

Biodiversity Analyses for NCSSF Certification Scenarios

Denis White, Susan Payne, Allan Branscomb, David Hulse
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The data and methods of the Willamette River Basin alternative futures project (Hulse et al. 2002), conducted by the Pacific Northwest Ecosystem Research Consortium (PNW-ERC), were adapted to analyze the potential impact of forest management practices based on the Montreal Protocols on biodiversity. This document describes the definition of biodiversity used in this study, data and methods used, and results and limitations of these analyses.

Definition of biodiversity

For the purposes of the NCSSF study, biodiversity is defined as “the habitat available for all native species of amphibians, reptiles, birds, and mammals that are presumed to currently occupy the study area, and that are not primarily associated with aquatic, agricultural, or urban types of habitats.” Many other definitions are possible, of course, however this is a practical and achievable definition similar to ones that have been published before (White et al. 1997, Freemark et al. 1996, Hulse et al. 2000).

Species lists and habitat relationships

The initial pool of species considered was all amphibian, reptile, bird, and mammal species presumed to currently occupy the Willamette River Basin (WRB), or to have been extirpated from the basin in the past century or so (Adamus et al. 2001). From this total of 279 species some reductions were made for this project.

First, species were eliminated that favored agricultural, urban, or aquatic habitats over forest and open habitats. The species-habitat relationships matrices (Adamus et al. 2001 attachments) were used to implement this screening criterion. Important habitats were defined as habitat classes 1-16, 21, and 26 and unimportant habitats as all others (see Appendix 1 for a list of habitats). The preference scores (for breeding, see below) were summed for the important and unimportant habitats. Species whose summed scores for the unimportant habitats were equal to or greater than their summed scores for important habitats were eliminated. Habitats defined as important were those most affected by the certification modeling. Species whose primary habitats were unimportant for the study might unduly influence the results if not excluded.

Second, species were eliminated that had very little or no habitat in the NCSSF study area of Benton, Polk, and Yamhill counties from the crest of the coast range to the Willamette River. The arbitrary criterion was to eliminate species whose habitat scores, that is, the product of the number of 30 meter pixels of habitat times the suitability score of that habitat, totaled less than or equal to 5000 units in the baseline landscape (see below). Species with very small amounts of habitat could have high percent changes in habitat between scenarios, results that could be especially susceptible to errors in the habitat suitability ratings as well as in the assignment of habitat types to pixels.

Finally, species that were extirpated in the past, such as the gray wolf or the condor (and not yet re-established in the case of the condor), or are introduced, such as the bullfrog or the ring-necked pheasant, were eliminated, leaving only current native species. The resulting total was 192 species, consisting of 10 amphibian, 15 reptile, 110 bird, and 57 mammal species (Appendix 2).

Because of special treatments accorded to riparian areas, species that had habitat requirements that favored these areas were reported separately as well as with others. Riparian species were defined according to their use of one or more of a selected set of adjacency rules used in the WRB analyses (see Appendix B of Adamus et al. 2001, for the rules). The rules used for riparian species were: R0, R30-0, R0CoR, R0<500, R0-streams, R0rivpd, RF0, and R0-breed.

In the Adamus et al. (2001) report and accompanying materials are species-habitat matrices that assign to each species a preference score for each of the 34 habitats used in the study. The scores are integers from 0 to 10, where 0 means that the species does not occur, and 10 means the highest level of preference of the species for the habitat. Scores are provided for breeding and feeding habitat (some species have one set of scores for both). For this study, as for White et al. (2002), only breeding scores were used. In particular, only the subset of these matrices pertaining to the species selected for the NCSSF study were used.

Landscape and habitat maps

Maps were provided from the certification modeling team for a baseline condition and four scenarios. The baseline condition was that of the PNW-ERC study and corresponded to the status of the study area in the early 1990s. Two of the scenarios also came from the PNW-ERC study, the Plan Trend 2050 scenario and the Pre-EuroAmerican scenario. The other two scenarios were the NCSSF certification scenarios, Full Certification and Modified Certification.

