Columbia River Power System Biological Opinion" (The Research, Monitoring and Evaluation Plan, http://www.efw.bpa.gov/cgi-bin/FW/welcome.cgi).

Because of the M&E efforts already underway in the Grande Ronde (e.g., NPT NEOH M&E program and CSMEP), a template for cataloging data, similar to that currently being used in the other federal pilot programs (e.g.,Wenatchee, John Day, and Upper Salmon), is available for application (Appendix 9). The template includes consideration of Tier 1, 2, and 3 variables, which are consistent with the FCRPS BiOp

5.5.2 Terrestrial Research Monitoring and Evaluation

The Grande Ronde Subbasin Terrestrial Team found preparation of the terrestrial assessment very challenging. Initial screening of IBIS and ONHIC data found both to be of questionable accuracy. Consequently the team spent much time analyzing the data for accuracy and validity. There is little if any local species population data for many of the selected focal species so changes in habitat from historic to current were the basis of the assessment. Data gaps and research needs are also addressed for each habitat type in the Synthesis section beginning on page 206.

Suggestions for monitoring and evaluation are:

- Determine population status in the Grande Ronde Subbasin of the American marten, olive-sided flycatcher, white-headed woodpecker, sage sparrow, Columbia spotted frog and yellow warbler. Data on these species is a prerequisite to meaningful discussions on the changes to habitats.
- Inventory and assess condition of aspen and mountain mahogany habitat types. Access USFS data, although these are limited, for baseline information.
- Conduct literature search and/or initiate studies to determine timing and type of use of these habitats by wildlife in the Grande Ronde Subbasin.
- Access USFS data and inventory priority habitats to determine habitat quality with reference to dependent focal species.
- Identify key wildlife habitat corridors/links.
- Identify and protect wildlife habitat corridors/links

Develop higher resolution habitat maps which accurately show location and extent of priority habitats (e.g., stringer wetlands).

6. Appendices

6.1 Appendix 1: References

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6.2 Appendix 2: Species Tables

Appendix Table 1. Fish Species known to occur in the Grande Ronde Subbasin

Species	Origin	Distribution
Spring Chinook (*Oncorhynchus tshawytscha*)	N	GRR & major tributaries
Fall Chinook (*Oncorhynchus tshawytscha*)	N	Lower GRR
Summer steelhead (*Oncorhynchus mykiss*)	N	GRR & major tributaries
Sturgeon (*Acipenser transmontanus*)	N	Lower GRR
Kokanee (*Oncorhynchus nerka*)	N	Wallowa Lake
Redband trout (*Oncorhynchus mykiss gibbsi*)	N	Basin wide
Bull trout (*Salvelinus confluentus*)	N	GRR & major tributaries
Mountain whitefish (*Prosopium williamsoni*)	N	GRR, WR.
Brook trout (*Salvelinus fontinalis*)	I	UGRR, WR, WMHL
Lake trout (*Salvelinus namaycush*)	I	Wallowa Lake
Westslope cutthroat (*Oncorhynchus clarki lewisi*)	I	Frances lake
Pacific lamprey (*Lampetra tridentata*)	N	unknown
Brook Lamprey (*Limper richardsoni*)	N	unknown
Mottled sculpin (*Cottus bairdi*)	N	mainstems and tributaries
Slimy sculpin (*Cottus cognatus*)	N	mainstems and tributaries
Torrent sculpin (*Cottus rhotheus*)	N	mainstems and tributaries
Shorthead sculpin (*Cottus confuses*)	N	mainstems and tributaries
Piaiute sculpin (*Cottus beldingi*)	N	mainstems and tributaries
Carp (*Cyprinus carpio*)	I	LGS
Northern pikeminnow (*Ptychocheilus oregonensis*)	N	lower reaches GRR, tribs
Chiselmouth (*Acrocheilus alutaceus*)	N	WSH
Peamouth (*Mylocheilus caurinus*)	N	WSH
Longnose dace (*Rhinichthys cataractae dulcis*)	N	WSH
Speckled dace (*Rhinichthys osculus*)	N	WSH
Redside shiner (*Richardsonius balteatus balteatus*)	N	WSH
Largescale sucker (*Catostomus macrocheilus*)	N	WSH
Mountain sucker (*Catostomus platyrhynchus*)	N	WSH
Bridgelip sucker (*Catostomus columbianus*)	N	WSH
Black crappie (*Poxomis nigromaculatus*)	I	LPS, LGS
White crappie (*Poxomis annularis*)	I	LPS, LGS
Largemouth bass (*Micropterus salmoides*)	I	LPS, LGS
Smallmouth bass (*Micropterus dolomieui*)	I	LPS, LGS
Bluegill (*Lepomis macrochirus*)	I	LPS, LGS
Pumpkinseed (*Lepomis gibbosus*)	I	LPS, LGS
Warmouth (*Lepomis gulosis*)	I	LPS, LGS
Yellow perch (*Perca flavescens*)	I	LPS, LGS
Channel catfish (*Ictalurus punctatus*)	I	LPS, LGS
Flathead catfish (*Pylodictis olivaris*)	I	LPS, LGS
Brown bullhead (*Ameiurus nebulosus*)	I	LPS, LGS

I=Introduced, N=Native, GRR=Grande Ronde River, UGRR= Upper Grande Ronde River, WR= Wallowa River, WMHL=Wallowa Mountain High Lakes, WSH= Widespread in Suitable Habitats, LPS= Lakes, Ponds & Sloughs, LGS= Low Gradient Streams.

Appendix Table 2. Wildlife Species in the Grande Ronde subbasin.

Common Name	Scientific Name	OR Occurrence	OR Breeding Status	WA Occurrence	WA Breeding Status
Amphibians					
Tiger Salamander	*Ambystoma tigrinum*	occurs	breeds	occurs	breeds
Long-toed Salamander	*Ambystoma macrodactylum*	occurs	breeds	occurs	breeds
Western Red-backed Salamander	*Plethodon vehiculum*	occurs	breeds	occurs	breeds
Tailed Frog	*Ascaphus truei*	occurs	breeds	occurs	breeds
Great Basin Spadefoot	*Scaphiopus intermontanus*	occurs	breeds	occurs	breeds
Western Toad	*Bufo boreas*	occurs	breeds	occurs	breeds
Woodhouse's Toad	*Bufo woodhousii*	occurs	breeds	occurs	breeds
Pacific Chorus (Tree) Frog	*Pseudacris regilla*	occurs	breeds	occurs	breeds
Oregon Spotted Frog	*Rana pretiosa*	occurs	breeds	occurs	breeds
Columbia Spotted Frog	*Rana luteiventris*	occurs	breeds	occurs	breeds
Northern Leopard Frog	*Rana pipiens*	occurs	breeds	occurs	breeds
Bullfrog	*Rana catesbeiana*	non-native	breeds	non-native	breeds
Total Amphibians:	**13**				
Birds					
Common Loon	*Gavia immer*	occurs	non-breeder	occurs	breeds
Pied-billed Grebe	*Podilymbus podiceps*	occurs	breeds	occurs	breeds
Horned Grebe	*Podiceps auritus*	occurs	breeds	occurs	breeds
Red-necked Grebe	*Podiceps grisegena*	occurs	breeds	occurs	breeds
Eared Grebe	*Podiceps nigricollis*	occurs	breeds	occurs	breeds
Western Grebe	*Aechmophorus occidentalis*	occurs	breeds	occurs	breeds
Clark's Grebe	*Aechmophorus clarkii*	occurs	breeds	occurs	breeds
American White Pelican	*Pelecanus erythrorhynchos*	occurs	breeds	occurs	breeds
Double-crested Cormorant	*Phalacrocorax auritus*	occurs	breeds	occurs	breeds
American Bittern	*Botaurus lentiginosus*	occurs	breeds	occurs	breeds
Great Blue Heron	*Ardea herodias*	occurs	breeds	occurs	breeds
Great Egret	*Ardea alba*	occurs	breeds	occurs	breeds
Cattle Egret	*Bubulcus ibis*	occurs	breeds	occurs	non-breeder
Green Heron	*Butorides virescens*	occurs	breeds	occurs	breeds

Common Name	Scientific Name	OR Occurrence	OR Breeding Status	WA Occurrence	WA Breeding Status
Black-crowned Night-heron	*Nycticorax nycticorax*	occurs	breeds	occurs	breeds
White-faced Ibis	*Plegadis chihi*	occurs	breeds	occurs	non-breeder
Turkey Vulture	*Cathartes aura*	occurs	breeds	occurs	breeds
Greater White-fronted Goose	*Anser albifrons*	occurs	non-breeder	occurs	non-breeder
Snow Goose	*Chen Ccaerulescens*	occurs	non-breeder	occurs	non-breeder
Ross's Goose	*Chen rossii*	occurs	non-breeder	occurs	non-breeder
Canada Goose	*Branta canadensis*	occurs	breeds	occurs	breeds
Trumpeter Swan	*Cygnus buccinator*	occurs	breeds	occurs	breeds
Tundra Swan	*Cygnus columbianus*	occurs	non-breeder	occurs	non-breeder
Wood Duck	*Aix sponsa*	occurs	breeds	occurs	breeds
Gadwall	*Anas strepera*	occurs	breeds	occurs	breeds
Eurasian Wigeon	*Anas penelope*	occurs	non-breeder	occurs	non-breeder
American Wigeon	*Anas americana*	occurs	breeds	occurs	breeds
Mallard	*Anas platyrhynchos*	occurs	breeds	occurs	breeds
Blue-winged Teal	*Anas discors*	occurs	breeds	occurs	breeds
Cinnamon Teal	*Anas cyanoptera*	occurs	breeds	occurs	breeds
Northern Shoveler	*Anas clypeata*	occurs	breeds	occurs	breeds
Northern Pintail	*Anas acuta*	occurs	breeds	occurs	breeds
Green-winged Teal	*Anas crecca*	occurs	breeds	occurs	breeds
Canvasback	*Aythya valisineria*	occurs	breeds	occurs	breeds
Redhead	*Aythya americana*	occurs	breeds	occurs	breeds
Ring-necked Duck	*Aythya collaris*	occurs	breeds	occurs	breeds
Greater Scaup	*Aythya marila*	occurs	non-breeder	occurs	non-breeder
Lesser Scaup	*Aythya affinis*	occurs	breeds	occurs	breeds
Harlequin Duck	*Histrionicus histrionicus*	occurs	breeds	occurs	breeds
Surf Scoter	*Melanitta perspicillata*	occurs	non-breeder	occurs	non-breeder
Bufflehead	*Bucephala albeola*	occurs	breeds	occurs	breeds
Common Goldeneye	*Bucephala clangula*	occurs	non-breeder	occurs	breeds
Barrow's Goldeneye	*Bucephala islandica*	occurs	breeds	occurs	breeds
Hooded Merganser	*Lophodytes cucullatus*	occurs	breeds	occurs	breeds
Common Merganser	*Mergus merganser*	occurs	breeds	occurs	breeds
Red-breasted Merganser	*Mergus serrator*	occurs	non-breeder	occurs	non-breeder

Common Name	Scientific Name	OR Occurrence	OR Breeding Status	WA Occurrence	WA Breeding Status
Ruddy Duck	*Oxyura jamaicensis*	occurs	breeds	occurs	breeds
Osprey	*Pandion haliaetus*	occurs	breeds	occurs	breeds
Bald Eagle	*Haliaeetus leucocephalus*	occurs	breeds	occurs	breeds
Northern Harrier	*Circus cyaneus*	occurs	breeds	occurs	breeds
Sharp-shinned Hawk	*Accipiter striatus*	occurs	breeds	occurs	breeds
Cooper's Hawk	*Accipiter cooperii*	occurs	breeds	occurs	breeds
Northern Goshawk	*Accipiter gentilis*	occurs	breeds	occurs	breeds
Swainson's Hawk	*Buteo swainsoni*	occurs	breeds	occurs	breeds
Red-tailed Hawk	*Buteo jamaicensis*	occurs	breeds	occurs	breeds
Ferruginous Hawk	*Buteo regalis*	occurs	breeds	occurs	breeds
Rough-legged Hawk	*Buteo lagopus*	occurs	non-breeder	occurs	non-breeder
Golden Eagle	*Aquila chrysaetos*	occurs	breeds	occurs	breeds
American Kestrel	*Falco sparverius*	occurs	breeds	occurs	breeds
Merlin	*Falco columbarius*	occurs	bred historically	occurs	breeds
Gyrfalcon	*Falco rusticolus*	occurs	non-breeder	occurs	non-breeder
Peregrine Falcon	*Falco peregrinus*	occurs	breeds	occurs	breeds
Prairie Falcon	*Falco mexicanus*	occurs	breeds	occurs	breeds
Chukar	*Alectoris chukar*	non-native	breeds	non-native	breeds
Gray Partridge	*Perdix perdix*	non-native	breeds	non-native	breeds
Ring-necked Pheasant	*Phasianus colchicus*	non-native	breeds	non-native	breeds
Ruffed Grouse	*Bonasa umbellus*	occurs	breeds	occurs	breeds
Sage Grouse	*Centrocercus urophasianus*	occurs	breeds	occurs	breeds
Spruce Grouse	*Falcipennis canadensis*	occurs	breeds	occurs	breeds
Blue Grouse	*Dendragapus obscurus*	occurs	breeds	occurs	breeds
Sharp-tailed Grouse	*Tympanuchus phasianellus*	reintroduced	breeds	occurs	breeds
Wild Turkey	*Meleagris gallopavo*	non-native	breeds	non-native	breeds
Mountain Quail	*Oreortyx pictus*	occurs	breeds	occurs	breeds
California Quail	*Callipepla californica*	occurs	breeds	non-native	breeds
Northern Bobwhite	*Colinus virginianus*	non-native	breeds	non-native	breeds
Virginia Rail	*Rallus limicola*	occurs	breeds	occurs	breeds
Sora	*Porzana carolina*	occurs	breeds	occurs	breeds
American Coot	*Fulica americana*	occurs	breeds	occurs	breeds

Common Name	Scientific Name	OR Occurrence	OR Breeding Status	WA Occurrence	WA Breeding Status
Sandhill Crane	*Grus canadensis*	occurs	breeds	occurs	breeds
Black-bellied Plover	*Pluvialis squatarola*	occurs	non-breeder	occurs	non-breeder
Pacific Golden-Plover	*Pluvialis fulva*	occurs	non-breeder	occurs	non-breeder
Semipalmated Plover	*Charadrius semipalmatus*	occurs	non-breeder	occurs	non-breeder
Killdeer	*Charadrius vociferus*	occurs	breeds	occurs	breeds
Black-necked Stilt	*Himantopus mexicanus*	occurs	breeds	occurs	breeds
American Avocet	*Recurvirostra americana*	occurs	breeds	occurs	breeds
Greater Yellowlegs	*Tringa melanoleuca*	occurs	non-breeder	occurs	non-breeder
Lesser Yellowlegs	*Tringa flavipes*	occurs	non-breeder	occurs	non-breeder
Solitary Sandpiper	*Tringa solitaria*	occurs	non-breeder	occurs	non-breeder
Willet	*Catoptrophorus semipalmatus*	occurs	breeds	occurs	non-breeder
Spotted Sandpiper	*Actitis macularia*	occurs	breeds	occurs	breeds
Upland Sandpiper	*Bartramia longicauda*	occurs	breeds	extirpated	bred historically
Long-billed Curlew	*Numenius americanus*	occurs	breeds	occurs	breeds
Marbled Godwit	*Limosa fedoa*	occurs	non-breeder	occurs	non-breeder
Sanderling	*Calidris alba*	occurs	non-breeder	occurs	non-breeder
Semipalmated Sandpiper	*Calidris pusilla*	occurs	non-breeder	occurs	non-breeder
Western Sandpiper	*Calidris mauri*	occurs	non-breeder	occurs	non-breeder
Least Sandpiper	*Calidris minutilla*	occurs	non-breeder	occurs	non-breeder
Baird's Sandpiper	*Calidris bairdii*	occurs	non-breeder	occurs	non-breeder
Pectoral Sandpiper	*Calidris melanotos*	occurs	non-breeder	occurs	non-breeder
Dunlin	*Calidris alpina*	occurs	non-breeder	occurs	non-breeder
Stilt Sandpiper	*Calidris himantopus*	occurs	non-breeder	occurs	non-breeder
Short-billed Dowitcher	*Limnodromus griseus*	occurs	non-breeder	occurs	non-breeder
Long-billed Dowitcher	*Limnodromus scolopaceus*	occurs	non-breeder	occurs	non-breeder
Common Snipe	*Gallinago gallinago*	occurs	breeds	occurs	breeds
Wilson's Phalarope	*Phalaropus tricolor*	occurs	breeds	occurs	breeds
Red-necked Phalarope	*Phalaropus lobatus*	occurs	non-breeder	occurs	non-breeder
Franklin's Gull	*Larus pipixcan*	occurs	breeds	occurs	non-breeder
Bonaparte's Gull	*Larus philadelphia*	occurs	non-breeder	occurs	non-breeder
Mew Gull	*Larus canus*	occurs	non-breeder	occurs	non-breeder
Ring-billed Gull	*Larus delawarensis*	occurs	breeds	occurs	breeds

Common Name	Scientific Name	OR Occurrence	OR Breeding Status	WA Occurrence	WA Breeding Status
California Gull	*Larus californicus*	occurs	breeds	occurs	breeds
Herring Gull	*Larus argentatus*	occurs	non-breeder	occurs	non-breeder
Thayer's Gull	*Larus thayeri*	occurs	non-breeder	occurs	non-breeder
Glaucous-winged Gull	*Larus glaucescens*	occurs	breeds	occurs	breeds
Glaucous Gull	*Larus hyperboreus*	occurs	non-breeder	occurs	non-breeder
Caspian Tern	*Sterna caspia*	occurs	breeds	occurs	breeds
Common Tern	*Sterna hirundo*	occurs	non-breeder	occurs	non-breeder
Forster's Tern	*Sterna forsteri*	occurs	breeds	occurs	breeds
Black Tern	*Chlidonias niger*	occurs	breeds	occurs	breeds
Rock Dove	*Columba livia*	non-native	breeds	non-native	breeds
Band-tailed Pigeon	*Columba fasciata*	occurs	breeds	occurs	breeds
Mourning Dove	*Zenaida macroura*	occurs	breeds	occurs	breeds
Yellow-billed Cuckoo	*Coccyzus americanus*	occurs	breeds	occurs	bred historically
Barn Owl	*Tyto alba*	occurs	breeds	occurs	breeds
Flammulated Owl	*Otus flammeolus*	occurs	breeds	occurs	breeds
Western Screech-owl	*Otus kennicottii*	occurs	breeds	occurs	breeds
Great Horned Owl	*Bubo virginianus*	occurs	breeds	occurs	breeds
Snowy Owl	*Nyctea scandiaca*	occurs	non-breeder	occurs	non-breeder
Northern Pygmy-owl	*Glaucidium gnoma*	occurs	breeds	occurs	breeds
Burrowing Owl	*Athene cunicularia*	occurs	breeds	occurs	breeds
Barred Owl	*Strix varia*	occurs	breeds	occurs	breeds
Great Gray Owl	*Strix nebulosa*	occurs	breeds	occurs	breeds
Long-eared Owl	*Asio otus*	occurs	breeds	occurs	breeds
Short-eared Owl	*Asio flammeus*	occurs	breeds	occurs	breeds
Boreal Owl	*Aegolius funereus*	occurs	breeds	occurs	breeds
Northern Saw-whet Owl	*Aegolius acadicus*	occurs	breeds	occurs	breeds
Common Nighthawk	*Chordeiles minor*	occurs	breeds	occurs	breeds
Common Poorwill	*Phalaenoptilus nuttallii*	occurs	breeds	occurs	breeds
Black Swift	*Cypseloides niger*	occurs	breeds	occurs	breeds
Vaux's Swift	*Chaetura vauxi*	occurs	breeds	occurs	breeds
White-throated Swift	*Aeronautes saxatalis*	occurs	breeds	occurs	breeds
Black-chinned Hummingbird	*Archilochus alexandri*	occurs	breeds	occurs	breeds

Common Name	Scientific Name	OR Occurrence	OR Breeding Status	WA Occurrence	WA Breeding Status
Calliope Hummingbird	*Stellula calliope*	occurs	breeds	occurs	breeds
Broad-tailed Hummingbird	*Selasphorus platycercus*	occurs	breeds	does not occur	not applicable
Rufous Hummingbird	*Selasphorus rufus*	occurs	breeds	occurs	breeds
Belted Kingfisher	*Ceryle alcyon*	occurs	breeds	occurs	breeds
Lewis's Woodpecker	*Melanerpes lewis*	occurs	breeds	occurs	breeds
Williamson's Sapsucker	*Sphyrapicus thyroideus*	occurs	breeds	occurs	breeds
Red-naped Sapsucker	*Sphyrapicus nuchalis*	occurs	breeds	occurs	breeds
Red-breasted Sapsucker	*Sphyrapicus ruber*	occurs	breeds	occurs	breeds
Downy Woodpecker	*Picoides pubescens*	occurs	breeds	occurs	breeds
Hairy Woodpecker	*Picoides villosus*	occurs	breeds	occurs	breeds
White-headed Woodpecker	*Picoides albolarvatus*	occurs	breeds	occurs	breeds
Three-toed Woodpecker	*Picoides tridactylus*	occurs	breeds	occurs	breeds
Black-backed Woodpecker	*Picoides arcticus*	occurs	breeds	occurs	breeds
Northern Flicker	*Colaptes auratus*	occurs	breeds	occurs	breeds
Pileated Woodpecker	*Dryocopus pileatus*	occurs	breeds	occurs	breeds
Olive-sided Flycatcher	*Contopus cooperi*	occurs	breeds	occurs	breeds
Western Wood-pewee	*Contopus sordidulus*	occurs	breeds	occurs	breeds
Willow Flycatcher	*Empidonax traillii*	occurs	breeds	occurs	breeds
Least Flycatcher	*Empidonax minimus*	occurs	non-breeder	occurs	breeds
Hammond's Flycatcher	*Empidonax hammondii*	occurs	breeds	occurs	breeds
Gray Flycatcher	*Empidonax wrightii*	occurs	breeds	occurs	breeds
Dusky Flycatcher	*Empidonax oberholseri*	occurs	breeds	occurs	breeds
Pacific-slope Flycatcher	*Empidonax difficilis*	occurs	breeds	occurs	breeds
Cordilleran Flycatcher	*Empidonax occidentalis*	occurs	breeds	occurs	breeds
Say's Phoebe	*Sayornis saya*	occurs	breeds	occurs	breeds
Ash-throated Flycatcher	*Myiarchus cinerascens*	occurs	breeds	occurs	breeds
Western Kingbird	*Tyrannus verticalis*	occurs	breeds	occurs	breeds
Eastern Kingbird	*Tyrannus tyrannus*	occurs	breeds	occurs	breeds
Loggerhead Shrike	*Lanius ludovicianus*	occurs	breeds	occurs	breeds
Northern Shrike	*Lanius excubitor*	occurs	non-breeder	occurs	non-breeder
Cassin's Vireo	*Vireo cassinii*	occurs	breeds	occurs	breeds
Hutton's Vireo	*Vireo huttoni*	occurs	breeds	occurs	breeds

Common Name	Scientific Name	OR Occurrence	OR Breeding Status	WA Occurrence	WA Breeding Status
Warbling Vireo	*Vireo gilvus*	occurs	breeds	occurs	breeds
Red-eyed Vireo	*Vireo olivaceus*	occurs	breeds	occurs	breeds
Gray Jay	*Perisoreus canadensis*	occurs	breeds	occurs	breeds
Steller's Jay	*Cyanocitta stelleri*	occurs	breeds	occurs	breeds
Western Scrub-Jay	*Aphelocoma californica*	occurs	breeds	occurs	breeds
Pinyon Jay	*Gymnorhinus cyanocephalus*	occurs	breeds	accidental	non-breeder
Clark's Nutcracker	*Nucifraga columbiana*	occurs	breeds	occurs	breeds
Black-billed Magpie	*Pica pica*	occurs	breeds	occurs	breeds
American Crow	*Corvus brachyrhynchos*	occurs	breeds	occurs	breeds
Northwestern Crow	*Corvus caurinus*	occurs	non-breeder	occurs	breeds
Common Raven	*Corvus corax*	occurs	breeds	occurs	breeds
Horned Lark	*Eremophila alpestris*	occurs	breeds	occurs	breeds
Tree Swallow	*Tachycineta bicolor*	occurs	breeds	occurs	breeds
Violet-green Swallow	*Tachycineta thalassina*	occurs	breeds	occurs	breeds
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	occurs	breeds	occurs	breeds
Bank Swallow	*Riparia riparia*	occurs	breeds	occurs	breeds
Cliff Swallow	*Petrochelidon pyrrhonota*	occurs	breeds	occurs	breeds
Barn Swallow	*Hirundo rustica*	occurs	breeds	occurs	breeds
Black-capped Chickadee	*Poecile atricapillus*	occurs	breeds	occurs	breeds
Mountain Chickadee	*Poecile gambeli*	occurs	breeds	occurs	breeds
Chestnut-backed Chickadee	*Poecile rufescens*	occurs	breeds	occurs	breeds
Bushtit	*Psaltriparus minimus*	occurs	breeds	occurs	breeds
Red-breasted Nuthatch	*Sitta canadensis*	occurs	breeds	occurs	breeds
White-breasted Nuthatch	*Sitta carolinensis*	occurs	breeds	occurs	breeds
Pygmy Nuthatch	*Sitta pygmaea*	occurs	breeds	occurs	breeds
Brown Creeper	*Certhia americana*	occurs	breeds	occurs	breeds
Rock Wren	*Salpinctes obsoletus*	occurs	breeds	occurs	breeds
Canyon Wren	*Catherpes mexicanus*	occurs	breeds	occurs	breeds
Bewick's Wren	*Thryomanes bewickii*	occurs	breeds	occurs	breeds
House Wren	*Troglodytes aedon*	occurs	breeds	occurs	breeds
Winter Wren	*Troglodytes troglodytes*	occurs	breeds	occurs	breeds

Common Name	Scientific Name	OR Occurrence	OR Breeding Status	WA Occurrence	WA Breeding Status
Marsh Wren	*Cistothorus palustris*	occurs	breeds	occurs	breeds
American Dipper	*Cinclus mexicanus*	occurs	breeds	occurs	breeds
Golden-crowned Kinglet	*Regulus satrapa*	occurs	breeds	occurs	breeds
Ruby-crowned Kinglet	*Regulus calendula*	occurs	breeds	occurs	breeds
Western Bluebird	*Sialia mexicana*	occurs	breeds	occurs	breeds
Mountain Bluebird	*Sialia currucoides*	occurs	breeds	occurs	breeds
Townsend's Solitaire	*Myadestes townsendi*	occurs	breeds	occurs	breeds
Veery	*Catharus fuscescens*	occurs	breeds	occurs	breeds
Swainson's Thrush	*Catharus ustulatus*	occurs	breeds	occurs	breeds
Hermit Thrush	*Catharus guttatus*	occurs	breeds	occurs	breeds
American Robin	*Turdus migratorius*	occurs	breeds	occurs	breeds
Varied Thrush	*Ixoreus naevius*	occurs	breeds	occurs	breeds
Gray Catbird	*Dumetella carolinensis*	occurs	breeds	occurs	breeds
Northern Mockingbird	*Mimus polyglottos*	occurs	non-breeder	occurs	breeds
Sage Thrasher	*Oreoscoptes montanus*	occurs	breeds	occurs	breeds
European Starling	*Sturnus vulgaris*	non-native	breeds	non-native	breeds
American Pipit	*Anthus rubescens*	occurs	breeds	occurs	breeds
Bohemian Waxwing	*Bombycilla garrulus*	occurs	non-breeder	occurs	non-breeder
Cedar Waxwing	*Bombycilla cedrorum*	occurs	breeds	occurs	breeds
Orange-crowned Warbler	*Vermivora celata*	occurs	breeds	occurs	breeds
Nashville Warbler	*Vermivora ruficapilla*	occurs	breeds	occurs	breeds
Yellow Warbler	*Dendroica petechia*	occurs	breeds	occurs	breeds
Yellow-rumped Warbler	*Dendroica coronata*	occurs	breeds	occurs	breeds
Black-throated Gray Warbler	*Dendroica nigrescens*	occurs	breeds	occurs	breeds
Townsend's Warbler	*Dendroica townsendi*	occurs	breeds	occurs	breeds
American Redstart	*Setophaga ruticilla*	occurs	breeds	occurs	breeds
Northern Waterthrush	*Seiurus noveboracensis*	occurs	breeds	occurs	breeds
Macgillivray's Warbler	*Oporornis tolmiei*	occurs	breeds	occurs	breeds
Common Yellowthroat	*Geothlypis trichas*	occurs	breeds	occurs	breeds
Wilson's Warbler	*Wilsonia pusilla*	occurs	breeds	occurs	breeds
Yellow-breasted Chat	*Icteria virens*	occurs	breeds	occurs	breeds
Western Tanager	*Piranga ludoviciana*	occurs	breeds	occurs	breeds

Common Name	Scientific Name	OR Occurrence	OR Breeding Status	WA Occurrence	WA Breeding Status
Green-tailed Towhee	*Pipilo chlorurus*	occurs	breeds	occurs	breeds
Spotted Towhee	*Pipilo maculatus*	occurs	breeds	occurs	breeds
American Tree Sparrow	*Spizella arborea*	occurs	non-breeder	occurs	non-breeder
Chipping Sparrow	*Spizella passerina*	occurs	breeds	occurs	breeds
Clay-colored Sparrow	*Spizella pallida*	occurs	non-breeder	occurs	breeds
Brewer's Sparrow	*Spizella breweri*	occurs	breeds	occurs	breeds
Vesper Sparrow	*Pooecetes gramineus*	occurs	breeds	occurs	breeds
Lark Sparrow	*Chondestes grammacus*	occurs	breeds	occurs	breeds
Black-throated Sparrow	*Amphispiza bilineata*	occurs	breeds	occurs	breeds
Sage Sparrow	*Amphispiza belli*	occurs	breeds	occurs	breeds
Savannah Sparrow	*Passerculus sandwichensis*	occurs	breeds	occurs	breeds
Grasshopper Sparrow	*Ammodramus savannarum*	occurs	breeds	occurs	breeds
Fox Sparrow	*Passerella iliaca*	occurs	breeds	occurs	breeds
Song Sparrow	*Melospiza melodia*	occurs	breeds	occurs	breeds
Lincoln's Sparrow	*Melospiza lincolnii*	occurs	breeds	occurs	breeds
Swamp Sparrow	*Melospiza georgiana*	occurs	non-breeder	occurs	non-breeder
White-throated Sparrow	*Zonotrichia albicollis*	occurs	non-breeder	occurs	non-breeder
Harris's Sparrow	*Zonotrichia querula*	occurs	non-breeder	occurs	non-breeder
Harris's Sparrow	*Zonotrichia querula*	occurs	non-breeder	occurs	non-breeder
White-crowned Sparrow	*Zonotrichia leucophrys*	occurs	breeds	occurs	breeds
Golden-crowned Sparrow	*Zonotrichia atricapilla*	occurs	non-breeder	occurs	non-breeder
Dark-eyed Junco	*Junco hyemalis*	occurs	breeds	occurs	breeds
Lapland Longspur	*Calcarius lapponicus*	occurs	non-breeder	occurs	non-breeder
Snow Bunting	*Plectrophenax nivalis*	occurs	non-breeder	occurs	non-breeder
Black-headed Grosbeak	*Pheucticus melanocephalus*	occurs	breeds	occurs	breeds
Lazuli Bunting	*Passerina amoena*	occurs	breeds	occurs	breeds
Bobolink	*Dolichonyx oryzivorus*	occurs	breeds	occurs	breeds
Red-winged Blackbird	*Agelaius phoeniceus*	occurs	breeds	occurs	breeds
Tricolored Blackbird	*Agelaius tricolor*	occurs	breeds	does not occur	not applicable
Western Meadowlark	*Sturnella neglecta*	occurs	breeds	occurs	breeds
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	occurs	breeds	occurs	breeds
Brewer's Blackbird	*Euphagus cyanocephalus*	occurs	breeds	occurs	breeds

Common Name	Scientific Name	OR Occurrence	OR Breeding Status	WA Occurrence	WA Breeding Status
Brown-headed Cowbird	*Molothrus ater*	occurs	breeds	occurs	breeds
Bullock's Oriole	*Icterus bullockii*	occurs	breeds	occurs	breeds
Gray-crowned Rosy-Finch	*Leucosticte tephrocotis*	occurs	breeds	occurs	breeds
Black Rosy-finch	*Leucosticte atrata*	occurs	breeds	does not occur	not applicable
Pine Grosbeak	*Pinicola enucleator*	occurs	breeds	occurs	breeds
Purple Finch	*Carpodacus purpureus*	occurs	breeds	occurs	breeds
Cassin's Finch	*Carpodacus cassinii*	occurs	breeds	occurs	breeds
House Finch	*Carpodacus mexicanus*	occurs	breeds	occurs	breeds
Red Crossbill	*Loxia curvirostra*	occurs	breeds	occurs	breeds
White-winged Crossbill	*Loxia leucoptera*	occurs	non-breeder	occurs	breeds
Common Redpoll	*Carduelis flammea*	occurs	non-breeder	occurs	non-breeder
Pine Siskin	*Carduelis pinus*	occurs	breeds	occurs	breeds
Lesser Goldfinch	*Carduelis psaltria*	occurs	breeds	occurs	breeds
American Goldfinch	*Carduelis tristis*	occurs	breeds	occurs	breeds
Evening Grosbeak	*Coccothraustes vespertinus*	occurs	breeds	occurs	breeds
House Sparrow	*Passer domesticus*	non-native	breeds	non-native	breeds
Total Birds:	**285**				
Mammals					
Virginia Opossum	*Didelphis virginiana*	non-native	breeds	non-native	breeds
Masked Shrew	*Sorex cinereus*	does not occur	not applicable	occurs	breeds
Preble's Shrew	*Sorex preblei*	occurs	breeds	occurs	breeds
Vagrant Shrew	*Sorex vagrans*	occurs	breeds	occurs	breeds
Montane Shrew	*Sorex monticolus*	occurs	breeds	occurs	breeds
Water Shrew	*Sorex palustris*	occurs	breeds	occurs	breeds
Merriam's Shrew	*Sorex merriami*	occurs	breeds	occurs	breeds
Pygmy Shrew	*Sorex hoyi*	does not occur	not applicable	occurs	breeds
Coast Mole	*Scapanus orarius*	occurs	breeds	occurs	breeds
California Myotis	*Myotis californicus*	occurs	breeds	occurs	breeds
Western Small-footed Myotis	*Myotis ciliolabrum*	occurs	breeds	occurs	breeds
Yuma Myotis	*Myotis yumanensis*	occurs	breeds	occurs	breeds
Little Brown Myotis	*Myotis lucifugus*	occurs	breeds	occurs	breeds
Long-legged Myotis	*Myotis volans*	occurs	breeds	occurs	breeds

Common Name	Scientific Name	OR Occurrence	OR Breeding Status	WA Occurrence	WA Breeding Status
Fringed Myotis	*Myotis thysanodes*	occurs	breeds	occurs	breeds
Long-eared Myotis	*Myotis evotis*	occurs	breeds	occurs	breeds
Silver-haired Bat	*Lasionycteris noctivagans*	occurs	breeds	occurs	breeds
Western Pipistrelle	*Pipistrellus hesperus*	occurs	breeds	occurs	breeds
Big Brown Bat	*Eptesicus fuscus*	occurs	breeds	occurs	breeds
Hoary Bat	*Lasiurus cinereus*	occurs	non-breeder	occurs	non-breeder
Townsend's Big-eared Bat	*Corynorhinus townsendii*	occurs	breeds	occurs	breeds
Pallid Bat	*Antrozous pallidus*	occurs	breeds	occurs	breeds
American Pika	*Ochotona princeps*	occurs	breeds	occurs	breeds
Pygmy Rabbit	*Brachylagus idahoensis*	occurs	breeds	occurs	breeds
Eastern Cottontail	*Sylvilagus floridanus*	non-native	breeds	non-native	breeds
Nuttall's (Mountain) Cottontail	*Sylvilagus nuttallii*	occurs	breeds	occurs	breeds
Snowshoe Hare	*Lepus americanus*	occurs	breeds	occurs	breeds
White-tailed Jackrabbit	*Lepus townsendii*	occurs	breeds	occurs	breeds
Black-tailed Jackrabbit	*Lepus californicus*	occurs	breeds	occurs	breeds
Least Chipmunk	*Tamias minimus*	occurs	breeds	occurs	breeds
Yellow-pine Chipmunk	*Tamias amoenus*	occurs	breeds	occurs	breeds
Red-tailed Chipmunk	*Tamias ruficaudus*	does not occur	not applicable	occurs	breeds
Yellow-bellied Marmot	*Marmota flaviventris*	occurs	breeds	occurs	breeds
Hoary Marmot	*Marmota caligata*	does not occur	not applicable	occurs	breeds
Merriam's Ground Squirrel	*Spermophilus canus*	occurs	breeds	does not occur	not applicable
Piute Ground Squirrel	*Spermophilus mollis*	occurs	breeds	does not occur	not applicable
Washington Ground Squirrel	*Spermophilus washingtoni*	occurs	breeds	occurs	breeds
Belding's Ground Squirrel	*Spermophilus beldingi*	occurs	breeds	does not occur	not applicable
Columbian Ground Squirrel	*Spermophilus columbianus*	occurs	breeds	occurs	breeds
Golden-mantled Ground Squirrel	*Spermophilus lateralis*	occurs	breeds	occurs	breeds
Eastern Fox Squirrel	*Sciurus niger*	non-native	breeds	non-native	breeds
Red Squirrel	*Tamiasciurus hudsonicus*	occurs	breeds	occurs	breeds
Douglas' Squirrel	*Tamiasciurus douglasii*	occurs	breeds	occurs	breeds
Northern Flying Squirrel	*Glaucomys sabrinus*	occurs	breeds	occurs	breeds
Northern Pocket Gopher	*Thomomys talpoides*	occurs	breeds	occurs	breeds

Common Name	Scientific Name	OR Occurrence	OR Breeding Status	WA Occurrence	WA Breeding Status
Townsend's Pocket Gopher	*Thomomys townsendii*	occurs	breeds	does not occur	not applicable
Great Basin Pocket Mouse	*Perognathus parvus*	occurs	breeds	occurs	breeds
Ord's Kangaroo Rat	*Dipodomys ordii*	occurs	breeds	occurs	breeds
American Beaver	*Castor canadensis*	occurs	breeds	occurs	breeds
Western Harvest Mouse	*Reithrodontomys megalotis*	occurs	breeds	occurs	breeds
Deer Mouse	*Peromyscus maniculatus*	occurs	breeds	occurs	breeds
Canyon Mouse	*Peromyscus crinitus*	occurs	breeds	does not occur	not applicable
Pinon Mouse	*Peromyscus truei*	occurs	breeds	does not occur	not applicable
Northern Grasshopper Mouse	*Onychomys leucogaster*	occurs	breeds	occurs	breeds
Bushy-tailed Woodrat	*Neotoma cinerea*	occurs	breeds	occurs	breeds
Southern Red-backed Vole	*Clethrionomys gapperi*	occurs	breeds	occurs	breeds
Heather Vole	*Phenacomys intermedius*	occurs	breeds	occurs	breeds
Meadow Vole	*Microtus pennsylvanicus*	does not occur	not applicable	occurs	breeds
Montane Vole	*Microtus montanus*	occurs	breeds	occurs	breeds
Long-tailed Vole	*Microtus longicaudus*	occurs	breeds	occurs	breeds
Water Vole	*Microtus richardsoni*	occurs	breeds	occurs	breeds
Sagebrush Vole	*Lemmiscus curtatus*	occurs	breeds	occurs	breeds
Muskrat	*Ondatra zibethicus*	occurs	breeds	occurs	breeds
Norway Rat	*Rattus norvegicus*	non-native	breeds	non-native	breeds
House Mouse	*Mus musculus*	non-native	breeds	non-native	breeds
Western Jumping Mouse	*Zapus princeps*	occurs	breeds	occurs	breeds
Common Porcupine	*Erethizon dorsatum*	occurs	breeds	occurs	breeds
Coyote	*Canis latrans*	occurs	breeds	occurs	breeds
Gray Wolf	*Canis lupus*	extirpated	bred-historically	occurs	breeds
Red Fox	*Vulpes vulpes*	occurs	breeds	occurs	breeds
Black Bear	*Ursus americanus*	occurs	breeds	occurs	breeds
Raccoon	*Procyon lotor*	occurs	breeds	occurs	breeds
American Marten	*Martes americana*	occurs	breeds	occurs	breeds
Fisher	*Martes pennanti*	occurs	breeds	occurs	breeds
Ermine	*Mustela erminea*	occurs	breeds	occurs	breeds
Long-tailed Weasel	*Mustela frenata*	occurs	breeds	occurs	breeds
Mink	*Mustela vison*	occurs	breeds	occurs	breeds

Common Name	Scientific Name	OR Occurrence	OR Breeding Status	WA Occurrence	WA Breeding Status
Wolverine	*Gulo gulo*	occurs	breeds	occurs	breeds
American Badger	*Taxidea taxus*	occurs	breeds	occurs	breeds
Western Spotted Skunk	*Spilogale gracilis*	occurs	breeds	occurs	breeds
Striped Skunk	*Mephitis mephitis*	occurs	breeds	occurs	breeds
Northern River Otter	*Lutra canadensis*	occurs	breeds	occurs	breeds
Mountain Lion	*Puma concolor*	occurs	breeds	occurs	breeds
Lynx	*Lynx canadensis*	occurs	breeds	occurs	breeds
Bobcat	*Lynx rufus*	occurs	breeds	occurs	breeds
Rocky Mountain Elk	*Cervus elaphus nelsoni*	occurs	breeds	occurs	breeds
Black-tailed Deer (westside)	*Odocoileus hemionus columbianus*	occurs	breeds	occurs	breeds
White-tailed Deer (eastside)	*Odocoileus virginianus ochrourus*	occurs	breeds	occurs	breeds
Moose	*Alces alces*	accidental	non-breeder	occurs	breeds
Pronghorn Antelope	*Antilocapra americana*	occurs	breeds	extirpated	bred-historically
Mountain Goat	*Oreamnos americanus*	reintroduced	breeds	occurs	breeds
Bighorn Sheep	*Ovis canadensis*	occurs	breeds	reintroduced	breeds
Total Mammals:	**92**				
Reptiles					
Painted Turtle	*Chrysemys picta*	occurs	breeds	occurs	breeds
Western Pond Turtle	*Clemmys marmorata*	occurs	breeds	occurs	breeds
Northern Alligator Lizard	*Elgaria coerulea*	occurs	breeds	occurs	breeds
Southern Alligator Lizard	*Elgaria multicarinata*	occurs	breeds	occurs	breeds
Long-nosed Leopard Lizard	*Gambelia wislizenii*	occurs	breeds	does not occur	not applicable
Short-horned Lizard	*Phrynosoma douglassii*	occurs	breeds	occurs	breeds
Desert Horned Lizard	*Phrynosoma platyrhinos*	occurs	breeds	does not occur	not applicable
Sagebrush Lizard	*Sceloporus graciosus*	occurs	breeds	occurs	breeds
Western Fence Lizard	*Sceloporus occidentalis*	occurs	breeds	occurs	breeds
Side-blotched Lizard	*Uta stansburiana*	occurs	breeds	occurs	breeds
Western Skink	*Eumeces skiltonianus*	occurs	breeds	occurs	breeds
Western Whiptail	*Cnemidophorus tigris*	occurs	breeds	does not occur	not applicable
Rubber Boa	*Charina bottae*	occurs	breeds	occurs	breeds
Racer	*Coluber constrictor*	occurs	breeds	occurs	breeds

Common Name	Scientific Name	OR Occurrence	OR Breeding Status	WA Occurrence	WA Breeding Status
Ringneck Snake	*Diadophis punctatus*	occurs	breeds	occurs	breeds
Night Snake	*Hypsiglena torquata*	occurs	breeds	occurs	breeds
Striped Whipsnake	*Masticophis taeniatus*	occurs	breeds	occurs	breeds
Gopher Snake	*Pituophis catenifer*	occurs	breeds	occurs	breeds
Western Terrestrial Garter Snake	*Thamnophis elegans*	occurs	breeds	occurs	breeds
Common Garter Snake	*Thamnophis sirtalis*	occurs	breeds	occurs	breeds
Western Rattlesnake	*Crotalus viridis*	occurs	breeds	occurs	breeds
Total Reptiles:	**21**				
Total Species:	**411**				

Appendix Table 3. Terrestrial Focal Species Selection Matrix for the Grande Ronde subbasin indicating species with any state or federal special status, critical functional link and/or functional specialization with additional annotations for number of KEFs, habitat associations, Partners in Flight species (PIF) and Habitat Evaluation Procedure species (HEP). Focal species are highlighted.

