STEHEKIN VALLEY VERTEBRATE INVENTORY

Kuntz and Glesne

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A Terrestrial Vertebrate Inventory of the Stehekin Valley, Lake Chelan National Recreational Area

Robert C. Kuntz II and Reed S. Glesne

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North Cascades National Park Service Complex
2105 Highway 20
Sedro Woolley, WA 98284

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National Park Service
Pacific Northwest Region
83 South King Street, Suite 212
Seattle, WA 98104

Abstract

Our objectives were to provide a baseline inventory of wildlife species and the habitats they use within the lower Stehekin Valley, Lake Chelan National Recreation Area. Using geographic information system technology, habitat polygons were grouped into fifteen wildlife habitat classes. Investigations of wildlife populations were largely restricted to four major wildlife habitat classes. These habitat classes represent 57 % of the total area in the valley and include: nutrient rich-deciduous, nutrient rich-mixed deciduous and conifer, upland mesic-conifer, and upland mesic-deciduous and conifer. Pitfall traps and time-constrained surveys of down wood, leaf litter, and rock piles were used to sample amphibians and reptiles. Live-trap grids and pitfall trap grids were used to sample small mammal populations. Self-activating cameras were used to document large mammal use of the valley. Breeding bird populations were surveyed using the station index method. Additional surveys were conducted to document harlequin duck use of the Stehekin River, winter bird use of the fifteen habitat classes, and mountain goat use of the mountain slopes above the Stehekin Valley. NOCA database information was used to document wildlife species not observed during this inventory.

We documented presence of 138 wildlife species within the lower Stehekin Valley from the summer of 1988 through late winter, 1992. Included in this total were five species of amphibians, eight species of reptiles, 25 species of mammals, and 104 species of birds. Federal and/or State endangered, threatened, or candidate species documented using the valley included common loon, bald eagle, northern goshawk, spotted owl, Vaux's swift, pileated woodpecker, western gray squirrel, Cascades frog, and spotted frog. Amphibians and reptiles were relatively scarce in the areas sampled. Pitfall traps captured a total of four long-toed salamanders, two northern alligator lizards, eight western fence lizards, and four Pacific tree frogs in 3,613 trap-nights of effort. A total of five long-toed salamanders, one western toad, and one northern alligator lizard were captured during 14 hours of time-constrained surveys. Forty four species of birds were detected on 23 station index counts in the four habitats selected for sampling. The predominant species included Hammond's flycatcher, Swainson's thrush, American robin, red-eyed vireo, yellow-rumped warbler, MacGillivray's warbler, western tanager, and dark-eyed junco. Results of the small mammal trapping indicate that nutrient rich habitat classes had a greater number of species and higher catch rates than found for upland mesic habitat classes. Twelve species of small mammals were captured in 5834 trap-nights of effort. Deer mice were the most abundant taxa collected. An estimate of seven to eleven harlequin duck pairs nested on the Stehekin River in both 1990 and 1991. Pair densities were 0.42 to 0.66 pairs/km in the two years. At least four harlequin duck broods were observed in 1990 and only one brood was seen in 1991. Based on high counts for one survey, six mountain goats were observed in 1991 and seventeen goats in 1992. Production, expressed as kids/100 adults was zero in 1991 and 13 kids/100 adults in 1992.

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INTRODUCTION

On September 7, 1989, North Cascades Conservation Council (NCCC) filed "a complaint for declaratory and injunctive relief" against the National Park Service (NPS). This lawsuit challenged a series of NPS incremental planning decisions, for which no cumulative effects environmental impact statement (EIS) was written. NPS and NCCC agreed to an "out-of-court" settlement, requiring NPS to complete an EIS for the Lake Chelan National Recreation Area (LCNRA) and areas within North Cascades National Park that include the Stehekin River drainage. Part of the EIS process includes addressing affects of these planning decisions on wildlife resources.

Information on the faunal resources of the Stehekin Valley is lacking. Few research studies or inventories have been conducted in the valley. A search of the North Cascades National Park Service Complex (NOCA) Natural Resources Database System identified bibliographic references from only two projects (Fielder 1991, Mason and Koon 1985) containing terrestrial vertebrate data for work completed within the Stehekin Valley. NOCA resource management staff maintain a wildlife observation database containing mostly anecdotal information.

In response to information needs for the general management plan and EIS, NOCA resource management embarked on a biological data gathering effort. The objectives of this project were to:

1. Develop a wildlife habitat map of the Stehekin Valley;
2. Develop species lists for birds, mammals, amphibians, and reptiles and their associated habitat classes;
3. Compare species richness between wildlife habitat classes;
4. Survey mountain goats (*Oreamnos americanus*) and determine productivity (kid/adult ratio); and
5. Survey harlequin duck use of the Stehekin River.

STUDY AREA

LCNRA occupies 25,090 ha of mountains and valleys within the North Cascades Range (Figure 1). Located east of the Cascades Divide, LCNRA is bisected by the Stehekin River, which feeds Lake Chelan and is part of the Columbia River Basin. The Stehekin River valley is a classic example of a U-shaped glacial trough, formed during the last ice age. The lower Stehekin Valley floor lies within the Douglas-fir (*Pseudotsuga menziesii*) zone (Franklin and Dyrness 1988). At its widest point, the valley floor at the head of Lake Chelan is 1.8 km wide and narrows to 0.6 km near High Bridge. Throughout the

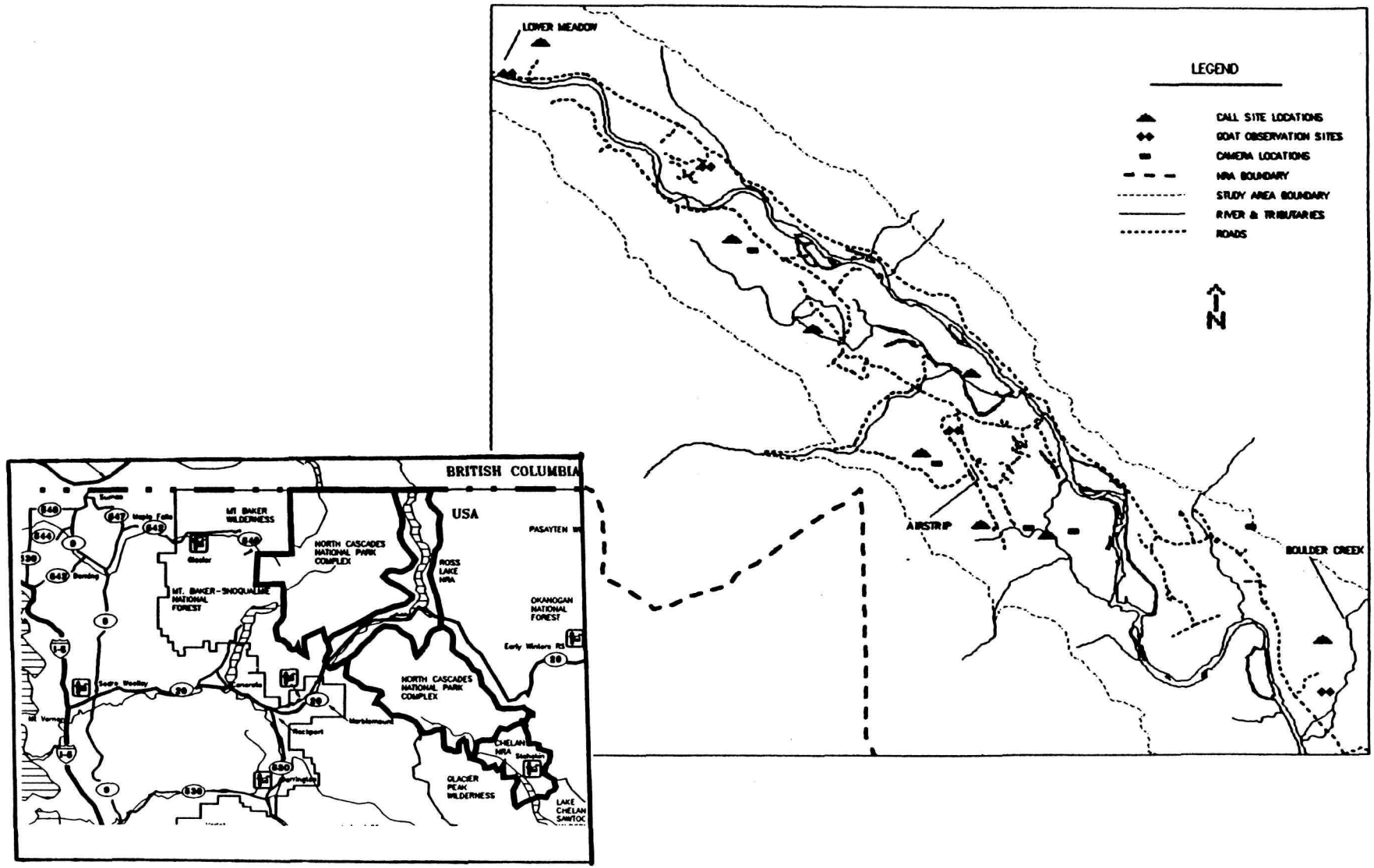

Figure 1. Map of the Stehekin Valley wildlife inventory study area.

lower Stehekin Valley, a community of small farms, year-round and summer homes, and scattered recreation-oriented businesses has existed for approximately the last 90 years.

