriver sites. Above Ice Harbor Dam the adjacent upland areas begin to include chukar habitat requirements, Intensive searching for chukars was not conducted on the lower 25 mi of the Snake River. Chukars were not recorded on regularly sampled transects, or incidentally recorded, on this stretch of the river. Intensive searching revealed several scattered chukar flocks above RM 25. These flocks were generally associated with the more extensive rock outcropping or cliff-tallus areas. Some flocks were found utilizing stock watering facilities several miles from the river. As long as water is supplied to these tanks for livestock, the chukars probably do not associate themselves with the river.

Lower Monumental, Little Goose, and Lower Granite Reservoirs.--Distribution of chukars on these reservoirs is essentially similar. Chukar habitat components occur regularly along this entire stretch of the river. Chukar flocks are also scattered throughout the entire area. Virtually all flocks located were also associated with rock outcroppings or cliff-talus slopes.

Flocks and individual birds may be found some distance from rock outcroppings as they feed or water during the day. When threatened or when preparing to roost for the night, the vast majority of chukar flocks seek the shelter of rock outcroppings or talus covered slopes. The birds appear to prefer a promontory as a roost, not necessarily the highest point but more frequently an area that rises above most of the surrounding topography. These exposed roosts are abandoned in favor of more sheltered sites during inclement weather.

In some instances, where adequate escape cover is available, chukar flocks occur in close proximity to humans. Chukar flocks were found near all 3 dam sites on this section of the river. They remained in the vicinity of Lower Granite Dam throughout its construction. They primarily concentrated on a hillside covered with large boulders and tallus, coming down to the river in the evenings to drink.

Several large side canyons cut back from the main river canyon along the lower Snake River. All of these were not searched, but those that were visited, notably Steptoe, Wawawai, and the Palouse River canyons, supported flocks of chukars year round if their water supply remained all year. Chukar flocks existed independent of the river, utilizing free running streams, springs, seeps, and livestock watering tanks. As some of these water sources dried up in the late summer and fall, chukars concentrated about the remaining water or moved down the side canyons to the main river.

Clearwater-Snake Rivers Confluence to Hells Canyon Dam.--The cities and suburbs of Lewiston, Clarkston, and Astoin cover the banks and adjacent upland areas from just downstream of the Snake and Clearwater Rivers confluence upstream for several miles. Chukars were not found in these urbanized areas but chukars were found on the north side of the canyon, above the industrial part of Lewiston. Here, where the rim is several miles back from the river, chukar flocks apparently do not associate with the river. Staying in these upland areas all year, water requirements are met by springs, intermittent streams, and stock watering facilities. Upriver from the urbanized areas, rock outcroppings and cliff-talus landforms occur closer to the river and the slopes begin to rise more steeply. Chukar distribution begins with these topographic features. Chukar flocks occur, scattered, the rest of the way upriver to Hells Canyon Dam.

In this portion of the study area the Snake River is free flowing in contrast to the extensive impoundments throughout the lower portion of the study area. Considerable difference in vegetation exists between this region and the reservoirs. The characteristic differences most influential to the chukars occur within the riparian vegetation. In this region, trees and shrubs appear as major components in much of the riparian zone vegetation. This portion of the Snake River also passes through high, mountainous country that is found in only one other segment, the adjacent Hells Canyon and Oxbow Reservoirs segment just upstream. Forests, primarily ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*), occur above the grass dominated upland habitats on this portion of the river. Intrusions by the forest communities reach the river banks at scattered points along the canyon. Chukars were not found to utilize these forests and savannah habitats to any great extent.

Chukars were primarily associated with steep, grass-covered slopes and adjacent cliff and/or talus areas. These habitats are essentially similar to those found along the reservoirs. The greatest difference in habitat utilization was found in the summer and fall. This contrast in pattern of use involves the distribution and composition differences in the riparian vegetation. Douglas hackberry occurs extensively along the banks of the free-flowing portion of the river. Chukars utilize the shade from these trees heavily during the summer and fall. They spend most of the hot portion of these days loafing and sleeping beneath low growing hackberry trees. Trees exhibiting this growth form are particularly heavily used when they occur near the river. Smooth sumac stands also showed intensive use when they occurred near a water source.

Numerous small tributaries feed into this portion of the Snake River. Many of these streams run year long, draining the mountains rising from both sides of the river. Other smaller, intermittent streams dry up after spring runoff. Most all of these side canyons support chukar flocks. The characteristic daily movement up and down the canyon slopes of the Snake River, in response to weather and food and water needs, also occurs in these smaller canyons. Where intervening ridges do not rise excessively, flocks were found which utilized the creek areas at times and the habitats along the river at other times. As the smaller tributaries dried up, chukar flocks in those areas concentrated themselves about existing springs or moved down to the main river canyon.

Although we were not able to gather actual quantitative data for the study area, we feel that the free-flowing portion of the river supports much higher concentrations of chukars than the reservoir areas do. While testing the feasibility of the audio census technique in 1974, more flocks of chukars were located per mile on this region than on the reservoir areas investigated. This could be the result of biases in sampling. But, taking into consideration the constraints placed on the census technique to obtain valid information, under similar circumstances more flocks and a greater number of birds were located along sampled portions of the free-flowing river than along any sampled portion of a reservoir. The only other bias that may be a significant influence involves having tested those areas with concentrations of chukars greater than average for the free-flowing river while inadvertently testing areas with lower than average concentrations along the reservoirs. Although this sampling was not extensive, we feel that the portions of the canyon sampled were representative of the chukar habitats contained within those respective study segments.

Hells Canyon and Oxbow Reservoirs.--Chukar flocks were found distributed throughout this segment of the river. Chukars apparently avoided the residential sites as they were not located in those areas. Occasional chukar flocks did utilize habitats just across the river from some developed sites. These developed areas compose such a small portion of the canyon that their occurrence has little effect on the number of chukars occurring in this segment. Virtually all of this segment contains suitable chukar habitat.