Species Common Name	Federal Listed[1]	State Listed[2]	Critical Functional Link	# of KEFs	Functional Specialist	Managed Species	IBIS Habitat Types Closely Associated With (Ref. #)[3]	# Habitats in Decline or Threatened	PIF Species	HEP Species
Long-toed salamander (*Ambystoma macrodactylum)*			Yes	1			21, 22, 24, 25	1		
Tailed frog (*Ascaphus truei)*		OR-SV					4, 25	1		
Western toad (*Bufo boreas)*		OR-SV WA-C					21, 22, 24, 25	1		
Woodhouse's toad (*Bufo woodhousii)*		OR-SPN					21, 22, 25	1		
Columbia spotted frog (*Rana luteiventris)*	C	OR-SUS WA-C					21, 22, 25	1		
Northern leopard frog (*Rana pipiens*)		OR-SC WA-LE					21, 22, 25	1		
Painted turtle (*Chrysemys picta)*		OR-SC					21, 22, 25	1		
Western pond turtle - *(Clemmys marmorata)*		OR-SC WA-LE					21, 22	0		

Species Common Name	Federal Listed[1]	State Listed[2]	Critical Functional Link	# of KEFs	Functional Specialist	Managed Species	IBIS Habitat Types Closely Associated With (Ref. #)[3]	# Habitats in Decline or Threatened	PIF Species	HEP Species
Desert horned lizard (*Phrynosoma platyrhinos)*		OR-SV					None	0		
Sagebrush lizard (*Sceloporus graciosus)*		OR-SV					None	0		
Ringneck snake (*Diadophis punctatus)*					Yes		None	0		
Striped whipsnake *(Masticophis taeniatus)*		WA-C					None	0		
Western rattlesnake (*Crotalus viridus)*		OR-SV					None	0		
Common Loon (*Gavia immer)*		WA-S					22	0		
Horned grebe (*Podiceps auritus)*		OR-SPN					21, 22	0		
Red-necked grebe *(Podiceps grisegena)*		OR-SC					21, 22	0		
Western grebe (*Aechmophorus occidentalis)*		WA-C					21, 22	0		
American white pelican *(Pelecanus*		OR-SV WA-					21	0		

Species Common Name	Federal Listed[1]	State Listed[2]	Critical Functional Link	# of KEFs	Functional Specialist	Managed Species	IBIS Habitat Types Closely Associated With (Ref. #)[3]	# Habitats in Decline or Threatened	PIF Species	HEP Species
erythrorhynchos)		LE								
Great blue heron (*Ardea herodias)*			Yes	3			19, 21, 22, 25	1		Yes
Turkey vulture (*Cathartes aura)*					Yes		None	0		
Canada goose *(Branta canadensis)*			Yes	1		Yes	19, 21, 22	0		Yes
Redhead *(Aythya collaris)*			Yes	1		Yes	21, 22	0		
Greater scaup (*Aythya marila)*			Yes	1		Yes	21	0		
Harlequin duck (*Histrionicus histrionicus)*		OR-SUS			Yes	Yes	21, 25	1		
Bufflehead (*Bucephala albeola)*		OR-SUS				Yes	4, 21, 22, 24	0		
Barrow's goldeneye (*Bucephala islandica)*		OR-SUS				Yes	4, 21, 22, 24	0		
Bald eagle (*Haliaeetus leucocephalus)*	LT	OR-LT WA-LT					21	0		
Northern goshawk (*Accipiter gentilis)*		OR-SC WA-C					5, 6, 7	2		

Species Common Name	Federal Listed[1]	State Listed[2]	Critical Functional Link	# of KEFs	Functional Specialist	Managed Species	IBIS Habitat Types Closely Associated With (Ref. #)[3]	# Habitats in Decline or Threatened	PIF Species	HEP Species
Swainson's hawk (*Buteo swainsoni)*		OR-SV					15, 16, 19		Yes	
Ferruginous hawk (*Buteo regalis)*		OR-SC WA-LT					15, 16	2		
Golden eagle (*Aquila chrysaetos)*		WA-C					None	0		
Merlin (*Falco columbarius)*		WA-C			Yes		None	0	Yes	
Gyrfalcon (*Falco rusticolus)*					Yes		None	0		
Peregrine falcon (*Falco peregrinus)*		OR-LE WA-S			Yes		None	0		
Sage grouse (*Centrocercus urophasianus)*	C	OR-SV WA-LT				Yes	15, 16	2		
Spruce grouse (*Falcinpennis canadensis)*		OR-SUS				Yes	None	0		
Sharp-tailed grouse (*Tympanuchus phasianellus)*		WA-LT					15, 16, 25	3		
Wild turkey (*Meleagris gallopavo)*			Yes	1		Yes	None	0	Yes	

Species Common Name	Federal Listed[1]	State Listed[2]	Critical Functional Link	# of KEFs	Functional Specialist	Managed Species	IBIS Habitat Types Closely Associated With (Ref. #)[3]	# Habitats in Decline or Threatened	PIF Species	HEP Species
Mountain Quail (*Oreortyx pictus*))		OR-SUS				Yes	None	0		
Sandhill crane *(Grus canadensis)*		OR-SV WA-LE					19, 22	0		
Upland sandpiper *(Bartramia longicauda)*		OR-SC WA-LE					15	1		
Long-billed curlew *(Numenius americanus)*		OR-SV					15, 16, 19	2		
Franklin's gull (*Larus pipixcan)*		OR-SPN					22	0		
Mew gull (*Larus canus)*			Yes	2			21	0		
Black tern (*Chlidonias niger)*			Yes	1			22	0		
Yellow-billed cuckoo (*Coccyzus americanus)*	C	OR-SC WA-C					25	1		
Flammulated owl (*Otus flammeolus)*		OR-SC WA-C					5, 7	1		
Snowy owl (*Nyctea scandiaca)*					Yes		None	0		

Species Common Name	Federal Listed[1]	State Listed[2]	Critical Functional Link	# of KEFs	Functional Specialist	Managed Species	IBIS Habitat Types Closely Associated With (Ref. #)[3]	# Habitats in Decline or Threatened	PIF Species	HEP Species
Northern pygmy owl *(Glaucidium niger)*		OR-SC			Yes		5	0		
Burrowing owl (*Athene cunicularia)*		OR-SC WA-C					15, 16	2		
Great gray owl *(Strix nebulosa)*		OR-SV					6, 7	2		
Boreal owl (*Aegolius funereus)*		OR-SUS			Yes		None	0	Yes	
Common nighthawk (*Chordeiles minor)*		OR-SC			Yes		None	0		
Common poorwill (*Phalaenoptilus nuttallii)*			Yes				None	0		
Black swift *(Cypseloides niger)*		OR-SPN			Yes		None	0	Yes	
Vaux's swift (*Chaetura vauxi)*		WA-C					21	0	Yes	
Black-chinned hummingbird (*Archilochus alexandri)*			Yes	1			None	0	Yes	
Rufous hummingbird *(Selasphorus rufus)*			Yes	2			None	0		

Species Common Name	Federal Listed[1]	State Listed[2]	Critical Functional Link	# of KEFs	Functional Specialist	Managed Species	IBIS Habitat Types Closely Associated With (Ref. #)[3]	# Habitats in Decline or Threatened	PIF Species	HEP Species
Lewis's woodpecker *(Melanerpes lewis)*		OR-SC WA-C					None	0		
Williamson's sapsucker *(Sphyrapicus thyroideus)*		OR-SUS					None	0	Yes	
Red-breasted sapsucker *(Sphyrapicus ruber)*			Yes	1			None	0	Yes	
White-headed woodpecker (*Picoides albolarvatus)*		OR-SC WA-C					7	1		
Three-toed woodpecker *(Picoides tridactylus)*		OR-SC					6	1	Yes	
Black-backed woodpecker (*Picoides arcticus)*		OR-SC WA-C					6	1		
Pileated woodpecker *(Dryocopus pileatus)*		OR-SV WA-C					None	0		
Olive-sided Flycatcher (*Contopus cooperi)*		OR-SV					4, 5		Yes	

Species Common Name	Federal Listed[1]	State Listed[2]	Critical Functional Link	# of KEFs	Functional Specialist	Managed Species	IBIS Habitat Types Closely Associated With (Ref. #)[3]	# Habitats in Decline or Threatened	PIF Species	HEP Species
Willow flycatcher *(Empidonax trailii)*		OR-SV/US					25	1	Yes	
Loggerhead shrike (*Lanius ludovicianus)*		OR-SV WA-C					13, 16, 19	2		
American crow (*Corvus brachyrhynchos)*			Yes	2			19, 20	0		
Horned lark (*Eremophila alpestris)*	C	OR-SC WA-C					15	1		
Bank swallow *(Riparia riparia)*		OR-SUS					21, 25	1		
White-breasted nuthatch (*Sitta carolinensis)*		WA-C					7	1		
Pygmy nuthatch *(Sitta pygmaea)*		OR-SV					7, 25	2	Yes	
Western bluebird (*Sialia mexicana)*		OR-SV					7	1		
Sage thrasher *(Oreoscoptes montanus)*		WA-C					16	1		
Yellow warbler (*Dendroica petechia)*							25	1		
Yellow-breasted chat *(Icteria virens)*		OR-SC					25	1	Yes	

Species Common Name	Federal Listed[1]	State Listed[2]	Critical Functional Link	# of KEFs	Functional Specialist	Managed Species	IBIS Habitat Types Closely Associated With (Ref. #)[3]	# Habitats in Decline or Threatened	PIF Species	HEP Species
Vesper sparrow *(Pooecetes gramineus)*		OR-SC WA-C					15, 16, 19	2	Yes	
Sage sparrow (*Amphispiza belli)*		OR-SC WA-C					16	1	Yes	
Grasshopper sparrow (*Ammodramus savannarum)*		OR-SV/PN					15, 19	1		
Bobolink *(Dolichonyx oryzivorus)*		OR-SV					19	0		
Tri-colored blackbird *(Agelaius tricolor)*		OR-SPN					22	0		
Western meadowlark *(Sturnella neglecta)*		OR-SC					15, 16, 19	2		Yes
Brown-headed cowbird *(Molothrus ater)*			Yes	1			None	0		
Black rosyfinch *(Leucosticte atrata)*		OR-SPN					10	0		
House finch *(Carpodacus mexicanus)*			Yes	3			19, 20	0		
Virginia oppossum			Yes	1			19, 20	0		

Species Common Name	Federal Listed[1]	State Listed[2]	Critical Functional Link	# of KEFs	Functional Specialist	Managed Species	IBIS Habitat Types Closely Associated With (Ref. #)[3]	# Habitats in Decline or Threatened	PIF Species	HEP Species
(Didelphis virginiana)										
Merriam's shrew *(Sorex merriami)*		WA-C					16	1		
Western small-footed myotis (Myotis ciliolabrum)		OR-SUS					13, 14, 15, 16, 21, 25	4		
Long-legged myotis (*Myotis volans)*		OR-SUS					4, 5, 7, 25	3		
Fringed myotis (Myotis thysanodes)		OR-SV					None	0		
Long-eared myotis *(Myotis evotis)*		OR-SUS					None	0		
Big brown bat (*Eptesicus fuscus)*			Yes	1			4, 5, 7, 15, 19, 20, 24, 25	2		
Townsend's big-eared bat *(Corynorhinus townsendii)*		OR-SC WA-C					21	0		
Pallid bat (*Antrozous pallidus)*		OR-SV					14, 16, 21, 22, 25	2		
American pika (*Ochotona princeps)*			Yes	1			10	1		

Species Common Name	Federal Listed[1]	State Listed[2]	Critical Functional Link	# of KEFs	Functional Specialist	Managed Species	IBIS Habitat Types Closely Associated With (Ref. #)[3]	# Habitats in Decline or Threatened	PIF Species	HEP Species
Pygmy rabbit *(Brachylagus idahoensis)*	LE	OR-SV WA-LE					16	1		
Snowshoe hare (*Lepus americanus*			Yes	1			4, 5, 6, 24, 25	2		
White-tailed jackrabbit *(Lepus townsendii)*		OR-SUS WA-C					15	1		
Black-tailed jackrabbit (*Lepus californicus)*		WA-C					16	1		
Golden-mantled ground squirrel (*Spermophilus lateralis)*			Yes	2			4, 5, 7, 13, 14	2		
Red squirrel *(Tamiasciurus hudsonicus)*			Yes	1			5, 6	1		
Northern pocket gopher *(Thomomys talpoides)*		WA-C	Yes	1			5, 6, 7, 15, 19	3		
American beaver (*Castor canadensis)*			Yes	4		Yes	21, 22, 25	1		
Deer mouse *(Peromyscus maniculatus)*			Yes	3			5, 6, 7, 13, 14, 15, 16, 19, 20, 22, 24, 25	5		

Species Common Name	Federal Listed[1]	State Listed[2]	Critical Functional Link	# of KEFs	Functional Specialist	Managed Species	IBIS Habitat Types Closely Associated With (Ref. #)[3]	# Habitats in Decline or Threatened	PIF Species	HEP Species
Bushy-tailed woodrat (*Neotoma cinerea)*			Yes	1			4, 5, 10, 13, 14, 16, 19, 25	3		
Montane vole (*Microtus montanus)*			Yes	1			14, 15, 19, 22	1		
Black bear *(Ursus americanus)*			Yes	6		Yes	None	0		
Raccoon (*Procyon lotor)*			Yes	2			19, 20, 22, 25	1		
American marten (*Martes americana)*		OR-SV					4, 5, 6	1		
Mink (*Mustela vison)*			Yes	1			21, 22, 24, 25	1		Yes
Mountain lion *(Puma concolor)*						Yes	None	0		
Canada lynx *(Lynx canadensis)*	LT	WA-LT			Yes		5, 6	1		
Rocky Mountain elk (*Cervus elaphus)*			Yes	2		Yes	None	0		
Mule deer *(Odocoileus hemionus)*						Yes	None	0		
White-tailed deer (*Odocoileus virginianus)*			Yes	2		Yes	None	0		

Species Common Name	Federal Listed[1]	State Listed[2]	Critical Functional Link	# of KEFs	Functional Specialist	Managed Species	IBIS Habitat Types Closely Associated With (Ref. #)[3]	# Habitats in Decline or Threatened	PIF Species	HEP Species
Pronghorn antelope *(Antilocapra americana)*						Yes	15, 16	2		
Mountain goat *(Oreamnos americanus)*						Yes	10	0		
Rocky Mountain bighorn sheep (*Ovis canadensis)*						Yes	10, 14	0		

[1] Federal Status: C = Candidate; LT = Listed Threatened; LE = Listed Endangered

[2] State Status WA: C = Candidate; LT=Listed Threatened; LE = Listed Endangered

[2] State Status OR: SV = Sensitive-Vulnerable; SC = Sensitive-Critical; SUS = Sensitive-Unclear Status; SPN = Sensitive-Peripheral or Naturally Rare; LE = Listed Endangered

[3] IBIS Habitat Type Reference #s: 4=Montane Mixed Conifer Forest; 5=Interior Mixed Conifer Forest; 6=Lodgepole Pine Forest and Woodlands; 7= Ponderosa Pine (and Interior White Oak) Forest and Woodlands; 10= Alpine Grasslands and Shrublands; 13= (Western Juniper and) Mountain Mahogany Woodlands; 14= Interior Canyon Shrublands; 15= Interior Grasslands; 16= Shrub-steppe; 19= Agriculture, Pastures and Mixed Environs; 20= Urban and Mixed Environs; 21 Open Water - Lakes, Rivers and Streams; 22= Herbaceous Wetlands; 24= Montane Coniferous Wetlands; 25= Interior Riparian-Wetlands; 8= Upland Aspen Forest; 9= Subalpine Parkland.

Appendix Table 4. Invertebrate Species of Conservation Concern in the Grande Ronde Subbasin

Species Name	Global Rank[1]	State Rank[2]	Comments
Stygobromus elliotii -a cave obligate amphipod	G1G2	WA: S?	
Stygonyx courtneyi -a cave obligate amphipod	G1G2	OR:S?	Oregon endemic
Phagocata oregonensis -a cave obligate planarian	G1G2	OR:S?	Oregon endemic
Stygoporus oregonensis -a cave obligate beetle	G1G2	OR:S?	Oregon endemic
Boloria bellona toddi -meadow fritillary	G5T4T5	OR:S?	Oregon endemic
Colias occidentalis pseudochristina - western sulphur	G3G4TU	WA:S1	
Euphyes vestris vestris -dun skipper	G5T4	WA:S1	
Lycaena mariposa charlottensis - Queen Charlotte's copper	G5T5	WA:S1	
Ochlodes yuma- yuma skipper	G5	OR:S1?; WA:S1	
Oeneis nevadensis gigas - greater arctic	G5TU	WA:S1	
Parnassius clodius shepardi - Shepard's parnassian	G5T?	WA:S1	
Speyeria coronis coronis - coronis fritillary	G5T3T4	OR:S1	
Farula constricta - a farulan caddisfly	G1?	OR:S1?	
Gomphus lynnae - Columbia clubtail	G2	OR:S1?; WA:S1	
Melanoplus lovetti - a spur-throat grasshopper	G1G2	OR:S?	Oregon endemic
Melanoplus oreophilus - a spur-throat grasshopper	G1G2	OR:S?	Oregon endemic
Melanoplus ostentus - a spur-throat grasshopper	G1G2	OR:S?	Oregon endemic
Melanoplus rehni - a spur-throat grasshopper	G1G2	OR:S?	Oregon endemic
Melanoplus sp. 12	G1G2	OR:S?	Oregon endemic
Melanoplus sp. 13	G1G2	OR:S?	Oregon endemic
Melanoplus sp. 16	G1G2	OR:S?	Oregon endemic
Melanoplus sp. 27	G1G2	WA:S?	Washington endemic
Melanoplus sp. 37	G1G2	OR:S?	Oregon endemic
Melanoplus sp. 58	G1G2	OR:S?	Oregon endemic
Melanoplus sp. 7	G1G2	OR:S?	Oregon endemic
Melanoplus sp. 8	G1G2	OR:S?	Oregon endemic
Ameletus amador- a mayfly	G1	OR:S?	
Ameletus andersoni - a mayfly	G1	OR:S?; WA:S?	
Ameletus dissitus - a mayfly	G1	OR:S?	
Ameletus exquisitus- a mayfly	G1	OR:S?; WA:S?	
Ameletus minimus - a mayfly	G1	OR:S?	
Ameletus tolae - a mayfly	G1	OR:S?	
Baetis caurinus - a mayfly	G1	OR:S?	
Baetisca columbiana - a mayfly	G1	WA:S?	

Leptophlebia pacifica - a mayfly	G1	OR:S?	Oregon endemic
Leucrocuta jewetti - a mayfly	G1	OR:S?	
Nixe rosea - a mayfly	G1	OR:S?	
Paraleptophlebia aquilina - a mayfly	G1	OR:S?	Oregon endemic
Paraleptophlebia falcula - a mayfly	G1	OR:S?	
Paraleptophlebia jenseni - a mayfly	G1	WA:S?	
Procloeon venosum - a mayfly	G1	OR:S?	
Serratella velmae - a mayfly	G1	OR:S?	
Acalypta lillianus - a lace bug	G4	OR:S1	
Micracanthia fennica - a shore bug	G1	OR:S1	
Onychiurus oregonensis -a cave obligate springtail	G1G2	OR:S?	Oregon endemic
Saldula villosa - a shore bug	G3	OR:S1	
Sixeonotus sp. 1 - a plant bug from Oregon	G2	OR:S1	
Teratocoris paladum - a plant bug	G4	OR:S1	
Vanduzeeina borealis californica - California scutellerid	G3T3	OR:S1	
Capnura anas - a stonefly	G1	OR:S?	Oregon endemic
Lednia tumana - meltwater lednian stonefly	G1	WA:S1	
Soliperla fenderi - Fender's soliperlan stonefly	G2	WA:S1S2	Washington endemic
Macromastus umpqua - a cave obligate millipede	G1G2	OR:S?	Oregon endemic
Anodonta californiensis - California floater	G3	OR:S1?; WA:S1S2	
Gonidea angulata - western ridged mussel	G3	OR:S3?; WA:S1S2	
Fluminicola sp. 19 - Keene Creek pebblesnail	GU	OR:S1	
Gyraulus crista - star gyro	G5	OR:S1; WA:S?	
Helisoma anceps - two-ridge rams-horn	G5	OR:S1; WA:S?	
Helisoma newberryi newberryi - Great Basin rams-horn	G1T?	OR:S1	
Juga hemphilli - barren juga	G2	OR:S2; WA:S1	
Juga hemphilli dallesensis - Dalles juga	G2T1	OR:S1; WA:S1	
Juga hemphilli hemphilli - barren juga	G2T1	OR:S1; WA:S1	
Juga hemphilli ssp. 1 - Indian Ford juga	G2T1	OR:S1	
Juga sp. 2 - Blue Mountains juga	G1	OR:S1	
Juga sp. 3 - brown juga	G2	OR:S1	
Physa megalochlamys - cloaked physa	G3	OR:S1	
Physella cooperi - olive physa	G3	OR:S1S2; WA:S?	
Physella hordacea - grain physa	G1	OR:S1; WA:S?	
Physella lordi - twisted physa	G5	OR:S2; WA:S1	
Physella sp. 1 - Owyhee wet-rock physa	G1	OR:S1	Oregon endemic
Physella virginea - sunset physa	G2	OR:S1; WA:S?	
Planorbella binneyi - coarse rams-horn	G4Q	OR:S2; WA:S1	
Pomatiopsis californica - Pacific walker	G1	OR:S1	
Pomatiopsis chacei - marsh walker	G1	OR:S1	
Promenetus exacuous - sharp sprite	G5	OR:S1; WA:S?	

Pyrgulopsis sp. 8 - Columbia springtail	G2	OR:S1	
Cryptomastix hendersoni - Columbia Oregonian	G2	OR:S1; WA:S?	
Cryptomastix populi - a land snail (Hells Canyon)	G2	OR:S1	
Cryptomastix sp. 3 - disc Oregonian	G2	OR:S1	
Helminthoglypta hertleini - Oregon shoulderband	G1	OR:S1	
Hemphillia burringtoni - keeled junping-slug	G1G2	WA:S?	
Hemphillia glandulosa - warty jumping-slug	G1G3	OR:S1	
Hemphillia malonei - Malone jumping-slug	G1	OR:S1	Oregon endemic
Monadenia fidelis celeuthia - Pacific sideband	G?T?	OR:S1	
Monadenia fidelis columbiana - Pacific sideband	G?T?	OR:S1	
Monadenia fidelis ssp. 1 - Deschutes sideband	G?T1	OR:S1	Oregon endemic
Monadenia sp. 1 - Modoc Rim sideband	G1	OR:S1	Oregon endemic
Oreohelix hammeri - Seven Devils mountainsnail	GU	OR:S1?	
Oreohelix junii - Grand Coulee mountainsnail	G1	WA:S?	
Oreohelix sp. 29 - Hells Canyon mountainsnail	G?	OR:S1	
Oreohelix strigosa delicata - Blue mountainsnail	G5T1	OR:S1	Oregon endemic
Oreohelix variabilis ssp. 1 - Deschutes mountainsnail	G2T1	OR:S1	Oregon endemic
Pristiloma pilsbryi - crowned tightcoil	G1	WA:S?	
Vespericola sp. 1 - Oaks Springs hesperian	G1	OR:S1	
Apochthonius forbesi - a cave obligate pseudoscorpion	G1G2	OR:S?	
Elliota howarthi - a cave obligate mite	G1G2	WA:S?	
Parobisium charlotteae - a cave obligate pseudoscorpion	G1G2	OR:S?	Oregon endemic
Taracus silvestrii - a cave obligate harvestman	G1G2	OR:S?	Oregon endemic
Driloleirus macelfreshi - Oregon giant earthworm	G1	OR:S1	

Natural Heritage Rank Definitions:

[1] **Global Rank (GRank)** characterizes the relative rarity or endangerment of the element world-wide. Two codes (e.g. G1G2) represent an intermediate rank:

G1 = Critically imperiled globally (5 or fewer occurrences).
G2 = Imperiled globally (6 to 20 occurrences).
G3 = Either very rare and local throughout its range or found locally in a restricted range (21 to 100 occurrences).
G4 = Apparently secure globally.
G5 = Demonstrably secure globally
Tn = Rarity of an infraspecific taxon. Numbers similar to those for Gn ranks above.
Q = Questionable.

[2] **State Rank (SRank)** characterizes the relative rarity or endangerment within the state of Washington. Two codes (e.g. S1S2) represent an intermediate rank:

S1 = Critically imperiled (5 or fewer occurrences).
S2 = Vulnerable to extirpation (6 to 20 occurrences).
S3 = Rare or uncommon (21 to 100 occurrences).
S? = Not yet ranked.

6.3 Appendix 3: Comprehensive Focal Species Accounts

6.3.1 Columbia Spotted Frog

Columbia Spotted Frog (*Rana luteiventris*). Keith Paul, USFWS, La Grande, Oregon.

Introduction

The Columbia spotted frog (CSF) is olive green to brown in color, with irregular black spots. They may have white, yellow, or salmon coloration on the underside of the belly and legs (Engle 2004). The hind legs are relatively short relative to body length and there is extensive webbing between the toes on the hind feet. The eyes are upturned (Amphibia Web 2004). Tadpoles are black when small, changing to a dark then light brown as they increase in size. CSFs are about one inch in body length at metamorphosis (Engle 2004). Females may grow to approximately 100 mm (4 inches) snout-to-vent length, while males may reach approximately 75 mm (3 inches) snout-vent length (Nussbaum et al. 1983; Stebbins 1985; Leonard et al. 1993).

Columbia Spotted Frog Life History, Key Environmental Correlates, and Habitat Requirements

Life History

Diet

The CSF eats a variety of food including arthropods (e.g., spiders, insects), earthworms and other invertebrate prey (Whitaker et al. 1982). Adult CSFs are opportunistic feeders and feed primarily on invertebrates (Nussbaum et al. 1983). Larval frogs feed on aquatic algae and vascular plants, and scavenged plant and animal materials (Morris and Tanner 1969).

In a study by Whitaker et al. (1982) in Grant County, OR (Blue Mountains) CSFs ate a wide variety of food items covering 98 food categories. Seventy-three categories consisted of insect materials, which represented 90.7% of the food by volume. Other invertebrates formed seven categories, and plant material formed three categories, representing 3.9% of the total volume. Frogs from the four variously managed sites displayed different dietary habits, indicating that land management practices may have caused changes in the abundance or composition of local insect populations.

Reproduction

The timing of breeding varies widely across the species range owing to differences in weather and climate, but the first visible activity begins in late winter or spring shortly after areas of ice-free water appear at breeding sites (Licht 1975; Turner 1958; Leonard et al 1996). Breeding typically occurs in late March or April, but at higher elevations, breeding may not occur until late May or early June (Amphibia Web 2004). Great Basin population CSFs emerge from wintering sites soon after breeding sites thaw (Engle 2001).

Adults exhibit a strong fidelity to breeding sites, with oviposition typically occurring in the same areas in successive years. Males arrive first, congregating around breeding sites, periodically vocalizing “advertisement calls” in a rapid series of 3-12 “tapping” notes that have little carrying power (Davidson 1995; Leonard et al. 1996). As a female enters the breeding area, she is approached by and subsequently pairs with a male in a nuptial embrace referred to as amplexus. From several hours to possibly days later, the female releases her complement of eggs into the water while the male, still clinging to the female, releases sperm upon the ova

(Amphibia Web 2004). Breeding is explosive (as opposed to season-long), occurring only in the first few weeks following emergence (USFWS 2002a). After breeding is completed, adults often disperse into adjacent wetland, riverine and lacustrine habitats (Amphibia Web 2004).

CSF's have a strong tendency to lay their eggs communally and it is not uncommon to find 25 or more egg masses piled atop one another in the shallows (Amphibia Web 2004). Softball-sized egg masses are usually found in groups, typically along northeast edges of slack water amongst emergent vegetation (USFWS 2002a). After a few weeks thousands of small tadpoles emerge and cling to the remains of the gelatinous egg masses. Newly-hatched larvae remain clustered for several days before moving throughout their natal site (USFWS 2002a). In the Columbia Basin tadpoles may grow to 100 mm (4 in) total length prior to metamorphosing into froglets in their first summer or fall. At high-elevation montane sites, however, tadpoles barely reach 45 mm (1.77 in) in total length prior to the onset of metamorphosis in late fall (Amphibia Web 2004). As young-of-the-year transform, many leave their natal sites and can be found in nearby riparian corridors (USFWS 2002a).

Females may lay only one egg mass per year; yearly fluctuations in the sizes of egg masses are extreme (Utah Division of Wildlife Resources 1998). Successful egg production and the viability and metamorphosis of CSF's are susceptible to habitat variables such as temperature, depth, and pH of water, cover, and the presence/absence of predators (e.g., fishes and bullfrogs) (Morris and Tanner 1969; Munger et al. 1996; Reaser 1996).

Migration

David Pilliod observed movements of approximately 2,000 m (6,562 ft) linear distance within a basin in montane habitats (Reaser and Pilliod, in press). Pilliod et al. 1996 (in Koch et al. 1997) reported that individual high mountain lake populations of *R. luteiventris* in Idaho are actually interdependent and are part of a larger contiguous metapopulation that includes all the lakes in the basin. In Nevada, Reaser (1996; in Koch et al. 1997) determined that one individual of R. luteiventris traveled over 5 km (3.11 mi) in a year (NatureServe 2003).

In a three-year study of R. luteiventris movement within the Owyhee Mountain subpopulation of the Great Basin population in southwestern Idaho, Engle (2000) PIT-tagged over 1800 individuals but documented only five (of 468) recaptures over 1,000 m (3,281 ft) from their original capture point. All recaptures were along riparian corridors and the longest distance between capture points was 1,765 m (5,791). Although gender differences were observed, 88 percent of all movement documented was less than 300 m (984 ft) from the original capture point (NatureServe 2003).

Though movements exceeding 1 km (0.62 mi) and up to 5 km (3.11 mi) have been recorded, these frogs generally stay in wetlands and along streams within 0.6 km (0.37 mi) of their breeding pond (Turner 1960, Hollenbeck 1974, Bull and Hayes 2001). Frogs in isolated ponds may not leave those sites (Bull and Hayes 2001) (NatureServe 2003).

In the Toiyabe Range in Nevada, Reaser (2000) captured 887 individuals over three years, with average mid-season density ranging from 2 to 24 frogs per 150 m (492 ft) of habitat (NatureServe 2003).

Mortality

Based on recapture rates in the Owyhee Mountains, some individuals live for at least five years. Skeletochronological analysis in 1998 revealed a 9-year old female (Engle and Munger 2000).

Mortality of eggs, tadpoles, and newly metamorphosed frogs is high, with approximately 5% surviving the first winter (David Pilliod, personal communication, cited in Amphibia Web 2004).

Habitat Requirements

General

This species is relatively aquatic and is rarely found far from water. It occupies a variety of still water habitats and can also be found in streams and creeks (Hallock and McAllister 2002). CSF's are found closely associated with clear, slow-moving or ponded surface waters, with little shade (Reaser 1997). CSF's are found in aquatic sites with a variety of vegetation types, from grasslands to forests (Csuti 1997). A deep silt or muck substrate may be required for hibernation and torpor (Morris and Tanner 1969). In colder portions of their range, CSF's will use areas where water does not freeze, such as spring heads and undercut streambanks with overhanging vegetation (IDFG et al. 1995). CSF's may disperse into forest, grassland, and brushland during wet weather (NatureServe 2003). They will use stream-side small mammal burrows as shelter. Overwintering sites in the Great Basin include undercut banks and spring heads (Blomquist and Tull 2002).

Breeding

Reproducing populations have been found in habitats characterized by springs, floating vegetation, and larger bodies of pooled water (e.g., oxbows, lakes, stock ponds, beaver-created ponds, seeps in wet meadows, backwaters) (IDFG et al. 1995; Reaser 1997). Breeding habitat is the temporarily flooded margins of wetlands, ponds, and lakes (Hallock and McAllister 2002). Breeding habitats include a variety of relatively exposed, shallow-water (<60 cm), emergent wetlands such as sedge fens, riverine over-bank pools, beaver ponds, and the wetland fringes of ponds and small lakes. Vegetation in the breeding pools generally is dominated by herbaceous species such as grasses, sedges (Cares spp.) and rushes (Juncus spp.) (Amphibia Web 2004).

Columbia Spotted Frog Population and Distribution

Distribution

Populations of the CSF are found from Alaska and British Columbia to Washington east of the Cascades, eastern Oregon, Idaho, the Bighorn Mountains of Wyoming, the Mary's, Reese, and Owyhee River systems of Nevada, the Wasatch Mountains, and the western desert of Utah (Green et al. 1997). Genetic evidence (Green et al. 1996) indicates that Columbia spotted frogs may be a single species with three subspecies, or may be several weakly-differentiated species.

The FWS recognizes four distinct population segments (DPS) based on disjunct distribution: the Wasatch Front DPS (Utah), West Desert DPS (White Pine County, NV and Toole County Utah), Great Basin DPS (southeast Oregon, southwest Idaho, and northcentral/northeast Nevada), and the Northern DPS (includes northeastern Oregon, eastern Washington, central and northern parts of Idaho, western Montana, northwestern Wyoming, British Columbia and Alaska) (C. Mellison, J. Engle, pers. comm., 2004).

There is still some uncertainty about whether the northeast Oregon frogs and the southeastern Washington frogs are part of the Great Basin or Northern population. This group of frogs (Blue and Wallowa Mountains) is isolated from the Great Basin population based on geography. Their habitat in the Blue and Wallowa Mountains is more like that of the Northern population (montane) than the Great Basin (high desert). Until more genetic work is completed, this account will refer to the Blue and Wallowa Mountain populations as part of the Northern DPS.

Two populations of CSFs are found within the Columbia River Basin: Northern DPS and Great Basin DPS. The Great Basin DPS is further divided into five subpopulations: southeastern Oregon, Owyhee, Jarbidge-Independence, Ruby Mountains, and Toiyabe (J. Engle, C. Mellison, pers. comm., 2004). Of the five subpopulations, only the eastern Oregon, Owyhee, and the Jarbidge-Independence occur in the Columbia River subbasin.

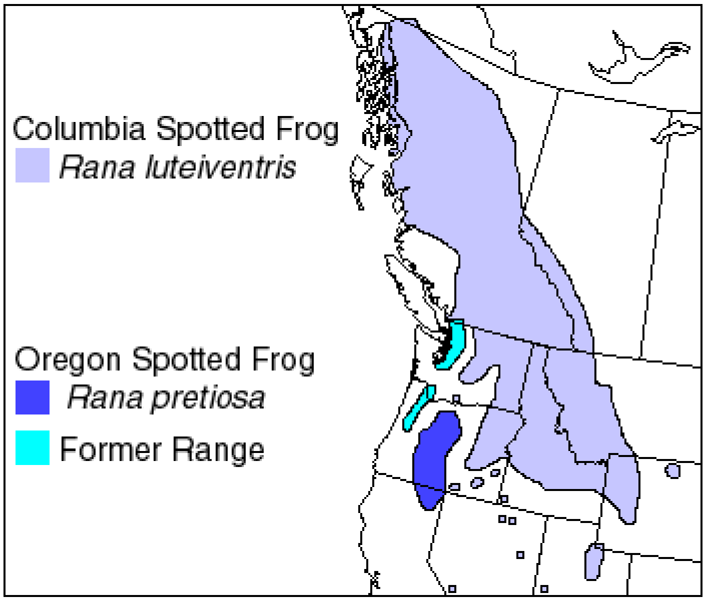
Historic

The historic range of the spotted frog includes Alaska, California, Idaho, Montana, Nevada, Oregon, Utah, Washington, Wyoming, and Alberta and British Columbia, Canada (Turner and Dumas 1972, Nussbaum et al. 1983, Hovingh 1986).

In Alaska, the historic distribution was restricted to southeast Alaska (Hodge 1976). Historic distributions in California include the Warner Mountains in Modoc County and a few locations in Lassen and Siskiyou County (Storer 1925). In Idaho, the historic range primarily occurred in the northern and central part of the state, where it is still considered common (Dumas 1964, 1966; Nussbaum et al. 1983), with scattered populations in the southwestern portion of the state. In Montana, the historical distribution occurred in the intermountain region of western Montana and extended east to the Rocky Mountain Front (Black 1969). The historical distribution in Nevada consisted of the north-central region of the state. In Oregon, spotted frogs were reported to have occurred throughout much of the state (Dumas 1966, Shay 1973, Marshall 1992). In Utah between 1930 and 1977, spotted frogs where recorded from 25 locations in Sanpete, Juab, Utah, Salt Lake, Wasatch, and Summit Counties and various locations along the western Utah/Nevada border (Utah Department of Natural Resources 1991). In Washington, spotted frogs were historically abundant throughout western Washington, including the Cascades and portions of eastern Washington. In Wyoming, the historical range included the northwest part of the state. In Canada, the spotted frog was historically found throughout British Columbia and the western edge of Alberta (USFWS 1992).

Historic range of the Northern population is most likely similar to that of the current range. Moving south into the southern populations (Great Basin, Wasatch Front, and West Desert) the range was most likely larger in size. Due to habitat loss and alteration, fragmentation, water diversion, dams, and loss of beaver the current distribution and abundance of CSF and suitable habitat has dramatically decreased.

Current



USGS, Northern Prairie Wildlife Research Center; range acquired from Green et al. 1997.

Wasatch Front DPS

Spotted frog populations in Utah represent the southern extent of the species range (Stebbins 1985). The Wasatch Front population occurs in isolated springs or riparian wetlands in Juab, Sanpete, Summit, Utah, and Wasatch counties in Utah. These counties are located within the Bonneville Basin of Utah. The Bonneville Basin encompasses the area that was covered by ancient Lake Bonneville and which, today, lies within the Great Basin province. The largest known concentration is currently in the Heber Valley; the remaining six locations are Jordanelle/Francis, Springville Hatchery, Holladay Springs, Mona Springs Complex/Burraston Ponds, Fairview, and Vernon (USFWS 2002b).

West Desert DPS

The West Desert spotted frog population occurs mainly in four large spring complexes. One new population, Vernon, was recently discovered in the eastern-most portion of the West Desert geographic management unit (GMU). CSFs in the West Desert DPS can be found along the eastern border of White Pine County, NV and Toole County, Utah. Populations have been extirpated from the northern portions of the West Desert range (USFWS 2002b).

Northern DPS

The Northern DPS includes northeastern Oregon, eastern Washington, central and northern parts of Idaho, western Montana, northwestern Wyoming, British Columbia and Alaska (J. Engle, C. Mellison, pers. comm., 2004). Populations within the Blue and Wallowa Mountains are found within this DPS.

Great Basin DPS

Nevada

The Great Basin population of Columbia spotted frogs in Nevada is geographically separated into three distinct subpopulations; the Jarbidge-Independence Range, Ruby Mountains, and Toiyabe Mountains subpopulations (USFWS 2002c).

The largest of Nevada's three subpopulation areas is the Jarbidge-Independence Range in Elko and Eureka counties. This subpopulation area is formed by the headwaters of streams in two major hydrographic basins. The South Fork Owyhee, Owyhee, Bruneau, and Salmon Falls drainages flow north into the Snake River basin. Mary's River, North Fork of the Humboldt, and Maggie Creek drain into the interior Humboldt River basin. The Jarbidge-Independence Range subpopulation is considered to be genetically and geographically most closely associated with Columbia spotted frogs in southern Idaho (Reaser 1997)(USFWS 2002c).

Columbia spotted frogs occur in the Ruby Mountains in the areas of Green Mountain, Smith, and Rattlesnake creeks on lands in Elko County managed by the U.S. Forest Service (Forest Service). Although geographically, Ruby Mountains spotted frogs are close to the Jarbidge-Independence Range subpopulation, preliminary allozyme evidence suggests they are genotypically different (J. Reaser, pers. comm., 1998). The Ruby Mountains subpopulation is considered discrete because of this difference (J. Reaser, pers. comm., 1998) and because it is geographically isolated from the Jarbidge-Independence Range subpopulation area to the north by an undetermined barrier (e.g., lack of suitable habitat, connectivity, and/or predators), and from the Toiyabe Mountains subpopulation area to the southwest by a large gap in suitable Humboldt River drainage habitat (USFWS 2002c).

In the Toiyabe Range, spotted frogs are found in seven drainages in Nye County, Nevada; the Reese River (Upper and Lower), Cow and Ledbetter Canyons, and Cloverdale, Stewart, Illinois, and Indian Valley Creeks. Although historically they also occurred in Lander County, preliminary surveys have found them absent from this area (J. Tull, Forest Service, pers. comm., 1998). Toiyabe Range spotted frogs are geographically isolated from the Ruby Mountains and Jarbidge-Independence Range subpopulations by a large gap in suitable habitat and they represent R. luteiventris in the southern-most extremity of its range. Genetic analyses of Great Basin Columbia spotted frogs from the Toiyabe Range suggest that these frogs are distinctive in comparison to frogs from the Ruby Mountains and Jarbidge-Independence Range subpopulation areas (Green et al. 1996, 1997; J. Reaser, pers. comm., 1998). Genetic (mtDNA) differences between the Toiyabe Range frogs and the Ruby Mountains frogs are less than those between the Toiyabe Range frogs and the Jarbidge-Independence Range frogs, but this may be because of similar temporal and spatial isolation (J. Reaser, pers. comm., 1998) (USFWS 2002c).

Idaho and Oregon

Surveys conducted in the Raft River and Goose Creek drainages in Idaho failed to relocate spotted frogs (Reaser 1997; Shipman and Anderson 1997; Turner 1962). In 1994 and 1995, the Bureau of Land Management (BLM) conducted surveys in the Jarbidge and Snake River Resource Areas in Twin Falls County, Idaho. These efforts were also unsuccessful in locating spotted frogs (McDonald 1996). Only six historical sites were known in the Owyhee Mountain range in Idaho, and only 11 sites were known in southeastern Oregon in Malheur County prior to 1995 (Munger et al. 1996) (USFWS 2002c).

Currently, Columbia spotted frogs appear to be widely distributed throughout southwestern Idaho (mainly in Owyhee County) and eastern Oregon, but local populations within this general area appear to be isolated from each other by either natural or human induced habitat disruptions. The largest local population of spotted frogs in Idaho occurs in Owyhee

County in the Rock Creek drainage. The largest local population of spotted frogs in Oregon occurs in Malheur County in the Dry Creek Drainage (USFWS 2002c).

Columbia Spotted Frog Population, Status, and Abundance Trends

Nevada

Declines of Columbia spotted frog populations in Nevada have been recorded since 1962 when it was observed that in many Elko County localities where spotted frogs were once numerous, the species was nearly extirpated (Turner 1962). Extensive loss of habitat was found to have occurred from conversion of wetland habitats to irrigated pasture and spring and stream dewatering by mining and irrigation practices. In addition, there was evidence of extensive impacts on riparian habitats due to intensive livestock grazing. Recent work by researchers in Nevada have documented the loss of historically known sites, reduced numbers of individuals within local populations, and declines in the reproduction of those individuals (Hovingh 1990; Reaser 1996a, 1996b, 1997). Surveys in Nevada between 1994 and 1996 indicated that 54 percent of surveyed sites known to have frogs before 1993 no longer supported individuals (Reaser 1997) (USFWS 2002c).

Little historical or recent data are available for the largest subpopulation area in Nevada, the Jarbidge-Independence Range. Presence/absence surveys have been conducted by Stanford University researchers and the Forest Service, but dependable information on numbers of breeding adults and trends is unavailable. Between 1993 and 1998, 976 sites were surveyed for the presence of spotted frogs in northeastern Nevada, including the Ruby Mountains subpopulation area (Shipman and Anderson 1997; Reaser 2000). Of these, 746 sites (76 percent) that were believed to have characteristics suitable for frogs were unoccupied. For these particular sites there is no information on historical presence of spotted frogs. Of 212 sites that were known to support frogs before 1992, 107 (50 percent) sites no longer had frogs, while 105 sites did support frogs. At the occupied sites, surveyors observed more than 10 adults at only 13 sites (12 percent). Frogs in this area appear widely distributed (Reaser 1997). No monitoring or surveying has taken place in northeastern Nevada since 1998. The Forest Service is planning on surveying the area during the summer of 2002 (USFWS 2002c).

Between 1993 and 1998, 339 sites were surveyed for the presence of Columbia spotted frogs in the Toiyabe Range. Surveyors visited 118 sites (35 percent) with suitable habitat characteristics where no frogs were present. Ten historical frog sites no longer had frogs when surveyed by Reaser between 1993 and 1996 (Reaser 1997). However, at 211 other historical sites, frogs were still present during this survey period. Of these 211 sites, surveyors reported greater than 10 adult frogs at 133 sites (63 percent) (Reaser 1997). In 2000, frog mark-recapture surveys of the Toiyabe Range subpopulation was conducted by the University of Nevada, Reno. Preliminary estimates of frog numbers in the Indian Valley Creek drainage were around 5,000 breeding individuals, which is greater than previously believed (K. Hatch, pers. comm., 2001). However, during the 2000-2001 winter, Hatch (2002) noted a large population decrease, ranging between 66 and 86.5 percent at several sites. Research is currently being conducted to help understand this apparent winterkill. Lack of standardized or extensive monitoring and routine surveying has prevented dependable determinations of frog population numbers or trends in Nevada (USFWS 2002c).

Idaho and Oregon

Extensive surveys since 1996 throughout southern Idaho and eastern Oregon, have led to increases in the number of known spotted frog sites. Although efforts to survey for spotted frogs have increased the available information regarding known species locations, most of these data suggest the sites support small numbers of frogs. Of the 49 known local populations in southern Idaho, 61 percent had 10 or fewer adult frogs and 37 percent had 100 or fewer adult frogs (Engle 2000; Idaho Conservation Data Center (IDCDC) 2000). The largest known local population of spotted frogs occurs in the Rock Creek drainage of Owyhee County and supports under 250 adult frogs (Engle 2000). Extensive monitoring at 10 of the 46 occupied sites since 1997 indicates a general decline in the number of adult spotted frogs encountered (Engle 2000; Engle and Munger 2000; Engle 2002). All known local populations in southern Idaho appear to be functionally isolated (Engle 2000; Engle and Munger 2000) (USFWS 2002c).

Of the16 sites that are known to support Columbia spotted frogs in eastern Oregon, 81 percent of these sites appear to support fewer than 10 adult spotted frogs. In southeastern Oregon, surveys conducted in 1997 found a single population of spotted frogs in the Dry Creek drainage of Malheur County. Population estimates for this site are under 300 adult frogs (Munger et al. 1996). Monitoring (since 1998) of spotted frogs in northeastern Oregon in Wallowa County indicates relatively stable, small local populations (less than five adults encountered) (Pearl 2000). All of the known local populations of spotted frogs in eastern Oregon appear to be functionally isolated (USFWS 2002c).

Legal Status

In 1989, the U.S. Fish and Wildlife Service (USFWS) was petitioned to list the spotted frog (referred to as *Rana pretiosa*) under ESA (Federal Register 54[1989]:42529). The USFWS ruled on April 23, 1993, that the listing of the spotted frog was warranted and designated it a candidate for listing with a priority 3 for the Great Basin population, but was precluded from listing due to higher priority species (Federal Register 58[87]:27260). The major impetus behind the petition was the reduction in distribution apparently associated with impacts from water developments and the introduction of nonnative species.

On September 19, 1997 (Federal Register 62[182]:49401), the USFWS downgraded the priority status for the Great Basin population of Columbia spotted frogs to a priority 9, thus relieving the pressure to list the population while efforts to develop and implement specific conservation measures were ongoing. As of January 8, 2001 (Federal Register 66[5]:1295-1300), however, the priority ranking has been raised back to a priority 3 due to increased threats to the species. This includes the Great Basin DPS Columbia spotted frog populations

Factors Affecting Columbia Spotted Frog Population Status
Key Factors Inhibiting Populations and Ecological Processes

<u>The present or threatened destruction, modification, or curtailment of its habitat or range</u>

Spotted frog habitat degradation and fragmentation is probably a combined result of past and current influences of heavy livestock grazing, spring development, agricultural development, urbanization, and mining activities. These activities eliminate vegetation necessary to protect frogs from predators and UV-B radiation; reduce soil moisture; create undesirable changes in water temperature, chemistry and water availability; and can cause restructuring of habitat zones through trampling, rechanneling, or degradation which in turn can negatively affect the available invertebrate food source (IDFG et al. 1995; Munger et al. 1997; Reaser 1997; Engle and Munger

2000; Engle 2002). Spotted frog habitat occurs in the same areas where these activities are likely to take place or where these activities occurred in the past and resulting habitat degradation has not improved over time. Natural fluctuations in environmental conditions tend to magnify the detrimental effects of these activities, just as the activities may also magnify the detrimental effects of natural environmental events (USFWS 2002c).

Springs provide a stable, permanent source of water for frog breeding, feeding, and winter refugia (IDFG et al. 1995). Springs provide deep, protected areas which serve as hibernacula for spotted frogs in cold climates. Springs also provide protection from predation through underground openings (IDFG et al. 1995; Patla and Peterson 1996). Most spring developments result in the installation of a pipe or box to fully capture the water source and direct water to another location such as a livestock watering trough. Loss of this permanent source of water in desert ecosystems can also lead to the loss of associated riparian habitats and wetlands used by spotted frogs. Developed spring pools could be functioning as attractive nuisances for frogs, concentrating them into isolated groups, increasing the risk of disease and predation (Engle 2001). Many of the springs in southern Idaho, eastern Oregon, and Nevada have been developed (USFWS 2002c).

The reduction of beaver populations has been noted as an important feature in the reduction of suitable habitat for spotted frogs. Beaver are important in the creation of small pools with slow-moving water that function as habitat for frog reproduction and create wet meadows that provide foraging habitat and protective vegetation cover, especially in the dry interior western United States (St. John 1994). Beaver trapping is still common in Idaho and harvest is unregulated in most areas (IDFG et al. 1995). In some areas, beavers are removed because of a perceived threat to water for agriculture or horticultural plantings. As indicated above, permanent ponded waters are important in maintaining spotted frog habitats during severe drought or winter periods. Removal of a beaver dam in Stoneman Creek in Idaho is believed to be directly related to the decline of a spotted frog subpopulation there. Intensive surveying of the historical site where frogs were known to have occurred has documented only one adult spotted frog (Engle 2000) (USFWS 2002c).

Fragmentation of habitat may be one of the most significant barriers to spotted frog recovery and population persistence. Recent studies in Idaho indicate that spotted frogs exhibit breeding site fidelity (Patla and Peterson 1996; Engle 2000; Munger and Engle 2000; J. Engle, IDFG, pers. comm., 2001). Movement of frogs from hibernation ponds to breeding ponds may be impeded by zones of unsuitable habitat. As movement corridors become more fragmented due to loss of flows within riparian or meadow habitats, local populations will become more isolated (Engle 2000; Engle 2001). Vegetation and surface water along movement corridors provide relief from high temperatures and arid environmental conditions, as well as protection from predators. Loss of vegetation and/or lowering of the water table as a result of the above mentioned activities can pose a significant threat to frogs moving from one area to another. Likewise, fragmentation and loss of habitat can prevent frogs from colonizing suitable sites elsewhere (USFWS 2002c).

Though direct correlation between spotted frog declines and livestock grazing has not been studied, the effects of heavy grazing on riparian areas are well documented (Kauffman et al. 1982; Kauffman and Kreuger 1984; Skovlin 1984; Kauffman et al. 1985; Schulz and Leininger 1990). Heavy grazing in riparian areas on state and private lands is a chronic problem throughout the Great Basin. Efforts to protect spotted frog habitat on state lands in Idaho have been largely unsuccessful because of lack of cooperation from the State. In northeast Nevada, the

Forest Service has completed three riparian area protection projects in areas where spotted frogs occur. These projects include altering stocking rates or changing the grazing season in two allotments known to have frogs and constructing riparian fencing on one allotment. However, these three sites have not been monitored to determine whether efforts to protect riparian habitat and spotted frogs have been successful. In the Toiyabe Range, a proposal to fence 3.2 kilometers (km) (2 miles (mi)) of damaged riparian area along Cloverdale Creek to protect it from grazing is scheduled to occur in the summer of 2002. In addition to the riparian exclosure, BLM biologists located a diversion dam in 1998 on Cloverdale Creek which was completely de- watering approximately 1.6 km (1 mi) of stream. During the summer of 2000, this area was reclaimed and water was put back into the stream. This area of the stream is not currently occupied by spotted frogs but it is historical habitat (USFWS 2002c).

The effects of mining on Great Basin Columbia spotted frogs, specifically, have not been studied, but the adverse effects of mining activities on water quality and quantity, other wildlife species, and amphibians in particular have been addressed in professional scientific forums (Chang et al. 1974; Birge et al. 1975; Greenhouse 1976; Khangarot et al. 1985) (USFWS 2002c).

Disease or predation

Predation by fishes is likely an important threat to spotted frogs. The introduction of nonnative salmonid and bass species for recreational fishing may have negatively affected frog species throughout the United States. The negative effects of predation of this kind are difficult to document, particularly in stream systems. However, significant negative effects of predation on frog populations in lacustrine systems have been documented (Hayes and Jennings 1986; Pilliod et al. 1996, Knapp and Matthews 2000). One historic site in southern Idaho no longer supports spotted frog although suitable habitat is available. This may be related to the presence of introduced bass in the Owyhee River (IDCDC 2000). The stocking of nonnative fishes is common throughout waters of the Great Basin. The Nevada Division of Wildlife (NDOW) has committed to conducting stomach sampling of stocked nonnative and native species to determine the effects of predation on spotted frogs. However, this commitment will not be fulfilled until the spotted frog conservation agreements are signed. To date, NDOW has not altered fish stocking rates or locations in order to benefit spotted frogs (USFWS 2002c).

The bull frog (Rana catesbeiana), a nonnative ranid species, occurs within the range of the spotted frog in the Great Basin. Bullfrogs are known to prey on other frogs (Hayes and Jennings 1986). They are rarely found to co-occur with spotted frogs, but whether this is an artifact of competitive exclusion is unknown at this time (USFWS 2002c).

Although a diversity of microbial species is naturally associated with amphibians, it is generally accepted that they are rarely pathogenic to amphibians except under stressful environmental conditions. Chytridiomycosis (chytrid) is an emerging panzootic fungal disease in the United States (Fellers et al. 2001). Clinical signs of amphibian chytrid include abnormal posture, lethargy, and loss of righting reflex. Gross lesions, which are usually not apparent, consist of abnormal epidermal sloughing and ulceration; hemorrhages in the skin, muscle, or eye; hyperemia of digital and ventrum skin, and congestion of viscera. Diagnosis is by identification of characteristic intracellular flask-shaped sporangia and septate thalli within the epidermis. Chytrid can be identified in some species of frogs by examining the oral discs of tadpoles which may be abnormally formed or lacking pigment (Fellers et al. 2001) (USFWS 2002c).

Chytrid was confirmed in the Circle Pond site, Idaho, where long term monitoring since 1998 has indicated a general decline in the population (Engle 2002). It is unclear whether the presence of this disease will eventually result in the loss of this subpopulation. Two additional sites may have chytrid, but this has yet to be determined (J. Engle, pers. comm., 2001). Protocols to prevent further spread of the disease by researchers were instituted in 2001. Chytrid has also been found in the Wasatch Columbia spotted frog distinct population segment (K. Wilson, pers comm., 2002). Chytrid has not been found in Nevada populations of spotted frogs (USFWS 2002c).

The inadequacy of existing regulatory mechanisms

Spotted frog occurrence sites and potential habitats occur on both public and private lands. This species is included on the Forest Service sensitive species list; as such, its management must be considered during forest planning processes. However, little habitat restoration, monitoring or surveying has occurred on Forest Service lands (USFWS 2002c).

In the fall of 2000, 250 head of cattle were allowed to graze for 45 days on one pasture in the Indian Valley Creek drainage of the Humboldt-Toiyabe National Forest in central Nevada for the first time in 6 years (M. Croxen, pers. comm., 2002). Grazing was not allowed in this allotment in 2001. Recent mark-recapture data indicated that this drainage supports more frogs than previously presumed, potentially around 5,000 individuals (K. Hatch, pers. comm., 2000). Perceived improvements in the status of frog populations in the Indian Valley Creek area may be a result of past removal of livestock grazing. The reintroduction of grazing disturbance into this relatively dense area of frogs has yet to be determined (USFWS 2002c).