The study area was confined to areas within the lower Stehekin Valley (Figure 1). Survey plots were placed within the boundaries of an ecological habitat map (Tanimoto 1991) developed for the valley. This boundary is defined as the Stehekin Valley floor from the head of Lake Chelan to 500 m elevation. In the northwestern part of the valley, where the valley floor is above 500 m, the study area follows a 33 m wide buffer along either side of the Stehekin Valley road to High Bridge. One exception to the definition of the study area boundary was made to include slopes of the valley walls above 500 m as part of a mountain goat survey.

METHODS

WILDLIFE HABITAT MAP:

Using geographic information system (GIS) technology, an ecological map, "Stehekin Valley Habitat Types" (Tanimoto 1991), was produced of the study area. This habitat map, based upon vegetal, hydrologic, and edaphic factors, contains 1479 polygons comprising 36 habitat classes. During the summer of 1991, NOCA resource management staff made several refinements to this map. NOCA staff mapped areas below 500 m near Weaver Point, not included because they were designated as "wilderness", to complete coverage of the valley floor. Additional ground-truthing corrected misidentified polygons and increased map accuracy. We divided one habitat class, designated "pastures/lawns/clearings" into four habitat classes (pastures/lawns; residential/commercial/park development; agriculture; and disturbed). One habitat class, "emergent vegetation" was added. This revised "Stehekin Valley Habitat Types" map now contains 1868 polygons comprising 40 habitat classes.

The "Stehekin Valley Habitat Types" map was used to develop a "Stehekin Valley Wildlife Habitat" map (Appendix 1). Because ecological patches (polygons) were small, many were linear in shape, and in juxtaposition to a mosaic of habitat classes, most habitats could not be sampled accurately to determine the vertebrate species using them. Instead, using the habitat definitions from the ecological map and personal communications with Phil Tanimoto, habitat classes were combined to develop more general wildlife habitat classes. As an example, all upland mesic habitat classes labelled as conifer (Douglas-fir upland mesic; ponderosa pine upland mesic; lodgepole pine upland mesic; grand fir upland mesic) were combined and renamed "upland mesic: conifer". This changed the number of polygons from 1868 to 1272 and the number of habitat classes from 40 to 15. For some

comparisons, wildlife habitat classes were further combined into broader classes, such as riparian (all nutrient rich classes) and upland (all upland mesic classes).

SAMPLING METHODS:

Inventories of the various terrestrial vertebrate groups surveyed in this study followed Hoffman (1988). Some adjustments were required to compensate for differences in habitat patch sizes and patterns. Consideration was weighted toward methods that could be used for long-term monitoring at reasonable levels of effort.

Selection and location of sampling sites were determined using the wildlife habitat map. Investigations of amphibians, reptiles, birds, and small mammals were largely restricted to four major wildlife habitat classes. These habitat classes represent 57% of the total area in the valley and include: nutrient rich-deciduous, nutrient rich-mixed deciduous and coniferous, upland mesic-conifer, upland mesic-mixed deciduous and conifer. Two patches in each of these habitat classes were chosen for intensive sampling. Patches chosen ranged in size from 12 ha to 99 ha and were shaped to allow sampling at least 150 m from the patch edge. To ensure species being detected were in the habitat patches sampled, 150-200 m are recommended as the minimum distance from patch edge or between stations (Bibby et al. 1992, Blondel et al. 1981). Transect points and study plots were placed as near as possible to the center of each patch. Some species detections may represent effects from adjacent habitat patches. Patches representing other habitats were not of sufficient size to provide accurate defendable results.

AMPHIBIANS AND REPTILES:

It is generally accepted that a combination of time-constrained searches, coarse woody debris surveys, and pitfall trapping are the most effective and efficient inventory methods available for amphibians and reptiles, (Corn and Bury 1990). A combination of pitfall trapping and time-constrained searches were used. Pitfall trapping provides data on the presence or absence of species. Because trapping effort can be quantified and standardized across study sites, relative abundances can be calculated. The main drawbacks of pitfall trapping include mortality and trapability, which differs widely among species (Bury and Corn 1987, Campbell and Christman 1982, Gibbons and Semlitsch 1981). Trapability refers to the probability of capturing an individual in a particular type of trap. Time-constrained searches are most useful for determining presence or absence of species. This method, also, provides initial data on the types of micro-habitats occupied by individual species. Time-constrained searches were employed to supplement data on those species with poor trapability and to survey micro-habitats (downed

logs, stumps, rock piles) that might have species we would not find in pitfall traps.

Sixteen pitfall traps, arranged in four by four grids with each trap 15 m apart, were installed in each of seven study sites. The eighth sample unit (nutrient rich: deciduous, Site 1) was not sampled, because the water table and flooding made it impossible to keep the traps from filling with water. Details of trap construction and installation are in Corn and Bury (1990). Drift fences were not used. Sampling began on June 19 and ended November 24, 1991. Grids were opened on a rotational schedule. Half of the grids were run for two weeks, the other half of the grids were opened the second two weeks. During each two week period, traps were opened for four or five consecutive nights each week of the sampling period. Traps were checked once daily.

Time-constrained searches were performed in downed logs, stumps, leaf litter, and rock piles in the four major habitat classes. Sampling began on September 18 and ended November 20, 1991. Effort was concentrated on downed logs. Logs were classified as to their decay level (Bartels et al. 1985) and searched using methods described by Corn and Bury (1990).

Most amphibians and reptiles captured in pitfall traps and/or found in logs and stumps were released at the site of capture. However, a few individuals were collected as voucher specimens. Standard curatorial procedures (Aubrey 1985, National Park Service 1990a and 1990b) were used for all specimens collected. All specimens collected were preserved in ethanol and sent to the Burke Museum, University of Washington for species verification.

BIRDS:

Birds were sampled using the Station Index Method (Mannan and Meslow 1981). This method provides a random estimate of the number and kinds of individuals in a particular location (Hoffman 1988). Two stations were flagged in each of the four major habitat classes, one station per each of the eight study patches. Each station was placed in the center of the patch being sampled. Three counts were conducted at each station, except Station 8 (upland mesic: mixed deciduous and coniferous, Site 2), which was censused only twice, due to high winds. Two counts were conducted between sunrise and two hours after sunrise. The third count was conducted at mid-day to sample diurnal species, such as hawks and flycatchers, which are more easily detected during periods when the sun is at its apex (Hoffman 1988). Censuses started on June 9 and were completed by July 5, 1991. Counts began ten minutes after arriving at the station to allow the birds to readjust to the presence of the observer. Individual bird detections were then tallied during three consecutive ten-minute periods. Detections are defined as "all birds observed or heard within

a 200 m radius of the count station". Every attempt was made to census only birds detected within the habitat class being surveyed. Counts were performed only on days without precipitation and with low wind velocity (less than 15 km/hour). All counts were performed by the same observer.

Winter bird species using the valley were surveyed during January and February, 1992, by observations recorded in each of the four predominant wildlife habitat classes. Observations were recorded by walking through the habitat class patch (same as used for station index counts) in a fashion similar to that used in the National Audubon Society's "Winter Bird Population Study" (Kolb 1965). In addition to sampling conducted in the four predominant wildlife habitat classes, miscellaneous observations were recorded in several other wildlife habitat classes (open water/emergent vegetation; human activity/use/disturbances).

Harlequin ducks, considered as a species of special concern by several northwestern states (Cassirer and Groves 1991, Wallen 1987, Kuchel 1977), were surveyed along the Stehekin River during April through September of 1990 and 1991. Fourteen surveys were completed from the mouth of the Stehekin River to High Bridge. Surveys were conducted by either walking adjacent to the river bank or by rafting down the river. During each survey, observers recorded information on group composition (males, females, young) and mapped all duck locations on aerial photographs.

MAMMALS:

Mammals were surveyed using a combination of live-trapping, pitfall trapping, self-activated camera stations, and ground searches for tracks, scat, and other evidence of presence. One live-trapping grid and one pitfall trapping grid were setup in each of the eight study patches. The pitfall grid in nutrient rich: deciduous, Site 1, was not used, because of flooding.

The live-trapping grids consisted of 15 traps arranged in rows (three rows of four and one row of three) with traps spaced 15 m apart. A combination of six small (2 in X 2 1/2 in X 6 1/2 in) and six large (3 in X 3 1/2 in X 9 in) Sherman traps, plus three small (7 in X 7 in X 24 in) Havahart traps were used in each grid. Traps were arranged so that adjacent traps were not of the same type. A mixture of rolled oats and peanut butter were used to bait each trap. All traps were placed at their trap sites at least 24 hours in advance of being set. Sampling began on June 19 and ended on October 4, 1991. Live-trapping grids were run on the same schedule as the pitfall. The pitfall trapping grids used for sampling mammals were the same as those used for sampling amphibians and reptiles.

Ground searches for evidence of tracks or scat were conducted

in each of the eight study patches. Documentation of this evidence included photographs of tracks and collection of scat. In addition to these searches, miscellaneous observations were recorded on ortho-photo (1:6000) maps for all wildlife habitats in the valley.

Self-activating camera stations were placed at locations within the study area to document use by mammals not sampled in trapping grids. Using 35 mm cameras with infrared censors, units were placed in locations near game trails or other areas of suspected mammal use. This method has been effective in sampling ursids, canids, felids, and mustelids (Almack 1990).