Topography similar to the free-flowing portion of the Snake River continues upstream through most of this segment. Slopes rise steeply from the narrow reservoirs, climbing into forested mountain areas. Occasional bars provide some relief from the otherwise precipitous landscape. Much of the vegetation is also similar. Bunchgrass dominates most of the area with the draws supporting concentrations of several shrub species. Occasionally forest types reach the reservoir edges, generally ponderosa pine. The most significant vegetational difference occurs in the riparian zone. Natural riparian vegetation persists only near the bases of Oxbow and Brownlee Dams. Both of these sites contain developed recreation and residential areas, and are therefore avoided by chukars. Away from these areas of constant disturbance, chukars can be found utilizing habitats near the reservoirs. The intensive use of riparian zones, such as observed along the free-flowing river in the summer, is not seen. This is primarily because the riparian vegetation found along these reservoirs does not offer the ideal conditions which occurred before inundation.

During the summer of 1974 chukar flocks were found at very high elevations in the mountains along this portion of the river. The birds were utilizing grass-covered ridges which interfingered with forested north slopes and draws. This elevation was apparently sought in response to the higher temperatures at lower elevations.

Testing of the audio census technique was not conducted on this study segment, therefore no comparison of population numbers with other segments is possible. An indication of the large number of chukars this segment supports was obtained in early January 1975. Exceptionally heavy snowfalls blanketed the area, forcing virtually all of the chukars from the surrounding slopes

down along the reservoirs. Hundreds of birds were concentrated under shrubs and trees just above the reservoir shorelines. This extraordinary weather dramatically revealed the large number of chukars residing on the slopes of this study segment. As the weather warmed in mid-January, chukars followed the retreating snowline redistributing themselves throughout typical winter range areas. From these observations it is obvious that this portion of the river supports a large population of chukars.

Brownlee Reservoir.--This segment comprises the upriver border of the study area. From the irrigated farmlands above Weiser, the reservoir stretches into the Snake River canyon. The steep, high mountains arise from gentler foothills covered by grasses and desert shrubs. Brownlee Reservoir has much less exposed rock along its shores than farther downstream. The river banks primarily have steep slopes covered by grasses. Few trees or shrubs occur along this shoreline. Heavy recreational use is made of areas where trees and tall shrubs are found. Chukar flocks must therefore rely almost entirely upon topographic relief and aspect differences for shelter.

Few tributaries carry water into the reservoir yearlong. Therefore, almost all of the chukars in the region associate directly with the river, especially during the summer-fall drought season. Some birds do concentrate about stock watering facilities, but these comprise a very small portion of the population. Scattered recreation sites and homes occupy small areas along the shoreline, but probably exert little influence on the chukar population because of the vast amount of contiguous habitat available for the birds' use. There has been little human development of the upland areas, where the chukars spend most of their time.

Little intensive searching for chukars was conducted on Brownlee Reservoir. Flocks were found liberally scattered along much of the reservoir. Most birds were located on the downriver portion of this study segment, nearer the dam. The Farewell Bend area was the furthest upriver that chukar were observed in this segment. Flocks located were generally well back from the reservoir. Only 3 of 17 flocks were observed near the reservoir edge. Several flocks were located near other water sources in adjacent upland sectors. This chukar distribution pattern, and lack of association with the river, is probably due to the paucity and distribution of escape cover and shelter near the reservoir shoreline. In August 1975 chukar flocks were located on the ridges above Brownlee Dam in ponderosa pine-savannah areas which were also being utilized by blue grouse. This was far higher than any chukars were found in 1974, especially during the summer months when chukar flocks are characteristically concentrated about water sources.

Waterfowl

Species Occurrence by Study Area Segment

For purposes of this report, waterfowl are defined to include the ducks, geese, mergansers, and swans. Grebes, loons, and coots will also be treated here because they are normally associated with the waterfowl group. Occurrence of waterfowl species in the study area segments is tabulated in Table 39. Species known and/or suspected to nest in each segment are also identified.

Table 39. Distribution of waterfowl species by study area segment.

SPECIES	STUDY AREA SEGMENT							
	1	2	3	4	5	6	7	8
Whistling Swan	X	X	X			X		X
Canada Goose	X*	X*	X*	X*	X*	X*	X*	X*
White-Fronted Goose								
Snow Goose	X			X		X		
Ross' Goose								
Mallard	X*	X*	X*	X*	X*	X*	X*	X*
Pintail	X	X*	X*	X	X	X	X	X*
Gadwall	X	X	X	X	X	X	X	X*
American Wigeon	X	X*	X*	X	X	X	X	X*
European Wigeon	X							
Northern Shoveler	X	X	X	X	X	X	X	X*
Green-Winged Teal	X*	X*	X*	X	X	X	X	X*
Blue-Winged Teal	X	X	X	X	X	X	X	X*
Cinnamon Teal	X			X				X*
Wood Duck	X		X		X	X		X*
Redhead	X			X	X	X	X	X*
Canvasback	X			X	X	X	X	X*
Ring-Necked Duck	X	X			X	X	X	X
Scaup	X	X			X	X	X	X*
Common Goldeneye	X	X	X	X	X	X	X	X
Barrow's Goldeneye	X	X	X	X	X	X	X	X
Bufflehead	X	X			X	X		X
Ruddy Duck	X	X		X				X*
Common Merganser	X	X	X*	X*	X	X	X	X*
Red-Breasted Merganser		X						
Hooded Merganser	X	X			X	X	X	X
Common Loon	X					X		X
Western Grebe	X	X				X	X	X
Horned Grebe	X					X	X	X
Eared Grebe				X		X		X
Pied-Billed Grebe	X	X				X	X	X*
American Coot	X	X	X	X	X	X	X	X*

*Indicates known or suspected nesting.

Nest Surveys

Nest surveys were conducted in all segments of the study area in 1974 and 1975. Initial nest searches were conducted between the first and third weeks in April and a followup check on nesting success and renesting attempts was conducted in mid-May. Although most nest searches were restricted to islands in 1974, approximately 6 man-days were spent searching mainland shorelines and cliff-ledge areas in the lower Snake River segments attempting to locate duck and goose nests in areas where nesting activity was suspected. No nests were found. For this reason, nest searches were restricted to the islands in 1975.