BLM policies direct management to consider candidate species on public lands under their jurisdiction. To date, BLM efforts to conserve spotted frogs and their habitat in Idaho, Oregon, and Nevada have not been adequate to address threats (USFWS 2002c).

The southernmost known population of spotted frogs can be found on the BLM San Antone Allotment south of Indian Valley Creek in the Toiyabe Range. Grazing is allowed in this area from November until June (L. Brown, pers. comm., 2002). The season of use is a very sensitive portion of the spotted frog annual life cycle which includes migration from winter hibernacula to breeding ponds, breeding, egg laying and hatching, and metamorphosing of young. Additionally, the riparian Standards and Guidelines were not met in 1996, the last time the allotment was evaluated (USFWS 2002c).

The status of local populations of spotted frogs on Yomba-Shoshone or Duck Valley Tribal lands is unknown. Tribal governments do not have regulatory or protective mechanisms in place to protect spotted frogs (USFWS 2002c).

The Nevada Division of Wildlife classifies the spotted frog as a protected species, but they are not afforded official protection and populations are not monitored. Though the spotted frog is on the sensitive species list for the State of Idaho, this species is not given any special protection by the State. Columbia spotted frogs are not on the sensitive species list for the State of Oregon. Protection of wetland habitat from loss of water to irrigation or spring development is difficult because most water in the Great Basin has been allocated to water rights applicants based on historical use and spring development has already occurred within much of the known habitat of spotted frogs. Federal lands may have water rights that are approved for wildlife use, but these rights are often superceded by historic rights upstream or downstream that do not provide for minimum flows. Also, most public lands are managed for multiple use and are subject to livestock grazing, silvicultural activities, and recreation uses that may be incompatible with spotted frog conservation without adequate mitigation measures (USFWS 2002c).

Other natural or manmade factors affecting its continued existence

Multiple consecutive years of less than average precipitation may result in a reduction in the number of suitable sites available to spotted frogs. Local extirpations eliminate source populations from habitats that in normal years are available as frog habitat (Lande and Barrowclough 1987; Schaffer 1987; Gotelli 1995). These climate events are likely to exacerbate the effects of other threats, thus increasing the possibility of stochastic extinction of subpopulations by reducing their size and connectedness to other subpopulations (see Factor A for additional information). As movement corridors become more fragmented, due to loss of flows within riparian or meadow habitats, local populations will become more isolated (Engle 2000). Increased fragmentation of the habitat can lead to greater loss of populations due to demographic and/or environmental stochasticity (USFWS 2002c).

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6.3.2 Great Blue Heron

Great Blue Heron (*Ardea herodias*). Paul Ashley and Stacey Stovall. 2004. Southeast Washington Subbasin Planning Ecoregion Wildlife Assessment.

Introduction

The great blue heron (*Ardea herodias*) is the largest, most widely distributed, and best known of the American herons (Henny 1972). Great blue herons occur in a variety of habitats from freshwater lakes and rivers to brackish marshes, lagoons, mangrove areas, and coastal wetlands (Spendelow and Patton in prep.).

Great Blue Heron Life History, Key Environmental Correlates, and Habitat Requirements

Life History

Diet

Fish are preferred food items of the great blue heron in both inland and coastal waters (Kirkpatrick 1940; Palmer 1962; Kelsall and Simpson 1980), although a large variety of dietary items has been recorded. Frogs and toads, tadpoles and newts, snakes, lizards, crocodilians, rodents and other mammals, birds, aquatic and land insects, crabs, crayfish, snails, freshwater and marine fish, and carrion have all been reported as dietary items for the great blue heron (Bent 1926; Roberts 1936; Martin *et al.* 1951; Krebs 1974; Kushlan1978). Fish up to about 20 cm in length dominated the diet of herons foraging in southwestern Lake Erie (Hoffman 1978). Ninety-five percent of the fish eaten in a Wisconsin study were 25 cm in length (Kirkpatrick 1940).

Great blue herons feed alone or occasionally in flocks. Solitary feeders may actively defend a much larger feeding territory than do feeders in a flock (Meyerriecks 1962; Kushlan 1978). Flock feeding may increase the likelihood of successful foraging (Krebs 1974; Kushlan 1978) and usually occurs in areas of high prey density where food resources cannot effectively be defended.

In southeast Washington, blue herons are often seen hunting along rivers and streams. In the winter months they are often seen hunting rodents in alfalfa fields (P. Fowler, WDFW, pers. comm.. 2003).

Reproduction

The great blue heron typically breeds during the months of March - May in its northern range and November through April in the southern hemisphere. The nest usually consists of an egg clutch between 3-7 eggs, with clutch size increasing from south to north. Chicks fledge at about two months.

Nesting

Great blue herons normally nest near the tree tops. Usually, nests are about 1 m in diameter and have a central cavity 10 cm deep with a radius of 15 cm. This internal cavity is sometimes lined with twigs, moss, lichens, or conifer needles. Great blue herons are inclined to renest in the same area year after year. Old nests may be enlarged and reused (Eckert 1981).

The male gathers nest-building materials around the nest site, from live or dead trees, from neighboring nests, or along the ground, and the female works them into the nest. Ordinarily, a pair takes less than a week to build a nest solid enough for eggs to be laid and incubated. Construction continues during almost the entire nesting period. Twigs are added mostly when the eggs are being laid or when they hatch. Incubation, which is shared by both partners, starts with the laying of the first egg and lasts about 28 days. Males incubate during the days and females at night.

Herons are particularly sensitive to disturbance while nesting. Scientists suggest as a general rule that there should be no development within 300 m of the edge of a heron colony and no disturbance in or near colonies from March to August.

Mortality

The great blue heron lives as long as 17 years. The adult birds have few natural enemies. Birds of prey occasionally attack them, but these predators are not an important limiting factor on the heron population. Draining of marshes and destruction of wetland habitat is the most serious threat. The number of herons breeding in a local area is directly related to the amount of feeding habitat.

Mortality of the young is high: both the eggs and young are preyed upon by crows, ravens, gulls, birds of prey, and raccoons. Heavy rains and cold weather at the time of hatching also take a heavy toll. Pesticides are suspected of causing reproductive failures and deaths, although data obtained up to this time suggest that toxic chemicals have not caused any decline in overall population levels.

Habitat Requirements

Minimum Habitat Area

Minimum habitat area is defined as the minimum amount of contiguous habitat that is required before a species will live and reproduce in an area. Minimum habitat area for the great blue heron includes wooded areas suitable for colonial nesting and wetlands within a specified distance of the heronry where foraging can occur. A heronry frequently consists of a relatively small area of suitable habitat. For example, heronries in the Chippewa National Forest, Minnesota, ranged from 0.4 t o 4.8 ha in size and averaged 1.2 ha (Mathisen and Richards 1978). Twelve heronries in western Oregon ranged from 0.12 t o 1.2 ha in size and averaged 0.4 ha (Werschkul *et al.* 1977).

Foraging

Short and Cooper (1985) provide criteria for suitable great blue heron foraging habitat. Suitable great blue heron foraging habitats are within 1.0 km of heronries or potential heronries. The suitability of herbaceous wetland, scrub-shrub wetland, forested wetland, riverine, lacustrine or estuarine habitats as foraging areas for the great blue heron is ideal if these potential foraging habitats have shallow, clear water with a firm substrate and a huntable population of small fish. A potential foraging area needs to be free from human disturbances several hours a day while the herons are feeding. Suitable great blue heron foraging areas are those in which there is no human disturbance near the foraging zone during the four hours following sunrise or preceding sunset or the foraging zone is generally about 100m from human activities and habitation or about 50m from roads with occasional, slow-moving traffic.

A smaller energy expenditure by adult herons is required to support fledglings if an abundant source of food is close to the nest site than if the source of food is distant. Nest sites frequently are located near suitable foraging habitats. Social feeding is strongly correlated with colonial nesting (Krebs 1978), and a potential feeding site is valuable only if it is within “commuting” distance of an active heronry. For example, 24 of 31 heronries along the Willamette River in Oregon were located within 100m of known feeding areas (English 1978). Most heronries along the North Carolina coast were located near inlets, which have large concentrations of fish (Parnell and Soots 1978). The average distance from heronries to inlets was 7.0 to 8.0 km. The average distance of heronries to possible feeding areas (lakes 140 ha in area) varied from 0 to 4.2 km and averaged 1.8 km on the Chippewa National Forest in Minnesota (Mathisen and Richards 1978). Collazo (1981) reported the distance from the nearest feeding grounds to a heronry site as 0.4 and 0.7 km. The maximum observed flight distance from an active heronry to a foraging area was 29 km in Ohio (Parris and Grau 1979).

Great blue herons feed anywhere they can locate prey (Burleigh 1958). This includes the terrestrial surface but primarily involves catching fish in shallow water, usually 150m deep (Bent 1926; Meyerriecks 1960; Bayer 1978).

Thompson (1979b) reported that great blue herons along the Mississippi River commonly foraged in water containing emergent or submergent vegetation, in scattered marshy ponds, sloughs, and forested wetlands away from the main channel. He noted that river banks, jetties, levees, rip-rapped banks, mudflats, sandbars, and open ponds were used to a lesser extent. Herons near southwestern Lake Erie fed intensively in densely vegetated areas (Hoffman 1978).

Other studies, however, have emphasized foraging activities in open water (Longley 1960; Edison Electric Institute 1980). Exposed mud flats and sandbars are particularly desirable foraging sites at low tides in coastal areas in Oregon (Bayer 1978), North Carolina (Custer and Osborn 1978), and elsewhere (Kushlan 1978). Cooling ponds (Edison Electric Institute 1980) and dredge spoil settling ponds (Cooper *et al.* in prep.) also are used extensively by foraging great blue herons.

Water

The great blue heron routinely feeds on soft animal tissues from an aquatic environment, which provides ample opportunity for the bird to satisfy its physiological requirements for water.

Cover

Cover for concealment does not seem to be a limiting factor for the great blue heron. Heron nests often are conspicuous, although heronries frequently are isolated. Herons often feed in marshes and areas of open water, where there is no concealing cover.

Reproduction

Short and Cooper (1985) describe suitable great blue heron nesting habitat as a grove of trees at least 0.4 ha in area located over water or within 250m of water. These potential nest sites may be on an island with a river or lake, within a woodland dominated swamp, or in vegetation near a river or lake. Trees used as nest sites are at least 5m high and have many branches at least 2.5 cm in diameter that are capable of supporting nests. Trees may be alive or dead but must have an "open canopy" that allows an easy access to the nest. The suitability of potential heronries diminishes as their distance from current or former heronry sites increases because herons develop new heronries in suitable vegetation close to old heronries.

A wide variety of nesting habitats is used by the great blue heron throughout its range in North America. Trees are preferred heronry sites, with nests commonly placed from 5 to 15 m above ground (Burleigh 1958; Cottrille and Cottrille 1958; Vermeer 1969; McAloney 1973). Smaller trees, shrubs, reeds (*Phragmites communis*), the ground surface, rock ledges along coastal cliffs, and artificial structures may be utilized in the absence of large trees, particularly on islands (Lahrman 1957; Behle 1958; Vermeer 1969; Soots and Landin 1978; Wiese 1978). Most great blue heron colonies along the Atlantic coast are located in riparian swamps (Ogden 1978). Most colonies along the northern Gulf coast are in cypress - tupelo (*Taxodium Nyssa*) swamps (Portnoy 1977). Spendelow and Patton (in prep.) state that many birds in coastal Maine nest on spruce (*Picea spp*.) trees on islands. Spruce trees also are used on the Pacific coast (Bayer 1978), and black cottonwood (*Populus trichocarpa*) trees frequently are used as nest sites along the Willamette River in Oregon (English 1978). Miller (1943) stated that the type of tree was not as important as its height and distance from human activity. Dead trees are commonly used as nest sites (McAloney 1973). Nests usually consist of a platform of sticks, sometimes lined with smaller twigs (Bent 1926; McAloney 1973), reed stems (Roberts 1936), and grasses (Cottrille and Cottrille 1958).

Heron nest colony sites vary, but are usually near water. These areas often are flooded (Sprunt 1954; Burleigh 1958; English 1978). Islands are common nest colony sites in most of the great blue heron's range (Vermeer 1969; English 1978; Markham and Brechtel 1979). Many colony sites are isolated from human habitation and disturbance (Mosely 1936; Burleigh 1958). Mathisen and Richards (1978) recorded all existing heronries in Minnesota as at least 3.3 km from human dwellings, with an average distance of 1.3 km to the nearest surfaced road. Nesting great blue herons may become habituated to noise (Grubb 1979), traffic (Anderson 1978), and other human activity (Kelsall and Simpson 1980). Colony sites usually remain active until the site is disrupted by land use changes.

A few colony sites have been abandoned because the birds depleted the available nest building material and possibly because their excrement altered the chemical composition of the soil and the water. Heron exretia can have an adverse effect on nest trees (Kerns and Howe 19667; Wiese 1978).

Great Blue Heron Population and Distribution

Population

Historic

In the past, herons and egrets were shot for their feathers, which were used as cooking utensils and to adorn hats and garments, and they also provided large, accessible targets. The slaughter of these birds went relatively unchecked until 1900 when the federal government passed the Lacey Act, which prohibits the foreign and interstate commercial trade of feathers. Greater protection was afforded in 1918 with the Migratory Bird Treaty Act, which empowered the federal government to set seasons and bag limits on the hunting of waterfowl and waterbirds. With this protection, herons and other birds have made dramatic comebacks.

In southeast Washington, few historical colonies have been reported. The Foundation Island colony is the oldest, but has been taken over by cormorants. It appears blue herons numbers in the colony have declined significantly.

One colony was observed from a helicopter in 1995 on the Touchet River just upriver from Harsha, but that colony appears to have been destroyed by a wind storm (trees blown down), and no current nesting has been observed in the area (Fowler per. com.)

Current

The great blue heron breeds throughout the U.S. and winters as far north as New England and southern Alaska (Bull and Farrand 1977). The nationwide population is estimated at 83,000 individuals (NACWCP 2001).

In southeast Washington, three new colonies have been discovered over the last few years. One colony on the Walla Walla River contains approximately 24 nests. This colony has been active for approximately 12 years. Two new colonies were discovered in 2003, one on a railroad bridge over the Snake River at Lyons Ferry, and one near Chief Timothy Park on the Snake River. The Lyons Ferry colony contained approximately 11 nests, and the Chief Timothy colony 5 nests (P. Fowler, WDFW, personal communication, 2003).

Distribution

Two known heron rookeries occur within the Walla Walla subbasin, one on the Walla Walla and one on the Touchet River (NPPC 2001). The Walla Walla River rookery contains approximately 13 active nests. The Touchet River rookery contains approximately 8-10 active nests. Blue herons are observed throughout the lowlands of southeast Washington near rivers or streams (P. Fowler, WDFW, personal communication, 2003).

Historic

No data are available.

Current

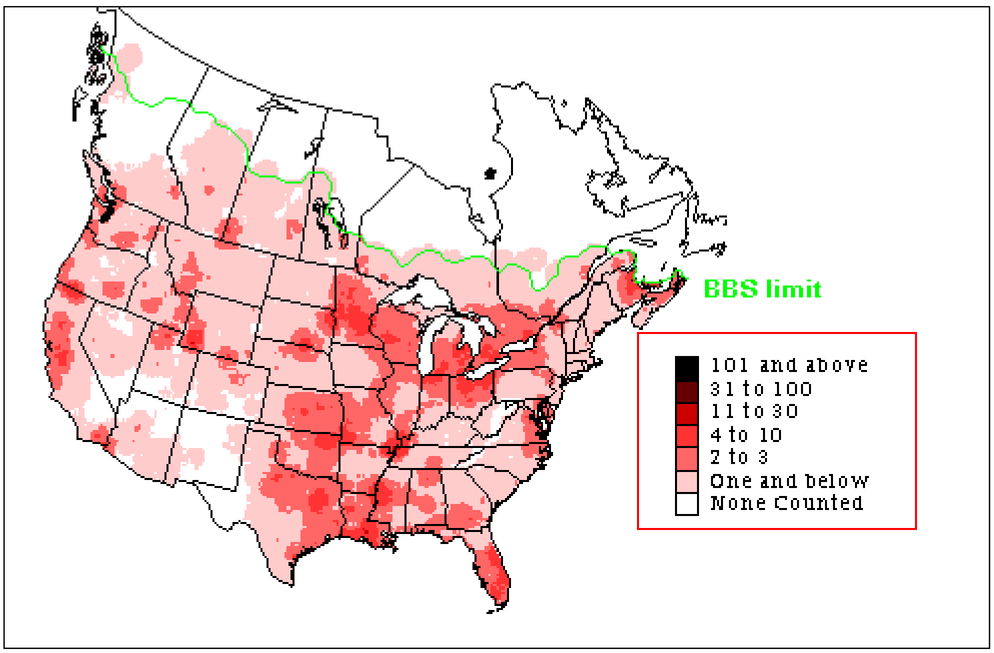


Figure 65. Great blue heron summer distribution from Breeding Bird Survey (BBS) data (Sauer *et al.* 2003).

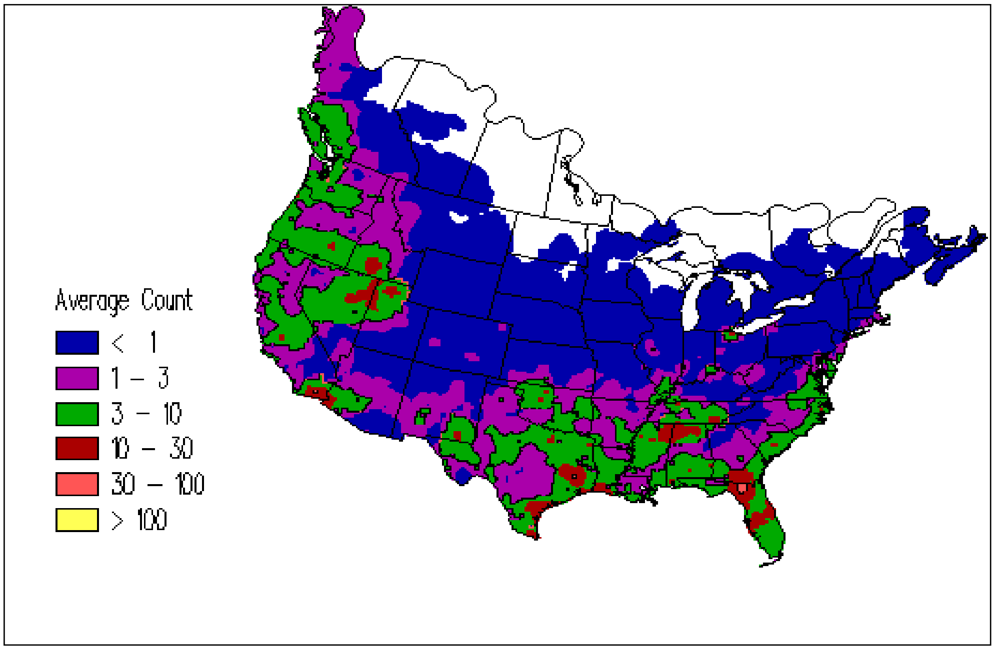


Figure 66. Great blue heron breeding distribution from Breeding Bird Survey (BBS) data (Sauer *et al.* 2003).

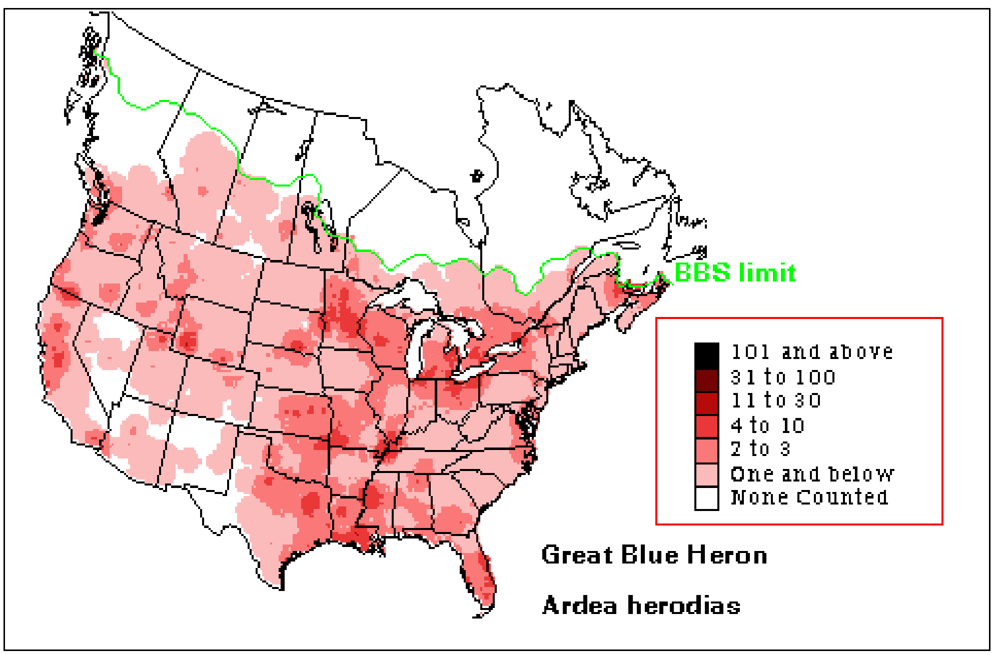


Figure 67. Great blue heron winter distribution from Christmas Bird Count (CBC) data (Sauer *et al.* 2003).

Great Blue Heron Status and Abundance Trends

Status

Surveys of blue heron populations are not conducted. However, populations appear to be stable and possibly expanding in some areas. Two new nesting colonies have been found in on the Lower Snake River (P. Fowler, WDFW, personal communication, 2003).

Trends

Populations in southeast Washington appear to be stable, and may actually be increasing.

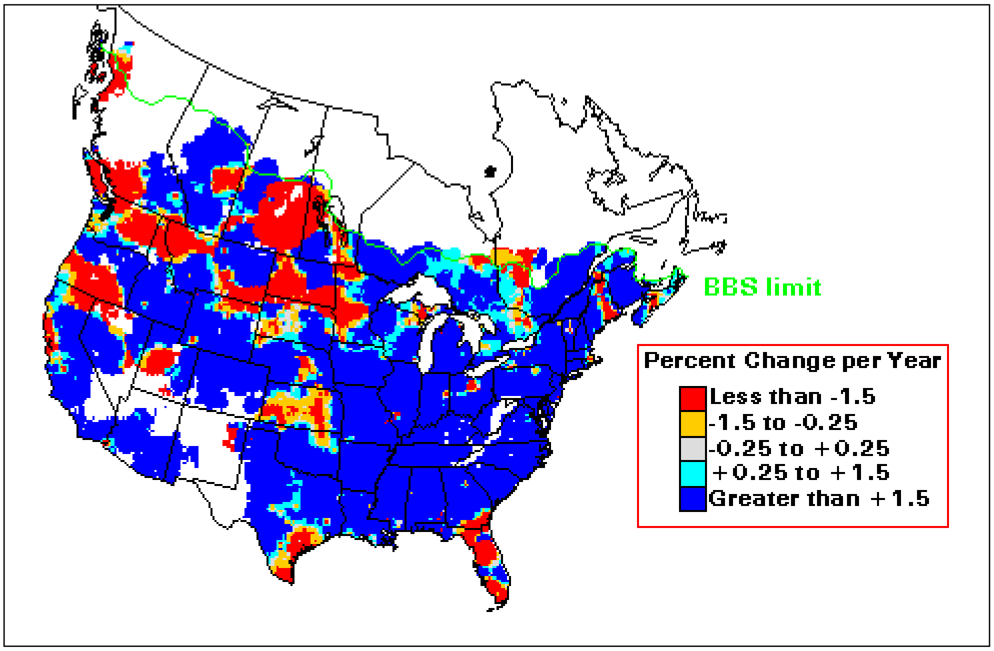
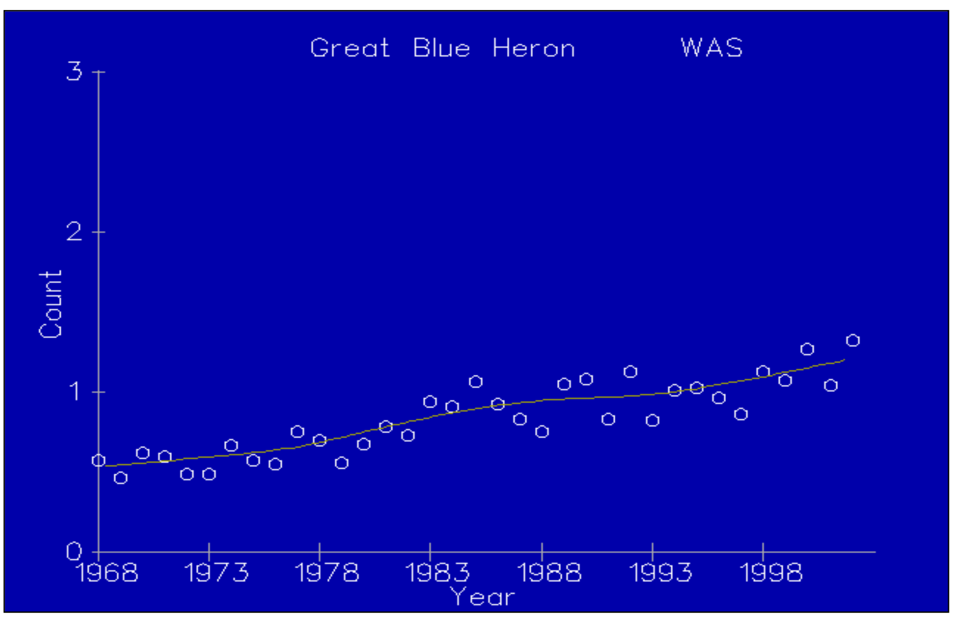


Figure 68. Great blue heron Breeding Bird Survey (BBS) trend results: 1966-1996 (Sauer *et al.* 2003).

Figure 69. Great blue heron Breeding Bird Survey (BBS) Washington trend results: 1966-2002 (Sauer *et al.* 2003).



Factors Affecting Great Blue Heron Population Status

Key Factors Inhibiting Populations and Ecological Processes

Habitat destruction and the resulting loss of nesting and foraging sites, and human disturbance probably have been the most important factors contributing to declines in some great blue heron populations in recent years (Thompson 1979a; Kelsall and Simpson 1980; McCrimmon 1981).

Habitat Loss

Natural generation of new nesting islands, created when old islands and headlands erode, has decreased due to artificial hardening of shorelines with bulkheads. Loss of nesting habitat in certain coastal sites may be partially mitigated by the creation of dredge spoil islands (Soots and Landin 1978). Several species of wading birds, including the great blue heron, use coastal spoil islands (Buckley and McCaffrey 1978; Parnell and Soots 1978; Soots and Landin 1978). The amount o f usage may depend on the stage of plant succession (Soots and Parnell 1975; Parnell and Soots 1978), although great blue herons have been observed nesting in shrubs (Wiese 1978), herbaceous vegetation (Soots and Landin 1978), and on the ground on spoil islands.

Water Quality

Poor water quality reduces the amount of large fish and invertebrate species available in wetland areas. Toxic chemicals from runoff and industrial discharges pose yet another threat. Although great blue herons currently appear to tolerate low levels of pollutants, these chemicals can move through the food chain, accumulate in the tissues of prey and may eventually cause reproductive failure in the herons.

Several authors have observed eggshell thinning in great blue heron eggs, presumably as a result of the ingestion of prey containing high levels of organochlorines (Graber *et al.* 1978; Ohlendorf *et al.* 1980). Konermann *et al.* (1978) blamed high levels of dieldrin and DDE use for reproductive failure, followed by colony abandonment in Iowa. Vermeer and Reynolds (1970) recorded high levels of DDE in great blue herons in the prairie provinces of Canada, but felt that reproductive success was not diminished as a result. Thompson (1979a) believed that it was too early to tell if organochlorine residues were contributing to heron population declines in the Great Lakes region.

Human Disturbance

Heronries often are abandoned as a result of human disturbance (Markham and Brechtel 1979). Werschkul *et al.* (1976) reported more active nests in undisturbed areas than in areas that were being logged. Tree cutting and draining resulted in the abandonment of a mixed-species heronry in Illinois (Bjorkland 1975). Housing and industrial development (Simpson and Kelsall 1979) and water recreation and highway construction (Ryder *et al.* 1980) also have resulted in the abandonment of heronries. Grubb (1979) felt that airport noise levels could potentially disturb a heronry during the breeding season.

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6.3.3 Bald Eagle

Bald Eagle (*Haliaeetus leucocephalus*). Keith Paul, USFWS, La Grande, Oregon.

Introduction

Bald eagles in the lower 48 states were first protected in 1940 by the Bald Eagle Protection Act and then were federally listed as endangered in 1967. In 1995, the bald eagle was reclassified as threatened in all of the lower 48 States. The bald eagle was proposed for delisting on July 6, 1999; a decision on whether to delist the bald eagle is pending (64 FR 36453). No critical habitat has been designated for the bald eagle (USFWS 2003).

The bald eagle is one of eight species of sea-eagle (genus *Haliaeetus*) worldwide (Brown 1977), and the only sea eagle found throughout North America (Stalmaster 1987). Large size, wingspan of 6.6-8.0 ft (200-243 cm) (Stalmaster 1987), and the contrast of white head and tail, and yellow eyes, beak, and legs, to dark brown body and wings make the adult bald eagle one of our most distinctive raptors (Isaacs and Anthony 2003a).

Bald Eagle Life History, Key Environmental Correlates, and Habitat Requirements

Life History

As our national symbol, the bald eagle is widely recognized. Its distinctive white head and tail do not appear until the bird is four to five years old. These large powerful raptors can live for 30 or more years in the wild and even longer in captivity (USFWS 2003).

Diet

Bald eagles consume a variety of prey that varies by location and season. Prey are taken alive, scavenged, and pirated (Frenzel 1985, Watson et al. 1991). Fish were the most frequent prey among 84 species identified at nest sites in south-central Oregon, and a tendency was observed for some individuals or pairs to specialize in certain species (Frenzel 1985). Wintering and migrant eagles in eastern Oregon fed on large mammal carrion, especially road-killed mule deer, domestic cattle that died of natural causes, and stillborn calves, as well as cow afterbirth, waterfowl, ground squirrels, other medium-sized and small rodents, and fish. Proportions varied by month and location. Food habitats are unknown for nesting eagles over much of the state (Isaacs and Anthony 2003a).

Reproduction

Bald eagles are most abundant in Oregon in late winter and early spring, because resident breeders (engaged in early nesting activities), winter residents, and spring transients are all present. Nest building and repair occur any time of year, but most often observed from February to June (Isaacs and Anthony unpublished data). Bald eagles are territorial when breeding but gregarious when not (Stalmaster 1987). They exhibit strong nest-site fidelity (Jenkins and Jackman 1993), but “divorce” has been documented (Frenzel 1985, Garrett et al 1993). Cooperative nesting by three adults was reported (Garcelon et al. 1995). Both sexes build the nest, incubate eggs, and brood and feed young (Stalmaster 1987). Egg laying occurs mid-February to late April; hatching late March to late May; and fledging late June to mid-Aug (Isaacs and Anthony unpublished data) (Isaacs and Anthony 2003a).

Bald eagles lay one to four eggs in late March or early April and both adults incubate the eggs for about 35 days until hatching. During the nest building, egg laying and incubating periods, eagles are extremely sensitive and will abandon a nesting attempt if there are excessive disturbances in the area during this time. The eaglets are able to fly in about three months and then, after a month, they are on their own. The first year is particularly difficult for young eagles. Only half may survive the first year due to disease, lack of food, bad weather, or human interference (USFWS 2003).

Migration

Bald eagles can be resident year-round where food is available; otherwise they will migrate or wander to find food. When not breeding, may congregate where food is abundant, even away from water (Stalmaster 1987). Migrants passing through Glacier National Park generally followed north-south flyways similar to those of waterfowl (McClelland et al. 1994). In contrast, juveniles and subadults form California traveled north to Oregon, Washington, and British Columbia in late summer and fall (D. K. Garcelon p.c., R. E. Jackman p.c.) (Isaacs and Anthony 2003a).

Mortality

Reviews of published literature (Harmata et al. 1999., Jenkins et al. 1999) suggested that survival varies by location and age; hatch-year survival was usually >60%, and survivorship increased with age to adulthood. However, recent work by Harmata et al. (1999) showed survival lowest among 3- and 4-year old birds (Isaacs and Anthony 2003a).

The major factor leading to the decline and subsequent listing of the bald eagle was disrupted reproduction resulting from contamination by organochlorine pesticides. Other causes of death in bald eagles have included shooting, electrocution, impact injuries, and lead poisoning (USFWS 2003).

Habitat Requirements
General

Bald eagles are generally associated with large bodies of water, but can occur in any habitat with available prey (Isaacs and Anthony 2003a).

Nesting Habitat

Bald eagles nest in forested areas near the ocean, along rivers, and at estuaries, lakes, and reservoirs (Isaacs and Anthony 2001). Consequently, shoreline is an important component of nesting habitat; 84% of Oregon nests were within 1 mi (1.6 km) of water (Anthony and Isaacs 1989). A nest in the Fort Rock Valley was the most distant from water at 18 mi (29 km) from the nearest shoreline (Isaacs and Anthony unpublished data). All nests observed in Oregon have been in trees, primarily Sitka spruce and Douglas-fir west of the Cascades and ponderosa pine, Douglas-fir, and sugar pine in eastern Oregon (Anthony and Isaacs 1989). Use of black cottonwood for nesting has increased recently as Columbia and Willamette River populations have increased. Bald eagles also nest in white fir, red fir, grand fir, incense-cedar, Oregon white oak, quaking aspen, and willow (Isaacs and Anthony unpublished data). Live trees are usually used for nest trees, although nests will continue to be used if the tree dies. Nest trees are usually large and prominent (Anthony et al. 1982). Large old trees have large limbs and open structure required for eagle access and nest territory. Some use has been made of artificial platforms placed in trees modified for Osprey (Witt 1996, Isaacs and Anthony unpublished data, R. Opp p.c.). Cliff nesting is thus for unknown, but possible, especially in sparsely forested areas of southeast Oregon (Isaacs and Anthony 2003a).

Wintering Habitat

Wintering eagles in the Pacific Northwest perch on a variety of substrates; proximity to a food source is probably the most important factor influencing perch selection by bald eagles (Steenhof et al. 1980). Favored perch trees are invariably located near feeding areas, and eagles consistently use preferred branches (Stalmaster 1976). Most tree perches selected by eagles provide a good view of the surrounding area (Servheen 1975, Stalmaster 1976), and eagles tend to use the highest perch sites available (Stalmaster 1976) (USFWS 1986).

Eagles use a variety of tree species as perch sites, depending on regional forest types and stand structures. Dead trees are used by eagles in some areas because they provide unobstructed view and are often taller than surrounding vegetation (Stalmaster 1976). Artificial perches may be important to wintering bald eagles in situations where natural perches are lacking. Along the Columbia River in Washington, where perch trees are not available, eagles regularly use artificial perches, including both crossarm perches and a tripod perch (Fielder, p.c.) (USFWS 1986).

Habitat requirements for communal night roosting are different form those for diurnal perching. Communal roosts are invariably near a rich food resource and in forest stands that are uneven-aged and have at least a remnant of the old-growth forest component (Anthony et al. 1982). Close proximity to a feeding area is not the only requirement for night roosting sites, as there are minimum requirements for forest stand structure. In open areas, bald eagles also use cottonwoods and willows for night roosting (Isaacs and Anthony 1983). Most communal winter roosts used by bald eagles offer considerably more protection from the weather than diurnal habitat. Roost tree species and stand characteristics vary considerably throughout the Pacific Northwest (Anthony et al 1982) (USFWS 1986).

Isolation is an important feature of bald eagle wintering habitat. In Washington, 98% of wintering bald eagles tolerated human activities at a distance of 300 m (328 yards) (Stalmaster and Newman 1978). However, only 50% of eagles tolerated disturbances of 150 m (164 yards; USFWS 1986).

Bald Eagle Population and Distribution
Distribution

The bald eagle is a resident of North America, and can be found throughout Alaska, Canada, the contiguous U.S. (AOU 1998) as far south as Baja California Sur, Mexico (Henny et al. 1978), and as far west as the Aleutian Is., Alaska (Anthony et al. 1999) (Isaacs and Anthony 2003a).

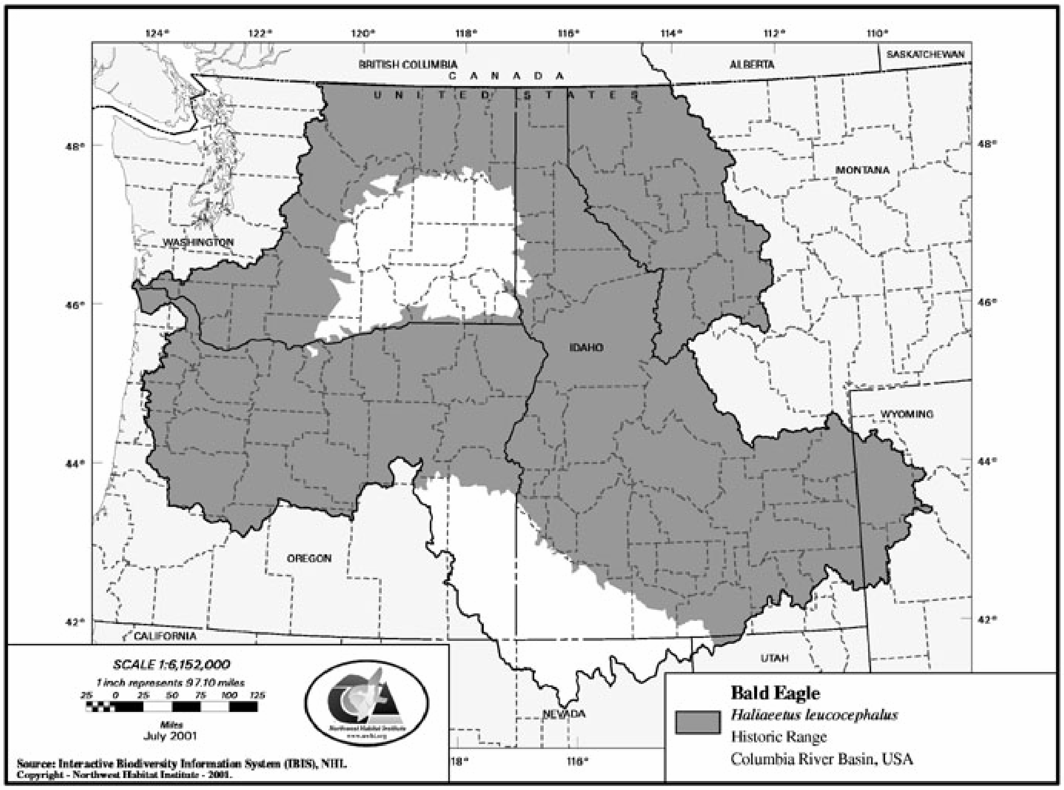

Figure 70. Bald eagle historic range in the Columbia River subbasin (IBIS 2003)

Historic

The status and distribution of bald eagle populations in the decades before World War II are poorly understood. Declines probably begin in some populations in the 19th century; other declines were probably not underway until the 1940's. Between 1947 and 1970, reproduction in most bald eagle populations declined drastically (Broley 1958, Sprunt et al. 1973), and the species disappeared form many parts of its breeding range (USFWS 1986).

Historical records provide evidence for the decline of bald eagles in the Pacific Northwest. Accounts by Baird (1858), Evermann (1886), Merrill (1888, 1897), Belding (1890), Bendire (1892), Woodcock (1902), Hall (1933a, 1933b), and Buechner (1953) document the abundance of bald eagles in the region during the late 19th century. Later records suggest that a population decline may have occurred at the beginning of the twentieth century (Bowles 1906, Dawson and Bowles 1909, Kitchin 1939). These suspected declines are difficult to quantify, however, because no intensive surveys were conducted until the latter part of the twentieth century. In some cases, historical records have confirmed the disappearance of breeding eagles form parts of their former range. Breeding populations of bald eagles in Oregon and Washington are still widely distributed, but historical information suggests significant declines and changes in distribution (USFWS 1986).

Current

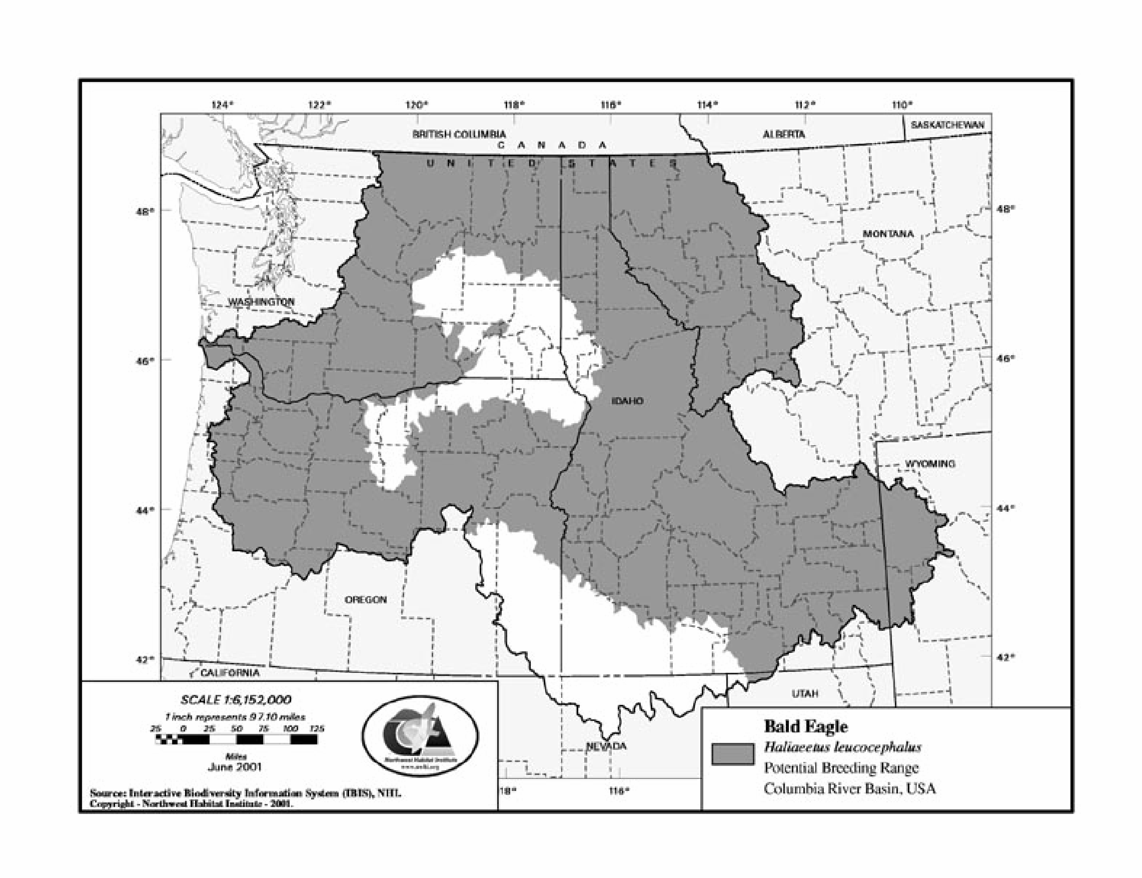

Figure 71. Bald eagle current breeding range in the Columbia River subbasin (IBIS 2003)

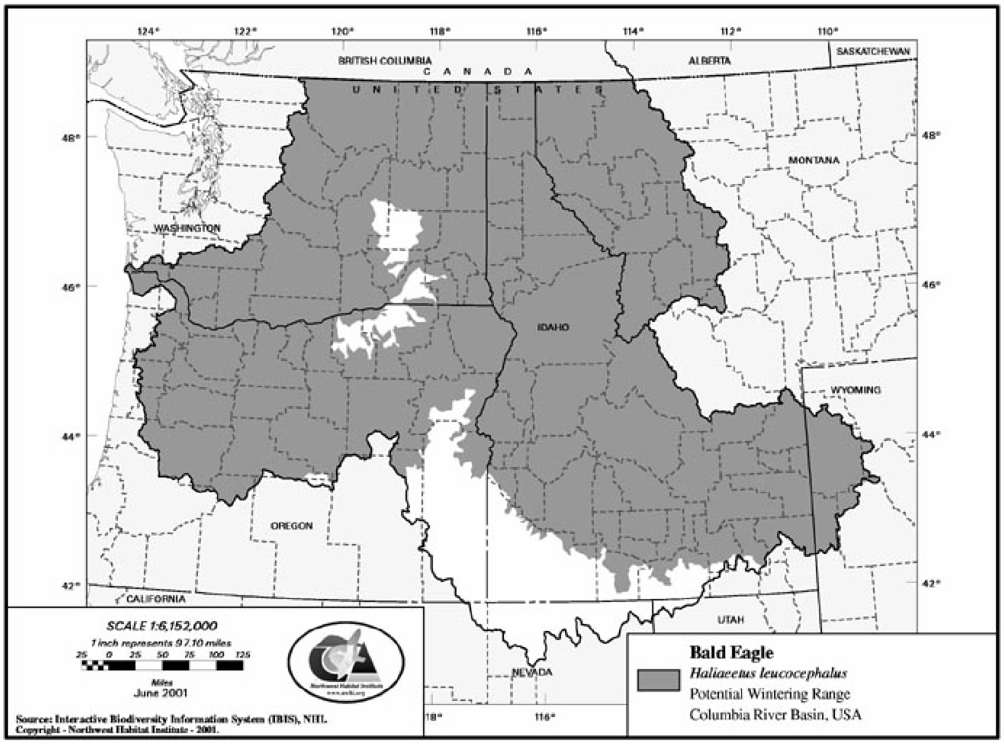

Figure 72. Bald Eagle Current Wintering Range (IBIS 2003)

In Oregon, the bald eagle nested in 32 of 36 counties. Those counties where breeding did not occur include Sherman, Gilliam, Morrow, and Malheur counties (Isaacs and Anthony 2001). Bald eagles can be found throughout the state during non-breeding. Variation locally in number of eagles and timing of peak abundance is due to weather and food supply. Eagles are very common in winter and early spring in the Klamath (Keister et al. 1987) and Harney (Garrett et al. 1988) basins, Columbia River estuary (Garrett et al. 1988), and L. Billy Chinook (Concannon 1998); common in winter and early spring at Hells Canyon, Oxbow, and Brownlee reservoirs, and along the Wallowa and Grande Ronde Rivers (Isaacs et al. 1992), the Crooked River Valley above Prineville Reservoir (Isaacs et al. 1993), the south end of the Willamette Valley (Isaacs unpublished data), the John Day River above Service Creek (Isaacs et al. 1996), the Columbia River in Lower Valley (Isaacs unpublished data), the Columbia River in the Umatilla National Wildlife Refuge area (Isaacs unpublished data), Goose Lower Valley (Isaacs unpublished data), Summer Lake and Chewaucan River downstream of Paisley (R.L. Madigan p.c.), and at Sauvie I. (Isaacs unpublished data); common in fall at Wickiup Reservoir (Isaacs unpublished data, G.J. Niehuser p.c.) and Odell Lake (Crescent Ranger District 1998) (Isaacs and Anthony 2003a).

An understanding of population structure, abundance, and distribution is complicated by multiple age classes, breeding status, nesting chronology, origin and movements of individuals, local and regional distribution and abundance of prey, local and regional weather, and season. For example, native and non-native juveniles (<1 yr old), subadults (1-4 yr old), and nonbreeding adults, and breeding adults can all occur in the same area (e.g., Klamath Basin) in winter and early spring (Isaacs and Anthony 2003a).

Bald Eagle Population, Status, and Abundance Trends
Population Status and Conservation

By 1940, the bald eagle had "become rather an uncommon bird" except along the coast and Columbia River, and in Klamath Co. (Gabrielson and Jewett 1940). Habitat loss (cutting of nest trees) and direct persecution (shooting, trapping, poisoning), probably caused a gradual decline prior to 1940. Between 1945 and 1974 over 4.5 million acres (1.8 million ha) of National Forest in Oregon were sprayed with DDT (Henny and Nelson 1981). Undocumented quantities were also applied on private forests and agricultural crops, and for mosquito control around municipalities. Consequently, the deleterious effects of DDT on reproduction (Stalmaster 1987) joined habitat loss and direct persecution as causes of decline through the early 1970’s when the population may have reached its historical low. By then, nesting pairs were extirpated in northeastern Oregon (Isaacs and Anthony 2001), where applications of DDT on National Forest land were common and widespread (Henny and Nelson 1981) (Isaacs and Anthony 2003a).

The bald eagle was declared threatened in Oregon, Washington, Michigan, Minnesota, Wisconsin, and Florida, and endangered in the other 43 contiguous states in 1978 under the federal Endangered Species Act (ESA) because of declining number of nesting pairs and reproductive problems caused by environmental contaminants (USDI 1978). The recovery plan for the Pacific states was completed in 1986 (USFWS 1986b). The bald eagle was listed as threatened under the Oregon ESA in 1987 (Marshall et al. 1996). Listing resulted in protection of eagle habitat and restriction on human activities near nest and roost sites. Site-specific planning was recommended for nest and roost protection (USFWS 1986). Forest management in nesting (Arnett et al. 2001) and roosting (DellaSala et al. 1998) habitat proved useful when declining forest health or fire danger threatened nest and roost trees. Habitat protection and management, the ban on use of DDT (Greier 1982) and reduced direct persecution due to education were followed by a recent population increase. Improved nesting success and a population increase led to a 1999 proposal to delist federally (USDI 1999). Oregon also may propose to delist the species (Isaacs and Anthony 2003a).

The upward population trend could reverse if the species is delisted without maintaining habitat-protection measures implemented under the ESA (e.g., USFS and BLM special habitat management for bald eagles, Oregon Forest Practices Rules protecting bald eagle sites on nonfederal forest land, and local zoning laws that protect wildlife habitat). Habitat degradation and a population decline could go undetected if monitoring of nesting and wintering populations is not continued. Contaminants have been implicated in reduced productivity of nesting pairs on the Columbia River downstream of Portland (Anthony et al. 1993, Buck 1999) and warrant continued monitoring (Isaacs and Anthony 2003a).