Mountain goat surveys were conducted during March, 1991, December, 1991, January, 1992, and March, 1992. Each survey consisted of six observation stations. Slopes were scanned with binoculars and/or spotting scopes for 30 to 60 minutes at each station. All goat observations were mapped and classified as adults or kids.

Data Analysis Methods:

Total number of captures of each species of small mammals, amphibians, and reptiles were tallied for each trapping grid and converted to capture rates (captures/100 trap-nights). Capture rates were used to determine relative abundance of small mammals, amphibians, and reptiles for each habitat class. Confidence intervals of 95 % were determined for the proportions of captures (presence/absence) of mammals from live traps and pitfall traps and of amphibians and reptiles for pitfall traps for each of the four major habitat classes according to methods found in Zar (1984: p. 378). Contingency table analysis (Zar 1984) was performed on both live trap and pitfall trap capture data for mammals to analyze if the proportion of captures among the various habitat classes were the same or if the alternative hypothesis, the proportion of captures varies among the four habitat classes was true. The proportions of captures for each habitat class were normalized using an "angular transformation" (Zar 1984:formula 14.5, p. 240). A Tukey Test for multiple comparisons of proportions (Zar 1984: pp. 401-402) was used to determine specific differences in capture proportions among the four habitat classes. Contingency table analysis and the Tukey Test were not performed for amphibian and reptile pitfall trapping data because sample sizes were too small.

Direct counts of individuals were used to determine breeding season bird species richness in each of the four major habitat classes. We developed rarefaction curves (Ludwig and Reynolds 1988) for each habitat class sampled to determine expected bird species richness as a function of sample size and to allow comparison of species richness between habitat classes. The Jaccard Index (Ludwig and Reynolds 1988:131) was used to calculate similarity coefficients between pairs of habitat

habitat classes. This index, based on presence/absence of species, is the proportion of the number of species found in common in two study units (habitat classes) to the total number of species in both study units.

For the winter bird, breeding bird atlas, and harlequin duck surveys, direct counts of species were used to determine species presence/absence in each of the 15 wildlife habitat classes occurring in the Stehekin Valley. This was accomplished by mapping all wildlife sightings on ortho-photos (1:6000) and digitizing these data into a GIS database.

RESULTS AND DISCUSSION

WILDLIFE HABITAT MAP:

Area and composition of the various wildlife habitat classes are shown in Appendix 2. Nearly 47 % (909 ha) of the Stehekin Valley is comprised of the three upland mesic habitat classes (deciduous, coniferous, and mixed). Nutrient rich habitat classes account for approximately 18 % (350 ha) of the area. The remaining 35 % (667 ha) of the valley has been grouped into eight other classes representing the following habitat classes: water and emergent vegetation, talus slopes/active erosion, talus drainage, ravines, xeric shrub, nutrient poor, sand/gravel/ cobble, and human use/disturbance. The human use/disturbance category accounts for approximately 6 % (115 ha) of the area.

AMPHIBIANS AND REPTILES:

A total of five amphibian species and eight reptile species were observed or trapped during the 1991 study period (Appendix 3). Amphibians and reptiles were relatively scarce in the four major wildlife habitat classes sampled (Tables 1 and 2). Capture rates for pitfall trap samples ranged from 0.097 (captures/100 trap-nights) in the nutrient rich: mixed habitat class to 1.136 in the upland mesic: conifer habitat class. Time-constraint surveys in these four wildlife habitats yielded only seven captures of three species during 14.1 hours of sampling. Combining the two sampling methods, the most common species captured were long-toed salamander (*Ambystoma macrodactylum*) and western fence lizard (*Sceleporus occidentalis*) with nine and eight captures, respectively. Eighteen (72 %) of the total captures were from the upland mesic habitat classes.

The Stehekin Valley contains a relatively depauperate terrestrial amphibian community. We documented only one salamander species and four frog/toad species. A Washington Department of Wildlife checklist (Hodge date unknown) identifies three salamanders and five frogs/toads as inhabiting the intermountain forest region of Washington. In

Table 1. Amphibian and reptile relative abundance and number of species captured by pitfall traps from four habitat classes in the Stehekin River drainage, Washington, June-October, 1991.

Habitat Class	Total Trap-nights	Total No. Captured	Catch (100 Trap-nights)	Confidence Interval(95%)	Total No. Species
Nutrient Rich-Deciduous	511	1	0.196	0.005 - 1.082	1
Nutrient Rich-Mixed	1024	1	0.097	0.002 - 0.542	1
Upland Mesic-Conifer	1056	12	1.136	0.588 - 1.965	3
Upland Mesic-Mixed	1022	4	0.391	0.107 - 0.997	2
Total	3613	18	0.498		4

Table 2. Number of amphibian and reptile species captured in pitfall (PF) traps (total effort=3153 trap-nights) and time-constrained (TC) surveys (total effort=14.1 hours) from four habitat classes in the Stehekin River drainage, Washington, June-October, 1991.

Species	Habitat Class							
	Nutrient Rich Deciduous		Nutrient Rich Mixed		Upland Mesic Conifer		Upland Mesic Mixed	
	PF	TC	PF	TC	PF	TC	PF	TC
Ambystoma macrodactylum	1	1		2			3	2
Bufo boreas		1						
Hyla regilla					3		1	
Elgaria coerulea		1	1		1			
Sceloporus occidentalis					8			

comparison, studies in unmanaged Douglas-fir forests in the southern Washington Cascades documented 13 species of amphibians (Aubry and Hall 1991). Two species of frogs documented within the study area, Cascades frog (*Rana cascadae*) and spotted frog (*Rana pretiosa*), are designated by the U. S. Fish and Wildlife Service (FWS) as "candidate species" for listing under the Endangered Species Act of 1973, as amended.

Eight species of reptiles have been recorded using habitats within the park complex (National Park Service files). Within the Stehekin Valley, we documented seven of these species, plus one new species of snake, racer (*Coluber constrictor*), which was suspected to be within the species' range, but had remained undocumented (Nussbaum et al. 1983) in NOCA (Appendix 3). In comparison, a Washington Department of Wildlife checklist (Hodge date unknown) lists 17 reptile species as inhabiting the intermountain forest region of Washington.

Our data were unable to distinguish any differences in species richness between nutrient rich and upland mesic habitat classes for amphibians and reptiles combined and may be related to our small sample size. However, McComb et al (1993) found that amphibian species richness did not differ between streamside riparian habitats and adjacent upslope habitats. Sixteen of 18 individuals captured in pitfall traps came from the two upland mesic habitat classes (Table 2). Factors that could influence these results are: (1) Western fence lizards made up half (8) of the captures in the upland mesic habitat classes. Western fence lizards prefer dry talus slopes and rock or log piles in wooded areas (Nussbaum et al 1983). These habitat features are more common in the upland mesic habitat classes. (2) Five species [northern alligator lizard (*Elgaria coeruleus*), western fence lizard (*Sceloporus occidentalis*), rubber boa (*Charina bottae*), racer (*Coluber constrictor*), western terrestrial garter snake (*Thamnophis elegans*) were documented using the active erosion / talus habitat class or rock piles (as micro-habitats) within the upland mesic habitat classes. Talus slopes are unique habitats (Maser et al. 1979) and have been documented to be important habitats for amphibians and reptiles (Herrington 1988). The active erosion / talus habitat class accounts for only 2.6 % of the area, but appears to be important micro-habitat sites for the valley's herpetofauna.

BIRDS:

Since 1988, a total of 96 species have been detected within the riparian and upland habitat classes of the Stehekin Valley (Appendix 3). An additional eight species were observed only on Lake Chelan during the study period. These detections are the result of Station Index counts (1991), winter bird surveys (1992), miscellaneous survey observations (1991), breeding bird atlas surveys (1988-91), and harlequin duck surveys

(1990-91). An additional 17 species are documented in the North Cascades Wildlife Database since 1980 (Appendix 3). These findings are similar to other studies, which found between 90 and 100 species using mixed conifer forest (Sanderson et al. 1980, Thomas 1979) in the interior Northwest.

Breeding Birds:

Three hundred twenty five birds of 44 species were detected on 23 Station Index counts (Table 3). The number of species detected in each of the four major habitat classes during the census visits ranged from 23 (upland mesic: conifer) to 27 (nutrient rich: mixed and upland mesic: mixed). The number of individuals recorded in these four habitat classes ranged from 68 (nutrient rich: deciduous) to 99 (upland mesic: mixed).

Using individuals detected, we calculated rarefaction curves to determine expected number of species in each habitat class. Effort was standardized to compare species richness between habitat classes. At a sample size of 55 individuals, the expected number of species ranged from 20 (upland mesic: conifer) to 23 (nutrient rich: deciduous and nutrient rich: mixed) (Figure 2). This sample size was chosen, because it was the highest common denominator among the four habitat classes. The rarefaction curves indicate nutrient rich habitat classes have slightly higher species richness than upland mesic habitat classes. However, both nutrient rich and upland mesic habitat classes contributed to the overall total species richness of the valley.

Eight species [Hammond's flycatcher (*Empidonax hammondii*), Swainson's thrush (*Catharus ustulatus*), American robin (*Turdus migratorius*), red-eyed vireo (*Vireo olivaceus*), yellow-rumped warbler (*Dendroica coronata*), MacGillivray's warbler (*Oporornis tolmiei*), western tanager (*Piranga ludoviciana*), and dark-eyed junco (*Junco hyemalis*)] dominated the composition of these four habitat classes (Table 3). These eight species were detected in all four habitat classes and represented 50 % (163/325) of all detections recorded. Twelve species (27 %) were detected in only one of the four habitat types. When all habitat classes are combined, 21 species (48 %) of the 44 total species detected were recorded three or fewer times.