The maps were provided using the land use and land cover classification of the PNW-ERC study, as described on page 78 of Hulse et al. (2002). For the purposes of the biodiversity assessment these classes were converted to the habitat classes listed in Appendix 1, using the cross-references in Table 4 of Adamus et al. (2001). In addition, a number of other modifications to the land use and land cover maps were performed in the PNW-ERC study as described in pages 7 through 12 of Adamus et al. (2001) and in Payne (2002).

Analysis methodology

The method used to assess of the status of biodiversity in the four scenarios in the study was very similar to that used in previous studies (White et al. 1997, Freemark et al. 1996, White et al. 2002). Given the definition of biodiversity, the assessment addressed changes in the quality and quantity of habitat for the species of interest between the baseline landscape and each of the four scenarios.

Each species had a total habitat score for the baseline and for each scenario. The habitat score was calculated by taking each individual habitat that the species was assigned to and multiplying the amount of that habitat by the species' preference score for that habitat, and then summing

these products across all habitats. The percentage change in these total habitat scores for each species relative to the baseline landscape was then computed for the two NCSSF scenarios, the PNW-ERC PlanTrend 2050 scenario and for the Pre-EuroAmerican scenario. The median of the percentage changes for different groups of species was used as a summary statistic. Positive values of the median percent change statistic meant that there was more habitat in the scenario than in the baseline, and negative values meant that there was less habitat. The groups of species analyzed were amphibians, reptiles, birds, and mammals, and all study species taken together. In addition, riparian and non-riparian (all other) species were analyzed.

An additional statistic was calculated for each scenario to report on the number of species that improved from the baseline compared to the number that did not. This statistic was defined as the number of species that gained total habitat, relative to the baseline, as described above, minus the number that lost total habitat, expressed as a percentage of the total number of species.

Results

There were substantial changes in the amount of land in each habitat class from the baseline to each scenario (Appendix 1). In addition to the changes in forest age classes due to the effects of different certification rules, other classes changed by large amounts as well, some due to choices in the way to handle some remotely sensed data. The Pre-EuroAmerican scenario was clearly very different in both forest structure and in much greater amounts of oak savanna, prairie (natural grass), and seasonal wetlands. These changes are reflected in the different results for wildlife habitat.

The scenarios had substantially different outcomes for different taxonomic groups and for the study species as a whole (Table 1, Figure 1). In Full Certification, all species taken together had a modest gain in total habitat of 1.6% whereas in Modified Certification there was a 5.5% loss of total habitat. More dramatically, birds in Full Certification gained 7.6% but lost 12.3% in Modified Certification. The median habitat loss of the ten amphibian species was even greater in Modified Certification. The Pre-EuroAmerican scenario showed substantial gains in total habitat for all groups, with a 23% gain for all species in the study taken as a whole.

Table 1. Change in total habitat area as median percent change relative to the baseline in each group of species.

Group	Number of species	Plan Trend	Modified Certification	Full Certification	Pre-EuroAmerican
Amphibians	10	-5.1	-15.1	0.4	10.7
Reptiles	15	29.2	0.6	-4.3	62.7
Birds	110	3.6	-12.3	7.6	33.6
Mammals	57	4.1	-2.8	1.2	11.9
Total	192	4.2	-5.5	1.6	23
Riparian	19	0	-29	0.9	10.4
Non-Riparian	173	5.1	-4.5	1.7	23.1