Midwinter Bald Eagle Count

Each January, the U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center's Snake River Field Station (SRFS) coordinates the Midwinter Bald Eagle Survey, in which several hundred individuals count eagles along standard, non-overlapping survey routes.

Nationwide counts of eagles were coordinated by the National Wildlife Federation from 1979 until 1992, when the Raptor Research and Technical Assistance Center (now SRFS) assumed responsibility for overseeing the count. Initial objectives of the survey were to establish an index to the total wintering Bald Eagle population in the lower 48 states, to determine eagle distribution during a standardized survey period, and to identify previously unrecognized areas of important winter habitat. In 1986, Millsap (Wildl. Soc. Bull. 14:433-440) reported results of the midwinter survey from 1979 through 1986.

As summarized in Steenhof et al. (2002), mid-winter population trends from 1986-2000 for the Pacific Northwest are: Oregon (+1.4%), Washington (+4.6%), Idaho (+1.9).

*For more specific data (by route), see: http://ocid.nacse.org/qml/nbii/eagles/

Bald Eagle Nest Locations and History of Use in Oregon and the Washington portion of the Columbia River Recovery Zone, 1971 through 2003

Compiled by Frank B. Isaacs and Robert G. Anthony, 2003b

Highlights

- The 2003 survey year was the 26th year of bald eagle nest site surveys in Oregon (OR) and the Washington (WA) portion of the Columbia River Recovery Zone (CRRZ).

- History of bald eagle use has been compiled for a total of 1,303 nest trees (1,173 in OR, 130 in WA) at 502 nest sites (456 in OR, 46 in WA). Bald eagle nests have been discovered in 33 of 36 (92%) counties in OR, and 6 of 7 counties in the WA portion of the CRRZ. Counties in OR with no reported nests are Sherman, Gilliam, and Morrow. The first nest tree for Malheur County, Oregon was discovered this year. There are no nests known in the Benton County, WA portion of the study area.

- 77 previously unknown nest trees were documented (68 in OR, 9 in WA); 25 were at 23 previously unknown breeding territories (21 at 19 in OR, 4 at 4 in WA), and 52 (47 in OR, 5 in WA) were at previously known territories.

- 458 of 490 (416 of 444 in OR, 42 of 46 in WA) sites surveyed (93%) were occupied by bald eagles. 466 nestlings (430 in OR, 36 in WA) were observed at 445 occupied sites (405 in OR, 40 in WA) where nesting outcome was determined. 5,199 eaglets have been counted at nests in OR since 1971.

- Nesting outcome was 1.06 young per occupied site in OR and 0.90 in WA, resulting in 5-year productivity of 1.03 young per occupied site for OR and 0.94 for WA. This is the second year in a row that the 5-year productivity for OR has been greater than the recovery goal of 1.00.

- Nesting success was 64% in OR and 52% in WA, resulting in 5-year nesting success of 64% in OR and 58% in WA. Young/successful site was 1.65 in OR and 1.71 in WA. Three nestlings were observed at 7 sites in OR and 1 site in WA.

- Nesting success for Recovery Zones with at least 5 occupied sites was highest in Recovery Zone 9 (Blue Mountains) with 1.62 young per occupied site, and was lowest in Recovery Zone 22 (Klamath Basin) with 0.94 young per occupied site. 1.0 young per occupied site in the CRRZ in 2003 was ≥1.0 for the second year in a row.

- Net increase in the OR population was 3.7% for 2003. Annual increase averaged 7.4% from 1980-2001; the increase in 2002 was 2.0%. Reasons for the relatively low increase the past 2 years are unknown. Population growth may be slowing, or survey effort has not been sufficient to document eagles nesting in new areas. Data gathered during the next two nesting seasons should help determine the trend.

- Six nest trees at six nest sites burned in wildfires in July and August.

Additional information on nest locations is available.

Factors Affecting Bald Eagle Population Status
Key Factors Inhibiting Populations and Ecological Processes

Currently, loss of habitat and human disturbance are still potential threats. Habitat loss results from the physical alteration of habitat as well as from human disturbance associated with development or recreation (i.e., hiking, camping, boating, and ORV use). Activities that can and have negatively impacted bald eagles include logging, mining, recreation, overgrazing (particularly in riparian habitats), road construction, wetland filling, and industrial development. These activities, as well as suburban and vacation home developments are particularly damaging when they occur in shoreline habitats. Activities that produce increased siltation and industrial pollution can cause dissolved oxygen reductions in aquatic habitats, reduction s in bald eagle fish prey populations followed by reductions in the number of eagles. Not all developments in floodplain habitats are detrimental to bald eagles, as some reservoirs and dams have created new habitat with dependable food supplies (USFWS 2003).

Although habitat loss and residual contamination remain a threat to the bald eagle's full recovery, breeding populations in most areas of the country are making encouraging progress. The following continue to be important conservation measures (USFWS 2003):

1. Avoid disturbance to nests during the nesting season: January – August.
2. Avoid disturbance to roosts during the wintering season: November – March.
3. Protect riparian areas from logging, cutting, or tree clearing.
4. Protect fish and waterfowl habitat in bald eagle foraging areas.
5. Development of site-specific management plans to provide for the long-term availability of habitat.

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6.3.4 White-headed Woodpecker

White-headed Woodpecker (*Picoides albolarvatus*). Paul Ashley and Stacey Stovall. 2004. Southeast Washington Subbasin Planning Ecoregion Wildlife Assessment.

Introduction

The white-headed woodpecker (*Picoides albolarvatus*) is a year round resident in the Ponderosa pine (*Pinus ponderosa*) forests found at the lower elevations (generally below 950m). White-headed woodpeckers are particularly vulnerable due to their highly specialized winter diet of ponderosa pine seeds and the lack of alternate, large cone producing, pine species.

Nesting and foraging requirements are the two critical habitat attributes limiting the population growth of this species of woodpecker. Both of these limiting factors are very closely linked to the habitat attributes contained within mature open stands of Ponderosa pine. Past land use practices, including logging and fire suppression, have resulted in significant changes to the forest structure within the Ponderosa pine ecosystem.

White-headed Woodpecker Life History, Key Environmental Correlates, and Habitat Requirements

Life History

Diet

White-headed woodpeckers feed primarily on the seeds of large Ponderosa pines. This is makes the white-headed woodpecker quite different from other species of woodpeckers who feed primarily on wood boring insects (Blood 1997; Cannings 1987 and 1995). The existence of only one suitable large pine (ponderosa pine) is likely the key limiting factor to the white-headed woodpecker's distribution and abundance.

Other food sources include insects (on the ground as well as hawking), mullein seeds and suet feeders (Blood 1997; Joe *et al.* 1995). These secondary food sources are used throughout the spring and summer. By late summer, white-headed woodpeckers shift to their exclusive winter diet of ponderosa pine seeds.

Reproduction

White-headed woodpeckers are monogamous and may remain associated with their mate throughout the year. They build their nests in old trees, snags or fallen logs but always in dead wood. Every year the pair bond constructs a new nest. This may take three to four weeks. The nests are, on average 3m off the ground. The old nests are used for overnight roosting by the birds.

The woodpeckers fledge about 3-5 birds every year. During the breeding season (May to July) the male roosts in the cavity with the young until they are fledged. The incubation period usually lasts for 14 days and the young leave the nest after about 26 days. White-headed woodpeckers have one brood per breeding season and there is no replacement brood if the first brood is lost.

The woodpeckers are not very territorial except during the breeding season. They are not especially social birds outside of family groups and pair bonds and generally do not have very dense populations (about 1 pair bond per 8 ha).

Nesting

Generally large ponderosa pine snags consisting of hard outer wood with soft heartwood are preferred by nesting white-headed woodpeckers. In British Columbia 80 percent of reported nests have been in ponderosa pine snags, while the remaining 20 percent have been recorded in Douglas-fir snags. Excavation activities have also been recorded in Trembling Aspen, live Ponderosa pine trees and fence posts (Cannings *et al.* 1987).

In general, nesting locations in the South Okanagan, British Columbia have ranged between 450 - 600m (Blood 1997), with large diameter snags being the preferred nesting tree. Their nesting cavities range from 2.4 to 9 m above ground, with the average being about 5m. New nests are excavated each year and only rarely are previous cavities re-used (Garrett *et al.* 1996).

Migration

The white-headed woodpecker is a non-migratory bird.

Habitat Requirements

Breeding

White-headed woodpeckers live in montane, coniferous forests from British Columbia to California and seem to prefer a forest with a relatively open canopy (50-70 percent cover) and an availability of snags (a partially collapsed, dead tree) and stumps for nesting. The birds prefer to build nests in trees with large diameters with preference increasing with diameter. The understory vegetation is usually very sparse within the preferred habitat and local populations are abundant in burned or cut forest where residual large diameter live and dead trees are present.

Highest abundances of white-headed woodpeckers occur in old-growth stands, particularly ones with a mix of two or more pine species. They are uncommon or absent in monospecific ponderosa pine forests and stands dominated by small-coned or closed-cone conifers (e.g., lodgepole pine or knobcone pine).

Where food availability is at a maximum such as in the Sierra Nevadas, breeding territories may be as low as 10ha (Milne and Hejl 1989). Breeding territories in Oregon are 104 ha in continuous forest and 321 ha in fragmented forests (Dixon 1995b). In general, open Ponderosa pine stands with canopy closures between 30 - 50 percent are preferred. The openness however, is not as important as the presence of mature or veteran cone producing pines within a stand (Milne and Hejl 1989). In the South Okanagan, British Columbia, Ponderosa pine stands in age classes 8 -9 are considered optimal for white-headed woodpeckers (Haney 1997). Milne and Hejl (1989) found 68 percent of nest trees to be on southern aspects, this may be true in the South Okanagan as well, especially, towards the upper elevational limits of Ponderosa pine (800 - 1000m).

White-headed Woodpecker Population and Distribution

Population

Historic

No data are available.

Current
No data are available.

Distribution
Historic
No data are available.

Current
These woodpeckers live in montane, coniferous forests from southern British Columbia in Canada, to eastern Washington, southern California and Nevada and Northern Idaho in the United States. The exact population of the white-headed woodpecker is unknown but there are thought to be less than 100 of the birds in British Columbia. See Figure_100, Figure_101, and Figure_102 for current distribution.

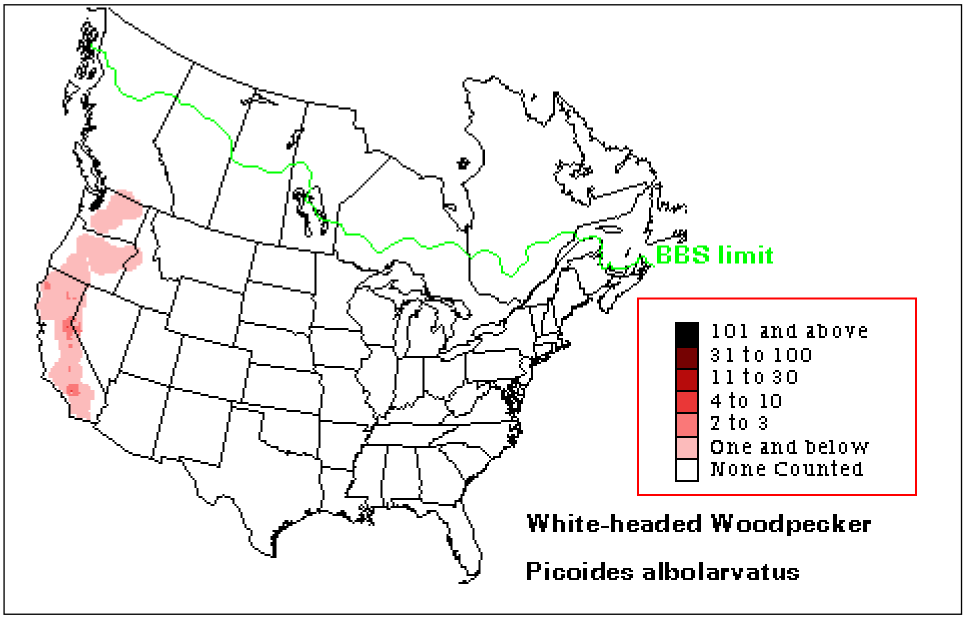

Figure 73. White-headed woodpecker year-round range (Sauer *et al*. 2003).

Woodpecker abundance appears to decrease north of California. They are uncommon in Washington and Idaho and rare in British Columbia. However, they are still common in most of their original range in the Sierra Nevada and mountains of southern California. The birds are non-migratory but do wander out of their range sometimes in search of food.

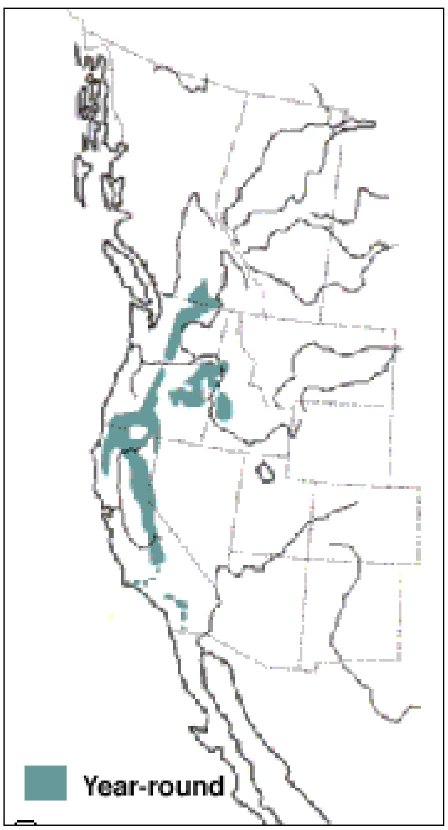

Figure 74 White-headed woodpecker breeding distribution (from BBS data) (Sauer *et al.* 2003).

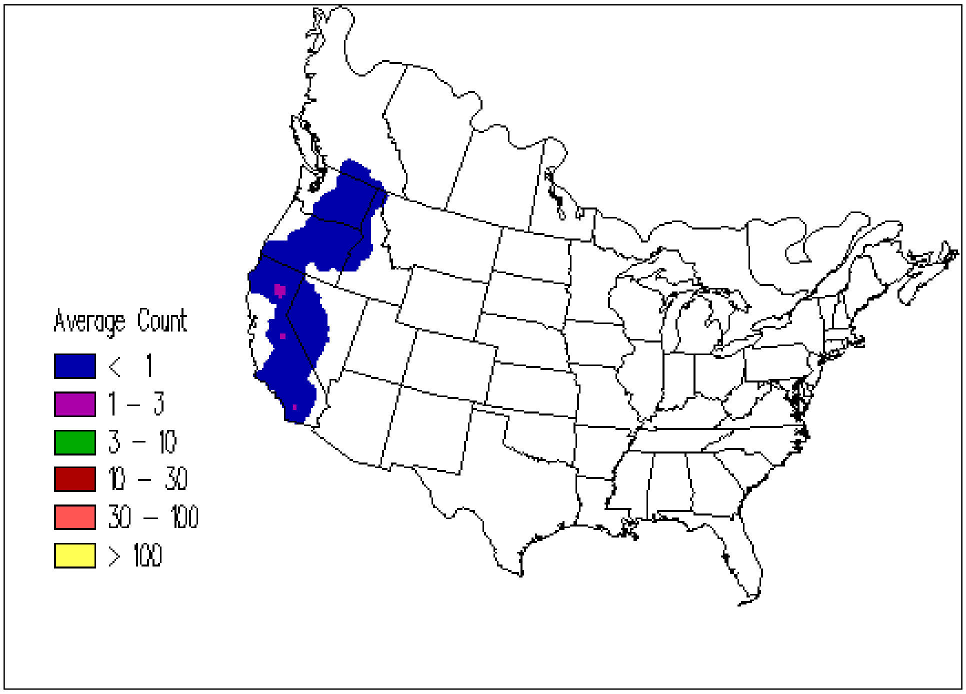

Figure 75. White-headed woodpecker winter distribution (from CBC data) (Sauer *et al.* 2003).

White-headed Woodpecker Status and Abundance Trends
Status
Although populations appear to be stable at present, this species is of moderate conservation importance because of its relatively small and patchy year-round range and its dependence on mature, montane coniferous forests in the West. Knowledge of this woodpecker's tolerance of forest fragmentation and silvicultural practices will be important in conserving future populations.

Trends

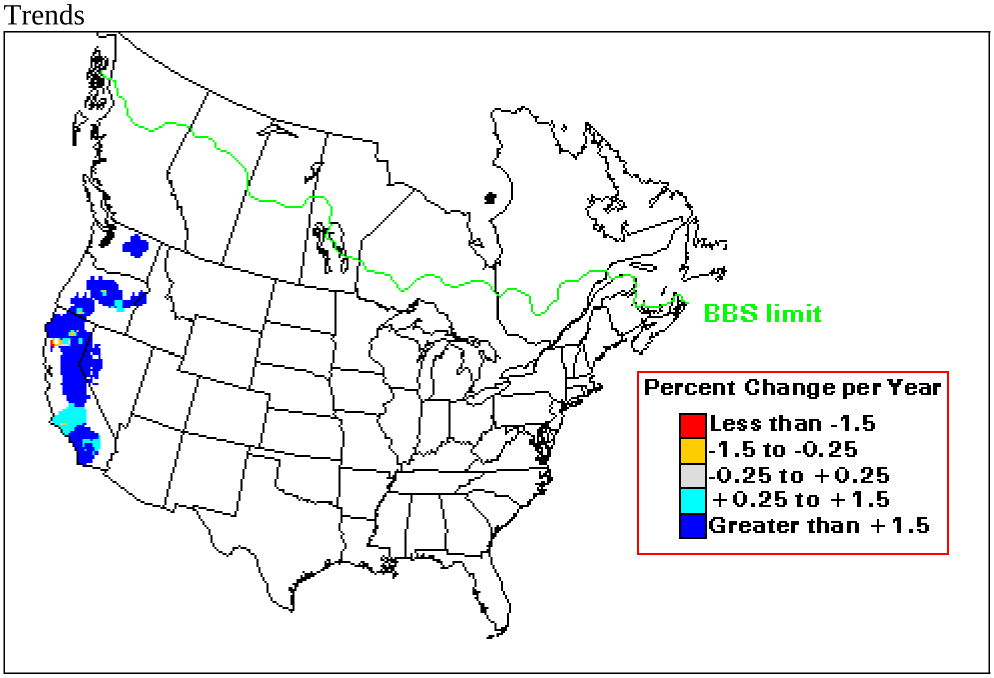

Figure 76. White-headed woodpecker Breeding Bird Survey (BBS) population trend: 1966-1996 (Sauer *et al.* 2003).

Factors Affecting White-headed Woodpecker Population Status

Key Factors Inhibiting Populations and Ecological Processes

Logging

Logging has removed much of the old cone producing pines throughout the South Okanagan. Approximately 27, 500 ha of ponderosa pine forest remain in the South Okanagan and 34.5 percent of this is classed as old growth forest (Ministry of Environment Lands and Parks 1998). This is a significant reduction from the estimated 75 percent in the mid 1800s (Cannings 2000). The 34.5 percent old growth estimate may in fact be even less since some of the forest cover information is incomplete and needs to be ground truthed to verify the age classes present. The impact from the decrease in old cone producing ponderosa pines is even more exaggerated in the South Okanagan because there are no alternate pine species for the white-headed woodpecker to utilize. This is especially true over the winter when other major food sources such as insects are not available. Suitable snags (DBH>60cm) are in short supply in the South Okanagan.

Fire Suppression

Fire suppression has altered the stand structure in many of the forests in the South Okanagan. Lack of fire has allowed dense stands of immature ponderosa pine as well as the more shade tolerant Douglas-fir to establish. This has led to increased fuel loads resulting in more severe stand replacing fires where both the mature cone producing trees and the large suitable snags are destroyed. These dense stands of immature trees has also led to increased competition for nutrients as well as a slow change from a Ponderosa pine climax forest to a Douglas-fir dominated climax forest.

Predation

There are a few threats to white-headed woodpeckers such as predation and the destruction of its habitat. Chipmunks are known to prey on the eggs and nestlings of white-headed woodpeckers. There is also predation by the great horned owl on adult white-headed woodpeckers. However, predation does not appreciably affect the woodpecker population.

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6.3.5 American Marten

American marten (Martes americana)

Distribution

In eastern Oregon, martens can be found in the Blue and Wallowa mountains (Verts and Carraway 1998).

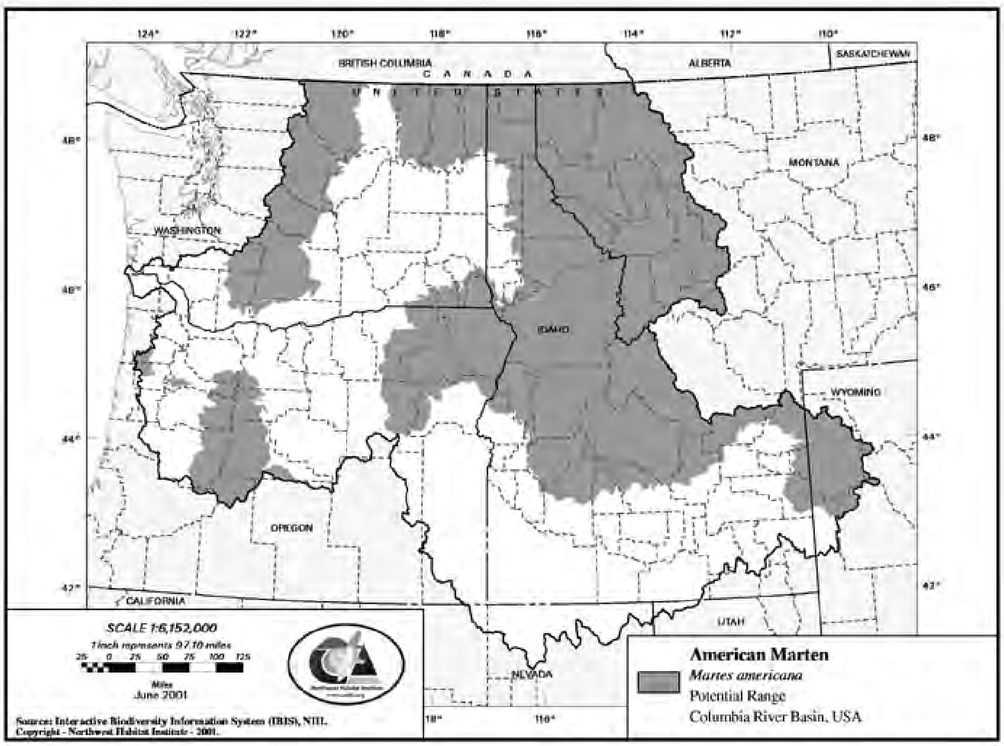

Figure 1. Current Distribution of American marten (*Martes americana*) in the Columbia River Basin (IBIS 2004).

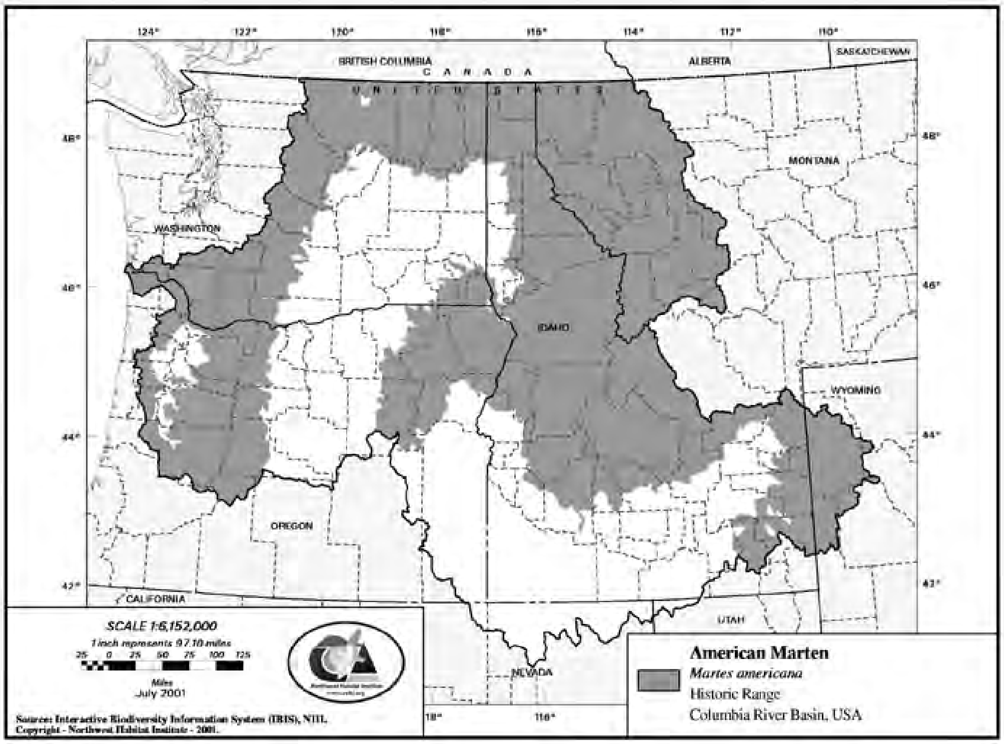

Figure 2. Historic distribution of American marten (*Martes americana*) in the Columbia River Basin (IBIS 2004).

Habitat and Density

The marten is a forest species capable of tolerating a variety of habitat types if food and cover are adequate (Strickland and Douglas 1987, cited in Verts and Carraway 1998).

Extensive logging and forest fires reduce the value of areas to martens, sometimes for many years (Strickland and Douglas 1987, cited in Verts and Carraway 1998). In addition to these areas supporting fewer individuals, martens in these areas have shorter life spans, are less productive, and suffer higher natural and trapping mortality than those in undisturbed forest (Thompson 1994, cited in Verts and Carraway 1998). In addition, martens captured significantly less mass of food per kilometer of foraging travel in logged forests (Thompson and Colgan, 1994, cited in Verts and Carraway 1998).

There is no known published quantitative information regarding habitats used by martens in Oregon (Verts and Carraway 1998).

*Evelyn Bull – working on marten studies

There are no estimates of density of martens for Oregon (Verts and Carraway 1998). Oregon Department of Fish and Wildlife has harvest data on marten.

Reported annual harvest of martens in Union and Wallowa Counties, OR (ODFW)

	Union	Wallowa		Union	Wallowa		Union	Wallowa
1969-1970	2		1978-1979	3		1987-1988		6
1970-1971	3		1979-1980		4	1988-1989	1	10
1971-1972	1		1980-1981		1	1989-1990		1
1972-1973		2	1981-1982		1	1990-1991	9	
1973-1974			1982-1983	2	1	1991-1992	2	
1974-1975		2	1983-1984			1992-1993		

1975-1976			1984-1985		10	1993-1994	9	2
1976-1977		18	1985-1986	8	10	1994-1995		1
1977-1978		4	1986-1987	1	29			

Diet

In Montana, remains of mammals occurred in 93.3% of 1,758 fecal droppings of martens; birds occurred in 12.0%, insects in 19.0%, and fruits in 29.2%. In California (Zielinski et al. 1983) and in Wyoming (Murie, 1961) the diet of martens is much the same as that in Montana (cited in Verts and Carraway 1998).

Remarks

We know little firsthand of the marten in Oregon, but we suspect that populations here likely will not increase greatly if short-rotation timber harvest and single-species replanting continue as recommended forest-management practices. Other practices, more of the past than of the present-such as burning or otherwise removing slash, snags, and downed logs, and large clear-cuttings-likely are detrimental to marten populations (Verts and Carraway 1998).

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6.3.6 Olive-sided Flycatcher

Olive-sided flycatcher (*Contopus cooperi*) Keith Paul, USFWS

© Shaw Creek Bird Supply

Introduction

The olive-sided flycatcher is one of the most recognizable breeding birds of Oregon's coniferous forests with its resounding, three-syllable, whistled song *quick, three beers* (Altman 2003) and its position of prominence perched atop a large tree or snag (Altman and Sallabanks 2000). This flycatcher undergoes one of the longest and most protracted migrations of all Nearctic migrants, wintering primarily in Panama and the Andes Mountains of South America (Altman and Sallabanks 2000).

Description, Life History, and Habitat Requirements

Description

The olive-sided flycatcher is a relatively large, somewhat bulky, large-headed, short-necked flycatcher that perches erect and motionless at the top of a tall tree or snag except when singing or darting out to capture flying insects (Altman 2003). The overall olive-gray plumage is generally nondescript except for a whitish stripe down the breast and belly which gives the impression of an unbuttoned vest, and white patches between the wings and lower back (Altman 2003).

Life History

Diet

Olive-sided flycatchers prey almost exclusively on flying insects including flying ants, beetles, moths, and dragonflies, but with a particular preference for bees and wasps (Bent 1942, Altman 2003).

Olive-sided flycatchers forage mostly from high, prominent perches at the top of snags or the dead tip or uppermost branch of a live tree (Altman 2003). They forage by "sallying" or "hawking" out to snatch a flying insect, and then often returning to the same perch ("yo-yo" flight) or another prominent perch (Altman 2003). Foraging behavior as an air-sallying insectivore requires exposed perches and unobstructed air space, thus tall trees or snags and broken canopy provide a better foraging environment than closed-canopy forest (Altman 2003, Altman and Sallabanks 2000). During the early reproductive period, the males usually forage from the tops of the tallest trees and snags, and females forage at lower heights and near the nest (Altman 2000, 2003).

Reproduction

Olive-sided flycatcher territory establishment and pairing begins upon arrival to breeding grounds (Altman 2003). Nest building is most evident during the first and second week of June, but completed nests have been reported as early as May 27 (Altman 2000). The nest area is aggressively defended by both members of the pair (Altman and Sallabanks 2000). Olive-sided flycatchers are monogamous. They produce 3-4 eggs per clutch and one clutch per pair. Incubation period lasts 14-15 days, nestling period lasts approximately 19-22. The hatching of nestlings from a successful first nest occurs mostly in second week of July. Olive-sides flycatchers will renest after a failed clutch until about July 1. The latest fledging of nestlings is August 30 (Altman 2000). Adults remain with fledglings for up to two weeks (Altman 2003).

Females appear to choose the nest site; nests are most often found in coniferous trees (Altman and Sallabanks 2003). The nest is constructed primarily, if not totally, by the female (Altman and Sallabanks 2003). The foundation of the nest is built with larger twigs, while smaller twigs and larger rootlets are used to frame the nest. They will often use arboreal lichens to cover edges of nest rim and to line the cup of the nest (Altman and Sallabanks 2000); grasses, fine rootlets, or pine needles may also be used to line the nest (Bent 1942)

<u>Breeding Territory/Home Range</u>

Nesting pairs are generally well spaced and require relatively large territory. While estimates of territory size vary, most are 24.7-49.2 acres (10-20 ha) per pair (Altman 1997) and some as large as 100 ac (40-45 ha) per pair (Altman 2003).

<u>Migration/Overwintering</u>

The olive-sided flycatcher is a long distance, complete migrant between its breeding grounds in North American and its wintering grounds in Central and South America (Murphy 1989). They have the longest migration route of any flycatcher breeding in North America (Murphy 1989).

In Oregon, the spring migration of olive-sided flycatchers is well documented because of the loud, distinctive song. Spring migration peaks in late May, earlier in southwest and coastal Oregon, and later in eastern Oregon. Timing of fall migration is less known, but peaks in late August and into the first week of September (Altman 2003).

<u>Survivorship</u>

There is limited knowledge of the life-span of olive-sided flycatchers. From Bird Banding Laboratory data, two individuals that were banded and recaptured were at least seven years old.

<u>Mortality</u>

Very limited data exists. In one instance, sibling competition caused mortality (Altman and Sallabanks 2000). Other data shows that olive-sided flycatcher remains were discovered in a peregrine nest (Cade et al. 1968).

Habitat Requirements

General

The olive-sided flycatcher breeds only in coniferous forests of North America and is associated with forest openings and forest edge. During migration olive-sided flycatchers have been observed in a great diversity of habitats compared to that of the breeding season, including lowland riparian, mixed or deciduous riparian at higher elevations and urban woodlots and forest patches (Altman 2003). Olive-sided flycatchers have been observed moving north through sagebrush flats in Malheur and Harney Counties, OR (M. Denny p.c., cited *in* Altman 2003).

Breeding/Foraging

Olive-sided flycatchers breed in coniferous forest, particularly in the following circumstances: within forest burns where snags and scattered tall, live trees remain; near water along the wooded shores of streams, lakes, rivers, beaver ponds, marshes, and bogs, often where standing dead trees are present; at the juxtaposition of late- and early-successional forest such as meadows, harvest units, or canyon edges; and in open or semi-open forest stands with a low percentage of canopy cover (Altman and Sallabanks 2000). In the Blue Mountains, territorial birds are found mostly along stream courses and around wet openings (M. Denny p.c. cited *in* Altman 2003). Tall, prominent trees and snags, which serve as foraging and singing perches, are common features of all nesting habitat.

Wintering/Foraging

Wintering habitat is similar to that on breeding grounds; forest edges and forest openings, especially where scattered tall trees or snags are present (AOU 1983, Stotz et al. 1992, 1996, Ridgely and Tudor 1994, Altman and Sallabanks 2000). They are most commonly found in mature evergreen forest (Petit et al. 1995, particularly montane forest (Willis et al. 1993, Ridgely and Tudor 1994, Stotz et al. 1996).

Population and Distribution
Distribution

Historic Distribution

The historic distribution of olive-side flycatchers is similar to the distribution today. Several Breeding Bird Atlases, including Michigan (Evers 1991), New York (Peterson 1988), Ontario (Cheskey 1987), and Monterey Co., CA (Roberson and Tenney 1993), report few significant changes in distribution during the twentieth century (Altman and Sallabanks 2000).

Current Distribution

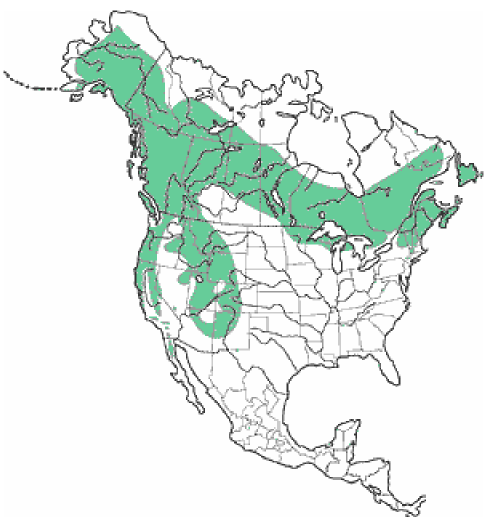

Figure 1. Birds of North America – Breeding distribution of the olive-sided flycatcher in North and Middle America.

The olive-sided flycatcher breeds only in coniferous forests of North America; from Alaska's boreal forest south to Baja California, in central North American south to northern Wisconsin, and in eastern North America south to northeast Ohio and southwest Pennsylvania, including all of New England, and locally in the Appalachians south to western North Carolina (Altman 2003).

Principal migratory route is throughout the forest of western North America, Mexico, and Central America (Bent 1942, Gabrielson and Lincoln 1959, Altman 2003).

Olive-sided flycatchers winter primarily in Panama and the Andes of northern and western South America, from northwestern Venezuela south through Ecuador to southeast Peru and northern Bolivia (Fitzpatrick 1980, DeGraaf and Rappole 1995, Altman 2003).

In Oregon, the olive-sided flycatcher breeds in low densities throughout conifer forests from near sea level along the coast to timberline in the Cascades and Blue Mountains (Altman 2003). The olive-sided flycatcher is most abundant throughout the Cascades (Sauer et al. 1997). In migration, they may occur in any forested habitat including forest patches, desert oases of southeast Oregon, urban forest, and deciduous or mixed deciduous/coniferous riparian forest (Altman 2003).

Population

Historic Population

Historic population numbers of olive-sided flycatchers are unknown.

Current Population and Status

Population trends for OSF based on Breeding Bird Surveys (BBS) data show highly significant declines for all continental (N. America), national (U.S. and Canada), and regional (e. and w. N. America) analysis, and for most state and physiographic region analyses (Sauer et al. 1997, Altman 2003). In Oregon, there has been a highly significant ($p < 0.01$) statewide decline of 5.1% per year from 1966-96 (Sauer et al. 1997, Altman 2003).

Causes of population decline have focused on habitat alteration and loss on the wintering grounds, because declines are relatively consistent throughout the breeding range of the species (Altman and Sallabanks 2000). Other factors potentially contributing to declines on the breeding grounds include habitat loss through logging, alteration of habitat from forest management practices (e.g., clearcutting, fire suppression), lack of food resources, and reproductive impacts from nest predation or parasitism (Altman 2003).

It has also been speculated by Hutto (1995a), that the olive-sided flycatcher may depend on early post-fire habitat, and has likely been negatively affected by fire-control policies of the past 50-100 years (Altman, 2003). The ability of forest management practices (e.g., selective cutting, clearcutting) to mimic natural disturbance regimes caused by forest fires has been questioned. Habitat created by these forest management scenarios may provide only the appearance of early post-fire habitat, but be lacking in some attributes or resources required by olive-sided flycatchers (Altman, 2003).

During the past 50 years, forest management resulted in an increase in forest openings and edge habitat, which has seemingly increased habitat for the olive-sided flycatcher. However, this dichotomy of increased habitat availability and declining populations may indicate that harvested forest represents an "ecological trap" (Hutto 1995b), where habitat may appear suitable, but reproductive success and/or survival is poor due to factors such as limited food resources, predation, or parasitism (Altman, 2003).

Continuing Threats

One of the largest continuing threats to the olive-sided flycatcher is deforestation in Central and South America. Diamond (1991), calculated that olive-sided flycatchers would lose 39% of their wintering habitat in the Andean montane forests between 1980 and 2000. This loss is in addition to habitat loss prior to 1980.

Continuing threats within the breeding range of olive-sided flycatcher include habitat loss to conversion to non-forest, alteration/degradation of habitat, reduced availability and acquisition of food resources, pesticides, and nest predation (Altman and Sallabanks 2003).

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6.3.7 Mountain Goat

Rocky Mountain goat (*Oreamnos americanus*) Keith Paul, USFWS

Introduction

The Rocky Mountain goat (RMG) is stocky, with a slender neck, thin black horns, and a short tail. Its pelage consists of white wool and guard hairs, often with scattered dark brown hairs on back and rump (Seton, 1929), sometimes forming a "clearly defined dark brown line" (Grant 1905), and including a pointed beard approximately five inches (130 mm) in length. The winter coat often appears yellowish, especially shortly before it is shed in the spring. The feet are larger than those of mountain sheep, with oval hooves and prominent dew "claws." RMGs consequently are able to traverse weaker snow crusts than are mountain sheep (Geist 1971; Rideout and Hoffman 1975).

Most archaeological evidence of RMGs in Oregon occurs in northeastern Oregon (Randolph and Dahlstrom 1977, Leonhardy and Thompson 1991, Lyman 1995) and dates from 300 – 1,500 years old (Figure 4). One 2000 year old archaeological record was found in Rattlesnake Creek in the Owyhee drainage of southeast Oregon (Lyman, 1988) but it is not clear whether this record is from a resident animal or whether it was traded for by indigenous peoples. Lyman (1988) suggested RMGs were present throughout the Oregon Cascades in suitable habitat, including Mt. Hood, Mt. Jefferson, and the Three Sisters based on pre-historic evidence from Washington, Oregon, and California (Richardson et al. 1829, Rideout and Hoffmann 1975, ODFW 2003).

Lewis and Clark provide the first European reports of RMGs in Oregon in their journals ca. 1806 (Moulton 1990). Accounts from other early explorers, ca. 1799 – 1815, also suggest RMGs were plentiful along the Columbia River and in the Cascade and Coast Ranges of Oregon and Washington (Figure 4; Ord 1815, Richardson et al. 1829, Suckley and Gibbs 1860, Coues 1897, Grant 1905). All accounts indicate goats were readily used by local indigenous people of the area (ODFW 2003).

RMGs indigenous to northeastern Oregon likely disappeared prior to European settlement during the late 19th and early 20th century (Grant 1905). Matthews and Coggins (1995) theorize improved mobility resulting form horses and more efficient weapons (firearms) may have influenced tribal hunting impacts on RMGs. RMGs likely disappeared from the Oregon Cascades during the 19th century as a result of climatic fluctuation, impacts of severe weather on isolated populations, and impacts of Native American hunters (Lyman 1988). RMGs have since been reintroduced to Oregon and are currently increasing in numbers (ODFW 2003).

Life History, Key Environmental Correlates, and Habitat Requirements

Life History

<u>Diet</u>

RMGs have a broad food tolerance and eat almost any forage including species not normally used by other ungulates (ODFW 2003). However, they tend to select flower-heads, buds, or foliage parts that are presumably more nutritious (Casebeer et al. 1950). Grasses are preferred in most areas and are used year round if available (Saunders 1955, Chadwick 1973, Smith 1976). Frequent conifer consumption, particularly firs (Saunders 1955, Geist 1971, Smith 1976) seems to be associated with severe winter conditions (Geist 1962, Kerr 1965, Johnson 1983).

A generalized foraging strategy allows goats to take advantage of the limited forage choices available. Goats, particularly nursery groups, appear to select topographically secure habitats and eat whatever is available (Johnson 1983). Seasonal variation in forage and habitat selection suggests needs become less important as kids age and the need for abundant quality forage increases (ODFW 2003).

Water requirements are largely unknown. In some areas, goats left areas when water dried up (Anderson 1940, Johnson 1983), which may explain the absence of goats form otherwise suitable habitat in Oregon (Wigal and Coggins 1982). Brandborg (1955) saw no evidence of daily movements to reach water in Idaho or Montana. Goats frequently eat snow, which may fulfill much of their water requirement. Further, succulent vegetation may allow goats to obtain their water requirement from forage (ODFW 2003).

Like other ungulates, goats frequent available mineral licks, with most use in May, June, and July (Brandborg 1955, McCrory 1965, Hebert 1967, Stevens 1979). All sex and age groups use mineral licks, although timing varies (Singer and Doherty 1985). Mineral constituents and concentrations vary considerably and undoubtedly affect attractiveness and nutritional value of licks. In Oregon, mineral blocks are used in the Wallowa Mountains. Goats exhibit high use of mineral blocks and placement has been effective in managing goat distribution (ODFW 2003).

Reproduction

RMGs also are polygamous and breed between early November and Mid-December (Geist 1964). Dominant males are very active, moving between herds in search of estrous females, and tending such females throughout their 2-3 day receptive period (DeBock 1970, Chadwick 1983). Gestation lasts about 180 days with the peak of births near the 1st of June. As parturition approaches, pregnant nannies seek seclusion, often in the steepest roughest terrain in their range. A single kid is normally born, although twinning is not uncommon in low density populations on productive ranges (Holroyd 1967, Hibbs et al. 1969, Houston and Stevens 1988). Triplets have been reported on rare occasions (Lentfer 1955, Hayden 1984, Hoefs and Nowlan 1998). Birth weights average 12 pounds and kids gain approximately 0.44 pounds per day for the first five months (Smith et al. 1995) (ODFW 2003).

Kids are precocious; they are able to move on steep slopes within hours of birth. During the first few days, the nanny and kid remain close with frequent nursing bouts (Brandborg 1955, Chadwick 1983). Nursing becomes less frequent and of shorter duration within 10 days (Stevens 1980) and effectively terminates by late August. Kids begin eating forage and ruminating shortly after birth, and forage regularly by six weeks of age (Brandborg 1955, Chadwick 1983). One to two weeks after birth nannies and kids rejoin other females and young in small nursery herds on summer ranges. Yearlings also join these nursery herds, while two year old males gradually assume a more solitary existence typical of adult males. Kids remain with their mothers through winter, benefiting from their mother's social status and access to foraging sites. Although orphaned kids con survive the winter, survival is enhanced if their mothers are present to break trails and paw for forage through deep snow (Chadwick 1983). Nannies become less tolerant of kids in spring, eventually abandoning them as they prepare for another birth. Although yearlings are part of nursery herds and benefit from the association, they are rejected and kept apart from newborn kids. Yearlings dig for their own forage in winter or utilize craters abandoned by others. Nannies often defend locations and exclude subordinates from the forage during tough winters. As a result, yearling winter mortality can be high (Smith et al. 1999, ODFW).

Home Range

Studies of RMG home range are few, but Rideout (1977) reported annual home ranges of 48.3, 31.1, 24.0, and 21.5 km² for yearlings, two-year olds, adult females and adult males, respectively. Females use traditional summer and winter ranges (Rideout 1977, Smith 1976). Males appear to have less fidelity to seasonal ranges (ODFW 2003).

Habitat Requirements

RMG habitat varies throughout North America ranging from dense coastal forests at sea level in Alaska (Smith 1986) and British Columbia (Hebert and Turnbull 1977) to alpine basins in Colorado (Hibbs 1967) and Oregon (Matthews and Coggins 1994). Good goat habitat is dominated by cliffs or extremely steep rocky slopes (Kerr 1965, Holroyd 1967, Johnson 1983, Chadwick 1983). Cliffs and rock outcrops provide security cover. Nannies utilize the least accessible and most secure crannies for parturition and the first days with new born kids (von Elsner-Schack 1986). Nursery groups and even large adult males stay close to such cliffs most of the time. Cliff areas are often broken by narrow talus chutes, lush avalanche slopes, or are adjacent to less precipitous areas of quality forage. Sunny, wind-swept south to west facing slopes limit snow depth and provide greatest food availability during winter. North and east facing slopes often have greater snow and water accumulations that lead to succulent summer forage (ODFW 2003).

Cover

Cliffs are important for thermal regulation. Overhangs, caves, lee sides of rocks or ridges, and dense conifers near cliffs provide shelter from sever weather. These features also provide protection from cold soaking rains and excessive heat during summer. Lingering snow banks are used by goats for summer cooling (ODFW 2003).

Mortality

Brandborg (1955) reported a 13-year-old RMG, and Richardson (1971) reported an 11-year-old male and a 10-year-old female. The oldest individuals represented among 165 skulls examined by Cowan and McCrory (1970) were an 18-year-old female and a 14-year-old male (Rideout and Hoffman 1975).

Predators of the RMG include the cougar (*Felis concolor*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), golden eagle (*Aquila chrysaetos*), and both black and grizzly bears (*Ursus americanus*, *U. arctos*). The cougar is probably the most serious of these, inasmuch as it can traverse rugged terrain and is large enough to attack and kill an adult mountain goat (Rideout and Hoffman 1975).

Harvest

RMG's were extirpated from Oregon prior to any formal regulatory or harvest management. Regulated RMG hunting began in 1965 in the Wallowa Mountains and continued through 1968. A total of 23 tags were issued and 20 animals (13 males and 7 females) were harvested. The population declined during this period, hunting was stopped following the 1968 season, and the season remained closed through 1996. The goat season reopened in 1997 for the Wallowa and Elkhorn Mountains with one tag in each area. As of October 2002, 38 goats have been legally harvested in Oregon (Table 1; ODFW 2003).

Table 1. Rocky Mountain goat harvest history in Oregon, 1965-2002 (ODFW 2003).

			Harvest	
Year	Hunt Area	Tags	Male	Female
1965	Hurricane Divide	5	4	1
1966	Hurricane Divide	5	3	2
1967	Hurricane Divide	5	3	2
1968	Hurricane Divide	8	3	2
1997	Hurricane Divide	1	1	0
1997	Elkhorn Mts.	1	1	0
1998	Hurricane Divide	1	1	0
1998	Elkhorn Mts.	2	2	0
1999	Hurricane Divide	1	0	1
1999	Elkhorn Mts.	2	2	0
2000	Hurricane Divide	1	1	0
2000	Elkhorn Mts.	2	2	0
2001	Hurricane Divide	2	2	0
2001	Elkhorn Mts.	2	2	0
2002	Hurricane Divide	2	1	0
2002	Elkhorn Mts.	2	2	0
Total		42	30	8

Annual hunting continues in both the Wallowa and Elkhorn Mountains with a limited number of tags. Similar to bighorn sheep, a person can hold only one controlled RMG tag in a lifetime. No tags are currently available to nonresidents. All tags are issued through a public drawing and the current bag limit is one goat. Currently, the goat season occurs during the mid September and runs 12 days (ODFW 2003).

In 2003, the Oregon Legislative Assembly adopted statute authorizing the Oregon Fish and Wildlife Commission to issue one special auction tag and one special raffle tag for hunting RMGs. Implementation will begin with a single raffle tag during the 2004 hunting season. Special auction and raffle tags will be valid for the months of September and October in all RMG hunting areas where the Commission authorizes controlled hunt tags (ODFW 2003).

Population and Distribution
Distribution
Rangewide Historic/Current

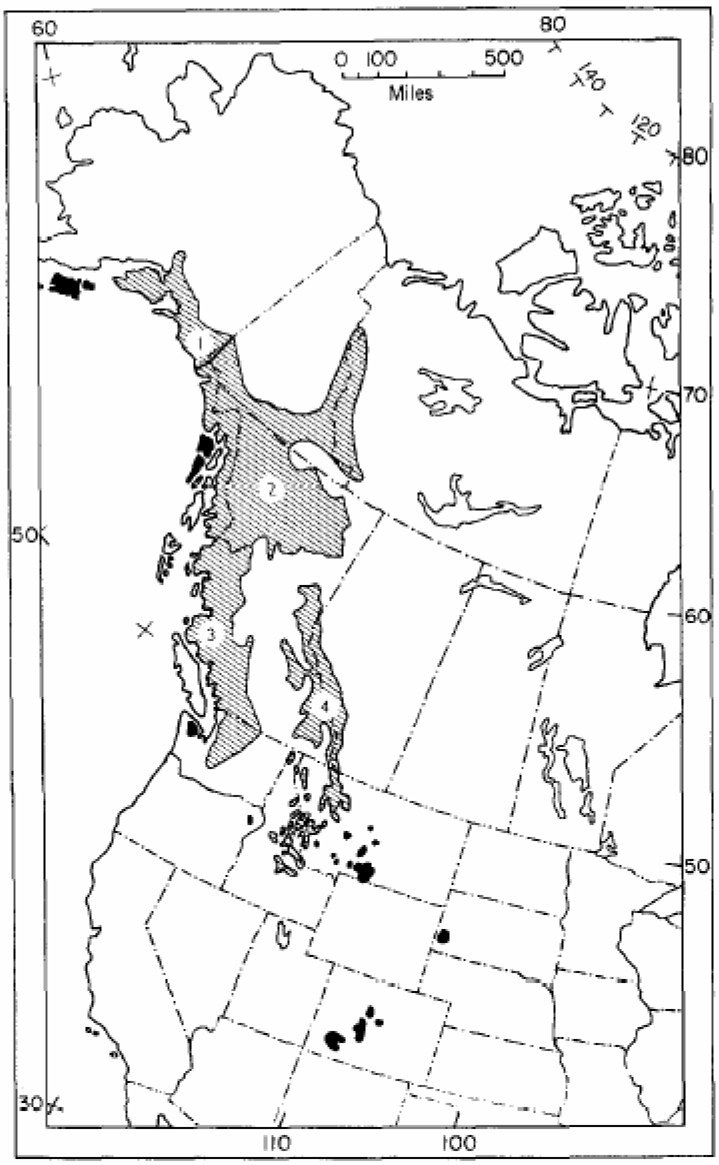

Figure 1. Distribution map of *Oreamnos americanus*. Shaded areas denote native ranges, which are still occupied; black areas show introduced herds. Ranges of subspecies formerly recognized are (1) *O. a. kennedyi*, (2) *O. a. Columbians*, (3) *O. a. americanus*, and (4) *O. a. missoulae*. Figure prepared by T. Swearingen (Rideout and Hoffman, 1975).