When Jaccard Similarity Coefficients were calculated, species composition was most similar between the two nutrient rich habitat classes and the mixed forest habitat classes (Table 4). The upland mesic: conifer habitat class' species composition was the least similar and differed equally among the nutrient rich and mixed habitat classes.

Table 3. Number of bird species detections from 23 (N) station index counts for four habitat classes in the Stehekin River drainage, Washington, June-July, 1991.

	Habitat Class			
	Nutrient Rich Deciduous (N=6)	Nutrient Rich Mixed (N=6)	Upland Mesic Conifer (N=6)	Upland Mesic Mixed (N=5)
Red-tailed Hawk	0	0	0	1
Blue Grouse	0	1	0	1
Ruffed Grouse	0	0	0	1
Barred Owl	0	1	0	0
Common Nighthawk	0	1	2	0
Black Swift	0	0	3	0
Swift spp.	0	4	0	1
Hummingbird spp.	0	0	1	0
Belted Kingfisher	2	0	0	1
Red-naped Sapsucker	0	0	1	1
Pileated Woodpecker	2	1	0	0
Woodpecker spp.	0	1	0	1
Olive-sided Flycatcher	1	1	0	0
Western Wood-Pewee	2	4	3	0
Hammond's Flycatcher	6	7	5	6
Steller's Jay	2	1	1	0
Black-capped Chickadee	1	0	0	0
Chestnut-backed Chickadee	2	4	0	8
Red-breasted Nuthatch	0	2	5	3
Brown Creeper	5	3	0	4
Winter Wren	3	2	0	3
Marsh Wren	1	0	0	0
Golden-crowned Kinglet	1	0	2	3
Veery	5	3	0	1
Swainson's Thrush	1	8	2	13
Thrush spp.	1	0	0	0
American Robin	11	10	4	6
Varied Thrush	3	4	0	0
Cedar Waxwing	0	0	1	0
Solitary Vireo	1	0	0	0
Warbling Vireo	0	2	0	1
Red-eyed Vireo	6	6	1	1
Nashville Warbler	0	1	0	2
Yellow Warbler	1	0	0	0
Yellow-rumped Warbler	1	4	6	10
Townsend's Warbler	0	2	0	10
MacGillivray's Warbler	3	1	2	1
Wilson's Warbler	0	0	1	0
Western Tanager	1	2	9	7
Brown-headed Cowbird	0	0	1	0
Chipping Sparrow	0	0	7	0
Song Sparrow	3	1	0	0
Dark-eyed Junco	1	4	13	5
Purple Finch	0	0	2	0
Finch spp.	0	2	0	1
Red Crossbill	0	0	1	0
Pine Siskin	0	0	0	4
Evening Grosbeak	2	0	1	3
Passerine spp.	0	0	1	0
Total Individuals	68	83	75	99
Total Species	25	27	23	27

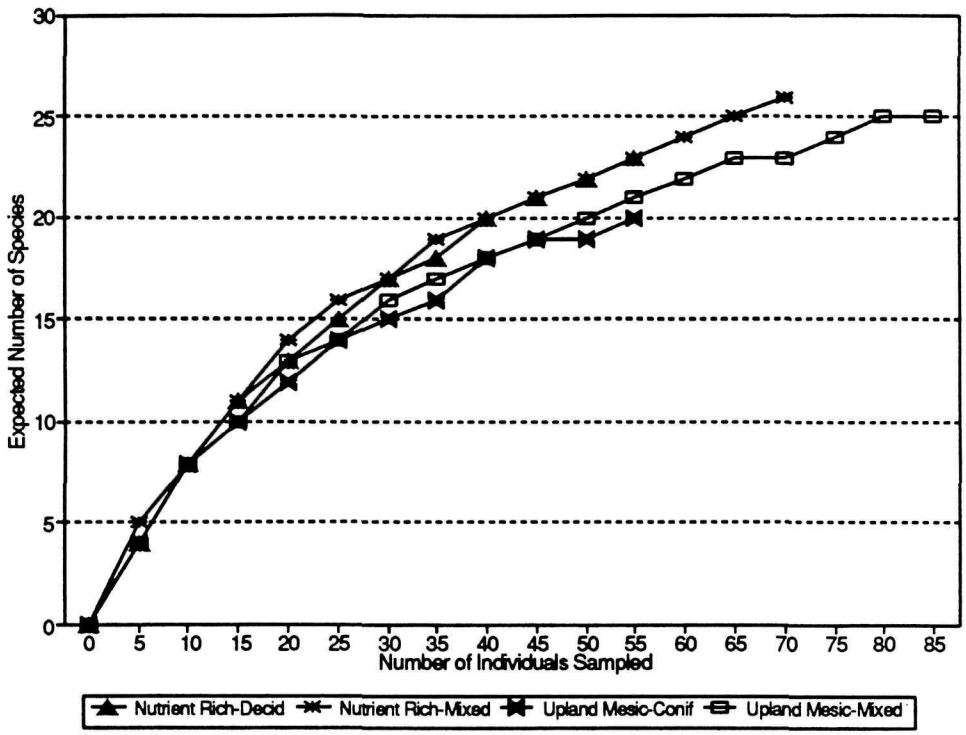

Figure 2. Rarefaction curves for the expected number of bird species observed from the four habitat classes in the Stehekin River drainage, Washington, June-July, 1991.

Table 4. Jaccard Similarity Coefficents based on presence and absence of bird species between habitat classes in the Stehekin River drainage, Washington June-July, 1991. (values range from 0 to 1, with greatest similarity occuring at a value of 1)

	Habitat Class			
Habitat Class	Nutrient Rich Deciduous	Nutrient Rich Mixed	Upland Mesic Conifer	Upland Mesic Mixed
Nutrient Rich Deciduous		0.53	0.32	0.41
Nutrient Rich Mixed			0.32	0.54
Upland Mesic Conifer				0.32

Winter Birds:

A total of 347 birds, representing 25 species, were detected during four days of observations in January and February, 1992 (Table 5). Wintering waterfowl were the predominate species detected, making up nearly half of the detections (171 individuals of 9 species). Pine siskin (*Carduelis pinus*), evening grosbeak (*Coccothraustes vespertina*), chestnut-backed chickadee (*Parus rufescens*), red-breasted nuthatch (*Sitta canadensis*), and golden-crowned kinglet (*Regulus satrapa*) were observed in moderate abundance. One adult bald eagle (*Haliaeetus leucocephalus*) was observed at the head of Lake Chelan.

Harlequin Ducks:

We recorded 103 observations of harlequin ducks on 14 surveys conducted during the breeding seasons of 1990 and 1991 (Table 6). An estimate of seven to eleven pairs of harlequin ducks nested on the Stehekin River, between the mouth of the river and High Bridge, during 1991. We observed a similar number of pairs on the river during 1990. Pair densities were estimated by dividing the maximum number of pairs observed on spring censuses (May 1990, April 1991) into the length of lower Stehekin River (length = 16.7 km). Pair densities ranged from 0.42 (1990, N = 7) to 0.66 (1991, N = 11) pairs per kilometer ($\bar{x}$ = 0.54). Harlequin ducks are considered a "species of concern" in Idaho, Montana, and Wyoming, due to low or declining populations. Cassirer and Groves (1991) found harlequin duck pair densities on streams in Idaho ranged from 0.06 pairs/km to 1.33 pairs/km ($\bar{x}$ = 0.21; N = 193.5 km). Studies conducted at Glacier National Park, Montana (Kuchel 1977), and at Grand Teton National Park, Wyoming (Wallen 1987), calculated harlequin duck pair densities at 0.67-0.91 pairs/km (n = 16 km) and 0.67-1.25 pairs/km (n = unknown), respectively.

Harlequin duck nests are very difficult to find (Cassirer and Groves 1991). We were unable to locate any nests during the study. Observations of broods on the river first occurred in mid-June of both years. Observed brood sizes ranged from one to six ($\bar{x}$ = 3.67, N = 12) in 1990 and two to six ($\bar{x}$ = 4, N = 2) in 1991. In 1990, broods observed on the early-August survey were not accompanied by females, and based on an approximate 42-day development period before flight (Wallen 1987, Bengston 1972), were assumed to have fledged. Three groups of fledglings were observed in August, 1990, and no groups of fledglings were observed in August, 1991. We observed no harlequin ducks on the lower Stehekin River on the early-September census in either year.

Harlequin ducks arrive on the Stehekin River from late March through April. Egg-laying probably occurs from late April to early June. Shortly after females begin incubation, males

Table 5. Number of bird species detections from four days of observations in the Stehekin River drainage, Washington, January-February, 1992.