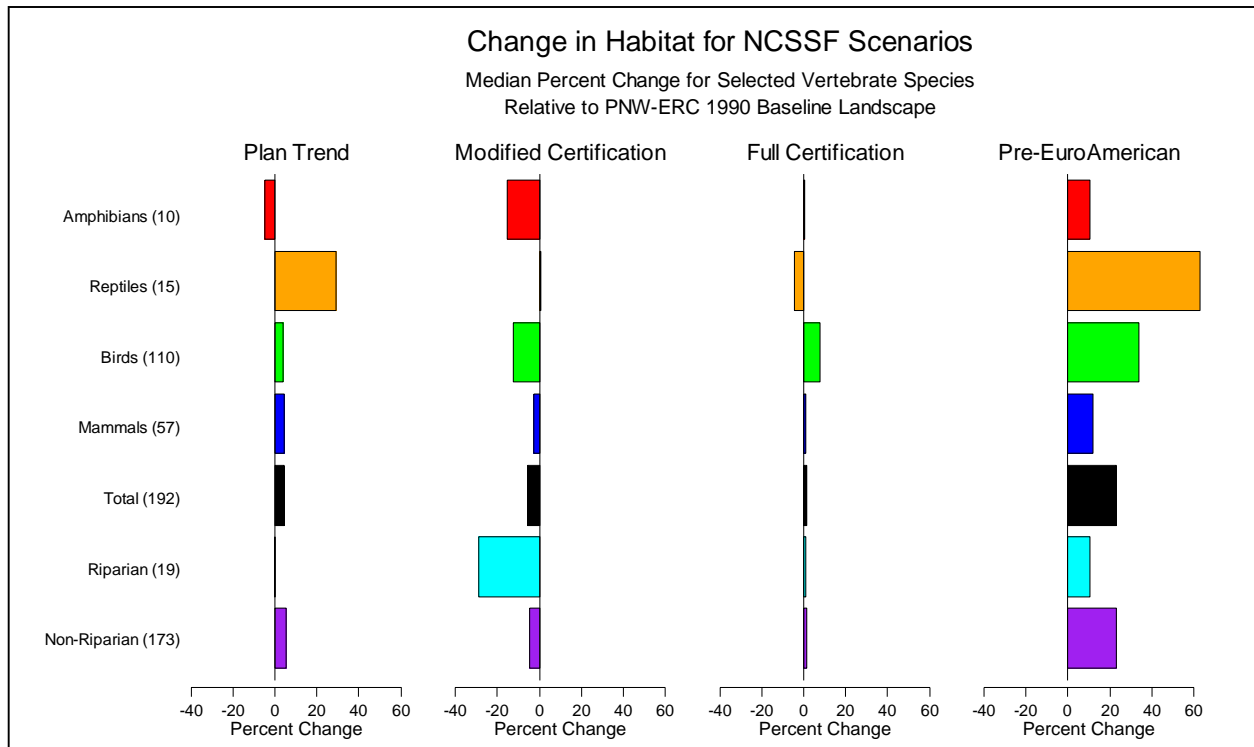


Figure 1. Graph of median percent change in habitat for subsets of species and all study species for each scenario.

The number of species gaining habitat versus losing habitat, relative to the baseline scenario, showed even greater differences. In Plan Trend, 31.2% more species gained than lost habitat; in Modified Certification, 35.4% more species lost than gained; in Full Certification, 11.5% more species gained than lost; and in Pre-EuroAmerican, 47.9% more gained than lost. Again, Modified Certification stood out with poor performance for habitat for study species.

Discussion and limitations

The interpretation of the results can be aided by data provided in Appendix 1. For each habitat class there are the number of species assigned to that class and the sum of those species' habitat preference scores. By examining both the total habitat scores and the amount of area in each habitat class, the relative importance of the changes in habitat can be assessed.

For example, in Modified Certification, the classes conifer closed 21-40 and 41-60 had substantially more, almost twice as much, area as in Full Certification and much more than in the baseline. However, these classes also had the lowest total habitat scores of all the forested habitats. Thus the poor performance of Modified Certification can be traced, in part, to changes in forest practices in this scenario that resulted in much more land in these conifer age classes. Similarly, the much greater land area in old growth conifer (200+) in the Pre-EuroAmerican scenario had a dramatic effect because that class was one of the highest scoring for total habitat.

There are important limitations to any conclusions drawn from this study. No assessment of species' population viability was performed to evaluate the potential persistence of species in the

study area. Thus, no inference can be drawn about whether there is enough habitat for any species to survive for some specified time period.