Oregon Historic/Current

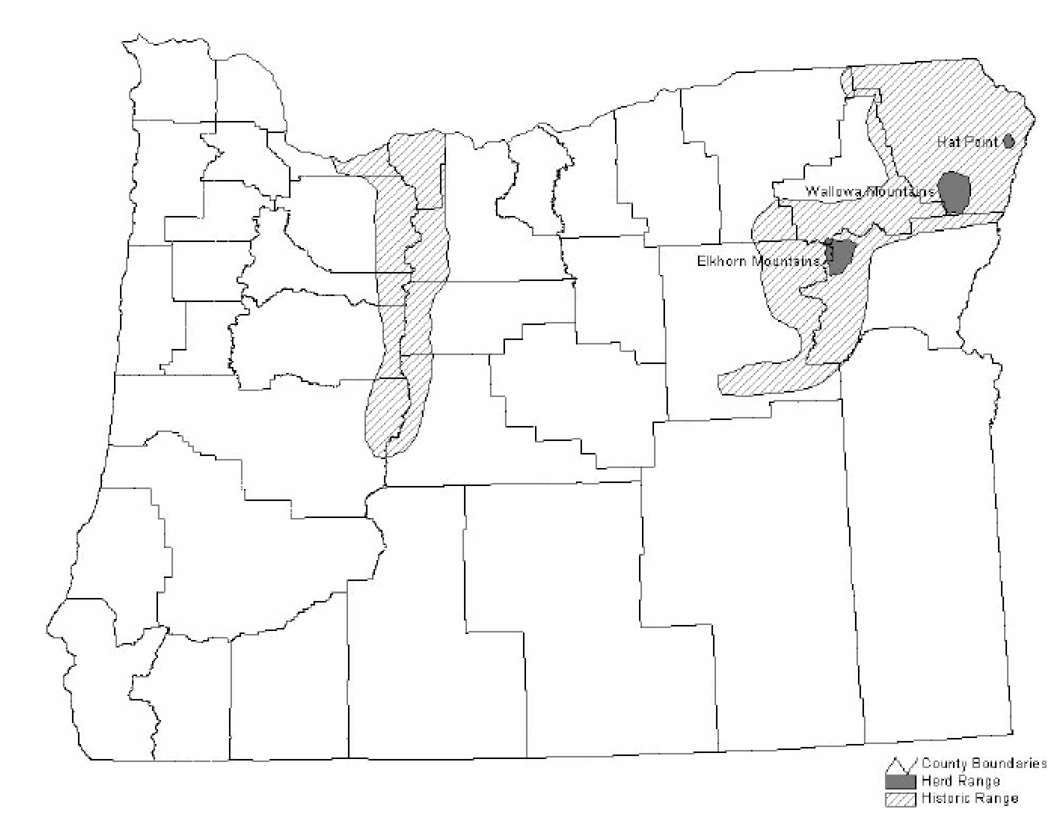

Figure 2. Historic and Current Distribution in Oregon (ODFW 2003).

RMGs were reintroduced to the Wallowa Mountains in 1950 when 5 animals from the Chopaka Mountains in Washington were released at the base of Joseph Mountain. Since 1950, 12 transplants from five sources have been made to four mountain ranges in Oregon. Thirty-three were released in the Wallowa's during the 1980's, and 20 were transplanted to the Wallowa's from the Elkhorn Mountains in 2002. From 1960-1976 three transplants totaling 15 goats were released in the Tanner Butte area of the Columbia River Gorge but none survived. A total of 21 goats from 3 sources were released in the Pine Creek drainage of the Elkhorn Mountains from 1983-1986. In July 2000, 16 goats were captured in the Elkhorn Mountains and transplanted to Sluice Creek in the Wallowa Mountains (ODFW 2003).

Population

Historic

There is no historic population data for RMG.

Current Population and Status

The Wallowa Mountains goat herd was established with five releases. The population remained static through the mid 1980's, never exceeding 45 animals. Kid recruitment has improved following additional releases and has remained moderately high (mean=39 kids:100 adults) since 1990. The 2002 population estimate for the Wallowa Mountains was 200 goats. Dispersal into vacant habitat adjacent to traditional core use areas is occurring throughout the Wallowa Mountains (ODFW 2003).

RMGs in the Elkhorn Mountains were established from 3 releases and annual surveys were initiated in 1987. Kid:adult ratios have been high and the population has increased rapidly with a 2002 population estimate of 150 goats. Individuals from this population continue to move into adjacent habitat including Vinegar Hill and the Strawberry Mountains (ODFW 2003).

RMGs transplanted to Hells Canyon in July 2000 continue to be monitored. Seven of the 16 individuals were radio collared and have remained near the release site. Reproduction has been good and the 2002 population estimate was 30 animals (ODFW 2003).

Table 2. Current status and 2002 population estimate for Rocky Mountain goats in Oregon (ODFW 2003).

Herd Name	# Releases (# Animals)	2002 Estimate	Status
Wallowa Mountains	4 (38)	200	Increasing
Elkhorn Mountains	3 (21)	150	Increasing
Hat Point	1 (16)	30	Increasing
Vinegar Hill	Dispersal	6	Unknown
Strawberry Mountains	Dispersal	4–6	Unknown
Wenaha River		2–3	Unknown
Cornucopia	1 (20)	6	No Data
Mt. Ireland		4–6	Unknown
Tanner Butte	3 (15)	0	Extirpated
Minimum Total		402	

Factors Affecting Population Status

Transplants

After RMGs were extirpated from Oregon, a reintroduction program was initiated in 1950. RMGs have been released on 12 separate occasions (Table 2). Early transplants in the Wallowa Mountains were successful. However, low productivity and overharvest limited population growth. Transplants during the 1980's stimulated population growth in the Wallowa Mountains herd and subsequent trapping was used to start the Elkhorn Mountains herd. By 2000, the Elkhorn herd had increased to a level that could support trapping and 36 goats have been moved to Hells Canyon since July 2000 (ODFW 2003).

Transplants to the Columbia Gorge in the 1980's likely failed because of small transplant size, scattering of individual goats, and too few males in the transplant (Matthews and Coggins, 1994). Observations of 1-4 individuals were occasionally reported from 1973-1990; however, no goats have been observed since 1990 (ODFW 2003)

Table 3. Rocky Mountain goat transplant history in Oregon, 1950-2002 (ODFW 2003).

Year	Origin of Stock	Male	Female	Total Released	Release Site	Range
1950	Chopaka Mt., WA	3	2	5	Joseph Mt.	Wallowa Mts.
1969-70	Olympic N.P., WA	2	6	8	Tanner Butte	Columbia Gor.
1975	Olympic N.P., WA	2	4	6	Tanner Butte	Columbia Gor.
1976	Olympic N.P., WA	1	0	1	Tanner Butte	Columbia Gor.
1983	NF Clearwater, ID	3	3	6	Pine Creek	Elkhorn Mts.
1985	Olympic N.P., WA	2	6	8	Hurricane Cr.	Wallowa Mts.
1985	Olympic N.P., WA	4	4	8	Pine Creek	Elkhorn Mts.
1986	Misty Fjord, AK	3	5	8	Hurricane Cr.	Wallowa Mts.
1986	Misty Fjord, AK	2	5	7	Pine Creek	Elkhorn Mts.
1989	Olympic N.P., WA	8	9	17	Hurricane Cr.	Wallowa Mts.
2000	Elkhorn Mts., OR	3	13	16	Sluice Creek	Hells Canyon
2002	Elkhorn Mts., OR	7	13	20	Summit Pt.	Wallowa Mts.
	Total	40	70	110		

Key Factors Inhibiting Populations and Ecological Processes

Because of the habitats that goats prefer, very little landscape manipulation is possible. Therefore, habitat that is available for RMG should be protected (if not already) and human access to that habitat should be limited by discouraging trails and roads that allow motorized vehicles. In areas where monitoring indicates overuse of forage species, goat management may include density reduction, use of techniques to discourage goat use or redistribute animals, or protection of specific plant communities (ODFW).

Research in Oregon by Vaughan (1975), found that low productivity was more likely responsible for lack of population growth rather than high mortality. Research also indicates that RMG populations are very sensitive to over-harvest, and goats cannot sustain harvest rates typical of other ungulate species (Haywood et al. 1980, Adams and Bailey 1982, Gonzalez-Voyer et al. in press). Harvest should be directed at the males because survival of nanny-kid groups is dependent on the dominant nanny leading the group between summer and winter ranges. Harvest of the nanny can compromise survival of the entire group (ODFW 2003).

Future Management and Research

ODFW realizes that RMG behavior has significant application to management. Therefore, ODFW believes that additional information is needed and/or refinement of technique to determine more accurate sex-ratio data, productivity, distribution, and seasonal range locations.

Population goals need to be established for specific goat herds. A population goal is defined as the optimal number sustainable in a particular area over time. Established goals will provide direct5ion for future population and human use management. Population goals may be difficult to establish without historical data for vacant or under-stocked ranges (ODFW 2003).

Primary management emphasis for the future will be to establish viable goat populations in all suitable habitat in Oregon (Table 4). Transplants will require landowner (private and/or government agency) cooperation (ODFW 2003).

Table 4. Proposed transplant sites for Rocky Mountain goats in Oregon (ODFW 2003).

Priority	Site Name	District	Limitations
1	Saulsberry Saddle	Wallowa	None
1	Eagle Creek[a]	Baker	None
1	Mt. Jefferson	Deschutes	Winter Range
1	Three Sisters	Deschutes	Winter Range
1	Upper Whitewater	CTWIR	None
1	Three-Fingered Jack	Deschutes	Winter Range
1	Wenaha River	Wallowa	None
1	Strawberry Wildnerness	Grant	None
1	Tanner Butte	Mid Col.	None
1	Herman Creek	Mid Col.	None

[a] Supplemental Release

RMGs are particularly vulnerable to hunting, and harvest should be strictly controlled and monitored. The following criteria will be used to determine hunt areas and tag numbers (ODFW 2003):

1. Herd population survey data should be indicative of a stable or growing population 3-5 years prior to initiation of harvest.

2. The population should be ≥ 50 animals comprised of at least 15% males.

3. Harvest should be no greater than 5% of the total population and no more than 50% of the harvest should be adult females. If more than 50% of the annual harvest is adult females, the following year's tag quota may be reduced.

Where goat numbers exceed established management goals or other social problems areas, additional removal of goats may be necessary. Trapping and transplanting, an increase in tags, salting to draw goats out of the area or other options may be employed (ODFW 2003).

RMG research should focus on management needs of local populations. Data on seasonal movements, habitat use, diet, and factors effecting reproduction or recruitment is needed to improve management of established populations. Herd health information from blood assays, identification of parasites and disease exposure are needed. Research designed to examine human impacts may be necessary in the future (ODFW 2003).

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6.3.8 Rocky Mountain Bighorn Sheep

Rocky Mountain Bighorn Sheep (*Ovis Canadensis Canadensis*) A. Sondenaa, NPT

Introduction

Bighorn sheep is a game species in Oregon and the adjacent states of Washington and Idaho. Sportsmen consider it a premier game species but hunting opportunities are limited due to low population numbers. Once common in many parts of the Basin, bighorns were extirpated throughout the Northwest earlier in the century due to over harvest, disease, and habitat loss. Reintroduction efforts have brought bighorns back to the Columbia Basin but many populations remain small and isolated.

Bighorn Sheep Life History and Habitat Requirements

Diet

Bighorn sheep are opportunistic foragers that utilize whatever plant species are available to them (Todd 1972). The primary component of bighorn sheep diet is grasses, although forbs and shrubs may contribute significantly to the diet in some regions or seasons (Shackleton et al. 1999). Bluebunch wheatgrass (*Pseudoregneria spicatum*), Idaho fescue (*Festuca ovina* var. *ingrata*), basin wild rye (*Elymus cinereus*), and various bluegrass (*Poa* spp.) and brome (*Bromus* spp.) species comprise the majority of grasses consumed by bighorns in the Columbia Basin. Despite this reliance on grasses, forbs often contribute the largest number of species to the bighorn diet (Shackleton et al. 1999), and may be seasonally more important during summer when they are more readily available. During winter shrubs can increase in importance compared to grasses and forbs (Keating et al. 1985) while the opposite may be true during spring and fall.

Diet varies seasonally (Shackleton et al. 1999, and references therein) and among individuals (Hickey 1975), and sex classes (Shank 1982). Shank (1982) attributed the variation in diets among ewes and lambs versus adult males to the different availability of plant species on the geographically segregated ranges of the two groups.

Reproduction

Female bighorn sheep reach sexual maturity at approximately 2.5 years of age although in some cases females can mate as young as 1.5 years and give birth as two year olds (Van Dyke 1978). Females are iteroparous, usually producing a single lamb (sometimes twins) yearly until they die or become too old to breed. Males, however, employ a semelparous breeding strategy and do not reach sexual maturity until about seven or eight years old (Geist 1971). Once rams reach sexual maturity they may actively breed ewes for only a few years but have the opportunity to sire many offspring during that time (Shackleton et al. 1999). Bighorns are polygamous with a few dominant rams performing most of the breeding (ODFW 2003).

Mating occurs during the fall rut, which typically lasts from 2-3 weeks. Timing of the rut varies geographically. In Alberta, Canada females were in estrous from mid November through mid December (Geist 1971), while herds in the Steens and Hart Mountains of Oregon are estimated to begin the rut in mid-October and continue through November (Verts and Carraway 1998). Pregnancy rates for rocky mountain bighorns appears to be high with reports of over 90% of the females being pregnant in some studies (Hass 1989, Jorgenson 1992). The gestation period for rocky mountain bighorns has been estimated at 173-176 days (Geist 1971, Blunt et al. 1972, Whitehead and McEwan 1980). Birth occurs in the spring during periods of high forage availability and as a result varies considerably across the geographic range of the species. In Oregon lambing generally occurs during April and May (ODFW 2003).

Just prior to parturition, ewes leave their group to seek suitable lambing habitat in steep, rocky terrain where they can give birth in seclusion. Shackleton et al. (1999: 122) attribute three primary functions to the isolation and ruggedness of lambing sites: 1) a relatively predator-proof habitat; 2) shelter from inclement weather; and 3) isolation required for the development of the mother-young bond. The female and her lamb will remain away from the herd for several days to a week to allow time to bond, and for the lamb to gain strength and coordination before rejoining the group (Smith et al. 1966, Geist 1971).

Mortality

Mortality factors vary by life stage. Young sheep may experience high rates of mortality during their first year of life. Date of birth and birth weight both contribute indirectly to early mortality rates (Geist 1971, Hass 1989). Lambs with low birth weight may be more susceptible to disease, predation or hypothermia during severe weather events. A study by Festa-Bianchet (1988) found that lambs born late in the season may miss the period of peak forage nutrition for lactating females, and therefore be more likely to die from inadequate nutrition.

Disease is a significant mortality factor for young bighorn. Pneumonia caused by *Pasteurella* has been a contributing factor in low lamb survival in several local populations throughout Oregon, Washington and Idaho (Coggins 1988, Akeson and Akeson 1992, Cassirer et al. 1996). Lungworms (*Protostrongylus*) have also been implicated in lamb mortalities at Hart Mountain, Oregon (Cottam 1985).

Predation by coyote, cougar, bobcat, and incidentally by wolverine and black bear can all contribute to lamb mortality (Shackleton 1985). Coyotes in particular have been shown to have significant impacts to lamb survival in some populations (Hebert and Harrison 1988, Hass 1989). The susceptibility of lambs to predators may be related to the availability and quality of escape/security cover (Shackleton et al. 1999)

The primary adult mortality factors are disease and predation. Recurrent infestations of lungworm, scabes (*Psoroptes ovis*), and *Pasturella* can have significant impacts to small, localized herds. Cassirer et al. (1996) documented the loss of 50-75% of the bighorns in 4 of 10 herds in the Hell's Canyon ecosystem of Oregon and Washington following a *Pasturella* outbreak in 1995. A more thorough discussion of the role of *Pasturella* in bighorn sheep recovery is provided in the Disease section below.

Cougar and humans appear to be the principle large predator of adult bighorns. In small populations or those being newly established through transplants, predation can be a significant factor in success and establishment of populations. In one case, four transplants into Hell's Canyon involving 53 sheep, experienced a loss of 11% of the transplanted individuals from cougar kills and human-caused mortalities, including road-kill of an animal attempting to cross a highway (Coggins et al. 2000).

Hunting currently and historically results in the greatest intended human caused form of mortality for Rocky Mountain bighorn sheep. Early harvest in the late 19th century didn't conform to any management constraints and harvest was often detrimental to a population. Since sheep were re-introduced to Oregon, harvest has been strictly targeted on rams. Human hunters (both legal and poachers) disproportionately select for mature, breeding-age rams. Limited hunting of ewes remains a possible tool to limit population growth in areas where a bighorn population has grown to the limits of its available habitat. However, to date, the Oregon Department of Fish and Wildlife has used trapping and transplanting as the primary tool to limit populations to available habitat constraints (ODFW, 2003).

The first Rocky Mountain bighorn hunt in Oregon was authorized in 1978 on Hurricane Divide. Since that time, 181 rams have been harvested from 7 areas (Table 1).

Table 1. Rocky Mountain bighorn sheep ram harvest in Oregon, 1978-2002.

		Rams	Years	Boone & Crockett Score	
Hunt	Unit	Harvested	Hunted	Range	Average
Hurricane Divide	Snake River, Minam, Imnaha, Pine	66	20	111 5/8 – 203 5/8	163 0/8
Lower Imnaha	Snake River	78	18	122 6/8 – 184 6/8	162 7/8
Sheep Mtn.	Pine	8	7	157 1/8 – 183 7/8	170 1/8
Lookout Mtn.	Lookout	2	2	162 5/8 – 181 4/8	172 1/8
Bear Creek	Minam	5	4	120 0/8 – 164 5/8	142 3/8
Chesnimnus-Sled Springs[a]	Chesnimnus, Sled Springs	10	8	159 2/8 – 200 6/8	182 3/8
Wenaha	Wenaha	12	6	124 2/8 – 184 0/8	157 4/8

	181	111 5/8 – 203 5/8	164 3/8

[a] Eight auction or lottery tags and four draw tagholders hunted area. (ODFW, 2003)

Bighorn sheep hunting has been closed since 1997 in all Rocky Mountain herd management units in SE Washington, including Mt. View, Black Butte, Wenaha, and Asotin Creek (WDFW 2003). In recent years, Nez Perce tribal members have exercised treaty-reserved rights to harvest bighorns within the Asotin Creek and Mt. View herds. In consideration of recovery goals, the Nez Perce Fish and Wildlife Commission instituted a conservation closure in 2003 on all treaty harvest of bighorn sheep within the Craig Mountain area in Idaho, that portion of NE Oregon supporting the Joseph Creek and Black Butte herds, and the Blue Mountains of SE Washington, including Asotin Creek. This action was taken to benefit population growth and ensure future opportunities for treaty harvest by Nez Perce Tribal members.

Habitat Requirements

Gregarious and extremely loyal to their home range, bighorns typically inhabit river canyons, talus slopes, cliffs, open meadows, and clear-cut or burned forests. The use of each habitat type varies seasonally and with requirements such as breeding, lambing, and thermal cover (Valdez and Krausman 1999). Habitat use also varies by sex with mature males occupying separate ranges from females, lambs, and immature rams. Males tend to inhabit areas of higher forage quality but greater predation risk, while maternal groups select habitat with greater security cover, even if this results in poorer forage quality or availability (Shackleton et al. 1999).

Elevational migrations are common, and bighorns will follow the wave of new vegetation upward in the spring. Preferred climate is relatively warm and arid with cold, dry winters. Low annual snowfall is important for lamb survival. Bighorn sheep require 4-5% of their body weight in water each day, but may be able to get sufficient water from succulent plants in the spring and snow in the winter to not be limited by standing water sources (Valdez and Krausman 1999). Bighorn sheep tend to avoid tall or overhanging vegetation that blocks their view of predators.

Bighorn Sheep Population and Distribution

Historic Population

Humans and mountain sheep have coexisted in North America for more than 30,000 years. Bighorn sheep were historically widespread throughout the drier, non-forested regions of western North America. Nowak (1991) estimated that 1.5 to 2 million individual *Ovis Canadensis* may have inhabited North America prior to their decline in the nineteenth century. Bighorns were an important historical resource for Native Americans. Horns and bones were used to make tools and ornaments, hides were used for clothing, and the meat was an important protein source (Valdez and Krausman 1999). Reports by early explorers, trappers and settlers suggest that at one time bighorn sheep were one of the most abundant large animals in Idaho. They were also especially abundant in Hell's Canyon and the Wallowa Mountains of Oregon (ODFW 2003). Lewis and Clark noted that the local Indians told them that bighorns were present in large numbers in the Clearwater Mountains of Idaho (Buechner 1960).

Overgrazing by cattle and sheep, disease, and uncontrolled hunting greatly reduced and often extirpated populations. In northeast Oregon, legal protection was afforded Rocky Mountain bighorns in 1911 but despite this effort, and the establishment of the Wallowa Mountains Sheep Refuge in 1927, Rocky Mountain Bighorns were extirpated from Oregon in 1945 (ODFW 2003). In Washington State, the last known Rocky Mountain bighorn was killed in 1917, with the remaining California bighorns were extirpated by the 1930's (WDFW 1995).

Bighorn populations have increased since the 1900's due to a series of reintroductions, but much of their previous range is still unoccupied (Wisdom et al. 2000). Transplanting is necessary to stimulate new populations in unoccupied habitats because bighorn are extremely loyal to their territories and will not readily move into new ranges (Parker 1985).

Current Population

There are currently four extant Rocky Mountain bighorn sheep herds within the Blue Mountains of southeast Washington: Asotin Creek, Black Butte, Wenaha, and Cottonwood Creek (Fowler 1999). An additional 11 herds occur in northeast Oregon (Table 2).

Table 2. Bighorn sheep population status within or adjacent to the Grande Ronde Subbasin in NE Oregon and SE Washington (ODFW 2003, WDFW 2003).

Herd	# Releases (# animals)	2002-3 Pop. Estimate	Current Status
Asotin Creek	3 (25)	45[a]	Increasing
Bear-Minam	4 (48)	35	Static
Black Butte	No Data	80	?
Cottonwood Creek	No Data	27	Static
Fox Creek	2 (24)	90	Increasing
Lone Pine	None[b]	12	Increasing
Lostine	1 (20)	80	Increasing
Lower Hells Canyon	3 (45)	35	Increasing
Lower Imnaha	3 (36)	165	Increasing
Muir Creek	2 (27)	25	Declining
Saddle Creek	None	12	Increasing
Sheep Mountain	4 (42)	35	Static
Upper Hells Canyon	2 (54)	45	Static
Upper Joseph Canyon	None	40	Increasing
Wenaha	2 (430)	65	Static

a) P. Fowler, WDFW, Personal Communication, 2004.
b) Established by natural dispersal from other herds.

Much of the current success of Rocky Mountain bighorn sheep populations is the direct result of reintroduction efforts. Table 3 provides an historical perspective on the transplant efforts in Oregon.

Table 3. Date, source and origin of stock used for Rocky Mountain bighorn sheep transplant into Oregon, 1939-2002.

Date	Source	Origin	Release Site	County	#
1939	Montana	Not Known	Hart Mountain	Lake	23
4/71	Alberta, Canada	Jasper Park	Upr Hells Canyon	Wallowa	20
11/71	Alberta, Canada	Jasper Park	Lostine River	Wallowa	20
1/76	Lostine River	Jasper Park	Bear Creek	Wallowa	17
1/77	Lostine River	Jasper Park	Bear Creek	Wallowa	8
1/78	Lostine River	Jasper Park	Battle Creek	Wallowa	5
1/79	Lostine River	Jasper Park	Battle Creek	Wallowa	29
1/79	Salmon R., ID	Panther Cr.	Lwr. Imnaha	Wallowa	15
1/81	Lostine River	Jasper Park	Hass Ridge	Wallowa	10
1/83	Lostine River	Jasper Park	Wenaha Canyon	Wallowa	15
1/84	Sullivan L., WA	Waterton/T. Falls	Bear Creek	Wallowa	11
1/84	Salmon R., ID	Panther Creek	Hass Ridge	Wallowa	11
12/84	Salmon R., ID	Cove Creek	Wenaha WA	Wallowa	28
12/85	Salmon R., ID	Ebenezer	Minam River	Wallowa	12
1/90	Tarryall CO	Tarryall, CO	Sheep Mtn.	Baker	21
2/90	Cottonwood Cr., CO	Cottonwood Cr.	Sheep Mtn.	Baker	9
12/93	Wildhorse Is., MT	Sun River MT	Cherry Creek	Wallowa	9
12/93	Wildhorse Is., MT	Sun River MT	Fox Creek	Baker	12
2/94	Wildhorse Is., MT	Sun River MT	Downey Creek	Wallowa	14

2/94	Wildhorse Is., MT	Sun River MT	Fox Creek	Baker	12
2/95	Alberta, Canada	Cadomin	Joseph-Cottonwood Cr.	Wallowa	16
2/95	Alberta, Canada	Cadomin	Jim Cr.	Wallowa	22
2/95	Alberta, Canada	Cadomin	Sheep Mtn.	Baker	10
2/95	Lostine, Oregon	Waterton/Jasper	Sheep Mtn.	Baker	2
12/97	Spences Bridge, B.C.	Baniff N.P.	Muir Creek	Wallowa	13
1/98	Lostine, Oregon	Waterton/Jasper	McGraw	Wallowa	15
2/99	Alberta, Canada	Cadomin	Muir Creek	Wallowa	14
2/00	Alberta, Canada	Cadomin	Minam River	Wallowa	17
2/00	Alberta, Canada	Cadomin	Big Sheep Creek	Wallowa	19
12/01	Lostine, Oregon	Waterton/Banff	Quartz Creek	Wallowa	15
	Total		Total		444

Currently there are 15 proposed transplant sites for Rocky Mountain bighorn sheep in Oregon (Table 4). Several areas of high quality habitat are rated as third priority for transplants due to on-going concerns over domestic sheep and goat grazing.

Table 4. Proposed transplant sites for Rocky Mountain bighorn sheep in Oregon. All Wallowa-Whitman National Forest sites are cleared.

Transplant Priority	Site Name	District	County	New or Supplement	Comments
1	Sluice/Rush Creek	Wallowa	Wallowa	New	
1	Sand/Yreka Creek	Wallowa	Wallowa	New	
1	Hat Point Plateau	Wallowa	Wallowa	Supplement	Summer Range Release
1	Minam	Wallowa	Wallowa	New	Predation, Non-Migratory
1	Deep Creek/Teaser Ridge	Wallowa	Wallowa	New	Domestic Goats, Private Land
1	Lone Pine	Wallowa	Wallowa	Supplement	
1	Quartz Cr/Two Corral	Wallowa	Wallowa	Supplement	
2	Big Sheep Creek	Wallowa	Wallowa	New	Domestic Sheep
3	Mid-Joseph Creek	Wallowa	Wallowa	Supplement	Domestic Sheep
3	Sheep Creek (G. Ronde)	Union	Union	New	Domestic Sheep
3	Deadhorse Ridge	Wallowa	Wallowa	New	Domestic Sheep
3	Spring Creek	Wallowa	Wallowa	New	Domestic Sheep
3	S. Fork Walla Walla	Umatilla	Umatilla	New	Domestic Sheep
3	Mud Creek	Wallowa	Wallowa	New	Domestic Sheep
3	Jim Creek	Wallowa	Wallowa	New	Domestic Sheep, Disease

Historic Distribution

The geographic range of the species is quite large and extends from southeastern British Columbia and southwestern Alberta south along the Cascade and Sierra Nevada mountains into Baja California, eastward through Montana to western North Dakota, South Dakota, and Nebraska as well as central Colorado and New Mexico, western Texas, and eastern Coahuila, Mexico (Verts and Carraway 1998).

Historical distribution of bighorns in Washington State in not entirely clear (WDFW 1995), but there is general agreement that Rocky Mountain bighorns inhabited the Blue Mountains region where they occupied all suitable habitat within the rugged river canyons of the area. In Oregon, Rocky Mountain bighorn sheep occupied suitable habitat from the John Day-Burnt River divide north and east to the Snake River and the Oregon-Washington state line (Figure 1).

Current Distribution

Current distribution is restricted to four geographic areas within the Blue Mountains: Asotin Creek, Black Butte, Wenaha, and Cottonwood Creek (Fowler 1999). An additional 11 populations occur within northeast Oregon (Figure 1, ODFW 2003).

Much of the bighorns' historic range is no longer suitable habitat because urbanization, cultivation, and fire suppression have permanently changed it. Native shrub and grasslands that were used as winter range have been converted to agriculture, and many of the important source habitats such as whitebark pine forests have gone through a successional transition to Engleman spruce-subalpine fir forests (Wisdom et al. 2000). These closed canopy forests offer a decrease in available forage and poor visibility for predator detection and are not preferred habitat. Some cliff areas and corridors between winter and summer ranges are currently inaccessible because bighorns will not cross through dense stands of closed timber (Wisdom et al. 2000).

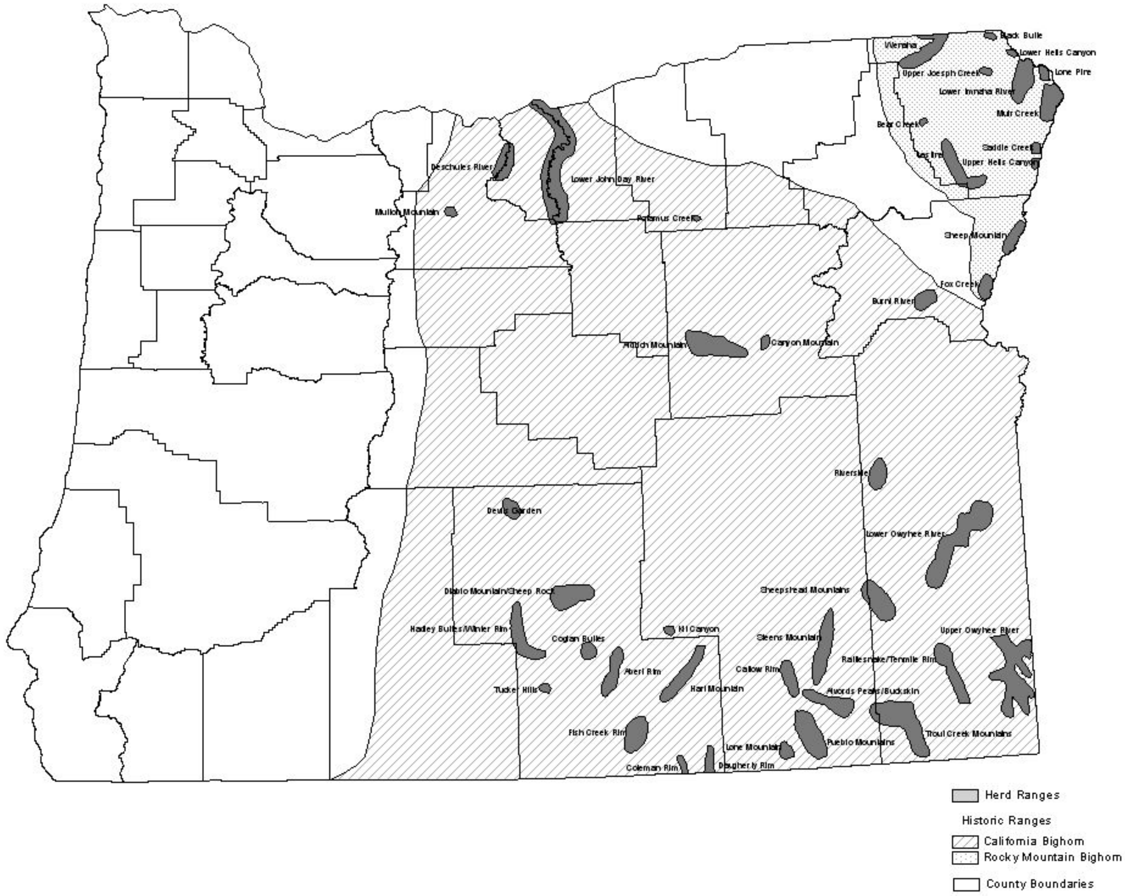

Figure 1. Historic and current distribution of Rocky Mountain and California bighorn sheep in Oregon (Adapted from Williams and Schommer 2001).

The current distribution of Rocky Mountain bighorn sheep is the result of transplants which targeted areas with suitable habitat that lacked conflicts with domestic sheep. The last Oregon population estimate in 2003 was 637 Rocky Mountain bighorns in 12 herds (ODFW 2003). Washington State estimates from 2002 were 239 Rocky Mountain bighorns within five herds (WDFW 2003).

Bighorn Sheep Status and Abundance Trends

Status

Currently, the Rocky Mountain bighorn sheep is classified as a game animal in Oregon and Washington State and is under the administrative management of the Oregon Department of Fish and Wildlife, and the Washington Department of Fish and Wildlife, respectively.

Trends

From the time of extirpation in the late-1910's to present, the Rocky Mountain bighorn sheep has improved in population until the present day as the result of transplants conducted by various wildlife management agencies. However, population growth has been hampered by repeated disease outbreaks as the result of contact with domestic sheep (ODFW 2003).

Factors Affecting Bighorn Sheep Population Status

Currently there are three key factors which threaten the successful re-establishment of a population of Rocky Mountain bighorn sheep in the Grande Ronde subbasin. They are: 1) the continuing threat of disease transmission from domestic sheep and goats; 2) a large portion of the bighorn sheep habitat not being in protected status and vulnerable to land management changes negative to bighorn sheep; and 3) the continued threat of noxious weed invasion on core Rocky Mountain bighorn sheep habitat in the Grande Ronde subbasin.

Habitat Loss

Within the Grande Ronde subbasin some bighorn sheep habitat has been lost due to land conversion for agricultural production and urban development. The steep, rugged nature of bighorn sheep habitat has, however, afforded some level of protection from some of the more destructive land uses. Changes in land use and vegetative communities have resulted in loss of connectivity between suitable habitat patches in some parts of the subbasin.

Habitat Degradation

Aggressive non-native plants and other noxious weeds are the primary factor negatively impacting habitat quality.

Across their range in Washington, Idaho, and Oregon bighorn habitat has suffered encroachment from yellow starthistle (*Centaurea solstitialis*), knapweed (*Centaurea* spp.), common crupina (*Crupina vulgaris*), rush skeleton weed (*Chondrilla juncea*), leafy spurge (*Euphorbia esula*), and other plants, which reduce forage quality and vigor. In the Asotin subbasin, habitat conditions are generally good but yellow starthistle and diffuse knapweed (Centaurea diffusa) are threats to the continued quality of Rocky Mountain bighorn sheep range.

Throughout much of the Subbasin, native interior grasslands have been replaced by agricultural crops or severely reduced as a result of competition from introduced weed species such as cheatgrass (*Bromus tectorum*). Native perennial bunchgrasses and shrubs are presently found only on a few "eyebrows" on steep slopes surrounded by wheat fields, or in non-farmed canyon slopes and bottoms within agricultural areas. Canyon grasslands have largely remained intact (unplowed) but have been subjected to weed encroachment and fragmentation which has decreased their utility as bighorn sheep habitat.

Livestock Grazing

Historical overgrazing of Rocky Mountain bighorn sheep habitat by domestic livestock has reduced range quality and increased competition for resources. Periods of historical overgrazing by livestock have contributed to the degredation of range quality and the susceptibility of native communities to introduced invasive plant species. Many of the range areas within the Grand Ronde subbasin are still recovering from historic overgrazing.

Domestic sheep and goat grazing presents a unique constraint on Rocky Mountain bighorn sheep recovery within the Grande Ronde subbasin due to the transmission of disease pathogens. This issue is covered in more detail below.

Disease

Disease transmission from domestic sheep and goats has proven to be the largest threat to wild bighorn sheep populations in the tri-state region of Oregon, Washington, and Idaho. The 2003 Oregon Bighorn Sheep and Rocky Mountain Goat Plans provides an explanation of the hazards of disease transmission in bighorn sheep. The following is quoted directly from that document:

Bighorn sheep are a big game species where disease is a management priority. Bighorns are susceptible to several diseases and parasites, which have caused both acute and chronic herd reductions. Although most other big game species are susceptible to various diseases and parasites, they generally are not impacted to the level observed in bighorns.

When bighorn sheep come in contact with domestic sheep, bighorns usually die of pneumonia within 3-7 days of contact (Martin et al. 1996, Schomer and Woolever 2001). Because exposed bighorns do not die immediately infected individuals may return to their herd and infect other individuals, which can cause 70–100% of the herd to die (Oregon Department of Fish and Wildlife, 2003).

The amount of separation necessary to protect bighorn sheep from interaction with domestic sheep is variable based on each location's specific circumstances. After a *pasteurella* dieoff in 1993 in an Aldrich Mountain California bighorn herd, trailing practices of a domestic sheep band were modified to provide 5 miles of separation in the spring and 20 miles of separation in the fall. This approach has protected that population of bighorns from any recurrence of *pasteurella* (Oregon Department of Fish and Wildlife, 2003). In Hells Canyon a 25 mile separation between Rocky Mountain bighorn sheep and domestic sheep has proven ineffective at insulating bighorns from *pasteurella* transmission (Schommer and Woolever, 2001).

Domestic sheep and goats are kept sporadically in small quantities in the river bottoms of the Asotin Creek and adjacent Snake River system, which introduces a source of disease into the area. The Mt. View herd occasionally is the source of individual dispersal of Rocky Mountain bighorn sheep to the Asotin sub-basin. These individual bighorn sheep could come in contact with domestic sheep and become infected with pasteurellosis. There is also a high probability that immigrant sheep from the Mt. View herd may infect the Asotin Creek herd with scabies (Fowler 1999)

With the exception of lungworm and scabies, most diseases negatively effecting bighorns commonly occur in domestic sheep and disease prevalence in bighorns generally increases with contact between bighorns domestic sheep. Following is a brief description of Pasteurellosis, which is primarily responsible for negatively effecting bighorn sheep.

Pasteurellosis

Pasteurellosis refers to pneumonia, septicemia, and other infections caused by bacteria of the genus *Pasteurella*, and has proven devastating to bighorn sheep. Prior to 2000, bacteria causing pasteurellosis were all classified as *Pasteurella* spp. In 2000 *Pasteurella haemolytica*, which has been implicated as causing many bighorn die-offs, was reclassified as *Mannhaemia haemolytica.* Although there are now two genera of bacteria involved in bighorn pneumonia outbreaks, the disease is still commonly referred to as Pasteruellosis.

Pasteurellosis has played a significant role in bighorn population declines throughout western North America (Miller 2000). Occurrence of epidemics followed settlement and establishment of domestic sheep grazing, and may reflect the introduction of novel pathogens causing bacterial pneumonia into naïve bighorn populations (Miller 2000). Disease, along with habitat degradation and unregulated hunting, resulted in extirpation of wild sheep from Oregon. In modern times, pasteurellosis outbreaks have occurred in 1972, 1983–84, 1986–87, 1995–96 and 1999 in some Oregon Rocky Mountain bighorn herds, and 1991 in the Aldrich Mountain California bighorn herd. Contact with domestic sheep or goats is the most likely source for these outbreaks. Ongoing research in Hells Canyon indicates pasteurellosis continues to be the leading cause of mortality in Washington's Rocky Mountain bighorns. The significant Hell's Canyon die off of 1995-96 was believed to have started when a feral goat interacted with wild bighorns in the Tenmile drainage south of Asotin (Cassirer et al. 1996).

Pneumonia outbreaks occur almost annually somewhere in the U.S. or Canadian bighorn range. Outbreaks range in severity from 100% mortality to only a few animals dying. During the 1995-96 die-off, the Black Butte, Mtn. View, and Wenaha herds experienced 75, 65, and 50 percent mortality, respectively (Cassirer et al. 1996). The die off did not affect the Asotin Creek herd (Fowler 1999). Poor lamb survival generally follows such an outbreak. Studies in Hells Canyon indicate lambs contract pneumonia and the disease can spread through entire lamb groups. In all probability, lambs contract the disease from their mothers. Long term monitoring of the Lostine, Oregon herd indicates surviving bighorns recover and eventually lamb survival increases.

Field treatment of pasteurellosis with antibiotics has had some success but prevention needs to be emphasized. The most effective prevention is separation between bighorns and domestic sheep or goats (Oregon Department of Fish and Wildlife, 2003).

Out-of-Subbasin Effects and Assumptions

The most obvious out-of-subbasin effect to Rocky Mountain bighorn sheep population recovery in the Grande Ronde subbasin is the transmission of disease into the subbasin from other herds. Coordinated interagency strategies covering a large geographic area, combined with effective public education and outreach, needs to be implemented to adequately address this complex social and biological issue.

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6.3.9 Western Meadowlark

Western Meadowlark (*Sturnella neglecta*) K. Paul, USFWS

Introduction

The western meadowlark is one of the most familiar and endearing avian images of grass- or sagebrush-dominated habitats throughout Oregon. They have a yellow breast and belly with a distinct black V across the chest. Meadowlarks are commonly found perched on fences along roadsides. Chosen as Oregon's state bird in 1927, it is one of the most widely distributed open-country species in the state, and one of the most abundant species in the arid desert country of eastern Oregon. It can be found in the state year-round, although most birds in eastern Oregon migrate out of the state in winter (Bob Altman 2003).

Description, Life History, and Habitat Requirements

Description

The western meadowlark is a medium-sized songbird with long, slender bill, short tail with rather rigid rectrices, and long legs and toes (Lanyon 1994). They have a dark crown with a light median stripe; a light line over the eye becomes bright yellow from eye to bill; upperparts with intricate concealing pattern of buffs, browns, and black streaks and bars; underparts bright yellow; he sides, flanks, and undertail-coverts dull white, broadly streaked and spotted with dusky black; the outer wing and tail feathers barred with black and brown; outer rectrices partly white (Lanyon 1994). Adult meadowlarks have a black shield-shaped or crescent-shaped patch on their chest (Lanyon 1994).

Life History

<u>Diet</u>

Western meadowlarks take mostly insects in late spring and summer, seeds in the fall, and where available, grain in winter and early spring (Altman 2003). Meadowlarks obtain food from the top of the ground, by probing beneath soil, and by searching under clods, manure, etc (Lanyon 1994). They show a preference for habitats with good grass and litter cover (Wiens and Rotenberry 1981). Favorite insects include beetles, crickets, grasshoppers, weevils, wireworms, cutworms, caterpillars, craneflies, sow bugs, and spiders (Csuti et al. 1997, Lanyon 1994). They occasionally eat snails, bird eggs, and carrion (Csuti et al. 1997).

<u>Reproduction</u>

Most nesting begins in late April, with the peak of nesting activity throughout May, although there is an early egg date of April 3 (Gabrielson and Jewett 1940, Altman 2003). In eastern Oregon, migrants first arrive in late February and most are on territories by April (Gilligan et al. 1994, Altman 2003). At Malheur National Wildlife Refuge (NWR), the earliest spring arrival has been February 6, with the average arrival February 27, peak of passage March 10-25, and earliest nesting April 23 (Littlefield 1990, Altman 2003).

Singing begins upon arrival on the breeding grounds, as early as March. The male often sings from an exposed perch (e.g., a powerline, fence post), but will also sing from the ground. A male's song is often immediately followed by a "rattle" call, which is a female vocalizing (Altman 2003).. The meadowlark's mating system is polygynous; males often have two mates concurrently, occasionally three (Lanyon 1994). Meadowlarks may renest after a failed nesting attempt, and can produce two broods in one season (Altman 2003). The normal clutch of 5 (range 3-7) eggs is incubated by the female for about two weeks. The young are fed by both parents for about a month (Csuti et al. 1997).

Nests are usually located in a pasture, prairie, or other grassland habitat; rarely in cultivated fields (Lanyon 1994). The nest is usually well concealed, on the ground, and often in fairly dense vegetation (Lanyon 1994). Nests are constructed of coarse dried grasses, stems of forbs, or fine bark, more or less interwoven with and attached to surrounding vegetation; lined with finer grasses (Lanyon 1994). The nests are typically domed shaped (Sibley 2000).

Breeding Territory/Home Range

Male meadowlarks have multipurpose territories within which they gather food, mate, and rear young, and which they defend against intruding meadowlarks (Lanyon 1994). Males alone establish and defend territories, for up to four weeks prior to arrival of females and until fledging of final brood (Lanyon 1994). Males unsuccessful in acquiring mates fail to maintain territories (Lanyon 1994). Territories ranged in size from 6.9-7.9 acres (2.8-3.2 ha) in Wisconsin (Lanyon 1994), 9.9-32 acres (4-13 ha) in Iowa (Kendeigh 1941), and 17.3 acres (7 ha) in Manitoba (Schaeff and Picman 1988). Csuti et al. (1997) reports territory size to range from a few to over ten acres.

Migration/Overwintering

Western meadowlarks are resident throughout much of their range, but migrate from colder northern and central regions and higher elevations as snow restricts foraging (Lanyon 1994). They tend to seek sheltered valleys during severe winter weather (Bent 1958). Fall migrants along the coast begin to appear in dunes and farm fields in late August and early September (M. Patterson p.c., cited in Altman 2003). In western valleys, flocks increase in size form August through October, probably due to arrival of northern migrants (Altman 2003). At Malheur NWR, autumn migrants arrive in early August and the peak of migration is August 20 through September 20 (Littlefield 1990, Altman 2003). A few linger into October and November there, with occasional wintering birds. During the nonbreeding season in western valleys, meadowlarks form foraging flocks that may vary from a few to over 100 birds. Wintering flocks on the north coast are usually <10 birds (M. Patterson p.c., cited in Altman 2003). In western Oregon valleys and along the coast, wintering flocks increase in size and number in late February and throughout March during early northward migration. Flocks break up by late March, and there is a pulse of migratory movement in early April (Altman 2003).

Survivorship

Captive birds maintained for breeding and studies of ontogeny of vocalizations normally lived 3-5 years; one female lived 9 years and one male 10 years in captivity (Lanyon 1979). There is no information for wild populations.

Mortality

Deaths of meadowlarks have been reported from eating grain poisoned for rodent or insect control (Griffen 1959), drowning in stock tanks (Chilgren 1979), exposure to deep snow and ice storms, and mowing in hay fields (Lanyon 1994). Eggs and nestlings are often deserted because of human activity (irrigation, mowing) (Lanyon 1994). Eggs or chicks are often trampled by livestock, eaten by foxes, domestic cats and dogs, coyotes, snakes, skunks, raccoons, and other small mammals (Lanyon 1957, Bent 1958, Lanyon 1994). Adults are often taken by various species of hawks (Lanyon 1994).

Habitat Requirements

Breeding/Foraging

Most common breeding habitat is native grasslands and pastures, but also in hay and alfalfa fields, weedy borders of croplands, roadsides, orchards, or other open areas and occasionally desert grassland (Lanyon 1994). Optimal breeding habitat in the Willamette Valley is lightly grazed pastures or fallow fields with grass height 1-2 ft (0.3-0.6 m), and shrub or tree cover <10% (Altman 2003). Marginal habitat is hayfields and cultivated grass fields (annual or perennial) with grass height 1-3 ft (0.3-1 m) and shrub or tree cover <25% (Altman 1999, Altman 2003). Cultivated grass fields are used as escape cover and to a lesser extent nesting cover, but have only limited use as foraging habitat (Altman 2003). Thus, quality foraging habitat for meadowlarks (e.g., lightly grazed pastures, fallow fields) needs to be adjacent to or within territories dominated by cultivated grass fields or hayfields in order for the latter habitats to be used for nesting (Altman 2003). Singing perches (fencelines, telephone pole, shrubs, trees, boulders) are essential components of all territories (Altman 2003).

Breeding habitat in eastern Oregon includes all types and conditions of shrub-steppe or rangeland habitat outside of forested areas (Altman 2003). Abundance of meadowlarks is greater in bunchgrass and sagebrush habitats that are free from grazing (Altman 2003). Holmes and Geupel (1998, cited in Altman 2003) noted that the three variables most highly associated with meadowlark abundance were percent open ground (negative association), and shrub height and bitterbrush density (positive associations).

General/Non-breeding/Foraging

Western meadowlarks use a variety of habitats including grasslands, savanna, cultivated fields, and pastures (Subtropical and Temperate zones) (AOU 1998). They prefer high forb and grass cover, low to moderate litter cover, and little or no woody cover (Sample 1989, Kimmel et al. 1992, Anstey et al. 1995, Hull et al. 1996, Madden 1996, NatureServe 2003). In shrubsteppe and desert grasslands, meadowlarks prefer mesic areas; low shrub cover and density; patchiness in vegetative structure and in heights of forbs and shrubs; and high coverage of grass, forb, and litter (Lanyon 1962, Rotenberry and Wiens 1980, Wiens and Rotenberry 1981, Wiens et al. 1987, McAdoo et al. 1989, Knick and Rotenberry 1995, NatureServe 2003). In general, meadowlarks prefer open, treeless areas (Salt and Salt 1976, Sample 1989, Johnson 1997), although a few shrubs may be used as song perches (Knick and Rotenberry 1995, NatureServe 2003).

Population and Distribution

Distribution

Historic Distribution

The historic distribution was smaller than the current distribution. The western meadowlark formerly bred only to the forest edge in Missouri, Illinois, and Wisconsin (Lanyon 1994). During the twentieth century, with forest clearing and expanding agriculture, the meadowlark population has undergone dramatic expansion of breeding range northeast; now breeding in colonies in Michigan, northern Indiana, northern Ohio, southern Ontario, and extreme western New York (Lanyon 1994). This expansion is remarkable in view of lack of significant eastward expansion in Missouri, Kansas, Oklahoma, and Texas (Robbins and Easterla 1992, Lanyon 1994). Lanyon (1956) notes, that the northeastward expansion is correlated with average spring precipitation, which may be a proximate factor governing expansion.