The mallard was the only duck species for which actual nesting activity was noted. However, other duck species are known to nest in the study area segments (Table 39) as evidenced by observation of broods prior to flight stage and synthesis of the literature. More duck nests would undoubtedly have been located if the nest searches had been more intensive regarding search of the ground surface area or additional searches of potential nesting habitats other than the islands; e.g., pond and marsh margins. All mallard nesting noted was located during goose nesting surveys conducted on islands. These data are summarized in Table 40. No success checks were conducted on these nests. The absence of emergent aquatic vegetation along reservoir shorelines undoubtedly accounts for a lack of diver duck nesting in the study area with the McNary Wildlife Recreation Area and the main unit of the McNary National Wildlife Refuge being exceptions.

Table 40. Summary of mallard nesting noted.

Study Segment and Island	Number Nests Found		Mean Clutch Size	
	1974	1975	1974	1975
Brownlee Reservoir				
Porters Island	1	0	-[a]	-
Goose Islands	2	0	9.0	-
Darrows Islands	0	1	-	11.0
Huffman Island	1	2	10.0	9.0
McNary Reservoir				
Sacajawea Island	1	0	9.0	-
Foundation Island	3	3	10.0	9.3
Badger Island	3	3[b]	9.0	6.6

[a]Destroyed by red fox.

[b]Seven females were flushed from suspected nest sites, but only 3 nests were located.

Tables 41 and 42 summarize the results of the 1974 and 1975 Canada goose nesting surveys conducted on McNary, Ice Harbor, Lower Monumental, and Little Goose Reservoirs. Nesting records for the Hanford Islands were obtained from Battelle-Pacific Northwest Laboratories. Total number of nests found includes active nests identified during the first nest search, renest attempts, and nests found on the second search but missed during the first search. The mean clutch size was calculated from successful nests found during the first nest search and subsequently checked. For total production estimates, the same hatching success was assumed for renest attempts and nests found during the second search which were not found during the first search as occurred for nests found during the first search and subsequently checked.

Total estimated gosling production was higher in 1975 compared to 1974. Gosling production was up 6.4 percent (729 goslings in 1974 to 779 in 1975) in the McNary Reservoir segment, exclusive of the Hanford Islands, and up 24 percent (152 goslings in 1974 to 200 goslings in 1975) on New York Island in Little Goose Reservoir.

Low water levels associated with levee inspections being carried out by U.S. Army Corps personnel during the peak of the nesting season were responsible for the low production in 1975 on the Hat Rock Islands in McNary Reservoir. Land bridges or mudflats, connecting the mainland to 3 of the 5 islands, were observed on 8 April 1975 when the water level was at 337.8 ft (msl). Four adult geese, killed by coyotes, were found and 6 nests with eggs were also found abandoned and/or destroyed. Coyotes were determined as the mammalian predator responsible, but predation had occurred within the last 2 days--after the water level was dropped. A land bridge also existed at this time to Foundation Island and a near land bridge existed to Badger Island. Fortunately no mammalian predators reached these 2 islands at this time. Some 124 nests could have been affected had predators reached these islands. Badger and Foundation Islands are the 2 most important nesting islands in McNary Reservoir.

Except for the incident mentioned above, nesting losses due to predation were minimal on islands in McNary Reservoir. On Sacajawea Island in 1975, the only nesting attempt was destroyed and an adult goose which had been killed by a mammalian predator (probably raccoon) was found nearby. Another type of predation was noted on Badger Island in 1974. A Great Basin gopher snake was found in a goose nest containing 5 goslings which were 3-4 days old. The gopher snake was tightly coiled around 1 gosling and would have killed the gosling by constriction but it was removed. This type of predation is felt abnormal, however, in that the adult goose had been kept away from the nest for some time due to the presence of the searchers' boat nearby.

On the Hanford Islands section of the McNary National Wildlife Refuge (Table 42), goose production has been stable for the 2 years of data, averaging 236 goslings. The number of unsuccessful nests is largely a result of desertion. In only 2 instances was mammalian and/or avian predation listed as the cause of an unsuccessful nesting attempt over the 2 years.

Table 41. Summary of Canada goose production on lower Snake River and McNary Reservoir, 1974 and 1975.

Location	No. Nests Found 1st Check		No. Nests hatched from 1st Check		Mean Clutch/ Successful Nest		Goslings Produced from 1st Check		Additional Nests Found 2nd Check		Total Est. Goslings Produced	
	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975
McNary Reservoir												
Hat Rock Island #1	2	3	2	1	6.0	5.3	12	5	0	0	12	5
Hat Rock Island #2	3	2	1	0	6.0	-	6	0	0	0	6	0
Hat Rock Island #3	6	4	4	0	5.3	-	19	0	0	0	19	0
Hat Rock Island #4	1	0	1	-	5.0	-	3	0	0	0	3	0
Hat Rock Island #5	2	4	2	3	7.0	5.3	14	16	0	0	14	16
Spaw Canyon Island (RM 304.0)	0	0	-	-	-	-	0	0	0	0	0	0
Badger Island	93	98	84	95	5.6	5.6	431	487	4	8	448	521
Foundation Island	39	30	37	29	5.1	5.9	173	145	0	2	173	155
Goat Island	2	2	1	2	5.4	8.0	5	16	0	0	5	16
Gull Island	1	1	1	1	5.4	6.0	5	6	0	0	5	6
Two Rivers Island	NC[1]	0	-	-	-	-	-	0	-	-	-	0
Casey Pond Islands	NC	3	-	3	-	5.7	-	17	-	0	-	17
Sacajawea Island	4	1	1	0	6.0	-	6	0	0	0	6	0
Dredge Island (RM 0.5)	1	0	1	-	5.0	-	5	0	0	0	5	0
Dike Ruins (RM 4.1)	1	2	1	1	5.0	5.0	5	5	0	0	5	5
Strawberry Islands[2]	5	7	1	0	4.0	-	4	0	0	NC	4	0
Dike Ruins (RM 5.9)	1	2	0	2	-	6.0	0	12	0	0	0	12
Locust Grove Island	2	1	1	1	3.0	4.0	3	4	0	0	3	4
Dredge Island (RM 7.6)	0	0	-	-	-	-	0	0	0	0	0	0
Goose Island	5	4	4	4	6.3	4.5	21	17	0	1	21	22
Total	168	164	142	142	5.3	5.6	712	730	4	11	729	779
Ice Harbor Reservoir												
Fish Hook Island	2	1	1	1	6.0	5.0	6	5	0	0	6	5
Lower Monumental Reservoir												
Palouse River Islands	0	0	-	-	-	-	0	0	0	0	0	0
Tucannon River Island	0	0	-	-	-	-	0	0	0	0	0	0
Little Goose Reservoir												
New York Island	28	36	26	34	6.0	5.7	152	192	0	2	152	200

[1] NC means not checked for that year.