Species	Number of Detections	Habitat Class
Horned Grebe	2	Open Water/Emergent Vegetation
Canada Goose	119	Open Water/Emergent Vegetation
Mallard	16	Open Water/Emergent Vegetation
American Wigeon	1	Open Water/Emergent Vegetation
Ring-necked Duck	4	Open Water/Emergent Vegetation
Common Goldeneye	2	Open Water/Emergent Vegetation
Barrow's Goldeneye	5	Open Water/Emergent Vegetation
Goldeneye spp.	8	Open Water/Emergent Vegetation
Bufflehead	16	Open Water/Emergent Vegetation
Common Merganser	6	Open Water/Emergent Vegetation
Bald Eagle	1	Nutrient Rich-Mixed
Belted Kingfisher	1	Sand/Gravel/Cobble
Downy Woodpecker	1	Nutrient Rich-Mixed
Northern Flicker	2	Nutrient Rich-Decid., Upland Mesic-Conif.
Steller's Jay	1	Nutrient Rich-Decid.
Common Raven	2	Over Upland Mesic-Conif.
Chestnut-backed Chickadee	16	Nutrient Rich-Mixed and Decid., Upland Mesic-Mixed and Conif.
Red-breasted Nuthatch	12	Nutrient Rich-Mixed, Upland Mesic-Mixed and Conif.
Brown Creeper	4	Nutrient Rich-Mixed and Decid., Upland Mesic-Conif.
Winter Wren	8	Nutrient Rich-Mixed and Decid., Upland Mesic-Mixed
American Dipper	3	Sand/Gravel/Cobble
Golden-crowned Kinglet	12	Nutrient Rich-Mixed and Decid., Upland Mesic-Mixed
Varied Thrush	3	Nutrient Rich-Mixed
Dark-eyed Junco	3	Upland Mesic-Conifer.
Pine Siskin	57	Nutrient Rich-Mixed and Decid., Upland Mesic-Mixed
Evening Grosbeak	42	Nutrient Rich-Decid., Upland Mesic-Mixed
Total Number	347	
Total Species	25	

Table 6. Harlequin duck use of the lower Stehekin River (High Bridge to the mouth), Washington, April-September, 1990-1991.

Date	Pairs	Total # By Sex M	F	Broods	Brood Size Mean (range)
05/17/90	7	10	8	0	
06/12/90	4	4	7	1	6.00
07/02/90	0	0	7	4	2.75 (1-4)
07/03/90	1	1	9	4	3.75 (1-6)
08/07/90	0	0	3	3	4.00 (2-6)
09/06/90	0	0	0	0	
04/26/91	11	18	11	0	
05/14/91	7	16	8	0	
05/28/91	3	7	7	0	
06/13/91	3	4	9	1	6.00
07/02/91	0	0	6	1	2.00
07/24/91	0	0	3	0	
08/13/91	0	0	5	0	
09/10/91	0	0	0	0	

depart and return to coastal waters. This life history trait eliminates opportunities for renesting, if clutch failure occurs. The 1990-91 survey data shows only one male observed after July 1. Observations of broods first occurred in mid-June of both the 1990-91 census years. This coincides with suspected egg-laying and harlequin duck incubation periods, which last 27-29 days (Bengston 1972). We continued to observe broods in July and last recorded broods on surveys in August. From late-August to mid-September, females and juvenile harlequin ducks leave the Stehekin River and return to coastal waters.

SMALL MAMMALS:

A total of 1626 individuals of twelve species were captured in the four habitat classes sampled in 1991 (Appendix 4). Eleven species were captured in live-traps and eight species were captured in pitfall traps. Catch/100 trap-nights was much higher for live-traps (68.03) than for pitfall traps (3.18) (Tables 7 and 8). Results of studies in the Oregon Cascades (Anthony et al. 1987) and the Oregon Coast Range (McComb et al. 1993) indicate small mammal species richness is higher than what we found in the Stehekin Valley.

Results of small mammal trapping indicate that nutrient rich habitat classes had a greater number of species and higher catch rates than found for upland mesic habitat classes in both live-trap samples and pitfall trap samples (Figure 3). Contingency Table Analysis indicates that the proportions of captures from both live-trap data and pitfall trap data varied among the four habitat classes and the null hypothesis was rejected (X^2 live trap = 377.85, $p < 0.05$; X^2 pitfall trap = 46.48, $p < 0.05$). We performed a Tukey Test for multiple comparisons to test which habitat classes were different with respect to small mammal capture proportions (Table 9). Analysis of the live-trap data for the four habitat classes show all habitat classes differed significantly ($p < 0.05$) and rejected the null hypothesis ($h°:p1=p2=p3=p4$). Analysis of the pitfall trap data produced similar results with the exception that there was no significant difference ($p < 0.05$) between the proportions of captures in nutrient rich: deciduous and nutrient rich: mixed habitat classes.

Deer mice (*Peromyscus maniculatus, P. oreas*) were the most common small mammals encountered, making up 87.3 % (1419/1626) of all captures (Figure 4). This is similar to results found by Anthony et al. (1987) in the Oregon Cascades (*P. maniculatus* capture rates = 76 % and 83 %). However, when live-trap and pitfall trap sampling are compared separately, shrews (*Sorex trowbridgei, S. monticolus, S. vagrans*) were the most common small mammal (66.1 % total captures) captured in the pitfall trap grids (Figure 4, Appendix 4). Regional analyses (Aubrey et al. 1991) of Pacific Northwest old-growth Douglas-fir forest studies also found *S. trowbridgei, S.*

Table 7. Small mammal relative abundance and number of species collected by live traps from four habitat classes in the Stehekin River drainage, Washington, May-October, 1991.

Habitat Class	Total Trap-nights	Total No. Captured	Catch (100 Trap-nights)	Confidence Interval(95%)	Total No. Species
Nutrient Rich-Deciduous	504	452	89.68	86.77 - 92.16	8
Nutrient Rich-Mixed	608	505	83.06	80.05 - 85.80	8
Upland Mesic-Conifer	576	239	41.49	38.28 - 43.93	5
Upland Mesic-Mixed	533	315	59.10	56.66 - 62.50	5
Total	2221	1511	68.03		11

Table 8. Small mammal relative abundance and number of species collected by pitfall traps from four habitat classes in the Stehekin River drainage, Washington, May-October, 1991.

Habitat Class	Total Trap-nights	Total No. Captured	Catch (100 Trap-nights)	Confidence Interval(95%)	Total No. Species
Nutrient Rich-Deciduous	511	31	6.07	4.20 - 8.54	6
Nutrient Rich-Mixed	1024	51	4.98	3.73 - 6.50	8
Upland Mesic-Conifer	1056	8	0.76	0.75 - 0.85	2
Upland Mesic-Mixed	1022	25	2.45	1.59 - 3.57	3
Total	3613	115	3.18		8

Table 9. Tukey test for multiple comparisons of proportions to determine specific differences in small mammal capture proportions, from live trap and pitfall trap data, among the four habitat classes. (breaks in underlined habitat classes represent significant differences, $p<0.05$)

	Live Trap			
Rank	1	2	3	4
Habitat Class	Nutrient Rich Decid.	Nutrient Rich Mixed	Upland Mesic Mixed	Upland Mesic Conifer.
	Pitfall Trap			
Rank	1	2	3	4
Habitat Class	Nutrient Rich Decid.	Nutrient Rich Mixed	Upland Mesic Mixed	Upland Mesic Conifer.

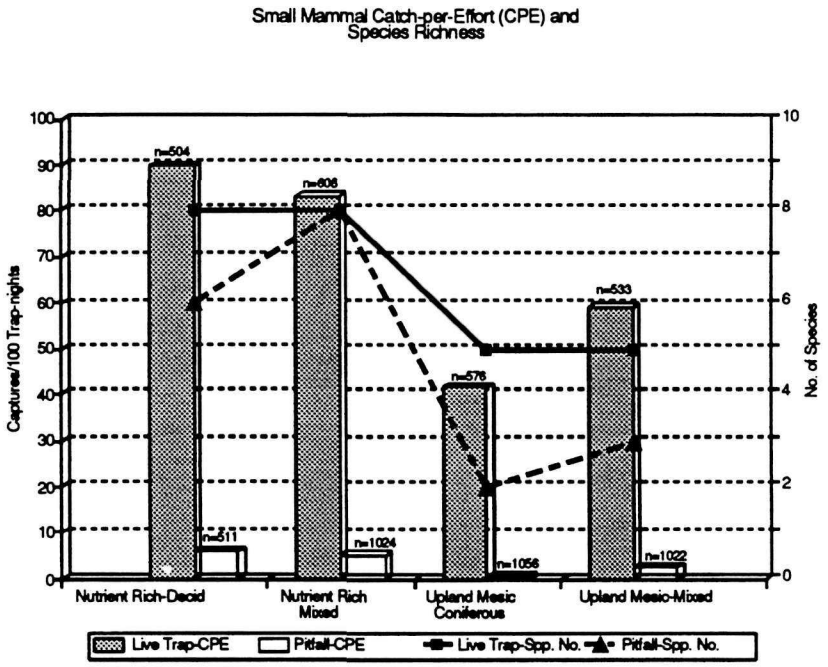

Figure 3. Small mammal relative abundance and number of species collected by live traps and pitfall traps from four habitat classes in the Stehekin River drainage, Washington, May-October, 1991.