Current Distribution

The western meadowlark breeds in grassland and shrub-grassland habitats south from c. British Columbia, east to w. Ontario and n. Minnesota, Michigan, and Wisconsin, south through the eastern edge of the Great Plains to westcentral Texas, and west through northwest Sonora, Mexico to northwest Baja California (Lanyon 1994). Winters in much of its breeding range south of Canada and the northern tier of the U.S., including Washington and Oregon (Altman 2003).

In Oregon, the meadowlark breeds in scattered locations along the coast, in western Oregon valleys, and throughout desert shrub-steppe, grassland, and agricultural areas of eastern Oregon (Altman, 2003). In eastern Oregon, meadowlarks enjoy a ubiquitous breeding distribution throughout unforested habitat up to 6,000 ft (1,830 m) (Gilligan et al. 1994), and they are one of the most common breeding species in all habitat types in shrub-steppe country (Altman 2003).

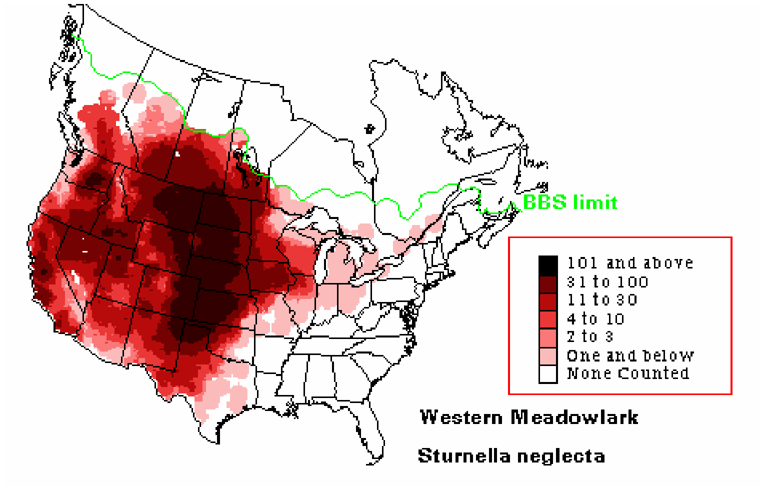

Figure 1. Western meadowlark breeding distribution from BBS data (1982-1996) (Sauer et al. 2001)

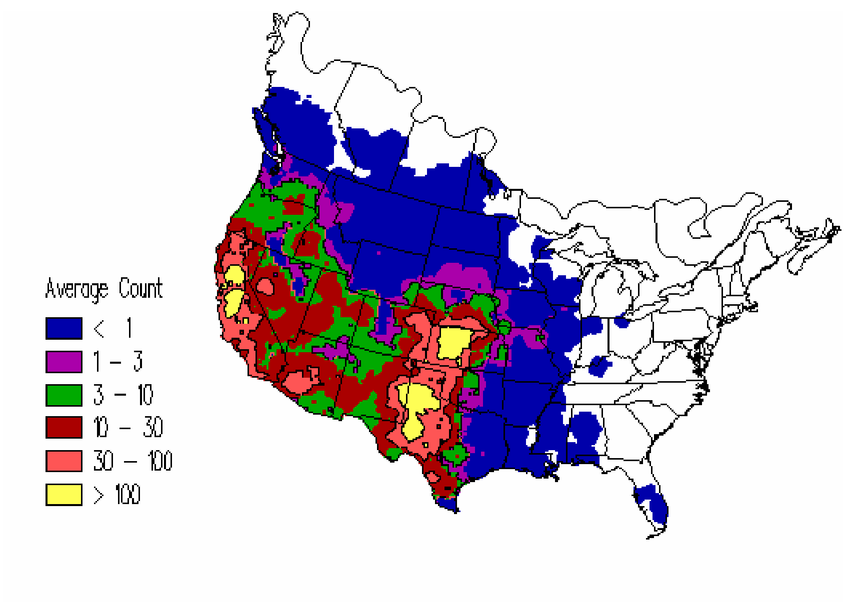

Figure 2. Western meadowlark winter distribution from CBC data (1982-1996) (Sauer et al. 2001)

Population

Historic Population

Historic population numbers are unknown.

Current Population and Status

Throughout the range of the western meadowlark in the U.S. and Canada, breeding populations have been declining slightly (annual rate of 0.6%), with the highest rates of decline in the northeast portion including Minnesota, Wisconsin, Michigan, Illinois, Indiana, Ohio, and Ontario, at annual rates of 4-9% (BBS 1968-1991) (Lanyon 1994).

Wintering populations in western Oregon are generally higher than breeding populations (Altman 2003). The highest wintering concentration in the state of Oregon is in the Rogue Valley (CBC, Altman 2003). Meadowlarks also winter in small flocks along the entire coast. Populations of meadowlarks are reduced in eastern Oregon, suggesting some birds migrate, but small wintering flocks at low elevations are not uncommon (Altman 2003). The highest concentrations in eastern Oregon are in Umatilla County (CBC, Altman 2003).

Population trends in Oregon based on BBS data indicate relatively stable long-term (1966-96) trends (1%/year decline, but non-significant ($p<0.01$) short-term (1980-96) declining trends (2.9%/year) (Sauer et al. 1997, Altman 2003). Populations in the Columbia Plateau BBS Region (includes all non-forest in e. Oregon, e. Washington, and s. Idaho) mirror the Oregon state trend; relatively stable long-term trends (non-significant decline of 0.6%/year), and highly significant declining short-term trends (2.6%/year) (Sauer et al. 1997, Altman 2003). Population trends based on Christmas Bird Count (CBC) data also indicate declining populations (Altman 2003).

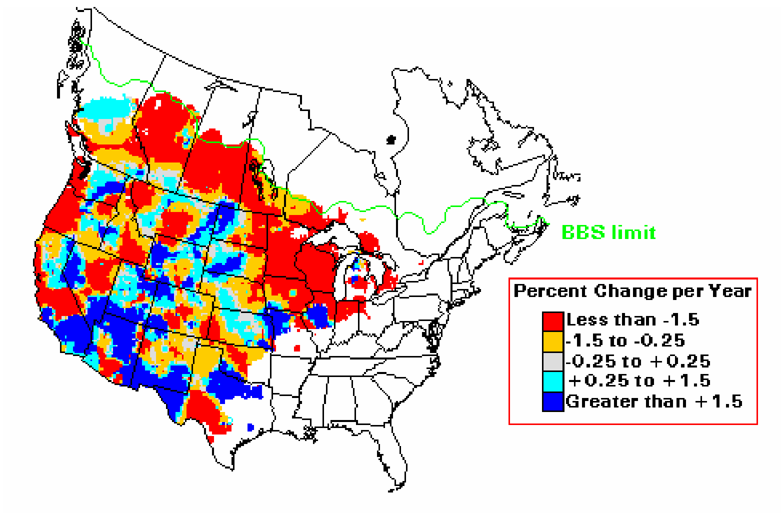

Figure 3. Western meadowlark population trend from BBS data (1966-1996) (Sauer et al. 1996)

Grande Ronde Subbasin

BBS Survey Route	Years	Number Detected
Howard Meadows 69206	1992-94, 96, 98-2003	1, 1, 0, 1, 3, 1, 0, 3, 5, 2
Flora 69007	1986-2003	17, 22, 11, 12, 8, 5, 22, 12, 11, 9, 12, 23, 18, 29, 29, 25, 38, 27
Troy 69207	1992-98, 2000-02	0, 0, 0, 0, 0, 0, 1, 1, 0, 0

Continuing Threats

Factors suspected to contribute to declines include conversion of native grasslands and shrub-steppe to non-suitable agriculture (e.g., rowcrops); habitat degradation from grazing; mortality at nest from trampling by livestock and agricultural practices such as mowing; a high degree of sensitivity to human disturbance near nest sites; and potential reproductive failures from use of pesticides or other contaminants (Lanyon 1994, Altman 2003). The meadowlark has been identified as a species of high concern under all proposed management options for the Interior Columbia Basin (also includes e. Oregon, Idaho, and parts of Montana and Nevada) (Saab and Rich 1997) (Altman 2003).

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6.3.10 Sage Sparrow

Sage Sparrow (*Amphispiza belli*) P.Ashley and S. Stovall, WDFW

Introduction

Sage sparrow (*Amphispiza belli*) is a species of concern in the West due to population decline in some regions and the degradation and loss of breeding and wintering habitats. Vulnerable to loss and fragmentation of sagebrush habitat, sage sparrows may require large patches for breeding. Sage sparrow can likely persist with moderate grazing and other land management activities that maintain sagebrush cover and the integrity of native vegetation.

Sagebrush habitats may be very difficult to restore where non-native grasses and other invasive species are pervasive, leading to an escalation of fire cycles that permanently convert sagebrush habitats to annual grassland.

Sage sparrows are still common throughout much of sagebrush country and have a high probability of being sustained wherever large areas (e.g., 130 hectares observed in Washington, Vader Haegen, pers. comm.) of sagebrush and other preferred native shrubs exist for breeding. Sage sparrows are likely to return to areas where sagebrush and other native vegetation have been restored. However, sagebrush habitats can be very difficult to reclaim once invaded by cheatgrass and other noxious non-native vegetation, leading to an escalation of fire frequency and fire intensity that permanently converts shrubsteppe to annual grassland.

Sage Sparrow Life History, Key Environmental Correlates, and Habitat Requirements

Life History

Diet

Sage sparrows eat insects, spiders, seeds, small fruits, and succulent vegetation. They forage on the ground, usually under or near shrubs. They may occasionally be observed gleaning prey items from main stems and leaves. Consumed vegetation and insect prey provide most water requirements (Martin and Carlson 1998).

Reproduction

Sage sparrow clutch size usually is three to four, sometimes five. Incubation lasts about 13 days. Nestlings are altricial. Individual females produce one to three broods annually. Reproductive success is greater in wetter years (Rotenberry and Wiens 1991).

In eastern Washington, 70 percent (n = 53) of clutches examined had 3 eggs (Rotenberry and Wiens 1989). Annual reproductive success in Idaho was 1.3 fledglings/nest and probability of nest success was 40 percent (Reynolds 1981). Estimate of nest success in eastern Washington is 32 percent (M. Vander Haegen, unpub. data in Altman and Holmes 2000).

Nesting

Sage sparrows form monogamous pair bonds in early spring; nesting behavior occurs from March to July. Nests are constructed by females in or under sagebrush shrubs and pairs raise 1-2 broods a season (Martin and Carlson 1998). Brown-headed cowbirds will parasitize sage sparrow nests; parasitized nests are often abandoned (Rich 1978). Chicks are altricial and fledge when 9-10 days of age. Both parents feed young for more than two weeks after fledging. Fledglings often sit low in shrubs or on the ground under shrubs (Martin and Carlson 1998).

Migration

Sage sparrow populations in Washington are migratory. Sage sparrows are present only during the breeding season, arriving in late February-early March. Birds winter in shrubsteppe habitats of the southwestern United States and northwestern Mexico.

Mortality

Little information is available on estimates of annual survival rates (Martin and Carlson 1998). Typical nest predators include, common raven (*Corvus corax*), Townsend's ground squirrel (*Spermophilus townsendi*), and gopher snakes (*Pituophis catenifer*) (Martin and Carlson 1998, Rotenberry and Wiens 1989). Predators of juvenile and adult birds include loggerhead shrike (*Lanius ludovicianus*) and raptors (Martin and Carlson 1998).

Habitat Requirements

Similar to other shrubsteppe obligate species, sage sparrows are associated with habitats dominated by big sagebrush (*Artemisia tridentata*) and perennial bunchgrasses (Paige and Ritter 1999). In shrubsteppe habitat in southwestern Idaho, habitat occupancy by sage sparrows increased with increasing spatial similarity of sites, shrub patch size, and sagebrush cover; landscape features were more important in predicting presence of sage sparrows than cover values of shrub species and presence of sagebrush was more important than shadscale (Knick and Rotenberry 1995).

Nesting

Habitat in the vicinity of sage sparrow nests in southwestern Idaho was characterized by lower sagebrush cover (23 percent), greater shrub dispersion (clumped vs. uniform), and taller shrub height (18 in.) than surrounding areas. Sage sparrows preferred nesting in large, live sagebrush plants; birds frequently nested in shrubs 16-39 in. tall, shrubs < 6 in. or > 39 in. were rarely used (Petersen and Best 1985). In eastern Washington, height of sagebrush nest shrubs averaged 90 cm (35 in.) (Vander Haegen 2003). In Idaho, nests were constructed an average distance of 34 cm (13 in.) above ground, 11 in. from the top, and 8 in. from the shrub perimeter (Petersen and Best 1985). Although sage sparrows generally place nests in sagebrush shrubs they frequently nest on the ground (Vander Haegen 2003).

Breeding

Washington breeders represent the northern subspecies *A. b. nevadensis.*.
In the northern Great Basin, sage sparrow is associated with low and tall sagebrush/bunchgrass, juniper/sagebrush, mountain mahogany/shrub, and aspen/sagebrush/bunchgrass communities for breeding and foraging (Maser *et al.* 1984). In Idaho, sage sparrows are found in sagebrush of 11 to 14 percent cover (Rich 1980). Martin and Carlson (1998) report a preference for evenly spaced shrubs; other authors (Rotenberry and Wiens 1980; Peterson and Best 1985) report association where sagebrush is clumped or patchy. Sage sparrows prefer semi-open habitats, shrubs 1-2 meters tall (Martin and Carlson 1998). Habitat structure (vertical structure, shrub density, and habitat patchiness) is important to habitat selection (Martin and Carlson 1998). Sage sparrow is positively correlated with big sagebrush (A*rtemisia tridentata*), shrub cover, bare ground, above-average shrub height, and horizontal patchiness; it is negatively correlated with grass cover (Rotenberry and Wiens 1980; Wiens and Rotenberry 1981; Larson and Bock 1984).

The subspecies *nevadensis* breeds in brushland dominated by big sagebrush or sagebrush-saltbush (Johnson and Marten 1992). Sage sparrows nest on the ground or in a shrub, up to about one meter above ground (Terres 1980). In the Great Basin, nests are located in living sagebrush where cover is sparse but shrubs are clumped (Petersen and Best 1985). Nest placement may be related to the density of vegetative cover over the nest, and will nest higher in a taller shrub (Rich 1980).

Breeding territory size in eastern Washington averages 1.5-3.9 ac but may vary among sites and years (Wiens *et al.* 1985). Territories are located in relatively large tracts of continuous sagebrush-dominated habitats. Territory size can vary with plant community composition and structure, increasing with horizontal patchiness (see Wiens *et al.* 1985). Sage sparrows are absent on sagebrush patches < 325 ac (Vander Haegen *et al.* 2000; M. Vander Haegen unpub. data in Altman and Holmes 2000).

Non-breeding

In migration and winter, sage sparrows are found in arid plains with sparse bushes, grasslands and open areas with scattered brush, mesquite, and riparian scrub, preferring to feed near woody cover (Martin and Carlson 1998; Meents *et al.* 1982; Repasky and Schluter 1994). Flocks of sage sparrows in the Mojave Desert appear to follow water courses (Eichinger and Moriarty 1985). Wintering birds in honey mesquite of lower Colorado River select areas of higher inkweed (S*uaeda torreyana*) density (Meents *et al.* 1982).

Sage Sparrow Population and Distribution

Population
Historic
No data are available.

Current

Sage sparrow populations are most abundant in areas of deep loamy soil and continuous sagebrush cover 3.3-6.6 feet high (Vander Haegen *et al.* 2000). In south-central Washington sage sparrows are one of the most common shrubsteppe birds (Vander Haegen *et al.* 2001). Sage sparrow breeding density was estimated at 121-207 individuals/km^2 over a two-year study at the Arid Lands Ecology Reservation in southern Washington (Wiens *et al.* 1987).
Density estimates ranged from 33-90 birds/km^2 in sagebrush habitat on the Yakima Training Center (Shapiro and Associates 1996), whereas Schuler *et al.* (1993) on Hanford Reservation, reported density from 0.23-21.03 birds/km^2.

The sedentary subspecies *belli* is found in the foothills of the Coast Ranges (northern California to northwestern Baja California) and the western slope of the central Sierra Nevada in California (Johnson and Marten 1992).

The subspecies *canescens* breeds in the San Joaquin Valley and northern Mohave Desert in California and extreme western Nevada, winters in the southwestern U.S. (Johnson and Marten 1992).

The subspecies *nevadensis* breeds from central interior Washington eastward to southwestern Wyoming and northwestern Colorado, south to east-central California, central Nevada, northeastern Arizona, and northwestern New Mexico. *Nevadensis* winters in the southwestern U.S. and northern Mexico (Johnson and Marten 1992).

Distribution
Historic

Jewett *et al.* (1953) described the distribution of the sage sparrow as a common summer resident probably at least from March to September in portions of the sagebrush of the Upper Sonoran Zone and of the neighboring bunchgrass areas of the Transition zone in eastern Washington. They describe its summer range as north to Wilbur and Waterville, Grand Coulee; east to Connell and Wilbur; south to Kiona, Kennewick, and Lower Flat, Walla Walla County; and west to Waterville, Moxee City, Sunnyside, Yakima, and Soap Lake. Jewett *et al.* (1953) also note that the sage sparrow was found practically throughout the sagebrush of eastern Washington, and in a few places, notably in the vicinity of Wilbur, Waterville, Prescott, and Horse Heaven, it ranges into the bunch grass as well. Jewett *et al.* (1953) report that Snodgrass found it the predominant sparrow in the sagebrush west of Connell. Hudson and Yocom (1954) described the sage sparrow as a summer resident and migrant in sagebrush areas of Adams, Franklin, and Grant counties. They report that Snodgrass reported it as common in western Walla Walla County.

Current
Data are not available.

Breeding

During the breeding season, sage sparrows are found in central Washington, eastern Oregon, southern Idaho, southwestern Wyoming, and northwestern Colorado south to southern California, central Baja California, southern Nevada, southwestern Utah, northeastern Arizona, and northwestern New Mexico (AOU 1983; Martin and Carlson 1998) (Figure_89).

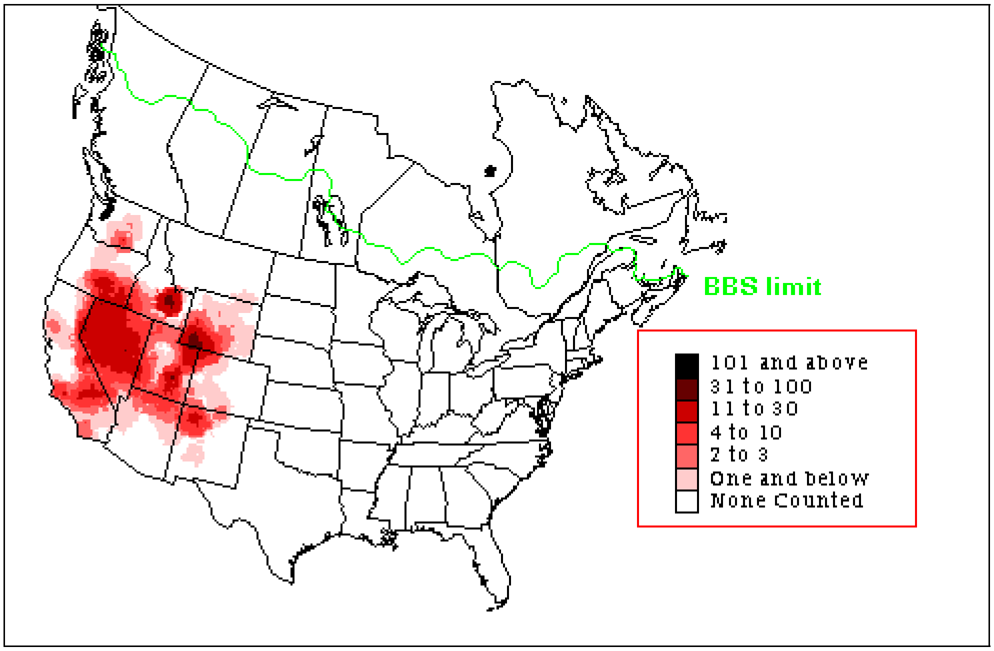

Figure 77. Sage sparrow breeding season abundance (from BBS data) (Sauer *et al.* 2003).

Non-breeding

Sage sparrows are found in central California, central Nevada, southwestern Utah, northern Arizona, and central New Mexico south to central Baja California, northwestern mainland of Mexico, and western Texas (AOU 1983; Martin and Carlson 1998) (Figure 90).

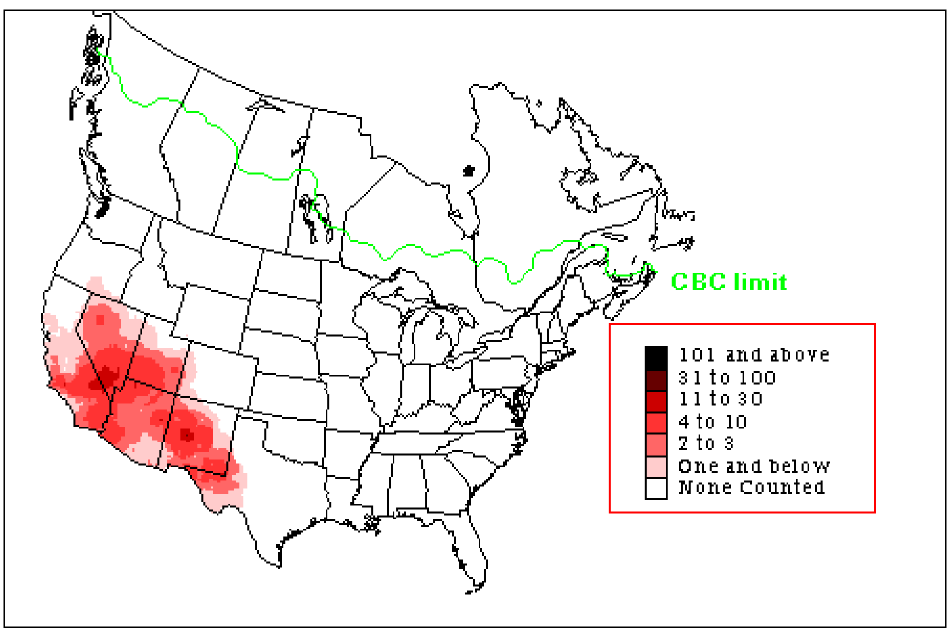

Figure 78. Sage sparrow winter season abundance (from CBC data) (Sauer *et al.* 2003).

Sage Sparrow Status and Abundance Trends

Status

North American Breeding Bird Survey (BBS) data indicate that sage sparrows have declined 1.0-2.3 percent in recent decades (1966-1991); greatest declines have occurred in Arizona, Idaho, and Washington (Martin and Carlson 1998). Sage sparrows are listed as a ‘candidate’ species (potentially threatened or endangered) by the Washington Department of Fish and Wildlife and are listed by the Oregon-Washington chapter of Partners in Flight as a priority species, and on the National Audubon Society Watch List. Based on genetic and morphometric differences, the subspecies *A. b. nevadensis* (currently found in east-central Washington) may be reclassified as a distinct species. Such an action would likely prompt increased conservation interest at the federal level.

Trends

The BBS data (1966-1996) for Washington State show a non-significant 0.3 percent average annual increase in sage sparrow survey-wide (n = 187 survey routes) (Figure_91). There has been a significant decline of -4.8 percent average per year for 1966-1979 (n = 73), and a recent significant increase of 2.0 percent average per year, 1980-1996 (n = 154; Sauer *et al.* 1997). BBS data indicate recent non-significant declines in California and Wyoming, 1980-1995. Generally, low sample sizes make trend estimates unreliable for most states and physiographic regions. Highest sage sparrow summer densities occur in the Great Basin, particularly Nevada, southeastern Oregon, southern Idaho, and Wyoming (Sauer *et al.* 1997). The BBS data (1966-1996) for the Columbia Plateau are illustrated in Figure_92.

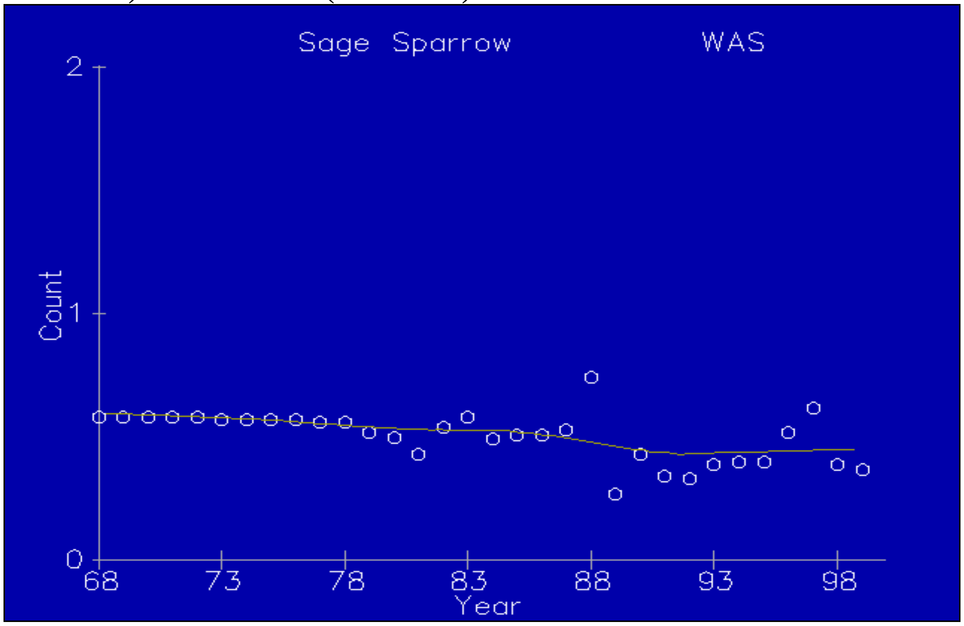

Figure 79. Sage sparrow population trend data(from BBS), Washington (Sauer *et al.* 2003).

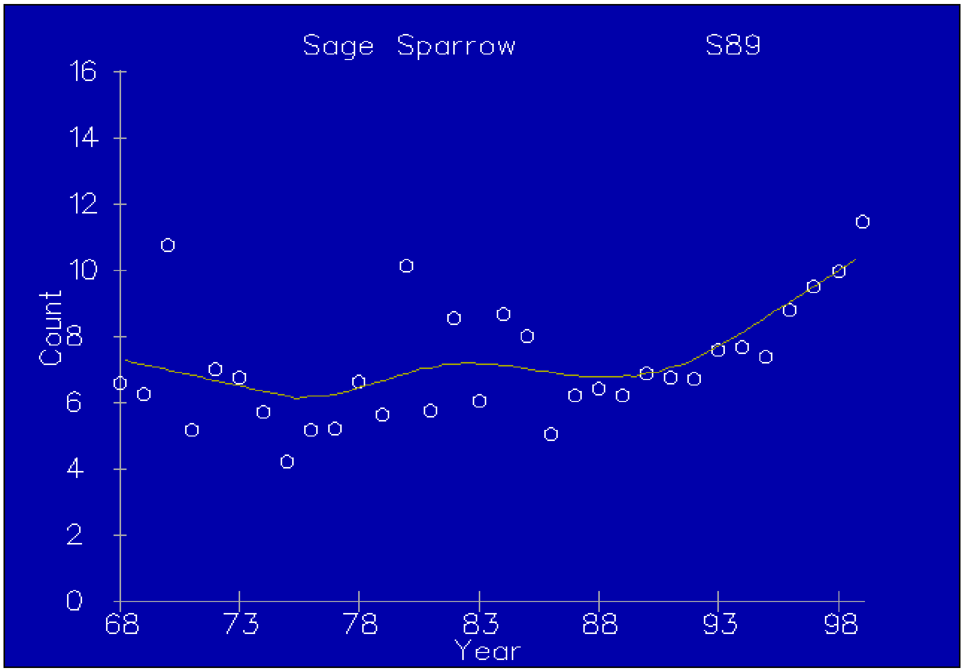

Figure 80. Sage sparrow trend results (from BBS data), Columbia Plateau (Sauer *et al.* 2003).

Christmas Bird Count (CBC) data show a significant decline in sage sparrows (-2.1 percent average per year; n = 160 survey circles) survey-wide for the period from 1959-1988. Sage sparrow trend estimates show declines in Arizona, New Mexico, and a significant decline in Texas (-2.2 percent average per year; n = 16). The highest sage sparrow winter counts occur in southern Nevada, southern California, Arizona, New Mexico, and west Texas (Sauer *et al.* 1996).

According to the ICBEMP terrestrial vertebrate habitat analysis, historical source habitats for sage sparrow occurred throughout most of the three ERUs within our planning unit (Wisdom *et al.* in press). Declines in source habitats were moderately high in the Columbia Plateau (40 percent), but relatively low in the Owyhee Uplands (13 percent) and Northern Great Basin (7 percent). However, declines in big sagebrush (e.g., 50 percent in Columbia Plateau ERU), which is likely higher quality habitat, are masked by an increase in juniper sagebrush (>50 percent in Columbia Plateau ERU), which is likely reduced quality habitat. Within the entire Interior Columbia Basin, over 48 percent of watersheds show moderately or strongly declining trends in source habitats for this species (Wisdom *et al.* in press) (from Altman and Holmes 2000).

Factors Affecting Sage Sparrow Population Status

Key Factors Inhibiting Populations and Ecological Processes

Habitat Loss

Because sage sparrows are shrubsteppe obligates. Sagebrush shrublands are vulnerable to a number of activities that reduce or fragment sagebrush habitat, including land conversion to tilled agriculture, urban and suburban development, and road and powerline rights of way. Range improvement programs remove sagebrush by burning, herbicide application, and mechanical treatment, replacing sagebrush with annual grassland to promote forage for livestock.

Agricultural set-aside programs (such as the Conservation Reserve Program [CRP]) may eventually increase the quantity of potential breeding habitat for sage sparrows but it is not clear how long this will take. Habitat objectives recommended for sage sparrows include; dominant sagebrush canopy with 10 - 25 percent sagebrush cover, mean sagebrush height >50 cm, high foliage density, mean native grass cover > 10 percent, mean exotic annual grass cover < 10 percent, mean open ground cover > 10 percent, and where appropriate provide suitable habitat conditions in patches >1000 ha (400ac) (Altman and Holmes 2000).

Fragmentation

The presence of relatively large tracts of sagebrush-dominated habitats is important as research in Washington indicates a negative relationship between sage sparrow occurrence and habitat fragmentation (Vander Haegen *et al.* 2000). Additionally, fragmentation of shrubsteppe habitat may increase vulnerability of sage sparrows to nest predation by generalist predators such as the common raven (*Corvus corax*) and black-billed magpie (*Pica hudsonia*) (Vander Haegen *et al.* 2002).

Livestock Management

Response to variation in grazing intensity is mixed. Sage sparrows respond negatively to heavy grazing of greasewood/Great Basin wild rye and shadscale/Indian ricegrass communities. They respond positively to heavy grazing of Nevada bluegrass/sedge communities, moderate grazing of big sage/bluebunch wheatgrass community, and to unspecified grazing intensity of big sage communities (see review by Saab *et al.* 1995). Because sage sparrows nest on the ground in early spring, and forage on the ground, maintenance of >50 percent of annual vegetative herbaceous growth of perennial bunchgrasses through the following season is recommended (Altman and Holmes 2000).

Pesticides/Herbicides

Large scale (16 km^2) aerial spraying of sagebrush habitat with the herbicide 2,4-D resulted in a significant decline in sage sparrow abundance 2 years post treatment. Because sage sparrows display high site fidelity to breeding areas birds may occupy areas that have been rendered unsuitable (Wiens and Rotenberry 1985).

Fire

Cheatgrass has altered the natural fire regime in the western range, increasing the frequency, intensity, and size of range fires. Fire kills sagebrush and where non-native grasses dominate, the landscape can be converted to annual grassland as the fire cycle escalates, removing habitat for sage sparrow (Paige and Ritter 1998).

Invasive Grasses

Cheatgrass readily invades disturbed sites, and has come to dominate the grass-forb community of more than half the sagebrush region in the West, replacing native bunchgrasses (Rich 1996). Crested wheatgrass and other non-native annuals have also fundamentally altered the grass-forb community in many areas of sagebrush shrubsteppe.

Brood Parasitism

Sage sparrow is an occasional host for brown-headed cowbird (*Molothrus ater*), and may abandon the nest (e.g., see Reynolds 1981). Prior to European-American settlement, sage sparrow was probably largely isolated from cowbird brood parasitism, but is now vulnerable where the presence of livestock, land conversion to agriculture, and fragmentation of shrublands creates a contact zone between the species (Rich 1978).

Predation

In Oregon, predation by Townsend ground squirrel (*Spermophilus townsendi*) affected sage sparrow reproductive success when squirrel densities were high. Sage sparrow populations in southeastern Washington and northern Nevada incurred high rates of nest predation, probably mainly by gopher snakes (*Pituophis melanoleucus*) (Rotenberry and Wiens 1989). Loggerhead shrikes (*Lanius ludovicianus*) prey on both adults and altricial young in nest, and can significantly reduce nest production (Reynolds 1979). Feral cats near human habitations may increase predation (Martin and Carlson 1998).

Out-of-Subbasin Effects and Assumptions

No data could be found on the migration and wintering grounds of the sage sparrow. It is a short distance migrant, wintering in the southwestern U.S. and northern Mexico, and as a result faces a complex set of potential effects during it annual cycle. Habitat loss or conversions is likely happening along its entire migration route (H. Ferguson, WDFW, pers. comm., 2003). Management requires the protection shrub, shrubsteppe, desert scrub habitats, and the elimination or control of noxious weeds. Migration routes, corridors, and wintering grounds need to be identified and protected just as its breeding areas.

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6.3.11 Rocky Mountain Elk

Rocky Mountain Elk (*Cervus elaphus nelsoni*)

Distribution

Rocky Mountain elk is one of two subspecies that occurs in Oregon. They inhabit most of eastern Oregon with major populations occurring in the Blue Mountains and south-central Oregon.

Habitat and Diet

Elk are polygamous, meaning that one bull, given the opportunity, can mate with more than one cow. Breeding behavior involves a complex social system, which revolves around mature bulls gathering harems. Mature bulls (defined here as 3½ years and older) typically begin gathering harems of cows in late August or early September and, under natural circumstances, conduct most of the breeding. Young bulls (yearlings and 2½-year-olds) typically cannot maintain harems in the presence of older males, and yearlings usually reach breeding maturity later in the year than older bulls. This complex process may be altered if bull/cow ratios and/or mature bull/young bull ratios become skewed toward cows and/or young bulls. Calf recruitment and survival is resilient over a wide range of bull/cow ratios.

Elk are in their poorest physical condition in late winter and early spring. Nutritional needs are high throughout spring and into the summer. Summer elk forage consists of a combination of lush forbs, grasses, and shrubs high in nutrients and easily digestible. Generally, higher elevation wet meadows, springs, and riparian areas in close proximity to forested stands offer these conditions for the longest period. Such areas provide nutritious forage and moist, cool places for bedding and escaping summer heat and insects. Elk achieve peak body condition during late summer and fall. Winter survival depends on fat reserves animals are able to store, thus, quality forage during summer and fall is crucial. As forage plants wither and dry on forest and rangelands, some elk respond by moving to irrigated private croplands. As Oregon's elk population has increased, depredation on private lands has become a problem and management challenge.

Winter is when elk survival is severely tested. Day length shortens, temperatures drop, and rain and snow increase. Forage becomes less abundant and accessible, and nutritional quality declines. Elk energy requirements can be high, and during this time they are dependent on stores of body fat. At this time they increasingly seek out an environment that helps minimize energy consumption. Such areas typically provide protection against weather and offer security for minimizing harassment or disturbance. During a typical winter, elk may loose 20 to 25 percent of their body weight. Elk losing more than 30 percent body weight likely will not survive.

Migration and Movements

Elk sometimes make significant movements in response to disturbances from humans and predators, and changes in seasonal weather patterns. Numerous studies have shown both Rocky Mountain and Roosevelt elk are sensitive to human disturbances such as motorized travel on and off roads (Rowland, et al., 2000). Roads are generally avoided by elk when they are open for use, but can be heavily utilized by elk as travel corridors when closed. Hunting seasons can drastically affect movements and distribution of elk. Herds exposed to 'opening day' hunting pressure usually disperse to cover areas and often break up into smaller bands. In some cases, elk move to private lands from public lands to avoid harassment, which can create damage problems on those lands (Conner, et al., 2001).

Rocky Mountain elk sometimes undergo long seasonal migrations that result in the movement of herds from one WMU to another. Telemetry studies have shown elk herds in a given summer range may move to different winter ranges depending on where they have traditionally wintered (Wilt, 1987). Most elk have an affinity for certain ranges and generally will use the same areas throughout their life. The severity of winter can often influence how far and at what elevation elk will move to avoid adverse weather. During mild winters, elk may not move far from summer range. Elk may use intermediate areas called transition range. Transition range is typically used in the late fall or early spring as migratory elk move between summer and winter ranges. Even with Rocky Mountain elk, some reside year-round in traditional winter and transition range.

Roles of Cover

Cover is an important component of elk habitat and provides both thermal and hiding properties. During summer it provides cooler, shaded areas for elk to bed during the heat of the day. During winter it provides a warmer, protected environment out of the cold, wind, rain, or snow. Lichens and other plants associated with cover can be an important source of forage for wintering animals. Adequate thermal cover reduces the energy needed by elk and contributes to overwinter survival.

Oregon's main elk ranges lack large blocks of unroaded wilderness that are present in some western states. This is particularly true on multiple-use federal lands where access by motorized and non-motorized traffic is largely unrestricted and increasing.

Forage

Adequate quality forage greatly influences the size and productivity of elk herds occupying an area. Elk meet nutritional requirements by selecting their diet from a variety of plant species available within the area they inhabit. Grasses, forbs, and browse from shrubs and trees all may be used. Forage palatability, digestibility, nutrient content, and availability influence diet selection. Seasonal variation in these factors influences the importance of various forage plants and specific areas used by feeding elk. When forage quality falls below what elk need to maintain nutritional requirements, body fat reserves are utilized and ultimately physical condition deteriorates. If this occurs over an extended period, such as a long, hard winter, fat reserves are depleted and loss of muscle occurs. During such conditions animals are more susceptible to accidents, disease, predation, and winterkill. Among pregnant cows, calf production and survival are reduced when cows experience a weight loss of more than 15 percent of their body weight. Death is likely for an elk if over-winter weight loss exceeds 30 percent of body weight.

Diseases and Parasites

Wild elk are hardy and have not been significantly impacted by diseases and parasites in Oregon. However, they can be subject to viral, bacterial and fungal diseases, and parasites. Brucellosis, chronic wasting disease (CWD), foot and mouth disease (FMD), and tuberculosis (TB) are the greatest disease threats to free-ranging elk herds; although, none of these diseases has been diagnosed in wild elk in Oregon.

Population Status and Conservation (From Oregon's Elk Management Plan 2003)

Historic records indicate both subspecies of elk were numerous and widely distributed in Oregon prior to arrival of non-native settlers. According to Vernon Bailey in his "The Mammals and Life Zones of Oregon" (1936), Rocky Mountain elk occupied the whole of the Blue Mountain Plateau in Northeastern Oregon. There are records of elk being plentiful in the Enterprise area in the Wallowa Mountains, and sighting and remains are reported form the Burns area and the John Day River. Bailey reported seeing old elk antlers at ranches throughout the Blue Mountains in 1895-96 and was told there were still a few elk in the wildest parts of the Blue Mountains.

Settlers hunted elk as a primary source of meat and harvest was unregulated. During the latter half of the 19th century 'market hunting' and human encroachment on elk range took a heavy toll on Oregon's elk populations. Market hunters killed thousands of elk for meat, hides and antlers. These products were sold in population centers in Oregon and shipped throughout the nation.

Reports of elk scarcity became common during the late 1880s. Elk populations were reduced to only a few small herds along the coast, in the Cascades, and Northeast Oregon and reached their lowest ebb by about 1910. The Oregon Legislature provided protection for elk in 1899 by making it illegal to sell meat from wild animals and by closing elk season from 1909 through 1932.

Concern for the future of elk continued after the season was closed. Early conservation efforts concentrated on restocking, and 15 elk from Jackson Hole, Wyoming, were released in an enclosure at Billy Meadows in Wallowa County on March 19, 1912. A second introduction of 15 elk to Billy Meadows from Jackson Hole was made in 1913. Elk from Billy Meadows were subsequently transplanted to other areas in Oregon. The first transplant occurred in 1917, when 15 elk were moved to Crater Lake National Park.

The scale of transplanting in the early 1900s was limited and alone does not account for the rapid increases in elk numbers and distribution. Recovery of elk in Oregon and elk expansion into much of their original range is largely the result of total protection of local remnant populations. By 1922, elk numbers had increased greatly in Umatilla, Baker, Union, Grant, Wallowa, Clatsop, and Tillamook counties, but authorities did not consider it possible to re-establish elk as a game animal at that time. However, by 1924 there were numerous complaints about competition between elk and domestic livestock. Elk hunting was re-established in Eastern Oregon in 1933 and in Western Oregon in 1938. Both subspecies of elk continue to increase in numbers and expand their range in several areas. However, elk numbers have stabilized in some areas after the adoption of MOs in 1994 and have declined in some Northeast Oregon Wildlife Management Units (WMUs). Elk continue to expand their range and numbers in the Siskiyou, Coast, Cascade, and Ochoco mountains and in the desert area of Southeastern and South-central Oregon.

Oregon's Elk Management Plan (February 2003)

The purpose of Oregon's Elk Management Plan is to guide elk management in Oregon for the next 10 years, with an interim review at 5 years. This plan will be used by the Oregon Department of Fish and Wildlife (ODFW) to guide management decisions related to elk, and to identify ODFW elk management policies and strategies to the public, other agencies, and private landowners. The elk management plan is an integral part of ODFW's wildlife management strategy. Species plans guide management for individual species, but also fit into ODFW's mission to manage all wildlife within the state of Oregon. This elk management plan reflects conditions in 2002 and those anticipated for the next 10 years.

Goals

Manage elk populations in Oregon to provide optimum recreational benefits to the public, be compatible with habitat capability and primary land uses, and contribute to a healthy ecosystem.

Objectives

1. Maintain recruitment of calves into elk populations at levels that support desired population levels while providing optimum recreational benefits.
2. Maintain bull ratios at or above management objective levels.
3. Maintain populations at or near established management objectives.
4. Maintain, enhance, and restore elk habitat.
5. Maintain consumptive and nonconsumptive recreational uses of Oregon's elk resource.
6. Minimize elk damage consistent with the guidelines of the adopted damage policy.

Management Practices Affecting Elk

Forest Management

Logging, thinning, prescribed burning, road management, and other forest management practices can maintain, enhance, or degrade elk habitat. The effects of these activities depend on whether elk habitat was a consideration during project design and how the project objectives relate to the habitat requirements of elk in the area. Valuable cover or forage can be lost through removal or rendered unusable by continued or increased human disturbance as a result of the project. However, if the project was designed with elk as an objective, management can improve the distribution of cover and forage, enhance forage quality and quantity, and maintain cover structure to meet thermal and security requirements.

Range Management

Range management practices are similar to timber management in that they can be either beneficial or detrimental. Most rangelands are in Eastern Oregon and livestock grazing is prevalent. Timing, intensity, and duration of livestock grazing can greatly affect elk habitat. Grazing that considers the needs of elk can be beneficial by removing old, unpalatable vegetation and stimulating new, succulent growth elk prefer. However, grazing that ignores elk can remove needed forage and damage important riparian habitat areas. Research also has demonstrated elk prefer areas without cattle and may move away from them if suitable habitat is available elsewhere.

Recreation Practices

Since inception of Oregon's Elk Plan in 1992, public lands have been under growing pressure to provide recreational opportunities. The challenge for elk and land managers will be not only to provide elk habitat but also ensure disturbance from recreationalists does not render it unusable by elk. Future elk management will likely be more about people management and the need to consider impacts from the myriad of recreational users.

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6.3.12 Yellow Warbler

Yellow Warbler (*Dendroica petechia*), P. Ashley and S. Stovall, WDFW

Introduction

The yellow warbler (*Dendroica petechia*) is a common species strongly associated with riparian and wet deciduous habitats throughout its North American range. In Washington it is found in many areas, generally at lower elevations. It occurs along most riverine systems, including the Columbia River, where appropriate riparian habitats have been protected. The yellow warbler is a good indicator of functional subcanopy/shrub habitats in riparian areas.

Yellow Warbler Life History, Key Environmental Correlates, and Habitat Requirements

Life History

Diet

Yellow warblers capture and consume a variety of insect and arthropod species. The species taken vary geographically. Yellow warblers consume insects and occasionally wild berries (Lowther *et al.* 1999). Food is obtained by gleaning from subcanopy vegetation; the species also sallies and hovers to a much lesser extent (Lowther *et al.* 1999) capturing a variety of flying insects.

Reproduction

Although little is known about yellow warbler breeding behavior in Washington, substantial information is available from other parts of its range. Pair formation and nest construction may begin within a few days of arrival at the breeding site (Lowther *et al.* 1999). The reproductive process begins with a fairly elaborate courtship performed by the male who may sing up to 3,240 songs in a day to attract a mate. The responsibility of incubation, construction of the nest and most feeding of the young lies with the female, while the male contributes more as the young develop. In most cases only one clutch of eggs is laid; renesting may occur, however, following nest failure or nest parasitism by brown-headed cowbirds (Lowther *et al.* 1999). The typical clutch size ranges between 4 and 5 eggs in most research studies of the species (Lowther *et al.* 1999). Egg dates have been reported from British Columbia, and range between 10 May and 16 August; the peak period of activity there was between 7 and 23 June (Campbell *et al.* in press). The incubation period lasts about 11 days and young birds fledge 8-10 days after hatching (Lowther *et al.* 1999). Young of the year may associate with the parents for up to 3 weeks following fledging (Lowther *et al.* 1999).

Nesting

Results of research on breeding activities indicate variable rates of hatching and fledging. Two studies cited by Lowther *et al.* (1999) had hatching rates of 56 percent and 67 percent. Of the eggs that hatched, 62 percent and 81 percent fledged; this represented 35 percent and 54 percent, respectively, of all eggs laid. Two other studies found that 42 percent and 72 percent of nests fledged at least one young (Lowther *et al.* 1999); the latter study was from British Columbia (Campbell *et al.* in press).

Migration

The yellow warbler is a long-distance neotropical migrant. Spring migrants begin to arrive in the region in April. Early dates of 2 April and 10 April have been reported from Oregon and British Columbia, respectively (Gilligan *et al.* 1994, Campbell *et al.* in press). Average arrival dates are somewhat later, the average for south-central British Columbia being 11 May (Campbell *et al.* in press). The peak of spring migration in the region is in late May (Gilligan *et al.* 1994). Southward migration begins in late July, and peaks in late August to early September; very few migrants remain in the region in October (Lowther *et al.* 1999).

Mortality

Little has been published on annual survival rates. Roberts (1971) estimated annual survival rates of adults at 0.526 ±0.077 SE, although Lowther *et al.* (1999) felt this value underestimated survival because it did not account for dispersal. The oldest yellow warbler on record lived to be nearly 9 years old (Klimkiewicz *et al.* 1983).

Yellow warblers have developed effective responses to nest parasitism by the brown-headed cowbird (*Molothrus ater*). The brown-headed cowbird is an obligate nest brood parasite that does not build a nest and instead lays eggs in the nests of other species. When cowbird eggs are recognized in the nest the yellow warbler female will often build a new nest directly on top of the original. In some cases, particularly early in the incubation phase, the female yellow warbler will bury the cowbird egg within the nest. Some nests are completely abandoned after a cowbird egg is laid (Lowther *et al.* 1999). Up to 40 percent of yellow warbler nests in some studies have been parasitized (Lowther *et al.* 1999).

Habitat Requirements

The yellow warbler is a riparian obligate species most strongly associated with wetland habitats and deciduous tree cover. Yellow warbler abundance is positively associated with deciduous tree basal area, and bare ground; abundance is negatively associated with mean canopy cover, and cover of Douglas-fir (*Pseudotsuga menziesii*), Oregon grape (*Berberis nervosa*), mosses, swordfern (*Polystuchum munitum*), blackberry (*Rubus discolor*), hazel (*Corylus cornuta*), and oceanspray (*Holodiscus discolor*) (Rolph 1998).

Partners in Flight have established biological objectives for this species in the lowlands of western Oregon and western Washington. These include providing habitats that meet the following definition: >70 percent cover in shrub layer (<3 m) and subcanopy layer (>3 m and below the canopy foliage) with subcanopy layer contributing >40 percent of the total; shrub layer cover 30-60 percent (includes shrubs and small saplings); and a shrub layer height >2 m. At the landscape level, the biological objectives for habitat included high degree of deciduous riparian heterogeneity within or among wetland, shrub, and woodland patches; and a low percentage of agricultural land use (Altman 2001).

Nesting

Radke (1984) found that nesting yellow warblers occurred more in isolated patches or small areas of willows adjacent to open habitats or large, dense thickets (i.e., scattered cover) rather than in the dense thickets themselves. At Malheur National Wildlife Refuge, in the northern Great Basin, nest success 44 percent (n = 27), however, cowbird eggs and young removed; cowbird parasitism 33 percent (n = 9) (Radke 1984).

Breeding

Breeding yellow warblers are closely associated with riparian hardwood trees, specifically willows, alders, or cottonwood. They are most abundant in riparian areas in the lowlands of eastern Washington, but also occur in west-side riparian zones, in the lowlands of the western Olympic Peninsula, where high rainfall limits hardwood riparian habitat. Yellow warblers are less common (Sharpe 1993). There are no BBA records at the probable or confirmed level from subalpine habitats in the Cascades, but Sharpe (1993) reports them nesting at 4000 feet in the Olympics. Numbers decline in the center of the Columbia Basin, but this species can be found commonly along most rivers and creeks at the margins of the Basin. A local breeding population exists in the Potholes area.

Non-breeding

Fall migration is somewhat inconspicuous for the yellow warbler. It most probably begins to migrate the first of August and is generally finished by the end of September. The yellow warbler winters south to the Bahamas, northern Mexico, south to Peru, Bolivia and the Brazilian Amazon.

Yellow Warbler Population and Distribution

Population

Historic

No historic data could be found for this species.

Current

No current data could be found for this species.