[2] Data courtesy U.S. Fish & Wildlife Service

Table 42. Summary of Canada goose production on Hanford Islands in Columbia River, 1974 and 1975[1].

LOCATION	Total Nests Found		No. Nests Successful		Mean Clutch/ Successful Nest		Total Goslings Produced	
	1974	1975	1974	1975	1974	1975	1974	1975
Island #14	0	0	0	0	-	-	0	0
Island #15	5	4	3	4	6.3	5.2	19	21
Island #16	0	0	0	0	-	-	0	0
Island #17	25	27	22	21	5.6	5.2	123	110
Island #18	8	5	6	5	6.2	6.4	37	32
Island #19	11	8	9	8	5.4	5.6	49	45
Island #20	5	6	3	4	4.3	6.0	13	24
Total	54	50	43	42	5.6	5.7	241	232

[1] Data courtesy Battelle-Pacific Northwest Laboratories

Data presented in Table 41 do not reflect production from mainland and/or cliff-ledge nesting geese. Our observations indicate that about 6 additional broods for each of the 4 lower Snake River projects would be a maximum for production estimates from this type of nesting.

In the middle Snake River, between Hells Canyon Dam and Asotin, Canada goose nesting activity is widely scattered and erratic from year to year. In 1974, 3 broods were observed between Hells Canyon Dam and Wild Sheep Rapids (RM 240.2) (J. Zanelli, personal communication, 1974). These broods were the result of mainland nesting as no islands occur in this portion of the Snake River. One brood was also noted at Big Bar (RM 224.0, left bank), in 1974, which undoubtedly resulted from mainland nesting. A check of artificial nest structures located on Big Bar revealed no nesting activity. Additional areas checked in 1974 and results include: Pittsburg Landing (RM 216.2)--nest found in bluebunch wheatgrass vegetation type at base of rocks 12 m from high water mark on Oregon shore and brood observed across the river on Pittsburg Landing; Bob Creek (RM 204.9)--nest with clutch off located on rock point on Oregon shore; Dug Bar (RM 196.2, left bank)--brood observed; Cochran Islands (RM 178.8)--intensive search revealed no nests; Wild Goose Island (RM 172.9)--2 nests located within 3 m of each other, 1 was successful with the clutch off and the other deserted with 4 eggs remaining; Upper Grande Ronde Island (RM 169.7)--1 nest assumed destroyed by man; Lower Grande Ronde Island (RM 169.0, right bank)--1 nest with clutch off. Lower Grande Ronde Island is actually part of the Idaho mainland and an island only during high flows. In 1975, searches of the Cochran Islands, Wild Goose Island, and Grande Ronde Islands revealed no nests but 1 brood was observed at the mouth of the Grande Ronde River. More nesting may have occurred, however, but we did not spend as much time in Hells Canyon in 1975 as we did in 1974 and therefore broods may have gone undetected.

Canada goose production on Brownlee, Oxbow, and Hells Canyon Reservoirs is summarized in Table 43. A notable increase in total estimated gosling production is evident in 1975 compared to 1974. Production was up 27.1 percent (540 goslings in 1974 to 741 goslings in 1975) in the Brownlee Reservoir segment. Large numbers of apparently nonbreeding geese were present during the nesting searches conducted in 1974. These geese may have initiated nesting in 1975 and caused the large increase in nesting noted on Huffman, Darrows, and Goose (Rapids) Islands. Red fox and raccoon predation was noted both years but was substantially higher in 1975. Potential production on Porters Island was totally lost both years due to desertion and/or predation. Resident red fox were known to be present and raccoons were suspected to reside on the island. In 1975, three adult geese which had been killed by predators were also found on Porters Island and 4 of 5 active nests were destroyed by predators. On Horse Island, 1 adult goose was found in 1975 which had been killed by a mammalian predator. Two adult geese, killed by predators (probably raccoons), were also found on the Goose Island closest to the Oregon shore, and 5 of 43 active nests were destroyed by predators. No predation occurred on the Goose Island closest to the Idaho shore. On the Darrows Island closest to the Oregon shore, 5 adult geese were found which had been killed by predators in 1975 and 3 of 34 clutches were destroyed by predators. Predators had also eaten eggs which were noted as being cold in abandoned nests on the first nest search. No predation was noted on the Darrows Island located closest to the Idaho shore and none on the Huffman Island.

Table 43. Summary of Canada goose production on Brownlee, Oxbow, and Hells Canyon Reservoirs, 1974 and 1975.

Location	No. Nests Found 1st Check		No. Nests hatched from 1st Check		Mean Clutch/ Successful Nest		Goslings Produced from 1st Check		Additional Nests Found 2nd Check		Total Est. Goslings Produced	
	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975
Hells Canyon Reservoir												
Big Bar Island	1	NC[1]	1	-	6.0	-	6	-	0	-	6	-
Oxbow Reservoir	0	NC	-	-	-	-	0	-	0	-	0	-
Brownlee Reservoir												
Huffman Island	30	69	26	67	6.0	5.6	148	344	2	3	158	356
Darrows Islands (2)[2]	47	57	43	45	5.6	5.3	213	228	0	3	213	232
Goose Islands (2)	27	43	26	27	6.4	5.3	157	138	0	4	157	143
Porters Island	5	5	0	0	-	-	0	0	0	0	0	0
Horse Island	2	5	2	1	6.0	5.0	12	5	0	1	12	10
Westlake Island	NC	1	-	0	-	-	-	0	-	0	-	0
BROWNLEE TOTALS	111	180	97	140	6.0	5.3	530	715	2	11	540	741

[1] NC means not checked for that year.