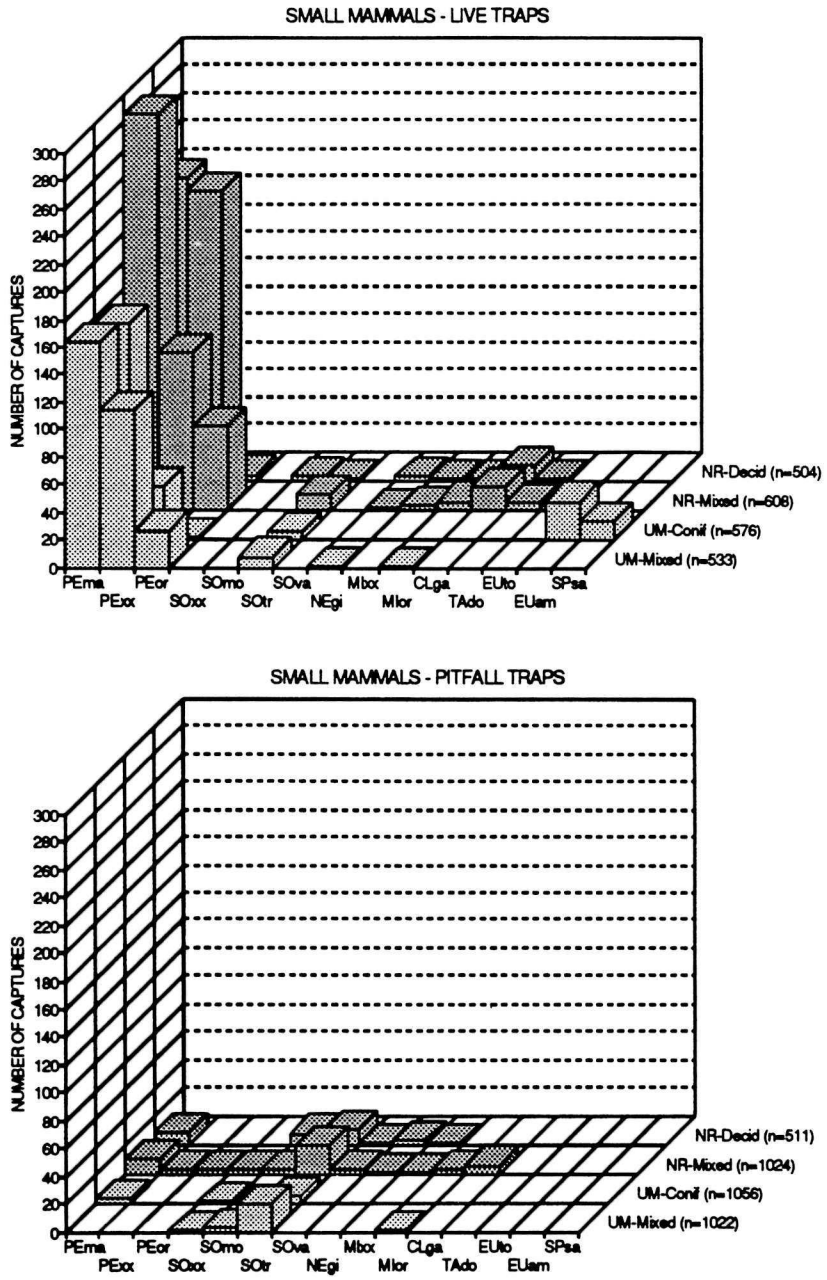

Figure 4. Total number of small mammals (by species) captured in pitfall and live traps from four habitat classes in the Stehekin River drainage, Washington, May - October, 1991.

(PEma - Peromyscus maniculatus, PExx - Peromyscus spp., PEor - Peromyscus oreas, SOxx - Sorex spp., SOmo - Sorex monticolus, SOtr - Sorex trowbridgei, SOva - Sorex vagrans, NEgi - Neurotrichus gibbsii, Mlxx - Microtus spp. Mlor - Microtus oregoni, CLga - Clethrionomys gapperi, TAdo - Tamiasciurus douglasii, EUto - Eutamias townsendii, EUam - Eutamias amoenus, SPsa - Spermophilus saturatus.)

monticolus, and *S. vagrans* to be abundant species captured in all provinces of their study. Seven species (*Clethrionomys gapperi, Eutamias amoenus, Spermophilus saturatus, Microtus oregoni, Neurotrichus gibbsii, Tamiasciurus douglasii, Eutamias townsendii*) made up only 6.4 % of the total captures. One species (*Sorex vagrans*) was caught only in the pitfall trap grids and four species (*Tamiasciurus douglasii, Eutamias amoenus, Eutamias townsendii, Spermophilus saturatus*) were captured only in the live trap grids.

Mountain Goats:

Table 10 shows the results of four mountain goat surveys conducted in the Stehekin Valley from March 6, 1991 to March 10, 1992. Based on the high counts for one survey, we identified six goats in 1991, and seventeen goats in 1992. To assess productivity, kid:adult ratios (expressed as the number of kids/100 adults) were examined. No kids were observed in 1991. The 1992 ratio was 13 kids/100 adults. The Public Utility District No. 1 of Chelan County (Chelan PUD) has surveyed mountain goats in the Stehekin Valley and shores above Lake Chelan since 1982. Chelan PUD reports that the ten-year (1982-1991) kid:adult ratio ranged from 14-43 kids/100 adults in the Stehekin Valley and ranged from 18-29 kids/100 adults for the total Lake Chelan study (Fielder 1991).

CONCLUSIONS

The distributional pattern of forest vegetation, plant species composition, and forest structure directly influence wildlife species composition, abundance, and distribution (Hall 1980). Our study compared riparian and upland forest habitat classes in the Stehekin Valley. Structural components of the vegetal habitat classes were not measured in this study. However, it was apparent from observations of the habitat classes that the riparian habitat classes and the mixed forest habitat classes have greater forest structure than the upland mesic: conifer habitat class. Tanimoto (1991) studied the distributional pattern of vegetation in the Stehekin Valley and performed an analysis of ecological habitat diversity, based on similarity of adjacent one ha plots. He found riparian habitat classes had greater habitat diversity than upland habitat classes. Riparian habitat classes had smaller patch size and exhibit greater heterogeneity than the upland habitat classes, which had larger patch sizes and were more homogeneous.

We documented presence of 138 terrestrial vertebrate species within the lower Stehekin Valley from the summer of 1988 through late winter, 1992. These included five species of amphibians, eight species of reptiles, 104 species of birds, and 21 species of mammals. Approximately 265 terrestrial vertebrate species could potentially occur within the Stehekin

Table 10. Number of adult (AD) and young (KID) mountain goats from four surveys, Stehekin Valley, Washington, March, 1991 - March, 199

Station*	03/06/91		12/18/91		01/08/92		03/10/92	
	AD	KID	AD	KID	AD	KID	AD	KID
1	1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	4	0	0	0	0	0
4	0	0	2	0	6	0	0	0
5	0	0	1	0	3	0	0	0
6	5	0	2	0	6	2	0	0
Total	6	0	9	0	15	2	0	0
KID/100 AD					13/100			

*Locations of survey station:

Station 1: head of Lake Chelan looking at cliffs above Weaver Point.
Station 2: near Boulder Creek, looking eastward at cliffs.
Station 3: near Hammett's house, looking NE at cliffs.
Station 4: airstrip, looking at cliffs on both sides of valley.
Station 5: McGregor Meadows, looking on NE side of road.
Station 6: lower field, looking on NE side of road.

Valley, including 25 species of amphibians and reptiles, 175 species of birds, and 65 species of mammals (National Park Service files, U.S. Forest Service files, Hodge date unknown, M. Johnson pers. comm.).

Results of our wildlife inventory found that species richness between riparian and adjacent upland habitat classes did not vary for amphibians and reptiles and was slightly higher in riparian habitat classes for birds and small mammals. Both the riparian and upland habitat classes contribute to the overall species richness in the valley. Other studies (Anthony et al. 1987, McComb et al. 1993) of riparian areas in the Pacific Northwest have shown conflicting results. Sample sizes for amphibians and reptiles (captures) and for birds (visual and auditory detections) were too small to draw significant conclusions. Vertebrate species, particularly birds, are highly mobile creatures. Study patch size and shape contribute to edge effect and cause additional problems in drawing conclusions from our data.

Winter bird species richness in the Stehekin Valley is significantly less than breeding season species richness. Species common during the breeding season either migrate or become much less common during winter. The most common species in January and February are wintering waterfowl and resident landbirds.

Relative abundance of small mammals was significantly different between riparian and upland habitat classes. Significant differences were also found between mixed forest classes and deciduous or coniferous classes. The upland mesic: conifer habitat class had little understory vegetation and appeared to lack the structural complexity of the other three habitat types. Structural complexity in forest habitats has been documented as a major factor influencing small mammal abundance (McComb 1993,). Deer mice had substantially higher capture rates in all habitat classes. However, when live-trap data is removed, the pitfall trap data showed higher capture rates for Trowbridge's shrew in both mixed forest habitat classes. Menkens et al. (1988) refers to individual capture probability as a major source of error when estimating small mammal abundance. The live-trap grids were saturated with deer mice on many occasions and probably had an effect on capture probability of other species.

No differences in the relative abundance of amphibians could be distinguished among the four habitat classes. However, reptiles tend to favor upland habitat classes (Nussbaum et al. 1983). This may be due to abundance of micro-habitat sites (rock piles) that occur in the upland habitat classes. Western fence lizards were captured in the upland mesic: conifer habitat class, exclusively. Dry talus slopes and rock pile are preferred micro-habitats used by fence lizards (Nussbaum et al 1983) and were common at capture sites. Both

mixed forest habitat classes had slightly higher numbers of bird detections than the deciduous or coniferous habitat classes.