Distribution

Historic

Jewett *et al.* (1953) described the distribution of the yellow warbler as a common migrant and summer resident from April 30 to September 20 in the deciduous growth of Upper Sonoran and Transition Zones in eastern Washington and in the prairies and along streams in southwestern Washington. They describe its summer range as north to Neah Bay, Blaine, San Juan Islands, Monument 83; east to Conconully, Swan Lake, Sprague, Dalkena, and Pullman; south to Cathlamet, Vancouver and Bly, Blue Mts., Prescott, Richland, and Rogersburg; and west to Neah Bay, Grays Harbor, and Long Beach. Jewett *et al. (*1953) also note that the yellow warbler was common in the willows and alders along the streamsof southeastern Washington and occurs also in brushy thickets. They state that its breeding range follows the deciduous timber into the mountains, where it porbably nests in suitable habitat to 3,500 or perhaps even to 4,000 feet – being common at Hart Lake in the Chelan region around 4,000 feet. They noted it was a common nester along the Grande Ronde River, around the vicinity of Spokane, around Sylvan Lake, and along the shade trees along the streets of Walla Walla.

Current

The yellow warbler breeds across much of the North American continent, from Alaska to Newfoundland, south to western South Carolina and northern Georgia, and west through parts of the southwest to the Pacific coast (AOU 1998). Browning (1994) recognized 43 subspecies; two of these occur in Washington, and one of them, *D.p. brewsteri*, is found in western Washington. This species is a long-distance migrant and has a winter range extending from western Mexico south to the Amazon lowlands in Brazil (AOU 1998). Neither the breeding nor winter ranges appear to have changed (Lowther *et al.* 1999).

The yellow warbler is a common breeder in riparian habitats with hardwood trees throughout the state at lower elevations. It is a locally common breeder along rivers and creeks in the Columbia Basin, where it is declining in some areas. Core zones of distribution in Washington are the forested zones below the subalpine fir and mountain hemlock zones, plus steppe zones other than the central arid steppe and canyon grassland zones, which are peripheral.

Figure 81. Breeding bird atlas data (1987-1995) and species distribution for yellow warbler (Washington GAP Analysis Project 1997).

Breeding

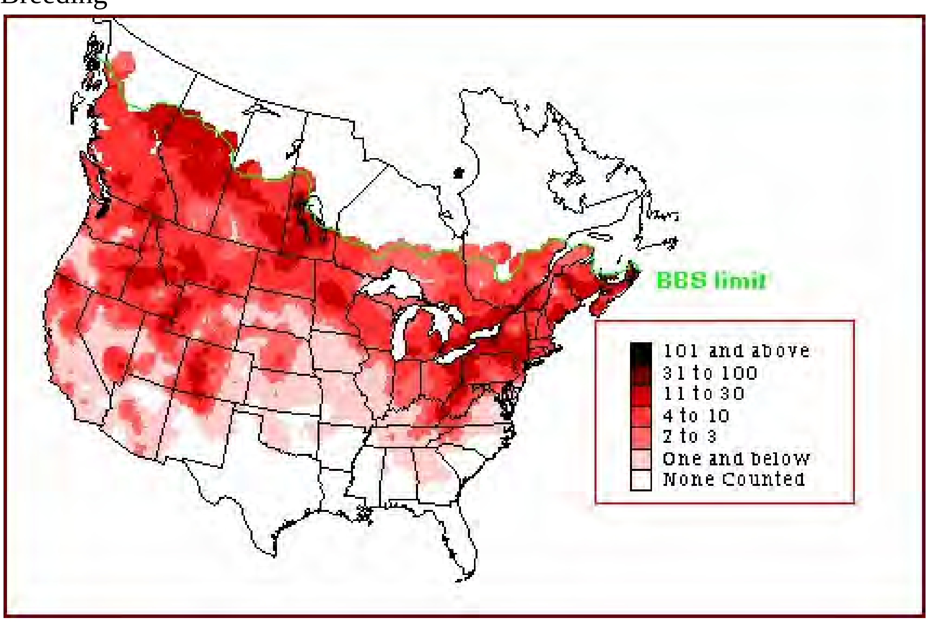

Figure 82 Yellow warbler breeding season abundance (from BBS data) (Sauer *et al.* 2003).

The yellow warbler breeds across much of the North American continent, from Alaska to Newfoundland, south to western South Carolina and northern Georgia, and west through parts of the southwest to the Pacific coast (AOU 1998).

Non-Breeding

This data is not readily available; however, the yellow warbler is a long-range neotropical migrant. Its winter range is from Northern Mexico south to Northern Peru.

Yellow Warbler Status and Abundance Trends

Status

Yellow warblers are demonstrably secure globally. Within the state of Washington, yellow warblers are apparently secure and are not of conservation concern (Altman 1999).

Trends

Yellow warbler is one of the more common warblers in North America (Lowther *et al.* 1999). Information from Breeding Bird Surveys indicates that the population is stable in most areas. Some subspecies, particularly in southwestern North America, have been impacted by degradation or destruction of riparian habitats (Lowther *et al.* 1999). Because the Breeding Bird Survey dates back only about 30 years, population declines in Washington resulting from habitat loss dating prior to the survey would not be accounted for by that effort.

Factors Affecting Yellow Warbler Population Status

Key Factors Inhibiting Populations and Ecological Processes

Habitat loss due to hydrological diversions and control of natural flooding regimes (e.g., dams) resulting in reduction of overall area of riparian habitat, conversion of riparian habitats, inundation from impoundments, cutting and spraying for ease of access to water courses, gravel mining, etc.

Habitat degradation from: loss of vertical stratification in riparian vegetation, lack of recruitment of young cottonwoods, ash, willows, and other subcanopy species; stream bank stabilization (e.g., riprap) which narrows stream channel, reduces the flood zone, and reduces extent of riparian vegetation; invasion of exotic species such as reed canary grass and blackberry; overgrazing which can reduce understory cover; reductions in riparian corridor widths which may decrease suitability of the habitat and may increase encroachment of nest predators and nest parasites to the interior of the stand.

Hostile landscapes, particularly those in proximity to agricultural and residential areas, may have high density of nest parasites (brown-headed cowbird) and domestic predators (cats), and be subject to high levels of human disturbance.

Recreational disturbances, particularly during nesting season, and particularly in high-use recreation areas.

Increased use of pesticide and herbicides associated with agricultural practices may reduce insect food base.

Out-of-Subbasin Effects and Assumptions

No data could be found on the migration and wintering grounds of the yellow warbler. It is a long-distance migrant and as a result faces a complex set of potential effects during it annual cycle. Habitat loss or conversions is likely happening along its entire migration route (H. Ferguson, WDFW, pers. comm. 2003). Riparian management requires the protection of riparian shrubs and understory and the elimination of noxious weeds. Migration routes, corridors and wintering grounds need to be identified and protected just as its breeding areas. In addition to loss of habitat, the yellow warbler, like many wetland or riparian associated birds, faces increased pesticide use in the metropolitan areas, especially with the outbreak of mosquito born viruses like West Nile Virus.

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6.3.13 American Beaver

American Beaver (Castor Canadensis) K. Paul, USFWS.

Distribution

In Oregon, the American beaver can be found in suitable habitats throughout the state (Verts and Carraway 1998).

Habitat

The beaver almost always is associated with riparian or lacustrine habitats bordered by a zone of trees, especially cottonwood and aspen (Populus), willow (Salix), alder (Alnus), and maple (Acer) (Verts and Carraway 1998). Small streams with a constant flow of water that meander through relatively flat terrain in fertile valleys and are subject to being dammed seem especially productive of beavers (Hill 1982, cited in Verts and Carraway 1998). Streams with rocky bottoms through steep terrain and more subject to wide fluctuations in water levels are less suitable to beavers. In large lakes with broad expanses subject to extensive wave action, beavers usually are restricted to protected inlets (Verts and Carraway 1998).

Harvest

Harvest of beavers in Oregon between 1969 and 1992 per 1,000 hectares in Union and Wallowa Counties were <1 and 1-10 respectively (ODFW, annual reports, cited in Verts and Carraway 1998).

Diet

Beavers are herbivorous. In summer, a variety of green herbaceous vegetation, especially aquatic species, is eaten (Jenkins and Busher 1979; Svendsen 1980, cited in Verts and Carraway 1998). In autumn and winter as green herbaceous vegetation disappears, beavers shift their diet to stems, leaves, twigs, and bark of many of the woody species that grow near the water (Verts and Carraway 1998). Bulbous roots of aquatic species also may be eaten in winter (Beer 1942, cited in Verts and Carraway 1998). Beavers cut mostly deciduous trees such as cottonwood, will, alder, maple, and birch, but in some regions, coniferous species may be used (Jenkins 1979, cited in Verts and Carraway 1998).

In southeastern Oregon, riparian-zone trees have been reduced or eliminated in many areas by browsing herbivores. However, comparison of growth of red willow (*Salix lasiandra*) in an area inaccessible to cattle but occupied by beavers with that in an area inaccessible to both cattle and beavers, indicated that beavers were not responsible for the deterioration. Although beavers harvested 82% of available stems annually, they cut them at a season after growth was completed and reserves were translocated to roots. Subsequent growth of cut willows increase exponentially in relation to the proportion of the stems cut by beavers (Kindschy 1985, cited in Verts and Carraway 1998).

Habits

Beavers, because of their ability to fell trees, dam streams (and irrigation ditches), dig canals, and tunnel into banks, and because of their taste for certain crops, doubtlessly have the greatest potential of any wild mammal in the state to affect the environment. Their economic value, both positive and negative, can be enormous, depending largely upon the point of view of those affected. However, the more subtle contributions such as to flood control, to maintenance of water flows, to fisheries management, and to soil conservation resulting from their activities, in the long term, may have the greatest economic value (Verts and Carraway 1998).

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6.4 Appendix 4: Data Sources

Table 65. GIS Data used by GRMWP to derive habitat acreages and create maps.

General Description	Source	Scale	Year	Notes
Vegetation Current	ONHIC	1:100,000	1987-2001	Data derived from sources at varying scale, overall scale 1:100,000
Vegetation Historic	ONHIC	1:100,000	Pre-1938	Data derived from sources at varying scale, overall scale 1:100,000
Wildlife Habitat Groups Current and Historic (based on ONHIC Vegetation Data)	ONHIC with modification by GRSB Wildlife Technical Group	1:100,000	Current 1987-2001, Historic Pre-1938	Data derived from sources at varying scale, overall scale 1:100,000
ONHIC Current Vegetation Data Sources	ONHIC	1:100,000		Depicts sources of vegetation data used to create wildlife habitat maps.
Streams (Strahler)	USGS/BLM	1:100,000		BPA modified USGS stream layer to identify the Strahler order of streams
Grande Ronde Subbasin Boundary	IBIS	1:100,000		Subbasin boundaries developed for NWPPC 2000 F&W Program
Grande Ronde Subbasin Boundary used for maps depicting Salmonid Populations	NOAA/GRMWP (NRCS/REO)	1:100,000		Salmonid Population Boundaries within the Grande Ronde subbasin were derived by merging the Pacific Northwest Hydrography Framework Clearinghouse Hydrologic Unit Boundaries for 6th field HUCS (subwatersheds). Subwatershed were merged to match the ISAB Salmonid population boundaries, the GRSB boundary based on the PNW Hydrography subbasin data is slightly different from the IBIS Subbasin boundary
Grande Ronde Subbasin Salmonid Population Boundaries	NOAA Fisheries	1:100,000		Developed by Interior Columbia Basin Technical Recovery Team
Grande Ronde Subbasin Salmonid Population Boundaries based on NRCS/REO huc	NRCS/REO	1:100,000		Because the project inventory database is tied to the NRCS/REO HUC definitions we merged 6th field HUCS to match the CRB-TRT population boundaries. These population boundaries are used for reports and maps in the inventory section.

General Description	Source	Scale	Year	Notes
boundaries				
Land Ownership	USFS	1:24,000		
Private lands	USFS	1:24,000		
Protected Lands	USFS & NPT	1:24,000		USFS Wilderness, Federal and State Wild and Scenic River Corridors, and Nez Perce Tribe Precious Lands
Focal Species – Current Distributions	ICBEMP	1:2,000,000	1996	
Elk Distribution & Migration Corridors	RMEF	1:250,000	1996-1999	M.A.P.™ Elk Habitat Project data

6.5 Appendix 5: Mangement Plans and Programs Relevant to Activities in the Grande Ronde Subbasin.

Table 66. Aquatic/Riparian/Fish Plans and Programs.

Agency Category	Lead Author(s)	Date	Title	Source/Website
Fed	Federal Caucus	2000 - 12	Conservation of Columbia Basin Fish - Final Basinwide Salmon Recovery Strategy	http://www.salmonrecovery.gov/strategy_documents.shtml
Fed	Federal Caucus	2003 - 09	Endangered Species Act 2003 Check-In Report for the Federal Columbia River Power System	http://www.salmonrecovery.gov/Progress_Report.pdf
Fed	Federal Caucus	2003 - 11	Endangered Species Act 2004/2004–2008 Implementation Plan for the Federal Columbia River Power System	http://www.salmonrecovery.gov/Implementation/Front_Matter_&_Imp_Plan.pdf
Fed	many	2002 - 12	National Wetlands Mitigation Action Plan	http://www.mitigationactionplan.gov/maphtml.html
Fed	NOAA Fisheries	2001 - 01	Guidance for Integrating Magnuson-Stevens Fishery Conservation and Management Act EFH Consultations with Endangered Species Act Section 7 Consultations	http://www.nwr.noaa.gov/1habcon/habweb/efh/national_finding_2-01.pdf
Fed	NOAA Fisheries	2003	Endangered and Threatened Species; Final Rule Governing Take of 14 Threatened Salmon and Steelhead Evolutionarily Significant Units (ESUs)	http://www.nwr.noaa.gov/1salmon/salmesa/final4d.htm
Fed	NOAA Fisheries	2003 - 08	Non-Fishing Impacts To Essential Fish Habitat And Recommended Conservation Measures	http://swr.nmfs.noaa.gov/EFH-NonGear-Master.PDF
Fed	NOAA Fisheries USFWS USACE USBR	2000 - 12	Endangered Species Act - Section 7 Consultation - Biological Opinion - Reinitiation of Consultation on Operation of the Federal Columbia River Power System, Including the Juvenile Fish Transportation Program, and 19 Bureau of Reclamation Projects in the Columbia Basin	http://www.nwr.noaa.gov/1hydrop/hydroweb/docs/Final/2000Biop.html
Fed	NOAA Fisheries ICBTRT	2003	Independent Populations of Chinook, Steelhead, and Sockeye for Listed Evolutionarily Significant Units Within the Interior Columbia River Domain - Working Draft	http://research.nwfsc.noaa.gov/trt/col_docs/IndependentPopChinSteelSock.pdf
Fed	NWPPC ISAB	2003	ISAB Comments on Draft NOAA Technical Recovery Team Documents Identifying Independent Salmonid Populations Within Evolutionarily Significant Units (Review of Interior Columbia TRT Draft Document)	
Fed	NWPPC ISAB	2003 - 03	A Review of Strategies for Recovering Tributary Habitat	http://www.nwcouncil.org/library/isab/isab2003-2.pdf
Fed	BLM/USFS Asotin Co. OSRP	1993	Wallowa & Grande Ronde Rivers - Final Management Plan/ Environmental Assessment	
Fed	USFS BLM	1995 - 02	PACFISH - Implementation of Interim Strategies for Managing Anadromous Fish-Producing Watersheds in Eastern Oregon and Washington, Idaho, and portions of California	http://www.fs.fed.us/r6/fish/9502-pacfish.pdf
Fed	USFS BLM	1995 - 07	INFISH - Inland Native Fish Strategy	http://www.fs.fed.us/r6/fish/

Agency Category	Lead Author(s)	Date	Title	Source/Website
Fed	USFS BLM	1997 - 09	Biological Assessment - Effects to Steelhead of Land and Resource Management Plans and Selected Federal Actions on National Forests and Bureau of Land Management Resource Areas in the Upper Columbia River Basin and Snake River Basin Evolutionarily Significant Units	http://www.fs.fed.us/r6/fish/biological_assessments/970916_steelhead_ba_cover_ltrh.htm
Fed	USFS BLM	1998	Biological Assessment - Effects to Bull Trout, Shortnose Sucker, Lost River Sucker, and Warner Sucker of Land and Resource Management Plans, and Associated Federal Actions on National Forests and Bureau of Land Management Resource Areas in the Columbia River, Klamath River, and Jarbidge River Basins	http://www.fs.fed.us/r6/fish/biological_assessments/980615-bull-trout-BA_final.htm
Fed	USFS BLM	1998	Lower Grande Ronde Subbasin Review	
Fed	USFWS	1976	Lower Snake River Fish and Wildlife Compensation Plan	http://lsnakecomplan.fws.gov/
Fed	USFWS	1998	Biological Opinion for the Effects To Bull Trout From Continued Implementation Of Land And Resource Management Plans And Resource Management Plans As Amended By The Interim Strategy For Managing Fish-Producing Watersheds In Eastern Oregon And Washington, Idaho, Western Montana, And Portions Of Nevada (Infish), And The Interim Strategy For Managing Anadromous Fish-Producing Watersheds In Eastern Oregon And Washington, Idaho, And Portions Of California (Pacfish).	http://www.fs.fed.us/r6/fish/biological-opinions/980823_bt_bo/980823_bt_bo_html_ver/980823_biological_opinion_bull_trouth.htm
Fed	USFWS	2002 - 10	Bull Trout (Salvelinus confluentus) Draft Recovery Plan	http://pacific.fws.gov/bulltrout/recovery/
GRMWP	Clearwater BioStudies	1993	Stream and Riparian Conditions in the Grande Ronde Basin 1993	
GRMWP	Mobrand	1995-96	Grande Ronde Model Watershed Ecosystem Diagnosis and Treatment (3 documents)	http://www.efw.bpa.gov/cgi-bin/efw/ws.exe/websql.dir/FW/PROJECTS/ProjectSummary.pl?NewProjNum=199404600
GRMWP			Summary of GRMWP Applicable Plans/Studies	http://www.oregon-plan.org/archives/steelhead_dec1997/st-14e09.html
State	Asotin Co.		Shoreline Management Act applies to the following streams and rivers in Asotin County:	http://search.leg.wa.gov/wslwac/WAC%20173%20%20TITLE/WAC%20173%20-%2018%20%20CHAPTER/WAC%20173%20-%2018%20-060.htm
State	ODEQ ODF ODA		Oregon State Programs For Managing Riparian Resources Report By The Riparian management work Group Appendix B: Oregon's Water Quality Standards And Criteria Related To Riparian Corridors	http://www.oregon-plan.org/Riparian/AppndxBstds.pdf
State	ODFW	1985	The effects of stream alterations on salmon and trout habitat in Oregon. Oregon Department of Fish and Wildlife, Portland, OR.Bottom, D.L., Howell, P.J., and Rodgers, J.D. 1985.	http://www.fishlib.org/Documents/Subbasins/bottom_toc.pdf
State	ODFW	1992	Steelhead Management Plan 1986-1992	http://www.fishlib.org/Documents/Subbasins/ODFW_2_toc.pdf

Agency Category	Lead Author(s)	Date	Title	Source/Website
State	ODFW	2001	Fisheries Management and Evaluation Plan, Snake River Steelhead ESU, Snake, Grande Ronde and Imnaha Rivers, Snake River Steelhead ESU, Warmwater and Sturgeon Recreational Fisheries	http://www.nwr.noaa.gov/1fmep/proposed/Snake_Sturgeon_Warmwater_FMEP_publicreviewdraft03092001.pdf
State	ODFW	2001 - 05	Flow Restoration Priorities for Recovery of Salmonids in Oregon: Grande Ronde Basin (part of Oregon Plan)	http://www.wrd.state.or.us/programs/salmon/08priorities.pdf
State	ODFW	2001 - 11	Hatchery and Genetics Management Plan for Grande Ronde River Spring Chinook Salmon	Appendix B of Grande Ronde Subbasin Summary
State	ODFW	2001 - 11	Hatchery and Genetics Management Plan for Grande Ronde Basin Summer Steelhead	Appendix C of Grande Ronde Subbasin Summary
State	ODFW	2003 - 03	Draft ODFW Native Fish Conservation Policy and Hatchery Management Policy	http://www.dfw.state.or.us/ODFWhtml/InfoCntrFish/PDFs/hatch.pdf
State	ODFW		Oregon trout, steelhead, and warmwater fish species plans	
State	ODFW	1995	Comprehensive Plan for Production and Management of Oregon's Anadromous Salmon and Trout, Part III: Steelhead Plan	
State	ODFW		Native Fish Conservation Policy and Guidelines	http://www.dfw.state.or.us/odfwhtml/infocntrfish/nfcp_qas.htm
State	ODFW CTUIR NPT WDFW	1990	Grande Ronde River Subbasin Salmon and Steelhead Production Plan	http://www.streamnet.org/subbasin/Grande.pdf
State	ODFW NPT CTUIR	2002 - 09	Grande Ronde Basin Spring Chinook Hatchery Management Plan	
State	ODSL		State Scenic Waterways Act	http://www.oregonstatelands.us/ORS_390.htm
State	ODSL		Oregon Wetland Conservation Plan	http://www.oregonstatelands.us/141-086_WCP.htm
State	ODSL		Oregon Wetland Conservation Statute	http://www.oregonstatelands.us/wetland_conv_stat.htm
State	ODSL OLCD	2004	Wetland Planning Guidebook	http://www.lcd.state.or.us/publicat/wetland_planning_guidebook.htm
State	Oregon	2000 - 06	Oregon Guidelines for Timing of In-Water Work to Protect Fish and Wildlife Resources	http://www.dfw.state.or.us/ODFWhtml/InfoCntrHbt/0600_inwtrguide.pdf
State	Oregon		Oregon Legislature Administrative Rules applied to ODFW (635 Division 07 – Fish Management and Hatchery Operation)	http://www.dfw.state.or.us/OARs/OARs.html
State	OWEB	1997	Oregon Plan for Salmon and Watersheds & Steelhead Supplement to the Oregon Plan	http://www.oregon-plan.org/
State	OWEB	1999	Oregon Aquatic Habitat Restoration And Enhancement Guide - Under the Oregon Plan for Salmon and Watersheds	http://www.oregon-plan.org/guidelines/habitat_restoration_guide1999/index.html
State	OWEB		Statewide Riparian Management Policy	http://www.oregon-plan.org/Riparian/FinalRipPolicy.pdf

Agency Category	Lead Author(s)	Date	Title	Source/Website
State	Washington State Joint Natural Resources Cabinet	1999	Statewide Strategy to Recover Salmon	http://www.governor.wa.gov/gsro/strategy/longversion.htm
State	WDFW	1997	Wild Salmonid Policy for Washington	http://wdfw.wa.gov/fish/wsp/wsp.htm
State	WDFW		Draft Steelhead Management Plan or Draft Snake River Wild Steelhead Recovery Plan	
State	WDFW WDOT USACE USFWS	1999	Aquatic Habitat Guidelines: An Integrated Approach to Marine, Freshwater, and Riparian Habitat Protection and Restoration	http://www.wdfw.wa.gov/hab/ahg/
State	WDFW WDOT WDOE	2003 - 04	AHG:Integrated Streambank Protection Guidelines	http://www.wdfw.wa.gov/hab/ahg/ispgdoc.htm
State	WDFW Western Washington Treaty Tribes	2000	Bull Trout and Dolly Varden Management Plan	http://www.wdfw.wa.gov/fish/bulltrt/bulldoly.htm
State	WDOE		Columbia River Initiative	http://www.ecy.wa.gov/programs/wr/cri/crihome.html
State	WDOE		Chapter 173-158 WAC, Flood Plain Management	http://www.ecy.wa.gov/biblio/wac173158.html
State	WDOE		Chapter 173-18 WAC, Shoreline Management Act – Streams And Rivers Constituting - Shorelines Of The State	http://www.ecy.wa.gov/biblio/wac17318.html
State	WDOE		Shoreline Master Program Guidelines	http://www.ecy.wa.gov/programs/sea/SMA/guidelines/index.html
Tribe	CRITFC	1995	Wy-Kan-Ush-Mi Wa-Kish-Wit: Spirit of the Salmon: The Columbia River Anadromous Fish Restoration Plan of the Nez Perce, Umatilla, Warm Springs and Yakama Tribes	http://www.critfc.org/text/trptext.html
Tribe	CTUIR	1995 - 03	Confederated Tribes of the Umatilla Indian Reservation, Columbia Basin Salmon Policy	http://www.umatilla.nsn.us/salmon.pdf
Tribe	NPT ODFW CTUIR	2000 - 04	Northeast Oregon Hatchery Project Spring Chinook Master Plan 2000 Technical Report	http://www.efw.bpa.gov/Environment/EW/EWP/DOCS/REPORTS/HATCHERY/A00000058-1.pdf
Tribe	NPT Wallowa County	1999 - 09	Wallowa County/Nez Perce Tribe Salmon Habitat Recovery Plan and Multi-Species Strategy	http://www.co.wallowa.or.us/salmonplan/

Table 67. Water Quality/Quantity Plans and Programs

Agency Category	Lead Author(s)	Date	Title	Source/Website
Fed	EPA	1972	Clean Water Act	http://www.epa.gov/r5water/cwa.htm
Fed	EPA	1998	Clean Water Action Plan	http://www.cleanwater.gov/action/toc.html
Fed	EPA		TMDL Policy/Program Documents	http://www.epa.gov/owow/tmdl/policy.html

GRMWP	Grande Ronde Water Quality Committee	2000	Upper Grande Ronde River Subbasin Water Quality Management Plan	http://www.deq.state.or.us/wq/tmdls/UprGR/UprGRWQMP.pdf
State	ODA Union SWCD	1999 - 09	Upper Grande Ronde Sub-Basin Agricultural Water Quality Management Area Plan Guidance Document	http://www.oda.state.or.us/nrd/water_quality/Plans_and_Rules/Plans/ugrplan.pdf
State	ODEQ	2000 - 05	Upper Grande Ronde Sub-Basin Total Maximum Daily Load (TMDL)	http://www.deq.state.or.us/wq/tmdls/UprGR/UprGRTMDL.pdf
State	ODEQ	2002	303(d) List of Impaired Waters in Oregon	http://www.deq.state.or.us/wq/wqfact/Final2002_303(d)list.pdf
State	Oregon	1993	Senate Bill 1010	http://www.oda.state.or.us/nrd/water_quality/WaterQualPDFs/Sb1010_brochure.pdf
State	OWRD		Allocation of Conserved Water	http://arcweb.sos.state.or.us/rules/OARS_600/OAR_690/690_018.html
State	OWRD		OWRD Administrative Rules	http://www.wrd.state.or.us/law/oar1999.shtml
State	WDFW		Hydraulic Code	http://www.wdfw.wa.gov/hab/hpapage.htm
State	WDOE		Chapter 173-204 WAC, Sediment Management Standards	http://www.ecy.wa.gov/biblio/wac173204.html
State	WDOE		Chapter 173-201A WAC, Water Quality Standards For Surface Waters Of The State Of Washington	http://www.ecy.wa.gov/biblio/wac173201a.html
State	WDOE		Washington's Water Quality Management Plan to Control Nonpoint Source Pollution - Final	http://www.ecy.wa.gov/biblio/9926.html
State	WDOE		Chapter 173-204 WAC, Sediment Management Standards	http://www.ecy.wa.gov/biblio/wac173204.html

Table 68. Wildlife & Plants Plans and Programs.

Agency Category	Lead Author(s)	Date	Title	Source/Website
Fed	BLM		Vale District Integrated Noxious Weed Management Plan	http://www.or.blm.gov/NEPA-RMP/es010504.htm
Fed	USFWS		A Blueprint for the Future of Migratory Birds Migratory Bird Program Strategic Plan 2004-2014	http://migratorybirds.fws.gov/mbstratplan/MBStratPlanTOC.htm
Fed	USFWS	1918	Migratory Bird Treaty Act of 1918	
PIF	PIF		Partners in Flight Landbird Conservation Plans	http://community.gorge.net/natres/pif.html
State	Asotin Co.		Asotin County Noxious Weed Board	http://www.co.asotin.wa.us/weed.html
State	ODA	2001 - 01	Oregon Noxious Weed Strategic Plan	http://www.oda.state.or.us/Plant/weed_control/plan/contents.html
State	ODA		Oregon Noxious Weed Control Program	http://www.oda.state.or.us/Plant/Weed_Control/index.html
State	ODFW		Wolf Plan	

State	ODFW	2003	Oregon's Mule Deer Management Plan	http://www.dfw.state.or.us/ODFWhtml/InfoCntrWild/PDFs/MuleDeerPlanFinal.PDF
State	ODFW	2003	Oregon's Elk Management Plan	http://www.dfw.state.or.us/ODFWhtml/InfoCntrWild/PDFs/Elk%20Planfinal.PDF
State	ODFW	2003 - 12	Oregon's Big Horn Sheep and Rocky Mountain Goat Management Plan	http://www.dfw.state.or.us/ODFWhtml/InfoCntrWild/PDFs/sgplan_1203.pdf
State	ODFW		Cougar, Black Bear, Migratory Game Bird Program Strategic Management Plan	
State	ODFW	1999	Oregon Wildlife Diversity Plan	http://www.dfw.state.or.us/ODFWhtml/InfoCntrWild/Diversity/PlanOrder.html
State	Oregon		Oregon Legislature Administrative Rules applied to ODFW (OAR 635 Division 008 – Department of Wildlife Lands)	http://www.dfw.state.or.us/OARs/OARs.html
State	WDFW	2001	Blue Mountains Elk Herd Plan	http://wdfw.wa.gov/wlm/game/elk/bluemtn.htm
State	WDFW	2003	Game Management Plan	
State	WDFW		Statewide Elk Management Plan, Bighorn Sheep Herd, Black Bear, State Ferruginous Hawk Recovery Plan, Bald Eagle Recovery Plan,	

Table 69. Broadscale Basin/Watershed Plans and Programs

Agency Category	Lead Author(s)	Date	Title	Source/Website
Fed	BLM		6840 - Special Status Species Management	http://www.or.blm.gov/Resources/Special-Status_Species/6840_ManualFinal1.pdf
Fed	BLM		Special Status Species Management for Oregon & Washington	http://www.or.blm.gov/Resources/Special-Status_Species/or9157.htm
Fed	USFWS	1973	The Endangered Species Act of 1973	http://endangered.fws.gov/esa.html
Fed	BLM		Northeastern Oregon Assembled Land Exchange (NOALE) and Resource Management Plan (RMP)	
Fed	BPA	1997	Watershed Management Program - Final Environmental Impact Statement – DOE/EIS-0265	http://www.efw.bpa.gov/cgi-bin/PSA/NEPA/SUMMARIES/WatershedManagement_EIS0265
Fed	BPA	2003 - 04	Fish and Wildlife Implementation Plan Final Environmental Impact Statement	http://www.efw.bpa.gov/cgi-bin/PSA/NEPA/SUMMARIES/FishWildlifeImplementation
Fed	NOAA Fisheries	2003 - 08	BIOP on BPA Habitat Improvement Program (HIP)	http://www.efw.bpa.gov/portal/Organizations/Government/Federal/Dept_of_Energy/BPA/Environment/NEPA/BiOps/NOAAFishHIPBiOp.pdf
Fed	NWPPC	1980	Pacific Northwest Electric Power Planning and Conservation Act	http://www.nwcouncil.org/library/poweract/default.htm
Fed	NWPPC	1999	Columbia River Basin Forum (Formerly The Three Sovereigns)	http://www.nwcouncil.org/fw/3sov/crbforum.htm

Fed	NWPPC	2000	NWPPC Fish and Wildlife Program	http://www.nwcouncil.org/fw/program/Default.htm
Fed	USFS	1990	Land and Resource Management Plan for the Umatilla National Forest	http://www.fs.fed.us/r6/uma/blue_mtn_planrevision/documents.shtml
Fed	USFS	1994	Northwest Forest Plan	
Fed	USFS	2001 - 10	Phillips-Gordon Ecosystem Analysis	http://www.fs.fed.us/r6/uma/projects/ecosystem/
Fed	USFS	1990	Land and Resource Management Plan for the Wallowa Whitman National Forest	http://www.fs.fed.us/r6/uma/blue_mtn_planrevision/documents.shtml
Fed	USFS	2000	Blue Mountains Forest Plan Revision	http://www.fs.fed.us/r6/uma/blue_mtn_planrevision/
Fed	USFS	2001	National Fire Plan (2001) - NFP	http://www.fireplan.gov/content/home/
Fed	USFS	2004 - 02	USDA Forest Service Strategic Plan (2000 Revision)	http://www2.srs.fs.fed.us/strategicplan/
Fed	USFS	1976	National Forest Management Act Of 1976	
Fed	USFS	2000	2000 Renewable Resources Planning Act (RPA) Assessment	http://www.fs.fed.us/pl/rpa/rpaasses.pdf
Fed	USFS BLM	2000 - 12	Interior Columbia Basin Ecosystem Management Project - Interior Columbia Basin Final Environmental Impact Statement	http://www.icbemp.gov/
GRMWP	GRMWP	1994	Grande Ronde Model Watershed Program: Operations -Action Plan	
GRMWP	GRMWP	2002	Phillips Creek Watershed Assessment	
GRMWP	GRMWP	2001	Willow Creek Watershed Assessment	
State	WDFW	1989	Priority Habitats and Species (PHS) Program	http://www.wdfw.wa.gov/hab/phspage.htm
State	Asotin Co.		Asotin County Zoning Ordinance, Flood Damage Prevention Ordinance, Critical Areas Ordinance	http://search.mrsc.org/nxt/gateway.dll/astnmc?f=templates&fn=astnpage.htm$vid=municodes:Asotin
State	ODF		Oregon Forestry Practices Act	http://159.121.125.11/fp/BackgroundPg/background.htm
State	OSP		Oregon State Police Coordinated Enforcement Program (CEP)	
State	Union SWCD		Grande Ronde River Basin Study	http://www.oregontrail.net/~uswcd/basin.htm
State	Union SWCD		Catherine Creek CRMP	http://www.oregontrail.net/~uswcd/ccrmp.htm#catherine
State	WDOE		Middle Snake Watershed Planning - WRIA 35	http://www.ecy.wa.gov/programs/wr/instream-flows/Images/pdfs/WorkPlan12-12-02.pdf
Tribe	NPT		Nez Perce Tribal Executive Committee Resolutions	http://www.nezperce.org/~code/
Tribe	NPT	2002	Precious Lands Wildlife Area Draft Management Plan	
Tribe	CTUIR	1995	CTUIR Columbia Basin Salmon Policy	www.umatilla.nsn.us/salmonpolicy.html

Table 70. Monitoring Plans and Programs

Agency Category	Lead Author(s)	Date	Title	Source/Website
?		?	Monitoring and Evaluation Plan for NEOH Imnaha and Grande Ronde Subbasin Spring Chinook Salmon.	
Fed	Federal Caucus	2003 - 09	Research, Monitoring & Evaluation Plan for the NOAA-Fisheries 2000 Federal Columbia River Power System Biological Opinion	http://www.salmonrecovery.gov/RME_Plan_09-2003.pdf
Fed	Federal Caucus	2004 - 01	A Joint ISAB and ISRP Review of the Draft Research, Monitoring & Evaluation Plan for the NOAA-Fisheries 2000 Federal Columbia River Power System Biological Opinion	http://www.salmonrecovery.gov/Implementation/ISABISRP_2004_1_RME_Plan_review.pdf
Fed	USFS	2001	2001 Monitoring & Evaluation Report (for Umatilla, Wallowa Whitman and Malheur Forests)	http://www.fs.fed.us/r6/uma/projects/monitor/
State	OWEB	2002 - 05	Monitoring Strategy for the Oregon Plan for Salmon and Watersheds	http://www.oweb.state.or.us/monitoring/
State	WDFW ODFW NHI CTUIR & others	2001	Inventory and Monitoring of Salmon Habitat in the Pacific Northwest - Directory and Synthesis of Protocols for Management/Research and Volunteers in Washington, Oregon, Idaho, Montana, and British Columbia	http://www.fishlib.org/Bibliographies/Protocols/exec_summ.html
Tribe	CRITFC	1996	A Monitoring Strategy For Application to Salmon-Bearing Watersheds - Technical Report 96-5	http://www.critfc.org/tech/96-5report.pdf

6.6 Appendix 6: Complete Grande Ronde Subbasin Project Inventory by Salmonid Population Units.

Due to its volume, the complete inventory of restoration and conservation projects in the Grande Ronde Subbasin is appended as a separate document/file in Portable Document Format (PDF) and included on digital copies of the Grande Ronde Subbasin Plan. For a summary of conservation and restoration activities in the subbasin, please see Section 4.4 (page **Error! Bookmark not defined.**).

6.7 Appendix 7: Species of Interest to the Tribes of the Grande Ronde Subbasin.

6.7.1 Species Recognized by Tribes – Submitted by the Nez Perce Tribe

The Nez Perce people are humbled by the legacy of the salmon and steelhead. For thousands of years salmon and steelhead and other fish have faithfully returned to the rivers to serve human beings as well as and other creatures, plants and animals. For native cultures in the Grande Ronde Subbasin, the continuation of human life depends on the return of these fish.

The Call For Help

The Creator wanted to know what animals of His creation would help the humans when they came to this land. The Creator said, "I want each one of you to come forward and be qualified to help these human beings. Because when they come, they will have a difficult time surviving without your help.

Salmon and Steelhead stepped forward and said, "We can help the human beings with our flesh." Salmon then said, "When we return to the rivers we will die. So the humans will have to catch us before that happens. And we will come up only during certain times of the year. That is when the humans need to fish for us." Steelhead said, "We will come in the wintertime. But we will give the humans something more than our flesh. We will give them something special. Glue will come from our skin. This glue can be used to make bows and spears. We will be in the river all winter long." So the Creator let Salmon and Steelhead become qualified to help the humans. Sockeye Salmon came forward and said, "We don't want to be big like Chinook and Coho Salmon. But our flesh will be red and tasty." Then Trout stepped up. He said, "We will look like Steelhead, but we will not go down to the ocean. We will stay in these waters. If the humans can find us they can have us for food." Then the Eel came out and said, "We don't want to look like Salmon, Steelhead or Trout. We want to be long. When we rest we will put our mouths on the rocks. But we will come every year. The humans can use our flesh for food too. This is how the fish became qualified to help the humans.

The Response

"Every fall the redfish (sockeye) were so plentiful up at Wallowa Lake that the fish would tickle the women's feet as they were trying to collect them." Rod Wheeler (Nez Perce Tribe)

"Our people used to gaff for salmon off the big rocks on the Imnaha River. There were times when we would catch a chinook that was so big that all you could do was lay on your belly on the rock and just hold on while the salmon tried to get away." Wilfred Scott (Nez Perce elder)

"A lady was fishing for redsides (steelhead) in the Wallowa River. She was standing in the river with a pitchfork. When a school of resides came by, she would scoop them up with the fork and toss them on the bank. In a little while so many resides swam up the river that they knocked her down." William Douglas (U.S. Supreme Court Justice)

"Our family used to make the trek from Cottonwood Creek down to Asotin Creek to collect eels. The men would get long poles with nets on them to catch eels and put them into a holding pool that the children had been instructed to build. At the end of the day, the kids had the job of gathering the eels from the pool and putting them into sacks to take back home or back to camp to eat." Vaughn Bybee (Nez Perce Tribe)

Salmon, steelhead and lamprey have served as a primary food source, trade item and cultural resource for thousands of years. The economy of the Nez Perce people has evolved around Northwest runs of these fish. Hunting and fishing rights guaranteed in treaties recognize the dependence on salmon and other fish. For example, the 1855 treaty with the Nez Perce in Article 3 states:

> The exclusive right of taking fish in all the streams where running through or bordering said reservation is further secured to said Indians; as also the right of taking fish at all usual and accustomed places in common with citizens of the Territory…

No subsequent treaty or agreement between the Nez Perce Tribe and the United States altered or affected this treaty-reserved right. These treaty-reserved fishing rights are the legal basis for the Tribe's involvement as co-managers and in salmon and steelhead restoration efforts in northeast Oregon and elsewhere.

In 1905, the *United States vs. Winans* case established what a "right" implied. The case involved a non-tribal member who attempted to prevent tribal members from fishing at a traditional site by buying and then claiming absolute title to the land (American Indian Resource Institute 1988). The Supreme Court ruled against this claim and established two important precedents. First, hunting and fishing rights are not rights granted by the government to tribal signatories, but rather they are rights reserved by the tribes in exchange for lands (American Indian Resource Institute 1988). Second, tribal members cannot be barred from accessing their usual and accustomed fishing sites since their reserved right is essentially an easement over private as well as public lands (Cohen, 1982).

Many Northwest tribes that historically relied on fishing also have language in their treaties that secures the right of taking fish "in common with citizens of the territory." This is an important concept for the Indian fishery off-reservation and in the Columbia River.

In 1974, a case tried in Washington Federal District Court established what was meant by the right of tribes to harvest fish "in common" with the citizens of the territory. Judge Boldt's decision relied heavily on understanding the situation under which the treaties were written. The court determined two distinct entities were involved during treaty making, Indian tribes and the United States, not just individual tribal members and individual citizens of the state (American Indian Resource Institute 1988). The separation of two political entities effectively denied the states' assertion that all citizens have the same rights with respect to harvesting fish.

The understanding that there are only two entities involved was then applied to actual allocation of harvestable fish. The court's interpretation was that harvest in common meant equal distribution between the two entities, or that each is allowed a 50/50 share (American Indian Resource Institute 1988). Judge Belloni applied the 50/50 principle to Columbia River fisheries in *U.S. v. Oregon* in 1975 (Nez Perce Tribe, et al. 1995). In their treaties ceding land to the United States, the Nez Perce Tribe had reserved the right to harvest fish in a manner that allows them to maintain a way of life. But although the rights to take fish and regulate the fishery resource have been clearly upheld in numerous courts, these rights are meaningless if there are no fish to be taken or resources to be managed (Nez Perce Tribe, et al. 1995).

The legal, historic, economic, social, cultural, and religious significance of the fish to the

Nez Perce Tribe continues today. The Nez Perce Tribe has a need to restore and sustain salmon and steelhead runs in the Grande Ronde Subbasin. The Nez Perce have always embraced the concept of stewardship. Tribal stewardship extends beyond humans to the whole of creation including the fisheries resources of the Grande Ronde Subbasin. The interdependence of the creation and the people is what traditional native thinkers call the connectedness of life. It is this concept that provides the motivation and basis for salmon and steelhead restoration. Thus, the Nez Perce Tribe has pursued avenues to protect and restore fish populations and habitats in the Grande Ronde Subbasin including participating in the subbasin planning process.

6.7.2 Species Recognized by Tribes – Submitted by the Confederated Tribes of the Umatilla Indian Reservation.

6.7.2.1 Pacific and western brook lamprey

It is documented that Pacific (*Lampetra tridentata*) lamprey were abundant in the Grande Ronde River Subbasin historically (Lane and Lane 1979, Swindell 1940). Until recently, each species received little attention from fish managers. Abundance and range are currently unknown for lamprey within the basin. Pacific lamprey are believed to be at or very near extinction.

Pacific lamprey historic and current distribution and abundance.

Pacific lamprey are distributed in North America from the Aleutian Islands south along the Pacific coast to Baja California, Mexico, and inland to the upper reaches of most rivers draining into the Pacific Ocean (Ruiz-Campos and Gonzalez-Guzman 1996). Historical distribution of *L. tridentata* in the Columbia and Snake Rivers was coincident wherever salmon occurred (Simpson and Wallace 1978). Access rather than distance from the ocean was suggested to be the important factor influencing regional distribution (Kan 1975).

The current distribution of Pacific lamprey in the Columbia River extends to Chief Joseph Dam and to Hells Canyon Dam in the Snake River. Both of these dams lack fishways and limit distribution of migrating fish. These describe the possible limits of distribution, but there has been no survey to examine the distribution throughout the Columbia River drainage. There are only sporadic reports of their presence because of the lack of survey data (Close et al. 1995). Both Lane and Lane (1979) and Swindell (1940) reported lamprey in the Grande Ronde Basin. Tribal members used to harvest lamprey at various locations in the basin.

Historical estimates of the Pacific lamprey population are not available. Oral interviews with tribal members indicate that the Grande Ronde River Subbasin once supported a fishery for Pacific lamprey. This area was utilized by the Nez Perce, Cayuse, Walla Walla, Palouse, and Sho-Ban Tribes (Lane and Lane 1979; Swindell 1941). Tribal members historically harvested eels, bull trout, whitefish, chinook and sockeye salmon, and steelhead. Tribal members spoke of catching and observing lamprey in Catherine Creek, Tony Vey Meadows, Lookingglass Creek, and the upper Grande Ronde River.

Wayne Huff, former ODFW screens operator, stated that Pacific lamprey disappeared in the 1970’s. He stated that the Wallowa and Imnaha rivers had thousands of Pacific lamprey prior to the 1970’s.

Bob Sayre, former ODFW biologist, stated that he viewed both adults and ammocoetes in Catherine Creek in the 1950’s. He stated that Pacific lamprey were abundant throughout the whole Grande Ronde system during the 1950’s and 1960’s.

Duane West, formerly with ODFW, stated that his crew electroshocked ammocoetes near La Grande in the mainstem Grande Ronde River in 1962.

Ken Witty, former ODFW district biologist, stated that there used to be large numbers of Pacific lamprey in the Imnaha and Wallowa systems. He stated that during his years as district biologist (from 1964 to 1990) he noticed lamprey populations were rapidly declining. Witty stated that fish agencies were too worried about declining salmon populations to worry about Pacific lamprey.

Melvin Farrow, CTUIR enrollee and former CTUIR Fisheries technician, stated that he observed ammocoetes at Tony Vey Meadows in the 1960's.

Armand Minthorn, CTUIR enrollee, spoke of fishing sites on Lookingglass Creek, Catherine Creek, Grande Ronde, Minam, and Wallowa rivers. These are areas that were also likely utilized by Pacific lamprey for spawning and rearing.

Keefe (ODFW, pers. comm.) stated that staff are operating rotary traps on the Wallowa River and upper Grande Ronde and have captured no lamprey. Lofy and McClean (CTUIR, pers. comm.) stated that no lamprey have been captured in Lookingglass Creek during trapping operations.

Tim Walters, ODFW biologist, stated that no lamprey were sampled or observed in any field activities in the Grande Ronde River subbasin for 1997.

In 1999, CTUIR staff conducted a presence/absence survey in the Grande Ronde River Basin. We sampled 18 Pacific lamprey larvae in 10 sites throughout the basin. Ammocoete sizes ranged from 70-150mm. It is important to recognize Pacific and western brook lampreys share many of the same life history characteristics and requirements, and it is very likely that restoration efforts will need to take place for recovery of Pacific lamprey in the basin. Further studies are needed in the Grande Ronde River Subbasin to completely understand the current abundance and distribution of Pacific lamprey.

Pacific lamprey life history. (as described in Close et al. 2002)

The present state of knowledge suggests that the life history of Pacific lamprey is very similar to sea lamprey (*Petromyzon marinus*). They spend the early part of their life burrowed in fine silt or sand filtering detritus and other particulate matter. After an extended time (4 to 6 years), larvae go through metamorphosis which includes major morphological and physiological changes preparing them for life at sea. The juveniles then move to the ocean to feed (1 to 3 years) before returning as adults for reproduction.

Pacific lamprey life cycle and ecological importance. (as described in Close et al. 2002)

Larval stage

Pacific lamprey exhibits a protracted freshwater juvenile residence in the stream benthos. Larvae, often referred to as ammocoetes, leave the nest approximately two or three weeks after hatching, drift downstream (usually at night), and settle in slow depositional areas such as pools and eddies (Pletcher 1963). The larvae then burrow into the soft sediments in the shallow areas along the stream banks (Richards 1980). The larval stage has been estimated to range from 4-6 years (Pletcher 1963; Kan 1975; Richards 1980) although it may extend up to 7 years (Hammond 1979; Beamish and Northcote 1989).

Larval Pacific lamprey can represent a large portion of the biomass in streams where they are abundant, thus making them an important component along with aquatic insects in processing nutrients, nutrient storage, and nutrient cycling (Kan 1975). Larval lampreys process nutrients by filter feeding on detritus, diatoms, and algae suspended above and within the substrate (Hammond 1979; Moore and Mallatt 1980). Larvae also possess high entrapment efficiency for food coupled with low food assimilation rates. For example, based on studies of other lamprey species (*L.*

planeri), larval Pacific lamprey may digest only 30-40% of the food taken in while passing large amounts of undigested food (Moore and Mallatt 1980).

*Downstream migrants

During metamorphosis, the larvae go through morphological and physiological changes to prepare for a parasitic lifestyle in salt water. Transformation of Pacific lamprey from the larval to young adult life stage generally occurs during July through November (Pletcher 1963; Hammond 1979; Richards and Beamish 1981).

Young adult lampreys begin their migration to the Pacific Ocean in the fall and continue through the spring. Time of entrance into salt water may differ among populations of Pacific lamprey due to environmental conditions (pers. comm., R.J. Beamish, Pacific Biological Station, Nanaimo, B.C., Canada). Kan (1975) suggested that coastal populations enter salt water in the late fall while inland populations enter in the spring. In the Nicola River of British Columbia, 99% of all metamorphosed lampreys migrated by April and May (Beamish and Levings 1991).

*Ocean life

The ocean life history stage of Pacific lamprey is not well understood, but the duration of ocean residency may vary. The parasitic-phase has been estimated to last for periods of up to 3.5 years for Pacific lamprey in the Strait of Georgia, British Columbia (Beamish 1980). Off the coast of Oregon, the duration of the ocean phase was estimated to range from 20 to 40 months (Kan 1975). Parasitic-phase Pacific lamprey have been collected at distances ranging from 10 to 100 km off the Pacific coast and at depths ranging from 100 to 800 m (Kan 1975; Beamish 1980).

The Pacific lamprey preys on a variety of fish species and marine mammals in the Pacific Ocean. Beamish (1980) reported five salmonid and nine other fish species that are known prey of Pacific lamprey (Table 1). Pacific lamprey has been reported to feed on finback (*Balaenoptera physalus*), humpback (*Megaptera nodosa*), sei (*Balaenoptera borealis*), and sperm (*Physeter catodon*) whales (Pike 1951). In addition, feeding occurs on a variety of midwater species such as Pacific hake (*Merluccius productus)* and walleye pollock *(Theragra chalcogramma)* in the open ocean (Beamish 1980).