Also, no assessment of the effects of errors in the habitat maps or in the species habitat preference scores was made. The habitat maps could be in error due to misclassifications in the original land use and land cover data (see Hulse et al. 2002 for discussions about these issues). The habitat preference scores determined by best professional judgment could be in error for a number of reasons. Thus, no inferences should be made about absolute amounts of habitat. In the end, these results are best viewed as approximate indicators of the effects of the different certification scenarios on the relative amounts of habitat for the selected set of species.

Acknowledgements

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Appendix 1. Acres in each habitat class in the baseline landscape and in each scenario, plus the number of species assigned to each habitat class and their total habitat preference. The small streams acreage was obtained from separate analyses described in Adamus et al. 2001; this acreage overlaps some of the area of the other classes.

Adamus Habitat Type	Number of species assigned	Total habitat score for all species	Acres	Acres	Acres	Acres	Acres
Habitat	Nspp	Score	Baseline	Plan-Trend	Modified Certification	Full Certification	Pre-Euro-American
1. Conifer 0-20 yrs	144	753	50399	126828	75135	60491	233
2. Conifer closed 21-40	120	467	45473	51333	142342	73691	0
3. Conifer closed 41-60	118	510	91756	17041	100948	61654	0
4. Conifer closed 61-80	119	635	35761	15287	68196	73240	0
5. Conifer closed 81-200	127	814	50377	67747	38042	90040	5062
6. Conifer closed 200+	127	918	7795	3828	17071	47360	245894
7. Mixed forest closed	151	859	151877	150675	24282	56318	20499
8. Hardwood closed	139	810	52591	51931	12073	22919	16140
9. Conifer semiclosed upland	153	890	642	641	56	1333	67376
10. Mixed semiclosed upland	156	981	912	912	127	334	5954
11. Hardwood semiclosed upland	145	967	1693	1725	297	758	354
12. Tree open upland	150	970	354	354	59	131	646
13. Oak savanna	135	783	0	0	0	1665	55764
14. Shrub dry, tree open valley	111	662	18533	17936	61279	42321	95722
15. Shrub wet valley	101	556	4624	4581	4620	5997	115
16. Christmas trees	72	267	3997	4077	752	1401	0
17. Orchards, hybrid poplar	45	122	3641	3792	974	1298	0
18. Vineyards, berries	48	133	603	419	174	196	0
19. Leafy vegetables	16	35	7040	3024	1921	2338	0
20. Grass short	42	122	961	935	661	513	0
21. Grass natural	64	397	1943	1901	900	2499	47566
22. Grass tall	48	185	25004	28293	8332	10210	0
23. Bare, burnt, fallow	13	35	2526	2514	1806	1828	0
24. Rock montane	38	130	0	0	0	0	16
25. Snow, ice	NA	NA	0	0	0	0	0
26. Seasonal wetlands	61	354	1155	1142	508	1170	7145
27. Lakes, permanent wetlands	15	112	385	385	379	384	234
28. Streams small	NA	NA	14917	14818	14928	14778	14699
29. Streams large	6	47	842	842	841	842	2106
30. Channel gravel	12	54	128	128	127	128	95
31. Built high density	32	59	457	1458	450	457	0
32. Built mid density	74	226	1583	2387	1559	1583	0
33. Built low density	99	465	6166	7100	5342	6117	0
34. Roads, railroads	0	0	1827	1827	1791	1827	0

Appendix 2. List of species used in the NCSSF study.