Two species of amphibians (Cascades frog and spotted frog) were recorded using wetlands habitats within the riparian zone. Both these species are federally listed "candidate" species. Presence of Cascades frogs in the Stehekin Valley provides new information on the elevational distribution of this species. Cascades frogs were thought to occur only above 500 m (K. McAllister pers. comm.). However, we found young Cascades frogs at 340 m in elevation.

Two federally listed "threatened" species (bald eagle and spotted owl) were recorded during field investigations. Bald eagles are occasionally observed along Lake Chelan and the Stehekin River in fall, winter, and spring (NOCA files). These eagles have been observed foraging on decaying fish. Several pairs of spotted owls nest within the Stehekin Valley (NOCA files, T. Flemming pers. comm.). These have been observed using mostly upland mesic habitat classes (T. Flemming pers. comm.). The peregrine falcon (*Falco peregrinus*) is federally listed as "endangered". Peregrine falcons have not been observed in the study area. However, the Stehekin Valley is within the species' distributional range and potential habitat does occur within the valley and adjacent mountain slopes. Two additional bird species (harlequin duck and northern goshawk), federally listed as "candidate" species, were recorded using habitat classes within the study area (Appendix 3). Harlequin ducks breed along the Stehekin River mainstem and goshawks breed within the Stehekin Valley in the upland mesic habitat class.

One mammal species (western gray squirrel), federally listed as "candidate" species, was recorded within the study area in the nutrient rich: conifer and upland mesic: conifer habitat classes. One "endangered" species [gray wolf (*Canis lupus*)], one "threatened" species [grizzly bear (*Ursus arctos*)] and three "candidate" species [Townsend's big-eared bat (Plecotus townsendii), fisher (*Martes pennanti*), and lynx *Felis lynx*)] have not been recorded within the Stehekin Valley since 1980. However, the Stehekin Valley is within the range of all of these species and potential habitat exists to support them. Wolverines (*Gulo gulo*), listed as a federal "candidate" species, has been observed within the Stehekin Valley since 1980 (North Cascades National Park Service Complex files), but was not observed during our field inventory.

Harlequin ducks use the lower Stehekin River from April through September each year. Pair densities in the lower Stehekin River were slightly lower than other studies conducted in Glacier National Park (Kuchel 1977) and Grand Teton National Park (Wallen 1987). Recent studies in Idaho (Cassirer and Groves 1991) had lower pair densities than our

study. Decline in harlequin duck distribution and lack of information about the species have caused several states to designate the harlequin duck as a "sensitive" species (Reel et al. 1989, Mosely and Groves 1990). Potential impacts to harlequin ducks include habitat loss (Johnson et al. 1987), human disturbance (Wallen 1987), and hunting (Goudie 1989). Conserving nesting and brood-rearing habitat is crucial if harlequin duck use of the lower Stehekin River is to continue.

We identified several habitat classes of particular importance to wildlife species. These include the nutrient rich riparian habitat classes (Appendix 2), the open water/emergent vegetation habitat class, and the active erosion/talus slope class. Rock piles were identified as special micro-habitat sites used by amphibians and reptiles. The riparian habitat classes comprise only 21 % of the lower Stehekin Valley. Yet 41 % of the private property in the valley is in these riparian habitat classes. We estimate approximately 76 ha of riparian habitat have already been altered within the valley. This does not include riparian habitat lost when Chelan PUD increased dam height in 1920's. Drastic reductions in riparian habitats have occurred in western North America outside national parks. The Stehekin Valley riparian ecosystem offers great management challenges and opportunities, if it is to remain intact for future generations.

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Appendix 1. Map of the Stehekin Valley study area showing the distribution of wildlife habitat classes.

Produced by: North Cascades National Park Service Complex
Software: GRASS

TITLE: Stehekin Vegetation reclassed to Wildlife Habitats
LOCATION: North Cascades National Park Service Complex, Washington

SCALE: 1 : 70892

REGION: 659752.02699325 5361593 674960.97725569 5352125

1 2 3 4 5 6 7 8 9 10
11 12 13 14 15

1 Deciduous - Nutrient Poor
2 Deciduous - Nutrient Rich
3 Mixed Deciduous and Coniferous - Nutrient Rich
4 Coniferous - Nutrient Rich
5 Coniferous - Upland Mesic
6 Deciduous - Upland Mesic
7 Mixed Deciduous and Coniferous - Upland Mesic
8 Slope and/or Talus Drainage Area
9 Active Erosion/Talus
10 Ravine
11 Xeric Uplands -- Sparse Vegetation
12 Snag Stands
13 Open Water/Emergent Vegetation
14 Sand/Gravel/River Cobble
15 Human Activity/Use/Disturbances

Appendix 2. Wildlife habitat classes of the Stehekin Valley, Washington.

Habitat Class	Habitat Number	Area (in hectares)	% Area
Nutrient poor: deciduous	1	58.6	3.0
Nutrient rich: deciduous	2	149.0	7.7
Nutrient rich: mixed deciduous and coniferous	3	145.2	7.5
Nutrient rich: coniferous	4	55.6	2.9
Upland mesic: coniferous	5	698.8	36.3
Upland mesic: deciduous	6	66.2	3.4
Upland mesic: mixed deciduous and coniferous	7	144.4	7.5
Slope and/or talus drainage area	8	60.6	3.1
Active erosion / talus	9	50.9	2.6
Ravine	10	19.0	1.0
Xeric uplands	11	64.5	3.3
Snag stands	12	0.2	0.0
Open water / emergent vegetation	13	257.6	13.4
Sand / gravel / river cobble	14	40.7	2.1
Human activity / use / disturbance	15	115.1	6.0
Total		1926.4	

Appendix 3. Terrestrial vertebrate species checklist for the Stehekin Valley, Washington.

BIRDS		HABITAT CLASS**														
Red-throated Loon	*Gavia stellata*											13				
Common Loon	*Gavia immer*											13				
Horned Grebe	*Podiceps auritus*											13				
Red-necked Grebe	*Podiceps grisegena*											13				
Western Grebe	*Aechmophorus occidentalis*											13				
American White Pelican*	*Pelecanus erythrorhynchos*											13				
Great Blue Heron	*Ardea herodias*	1	2									13	14	15		
Trumpeter Swan*	*Cygnus buccinator*											13				
Greater White-fronted Goose*	*Anser albifrons*											13				
Canada Goose	*Branta canadensis*											13	14	15		
Wood Duck	*Aix sponsa*											13				
Green-winged Teal	*Anas crecca*											13				
Mallard	*Anas platyrhynchos*	1	2	3								13				
Cinnamon Teal	*Anas cyanoptera*											13				
Northern Shoveler	*Anas clypeata*											13				
American Wigeon	*Anas americana*											13				
Ring-necked Duck	*Aythya collaris*											13				
Harlequin Duck	*Histrionicus histrionicus*											13	14			
Barrow's Goldeneye	*Bucephala islandica*											13				
Common Goldeneye	*Bucephala clangula*											13				
Bufflehead	*Bucephala albeola*											13				
Hooded Merganser*	*Lophodytes cucullatus*											13				
Common Merganser	*Mergus merganser*											13	14			
Osprey	*Pandion haliaetus*											13		15		
Bald Eagle	*Haliaeetus leucocephalus*			3									14			
Northern Harrier	*Circus cyaneus*													15		
Sharp-shinned Hawk	*Accipiter striatus*															
Cooper's Hawk	*Accipiter cooperii*															
Northern Goshawk	*Accipiter gentilis*		2			5				10						
Red-tailed Hawk	*Buteo jamaicensis*		2			5		7								
Blue Grouse	*Dendragapus obscura*			3				7								
Ruffed Grouse	*Bonasa umbellus*		2	3		5	6	7								
California Quail	*Callipepla californica*					5					11					
Sora*	*Porzana carolina*											13				
American Coot	*Fulica americana*											13		15		
Killdeer	*Charadrius vociferus*												14			
Spotted Sandpiper	*Actitis macularia*												14			
Wilson's Phalarope*	*Phalaropus tricolor*											13				
Ring-billed Gull*	*Larus delawarensis*											13	14			
California Gull*	*Larus californicus*											13	14			
Band-tailed Pigeon*	*Columba fasciata*															
Mourning Dove*	*Zenaida macroura*															

* Species documented in NOCA database file between 1980 and 1987, but undocumented during the study period of 1988-1992.