[2] 1974 data courtesy Idaho Department of Fish and Game.

Selective predator control on Horse, Porters, Goose, and Darrows Islands just prior to initiation of the nesting season would increase nesting success. In addition, the Goose Island closest to the Oregon shore is actually composed of 3 parts of sub-islands. The 2 parts on the upstream end are very densely vegetated with willow. Little nesting is occurring here because of this and it is also providing excellent raccoon habitat. A treatment of these 2 sub-islands with a herbicide to kill the standing live vegetation, and then prescribe burning the area the following summer or fall to consume the dead stems and kill sprouting that has occurred would create more optimal nesting conditions on this island and perhaps reduce predation losses.

Nesting density in McNary Reservoir was very high on Badger and Foundation Islands. Badger Island (41 acres) averaged 2.3 nests per acre in 1974 and 2.4 nests per acre in 1975 while Foundation Island (19 acres) averaged 2.1 nests per acre in 1974 and 1.6 nests per acre in 1975. New York Island (48 acres) in Little Goose Reservoir had 0.6 nests per acre in 1974 and 0.8 nests per acre in 1975. The nesting density on Huffman Island in upper Brownlee Reservoir would also be high in 1975 but the acreage of this island is not known.

Changes in Canada Goose Nesting Status

From 1947 through 1953, Yocom (1961) conducted nesting surveys on the Snake River from the Grande Ronde River junction to the mouth--approximately 170 mi. This was prior to construction of any of the lower Snake River projects. He estimated an average of 240 breeding pairs per year along this portion of the Snake River for the 7 nesting seasons covered, "including about 17 pairs from the southeast corner of the state to Wawawai, 70 pairs from Wawawai to Riparia, and 153 pairs from there to the mouth of the river." Buss and Wing (1966) conducted nesting studies on 6 islands of the Snake River from 1954 through 1965, except 1962. The study area was between Wawawai and Central Ferry and prior to inundation of the Little Goose and Lower Granite projects. All 6 islands are now inundated. During the 11 annual nesting surveys they conducted, total goose nests found averaged 20.7 and ranged from 16 in 1964 to 30 in 1965. These figures do not include nesting activity which may have taken place on the mainland or cliff-ledges.

Our nesting surveys, conducted in 1974 and 1975, indicate an average of 75 breeding pairs of Canada geese nested each year along the lower Snake River from the Grande Ronde River to the mouth. This is assuming an average of 3 nesting pairs between the Grande Ronde River and Lewiston and 6 nesting pairs for each of the 4 lower Snake River projects which nested on the mainland or on cliff-ledge sites, in addition to the data presented in Table 41. This is a decrease of approximately 165 nesting pairs or 69 percent compared to Yocom's (1961) study. Although we have no direct way of comparing our data to that of Buss and Wing (1966), one might speculate that when Little Goose Reservoir was filled the geese which nested on the islands they studied may have moved to New York Island, located about 4 mi below Central Ferry, which was created at the time of inundation. If this occurred, then the number of nesting pairs in this portion of the river are comparable and may also partially explain why the goslings hatched on New York Island are brooded or raised 8 to 12 mi upstream.

Hansen and Oliver (1951) studied nesting Canada geese between Richland and the McNary Dam site at Umatilla in 1950 or prior to the filling of McNary Reservoir. They estimated that approximately 174 pairs of geese were using this portion of the Columbia River. Our data average 204 nesting pairs for the 1974 and 1975 nesting seasons (Tables 41 and 42) in the same area. This does not include the geese which are nesting on the main portion of the McNary National Wildlife Refuge but does include the nesting on the Hanford Islands portion of the Refuge. Thus, a substantial increase in number of nesting pairs of Canada geese is evident now compared to Hansen and Oliver's (1951) 1950 study.

We have acquired no data which would allow us to compare long-term changes in nesting status on the islands at the upper end of Brownlee Reservoir.

Nesting Habitat

During the 2 nesting seasons covered in this study (1974 & 1975), we examined the vegetation or substrate at 691 Canada goose nests (Table 44). Analysis of these data relative to the vegetation types available on the islands involved indicates that nest sites were selected independent of substrate or dominant lifeform of vegetation. Nests were located on a great diversity of substrates and vegetation lifeforms ranging from debris (primarily driftwood and other plant material accumulations below the high water mark along shorelines), vegetation, sand, rock, and artificial nest structures to waterfowl hunting blinds.

Of the 691 nest sites examined, 343 sites were dominated by shrubs (49.6 percent), 171 sites by forbs (24.7 percent), 88 sites by grasses (12.7 percent), 46 sites by trees (6.7 percent), and 17 sites by grasslike plants (2.5 percent). In addition, 14 nests were located in debris (2.0 percent), 2 nests on sand (0.3 percent), 1 nest in rocks (0.1 percent), 6 nests in manmade nesting structures (0.9 percent), and 3 nests in hunting blinds (0.4 percent).

Distance from high water mark to the nest site was recorded for each nest located. These data are summarized in Table 45. Only the dike ruins and a few of the islands (namely Huffman, Fish Hook, Gull, and Goat Islands) were less than 40 m wide for most of the surface area. A definite preference for the first 10 m in from the high water mark perimeter of the islands was noted. Fifty-three percent of the nests found in 1974 and 65 percent of those found in 1975 were within 10 m of the shoreline. During the 2 nesting seasons covered, only 14 or 2 percent of 691 Canada goose nests were found in the floodplain or where high water levels would have affected the success of these nests. Only 2 nests were actually flooded. One nest on New York Island was lost in 1975 due to bank erosion.

Yocom's (1962) documentation of the history of the Canada goose in our study area indicates that the current nesting population is recent in origin (early 1900s) and the increase in nesting pairs coincides with the increase in farming activities. Other factors which undoubtedly favored the spread of this breeding population include better protection resulting from game laws,

Table 44. Dominant lifeform of vegetation or landform substrate at 691 Canada goose nest sites.