<u>Scientific Name</u>	<u>Common Name</u>	<u>Riparian</u>
<i>Ambystoma macrodactylum</i>	Long-Toed Salamander	
<i>Aneides ferreus</i>	Clouded Salamander	
<i>Batrachoseps wrighti</i>	Oregon Slender Salamander	
<i>Ensatina eschscholtzii</i>	Ensatina	
<i>Plethodon dunni</i>	Dunn's Salamander	*
<i>Plethodon vehiculum</i>	Western Red-Backed Salamander	
<i>Rhyacotriton variegatus</i>	Southern Torrent Salamander	*
<i>Ascaphus truei</i>	Tailed Frog	*
<i>Pseudacris regilla</i>	Pacific Treefrog	
<i>Rana aurora</i>	Red-Legged Frog	
<i>Ardea herodias</i>	Great Blue Heron	*
<i>Butorides virescens</i>	Green Heron	*
<i>Branta canadensis</i>	Canada Goose	*
<i>Aix sponsa</i>	Wood Duck	*
<i>Lophodytes cucullatus</i>	Hooded Merganser	*
<i>Cathartes aura</i>	Turkey Vulture	
<i>Pandion haliaetus</i>	Osprey	*
<i>Elanus caeruleus</i>	White-Tailed Kite	
<i>Haliaeetus leucocephalus</i>	Bald Eagle	*
<i>Circus cyaneus</i>	Northern Harrier	
<i>Accipiter striatus</i>	Sharp-Shinned Hawk	
<i>Accipiter cooperii</i>	Cooper's Hawk	
<i>Accipiter gentilis</i>	Northern Goshawk	
<i>Buteo jamaicensis</i>	Red-Tailed Hawk	
<i>Falco sparverius</i>	American Kestrel	
<i>Dendragapus obscurus</i>	Blue Grouse	
<i>Bonasa umbellus</i>	Ruffed Grouse	
<i>Oreortyx pictus</i>	Mountain Quail	
<i>Rallus limicola</i>	Virginia Rail	
<i>Gallinago gallinago</i>	Common Snipe	
<i>Phalaropus tricolor</i>	Wilson's Phalarope	
<i>Brachyramphus marmoratus</i>	Marbled Murrelet	
<i>Columba fasciata</i>	Band-Tailed Pigeon	
<i>Zenaida macroura</i>	Mourning Dove	
<i>Otus kennicottii</i>	Western Screech-Owl	
<i>Bubo virginianus</i>	Great Horned Owl	
<i>Glaucidium gnoma</i>	Northern Pygmy-Owl	
<i>Strix occidentalis caurina</i>	Spotted Owl	
<i>Strix varia</i>	Barred Owl	
<i>Asio otus</i>	Long-Eared Owl	
<i>Asio flammeus</i>	Short-Eared Owl	
<i>Aegolius acadicus</i>	Northern Saw-Whet Owl	
<i>Chordeiles minor</i>	Common Nighthawk	
<i>Selasphorus rufus</i>	Rufous Hummingbird	
<i>Melanerpes formicivorus</i>	Acorn Woodpecker	
<i>Sphyrapicus ruber</i>	Red-Breasted Sapsucker	
<i>Picoides pubescens</i>	Downy Woodpecker	
<i>Picoides villosus</i>	Hairy Woodpecker	
<i>Picoides arcticus</i>	Black-Backed Woodpecker	
<i>Colaptes auratus</i>	Northern Flicker	
<i>Dryocopus pileatus</i>	Pileated Woodpecker	
<i>Contopus cooperi</i>	Olive-Sided Flycatcher	