Anadromous Pacific lamprey should not be viewed as a pest species like sea lamprey (*Petromyzon marinus*) of the Laurentian Great Lakes (e.g., Eschmeyer 1955; Moffett 1956; Coble *et al*. 1990). In the Great Lakes, an entire community of naive prey was exposed to an exotic predator. Most lampreys around the world live in equilibrium with their hosts (Renaud 1997). Pacific lamprey have co-adapted with their prey, which includes Pacific salmon. Beamish (1980) could find no evidence that increased lamprey production in the Skeena River would lead to predation problems on its sockeye salmon. The effect of intense commercial harvests of Pacific hake, walleye pollock, and ground fishes on the food chain dynamics of the north Pacific Ocean ecosystem and on Pacific lamprey is not well understood, but likely substantial.

Returning adult Pacific lamprey are an important part of the food web for many species of freshwater fishes, birds, and mammals. Spawned out carcasses of lampreys are important dietary items for white sturgeon (*Ascipenser transmontanus*) in the Columbia and Fraser Rivers (Semakula and Larkin 1968; Galbreath 1979). Wolf and Jones (1989) reported the great blue heron (*Ardea herodias*) as a predator of spawning adult Pacific lamprey. Mink (*Mustela vison*) are also noted by Beamish (1980) as a predator of adult lampreys. In addition, fishermen have utilized adult Pacific lamprey as bait for sturgeon in the Columbia River Basin.

*Spawning migration

Beamish (1980) suggested that returning adult lampreys enter fresh water between April and June and complete migration into streams by September. Pacific lamprey overwinter in fresh water and spawn the following spring (Beamish 1980). Pacific lamprey does not feed during the spawning migration. They utilize stored carbohydrates, lipids, and proteins for energy (Read 1968). Beamish (1980) observed a 20% shrinkage in body size from the time of freshwater entry to spawning. Pacific lamprey along the coast of Oregon usually begins to spawn in May when water temperatures reach 10°C to 15°C and continue to spawn through July. In the Babine River system in British Columbia, Pacific lamprey was observed spawning from June through the end of July (Farlinger and Beamish 1984).

Pacific lamprey has very high fecundity compared to North American Pacific salmon species. Fecundity for Pacific lamprey in Oregon streams ranged from 98,000 to 238,400 eggs per female (Kan 1975), while fecundities for five North American Pacific salmon species ranged from 1,200 to 17,000 eggs per female (Burgner 1991; Heard 1991; Salo 1991; Healey 1991; Sandercock 1991). Relative fecundity in Pacific lamprey was significantly lower in an interior Columbia River tributary compared to Oregon coastal streams. Relative fecundity was 522.15 and 503.44 eggs/g body wt. in lamprey from the Umpqua and Molalla Rivers, and 417.94 eggs/g body wt. in the John Day River (Kan 1975). Kan (1975) suggested that the lower relative fecundity in the John Day lampreys was due to a higher cost of migration.

Pacific lamprey spawning success and production of larvae are not well understood. However, sea lamprey in the Great Lakes was estimated to only deposit 14% of their eggs in nests. The survival of sea lamprey eggs deposited in the nests was estimated to be up to 90% (Manion and Hanson 1980). During Pacific lamprey spawning, eggs were observed to overflow the nests and were actively eaten by rainbow trout (*O. mykiss*) and speckled dace (*Rhinichthys osculus*) in the Umatilla River, Oregon (pers. comm. J. Bronson, Confederated Tribes of the Umatilla Indian Reservation, Tribal Fisheries Program). After spawning, Pacific lamprey die within 3 to 36 days (Mattson 1949; Pletcher 1963; Kan 1975). Adult carcasses are likely a major contributor of nutrients in oligotrophic streams (Wilpfli et al. 1998; Fisher Wold and Hershey 1999).

Prey and Predation

Larval Pacific lamprey constitutes a food source for other animals. There are two primary periods when larvae are subjected to predation: during emergence from nests and during scouring events that dislodge the larvae from their burrows. Pfeiffer and Pletcher (1964) found coho salmon (*Oncorhynchus kisutch*) fry ate emergent larval lampreys. In addition, larvae are commonly used for bait to catch the exotic smallmouth bass (*Micropterus dolomieui*) in the lower reaches of the John Day River, Oregon (pers. comm. J. Bronson, Confederated Tribes of the Umatilla Indian Reservation, Tribal Fisheries Program).

Young adult lampreys migrating downstream may have buffered salmonid juveniles from predation by fishes and birds. Pacific lamprey are found in the diets of northern pikeminnow (*Ptychocheilus oregonensis)* and channel catfish (*Ictalurus punctatus)* in the mainstem Snake River (Poe et al. 1991). Further, Merrell (1959) found that lampreys comprised 71% by volume of the diets in California gulls (*Larus californicus*), ringbill gulls (*Larus delawarensis*), western gulls (*Larus occidentalis*), and Fosters tern (*Sterna forsteri*) in the mainstem Columbia River during early May. This is interesting, in light of the controversy concerning waterbird predation on salmon smolts in the Columbia River estuary (Collis et al. 2001).

Adult lampreys may have been an important buffer for upstream migrating adult salmon from predation by marine mammals. From the perspective of a predatory sea mammal, lampreys have at least three virtues: (1) they are easier to capture than adult salmon; (2) they have higher caloric value per unit weight than salmonids; and (3) their migration in schools means fertile feeding patches. Pacific lamprey is extraordinarily rich in fats, much richer than salmon. Caloric values for lamprey range from 5.92 to 6.34 kcal/g wet weight (Whyte et al. 1993); whereas salmon average 1.26 to 2.87 kcal/g wet weight (Stewart et al. 1983). In fact, the work of Roffe and Mate (1984) revealed that the most abundant dietary item in seals and sea lions was Pacific lamprey. As a result, marine mammal predation on salmonids may now be much more severe because lamprey populations have declined.

Pacific lamprey cultural significance to tribes. (as described in Close et al 1995)

The cultural significance of the Pacific lamprey in the Columbia and Snake River Basins is directly related to the Northwest tribes. Tribal peoples of the Pacific Coast and interior Columbia Basin have harvested these fish for subsistence, ceremonial, and medicinal purposes since time immemorial. The tribes use the common name "eel" when in reference to Pacific lamprey in the Basins. The fish are often harvested at locations were the geology favors capture such as falls or barriers. Two well known places where tribal members historically harvested Pacific lamprey (eels), were at Kasuth near the mouth of the Snake River and at Wallula near the mouth of the Walla Walla River. Eeling is usually done at night when the fish are most active. Active capture methods are used such as a hook on a pole or dip nets. The fish are then prepared traditionally by drying or roasting. Lamprey are part of the Columbia River tribal culture and are important in ceremonies and celebrations the same as many other foods. Eels are also used medicinally for their oils, and is often used as hair grease. There are many legends that are associated with the eels, such as the eel and the sucker:

> *I have heard it said that long ago before the people, the animals were preparing themselves for us. The animals could talk to each other during this time. The eel and the sucker liked to gamble so they began to gamble. The wager was their bones. The eel began to lose but he new he could win. The eel kept betting until he lost everything. That is why the eel has no bones and the sucker has many bones.*

Western brook lamprey life history. (Scott and Crossman 1973; Wydoski and Whitney 2003)

Western brook lamprey spawning occurs April-July, depending on stream temperature. 12 lampreys have been observed on a single nest, and other spawning groups are known to superimpose on nests. Eggs likely hatch in 10 days in $10^{o}C$-$15^{o}C$ water in Oregon, and ammocoetes typically have left nests within 30 days post hatch and burrow into depositional areas to rear. Ammocoetes are filter feeders that feed upon desmids, diatoms, algae and detritus. Pletcher (1963) suggested that western brook lampreys live up to 6 years in British Columbia. Larger ammocoetes metamorphose from August to November and adult size varies (130-200mm). Mature adults do not feed, their only function is to reproduce. Many life history characteristics and requirement are shared by both the western brook and Pacific lampreys.

Western brook lamprey historic and current distribution and abundance.

Western brook lampreys are distributed in coastal streams of western North America from California to British Columbia. In Washington, this lamprey is found in coastal and Puget Sound streams and as far inland as the upper reaches of the Yakima River (Wydoski and Whitney 2003).

Currently, there is no information available to suggest that there is still population of western brook lamprey in the Grande Ronde River Subbasin. In 1999, a presence/absence survey conducted by CTUIR in the Grande River Subbasin did not result in capture of any western brook lampreys.

Western brook lamprey ecological importance.

Little is currently known on the ecological importance of western brook lampreys. It has been observed that various sculpin and salmonids prey upon eggs at the time of spawning, and it can be assumed that many of the same reasons the Pacific lamprey is ecologically important, applies for the western brook lamprey due to the fact that the two species share many of the same life history characteristics.

Western brook lamprey cultural importance.

Oral history interviews suggest that the western brook lamprey was an important part of tribal culture. CTUIR tribal members referred to the western brook lamprey as the short eel, and it was said that Jasper Shippentower used to collect this species in Meacham Creek of the Umatilla River Subbasin, Oregon (Jackson et al 1997). As mentioned above, tribal members used to harvest lampreys in the Grande Ronde drainage (Lane and Lane 1979, Swindell 1940). Lamprey are an integral part of Columbia and Snake River tribal cultures and other tribes along the Pacific coast (Anglin et al. 1979; Mattson 1949; Pletcher 1963).

6.7.2.2 Freshwater Mussels

Freshwater mussels (Mollusca: Unionoida) are vital components of intact salmonid ecosystems and are culturally important to Native Americans. However, in part because freshwater mussels are sensitive to a myriad of pollutants and ecosystem alterations, these animals are now one of the most endangered faunal groups in North America.

Although the greatest diversity of freshwater mollusks occurs in the southeastern United States, the western states contain at least six endemic mussel species, and many endemic snail species. Historically, at least seven mussel species occurred in Oregon and Washington: the western pearlshell, Margaritifera falcata (Gould, 1850); western ridged mussel, Gonidea angulata (I. Lea, 1838); Yukon floater, Anodonta beringiana Middendorff, 1851; California floater, Anodonta californiensis I. Lea, 1852; western floater, Anodonta kennerlyi I. Lea, 1860; winged floater, Anodonta nuttalliana I. Lea, 1838; and Oregon floater, Anodonta oregonensis I. Lea, 1838 (USFS Mollusk Database 2004, Williams et al. 1993, Frest and Johannes 1995).

In the Grande Ronde Subbasin, little is known about the historical or current occurrence and abundance of freshwater mussels, although mussels historically and currently occur in surrounding drainages. In addition, we know of no historical or recent systematic surveys for freshwater mussels in the Grande Ronde River Subbasin.

Freshwater Mussel Life History

Freshwater mussels are unique among bivalves in that they require a host fish to complete their life cycle. Unlike male and female marine bivalves, which release sperm and eggs into the water column where fertilization takes place, fertilization of freshwater mussels takes place within the brood chambers of the female mussel. The female mussel carries the fertilized eggs in the gills until they develop into a parasitic stage called glochidia. Female mussels then release the glochidia into the water column where they must come into contact with a suitable host fish species. Once the glochidia are released they will survive for only a few days if they do not successfully attach to a host fish (O’Brien and Brim Box 1999, O’Brien and Williams 2002). Glochidia may attach to a non-host fish, but the glochidium will fail to encyst and will eventually be sloughed off. After successfully attaching to the host fish, glochidia metamorphose and drop to the substrate to become free-living juveniles (Jones 1950, Howard 1951). The time required for glochidial metamorphosis varies with water temperature and among mussel species.

The mussel/fish relationship is usually species-specific (Lefevre and Curtis 1912); only certain species of fish can serve as suitable hosts for a particular mussel species. The number of host fish utilized by a mussel species varies. Some mussel species have a very restricted number of host fish species (Watters 1994, Michaelson and Neves 1995) while other mussels parasitize a wide range of fish species (Watters 1994, Haag and Warren 1997). To increase their chances of coming into contact with a suitable host fish, some mussel species lure potential host fish by extending brightly colored portions of their mantles that mimic minnows, insects, or other prey (Coker et al. 1921, Kraemer 1970). In addition, some mussels release glochidia into the water column when light sensitive spots are stimulated by the shadow of a passing fish (Kraemer 1970, Jansen 1990). Other mussel species have evolved elaborate lures resembling fish food as mechanisms to attract specific host fishes (Haag et al. 1995, Hartfield and Butler 1997, O'Brien and Brim Box 1999). Knowledge of the reproductive biology of many mussels is incomplete (Jansen 1990), and the host fishes are known for only about a quarter of the mussel species in North America (Watters 1994).

The duration of the parasitic stage varies from about a week to several months (Fuller 1974, Oesch 1984, Williams et al. 1992), depending on mussel species and as a function of water temperature (higher temperatures causing shorter durations) (O'Brien and Brim Box 1999). After metamorphosis, juvenile mussels drop off from their host fish, and must fall to substrate suitable for their adult life requirements or they will not survive. Suitable substrates include those that are firm but yielding and stable (Fuller 1974). In general, shifting sands and suspended fine mud, clays and silt are considered harmful to both juvenile and mature mussels (Fuller 1974, Williams et al. 1992, Brim Box and Mossa 1999, Brim Box et al. 2002).

Mussels orient themselves on the bottom of a stream with their anterior ends buried in the substrate, usually with the two valves slightly open, which allows the intake of water through an incurrent siphon (and food and oxygen) while allowing waste materials to leave the body through an excurrent siphon (Oesch 1984). Food items include organic detritus, algae and diatoms (Coker et al. 1921, Matteson 1955, Fuller 1974). Increases in fine sediment, whether deposited or suspended, may impact mussels by interfering with feeding and/or respiration (Fuller 1974, Brim Box and Mossa 1999).

Although considered fairly sedentary, adult mussels may move in response to abnormal or transient ecological events. For example, water level fluctuations may cause some mussel species to seek deeper water (Coker et al. 1921, Oesch 1984). Often in late summer, mussel trails are visible as the water recedes. However, mussels colonize upstream areas mainly through the use of the parasitic glochidial life stage. Without this stage, freshwater mussel populations would, over generations, slowly shift downstream.

Freshwater Mussel Ecological Importance

The richest mollusk fauna in the world is found in North America north of Mexico, and is represented by about 600 species of gastropods and 340 species of bivalves. Freshwater mussels are also considered the most endangered faunal group in North America, with over 70% of species either imperiled or extinct (Neves et al. 1997). Extinction rates for freshwater mussels are an order of magnitude higher than expected background levels (Nott et al. 1995), and mussels are imperiled disproportionately relative to terrestrial species (e.g., birds and mammals) (Williams et al. 1993). Given that freshwater mussels are an endangered global resource, they are assigned tremendous ecological importance by many freshwater biologists (Corn 1994).

Freshwater mussels are ecologically important because they are primary consumers, detritivores and act as nutrient sinks (McMahon and Bogan 2001). In addition, freshwater mussels filter and clarify large amounts of waters and therefore contribute to maintaining water clarity (McMahon and Bogan 2001). Freshwater mussels can also be important food items for fish, mink, otters and raccoon (Dillon, Jr. 2000).

Freshwater Mussel Historic Distribution and Abundance

Historical Data Collection

Ninety-seven records of historical mussel occurrences in Oregon were obtained, dating back to 1838, from the US Forest Service Freshwater Mollusk Database. Of these records, only two do not list a specific drainage. Accounts from the Columbia River drainage comprise about a third of these records. These records from the Columbia Basin include five of the eight species known to currently occur in the western United States: Anodonta beringiana, Anodonta nuttalliana, Anodonta oregonensis, Gonidea angulata and Margaritifera falcata. No records, however, were found from the Grande Ronde River Subbasin, although numerous records were found from other Columbia River tributaries.

Museum Collections

A total of 81 historical records of freshwater mussels from the western United States (i.e., shell material reposited in museum collections) were found at the United States National Museum (Smithsonian Institution) and California Academy of Sciences. Over half of these records of freshwater mussels were from the Columbia River drainage. However, none was from the Grande Ronde River Subbasin.

Freshwater Mussel Current Distribution and Abundance

Little is know about the current distribution and abundance of freshwater mussels in the Grande Ronde River Subbasin, mainly because systematic surveys for mussels have not been conducted in the basin. However, freshwater mussels were found recently in other drainages near the Grande Ronde (e.g., Umatilla, Walla Walla, John Day). A systematic survey of the entire subbasin for freshwater mussels is needed in order to determine the current distribution of all three genera of western freshwater mussels in the Grande Ronde River Subbasin.

Freshwater Mussel Cultural Significance to Tribes

Historically freshwater mussels were an important food for tribal peoples of the Columbia River Basin. Native Americans in the interior Columbia River Basin harvested freshwater mussels for at least 10,000 years (Lyman 1984). Ethnographic surveys of Columbia Basin tribes reported that Native Americans collected mussels in late summer and in late winter through early spring during salmon fishing (Spinden 1908, Ray 1933, Post 1938). A few tribal elders from the Columbia and Snake River basins recalled that mussels were collected whenever conditions of the rivers were favorable (Hunn 1990, Chatters 1995). Tribal harvesters collected mussels by hand. When wading was not possible they used forked sticks (Post 1938). They prepared mussels for consumption by baking, broiling, steaming, and drying (Spinden 1908, Post 1938). The Umatilla Tribe preferred to boil freshwater mussels for consumption (Ray 1942).

Native American use of freshwater mussels decreased during the last 200 years, probably due to declines in native populations and assimilation following Euro-American settlement (Chatters 1987). A Umatilla tribal elder, however, remembered his parents trading fish for dried mussels as late as the 1930s (Eli Quaempts, per. com., 1996, CTUIR tribal member). In addition, shell middens found at village sites near the mouth of the Umatilla River, as well as the presence of mussels at burial sites in the same area, suggest that historically freshwater mussels were important to the indigenous peoples of the mid-Columbia River Plateau for multiple reasons.

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6.8 Appendix 8: EDT LIFE HISTORY SUMMARY, GEOGRAPHIC AREAS AND REACHES WITHIN EACH POPULATION & POPULATION CHARACTERISTICS SUMMARIES.

Spring Chinook Populations

Table 71. Wenaha Spring Chinook geographic areas and reaches

37 reaches, 5 geographic areas

Section	Geographic Area	Included Streams
Main GR	Lower GR 1	Grande Ronde 1-12 (mouth of Wenaha)
Wenaha	Lower Wenaha	Wenaha 1
	Upper Wenaha R	Wenaha 2,3, 4, 5, 6
	Wenaha Tribs	Weller Creek, Butte Creek, Rock Creek (Wenaha), Slick Ear Cr, Beaver Creek (Wenaha)
	Wenaha Forks	Wenaha NF, SF, Jaussaud Cr, Milk Cr (Wenaha)

Table 72. Minam Spring Chinook geographic areas and reaches

54 reaches, 7 geographic areas

Section		Geographic Area	Included Streams
Main GR	1	Lower Grande Ronde 1	Grande Ronde 1-12 (mouth of Wenaha)
Main GR	2	Lower Grande Ronde 2	Grande Ronde 13-25 (mouth of Wallowa)
Wallowa	3	Lower Wallowa River	Wallowa 1,2,3
Minam	4	Lower Minam River	Minam 1,2,3 Squaw Cr(Minam), Gunderson Cr
	5	Mid Minam River	Minam 4,5,6,
	6	Little Minam	Little Minam, Goulder Cr, Dobbin Cr
	7	Upper Minam River	Minam 7,8,9, Minam – N, Elk Cr

Table 73. Wallowa-Lostine geographic areas and reaches

108 reaches, 12 geographic areas

Section		Geographic Area	Included Streams
Main GR	1	Lower Grande Ronde 1	Grande Ronde 1-12 (mouth of Wenaha)
Main GR	2	Lower Grande Ronde 2	Grande Ronde 13-25 (mouth of Wallowa)
Wallowa	3	Lower Wallowa River	Wallowa 1,2,3
	4	Mid Wallowa River	Wallowa 4-10 (mouth of Lostine)
	5	Lower Bear Creek (Wallowa)	Bear Cr (Wallowa) 1,2
	6	Upper Bear Creek (Wallowa)	Bear 3, 4,5, Little Bear, Doc CR, Goat Cr
	7	Lower Lostine	Lostine 1-6
	8	Upper Lostine	Lostine 7,8, Lake Creek
	9	Spring Creek (Wallowa)	Spring Cr (Wallowa)
	10	Upper Wallowa River	Wallowa 11 – 19 (Wallowa Lake)
	11	Hurricane Creek	Hurricane Cr 1-6
	12	Prairie Creek	Prairie Cr, Hayes Frok, OK Gulch Fork

Table 74. Lookingglass Spring Chinook geographic areas and reaches

53 reaches, 6 geographic areas

Section		Geographic Area	Included Streams
Main GR	1	Lower Grande Ronde 1	Grande Ronde 1-12 (mouth of Wenaha)
Main GR	2	Lower Grande Ronde 2	Grande Ronde 13-25 (mouth of Wallowa)
Mid-Main GR	3	Middle Grande Ronde 1	Grande Ronde 26 – 27 (mouth of Lookingglass)
Lookingglass	4	Lower Lookingglass	Lookingglass 1-4, Jarboe
	5	Little Lookingglass	Little Lookingglass, Mottet, Buzzard Cr
	6	Upper Lookingglass	Lookingglass 5-7, Eagle Cr, Summer Cr

Table 75. Catherine Creek Spring Chinook geographic areas and reaches

73 reaches, 10 geographic areas

Section		Geographic Area	Included Streams
Main GR	1	Lower Grande Ronde 1	Grande Ronde 1-12 (mouth of Wenaha)
Main GR	2	Lower Grande Ronde 2	Grande Ronde 13-25 (mouth of Wallowa)
Mid-Main GR	3	Middle Grande Ronde 1	Grande Ronde 26 – 27 (mouth of Lookingglass)
Mid-Main GR	4	Middle Grande Ronde 2	Grande Ronde 28 – 34B (mouth of Catherine Creek)
Indian Creek	5	IndianLow	Indian 1,2, Shaw Cr, Little Indian Cr
Catherine Creek	6	Lower Catherine	Catherine 1
	7	Middle Catherine	Catherine 2-9
	8	Middle Catherine Tribs	Pyles Canyon Ladd Cr, Little Catherine Cr, Milk Cr, Scout Cr
	9	SF Catherine Creek	Catherine SF, , Collins Cr, Sand Pass Cr
	10	NF Catherine Creek	Catherine NF& MF, Buck Cr (Catherine)

Table 76. Upper Grande Ronde geographic areas and reaches

118 reaches, 17 geographic areas

Section		Geographic Area	Included Streams
Main GR	1	Lower Grande Ronde 1	Grande Ronde 1-12 (mouth of Wenaha)
Main GR	2	Lower Grande Ronde 2	Grande Ronde 13-25 (mouth of Wallowa)
Mid-Main GR	3	Middle Grande Ronde 1	Grande Ronde 26 – 27 (mouth of Lookingglass)
Mid-Main GR	4	Middle Grande Ronde 2	Grande Ronde 28 – 34B (mouth of Catherine Creek)
Main GR	5	Middle Grande Ronde 3	GR-35A, 35B & 36 (Grande Ronde Valley)
Main GR	6	Middle Grande Ronde 4	GR-37 – 44 (mouth of meadow Creek)
	7	Mid Grande Ronde Tribs 4	Whiskey, Little Whiskey, Spring Cr, Jordan Cr, Bear Cr (4^{th} GR), Beaver Cr, Hodoo Cr, Warm Springs Cr
	8	Lower Meadow Creek	Meadow Cr (2^{nd} GR) 1,2, 3, Marley Cr
	9	McCoy Creek	Dark Canyon, McCoy Cr, McIntyre Cr, Syrup Cr
	10	Upper Meadow Creek	Meadow Cr (2^{nd} GR) 4-9, Burnt Corral Cr, Sullivan Gulch, Battle Cr, Bear Cr (Meadow), Peet Cr, Waucup Cr
	11	Upper Grande Ronde 1	GR 45-48 (mouth of Limber Jim)
	12	Fly Creek	Fly Cr, Little Fly, Lookout Cr, Squaw Cr (Fly), Umapine Cr
	13	Sheep Creek (GR)	Sheep Creek (2^{nd} GR), Dry Cr, Chicken Cr, Indiana Cr
	14	Limber Jim	Limber Jim Cr, Marion Cr
	15	Upper GR 2	GR 49-51
	16	Clear Creek	Clear 1,2,3, Little Clear, tribs
	17	Upper Grande Ronde 3	GR 52, 53, EF, Tanner Gulch

Summer Steelhead Populations

Table 77. Lower Grande Ronde Steelhead geographic areas and reaches

119 reaches, 14 geographic areas

Section		Geographic Area	Included Streams
Main GR	1	Lower GR 1	Grande Ronde 1-12 (mouth of Wenaha)
Main GR	2	Lower GR tribs 1	Shumaker Creek, Deer Creek (GR), Buford Creek & Applegate Canyon, Rattlesnake Creek, Cottonwood Creek (GR), Bear Creek (1st GR)
	3	Lower Wenaha	Wenaha 1
Wenaha	4	Crooked (Wenaha)	Crooked Creek
	5	Upper Wenaha R	Wenaha 2,3, 4, 5, 6
	6	Wenaha Tribs	Weller Creek, Butte Creek, Rock Creek (Wenaha), Slick Ear Cr, Beaver Creek (Wenaha)
	7	Wenaha Forks	Wenaha NF, SF, Jaussaud Cr, Milk Cr (Wenaha)
Main GR	8	2**GRLowMain2**	**Grande Ronde 13-25 (mouth of Wallowa)**
	9	Courtney Creek	Courtney Cr, Little Courtney, Bobcat, Shamrock Cr
	10	Lower Mud	Mud 1, 2, Buck CR, Burnt Cr
	11	Upper Mud	Mud 3 – 7, McAlister, Sled, Evans, Tepee, McCubbin
	12	Wildcat	Wildcat Cr, Wallupa, Bishop Cr.
	13	Lower GR Tribs 2	Ward Canyon, Sickfoot Cr, Elbow, Bear Cr (3rd GR), Alder Cr (GR), Meadow Cr (1st GR), Clear Cr (1st GR), Sheep Cr (1st GR)
	14	Grossman	Grossman Cr, Deep Cr

Table 78. Joseph Creek Steelhead geographic areas and reaches

63 reaches, 9 geographic areas

Section	Geographic Area	Included Streams
Main GR	GR-1	
Joseph Creek	Lower Joseph	Joseph 1, 2, 3
	Cottonwood Creek	Cottonwood Creek, Horse Creek, Broady Creek
	Joseph Tribs	Peavine Creek, Cougar Creek, Sumac Creek
	Upper Joseph Cr	Joseph 4, 5, 6
	Swamp Creek	Swamp Creek, Davis Creek
	Crow Creek	Crow Creek, Elk Creek
	Lower Chesnimus Cr	Chesnimus 1,2,3, 4, Gooseberry Creek, Butte Creek, Pine Cr, Alder Cr (Chesnimnus), Salmon Cr, Dry Salmon
	Upper Chesnimus Creek	Chesnimus 5 – 9, NF & SF, Peavine Creek (Chesnimus), McCarty Gulch, Telephone Gulch, Doe Cr, Billy Creek, Devils Run Creek, Poison Creek, Summit Creek, TNT Gulch, Vance Draw

Table 79. Wallowa Steelhead geographic areas and reaches

143 reaches, 26 geographic areas

Section		Geographic Area	Included Streams
Main GR	1	Lower Grande Ronde 1	Grande Ronde 1-12 (mouth of Wenaha)
Main GR	2	Lower Grande Ronde 2	Grande Ronde 13-25 (mouth of Wallowa)
Wallowa	3	Lower Wallowa River	Wallowa 1,2,3
	4	Lower Wallowa Tribs	Howard Cr, Fisher Cr
Minam	5	Lower Minam River	Minam 1,2,3
	6	Lower Minam Tribs	Squaw Cr(Minam), Gunderson Cr
Minam	7	Mid Minam River	Minam 4,5,6,
	8	Mid Minam Tribs	Cougar Creek, Trout (Minam), Murphy Cr
Minam	9	Little Minam	Little Minam, Goulder Cr, Dobbin Cr
Minam	10	Upper Minam River	Minam 7,8,9, Minam – N, Elk Cr
	11	Mid Wallowa River	Wallowa 4-10 (mouth of Lostine)
	12	Deer Creek (Wallowa)	Deer CR (Wallowa), Sage Cr.
	13	Mid Wallowa Tribs	Fountian Conyon, Water Canyon, Parsnip
	14	Rock Creek (Wallowa)	Rock CR (Wallowa), Dry Cr (Wallowa), Reagin Gulch
	15	Lower Bear Creek (Wallowa)	Bear Cr (Wallowa) 1,2
	16	Upper Bear Creek (Wallowa)	Bear 3, 4,5, Little Bear, Doc CR, Goat Cr
	17	Whiskey Cr (Wallowa)	Whiskey CR, Straight Whiskey Cr
	18	Lower Lostine	
	19	Upper Lostine	
	20	Spring Creek (Wallowa)	Spring Cr (Wallowa)
	21	Upper Wallowa Tribs	Trout Cr (Wallowa), Little Hurricane Cr
	22	Upper Wallowa River	Wallowa 11 – 19 (Wallowa Lake)
	23	Hurricane Creek	Hurricane Cr 1-6
	24	Prairie Creek	Prairie Cr, Hayes Frok, OK Gulch Fork
	25	Wallowa Lake	Wallowa 20, 21
	26	Above Wallowa Lake	Wallowa 22 – above Wallowa Lake

Table 80. **Upper Grande Ronde Steelhead geographic areas and reaches**

167 reaches, 38 geographic areas

Section		Geographic Area	Included Streams
Main GR	1	Lower Grande Ronde 1	Grande Ronde 1-12 (mouth of Wenaha)
Main GR	2	Lower Grande Ronde 2	Grande Ronde 13-25 (mouth of Wallowa)
Mid-Main GR	3	Middle Grande Ronde 1	Grande Ronde 26 – 27 (mouth of Lookingglass)
	4	Middle Grande Ronde Tribs 1	Duncan Canyon, Rysdam Canyon,
Lookingglass	5	Lower Lookingglass	Lookingglass 1-4, Jarboe
	6	Little Lookingglass	Little Lookingglass, Mottet, Buzzard Cr
	7	Upper Lookingglass	Lookingglass 5-7, Eagle Cr, Summer Cr
	8	Middle Grande ronde Tribs 2	Cabin Cr, Gordon CR, Medicine Cr
Mid-Main GR	9	Middle Grande Ronde 2	Grande Ronde 28 – 33 (beginning of GR Valley)
Phillips Creek	10	Phillips Creek	Phillips, Little Phillips, Bailey, Pedro, Clark
Indian Creek	11	IndianLow	Indian 1,2, Shaw Cr, Little Indian Cr
	12	IndianUp	Indian 3- 6, Camp Cr, Indian EF
Willow Creek	13	WillowLow	Willow 1,2,3,4, Mill Cr, End Cr, Coon Cr
	14	WillowUp	Willow 5, Dry Cr (willow), Finley CR, Smith Cr, Fir Cr, Lewis Branch
Catherine Crk	15	Lower Catherine	Catherine 1
	16	Lower Catherine Tribs	Mill Cr, Little Cr,
	17	Middle Catherine	Catherine 2-9
	18	Middle Catherine Tribs	Pyles Canyon Ladd Cr, Little Catherine Cr, Milk Cr, Scout Cr
	19	SF Catherine Creek	Catherine SF, , Collins Cr, Sand Pass Cr
	20	NF Catherine Creek	Catherine NF& MF, Buck Cr (Catherine)
Main GR	21	Middle Grande Ronde 3	GR-34 A (mouth of Catherine Creek), to 36 (Grande Ronde Valley)
Main GR	22	Middle Grande Ronde 4	GR-37 – 44 (mouth of meadow Creek)
	23	Lower 5 points	Five Points Cr1, Pelican Cr, Dry Cr (Five Points), California Gulch
	24	Upper 5 Points	Five Points 2, 3, Fiddlers Hell, Mt Emily
	25	Rock Creek (GR)	Rock Cr, Sheep Cr (GR Rock), Little Rock Cr
	26	Mid Grande Ronde Tribs 4	Whiskey, Little Whiskey, Spring Cr, Jordan Cr, Bear Cr (4th GR), Beaver Cr, Hodoo Cr, Warm Springs Cr
	27	Lower Meadow Creek	Meadow Cr (2nd GR) 1,2, 3, Marley Cr
	28	McCoy Creek	Dark Canyon, McCoy Cr, McIntyre Cr, Syrup Cr
	29	Upper Meadow Creek	Meadow Cr (2nd GR) 4-9, Burnt Corral Cr, Sullivan Gulch, Battle Cr, Bear Cr (Meadow), Peet Cr, Waucup Cr
	30	Upper Grande Ronde 1	GR 45-48 (mouth of Limber Jim)
	31	Fly Creek	Fly Cr, Little Fly, Lookout Cr, Squaw Cr (Fly), Umapine Cr
	32	Sheep Creek (GR)	Sheep Creek (2nd GR), Dry Cr, Chicken Cr, Indiana Cr
	33	Limber Jim	Limber Jim Cr, Marion Cr
	34	Meadowbrook	Meadowbrook Cr
	35	Upper GR 2	GR 49-51
	36	Clear Creek	Clear 1,2,3, Little Clear Cr
	37	Upper Grand Ronde Tribs 1	Warm Springs Cr
	38	Upper Grande Ronde 3	GR 52, 53, EF, Tanner Gulch

Spring Chinook Population Characteristics used in EDT Model

Table 81. UGR Spring Chinook Population Characteristics used in EDT Model

Species	Population	Juvenile Life History			Ocean Age at return					First Week Spawning	Last Week Spawning
		Life History Pattern	%		0	1	2	3	4		
Spring Chinook	Upper Grande Ronde Spring Chinook	Stream Type - Resident	80	Proportion		0.126	0.689	0.185		8/20-26	9/10-16
		Stream Type - Migrant	20	Males		1.000					
				Females			0.699	0.674			
				Eggs/Fem			4050	5150			

Table 82. Wallowa-Lostine Spring Chinook Population Characteristics used in EDT Model

Species	Population	Juvenile Life History			Ocean Age at return					First Week of Spawning	Last Week of Spawning
		Life History Pattern	%		0	1	2	3	4		
Spring Chinook	Wallowa-Lostine Spring Chinook	Stream Type -Resident	30	Proportion		0.125	0.570	0.304		8/20-26	9/17-23
		Stream Type - Migrant	70	Males		1					
				Females			0.705	0.688			
				Eggs/Fem			4900	5520			

Table 83. Wenaha Spring Chinook Population Characteristics used in EDT Model

Species	Population	Juvenile Life History			Ocean Age at return					First Week of Spawning	Last Week of Spawning
		Life History Pattern	%		0	1	2	3	4		
Spring Chinook	Wenaha Spring Chinook	Stream Type – resident	70	Proportion		0.113	0.734	0.152		8/20-26	9/17-23
		Stream Type – Migrant	30	Males		1.000					
				Females			0.592	0.525			
				Eggs/Fem			4050	5150			

Table 84. Minam Spring Chinook Population Characteristics used in EDT Model

Species	Population	Juvenile Life History			Ocean Age at return					First Week of Spawning	Last Week of Spawning
		Life History Pattern	%		0	1	2	3	4		
Spring Chinook	Minam Spring Chinook	Stream Type -resident	45	Proportion		0.104	0.706	0.191		8/13-19	9/17-23
		Stream Type - migrant	55	Males		1.000					
				Females			0.590	0.644			
				Eggs/Fem			4900	5520			

Table 85. Catherine Creek Spring Chinook Population Characteristics used in EDT Model

Species	Population	Juvenile Life History			Ocean Age at return					First Week of Spawning	Last Week of Spawning
		Life History Pattern	%		0	1	2	3	4		
Spring Chinook	Catherine Creek Spring Chinook	Stream Type –Resident	70	Proportion		0.126	0.689	0.185		8/20-26	9/10-16
		Stream Type – Migrant	30	Males		1.000					
				Females			0.733	0.535			
				Eggs/Fem			3750	4150			

Table 86. Lookingglass Creek Spring Chinook Population Characteristics used in EDT Model

Species	Population	Juvenile Life History			Ocean Age at return					First Week of Spawning	Last Week of Spawning
		Life History Pattern	%		0	1	2	3	4		
Spring Chinook	Catherine Creek Spring Chinook	Stream Type -Resident	20	Proportion		0.126	0.689	0.185		8/13-19	9/17-23
		Stream Type - Migrant	80	Males		1.000					
				Females			0.733	0.535			
				Eggs/Fem			3750	4150			

Summer Steelhead Population Characteristics used in EDT Model

Table 87. UGR Summer Steelhead Population Characteristics used in EDT Model

		Juvenile Life History				Ocean Age at return					First Week of Spawning	Last Week of Spawning
		Life History Pattern	Smolt Age	%		0	1	2	3	4		
Summer Steelhead	Upper Grande Ronde Summer Steelhead	Resident	1	2.5	Proportion		71	29	0		3/26-4/1	5/14-20
		Migrant	1	2.5	Males		41	40				
		Resident	2	45	Females		59	60				
		Migrant	2	45	Eggs/Fem		3900	5400				
		Resident	3	2.5								
		Migrant	3	2.5								

Table 88. Joseph Creek Summer Steelhead Population Characteristics used in EDT Model

Species	Population	Juvenile Life History				Ocean Age at return					First Week of Spawning	Last Week of Spawning
		Life History Pattern	Smolt Age	%		0	1	2	3	4		
Summer Steelhead	Joseph Creek Summer Steelhead	Resident	1	2.5	Proportion		71	29	0		3/12-18	5/14-20
		Migrant	1	2.5	Males		41	40				
		Resident	2	45	Females		59	60				
		Migrant	2	45	Eggs/Fem		3900	5400				
		Resident	3	2.5								
		Migrant	3	2.5								

Table 89. Wallowa Summer Steelhead Population Characteristics used in EDT Model

Species	Population	Juvenile Life History				Ocean Age at return					First Week of Spawning	Last Week of Spawning
		Life History Pattern	Smolt Age	%		0	1	2	3	4		
Summer Steelhead	Wallowa Summer Steelhead	Resident	1	2.5	Proportion		71	29	0		3/12-18	5/14-20
		Migrant	1	2.5	Males		41	40				
		Resident	2	45	Females		59	60				
		Migrant	2	45	Eggs/Fem		3900	5400				
		Resident	3	2.5								
		Migrant	3	2.5								

Table 90. LGR Summer Steelhead Population Characteristics used in EDT Model

Species	Population	Juvenile Life History				Ocean Age at return					First Week of Spawning	Last Week of Spawning
		Life History Pattern	Smolt Age	%		0	1	2	3	4		
Summer Steelhead	LGR Summer Steelhead	Resident	1	2.5	Proportion		71	29	0		3/12-18	5/14-20
		Migrant	1	2.5	Males		41	40				
		Resident	2	45	Females		59	60				
		Migrant	2	45	Eggs/Fem		3900	5400				
		Resident	3	2.5								
		Migrant	3	2.5								

6.9 Appendix 9: Definitions of key performance measures used to evaluate fish populations and habitat in Grande Ronde M&E efforts (CSMEP unpublished data).

	Performance Measure Primary Data	Definition of Peformance Measure
Abundance	Adult Escapement	Derived or raw measure. Number of adult fish that have "escaped" past fisheries to a certain point (e.g., the mouth of the Columbia). Equals ***adult spawner abundance*** if considering all fisheries (i.e. adults on spawning ground). May be derived using additional data such as harvest information (catch or rates), escapement to spawning ground (from weir or redd counts), upstream conversion rates, etc (e.g., Beamesderfer et al 1997). It is a raw measure if it is escapement to the spawning ground.
	Fish per Redd	Derived measure. Number of spawners (male + female) /# of counted redds, or the number of females per redd.
	Adult Spawner Abundance	Derived or Raw measure. Direct count of the number of fish on spawning ground (e.g., wier count) (or expanded estimate from redd counts, carcass recovery)
	Index of Spawner Abundance (redd counts)	Raw measure (primary). Counts of redds in spawning areas. This is data from which spawner abundance is estimated (e.g., Snake River spring-summer chinook). Data may be collected in a number of ways for variety of purposes such as index counts (e.g., peak counts on small section of tributary for trends), or extensive area counts over a large portion of a tributary approaching a complete census (absolute abundance), using a probability based sampling approach such as EMAP for presence/abscence type surveys.
	Hatchery Fraction	Raw measure (primary): Percent of fish on spawning ground that originated from hatchery and strayed to natural spawning ground. Determined from carcass or weir sampling.
	Harvest	Raw measure (primary). Number of fish caught in ocean, mainstem or tributary fisheries (commercial, tribal, or recreational). Determined from commercial landings, creel surveys, etc.
	Index of Juvenile Abundance (Density)	Raw measure (secondary). Number of fry, parr, or smolts per unit area of rearing habitat.
	Juvenile Emigrant Abundance	Raw measure (primary). Estimates of the total number of fry, parr, or smolts emmigrating from tributary streams (e.g., determined from rotary screw trap estimates).
	Hatchery Production Abundance	Raw measure (primary). Number of parr, or smolts released from a hatchery per year.

	Performance Measure	
	Primary Data	**Definition of Peformance Measure**
	Smolt Equivalents	Derived measure. Requires estimating number of smolts to some point in time. For example, converting the number of smolts from a tributary to the number of smolt equivalents at the first mainstem dam. An estimated tributary-to-dam survival rate is multiplied by the estimated smolt abundance for a tributary. Parr abundance can also be expressed in terms of smolt equivalents. This requires an estimated parr-to-smolt-at-dam survival rate, which is multiplied by the estimated number of parr. This latter survival rate includes both overwinter survival and tributary-to-dam survival components.
	Run Prediction	Derived measure. Short term forecast of expected future adult returns to some point (e.g., mouth of Columbia, or Snake River) based on current data (e.g. # smolts out, prior yearrs adult returns, etc.).
Survival-Productivity	Smolt-to-Adult Return Rate	Raw measure (secondary): Number of adults from a given brood year returning to a point (e.g., LGR dam) divided by the number of smolts that left this point 1-3 years prior, integrated over all return years.
	Parent Progeny Ratio (lambda, adult-to-adult)	Derived measure: Lamda, the median annual population growth rate estimate from adult-to-adult data (BiOp 2000, pg 6-4). Raw or derived measure: adult-to-adult can be either the ratio of return spawner to parent spawner abundance using expanded estimates, or a raw measure using ratio of return redds to parent redds.
	Recruit/spawner (smolt per female or redd)	Derived measure: Production to some life history stage derived as the ratio of returns to some location (e.g., smolts out, or adult returns to Columbia R., adult returns to the Yakima river) divided by the number at some life stage preceding it. For example, smolt production is the ratio of smolt abundance to brood year spawner abundance.
	Pre-spawn Mortality	Raw measure (primary): percent of returning adults that die after reaching spawning ground, but before spawning.
	Juvenile freshwater survival rate (egg-to-fry/parr.smolt, parr-to-smolt)	Derived or raw measure: Derived if estimated using information from independent programs (e.g., redd counts, fecundity estimates, and parr estimates collected in separate studies for the same tributary could be used to estimate an egg to parr survival rate). Raw measure if estimated in studies (e.g., use of instream incubation boxes to estimate survival-to-emergence (an index of egg-to-fry survival), or release of wild adult spawners to fenced-off stream areas followed by estimates of fry or parr abundance from those spawners to estimate egg-to-fry, or egg-to-parr survival rates).

	Performance Measure	
	Primary Data	**Definition of Peformance Measure**
	Juvenile Survival to first mainstem dam	Raw measure (secondary): Survival rate measure estimated from detection of PIT tagged smolts at first mainstem dam, or model derived survival rates based on detections at first and second mainstem dams (e.g., using SURPH, Steve Smith NOAA). Smolts or parr are tagged in the tributary rearing areas.
	Juvenile Survival past Mainstem Dams	Raw measure (secondary): Survival from first dam where stock enters maintem Columbia or Snake River to Bonneville. Derived from PIT tag detections.
	In-hatchery Life Stage Survival	Raw measure (secondary): egg to fry, parr or smolt survival in hatchery. Ratio of number of eggs spawned to number at lifestage.
	Post-release Survival	Raw measure (secondary): Survival from stage released (e.g., parr or smolt) to further sampling points (e.g. rotary screw traps at outlet of tributary, first mainstem dam encounterd by smolts, dam encountered on return).
Distribution	Adult Spawner Spatial Distribution (within tributaries)	Raw measure: Tributary spawner distribution - extensive estimates of where spawners are found within a tributary. Subbasin spawner distribution - presence/absence surveys across mulitple tributaries within a subbasin.
	Stray Rate	Derived or raw measure (secondary): Carcass surveys of spawning grounds, or wier sampling, looking for marks or tags or taking scale and tissue samples for DNA analysis.
	Juvenile Rearing Distribution	Raw measure: Raw measure at smaller spatial scales, for example Idaho Fish and Game's General Parr Monitoring program which collects parr counts in multiple tributarys and sites within them.
	Disease Frequency	Percent of fish containing particular diseases or prescence/absence of a particulatr disease. (Need to develop a better definition, Paul Kucera suggest contacting Kathy Clemens at the Dworshak fish hatchery).
Genetic	Genetic Diversity	Indices of genetic diversity - measured within a tributary (heterozygosity - allozymes, microsats), or among tributaries across populations aggregates (e.g., FST).
	Reproductive Success (Parentage)	Derived measure: determining hatchery:wild proportions, effective population size is modeled.
Life History	Age–at–Return	Raw measure (primary): Age distribution of spawners on spawning ground determined from length or scale analysis from carcass surveys.
	Age–at-Emigration	Raw measure (primary): Age distribution of emigrants (e.g., proportion of emigrants at fry, parr, pre-smolt, and smolt stages) from tribbutarys determined from rotary screw trap or weir collection, scale collection, or inferences from size.
	Size-at-Return	Raw measure (primary): Size distribution of spawners on spawning ground determined from length or scale analysis from carcass surveys.

	Performance Measure	
	Primary Data	**Definition of Peformance Measure**
	Size-at-Emigration	Raw measure (primary): Size distribution (length, weight) of emigrants (e.g., proportion of emigrants at fry, parr, pre-smolt, and smolt stages) from tribbutarys determined from rotary screw trap or weir collection.
	Condition of Juveniles at Emigration	
	Adult Spawner Sex Ratio	Raw measure (primary): carcass or wier counts.
	Fecundity	Derived or raw measure (primary): Derived if determined indirectly using existing length-fecundity relationships. Raw measure if based on direct sampling of returning females.
	Adult Run-timing	Raw measure (primary): arrival at mouth of major tributaries. Peak, range, 10th-90th percentiles
	Spawn-timing	Raw measure (primary): within major tributaries. Peak, range and 10th-90th percentiles.
	Juvenile Emigration Timing	Raw measure (primary): within major tributaries. Peak, range and 10th-90th percentiles.
	Mainstem Arrival Timing (first mainstem dam)	Raw measure (primary): Mouth of Columbia (Bonneville dam). Peak, range and 10th-90th percentiles.
Habitat	***Water Quality***	**Habitat definitions (based on Hillman 2003, see that ref for fuller definitions).**
	Temperture	Water temperature
	Turbidity	Sediment related indicators of water quallity,
	Conductivity	Ability of water to conduct an electric current. Measured as micromhos/centimeter (μmhos/cm)
	pH	Concentration of hydrogem ions in water (moles per liter)
	Dissolved Oxygen	Amount of dissolved oxygen in water. Usually measure as mg per liter (mg/L).
	Nitrogen	Indicator of nutrient loading.
	Phosphorous	Indicator of nutrient loading.
	Habitat Access (artificial physical barriers)	
	Road Crossings	Artificial physical barrier
	Diversion Dams	Artificial physical barrier
	Fishways	Artificial physical barrier
	Habitat Quality	
	Dominant substrate	Most common particle size that makes up the composition of material along the streambed. This indicator describes the dominant material in spawning and rearing areas.
	Embeddedness	A measure of the degree to which fine sediments surround or bury larger particles. An indicator of the quality of overwintering habitat for juvenile salmonids.

Performance Measure	
Primary Data	**Definition of Peformance Measure**
Depth fines	Depth fines refers to the amount of fine sediment (<0.85 mm) within the streambed. Hillman 2003 recommends estimating it at depth of 15-30 cm (6-12 inches) within spawning gravels.
LWD (pieces/km)	Large Woody Debris (LWD) is large pieces of relatively stable woody material located within the bankfull channel and appearing to influence bankfull flows. Also referred to as Large Organic Debris (LOD) and Coarse Woody Debris (CWD). The definition of LWD varies greatly amongst institutions (see Hillman 2003 page 48).
Pool frequency (pools/km)	Slow water habitat with a gradient <1%, normally deeper and wider than aquatic habitats upstream and downstream from it, must span half the wetted width, inclued the thalweg, and maximum depth must be at least 1.5 times the crest depth.
Pool quality	Ability of pool to support the growth and survival of fish, based on size (diameter and depth) and amount and quality of cover.
Side channels and backwaters (off channel habitat)	Types of off-channel habitat.
Channel condition	
Width/depth ratio	An index of cross-section shape of stream channel at bankfull level.
Wetted width	Width of water surfac measured perpendicular to the direction of flow. Used to estimate water surface area, which is used to calculate density of fish within the site or reach.
Bankfull width	Width of the channel (water surface) at the bankfull stage, which corresponds to the channel forming discharge.
Bank Stability	Streambank stability in an indicator of streambank condition.
Riparian Condition	
Riparian structure	Type and amount of various types of vegetation within the riparian zone. Used to evaluate health and level of disturbance of the stream corridor. Provides an indication of the present and future potential for various types of organic inputs and shading.
Riparian disturbance	Prescence and proximity of various types of human land-use activities within the riparian area (e.g., walls, dikes, riprap, dams, etc.). Affects the quantity and quality of aquatic habitat for fish.
Canopy cover	Riparian canopy cover over a stream.
Flows and Hydrology	
streamflow	
Watershed Condition	

Performance Measure	
Primary Data	**Definition of Peformance Measure**
Watershed road density (e.g., roads/km^2)	An index of total length of roads within a watershed.
Riparian-road index	Total mileage of roads within riparian areas divided by the total number of stream kilometers within the watershed (e.g., roads falling within federal buffer zones i.e. all areas within 300 ft either side of a fish bearing stream, within 150ft of a permanent nonfish-bearing stream, or within the 100-year floodplain).
Land Ownership	Index of watershed disturbance. Describes surface status of the basin - delineates the portions of the basin owned by federal, state, county, tribal, and private entities.
Land use	Index of watershed disturbance. Deliniates the portions of the basin that are subject to specific land uses (e.g., urban, agriculture, range, forest, wetlands, etc.).