Study Segment and Island	Total nests found		Vegetation at Nest Site/Number of Nests Found																			
			Debris		Grasslikes		Grass		Forbs		Shrubs		Trees		Sand		Rock		Nest structure		Blind	
	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975
Brownlee Reservoir																						
Horse Island	2	6	-	-	-	-	2	4	-	1	-	-	-	1	-	-	-	-	-	-	-	-
Porters Island	5	5	-	-	-	-	4	1	1	4	-	-	-	-	-	-	-	-	-	-	-	-
Goose Islands	27	47	-	2	-	-	17	13	10	26	-	4	-	1	-	-	-	1	-	-	-	-
Darrows Islands	34[1]	60	-	1	-	-	5	5	7	16	22	36	-	1	-	1	-	-	-	-	-	-
Huffman Island	30	72	-	-	-	3	1	-	15	20	13	41	-	7	1	-	-	-	-	-	-	1
SUBTOTAL	98	190	-	3	-	3	29	23	33	67	35	81	-	10	1	1	-	1	-	-	-	1
Little Goose Reservoir																						
New York Island	28	38	2	3	-	-	12	20	7	3	3	8	1	1	-	-	-	-	3	3	-	-
Ice Harbor Reservoir																						
Fish Hook Island	2	1	-	-	-	-	-	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-
McNary Reservoir																						
Goose Island	5	5	-	-	-	-	3	1	2	3	-	1	-	-	-	-	-	-	-	-	-	-
Locust Grove Island	2	1	-	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-	-	-	-	-
Dike Ruins	2	4	1	-	-	-	-	-	-	1	1	3	-	-	-	-	-	-	-	-	-	-
Sacajawea Island	4	1	-	-	-	-	-	-	-	-	3	1	1	-	-	-	-	-	-	-	-	-
Casey Pond Islands	NC[2]	3	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	1
Gull Island	1	1	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
Goat Island	2	2	-	-	-	-	-	-	-	-	2	-	-	2	-	-	-	-	-	-	-	-
Foundation Island	39	32	-	-	-	-	-	-	10	11	24	4	5	17	-	-	-	-	-	-	-	-
Badger Island	97	106	2	2	10	4	-	-	5	10	77	90	3	-	-	-	-	-	-	-	-	-
Hat Rock Islands	14	13	-	1	-	-	-	-	7	3	5	4	1	5	-	-	-	-	-	-	1	-
SUBTOTAL	166	168	3	3	10	4	3	1	26	32	113	103	10	24	-	-	-	-	-	-	1	1
GRAND TOTAL	294	397	5	9	10	7	44	44	68	103	151	192	11	35	1	1	-	1	3	3	1	2

[1] Data on vegetation at nest sites collected for 34 of 47 nests located.

[2] Not checked for 1974.

Table 45. Distance from high water mark to nest site for 691 Canada goose nests.

Study Segment and Island	Total nests found		Distance from High Water (meters)/Number of Nests Found											
			Floodplain		0-10.0		10.1-20.0		20.1-30.0		30.1-40.0		>40.1	
	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975
Brownlee Reservoir														
Horse Island	2	6	-	-	2	1	-	-	-	-	-	1	-	4
Porters Island	5	5	-	-	1	3	1	-	-	-	-	-	3	2
Goose Islands	27	47	-	3	13	28	8	8	2	3	4	4	-	1
Darrows Islands	34[1]	60	-	1	22	45	6	3	1	3	1	4	4	4
Huffman Island	30	72	1	5	21	58	4	7	4	1	-	1	-	-
SUBTOTAL	98	190	1	9	59	135	19	18	7	7	5	10	7	11
Little Goose Reservoir														
New York Island	28	38	-	2	9	18	9	6	2	2	3	3	5	7
Ice Harbor Reservoir														
Fish Hook Island	2	1	-	-	2	1	-	-	-	-	-	-	-	-
McNary Reservoir														
Goose Island	5	5	-	-	3	1	-	-	1	1	-	-	1	3
Locust Grove Island	2	1	-	-	1	-	-	1	-	-	-	-	1	-
Dike Ruins	2	4	-	-	2	4	-	-	-	-	-	-	-	-
Sacajawea Island	4	1	-	-	-	1	1	-	1	-	2	-	-	-
Casey Pond Island	NC[2]	3	-	-	-	2	-	1	-	-	-	-	-	-
Gull Island	1	1	-	-	1	1	-	-	-	-	-	-	-	-
Goat Island	2	2	-	-	2	2	-	-	-	-	-	-	-	-
Foundation Island	39	32	-	-	20	23	12	8	7	1	-	-	-	-
Badger Island	97	106	-	1	48	59	17	12	7	11	8	8	17	15
Hat Rock Islands	14	13	-	1	9	12	5	-	-	-	-	-	-	-
SUBTOTAL	166	168	-	2	86	105	35	22	16	13	10	8	19	18
GRAND TOTAL	294	397	1	13	156	259	63	46	25	22	18	21	31	36

[1] Data collected for 34 of 47 nests located.

[2] Not checked for 1974.

disbursing of human populations away from the river, and cheatgrass establishment which provided green food in late fall, winter, and early spring (Yocom 1961, 1962). Currently this goose population is an island nesting population. Only 1 nesting attempt (middle Snake River) was noted on the mainland during the 2 nesting seasons evaluated in this study. One additional observation in April 1974 of a lone Canada goose flying over the canyon slope in Little Goose Reservoir and subsequently landing on a basalt-cliff-ledge suggested possible cliff-nesting activity but we were unable to verify this. Buss and Wing (1966:34) reported that "Yocom (unpublished data) found several goose nests on these ledges" during nesting studies conducted from 1947 through 1953 in the lower Snake River. During nesting studies they conducted from 1954 through 1965, except 1962, in what is now Lower Granite Reservoir, no ledge-nesting was documented although 2 observations suggested this possibility.

Nest site selection appears to be primarily related to (1) the availability of island nesting habitat and (2) the availability of suitable brood foraging areas in close proximity to the island nesting habitat.

Brooding Habitat

Ducks.--Few duck broods were noted during the study. No intensive effort was conducted to specifically locate duck broods due to the extensiveness of the study area and the difficulty associated with locating broods.