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<i>Contopus sordidulus</i>	Western Wood-Pewee	
<i>Empidonax traillii</i>	Willow Flycatcher	
<i>Empidonax hammondi</i>	Hammond's Flycatcher	
<i>Empidonax oberholseri</i>	Dusky Flycatcher	
<i>Empidonax difficilis</i>	Pacific-Slope Flycatcher	
<i>Tyrannus verticalis</i>	Western Kingbird	
<i>Tachycineta bicolor</i>	Tree Swallow	
<i>Tachycineta thalassina</i>	Violet-Green Swallow	
<i>Perisoreus canadensis</i>	Gray Jay	
<i>Cyanocitta stelleri</i>	Steller's Jay	
<i>Aphelocoma californica</i>	Western Scrub-Jay	
<i>Corvus brachyrhynchos</i>	American Crow	
<i>Corvus corax</i>	Common Raven	
<i>Poecile atricapillus</i>	Black-Capped Chickadee	
<i>Poecile gambeli</i>	Mountain Chickadee	
<i>Poecile rufescens</i>	Chestnut-Backed Chickadee	
<i>Psaltriparus minimus</i>	Bushtit	
<i>Sitta canadensis</i>	Red-Breasted Nuthatch	
<i>Sitta carolinensis</i>	White-Breasted Nuthatch	
<i>Certhia americana</i>	Brown Creeper	
<i>Thryomanes bewickii</i>	Bewick's Wren	
<i>Troglodytes aedon</i>	House Wren	
<i>Troglodytes troglodytes</i>	Winter Wren	
<i>Cistothorus palustris</i>	Marsh Wren	
<i>Regulus satrapa</i>	Golden-Crowned Kinglet	
<i>Sialia mexicana</i>	Western Bluebird	
<i>Myadestes townsendi</i>	Townsend's Solitaire	
<i>Catharus ustulatus</i>	Swainson's Thrush	
<i>Catharus guttatus</i>	Hermit Thrush	
<i>Turdus migratorius</i>	American Robin	
<i>Ixoreus naevius</i>	Varied Thrush	
<i>Chamaea fasciata</i>	Wrentit	
<i>Bombycilla cedrorum</i>	Cedar Waxwing	
<i>Vireo solitarius</i>	Cassin's Vireo	
<i>Vireo huttoni</i>	Hutton's Vireo	
<i>Vireo gilvus</i>	Warbling Vireo	
<i>Vireo olivaceus</i>	Red-Eyed Vireo	*
<i>Vermivora celata</i>	Orange-Crowned Warbler	
<i>Dendroica petechia</i>	Yellow Warbler	*
<i>Dendroica coronata</i>	Yellow-Rumped Warbler	
<i>Dendroica nigrescens</i>	Black-Throated Gray Warbler	
<i>Dendroica townsendi</i>	Townsend's Warbler	
<i>Dendroica occidentalis</i>	Hermit Warbler	
<i>Oporornis tolmiei</i>	Macgillivray's Warbler	
<i>Geothlypis trichas</i>	Common Yellowthroat	
<i>Wilsonia pusilla</i>	Wilson's Warbler	
<i>Icteria virens</i>	Yellow-Breasted Chat	
<i>Piranga ludoviciana</i>	Western Tanager	
<i>Pheucticus melanocephalus</i>	Black-Headed Grosbeak	
<i>Passerina amoena</i>	Lazuli Bunting	
<i>Pipilo maculatus</i>	Spotted Towhee	
<i>Spizella passerina</i>	Chipping Sparrow	
<i>Poocetes gramineus</i>	Vesper Sparrow	
<i>Passerculus sandwichensis</i>	Savannah Sparrow	
<i>Ammodramus savannarum</i>	Grasshopper Sparrow	
<i>Melospiza melodia</i>	Song Sparrow	