**Habitat class descriptions associated with numeric codes are shown in Appendix 2.

Appendix 3. (continued)

BIRDS		HABITAT CLASS**												
Western Screech-Owl	*Otus kennicottii*													
Great Horned Owl	*Bubo virginianus*													
Northern Pygmy-Owl	*Glaucidium gnoma*				5									
Spotted Owl	*Strix occidentalis*				5									
Barred Owl	*Strix varia*		2	3										
Common Nighthawk	*Chordeiles minor*			3	5									
Black Swift	*Cypseloides niger*				5									15
Vaux's Swift	*Chaetura vauxi*			3										15
Calliope Hummingbird	*Stellula calliope*				5									
Rufous Hummingbird	*Selasphorus rufus*				5									
Belted Kingfisher	*Ceryle alcyon*		2	3		7						13	14	15
Red-naped Sapsucker	*Sphyrapicus nuchalis*				5	7								
Red-breasted Sapsucker	*Sphyrapicus ruber*													
Downy Woodpecker	*Picoides pubescens*			3	5		8							
Hairy Woodpecker	*Picoides villosus*	1		3										
Northern Flicker	*Colaptes auratus*		2	3		7								15
Pileated Woodpecker	*Dryocopus pileatus*		2	3	5	7								15
Olive-sided Flycatcher	*Contopus borealis*		2	3										
Western Wood-Pewee	*Contopus sordidulus*		2	3	5									
Hammond's Flycatcher	*Empidonax hammondii*		2	3	5	7								
Pacific-slope Flycatcher	*Empidonax difficilis*													
Say's Phoebe	*Sayornis saya*													15
Western Kingbird	*Tyrannus verticalis*													
Tree Swallow	*Tachycineta bicolor*													15
Violet-green Swallow	*Tachycineta thalassina*													15
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*													15
Barn Swallow	*Hirundo rustica*													15
Gray Jay*	*Perisoreus canadensis*													
Steller's Jay	*Cyanocitta stelleri*		2	3	5	7								
Clark's Nutcracker	*Nucifraga columbiana*				5			9						
Black-billed Magpie*	*Pica pica*													
American Crow*	*Corvus brachyrhynchos*				5									
Common Raven	*Corvus corax*													
Black-capped Chickadee	*Parus atricapillus*		2											
Chestnut-backed Chickadee	*Parus rufescens*		2	3	5	7								
Red-breasted Nuthatch	*Sitta canadensis*			3	5	7								
Brown Creeper	*Certhia americana*		2	3	5	7								
House Wren	*Troglodytes aedon*													15
Winter Wren	*Troglodytes troglodytes*		2	3		7								
Marsh Wren	*Cistothorus platensis*		2											
American Dipper	*Cinclus mexicanus*	1	2	3								13	14	
Golden-crowned Kinglet	*Regulus satrapa*	1	2	3	5	7								
Townsend's Solitaire	*Myadestes townsendi*													
Veery	*Catharus fuscescens*		2	3		7								

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**Habitat class descriptions associated with numeric codes are shown in Appendix 2.

Appendix 3. (continued)

BIRDS		HABITAT CLASS**													
Swainson's Thrush	*Catharus ustulatus*		2	3		5		7							
Hermit Thrush*	*Catharus guttatus*														
American Robin	*Turdus migratorius*		2	3		5	6	7							
Varied Thrush	*Ixoreus naevius*		2	3		5									
Gray Catbird	*Dumetella carolinensis*	1													
American Pipit	*Anthus rubescens*												14		
Cedar Waxwing	*Bombycilla cedrorum*					5								15	
European Starling	*Sturnus vulgaris*					5								15	
Solitary Vireo	*Vireo solitarius*		2												
Warbling Vireo	*Vireo gilvus*			3				7							
Red-eyed Vireo	*Vireo olivaceus*		2	3		5		7							
Nashville Warbler	*Vermivora ruficapilla*			3				7							
Yellow Warbler	*Dendroica petechia*		2												
Yellow-rumped Warbler	*Dendroica coronata*		2	3		5		7							
Townsend's Warbler	*Dendroica townsendi*			3				7							
American Redstart	*Setophaga ruticilla*			3											
MacGillivray's Warbler	*Oporornis tolmiei*		2	3		5		7							
Common Yellowthroat	*Geothlypis trichas*											13			
Wilson's Warbler	*Wilsonia pusilla*					5									
Western Tanager	*Piranga ludoviciana*		2	3		5		7	8						
Black-headed Grosbeak	*Pheucticus melanocephalus*														
Lazuli Bunting	*Passerina amoena*														
Rufous-sided Towhee	*Pipilo erythrophthalmus*					5									
Chipping Sparrow	*Spizella passerina*					5									
Song Sparrow	*Melospiza melodia*		2	3											
White-crowned Sparrow*	*Zonotrichia leucophrys*														
Dark-eyed Junco	*Junco hyemalis*		2	3		5		7						15	
Red-winged Blackbird	*Agelaius phoeniceus*					5									
Brewer's Blackbird*	*Euphagus cyanocephalus*														
Brown-headed Cowbird	*Molothrus ater*					5								15	
Northern Oriole*	*Icterus galbula*														
Purple Finch	*Carpodacus purpureus*					5									
Red Crossbill	*Loxia curvirostra*					5							14		
White-winged Crossbill*	*Loxia leucoptera*														
Pine Siskin	*Carduelis pinus*		2	3				7						15	
Evening Grosbeak	*Coccothraustes vespertinus*		2			5		7							
MAMMALS															
Vagrant Shrew	*Sorex vagrans*		2	3											
Montane Shrew	*Sorex monticolus*		2	3											
Trowbridge's Shrew	*Sorex trowbridgei*		2	3		5		7						15	
Shrew-Mole	*Neurotrichus gibbsii*		2	3				7							
Bat (spp.)															

* Species documented in NOCA database file between 1980 and 1987, but undocumented during the study period of 1988-1992.

**Habitat class descriptions associated with numeric codes are shown in Appendix 2.

Appendix 3. (continued)

MAMMALS		HABITAT CLASS**											
Snowshoe Hare	*Lepus americanus*												15
Yellow-pine Chipmunk	*Eutamias amoenus*			3	4	5	6						15
Townsend's Chipmunk	*Eutamias townsendii*			3		5							
Cascades Golden-mantled Ground	*Spermophilus saturatus*					5						14	15
Western Gray Squirrel	*Sciurus griseus*				4	5							
Douglas' Squirrel	*Tamiasciurus douglasii*		2	3		5		7	8				
Northern Flying Squirrel	*Glaucomys sabrinus*												
Beaver	*Castor canadensis*	1	2	3		5					13		
Deer Mouse	*Peromyscus maniculatus*	1	2	3		5		7					15
Forest Deer Mouse	*Peromyscus oreas*		2	3		5		7					
Bushy-tailed Woodrat	*Neotoma cinerea*					5			9				15
Gapper's Red-backed Vole	*Clethrionomys gapperi*		2	3									
Long-tailed Vole	*Microtus longicaudus*												
Creeping Vole	*Microtus oregoni*		2	3				7					
Muskrat*	*Ondatra zibethicus*												
Porcupine*	*Erethizon dorsatum*												
Red Fox*	*Vulpes vulpes*												
Black Bear	*Ursus americanus*	1	2	3		5		7			11		15
Raccoon	*Procyon lotor*		2	3									
Marten	*Martes americana*			3									
Long-tailed Weasel*	*Mustela frenata*												
Mink*	*Mustela vison*												
Wolverine*	*Gulo gulo*												
Skunk (spp.)*													
River Otter*	*Lutra canadensis*												
Mountain Lion	*Felis concolor*		2										
Elk	*Cervus elaphus*				4								
Mule Deer	*Odocoileus hemionus*	1	2	3	4	5		7	9		13		15
White-tailed Deer*	*Odocoileus virginiana*												
Moose	*Alces alces*									11			15
Mountain Goat	*Oreamnos americanus*												
AMPHIBIANS													
Long-toed Salamander	*Ambystoma macrodactylum*		2	3				7					
Western Toad	*Bufo boreas*	1	2	3		5		7					
Cascades Frog	*Rana cascadae*	1		3							13		
Spotted Frog	*Rana pretiosa*												
Pacific Treefrog	*Hyla regilla*					5		7					15
REPTILES													
Painted Turtle	*Chrysemys picta*										13		
Rubber Boa	*Charina bottae*								9				
Racer	*Coluber constrictor*												15
Northern Alligator Lizard	*Elgaria coeruleus*		2	3		5			9				
Western Fence Lizard	*Sceloporus occidentalis*			3		5			9	11			
Common Garter Snake	*Thamnophis sirtalis*						6				13		
Western Terrestrial Garter Snake	*Thamnophis elegans*	1		3					9				15
Western Rattlesnake	*Crotalus viridis*							7		11			

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**Habitat class descriptions associated with numeric codes are shown in Appendix 2.

Appendix 4. Number of small mammal species captured in live traps (2221 trap-nghts of total effort) and pitfall traps (3153 trap-nights of total effort) from four habitat classes in the Stehekin River drainage, Washington, June - October, 1991

LIVE TRAPS

Species	Habitat Class: Nutrient Rich Deciduous	Nutrient Rich Mixed	Upland Mesic Conifer	Upland Mesic Mixed
Peromyscus maniculatus	220	286	156	163
Peromyscus oreas	4	60	1	27
Peromyscus spp.	210	114	38	115
Sorex monticolus	2			
Sorex trowbridgei	1	11	5	8
Sorex vagrans				
Sorex spp.				
Neurotrichus gibbsii	2	1		1
Microtus oregoni	1	6		1
Microtus spp.	1	2		
Clethrionomys gapperi	10	16		
Tamiasciurus douglasii	1	5		
Eutamias amoenus			27	
Eutamias townsendii		4		
Spermophilus saturatus			12	
TOTAL	452	505	239	315

PITFALL TRAPS

Species	Habitat Class: Nutrient Rich Deciduous	Nutrient Rich Mixed	Upland Mesic Conifer	Upland Mesic Mixed
Peromyscus maniculatus	9	10	2	
Peromyscus oreas		2		
Peromyscus spp.		2		
Sorex monticolus	8	2		2
Sorex trowbridgei	10	20	5	21
Sorex vagrans	1	2		
Sorex spp.		3	1	1
Neurotrichus gibbsii	2	1		
Microtus oregoni		2		1
Microtus spp.	1	1		
Clethrionomys gapperi		6		
TOTAL	31	51	8	25

As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural and cultural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interest of all our people. The department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

February 1993