Mallard broods were the most numerous duck broods noted throughout the study area. On McNary Reservoir, mallard broods were observed primarily in ponds and embayments associated with the McNary National Wildlife Refuge, McNary Wildlife Recreation Area, Yakima River mouth, Walla Walla River mouth, and Finley-Hover Park area. Mallard and blue- and green-winged teal broods were also noted in the ponds above U.S. Highway 730 between Juniper Canyon and Hat Rock State Park and at Hat Rock State Park. Pintail, American wigeon, northern shoveler, cinnamon and blue- and green-winged teal, redhead, common merganser, and American coot broods were also observed in this segment but in much lower numbers than mallards and primarily on the McNary National Wildlife Refuge and McNary Wildlife Recreation Area.

On the four lower Snake River reservoirs--Lower Granite, Little Goose, Lower Monumental, and Ice Harbor--mallard, pintail, American wigeon, and common merganser broods were observed. One observation of a grebe (probably pied-billed grebe) brood was recorded at the mouth of Alpowa Creek in 1975. Most observations of duck broods on these three segments were associated with alluvial bars where embayments with shallow water and mudflats are found. Examples of this habitat include Big Flat and the designated fish and wildlife management area at Simmons on Ice Harbor; Ayer area, bar just downstream from John, Tucannon River mouth, and Riparia area on Lower Monumental; the bar (right bank) below New York Island, Meadow Creek-Deadman Creek embayment, Washington State University's Agriculture Experiment Station lands, Rice Bar, and Swift Bar on Little Goose; Wawawai embayment, bar at Knoxway Canyon, bar (left bank) at Kelly Rapids, bar across reservoir from Steptoe Canyon, Alpowa Creek mouth area, and the bar area at the mouth of Tammany Creek on Lower Granite.

In the 2 middle Snake River segments, only common merganser broods were observed during the study. Although no areas were identified as concentrated brooding areas for this species, broods were observed in two consecutive years at Coon Hollow (RM 178.4--left bank). Backwater, eddy areas with a rocky shoreline and interspersed sand bars characterized the preferred brooding habitat for the common merganser here. Although no other duck broods were actually observed, we strongly suspect sparse, scattered nesting by mallards, pintails, American wigeon, and blue- and green-winged teal in the middle Snake River reaches. Pairs of these species were observed in the canyon from Asotin to Hells Canyon Dam just prior to nesting and adults and immatures were noted later in the fall, though no actual broods of these species were noted prior to flight stage.

Common merganser broods were also the only broods noted on Hells Canyon and Oxbow Reservoirs and on Brownlee Reservoir below Farewell Bend. No preferred brooding habitats were identified. Scattered nesting by the same species mentioned for the 2 middle Snake River segments is also suspected in these 2 segments for the same reasons presented above. Numerous mallard and a few green-winged teal broods were observed in upper Brownlee Reservoir--from Westlake Island down to the Farewell Bend area. Most broods were observed along island shorelines and in sloughs associated with the mainland and islands.

Geese.--Canada goose brooding areas were more easily identified than with ducks for 2 major reasons. First, adult geese and older goslings are more conspicuous than are ducks. Factors involved with conspicuousness include not only the larger size of adults and goslings but also the lower phenological development of herbaceous vegetation at the time most goose broods leave the nesting areas. Second, the tendency of most geese in major nesting areas to "gang" brood the goslings allows for relatively easy location of brooding habitats where this occurs.

In McNary Reservoir, the peninsula portion of the McNary Wildlife Recreation Area, which extends out into the reservoir between Badger Island and Foundation Island, receives nearly all of the brooding activity from production on these 2 islands, and perhaps from Goat and Gull Islands. Cereal crops and legumes planted on the peninsula by the Washington Game Department provide brood forage in close proximity to the major nesting islands. Coinciding with the creation of Badger and Foundation Islands at the time McNary Reservoir was filled and with the planting of grain crops on the peninsula, an increase in numbers of nesting Canada geese occurred on Badger and Foundation Islands. Closeness of brood foraging areas was undoubtedly a major factor. At the same time, a reduction in numbers of nesting Canada geese occurred on the Strawberry Islands. Shrub and tree succession or closing of the overstory canopy has been speculated as a factor on lower Strawberry Island but does not appear to affect nesting on Badger and Foundation Islands. Loss of brood foraging areas in the vicinity of the Strawberry Islands due to housing developments may have also been a factor.

Broods produced on the Hat Rock Islands were observed to forage on the islands and along the nearby mainland shoreline. No major movement of the goslings, by adult geese, away from the nesting islands occurred. There is, however, a lack of better brood foraging areas in the vicinity. Likewise,

adult geese and broods were frequently observed feeding along the river shoreline and on the nesting islands and dike ruins in the McNary Reservoir portion of the Snake River, especially the first 4.5 mi below Ice Harbor Dam (south shore). A few broods were also observed foraging in Sacajawea State Park and may have been from production in this stretch of the reservoir and/or from the Columbia River island lying just upstream from the park.

We were unable to identify any brood foraging areas for goslings produced on the Hanford Islands (#'s 14-20) in the Columbia River. Batelle personnel were also not aware of any major brood foraging areas. The goslings are not on the nesting islands when nesting success checks are conducted in May and apparently not brooding along the adjacent mainland shoreline in our study area. Adult geese may be taking the goslings upstream above the AEC boundary, and/or to the irrigated croplands across the Columbia River from Richland (RM 339-344, left bank).

In Ice Harbor Reservoir, the island across from the Fish Hook Recreation Area, served as both nesting and brooding habitat. One clutch was successfully hatched and raised there during both years of the study. In addition, 2-3 broods were noted on the bar (RM 283.0) just upstream from Votaw in 1974, prior to flight stage, and were therefore assumed to have resulted from shoreline and/or cliff-ledge nesting.

In Little Goose Reservoir, an interesting movement of goslings from New York Island occurs immediately after the hatch period. Goslings are not raised on the island. Although a few broods were observed on the bar (RM 76.5, right bank) just downstream from New York Island (RM 78.0), most goslings are apparently taken upstream by the adult geese to the pastures and croplands at the Washington State University Agricultural Experiment Station (RM 85.5-89.0, left bank). Some broods may also be taken as far upstream as Rice Bar (RM 92.0-94.0, left bank) because broods were noted there also. This represents upstream movements to brooding areas of from 8 to 12 river miles.