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<i>Zonotrichia leucophrys</i>	White-Crowned Sparrow	
<i>Junco hyemalis</i>	Dark-Eyed Junco	
<i>Agelaius phoeniceus</i>	Red-Winged Blackbird	*
<i>Sturnella neglecta</i>	Western Meadowlark	
<i>Molothrus ater</i>	Brown-Headed Cowbird	
<i>Icterus galbula</i>	Bullock's Oriole	
<i>Carpodacus purpureus</i>	Purple Finch	
<i>Loxia curvirostra</i>	Red Crossbill	
<i>Carduelis pinus</i>	Pine Siskin	
<i>Carduelis psaltria</i>	Lesser Goldfinch	
<i>Carduelis tristis</i>	American Goldfinch	
<i>Coccothraustes vespertinus</i>	Evening Grosbeak	
<i>Sorex vagrans</i>	Vagrant Shrew	
<i>Sorex pacificus</i>	Pacific Shrew	
<i>Sorex bendirii</i>	Pacific Water Shrew	*
<i>Sorex trowbridgii</i>	Trowbridge's Shrew	
<i>Sorex bairdi</i>	Baird's Shrew	
<i>Sorex sonomae</i>	Fog Shrew	
<i>Neurotrichus gibbsii</i>	Shrew-Mole	
<i>Scapanus townsendii</i>	Townsend's Mole	
<i>Scapanus orarius</i>	Coast Mole	
<i>Myotis lucifugus</i>	Little Brown Myotis	
<i>Myotis yumanensis</i>	Yuma Myotis	
<i>Myotis evotis</i>	Long-Eared Myotis	
<i>Myotis thysanodes</i>	Fringed Myotis	
<i>Myotis volans</i>	Long-Legged Myotis	
<i>Myotis californicus</i>	California Myotis	
<i>Lasionycteris noctivagans</i>	Silver-Haired Bat	
<i>Eptesicus fuscus</i>	Big Brown Bat	
<i>Lasiurus cinereus</i>	Hoary Bat	
<i>Sylvilagus bachmani</i>	Brush Rabbit	
<i>Lepus americanus</i>	Snowshoe Hare	
<i>Lepus californicus</i>	Black-Tailed Jackrabbit	
<i>Aplodontia rufa</i>	Mountain Beaver	
<i>Tamias townsendii</i>	Townsend's Chipmunk	
<i>Spermophilus beecheyi</i>	California Ground Squirrel	
<i>Sciurus griseus</i>	Western Gray Squirrel	
<i>Tamiasciurus douglasii</i>	Douglas' Squirrel	
<i>Glaucomys sabrinus</i>	Northern Flying Squirrel	
<i>Thomomys mazama</i>	Western Pocket Gopher	
<i>Thomomys bulbivorus</i>	Camas Pocket Gopher	
<i>Peromyscus maniculatus</i>	Deer Mouse	
<i>Neotoma fuscipes</i>	Dusky-Footed Woodrat	
<i>Neotoma cinerea</i>	Bushy-Tailed Woodrat	
<i>Clethrionomys californicus</i>	Western Red-Backed Vole	
<i>Phenacomys albipes</i>	White-Footed Vole	
<i>Phenacomys longicaudus</i>	Red Tree Vole	
<i>Microtus townsendii</i>	Townsend's Vole	
<i>Microtus longicaudus</i>	Long-Tailed Vole	
<i>Microtus oregoni</i>	Creeping Vole	
<i>Microtus canicaudus</i>	Gray-Tailed Vole	
<i>Zapus trinotatus</i>	Pacific Jumping Mouse	
<i>Erethizon dorsatum</i>	Common Porcupine	
<i>Canis latrans</i>	Coyote	
<i>Urocyon cinereoargenteus</i>	Gray Fox	
<i>Ursus americanus</i>	Black Bear	

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<i>Procyon lotor</i>	Raccoon	
<i>Martes americana</i>	American Marten	
<i>Martes pennanti</i>	Fisher	
<i>Mustela erminea</i>	Ermine	
<i>Mustela frenata</i>	Long-Tailed Weasel	
<i>Mustela vison</i>	Mink	*
<i>Spilogale gracilis</i>	Western Spotted Skunk	
<i>Mephitis mephitis</i>	Striped Skunk	
<i>Lutra canadensis</i>	Northern River Otter	*
<i>Felis concolor</i>	Mountain Lion	
<i>Lynx rufus</i>	Bobcat	
<i>Cervus elaphus</i>	Elk	
<i>Odocoileus hemionus</i>	Black-Tailed Deer	
<i>Chrysemys picta</i>	Painted Turtle	*
<i>Clemmys marmorata</i>	Western Pond Turtle	*
<i>Elgaria coerulea</i>	Northern Alligator Lizard	
<i>Elgaria multicarinata</i>	Southern Alligator Lizard	
<i>Sceloporus occidentalis</i>	Western Fence Lizard	
<i>Eumeces skiltonianus</i>	Western Skink	
<i>Charina bottae</i>	Rubber Boa	
<i>Coluber constrictor</i>	Racer	
<i>Contia tenuis</i>	Sharptail Snake	
<i>Diadophis punctatus</i>	Ringneck Snake	
<i>Pituophis catenifer</i>	Gopher Snake	
<i>Thamnophis elegans</i>	Western Terrestrial Garter Snake	*
<i>Thamnophis ordinoides</i>	Northwestern Garter Snake	
<i>Thamnophis sirtalis</i>	Common Garter Snake	
<i>Crotalus viridis</i>	Western Rattlesnake	