On a goose brooding survey flown in July 1974, 14 geese (2 broods) were observed along the shoreline at RM 76.5 (right bank) and 60 geese (estimated 9 broods) were observed grouped along the shoreline at RM 87.0 (left bank). Although this accounts for only 41 percent of the clutches which hatched successfully on New York Island, it did identify the lands of the Washington State University Agricultural Experiment Station as the major brooding area for production from New York Island.

No geese were observed in the Lower Granite segment on the flight mentioned above. However, a minimum of 5 broods were known to be present from a boat survey conducted on 22 May 1974. This production undoubtedly resulted from shoreline and/or cliff-ledge nesting. Although these observations were made prior to the filling of Lower Granite Reservoir, the brood locations correspond quite closely with what would now be considered good brood foraging areas. Three broods were observed at RM 122.0 (left bank) which is just above a brood foraging bar at RM 120.0. Two broods were observed at RM 111.6 (left bank) just upstream and across the river from Wawawai, but these brood foraging areas have now been inundated. A good brood foraging area does exist, however, just upstream from here at Knoxway Canyon (RM 116.0, left

bank) and will undoubtedly be used in the future. The bar area across the reservoir from Steptoe Canyon at RM 127.5 (left bank) is also potential goose brooding habitat.

From Asotin to the confluence of the Salmon and Snake Rivers, the following potential goose brooding areas were identified: RM 148.5 (right bank) about 2 mi above Asotin, mouth of Tenmile Creek (left bank), RM 160 just below Buffalo Rock (right bank), mouth of Billy Creek (right bank), RM 166.5 near Lewis Rapids (right bank), RM 167-169.5 across from the mouth of the Grande Ronde River (right bank)--broods were observed here in 1974 and 1975 that probably hatched on Wild Goose and Grande Ronde Islands and/or the adjacent mainland, RM 176.1 near China Garden Creek (right bank), and in the Cache-Cave Creeks area. These are areas where geese were frequently observed resting and feeding.

Potential goose brooding areas from the confluence of the Salmon and Snake Rivers to Hells Canyon Dam include: mouth of Eureka Creek (left bank), Dug Bar area (RM 195-196.8), Christmas-Dry Creeks area to Bar Creek (RM 201-202.1), Wolf Creek to Getta Creek (RM 203-205.6), Camp and Somers Creeks area (RM 210)--broods observed here in 1974 and 1975, Pittsburg Landing area (RM 214-216.4), Kirby Creek (RM 218.9), Big Bar Area (RM 223-225.5), and RM 227.4 just below Willow Creek (right bank).

Two goose brooding areas were identified on the Oxbow and Hells Canyon Reservoirs segment and both areas are on Hells Canyon Reservoir. One to 2 broods were noted each year of the study at Big Bar (RM 256.3) utilizing the shoreline on Big Bar Island and the white sweetclover vegetation type on Big Bar. Adult geese were also observed brooding goslings at Homestead, Oregon (RM 265.8) on pasture lands near the reservoir shoreline. No goose broods were noted on Oxbow Reservoir prior to flight stage.

On Brownlee Reservoir, nearly all goose nesting occurs on the islands at the upper end of the reservoir and above. The two major brooding areas identified are in close proximity to the major nesting islands--Huffman, Darrows (2), and Goose (2) Islands. The pasture lands and hayfields (primarily alfalfa) at RM 337.5-338.1 (right bank) served as the major brooding areas for production undoubtedly from Darrows Islands and Huffman Island. A few broods were also observed below Huffman Island at Farewell Bend State Park. A second major brooding area is along the shoreline at and just upstream from Oasis, Oregon (left bank). This area is adjacent to Lower Goose Island, a major nesting island, and on the downstream end of Porters Flat. Individual broods were also noted feeding along the mainland and island shorelines from Westlake Island downstream to Huffman Island.

Census Data

Fall Waterfowl Survey.--Waterfowl counts conducted by the U.S. Fish and Wildlife Service during October, November, and December from 1967-1975 are presented in Tables 46-49 for portions of the McNary Reservoir segment. No attempt was made to distinguish between duck species, other than mallards, except for counts conducted in 1975. Beginning in 1974, waterfowl counted in the Hanford Islands section of our study area are included with the total

Table 46. Waterfowl census data for McNary Pool to Yakima River, U. S. Fish & Wildlife Service.

	YEAR - MONTH																							
	1967			1968			1969			1970			1971			1972		1973		1974	1975		
SPECIES	Oct	Nov	Dec	Oct	Nov	Dec	Oct	Nov	Dec	Oct	Nov	Dec	Oct	Nov	Dec	Oct	Nov	Oct	Nov	Nov[1]	Oct	Nov	Dec
Mallard	1,275	3,200	7,500	1,100	10,000	7,100	1,000	3,200	13,000	6,700	8,500	19,000	4,100	2,500	8,500	1,350	17,000	4,250	22,000	7,955	5,100	17,050	75,050
Other Ducks	2,000	None Listed	7,000	5,750	4,000	6,110	2,500	1,000	2,600	2,000[2]	2,000	2,100	250	3,900	1,600	1,250	2,500	2,250	1,025	1,350	3,450[5]	950[6]	0
Geese	20	780	1,700	870	190	790	250	950	2,850	1,508[3]	1,600	4,600	800	1,400	350	801[4]	6,300	2,575	1,925	2,075	2,150	700	12,000
Whistling Swan	0	0	0	0	0	0	0	0	0	0	0	0	0	10	70	0	0	0	0	4	0	0	0
American Coot	1,650	0	400	1,850	1,600	0	700	650	500	700	500	1,200	100	1,300	500	350	1,100	425	0	0	0	0	0

[1] Includes Walla Walla Game Range count.

[2] 1500 redheads included in 2000.

[3] Includes 6 snow geese and 2 blue geese.

[4] Includes 1 snowgoose.

[5] Includes 3000 American wigeon and 450 pintails

[6] Includes 600 American wigeon, 300 pintails and 50 redheads